

A mapping theory of agrammatic comprehension deficits

William O'Grady^{a,*} and Miseon Lee^b

^a *Department of Linguistics, University of Hawaii, 1890 East-West Road, Honolulu, HI 96822, USA*

^b *School of Linguistics and Applied Language Studies, The University of Reading, UK*

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Abstract

This paper offers evidence for the Isomorphic Mapping Hypothesis, which holds that individuals with agrammatic aphasia tend to have difficulty comprehending sentences in which the order of NPs is not aligned with the structure of the corresponding event. We begin by identifying a set of constructions in English and Korean for which the IMH makes predictions distinct from those of canonical order and trace-based theories of agrammatic comprehension. Then, drawing on data involving the interpretation of those patterns by English-speaking and Korean-speaking agrammatics, we argue for the conceptual and empirical superiority of the isomorphic mapping account.

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1. Introduction

Work over the past three decades has yielded various grammar-oriented hypotheses concerning the nature of the comprehension deficit associated with agrammatic aphasia. A first class of hypotheses, which we will refer to as “canonical order models,” holds that agrammatic aphasias have difficulty with structures whose word order departs from the basic, most frequently manifested word order pattern of the language—agent + verb + theme, in the case of English. Proposals of this type have been put forward by Schwartz, Saffran, and Marin (1980), Caplan, Baker, and Dehaut (1985), Caplan and Futter (1986), Schwartz, Linebarger, Saffran, and Pate (1987), St. John and Gernsbacher (1998), and Dick et al. (2001), among others.

A second class of hypotheses, which we will call “trace-based” theories, focuses on traces as a major source of agrammatic comprehension difficulties. Perhaps the best-known example of such a theory is Grodzinsky's (1995, 2000) Trace Deletion Hypothesis (TDH).

(1) The Trace Deletion Hypothesis (TDH)

Traces are absent from the syntactic representations of Broca's aphasias.

On Grodzinsky's account, the loss of traces interferes with the assignment of thematic roles to moved constituents, forcing recourse to default strategies that determine thematic roles based solely on linear position in sentences that have undergone movement (e.g., ‘Take the first NP to be the agent’).

Another trace-based theory, the Double Dependency Hypothesis (DDH) of Mauner, Fromkin, and Cornell (1993), maintains that traces survive but that their relationship to their antecedent is disrupted.

(2) The Double Dependency Hypothesis (DDH)

The dependency between a referential NP and its trace is disrupted in syntactic chains.

When there is only one antecedent-trace dependency, it is claimed, the syntactic representation will be incomplete but still unambiguously interpretable. When there are two such dependencies, however, the representation becomes semantically ambiguous and inter-

* Corresponding author. Fax: 1-808-956-9166.

E-mail address: ogrady@hawaii.edu (W. O'Grady).

pretive difficulties arise since it is unclear “which NP is coindexed with what” (Beretta et al., 2001, p. 410).

The purpose of this paper is to present evidence from English and Korean which calls into question the adequacy of both canonical order and trace-based theories of agrammatic comprehension, offering support instead for a particular view of the relationship between structure and meaning that we call the Isomorphic Mapping Hypothesis. We consider this hypothesis in the next section. We then explore evidence for this hypothesis from the study of English locative and instrumental patterns (Sections 3 and 4), Korean scrambling patterns (Section 5), and Korean passives (Section 6). A brief concluding section follows.

2. The isomorphic mapping hypothesis

The essence of our proposal is that agrammatics tend to have difficulty with sentences in which the order of NPs is not aligned with the structure of the corresponding event. This idea can be formulated as follows:

- (3) The Isomorphic Mapping Hypothesis (IMH)¹
 A non-isomorphic mapping between syntactic representations and the corresponding event increases processing difficulty.

In a typical active clause, the agent-theme order is isomorphic with the corresponding event, which involves an action that originates with the agent and is directed toward the theme (e.g., Croft, 1991, p. 262; Langacker, 1995, pp. 18–20; Pinker, 1989, p. 193; Ritter & Rosen, 1998; Talmy, 1988; Van Voorst, 1988, p. 27).

- (4) The child threw the ball. ← sentence

 ← event

In contrast, passive sentences are non-isomorphic with the corresponding event, since the order of the verb's arguments does not reflect the event's development.

- (5) The ball was thrown by the child. ← sentence

 ← event

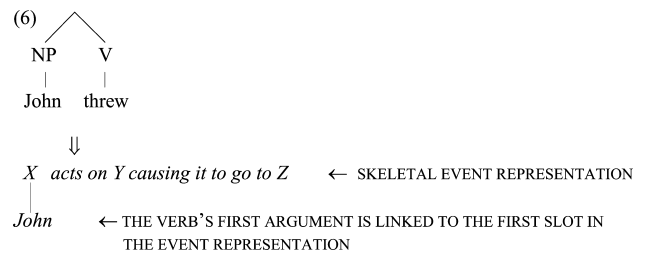
Dik (1989), among others, has suggested that an isomorphic mapping between a sentence's word order and the structure of the event it denotes facilitates

¹ In work on language acquisition, the term ‘iconic’ is sometimes used (e.g., Cho, Lee, O'Grady, Song, & Suzuki, 1998).

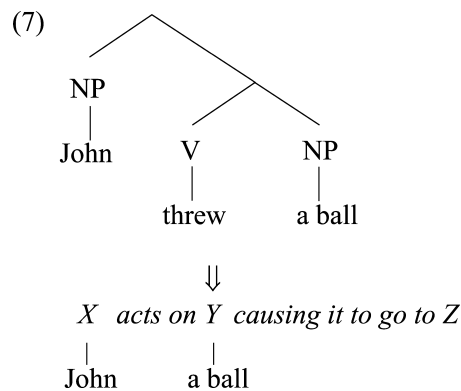
comprehension in general, and this idea underlies our proposal as well. In particular, we propose that a non-isomorphic relationship between a sentence's word order and the structure of the corresponding event increases processing difficulty, which in turn compromises comprehension.

As its name suggests, the IMH belongs to the class of ‘mapping theories’ (e.g., Linebarger, 1995), which seek to trace agrammatic comprehension disorders to processing deficits that affect operations on syntactic representations, especially those that deal with the mapping between syntactic structure and other levels of representation. We take isomorphism to be important for the syntax–semantics mapping because listeners presumably must construct a representation corresponding to the real-world event denoted by the sentence as they process its syntactic structure.

Take for example the sentence *John threw a ball to Mary*, which denotes a transfer event. As this sentence is processed from left to right, the first step is to combine the subject with the verb, whose properties in turn permit the projection of a skeletal event representation with the referent of the subject in the actor role.



The next NP to be encountered is the theme *a ball*, which fits into the second argument slot in the event representation.

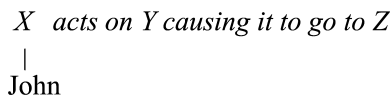
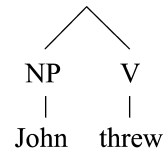


When the final argument (the goal *Mary*) is encountered, it can then be straightforwardly associated with the third slot in the event representation.

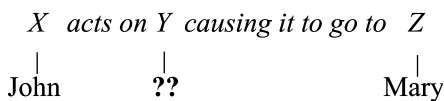
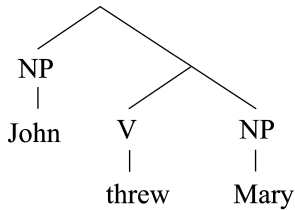
However, matters are not so simple in the case of a double object dative such as *John threw Mary a ball*.

Here, the second NP is the goal, which forces the listener to “skip over” a slot in the event representation and return to it later, as shown in (8). This, we assume, is the source of the processing cost associated with non-isomorphic word order and is the reason why subjects with processing deficits (including, by hypothesis, aphasics) show a preference for isomorphism.

- (8) **Step 1:** Combination of the subject with the verb; projection of the skeletal event representation; association of the subject with the first slot in that representation.



- Step 2:** Combination of the verb with its second argument (the goal *Mary*); association of that argument with the *third* slot in the event representation.



A variety of studies report that double object patterns are in fact more difficult than the prepositional dative for agrammatics (e.g., Caplan & Futter, 1986; Caplan et al., 1985; Heilman & Scholes, 1976). These findings are consistent with the IMH, but do not offer direct support for it since the double object dative is widely assumed to manifest a non-canonical order in English and to be derived via movement from the more basic prepositional dative pattern (e.g., Hickok, 1992; Kolk & Weijts, 1996, p. 111), yielding the representation in (9). (Here and elsewhere, we assume that trace-based theories adopt the VP-internal subject hypothesis, according to which the subject originates inside the VP—e.g., Beretta et al., 2001, p. 409; Grodzinsky, 2000, p. 6; Maunder et al., 1993, p. 355.)

- (9) [IP John_i [VP t_i handed Mary_j a ball t_j]].

Canonical order models and trace-based theories thus arguably make the same prediction as the IMH in this case, which is that the double object pattern should be more difficult to comprehend than its prepositional dative counterpart.

Exactly, the same problem arises in the case of passive constructions, which all three theories predict to be more difficult than their active counterparts—the IMH because of the non-isomorphic mapping (see the discussion of (5) above), canonical order models because of their non-basic theme-agent order, and trace-based theories because of the NP-trace relations that they contain (see Section 4).

Relative clauses and cleft structures—two other patterns that are frequently investigated in research on aphasic comprehension disorders—work the same way.²

- (10) a. Subject relative clause (isomorphic)
the boy_i [that [IP t_i [VP t_i pushed the girl]]]
agent theme
- b. Direct object relative clause (non-isomorphic)
the boy_j [that [IP the girl_i [VP t_i pushed t_j]].
theme agent
- (11) a. Subject cleft (isomorphic)
It was the boy_i [that [IP t_i [VP t_i pushed the girl]]].
agent theme
- b. Direct object cleft (non-isomorphic)
It was the boy_j [that [IP the girl_i [VP t_i pushed t_j]].
theme agent

Once again, the non-isomorphic patterns also manifest a non-canonical word order, with two trace-antecedent dependencies. Crucially, though, there are various pairs of constructions for which the predictions of the different theories can be teased apart. We consider one such contrast in the next section.

3. English locatives and instrumentals

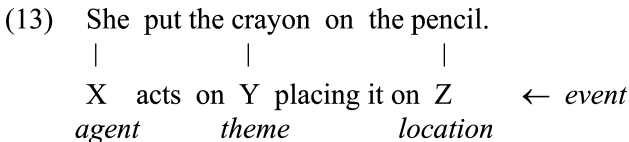
A first opportunity to compare the IMH to canonical order models and trace-based theories involves the following two patterns from English:

² We simplify slightly here by coindexing the trace corresponding to the relativized NP with the head noun rather than with a null operator, as is commonly assumed.

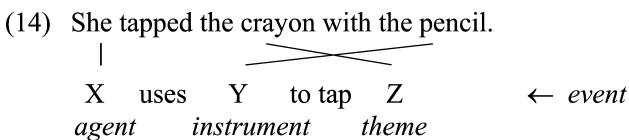
- (12) a. The direct object-locative pattern:
She put the crayon on the pencil.
- b. The direct object-instrument pattern:
He tapped the crayon with a pencil.

Not only do these two patterns exhibit canonical word order, they are treated alike by trace-based theories, although the precise nature of that treatment has varied over the years. In traditional work, neither the direct object nor the PP moves in either pattern. In more recent work within the Minimalist Program, in contrast, the direct object moves for Case checking purposes in both patterns—either to the specifier position of an Agreement projection (Chomsky, 1993) or to a specifier position within VP (Chomsky, 1995).³ Crucially, though, the locative and instrumental patterns do not differ with respect to whether movement of the direct object is posited. Movement either takes place in neither or it takes place in both.

The two patterns have a very different status with respect to isomorphism, however, since only the locative construction employs a word order that is aligned with the structure of the corresponding event. Consider in this regard the locative sentence in (12a), in which the agent acts on the crayon causing it to move to a position on top of the pencil. This yields the mapping relationship depicted in (13), in which the order of the constituents is isomorphically aligned with the corresponding event.



In the instrumental sentence in (12b), in contrast, the agent acts first on the pencil, which is then used to tap the crayon. This gives the state of affairs depicted in (14), which departs from the word order (agent, theme, instrument) found in the corresponding sentence.



In light of these differences, the IMH allows us to predict that if agrammatics have trouble interpreting

³ Views differ on whether this movement is ‘overt’ or ‘covert.’ Chomsky (1995) assumes the latter, while Lasnik (1999) argues for the former.

Table 1
Predictions for English theme-instrument and theme-locative patterns

| Hypothesis | Theme-instrument | Theme-locative |
|-------------------------------|------------------|----------------|
| Canonical order models | No difference | No difference |
| Trace Deletion Hypothesis | No difference | No difference |
| Double Dependency Hypothesis | No difference | No difference |
| Isomorphic Mapping Hypothesis | Harder | Easier |

either structure, the instrumental construction should be more difficult than the locative pattern.

In contrast, trace-based theories such as the TDH and DDH make no such prediction: because the locative construction and the instrumental pattern either have no traces (the traditional view) or traces in the same place (the current view), there is no reason to expect a difference in their comprehensibility to agrammatics (see Table 1).

3.1. Method

To test the prediction of the IMH, we conducted a comprehension experiment with six normal native speakers of English (two males and four females; mean age = 19.7) and six English-speaking Broca’s aphasic patients (one female and five males; mean age = 59.3). Scores on the western aphasia battery (WAB, Kertesz, 1982) and an analysis of narrative discourse indicate that all six impaired subjects suffer from Broca’s aphasia with agrammatism, resulting from a single lesion in the left hemisphere. The mean aphasia quotient (AQ) derived from the WAB was 74.7 (range 62.2–82.3), with auditory comprehension superior to speech. All the aphasic subjects had at least a high-school education (mean = 18 years) and five were right-handed. They were between two and 12 years post-stroke at the time of the study. Testing of visual and hearing acuity showed abilities adequate for test performance.

The experiment consisted of 20 semantically reversible sentences: 10 locative sentences such as (15) and 10 instrumental sentences such as (16).⁴ (All test items were interspersed and presented in random order.)

(15) Put the crayon on the pencil. (locative pattern; isomorphic)

(16) Tap the crayon with the pencil. (instrumental pattern; non-isomorphic)

⁴ Because our concern is with the order of non-subject NPs within the VP portion of the sentence and in order to make the task maximally simple, we used the imperative construction in this and the next two experiments. We assume that its null subject originates (like other subjects) in the specifier position of VP, creating the second antecedent-trace dependency relevant to the DDH. If there is no such dependency, then the DDH simply makes no prediction in this case.

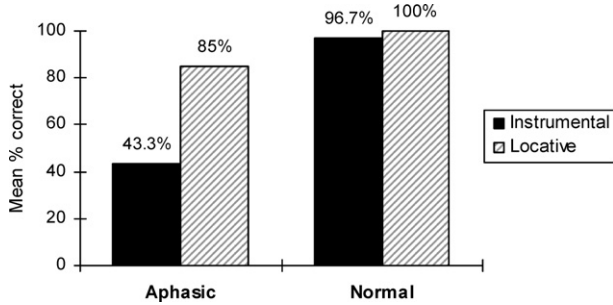


Fig. 1. Comprehension of English instrumental and locative patterns.

The subjects, who were tested individually in a quiet place, were asked to respond to the test sentences with the help of props provided by the experimenter.

3.2. Results and discussion

As Fig. 1 illustrates, the normals encountered little or no difficulty with any of the test patterns—they had a score of 96.7% on the instrumental pattern and 100% on the locative structure. However, matters were very different for the agrammatic subjects. They did well on the locative pattern (with a mean score of 85% correct, *SD* = 17.6), but they performed poorly on the instrumental construction (mean 43% correct, *SD* = 34.5).

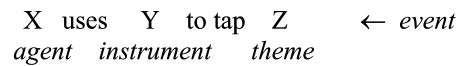
The difference between the locative and instrumental patterns is significant for the agrammatics ($t(5) = -2.834, p = .036$), but not for the normals ($t(5) = -1.581, p > .05$). Moreover, the difference in the performance of the agrammatics and the normals is significant on the instrumental pattern ($t(5) = -4.000, p = .010$), but not on the locative pattern ($t(5) = -12.087, p > .05$). This is precisely what the IMH would lead us to expect—difficulty for agrammatics on the non-isomorphic pattern.

4. Topicalization and instrumentals

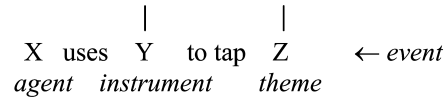
A further phenomenon involving instrumentals is also of interest. As illustrated in (17), it involves the contrast between instrumental patterns with the canon-

ical V-NP-PP order and patterns in which the instrumental phrase has been topicalized.

- (17) a. Canonical instrumental pattern (non-isomorphic): Tap the crayon with the pencil.



- b. Topicalized instrumental pattern (isomorphic): With the pencil, tap the crayon.



The significance of this contrast is that it is the infrequent, non-canonical order that is isomorphic with the corresponding event. This in turn yields a sharp difference in the predictions of the IMH and of canonical order models (see Table 2).⁵

4.1. Method

To test these predictions, we interspersed 10 topicalized instrumental patterns such as (17b) among the plain instrumental and locative sentences in the experiment discussed in the previous section. The subjects (the six agrammatic aphasics and six normals described above) were asked to respond to the test sentences with the help of props provided by the experimenter. As noted earlier, all subjects were tested individually in a quiet place.

4.2. Results and discussion

Fig. 2 summarizes our results.

The normals encountered little or no difficulty with either of the test patterns—they had a score of 96.7% on the canonical pattern and 100% on its non-canonical counterpart. Matters were very different for the agrammatic subjects, however. As Fig. 2 shows, they did well on the non-canonical pattern (with a mean score of 83.3%, *SD* = 34.45), but they performed poorly on the canonical construction (with a mean score of just 43.3%, *SD* = 15.06). This difference is significant ($t(5) = -3.038, p = .029$).

The IMH correctly predicts this result—difficulty for agrammatics on the non-isomorphic pattern. But it is the precise opposite of what canonical order models

Table 2 Predictions for English canonical and topicalized instrumental patterns

| Hypothesis | Theme-instrument order (canonical, but non-isomorphic) | Instrument-theme order (non-canonical, but isomorphic) |
|------------------------|--|--|
| Isomorphic Mapping | Hard | Easy |
| Canonical order models | Easy | Hard |

⁵ We attribute no prediction to the TDH here since the entire PP is moved, keeping together the NP and the preposition that determines its thematic role. The DDH also seems to make no prediction, since it is concerned only about the traces of 'referential NPs.'

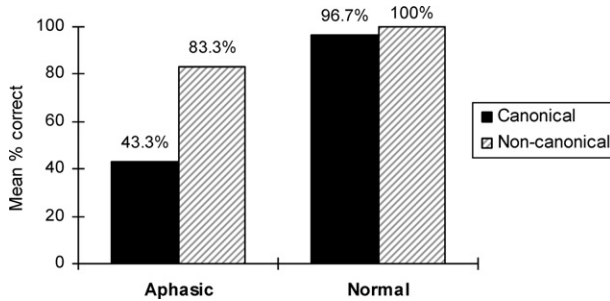


Fig. 2. Comprehension of English canonical and non-canonical instrumental patterns.

predict, since it is the frequent, regular pattern that creates difficulty.

5. Scrambling in Korean

As Beretta et al. (2001) note, Korean permits relatively free ‘scrambling’ of the verb’s arguments, so that both the agent-theme pattern in (18a) and the theme-agent pattern in (18b) are perfectly acceptable. (Nom = nominative; Acc = accusative; SE = sentence ender)

(18) a. Basic form (canonical and isomorphic)

agent *theme*
 [IP Kay-ka_i [VP t_i saca-lul mwul-eyo]].
 dog-Nom lion-Acc bite-SE
 ‘The dog bites the lion.’

b. Scrambled form (non-canonical and non-isomorphic)

theme *agent*
 Saca-lul_j [IP kay-ka_i [VP t_i t_j mwul-eyo]].
 lion-Acc dog-Nom bite-SE
 ‘The dog bites the lion.’

As the representation in (18b) indicates, Beretta et al. assume that there are two antecedent-trace relations in this sentence—one involving the direct object, which has been moved to the front of the sentence from the position immediately preceding the verb, and one involving the subject, which has moved from a VP-internal position to the specifier position in IP. As in the case of the various patterns considered in Sections 1 and 2, all approaches to comprehension deficits—canonical order models, trace-based theories, and the IMH—predict that such patterns should be difficult for Broca’s patients, and indeed they are: Beretta et al. report chance performance on the scrambled pattern by all three of their subjects on a picture-matching task, compared to above-chance performance on the canonical pattern, where there is only one antecedent-trace relation.

Although the contrast in (18) does not permit us to choose among the various hypotheses under consideration, the pair of sentences exemplified in (19) offers an opportunity to do so.

(19) a. *agent* *goal* *theme*
 Ai-ka kay-eykey so-lul mil-ess-ta.
 child-Nom dog-Dat cow-Acc push-Pst-Decl
 ‘The child pushed a cow to the dog.’

b. *agent* *theme* *goal*
 Ai-ka so-lul kay-eykey mil-ess-ta.
 child-Nom cow-Acc dog-Dat push-Pst-Decl
 ‘The child pushed a cow to the dog.’

The agent–goal–theme pattern in (19a) is more frequent (Cho et al., 1998; Sohn, 1994, p. 232) and is typically taken to represent the neutral or canonical order (Sohn, 1996, p. 86). It is commonly assumed that the theme–goal order in (19b) is derived from it via movement, giving the representation depicted below.⁶

(20) [IP Ai-ka_i [VP t_i so-lul_j kay-eykey t_j mil-ess-ta]].
 child-Nom cow-Acc dog-Dat push-Pst-Decl
 ‘The child pushed a cow to the dog.’

As can be seen here, there are two antecedent-trace dependencies, one involving the direct object, which has moved to the left of the indirect object, and the other involving the subject which has moved from inside the VP to the Spec of IP position. The DDH and canonical order models therefore both make the same prediction: comprehension should be compromised on such patterns.⁷

Crucially, the IMH makes the opposite prediction, for it is the derived theme–goal order that is isomorphic with the corresponding situation: the agent (the child)

⁶ Evidence for this analysis includes the contrasts observed in the following sentences:

- a. *A dative antecedent preceding an accusative anaphor*
 Nay-ka kewul-lo John-eykey_i caki-lul_j pichwuepoyecwu-ess-ta.
 I-Nom mirror in John-Dat self-Acc show -Pst-Decl
 ‘I showed to John himself in the mirror.’
- b. *An accusative antecedent preceding a dative anaphor*
 ?*Nay-ka kewul-lo John-ul_i caki-eykey_i pichwuepoyecwu-ess-ta.
 I-Nom mirror in John-Acc self-Dat show -Pst-Decl
 ‘I showed John to himself in the mirror.’

The fact that coreference in the (b) pattern is less natural than in its (a) counterpart suggests a weak ‘reconstruction effect’: the accusative-marked NP originates in a position lower than the dative and returns there in Logical Form. Takano (1998) offers extensive arguments along these lines for the typologically identical Japanese.

⁷ In the analyses put forward by Grodzinsky, the TDH appears to be concerned only with disruptions in the assignment of thematic roles to overt subjects, and therefore makes no prediction here. However, the version of the TDH developed by Hickok (1992), cited by Kolk and Weijts (1996, p. 111), apparently extends to the assignment of thematic roles to direct objects and would therefore predict the relative difficulty of the theme–goal order, with its moved direct object.

Table 3
Predictions for Korean theme–goal and goal–theme patterns

| Hypothesis | Goal-theme order (9a) | Theme-goal order (9b) |
|-------------------------------|-----------------------|-----------------------|
| Canonical order models | Easier | Harder |
| Double Dependency Hypothesis | Easier | Harder |
| Isomorphic Mapping Hypothesis | Harder | Easier |

acts upon the theme (the cow) causing it to move to the goal (the dog).

- (21) NP1 NP2 NP3
 | | |
 X acts on Y causing it to go to Z
 agent theme goal

The IMH therefore predicts that agrammatics will encounter difficulty with the goal–theme construction, but not with its theme–goal counterpart (see Table 3).

5.1. Method

To test the validity of these predictions, O'Grady and Lee (2001) conducted a comprehension experiment with four agrammatic aphasics (three males and one female). All patients were right-handed monolingual speakers of Korean with 12–16 years of education; they ranged in age from 40 to 50 (mean age = 43.75). The patients had been diagnosed as having Broca's aphasia with agrammatism based on the Boston Diagnostic Aphasia Examination, the Aphasia Severity Rating Scale, and clinical evaluation by two speech therapists; CT scans performed at the onset of symptoms (6–69 months prior to our study) demonstrated a unilateral left-sided lesion.

The experiment was built around 40 semantically reversible sentence types such as (22), half employing the theme–goal order and the other half the goal–theme order.

- (22) Sample test item (theme–goal order):
 Kom-ul so-eykey milecwu-si-eyo
 bear-Acc cow-Dat push -Hon-SentEnder
 'Will you push the bear to the cow?'

The subjects, who were tested individually in a quiet place, were asked to respond to the test sentences with the help of stuffed toys and other props provided by the experimenter.

To establish a base line for evaluating our results, we administered the experiment to nine right-handed monolingual native speakers of Korean living in Seoul, Korea (four males and five females, all with 16–18 years of education and ranging in age from 31 to 59 years; mean age = 39.9 years).

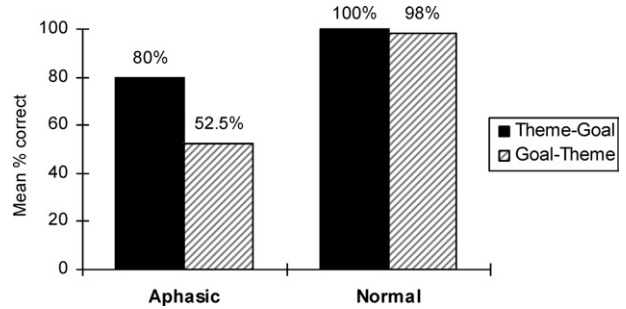


Fig. 3. Comprehension of Korean theme/goal patterns.

5.2. Results and discussion

As Fig. 3 illustrates, the normals encountered no difficulty with either pattern: the mean proportion of correct responses for both structures exceeded 98%. The results for the agrammatics were quite different, however. They performed above chance on the theme–goal pattern, in which the order of the NPs was isomorphic with the structure of the corresponding event even though it does not employ the canonical word order of Korean and even though it contains two antecedent-trace dependencies. In contrast, they performed at chance on the canonical and trace-less goal–theme pattern.

This accords with the predictions of the IMH—success on the isomorphic pattern and difficulty on the non-isomorphic pattern independent of canonical word order or the presence of traces.

6. The problem of Korean passives

Beretta et al. suggest that a key contrast favoring the DDH over both the TDH and canonical order models comes from the Korean passive patterns illustrated in (23).⁸

- (23) a. Canonical form (theme-agent order)
 [IP Saca-ka_i [VP kay-eykey_j t_i mwul-l_ij-eyo]].
 lion-Nom dog-by bite-Pass-SE
 'The lion is bitten by the dog.'
- b. Scrambled form (agent-theme order)
 Kay-eykey_j [IP saca-ka_i [VP t_j t_i mwul-l_ij-eyo]].
 dog-by lion-Nom bite-Pass-SE
 'The lion is bitten by the dog.'

As Beretta et al. note, canonical order models predict above-chance comprehension on (23b), where scrambling has restored the canonical agent-theme order. In contrast, the DDH predicts chance performance on both

⁸ The DDH posits a referential dependency between the demoted agent and the passive morpheme in the verb (Beretta et al., 2001, p. 411; Mauner et al., 1993, p. 356).

Table 4
Predictions for Korean passives

| Hypothesis | Theme-agent order | Agent-theme order |
|------------------------------|-------------------|-------------------|
| Canonical order hypothesis | Hard | Easy |
| Trace Deletion Hypothesis | Hard | Easy |
| Double Dependency Hypothesis | Hard | Hard |

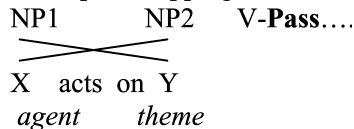
patterns because there are two dependencies in (23a) and three in (23b). The TDH predicts difficulties with sentence (23a) only, where the strategy of taking the first NP to be the agent runs afoul of the theme-agent order (see Table 4).

Beretta et al. report that their subjects performed at chance not only on the passive sentences with canonical theme-agent word order, which is expected on all accounts, but also on scrambled passive patterns such as (23b), in which the agent precedes the theme—as only the DDH predicts.

At first glance, these results appear to be problematic for the IMH. In particular, we must ask why performance should be so poor on the scrambled passive, which shows an isomorphic agent-theme word order.

One possibility that we would like to explore in future work is that subjects take note of the passive suffix (Linebarger, 1995, p. 67) and recognize that it signals a realignment of the mapping between argument structure and grammatical relations,⁹ with the theme encoded as subject rather than direct object. Assuming a low sensitivity to case marking in NP NP V patterns, it is possible that Broca's patients *attempt* to link the first NP (normally the subject in Korean) to the second (theme) position in event structure in ALL passive-marked sentences—scrambled or not. This results in an isomorphism problem, which in turn leads to the observed comprehension difficulties.

(24) Attempted mapping:



The key assumption here is that the passive morpheme triggers an attempt to link the first NP to the second argument position in event structure. Were it not for the presence of this morpheme, nothing would prevent association of the first NP with the *first* argument position in scrambled passive constructions, giving the

⁹ This suggestion assumes a greater sensitivity to the passive suffix than to case markers. This could come about for a variety of reasons, including salient positioning (the passive suffix is close to the end of the sentence) and cue validity (case is a poor predictor of thematic roles in Korean, whereas the passive suffix reliably signals a change in argument structure and its relationship to syntactic structure).

above-chance performance that the isomorphism account would otherwise predict in these patterns. There is a simple way to test this hypothesis: we predict that *suffix-less* passives will show the full isomorphism effect.

Korean does in fact have one such passive: the verb *mac-ta* 'be hit' is inherently passive in that it takes a theme subject and an oblique agent (arguably the defining properties of a passive construction), even though it has no passive suffix. (It also has no active counterpart.) For instance:

- (25) Kay-ka ai-eykey mac-ayo.
dog-Nom child-by be.hit-SE
'The dog is being hit by the child.'

This raises the question of how Korean aphasics will perform on the comprehension of such sentences and on their scrambled counterparts.

- (26) a. Basic order (theme-agent: non-isomorphic)
Kay-ka ai-eykey mac-ayo.
Dog-Nom child-by be.hit-SE
'The dog is being hit by the child.'
- b. Scrambled order (agent-theme: isomorphic)
Ai-eykey kay-ka mac-ayo.
child-by dog-Nom be.hit-SE
'By the child, the dog is being hit.'

Our theory predicts that they will do well on the scrambled pattern (which is isomorphic and contains no passive suffix), but not on the non-isomorphic canonical pattern. In contrast, the DDH makes the opposite prediction, since the theme-agent order has at most one trace (left by raising of the subject from a VP-internal position to the Specifier of IP), whereas the agent-theme order contains two traces—one associated with the scrambled 'by-phrase' and the other with the subject.

- (27) Ai-eykey_j [_{IP} kay-ka_i [_{VP} t_i t_j mac-eyo]].
child-by dog-Nom be.hit-SE

Lee (2000) investigated the ability of four Korean-speaking agrammatics (the same four patients who participated in the scrambling study) to interpret such patterns via a picture-matching task. The test items consisted of 40 sentences containing an "inherently passive" verb, 20 with the basic subject-first order and 20 with the scrambled order.

Fig. 4 summarizes Lee's results.

As can be seen here, the subjects performed at chance on the non-isomorphic theme-agent pattern, but above chance on the isomorphic agent-theme construction. (This difference is significant: $t(3) = -7.348, p = .005$.) This is just what the IMH predicts.

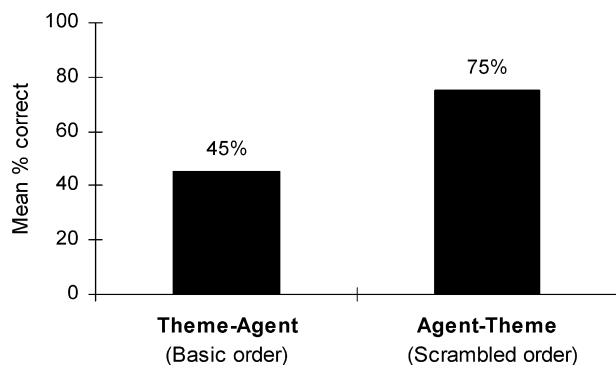


Fig. 4. Comprehension of Korean inherent passives by agrammatics.

7. Conclusion

In sum, there is much to recommend the Isomorphic Mapping Hypothesis. On the empirical side, it provides a superior account of a variety of crucial contrasts, including English locative and instrumental constructions, topicalization involving instrumental phrases, Korean scrambling patterns, and (with the help of an additional assumption about the passive suffix) inherent versus morphological passives in Korean.

There are also advantages on the conceptual side, especially with respect to traditional canonical order models, which typically offer no principled explanation for why particular patterns should be canonical. (Frequency is a possible factor in many cases, but cannot be right in general, as shown in our discussion of topicalized instrumental patterns in English and of theme/goal patterns in Korean.) In contrast, the IMH traces the word order preferences associated with agrammatic aphasia to mapping between a sentence's syntactic structure and the corresponding event representation. In particular, we have proposed that significant comprehension problems arise when the processor cannot associate an NP in the *n*th position in the syntactic representation with the corresponding slot in the event representation.¹⁰

As such, our proposal makes a contribution to a processing approach to comprehension deficits in aphasia, fitting well with the idea that the computational system for forming and interpreting sentences is intact but 'underpowered' in ways that compromise its ability to deal with phenomena that tax the processor in one way or another. In the case at hand, the 'tax' comes from a misalignment that affects the mapping between a

sentence's syntactic structure and the representation of the event that it denotes.

As we have seen, the effects of this misalignment can be severe, significantly affecting the ability of aphasics to understand the sentences in question. (In fact, even the normals in our experiments manifest a slight preference for the isomorphic patterns.) This cannot be the only way in which cost is added to the processes underlying sentence comprehension, of course. However, the data presented here suggests that it may well be one of the ways in which this happens, and that it has consequences for the comprehension of a number of well-studied constructions.

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¹⁰ A referee raises the interesting question of whether this hypothesis might lead to predictions concerning deficits on tasks not relating to the structural complexity of sentences. It is indeed possible that a preference for isomorphism extends to other domains, and that departures from this preference have particularly severe consequences for aphasics. Although nothing in the theory we have outlined here predicts that the observed linguistic deficits must have counterparts in other domains, the matter is no doubt worthy of further investigation.

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