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# Mapping Sentences to Case Frames

by

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*Abstract:* This paper describes a range of phenomena that a case frame system should be able to handle and proposes generalizations to capture this behavior which are formulated as a set of production-like rules. These rules allow the possible surface orders of cases found in English declarative sentences to be generated from a case frame. This is important for the implementation of a case frame builder described here which requires the ability to determine what cases in a case frame can appear in a grammatical role. The appendix contains an in detail survey of some English verbs which illustrate the types of mapping found in English.

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## Section 1: Introduction

A case frame makes predicate-argument relations in a sentence explicit, but how are these relations extracted from an English sentence? And given a case frame, what arrangements of its cases can be found in sentences?

Describing these processes is not a trivial task. The information in a case frame may be expressed in a variety of ways in an English sentence. The verb *present* allows the following choices:

(1) The judge presented the prize to the boy.
(2) The judge presented the boy with the prize.
(3) The judge presented the boy the prize.

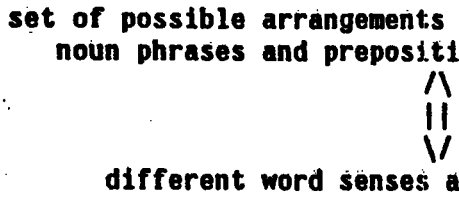
The example above also shows that the position of noun phrases with respect to a verb is not usually sufficient to uniquely determine what case it fills. Active-passive sentence pairs are another example of this: the grammatical subject of an active sentence and of its corresponding passive form do not fill the same case. Even prepositions, which are supposed to signal cases, can mark more than one case. *With* can mark the neutral, comitative, instrument, and manner cases. Before a case frame can be filled, the proper case frame must be chosen since some words have several:

(4) The committee met with the visitor.
(5) The proposal met with disapproval.

In (4), *meet* has an agent as subject, while in (5) it takes a neutral. *With* marks the neutral and manner cases respectively, in (4) and (5). Choosing the right case frame is a part of the word sense problem that must be solved at the case frame level.

The case frame component of a natural language system will have to

determine word sense and fill case frames in parallel to take advantage of the feedback necessary between the two processes. The word sense of a predicate must be disambiguated to determine what case frame to fill, but clues provided in the sentence for the presence of a case can guide the choice of a word sense. This interaction reflects the most general form of the relation below which is associated with any word having a case frame:




The mapping from English to a case frame involves disambiguating word sense and performing case assignments. And, for each word sense's case frame, there are several possible arrangements of cases in a sentence that can be generated.

This paper will ignore the problem of word sense. It will focus on the mapping between case frames and English sentences assuming that each predicate has one case frame. I will look almost exclusively at verbs since they show some of the more complicated and varied forms of the mappings as well as being the most thoroughly discussed examples. With verbs, the mapping problem is reduced to relating the grammatical relations of subject, direct object, and indirect object, and prepositional phrases to the cases they fill. I will be primarily concerned with active forms of the verbs.

Much of the previous work on case frames has been of a descriptive nature. The main concerns included the choice of a basic set of cases and the assignment of case frames to verbs. This work brought out the complex

behavior of certain English verbs, but does not provide a systematic account of the observed behavior. In "The Case for Case" [Fillmore 1968], Fillmore shows the generalizations cases can capture and outlines how a case frame can be mapped to a sentence, but only sketches the rules involved. Celce-Murcia [1972] has grouped English verbs according to the patterns of behavior they participate in. She uses these patterns or paradigms to recognize cases in English sentences. Celce-Murcia's paradigms identify interesting classes of verbs, but not all the paradigms account for the full range of sentences that some of the verbs can occur in. There is no attempt at unifying the paradigms. Stockwell et al. [Stockwell, Schachter, and Partee 1973] use case frames as a deep structure for a transformational grammar and propose transformations to map the case frames onto the grammatical relations of subject and object. Their solution will be examined closely in Section 5 since it provided a starting point for the analysis proposed in Section 6.

The next section will consider the place of a case system in the spectrum of syntactic and semantic representations. The components of a case frame and an implementation of a case frame builder are discussed in Section 3. The implementation method demonstrates the importance of a mechanism for mapping case frames to grammatical relations. Various methods of performing the mapping are considered in Section 5 after summarizing in Section 4 the major trends emerging from a survey of some verb classes which is described in the appendix. Finally, a mapping process based on production-like rules is discussed.

## Section 2: Case Frames: A Semantic or Syntactic Representation?

The case representation discussed here is only intended to capture predicate-argument relations and word-sense disambiguation, but no deeper semantic generalizations. Case frames are an intermediate level in the mapping from an English sentence to its deep semantic representation. Although the case frame builder in a natural language system may interact with the semantic component to resolve word sense questions, case frames allow the semantic component to remain unaware of how predicate-argument relations are expressed in the sentence.

The purpose of a case frame representation as an intermediate step in the mapping from a sentence to its semantic representation is similar to that of functional decomposition. The case frame component can use a limited number of cases, enough to capture the different behaviors present in English sentences. Each case should embody a particular type of behavior in the case frame-grammatical relation mapping. Cases are not expected to reflect semantic roles; the slot names of the deep semantic frame may be chosen according to the frame's function. The process of lexical decomposition can be done, if desired, in the mapping from case frames to deep frames.

This theory of the place of case frames in a natural language system has been embedded in the natural language understander for the Personal Assistant project [Bullwinkle 1977, Goldstein and Roberts 1977]. The example below compares the case frame and deep frames for the verb *schedule* in sentence (1).

(1) I want to schedule a meeting at 3 p.m. Tuesday.

The case frame for *schedule* is on the left. The resulting deep frames are on the right.

```
schedule1
        agt     I
        neut    meeting
        time    3 p.m. Tuesday
```

```
schedule36
        actor           I
        activity        meeting37

meeting37
        when    3 p.m. Tuesday
```

The case frame for *schedule* fills slots of the deep frames of both *schedule* and *meeting*. In the PA domain, the mapping is done by means of simple functions such as the one below:

```
(SET-MAP (SCHEDULE1 SCHEDULE)
        (=> AGT (FILL ACTOR))
        (=> NEUT (FILL ACTIVITY))
        (=> TIME (INSERT-INTO NEUT WHEN))
        (=> PLACE (INSERT-INTO NEUT WHERE)))
```

This function maps the SCHEDULE1 word sense of *schedule* onto an instance of the deep SCHEDULE frame. The function FILL fills the actor slot of the deep frame with the agent of the case frame. The INSERT-INTO function puts the time and place cases into the when and where slots respectively of a frame created for the neutral case.

## Section 3: Filling a Case Frame

Mitchell Marcus has implemented a case frame builder to convert the annotated surface structure produced by his parser [Marcus 1976] to a case frame representation. Marcus' case frames consist of four components:

1. Predicate: the root of the word whose case frame it is.
2. Specializers: added information about the predicate such as the

auxiliaries preceding a verb or the determiner preceding a noun.

3. Cases: the filled cases present in this use of the predicate.

4. Modifiers: phrases which are case frames themselves used to modify an entire case frame rather than to specify a case. Modifiers are optional sentence level comments such as time or location.

The parser communicates with the case frame builder via messages informing it to fill in any of the four components, check that the obligatory slots of a case frame are filled, and check if a node of the annotated surface structure fits in a case frame. The problem of determining whether a prepositional phrase is a case or a modifier, a decision which may require semantic interaction, will not be discussed here. The concern is the means employed to fill the case slots of a case frame.

When Marcus' case frame builder is asked to fill a case slot of a case frame, the parser specifies the grammatical role of the node which is to be inserted: subject, object, or prepositional phrase. The case frame builder must be able to generate all possible cases that can have the specified grammatical role from the predicate's case frame. The interdependence of cases and grammatical roles means that each candidate must be paired with the cases which remain to be filled if it is chosen.

This results in a fifth component of a case frame which is used during the case filling process: a list of hypotheses describing the different ways to fill the case frame. Each hypothesis has two parts: the cases filled so far and the cases which remain to be filled. Initially, there is only one hypothesis consisting of no filled cases and the case frame from the predicate's lexical entry. Each time the case frame builder is asked to fill a slot with a certain grammatical role, the remaining

cases in each hypothesis are examined for cases that can fill the role. Each such case results in a new hypothesis in which the chosen case is added to the hypothesis' filled case list. If no cases remain in the hypothesis or none of the cases remaining can fill that grammatical role, the hypothesis is discarded. This can also happen if an obligatory slot is left unfilled after the subject, objects, and prepositional phrases associated with the predicate have been found. Choices between certain hypotheses will have to be made according to semantic criteria, for example, the decision whether *the rock* is agent or instrument in "The rock broke the window." This ability is not part of the case frame builder, but the decision will be made by asking questions of the semantics component.

The case frame builder must be able to generate all possible candidates for a grammatical role from a case frame; this information can be extracted from the results of the process which maps an underlying case frame to the alternative sequences of cases appearing in sentences. Mechanisms for performing the mapping are considered in Sections 5 and 6. In an early version of the case frame builder, the component which generates the candidates uses the rules of SS&P discussed in Section 5B. A second version incorporates the rules proposed in Section 6.

## Section 4: Putting the Pieces Together

This section provides an overview of the phenomena a case system must be able to handle. A more extensive survey is left to the appendix where the case frames of a set of English verbs are considered.

The case names used here are: agent, instrument, neutral, dative, and locative. This list is not meant to be exhaustive, but will be sufficient to cover the examples in this section and the appendix. This set of cases is included in the one used in SS&P [Stockwell et al. 1973]. Neutral corresponds to Celce-Murcia's theme and Fillmore's objective [Fillmore 1967, 1968] and patient [Fillmore forthcoming] cases. Celce-Murcia's use of the locus and goal cases cuts across the use of the dative and locative here. The correspondence between these uses will be discussed in part A of Section 5.

The behavior of the agent is uncomplicated: it can only appear in subject position in active sentences or marked with *by* in passives. The remainder of this section will look at the roles of the instrument, neutral, locative, and dative, as well as the relation of aspect to case frames. I have indicated the case assignment assumed for each example; any comments on alternative possibilities are in the appendix.

## A. The Role of the Instrument

The sentences below give a complete characterization of the behavior of the instrumental case.

(1) The boy (A) broke the window (N) with a rock (I).
(2) The rock (I) broke the window (N).
(3) The window (N) broke.
(4) * The window (N) broke with a rock (I).

The instrument appears in a prepositional phrase marked by *with* in sentences with agentive subjects. The instrument may lose its marking preposition and displace the subject if the agent case is optional for that verb. However, a prepositional phrase in the instrumental case cannot be

tacked on to sentences with subjects in cases other than the agent, as sentence (4) shows.

An instrument marked by *with* can often be added to a sentence with an agentive subject {note 1}. Unlike the other cases being discussed, it is never obligatory; therefore, the instrument should not be considered an essential part of any case frame. Deciding whether an agent is optional or obligatory should not be based on the instrument's ability to displace it.

B. Aspect and Case Frames

The subtle difference in meaning between the two sentences below has led to discussion of whether the two sentences represent two word senses of *smear*, each with different case frames.

(5) He smeared paint on the wall.
(6) He smeared the wall with paint.

In (6) the whole wall has been covered with paint, but in (5) the whole wall has not necessarily been covered. Sentence (5) is referred to as the incompletive aspect of the verb, and (6) as the completive aspect. In the latter it can be inferred that the action was completed, but in the former no such inference is possible. The completiveness is with respect to the extent of the action and independent of time. *Smear* belongs to Celce-Murcia's class of verbs of joining, as do *spread*, *hang*, and *spray*. Celce-Murcia describes two other classes of verbs showing aspect differences: verbs of separating which include *drain*, *empty*, and *rob* and verbs of surface contact which include *hit*, *throw*, and *pelt*.

Verb tenses also reflect differences in aspect:

(7) The boy had eaten.

(8) The boy was eating.

The perfect sentence (7) implies that the boy has finished eating, but the progressive sentence (8) does not allow this inference to be made. The difference in aspect here is with respect to completed and ongoing actions in time. Another place where aspect differences are found is in verb-particle constructions:

(9) The girl jumped.
(10) The girl jumped up.

In (9) the act of jumping is repeated while in (10) there is only one jump occurring, but this difference is not present in all dialects. The presence or absence of a marking preposition can also cause aspect changes:

(11) The hunter shot the lion.
(12) The hunter shot at the lion.

Sentence (11) is completive, the lion has been shot, but in (12), the incompletive sentence, the lion has not necessarily been shot.

A decision about where aspect differences in English should be represented must be made before *smear*'s case frame can be chosen. The examples of aspect differences above which do not involve case frames show that the aspect problem is not limited to the case frame level. For this reason I will not try to represent the differences in aspect by assigning completive and incompletive readings of a verb two different case frames. The aspect differences do not affect the predicate-argument relations in *smear* which would be another reason for assigning different case frames. *Smear* will be given one case frame: agent, neutral, locative. A case frame builder will be able to recognize the differences in aspect from the marking prepositions.

C. The Place of the Neutral, Dative, and Locative

The use of the dative here is more restricted than in some other case systems [Celce-Murcia 1972, Fillmore 1968, SS&P 1973]. Often the case frames of pairs of verbs such as *see* and *look at* or *hear* and *listen* are differentiated by calling the subject of the first member of each pair dative and the subject of the second member agent. This is done for semantic considerations. These verbs will all be treated as taking agents as subjects because the syntactic behavior of their subjects is the same.

In other work, the major distinction between the dative and locative is the use of the dative as subject of verbs such as *see* and *hear*, but this distinction is inapplicable here. Therefore, it is possible that the dative and locative could be combined into one case, but for the present the distinction has been retained in the example sentences. The difference between the two is that unlike the locative, the dative can co-occur with indirect objects.

Neutrals occur unmarked as subjects or objects, or marked in prepositional phrases. Locatives and datives appear as subjects, direct objects, or in prepositional phrases. In case frames with optional agents, the neutral may be moved into subject position from a direct object position if the agent is omitted.

(13) The boy (A) dropped the book (N) on the floor (L).
(14) The book (N) dropped on the floor (L).

Locatives and datives do not occur in subject position with verbs whose case frames have agents (the one exception is *fill*).

(15) The man (A) hung pictures (N) on the wall (L).
(16) The pictures (N) hung on the wall (L).
(17) The man (A) hung the wall (L) with pictures (N).

(18) * The wall (L) hung with pictures (N).

Verbs with agentless case frames can have neutral, locative, or dative subjects.

(19a) Bees (N) are swarming in the garden (L).
(19b) The garden (L) is swarming with bees (N).

(20a) The book (N) is familiar to me (D).
(20b) I (D) am familiar with the book (N).

Examining the left to right orders of cases in English sentences shows that neutrals can either precede or follow datives and locatives; some verbs allow both orders, others only one.

(21) He (A) spread butter (N) on the bread (L).
(22) He (A) spread the bread (L) with butter (N).

A case system must incorporate a mechanism that permits both orders, either by allowing the neutral to occur in two positions in the case frame or by allowing the neutral to shift positions. The generalization should concern the neutral; otherwise, two will be necessary: one for the locative and one for the dative. The order should be determined before the assignment of cases to subject and object positions. Subject-object assignment depends on the presence or absence of the agent in the case frame while the relative order of the neutral and locative or dative is independent of the agent, for example, compare *swarm* and *spread*.

## Section 5: Capturing the Patterns

Any mechanism for mapping case frames to grammatical relations should demonstrate the following properties:

1. Be able to handle the verbs in the appendix.

2. Incorporate the observations of Section 4.
3. Minimize the idiosyncratic information in each verb's lexical entry.

Several proposals for carrying out the mapping will be described in this section, and each will be considered with respect to the three criteria listed above.

A. Celce-Murcia's Paradigms

The purpose of Celce-Murcia's paradigms is to "summarize or recapitulate the functional relations and syntactic and semantic features of large classes of verbs" [Celce-Murcia 1972]. Each paradigm is a set of patterns of case names associated with grammatical relations which is common to a group of verbs. The ergative paradigm which *drop*, *open*, and *break* belong to contains two basic patterns:

1. The subject is the causal actant (= agent) and the object is the theme (= neutral).
2. The subject is the theme and there is no object.

Most of the paradigms Celce-Murcia describes contain only one pattern. Some verbs can belong to more than one paradigm. Verbs with completive and incompletive aspects belong to two since Celce-Murcia represents the aspect difference with two different case frames.

Although Celce-Murcia's classification of verbs is extensive, the paradigms she proposes only cover the general behavior of verbs in each group. The paradigms do not include all possible permutations of cases found in sentences with some verbs. *Hang*, a verb of joining, occurs in sentences of the form (1)-(3):

(1) He hung the wall with pictures.

(2) He hung pictures on the wall.
(3) Pictures hung on the wall.

Celce-Murcia would put (1) in the completive and (2) in the incompletive paradigm. These paradigms do not allow for (3), but (2) and (3) together fit the ergative paradigm or (3) alone fits the intransitive paradigm. *Hang* could be marked as belonging to one of the following three sets of paradigms:

1. the completive, incompletive, and intransitive paradigms
2. the completive and ergative paradigms
3. the completive, incompletive, and ergative paradigms

The third alternative is redundant since (2) will belong to the incompletive and ergative paradigms, yet marking that the verb belongs to these paradigms expresses the correct generalizations about the verb *hang*. There is a more serious problem with *hit* (see appendix) which could possibly be resolved by assigning it to several paradigms.

Identifying paradigms provides a shorthand description for a group of common combinations of cases filling grammatical relations in a sentence. Each verb's lexical entry contains the names of the paradigms to which it belongs. This is not much better than explicitly listing the alternative permutations of cases found in sentences with that verb, especially since a paradigm usually captures only one pattern. Celce-Murcia does not describe how the paradigm to which a sentence belongs is recognized. Her only example of the recognition process involves a member of the ergative paradigm; there was no need to choose between paradigms. Celce-Murcia's paradigms show the existence of a finite set of mappings between grammatical relations and cases, but she does not provide any unifying generalizations concerning the mapping process.

Celce-Murcia [1972] calls the use of the dative in Dative Shift verbs the goal case and proposes a rule of Goal Focus to create indirect objects. She uses the locus and goal cases to distinguish aspect within a case frame: the locative of the completive aspect is the locus, while the locative of the incompletive aspect is the goal. Celce-Murcia is unable to handle verbs with aspectual differences and verbs with Dative Shift using a single mechanism because of the different case assignments she makes to the two verb classes.

B. Stockwell, Schachter, and Partee's Approach

SS&P [1973] use a transformational framework to formalize their solution to the mapping problem. Their mechanism is based on a set of rules for finding the grammatical relations of subject and object and prepositional phrases from an ordered list of cases. Variations on this basic idea will be discussed in the remaining proposals. In Marcus' case frame builder, the three most fundamental of SS&P's rules are incorporated into the functions that generate the cases that a grammatical role may fill.

The case frame in a verb's lexical entry consists of a subset of the ordered list of cases below:

(neutral) (dative) (locative) (instrument) (agent)

Each case present in the case frame is marked optional or obligatory (parentheses around the name of a case will indicate that it is optional, none indicate that it is obligatory). To turn the case frame into the possible sequences appearing in English sentences, the following rules,

which were expressed in transformatical terms by SS&P, are used:

(R1) Finding the Subject: the rightmost case must become the subject if it is obligatory. If it is optional, it may be discarded and the rule applied to the remaining cases.

(R2) Finding the Objects: the objects are found by reading from left to right until the number of objects is used up. The objects occur with no preposition.

(R3) Prepositional Phrases: the remaining cases occur marked by prepositions. Each case has a default marking prepositions associated with it. If a verb requires some other preposition, it must be specified in the verb's lexical entry.

As an example of the use of the rules, consider the verb *break*:

(4) The boy (A) broke the window (N) with a rock (I).
(5) The rock (I) broke the window (N).
(6) The window (N) broke.

SS&P's case frame for *break* is: N (I) (A) . The neutral is obligatory, but the other cases are optional. None of *break*'s cases are marked by unusual prepositions. Applying (R1), the agent, the rightmost case, can become the subject. Then by (R2), the neutral, the leftmost case, will be the object, and by (R3) the instrument will be marked by *with*. This gives the structure in (7) which is that of (4):

(7) *A* break *N* with *I*.

Alternatively, since the agent is optional, it could have been discarded by (R1) leaving the instrument case as the rightmost case, and therefore, a candidate for subject. Once again by (R2) the neutral will be the object resulting in the pattern underlying (5):

(8) *I* break *N*.

(R1) could have been applied in a third way: both the agent and instrument, which are optional, could have been omitted leaving the neutral as the subject and no other cases as in (6). Sentence (9) cannot occur

since by (R1) the instrument must be deleted from the case frame if the neutral occurs as subject.

(9) * The window (N) broke with a rock (I).

The first obligatory case must be chosen as the subject; this prevents *break* from occuring with no subject. It also allows verbs to have neutrals which do not occur in subject position by having an obligatory case to the right of the neutral in the case frame.

The rules described so far are independent of the verb and the cases present in the case frame; as a result they are inadequate. There is no way of allowing the neutral to follow a dative or locative object as in *give* or *smear*, and no way for a neutral subject to precede a dative or locative as with *swarm*, *familiar*, and *drop*. Verbs like *hang* allow a neutral subject and a locative marked by a prepositional phrase, but not a locative subject followed by a neutral marked by a prepositional phrase. The rules will generate the latter sequence, but not the former. These problems can be handled in several ways:

1. allow verbs to have more than one case frame
2. have two underlying case orders
3. formulate rules that allow the case frame to be reordered
   a. these rules can depend on grammatical relations
   b. these rules can depend on the cases

The first two possibilities preserve the independence of the rules from the verb and case configuration, but are unsatisfactory for other reasons to be discussed in the parts C and D of this section. Possibility (3b) is discussed in Section 7. The method adopted by SS&P to overcome the inadequacies is that of (3a): rules (transformations in their framework) that allow certain cases to become subjects or objects, overriding (R1)-

(R3).

SS&P's subjectivalization and objectivalization transformations can be considered general functions that move a case into subject or object position. The lexical entry of a verb must indicate whether either of the transformations apply to it, as well as specifying the case which is to be moved and the preposition which is to mark the case that would have occupied that position. *Swarm* allows its locative to subjectivalize while *smear*'s locative objectivalizes. In both verbs, the neutral will be marked by *with*. In Dative Shift verbs such as *give*, the dative objectivalizes. Subjectivalization is not used for ergative verbs like *drop*, instead SS&P modify (R1): if the next choice for subject is a marked locative, then the first choice for object becomes the choice for subject. This treatment is inadequate because ergative verbs show the same behavior with datives, for example the verb *ring*:

(10) He (A) rang the bell (N) for class (D).
(11) The bell (N) rang for class (D).

The underlying case order and rules (R1)-(R3) give special properties to the neutral and agent since they occur at either end of the list. The subjectivalization and objectivalization transformations which SS&P propose allow the behavior of any verb to be duplicated. The mechanism is so general that any cases could be put in subject or object position even if they are never found there. The use of subjectivalization and objectivalization on verbs with neutrals that shift could be combined into one process if a transformation formulated in terms of cases were used. SS&P are concerned with mapping cases to the grammatical relations of subject and object, so their transformations are formulated in these

terms.

C. Multiple Case Frames

One way to preserve a constant underlying order of cases and a uniform method of processing case frames is to assign two different case frames to verbs that undergo SS&P's subjectivalization and objectivalization transformations. The transformations will not be necessary since each order can be represented by a different set of case assignments. As a result, more of the burden is shifted to word sense since the different case frames will be treated as different word senses.

Even if verbs were given two case frames, case assignment would still be a problem. The case assignment should be such that only (R1)-(R3) are necessary. The figure below shows possible case assignments for some of the verbs discussed earlier.

| Verb | One case frame option | Two frame option 1 | 2 |
|---|---|---|---|
| break | N I A | N I A | |
| swarm | N L | N L or I A | L A |
| smear | N L A | N L A | N I A |
| drop | N L A | L A | N L A |

An argument against two underlying case frames for verbs like *swarm* and *smear* was brought up in the discussion of aspect. As long as the aspect difference is recorded, there is no reason to indicate it by using two different case frames since case frames are supposed to show predicate-argument relations which are independent of aspect. With two case frames, predicate-arguments relations are no longer made explicit by the case frame. The two frames for *drop* show this: the agents of the two frames do not fill the same role. The agent of frame 1 is the neutral of frame 2.

For verbs such as *give* there do not seem to be two plausible case assignments. One case frame could be N D A, but what assignment could be made to the shifted version? Any choice would be arbitrary. A second alternative would be to undo the Dative Shift transformation in the grammar.

D. Two Underlying Orders of Cases

Rather than having two underlying case frames for some verbs, (R1)-(R3) could be applied to two different orders of cases, one corresponding to SS&P's order, *N D L I A*, and one with a shifted neutral, *D L N I A*. Unlike the previous proposal, this one will not give more responsibility to the word sense component. Some possible case assignments are shown below:

| Verb | N D L I A order | D L N I A order |
|---|---|---|
| break | N I A | ----- |
| give | N D A | D N A |
| smear | N L A | L N A |
| swarm | N L | L N |
| drop | N L A | L N |

Each verb's lexical entry will have to specify not only the case orders that verb can occur with, but also the cases in each order. The verb *drop* has different cases associated with each order. The surface order "*A* drop *N* (*L*)" is derived from *N L A*, the surface order "*N* drop (*L*)" from *L N*. Either order may produce completive or incompletive sentences, there is no clean division. The order *N D L I A* produces (12) and (13):

(12) The garden is swarming with bees. (completive)
(13) He smeared paint on the wall. (incompletive)

while the other aspects of (12) and (13) would be derived from the order

*D L N I A.*

## Section 6: Rules for Mapping Case Frames

In this section I will propose a set of rules for mapping an ordered list of cases to a set of reordered lists of cases, each representing the left to right order of cases in a sentence. These rules are intended to spell out the generalizations described in Section 4. They are formulated to express properties of the cases themselves rather than those of the grammatical relations. The initial set of cases will be the same ordered list used by SS&P except that I have collapsed the dative and locative into one case, dative/locative, since their behavior with respect to the rules below is identical:

(neutral) (dative/locative) (instrument) (agent)

The list above includes most of the cases that can occur unmarked; these are the cases whose behavior needs to be explained. Additional cases will be needed, but most will probably always occur with marking prepositions. Therefore, they will not affect the statement of the rules below and can be inserted into the right place in the ordered list of cases above (note 2).

A verb's case frame will consist of a subset of the case list. Associated with each case will be an indication of whether it is optional or obligatory. The marking preposition of each case must be specified. Most cases have default prepositions associated with them, so the preposition need only be specified if it differs. Cases which are never marked are marked by a null preposition.

I will now list the set of rules in the order in which they apply. The left-hand side of the rule is a template which should be matched against the case frame. If it matches, the case frame is changed to match the right hand side. *X* matches a string of cases of arbitrary length. Case names match against the case of the same name. If the name appears without parentheses, it must be present; if it is enclosed in parentheses it should be matched against the case only if it is present. The notation *{a b}* indicates disjunction, either *a* or *b* must be present.

(r1) N D/L X (I) (A) ==> D/L X N (I) (A)

Rule (r1), Neutral Shift, shifts the neutral from the leftmost position in the case frame to the rightmost position preceding the instrument and agent. Each verb's lexical entry must specify if the rule is optional, obligatory, or inapplicable. The pattern matching variable *X* was included for other cases not included in the list above. Ensuring that the shifted neutral is marked is not a problem. All cases have associated prepositions and a later rule will delete prepositions from the subject and object.

(r2) X I A ==> I X optional

This rule allows the instrument to optionally become the subject. The agent is deleted when the instrument is fronted.

(r3) N X (I) A[+opt] ==> N X optional

Rule (r3) allows the neutral of verbs that have not undergone Neutral Shift to become subjects if the agent is optional. The agent and the instrument, if it is present, are deleted. The rule will not apply to a case frame that has undergone Neutral Shift since the neutral will no longer be in the leftmost position.

(r4) X A ==> A X obligatory

Rule (r4) moves the agent into subject position if it is present in the case frame.

(r5) {A I} {N D/L} X ==> {N D/L} X {A I}[prep=by] optional

Rule (r5) generates passives. The statement of this rule implies that sentences with neither agent or instrument subjects have no passive, which seems generally true (an exception is *contain*). These sentences usually have no object that can become the subject of the passive sentence.

(r6) ({A I}) {N D/L} X ==> ({A I})[prep=0] {N D/L}[prep=0] X

This rule marks the subject and direct object of a sentence by realizing certain prepositions as null prepositions. If the first case is an agent or instrument, it appears as subject. If it is followed by a neutral, dative, or locative, they lose their prepositions and become objects. If the first case is neutral, dative, or locative, it must be the subject, so it has no preposition. Any remaining cases keep their prepositions.

The statement of (r5) and (r6) suggest that the agent and instrument and also the neutral, dative/locative form natural classes. These classes could be defined as:

(r7) S -> {A I}
(r8) O -> {N D/L}

Then (r5) and (r6) can be rewritten as (r5') and (r6'):

(r5') S O X ==> O X S[prep=by] optional

(r6') (S) O X ==> (S)[prep=0] O[prep=0] X

Cases that are optional do not need to appear in a sentence. An additional rule could be formulated to take care of this. Another rule which I will not formulate is the rule that marks the leftmost case in the

derived order, the subject, as being obligatory since the subject must always appear even if the case is an optional one.

To show how these rules apply, I will work through the derivation of the alternative sentences containing *drop*. The case frame is represented as a list of ordered triples. Each triple consists of a case name, whether it is optional or obligatory, and its marking preposition. *Drop*'s case frame is:

(N oblig nil) (L opt LOC-Preps) (A opt nil)

where LOC-Preps represents the set of locative prepositions. Rule (r3) can apply to *drop*'s case frame to produce:

(N oblig nil) (L opt on)

(r6) must apply to the output of (r3) but causes no change. If (r3) were not applied, then (r4) applies:

(A oblig nil) (N oblig nil) (L opt on)

(r6) must be applied to the output of (r4), but causes no changes. The case frames of some verbs, the surface orders generated from the case frames, and the rules applied to derive each are shown below.

BREAK
Case Frame: (N oblig nil) (I opt with) (A opt nil)
Neutral Shift: not applicable
Surface Orders Generated From the Rules:

| | |
|---|---|
| (A oblig nil) (N oblig nil) (I opt with) | r4, r6 |
| (I oblig nil) (N oblig nil) | r2, r6 |
| (N oblig nil) | r3, r6 |

GIVE
Case Frame: (N opt nil) (D opt to) (A oblig nil)
Neutral Shift: optional
Surface Orders Generated From the Rules:

| | |
|---|---|
| (A oblig nil) (N opt nil) (D opt to) | r4, r6 |
| (A oblig nil) (D opt nil) (N opt nil) | r1, r4, r6 |

SWARM
Case Frame: (N oblig with) (L opt in)
Neutral Shift: optional
Surface Orders Generated From the Rules:

| | |
|---|---|
| (N oblig nil) (L opt in) | r6 |
| (L oblig nil) (N oblig with) | r1, r6 |

HANG
Case Frame: (N oblig with) (L opt on) (A opt nil)
Neutral Shift: optional
Surface Orders Generated From the Rules:

| | |
|---|---|
| (A oblig nil) (N oblig nil) (L opt on) | r4, r6 |
| (A oblig nil) (L oblig nil) (N oblig with) | r1, r4, r6 |
| (N oblig nil) (L opt on) | r3, r6 |

Two verbs that the rules above do not handle are *contain* and *fill*, which seem to be exceptions to the generalizations (see appendix). The active form of *contain* would require an additional rule that allows the locative to subjectivalize.

## Section 7: Some Missing Pieces

The set of rules just described incorporates the properties of case frames discussed in Section 4. Rather than using transformations based on grammatical relations, these rules describe properties of the different cases. Unlike SS&P's subjectivalization and objectivalization transformations, these rules do not force the lexical entry of a verb to specify cases to which they apply. Neutral Shift is the only rule whose applicability depends on the verb rather than the structure of the case frame.

The rules of the previous section are only a first attempt at formalizing the behavior of cases in this way. The passive rule (r5) may be too restrictive. The treatment of marking prepositions must be expanded

to handle cases marked by multiple prepositions, and to include the use of *by* as a passive marker. The indirect object form of verbs like *supply* cannot be generated with the rules of Section 6. Prepositional phrases of the form *from...to...* and *to...from...* require further investigation; one question that needs to be considered is whether this construction marks one case or two. Several classes of verbs need to be examined in more detail, among them are the verbs of separating and verbs of transfer such as *buy*, *pay*, *rent*. Noun phrases also have case frames but their surface structure is different from that of verbs. Trying to understand the behavior of noun phrases' case frames and relating it to the proposal discussed here for verbs should provide more insight into the properties of case frames and a further test for the adequacy of this model.

## Appendix

This appendix examines on a verb by verb basis the alternative distributions in English sentences of the cases in a variety of verbs' case frames. The set of verbs considered is not intended to exhaust the verb classes of English, although it includes examples from most of Celce-Murcia's paradigms [Celce-Murcia 1972].

The verbs will be approached from a descriptive point of view, and previous treatments of these verbs' case frames will be reviewed. The following properties of each verb's case frame will be considered:

(1) Which positions can each case occur in?
(2) Which cases are optional? Which are obligatory?
(3) Which cases are interdependent?

The choice of case assignments to a verb will not be discussed unless it has caused a lot of comment. Rather, the implications of the assignments for constructing a mechanism to do the mapping will be pointed out.

The verbs considered are: *drop*, *break*, *give*, *supply*, *be familiar*, *smear*, *hang*, *swarm*, *hit*, and *drain*. Section 4 summarizes the major trends that emerged from this survey. The appendix ends with a discussion of *fill* and *contain*, two verbs that do not fit the patterns described in Section 4. They do not seem to be members of any of the classes, but rather exceptions.

### DROP

(1) The boy (A) dropped the book (N) on the floor (L).
(2) The book (N) dropped on the floor (L).

In sentence (1) the direct object of *drop* undergoes a state change. In

sentence (2), the agent is no longer present, and the direct object of the previous sentence has become the subject of (2). The locative case is optional for *drop* and is marked by a preposition. The position of the locative does not change: it is marked in both sentences. There is no object in (2). This verb belongs to what Celce-Murcia calls the ergative paradigm, the class of verbs whose neutral can move from direct object position to subject position if no agent is present.

BREAK

The verb *break* is a favorite example for illustrating the predicate-argument relations which case frames make obvious even though they are not consistently expressed in the grammatical relations, that is subject, objects, and prepositional phrases.

(3) The boy (A) broke the window (N) with a rock (I).
(4) The rock (I) broke the window (N).
(5) The window (N) broke.
(6) * The window (N) broke with a rock (I).

The subject of *break* can be filled by three different cases: agent, instrument, and neutral. The object is always the neutral; when there is no object in the sentence, the neutral appears as subject. The instrument can occur as subject if there is no agent, or marked by the preposition *with* when the agent is present. The neutral is always present. Sentence (6) shows that a neutral subject cannot occur if the sentence has a marked instrument. Therefore, when a sentence of this form is grammatical, the prepositional phrase marked by *with* cannot be an instrument.

Since the instrument can occur with almost any verb, it is probably better to observe the sentences above disregarding the instrument.

Ignoring the instrument shows that *break* belongs to the ergative paradigm. The following pair of sentences show that fact more clearly, as well as showing that *break* can take a locative:

(7) I (A) broke the hammer (N) on the vase (L).
(8) The hammer (N) broke on the vase (L).

The neutral subjects of (5) and (8) is definite evidence that the agent of *break* is optional.

Sentence (7) is from Fillmore's paper "The Case for Case Reopened" [Fillmore forthcoming]. This paper contains the only analysis I am aware of that assigns a case frame to *break* that differs from the one here, including Fillmore's own earlier analysis [Fillmore 1967, 1968]. Fillmore gives the following analysis:

(9) I (A) broke the vase (goal) with a hammer (N).
(10) I (A) broke the hammer (N) on the vase (goal).

I will contrast the two analyses and explain Fillmore's reasons for the change in analysis after the discussion of *hit* since the choice of case frame results from comparing these verbs. In fact, the analysis of *hit* was like *break* in [Fillmore 1967] while the reverse is true in [Fillmore forthcoming].

GIVE

*Give* is an example of a Dative Shift verb.

(11) Bill (A) gave the book (N) to Mary (D).
(12) Bill (A) gave Mary (D) the book (N).

The dative which is marked by to in (11) can shift to direct object position, losing its marking preposition. If *give* only has a direct object the neutral is obligatory. Sentence (13) cannot have a dative reading,

although when the marked dative is a generic noun phrase, it can occur without a neutral as in (15) (note 3).

(13) * Bill (A) gave Mary (D).
(14) Bill (A) gave the book (N).
(15) Bill (A) gave to the poor (D).

The case assignment to *give* in other work is consistent with the assignment just described. Celce-Murcia calls the use of dative with *give* the goal case. The contrast between this use and the use she calls the locus will be described in the next example.

SUPPLY

*Supply* differs slightly from the Dative Shift verbs like *give*; its neutral can shift into indirect object position or be marked by *with*:

(16) The school (A) supplied lunch (N) to the children (D).
(17) The school (A) supplied the children (D) with lunch (N).
(18) The school (A) supplied the children (D) lunch (N).

The occurrence of *with* in (17) marks a neutral and not an instrumental. *Lunch* cannot be the subject of sentence (19) which should be possible if it were an instrument.

(19) * Lunch (N) supplied the children (D).

When there is no following prepositional phrase or indirect object, the direct object of *supply* can have a dative, neutral, or ambiguous reading.

(20) The market supplies the vegetables (N).
(21) The market supplies the restaurant (D or possibly N).

It is difficult to find sentences with only a dative reading.

Celce-Murcia does not consider *supply* to be part of the transfer paradigm to which *give* belongs, but classifies it as a verb of joining

along with *smear* (discussed below). This is because the neutral of *smear* can shift out of object position and be marked by *with*. Celce-Murcia calls the occurrences of the dative in (16) and (18) the goal case, and the occurrence in (17) the locus.

FAMILIAR

The adjective *familiar* has a case frame with an obligatory neutral and an optional dative but no agent:

(22) I (D) was familiar with his work (N).
(23) His work (N) was familiar to me (D).

The marked datives and neutrals of *familiar* occur with the same prepositions as they do with *supply*. The difference is that *supply* has an agent while *familiar* does not. What would have appeared as objects of the former have appeared as the subjects of the latter. In both, the neutral and dative can interchange positions.

SMEAR

Sentences (24) and (25) illustrate the incompletive and completive aspects of *smear* respectively. In (25) the whole wall has been smeared with paint, while in (24) this inference cannot be made.

(24) He smeared paint on the wall.
(25) He smeared the wall with paint.

The aspect difference will not be reflected in the case frame of *smear* (see Section 4B). *Smear* will be assigned one case frame: agent, neutral, and locative. Reading from left to right, the cases in (24) are agent, neutral, locative and in (25) they are agent, locative, neutral. The

locative in *smear* is playing the same role as the dative in *supply*. Fillmore [1968] gives *smear* the case frame agent, instrument, neutral, but an instrument cannot shift to direct object position as it would have to in *smear*. Fillmore's later analysis [Fillmore forthcoming] and SS&P's analysis are consistent with the one proposed here.

Celce-Murcia takes an alternative approach. She assigns two paradigms with different case frames to *smear*. She does this to capture the semantic distinction and because there are verbs that can occur in only one or the other of the two patterns *smear* occurs in, for example *put*

(26) I (A) put the book (N) on the table (L).
(27) * I (A) put the table (L) with the book (N) (note 4).

The completive aspect is given the case frame agent, locus, neutral, the incompletive aspect is given the case frame agent, neutral, goal.

HANG

*Hang*, another member of Celce-Murcia's class of verbs of joining, shows slightly more complex behavior than *smear*.

(28) The man (A) hung the pictures (N) on the wall (L).
(29) The man (A) hung the wall (L) with pictures (N).
(30) The pictures (N) hung on the wall (L).

Sentences (28) and (29) parallel the behavior of *smear* in (24) and (25) and show the same aspect differences. Sentence (30) like (28) is in the incompletive aspect. These two sentences follow the pattern of the example sentences for *drop*. In her analysis, Celce-Murcia does not explain where her paradigms would allow (30).

Sentence (30) shows that the agent of *hang* is optional, but the following sentences with no agent are ungrammatical:

(31) * The wall (L) hung with pictures (N).
(32) * Pictures (N) hung the wall (L).

Sentence (31) suggests that although a neutral may become subject when an agent is optional, a locative cannot. Sentence (32) shows that the *with* cannot mark an instrument. The neutral of *hang* is obligatory:

(33) I (A) hung the pictures (N).
(34) * I (A) hung the wall (L).

Although a sentence with an agent and neutral is grammatical, on with an agent and locative is not. (34) is only grammatical if *the wall* is given a neutral reading, but then the sentence is nonsensical. The neutral cannot appear alone:

(35) * Pictures (N) hung.

This is probably because (35)'s source could be either (30) or the ungrammatical (32). This means that when the neutral is the subject, the locative must be obligatory. In fact, whenever the neutral is not the direct object the locative is obligatory:

(36) * The man (A) hung with pictures (N).

## SWARM

The similarity in *smear*'s and *supply*'s case frames and surface representations is also found between *swarm* and *familiar*. *Swarm* like *smear* is a verb of joining, but like *familiar* it has no agent:

(37) The garden (L) is swarming with bees (N).
(38) The bees (N) are swarming in the garden (L).

The incompletive-completive aspect distinction found in *smear* shows up in (37) and (38). In (37) the bees are all over the garden, but in (38) they are only in some part of it. Celce-Murcia proposes that *swarm* belongs to

two paradigms, a completive and an incompletive one. She again points out that there are certain agentless verbs that can occur in sentences with one or the other of the forms in (37) and (38):

(39) Passengers (N) are riding in the bus (L) {note 5}.
(40) The bus (L) is sagging with passengers (N).

*Swarm* and *familiar* together show that in agentless verbs locative and datives can either precede or follow the neutral.

HIT

*Hit* belongs to what Celce-Murcia calls the class of surface contact verbs. Verbs in this class show aspect differences:

(41) He hit the fence with a stick.
(42) He threw the ball at the window.

In the completive sentence (41), contact is made: the stick touches the fence. No inference of whether or not the ball hit the window can be made from the incompletive sentence (42). Celce-Murcia analyzes the verbs in this class as falling into two paradigms, an incompletive one and a completive one. The two paradigms are agent, neutral, goal for the incompletive and agent, locus, neutral for the completive. Celce-Murcia does not examine the full range of *hit*'s behavior; she considers a sentence of the form of (43), but does not mention the possibility of sentences of the form of (44) or (45). Although (45), like (42), has a marked locative, the sentence is completive, so it cannot be part of the incompletive paradigm.

(43) The boy hit the stick on the fence.
(44) The boy hit the fence with the stick.
(45) The stick hit the fence.

Fillmore's two analyses of *hit* should be considered in relation to his analyses of *break*. In his earlier analysis [Fillmore 1967], Fillmore examined only part of the evidence, that provided by the forms of the three pairs of sentences below:

(46a) The boy broke the window with a rock.
(46b) The boy hit the fence with a stick.

(47a) A rock broke the window.
(47b) The stick hit the fence.

(48a) The window broke.
(48b) * The fence hit {note 6}.

From these sentences, Fillmore decides to attribute the ungrammaticality of (48b) to a difference in *hit* and *break*'s case frames: *hit*'s takes a locative and *break*'s takes a neutral. Otherwise, the two verbs have the same case frame, they both have agents and instruments. In a later paper [Fillmore forthcoming], Fillmore's analysis also takes the following pair of sentences into account:

(49a) The boy broke the hammer on the vase.
(49b) The boy hit the stick against the fence.

He proposes that *hit*'s case frame is agent, patient (=neutral), goal (=locative), assigning the cases as follows:

(50) The boy (A) hit the fence (G) with the stick (P).
(51) The boy (A) hit the stick (P) against the fence (G).
(52) The stick (P) hit the fence (G).

This is also SS&P's analysis of *hit*. It shows the same alternation of the neutral and locative (patient and goal) as *smear*. The problem though is explaining (52). The behavior of the phrase *the stick* resembles an instrument rather than a neutral in (50) and (52), but instruments do not appear in object position although in (51) the phrase *the stick* does.

Fillmore then makes a parallel assignment to *break*:

(53) The boy (A) broke the vase (G) with a hammer (N).
(54) The boy (A) broke the hammer (N) on the vase (G).

There seems to be no justification for this assignment. In (53) and (54) the vase and hammer are being broken respectively. The sentences can be paraphrased by (55) and (56):

(55) The boy broke the vase.
(56) The boy broke the hammer.

The direct objects of both sentences can be interpreted as things which are broken, so there is no reason for them to be assigned to different cases. The result of trying to paraphrase the corresponding sentences with *hit* is different.

(57) The boy hit the stick.
(58) The boy hit the fence.

In (57) and (58) the stick and fence are being hit. Fillmore [forthcoming] points out that although (58) may be a paraphrase of (50), (57) is not a paraphrase of (51). Fillmore takes this as an indication that the goal case is obligatory for *hit*. Another possibility is that (50) and (51) are different word senses of *hit*. Sentence (59) which has the same syntactic structure as (51) can be paraphrased by (60):

(59) I hit my head on the doorway.
(60) I hit my head.

Then (51) would be considered one word sense with case frame agent, neutral, locative, and (50), (57), and (59) would be a second sense with case frame agent, neutral, locative, and instrument. The difference would be that the first sense has an obligatory locative.

There is one aspect of *hit*'s behavior illustrated by sentence (61)

which should not be confused with the sentences considered so far.

(61) The boy hit his brother on the head.

The phrase *his brother on the head* is an example of inalienable possession. It functions as one unit which can be replaced by a possessive.

(62) The boy hit his brother's head.

DRAIN

*Drain* is a member of Celce-Murcia's class of verbs of separating. These verbs, like the verbs of joining, may have an alternation of marked and unmarked locatives and neutrals. The marking prepositions are *from* instead of *on* and *of* instead of *with*.

(63) He drained the tank of water.
(64) He drained water from the tank.

Very few verbs show the alternation of (63) and (64), although there are many verbs that can take one form or the other:

(65) He relieved the soldier of his duties.
(66) He cleared the dishes from the table.

Celce-Murcia [1972] points out that the two uses of *drain* show aspect differences. Sentence (63) is completive: no water is left in the tank. Sentence (64) is incompletive: water could be left in the tank.

FILL

Celce-Murcia includes *fill* among the verbs of joining and SS&P assign it a case frame with agent, neutral, and locative:

(67) The farmer (A) filled the truck (L) with hay (N).
(68) The truck (L) fileed with hay (N).
(69) Hay (N) filled the truck (L).

*Fill* is unusual because with this case assignment its locative is never marked. This is not typical of the locative although it can be a characteristic of the neutral. The word *truck* in (67)-(69) does appear in positions in which neutrals are found, but then *hay* would be called an instrument. Even though neutrals can shift from object position as in (67) to subject position as in (68), this does not happen if the result is a neutral subject and an instrument marked by *with*. Further evidence that *hay* is not an instrument is provided by the following sentence:

(70) The farmer filled the truck with hay with a pitchfork.

In (70), *pitchfork* is clearly an instrument. Neutrals in verbs of joining may be marked by *with*, so there is no reason for *hay* not to be the neutral. Sentence (67) has the structure of one of the two forms of *smear*, but *fill* does not have the alternation of marked and unmarked locatives and neutrals found in *smear*. *Fill* differs from *smear* and *hang* in two ways: the locative in *hang* cannot become subject in the way that *fill*'s does in (68) and the neutral of *hang* does not move to subject position like *fill*'s does in (69). In contrast to *hang*, which has an obligatory neutral, the neutral of *fill* is optional:

(71) The farmer (A) filled the truck (L).
(72) The truck (L) filled.

*Fill*, then, does not conform to the patterns of the other verbs considered.

CONTAIN

A passive sentence provides a clue to *contain*'s case frame:

(73) Water is contained in the pool.

Sentence (73) shows that *contain*'s case frame includes a locative marked by

*in*. The subject of the passive sentence is the neutral and appears as the object of the active sentence (74):

(74) The pool (L) contains water (N).

The locative of (73) has moved into subject position in (74) losing its marking preposition. Sentence (74) is still the same word sense as (73), but there is a second sense of *contain* with an agent-neutral case frame:

(75) The dam (A) contained the flood (N).
(76) The flood (N) was contained by the dam (A).

*Contain* differs from other verbs with agentless case frames in having a passive form, for example *swarm* has none. Also, *contain* has an unmarked neutral when its locative is subject while *swarm*'s neutral is marked by *with*. *Contain*, like *fill* does not follow the patterns of other verbs.

## Notes

{note 1}
Sometimes the presence of a *with* in the sentence can prevent the addition of an instrument even though the *with* marks another case.

(1) * I hung the wall with pictures with nails.
(2) I filled the truck with hay with a pitchfork.

This is probably due to stylistic considerations. There are some verbs which do not take instruments; among them are *meet*, *drop*, and *lose*.

{note 2}
The missing cases might include time, comitative, and manner. Time and comitative are always marked. The manner case can become subject, and an additional rule will be needed to allow this.

{note 3}
*Write*, another Dative Shift verb, allows the dative to appear in direct object position, and allows the marked dative to occur without a neutral even if it is not a generic noun phrase.

(1) Bill (A) wrote a letter (N).
(2) Bill (A) wrote to Mary (D).
(3) Bill (A) wrote Mary (D).

{note 4}
*Put* can occur in sentences which resemble completive sentences, but in them *with* marks the locative. In (1), the soap has been put in the vicinity of the wash.

(1) I (A) put the soap (N) with the wash (L).

{note 5}
The sense of *ride* in (39) is different from that in (1) below where *ride* has an agent-neutral case frame.

(1) John (A) is riding the horse (N).

{note 6}
The agent of *hit* can occur alone in subject position as in (1), but the neutral and locative do not.

(1) When the storm hit, we were indoors.

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