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Choice of Passive Voice Is Affected by Verb Type and Animacy

FERNANDA FERREIRA

Michigan State University

In four experiments, subjects were presented with two nouns and a verb and asked to construct a sentence. The primary manipulation was whether the verb was "normal" (agent-theme or experiencer-theme, such as AVOIDED) or theme-experiencer (e.g., CHALLENGED), and the dependent measure was the syntactic form of the sentence (and, secondarily, the time to formulate the sentence). The experiments demonstrated that passives occur more frequently with theme-experiencer verbs than with normal verbs, and passives occur more frequently when the two nouns differ in animacy rather than both being animate. In addition, passives took longer to formulate than actives. The results indicate that speakers attempt to place more prominent thematic roles (agent, experiencer) in the subject position of a sentence.

A deliberation familiar to virtually all academic writers is whether to express an idea using the active or passive voice: Should one say *One form was filled out by each subject* (passive) or *Each subject filled out one form* (active)? The *Publication Manual of the American Psychological Association* (1983) takes the position that the active voice is stylistically preferable, as do many other works on effective writing (Strunk & White, 1972; Williams, 1990). Nevertheless, many writers encounter circumstances in which a passive sentence seems more appropriate than an active. Furthermore, although passive sentences are certainly less common than actives in English (Hopper & Thompson, 1980; Svartvik, 1966), passives do occur in both oral and written discourse and are found quite frequently in expository discourse (Quirk, Greenbaum, Leech, & Svartvik, 1972). The question I address in this article is how speakers decide between the active and passive form. The more general question is: How do speakers choose from among the syntactic options they have available for conveying some propositional content?

One possibility is that syntactic variations allow the language production system to adapt to differing activation levels of entities in conceptual memory, a notion that has been extensively explored by Bock (Bock, 1986, 1987a, 1987b; Bock & Warren, 1985; Kelly, Bock, & Keil, 1986). In one study (Bock, 1986), subjects were presented with a priming word such as *thunder* and then a picture of lightning striking a church. Subjects tended to describe the picture with an active sentence such as *Lightening is striking the church.* When the priming word preceding the same picture was one such as *worship*, subjects tended to describe the picture with a passive such as *The church is being struck by lightning.* Bock argued that the prime activates the corresponding concept and the activated concept tends to grab the earliest syntactic position in the sentence. The language production system then adjusts the structure of

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the sentence to accommodate that placement. If the activated concept is the argument corresponding to agent or instrument (e.g., *lightning* in the above example), the sentence is likely to be in the active voice. If the activated concept is the theme or location (*the church* in the same example), the sentence is likely to be a passive.

Other work has shown that the earliest sentence position tends to be occupied by nouns that are concrete and imageable (Bock & Warren, 1985), prototypical (Kelly et al., 1986), and animate (Bates & MacWhinney, 1982; Bock, 1982; Bock, Loebell, & Morey, 1992; MacWhinney, 1977; van Oosten, 1984). These characteristics also tend to describe agents. An agent is the voluntary instigator of some action (Fillmore, 1968; Jackendoff, 1990) and so tends to be animate (because inanimate entities generally lack volition), as well as concrete and prototypical (Lakoff, 1987). In English, placement of the agent in subject position almost invariably results in an active sentence. For example, in *Mary kicked the table,* the subject *Mary* is the agent of the action of kicking and the object *the table* is the theme. This tendency to place agents in subject position may be one reason for the higher frequency of actives over passives in English (Quirk et al., 1972).

Sentences also tend to be organized so that information known to speaker and listener (given information) occurs earlier in a sentence than new information (Haviland & Clark, 1974). Therefore, another reason that actives occur more frequently than passives is that speakers tend to make the instigator of an action the topic or given information of a discourse (Lakoff, 1987; van Oosten, 1984). The agent would thus take the earliest sentence position, resulting in active structures. However, if the theme of an action (the entity acted upon) happens to be the discourse topic, then speakers will tend to produce passive sentences (Tomlin, 1983). Thus, speakers tend to place topics in subject position, and because agents are frequent (almost default) topics, active sentences predominate over passives.

Thus far I have discussed cases in which the speaker's desire to make the agent the subject of a sentence results in the production of active structures. But the preference for sentences such as *Bill feared the mugger* over *The mugger was feared by Bill* suggests that other thematic roles besides agent also have a strong affinity for subject position. In *Bill feared the mugger, Bill* plays the role of experiencer (an entity experiencing a mental state) and *the mugger* is a theme. In *Mary kicked the table, Mary* is an agent and *the table* is a theme. It appears that when an agent or experiencer competes with a theme for subject position, the agent or experiencer is likely to win. This tendency is consistent with the thematic hierarchy (Grimshaw, 1990; Gruber, 1965; Jackendoff, 1972, 1987), a hypothesized ordering of thematic roles by prominence. The agent is highest in the hierarchy and the experiencer is immediately below. Next are location, source (the starting point of a moved object), and goal (the location toward which an object is moving), which are all equally prominent. The theme is at the bottom of the hierarchy. (Although it is often useful to distinguish between theme and patient (Fillmore, 1968; Jackendoff, 1987), the differences between them are not relevant for my purposes, and so I use the term *theme* to cover both.) The thematic hierarchy has been shown to influence coreference (Belletti & Rizzi, 1988) and the well-formedness of nominals (Grimshaw, 1990). The thematic hierarchy also appears to influence the competition for subject position—the more prominent role wins.

One way to test further the notion that the more prominent role on the thematic hierarchy is assigned to the sentential subject is to examine a unique class of English verbs that I label *theme-experiencer verbs.* Theme-experiencer verbs assign the role of theme to the subject of an active sentence and experiencer to the object. For example,

in the sentence *Bill amazed Tom*, Tom is the experiencer of the emotion of amazement and Bill is the theme. Other such verbs include *alarm, disgust,* and *impress* (see Levin, 1993, for a large list of such verbs, and Belletti & Rizzi, 1988, for a discussion of their syntactic and semantic properties). A test that can be used to help identify theme-experiencer verbs is to construct a simple active sentence consisting of an inanimate subject, a verb, and an object. If the resulting sentence is not anomalous, then the chosen verb is very likely a theme-experiencer verb. For example, *The rock chased/saw/liked Tom* are all anomalous; *The rock alarmed/disgusted/impressed Tom* are not. The logic underlying this test is that a theme can be inanimate but an agent cannot (Jackendoff, 1972); therefore, theme-experiencer verbs but not experiencer-theme or agent-theme verbs can accommodate inanimate subjects in the subject position of active clauses.[1]

If prominence on the thematic hierarchy influences assignment of arguments to subject position, speakers should have some tendency to produce passives with theme-experiencer verbs. This prediction follows because experiencers are higher on the hierarchy than themes. A strong prediction would be that passives will actually be more common than actives with theme-experiencer verbs. However, if a speaker's desire to maintain agents and experiencers as subjects is only one of many factors leading to the dearth of passives in discourse, then this prediction is not likely to be confirmed. Instead, one might predict that passives will be more frequent with theme-experiencer verbs than with agent-theme and experiencer-theme verbs. Agent-theme verbs assign the role of agent to the subject of an active sentence (e.g., *Mary* in *Mary kicked the table*) and theme to the object (*the table*). Experiencer-theme verbs assign the role of experiencer to the subject of an active sentence (e.g., *Bill* in *Bill feared the mugger*) and theme to the object (*the mugger*). For the remainder of this article, I group agent-theme and experiencer-theme verbs together into a class I will call *normal verbs*, because the two sets of verbs have the same essential property: the active structure results in the placement of the more prominent role in subject position. (Of course, many properties distinguish these two verb types, but they are not at issue in this study.) In contrast, theme-experiencer verbs assign the role of theme to the subject of an active sentence (e.g., *Bill* in *Bill amazed Tom*) and experiencer to the object (*Tom*). Theme-experiencer verbs thus require the passive structure to make the more prominent role the sentential subject.

In this paper I examine the possibility that the prominence of thematic roles on the thematic hierarchy affects sentence production in the way I have just outlined. I describe four experiments in which subjects received two nouns and a verb and used those words to compose and speak a sentence. The verb was either normal (agent-theme or experiencer-theme) or theme-experiencer, and the dependent measure was the syntactic form of the sentence: whether the speaker produced an active or a passive structure. The first experiment demonstrates the effect that passives are more common with theme-experiencer than with normal verbs. The second experiment shows that this effect holds even

[1] Copular verbs also permit inanimate subjects (e.g., *The rock is/seems heavy*), but these were excluded from the present study because they are not theme-experiencer verbs. The following test distinguishes theme-experiencer verbs from agent-theme verbs with an inanimate agent: Construct a sentence with the critical verb in its active form and with only inanimate nouns: e.g., *The stone broke the window* vs ??*The stone alarmed/disgusted/impressed the window*. The anomalous cases identify the theme-experiencer verbs, because an experiencer must be an entity capable of possessing mental states. In other words, if a normal verb is used with an inanimate agent and a theme, both arguments can be inanimate; in contrast, theme-experiencer verbs cannot be used with two sentence arguments because one of them must be an experiencer and experiencers must be capable of mentation.

when both entities in the sentence are animate. The third experiment demonstrates that both the thematic structure of the verb and the animacy of the participating noun phrases affect whether a speaker produces an active or passive sentence. The final experiment rules out an alternative explanation of the effect.

Experiment 1

In this experiment I tested the prediction that passives would be more common with theme-experiencer verbs than with normal verbs. Subjects were presented with a word triple on a computer monitor, two nouns and a past-tense verb (always in that order), and then the subjects produced a sentence using only those content words. The verb was either a normal or a theme-experiencer verb. The noun pairs differed in whether they were semantically connected (e.g., *layoffs manager worried*) or not (*toilets manager worried*). Within a pair of nouns, one was always animate and the other inanimate. The primary measure was the syntactic form of the sentence; a secondary measure was the time subjects required to formulate a sentence from the word triple.

Method

Subjects. The subjects were 40 undergraduates from the University of Alberta who participated in the experiments in exchange for partial credit in their introductory psychology courses. All subjects were native speakers of Canadian English and were naive with respect to the hypotheses of the experiment.

Materials. Forty word triples were constructed for the experiment (given in Appendix A). Each triple consisted of two nouns and a past-tense verb, ordered as NOUN NOUN VERBED. The two nouns of the triple were matched in frequency and syllable length, but differed in animacy. Three variables were manipulated: First, the verb was either normal or theme-experiencer. An example of a triple with a normal verb was LAYOFFS MANAGER ORDERED, and with a theme-experiencer verb LAYOFFS MANAGER WORRIED.

The categorization of verbs into the two categories was made in the following way: First, the Brandeis Verb Lexicon (Grimshaw & Jackendoff, 1991) was used to identify a large set of verbs that could take a direct object; this narrowed the verbs to be considered to those that could follow the subject-verb-object structure necessary for the active/passive alternation. Next, the inanimacy test (described in the Introduction) was used to identify verbs of the two types. Each verb was inserted into the template sentence *The rock ____ed John.* If the resulting structure was not anomalous, the verb was classified as theme-experiencer; if the result was anomalous, the verb was classified as normal. (The phrase *the rock* was used because it denotes an object that most would agree is highly inanimate, and is hard to imagine having intentions or volitions even on a metaphorical usage.) The result was two lists of verbs of each type. Finally, 40 normal and 40 theme-experiencer verbs were selected from each list which seemed intuitively to have the appropriate thematic role structure.[2] Across the list of 40 items, the two types of verb were matched on frequency and syllable length.

The second manipulated variable was whether the two nouns of a triple were semantically connected or not. This designation was judged intuitively by two research assistants and me. An example of a triple in which the nouns are semantically con-

[2] As examination of Appendix A makes clear, the normal verbs ultimately chosen for the experiment were ones that tended to prefer human agents or experiencers (e.g., *protested, painted, applauded*). The reason for this bias is that the theme-experiencer verbs seemed better suited to human than to nonhuman experiencers—that is, it is a bit odd to think of something like a cat being offended, disgusted, or worried, because of the attribution of rather complex mental states to nonhuman animals. Because the normal verbs had to occur with the same nouns as the theme-experiencer verbs, the result was a bias toward the selection of normal verbs that could take human agents and experiencers.

nected is LAYOFFS MANAGER WORRIED; an example in which the nouns are not as semantically connected is TOILETS MANAGER WORRIED. The purpose of this manipulation was to see whether degree of semantic connectedness affected either the frequency of passive sentences or the time it took subjects to formulate a sentence.

The third variable was a counterbalancing variable concerning the order of the two nouns in the triple: The two nouns either occurred in the order animate–inanimate or inanimate–animate. An example of the first ordering is MANAGER LAYOFFS WORRIED; an example of the second is LAYOFFS MANAGER WORRIED.

Procedure. Subjects were run individually in a small room. They were seated at a table with an SVGA monitor, a Shure Prologue microphone, and a button panel in front of them. Each trial consisted of the following events. First, the message "Press button to begin next trial" appeared on the monitor. When subjects pressed the button, the screen cleared and then the three words were presented together on a single line and entirely in lower case. Subjects were told to read the three words and formulate a sentence using only those words and whatever function words were needed to connect the three words into a sentence. The distinction between content and function words was defined for the subject in the instructions. Subjects were also specifically told that they could include articles such as *the,* prepositions such as *of,* and "helping verbs" such as *was.* They were asked not to include adjectives, verbs, or nouns. It is possible that these instructions might have created a bias for subjects to avoid passives, because the passive requires more words than the actives. However, this bias would be present in all the conditions and so would not affect the pattern of results.

Once the subjects had formulated a sentence from the word triple, they pushed the button again. This button-press caused the screen to become blank and triggered the record function on a Tascam Model 122 MK II cassette taperecorder interfaced with a 486-33 microcomputer. The subjects spoke their sentences out loud into the microphone and the responses were recorded onto cassette tape. The subjects then hit a button one last time to indicate that they were finished speaking, and this button-press put the cassette tape deck into record-pause mode. Subjects continued in this fashion for all 40 trials. Order of items was randomized differently for each subject. The experimental session was preceded by a practice session consisting of 10 trials. The entire experiment lasted approximately 30 min.

Design. The experiment had a 2×2×2 design: verb type (normal or theme-experiencer), semantic connectedness (high vs low), and noun ordering (animate–inanimate vs inanimate–animate). Each subject saw one item (one triple) in only one of the eight experimental conditions, but across items received all conditions of the experiment.

Data analysis. Sentences produced by the subjects were analyzed into four categories. A *passive* response had the form *Noun Phrase (NP) was verbed by NP.* To count as a passive response, the verb had to occur in the form *was verbed* and the by-phrase had to be included (so, for example, the responses *The manager is worrying about the layoffs* or *The manager was worried about the layoffs* would not be counted as passives for the purposes of this experiment). A *truncated passive* had the form *NP was verbed*; that is, the verb again had to be in the past participle form but with no words after. An *active* response had the form *NP verbed NP*; both arguments of the verb had to be included and the verb had to be in the past tense. Finally, a response of *other* was any response that did not fall into these three categories, including responses with extra content words (e.g., *The manager was worried by the upcoming layoffs*) ones in which word categories were used inappropriately (e.g., *The manager had a*

lot of worries about the layoffs), null responses, and so on.

The primary dependent measure was the percentage of passive responses. In addition, I analyzed the amount of time subjects spent studying the word triples in each of the eight experimental conditions and as a function of the type of response produced by the subject. In each case, the experiment was analyzed using a 2×2×2 repeated-measures analysis of variance (ANOVA). As will be seen below, passives occurred quite rarely in some conditions of the experiment, and so it might be argued that it is more appropriate to perform analyses on data that have undergone an arcsin transformation rather than on the raw data. However, analyses on the transformed data yielded virtually identical results to analyses on untransformed data, so I report only the latter in this paper. All reported results are significant at the $\alpha = .05$ level by both subjects (F_1) and items (F_2) unless otherwise noted.

Results and Discussion

The most important result was that full passives were indeed more frequent with theme-experiencer verbs than with normal verbs (31% vs 4% of all responses, respectively). The effect was reliable, $F1\ (1,39) = 82.64$, $F2(1,39) = 138.51$. The only other significant effect was an interaction between verb type and noun order (animate–inanimate or inanimate–animate), $F1(1,39) = 4.97$, $F2(1,39) = 4.06$. The pattern is shown in Table 1.

TABLE 1
PERCENTAGE OF PASSIVE RESPONSES, EXPERIMENT 1

	Normal verb	Theme-experiencer verb	Mean
Noun order			
Animate–inanimate	3	33	18
Inanimate–animate	5	28	17
Mean	4	31	

With a normal verb, the percentage of passives did not vary with noun order, perhaps because performance was at floor levels. With the theme-experiencer verbs, however, the order of nouns on the monitor had some effect. When the nouns were ordered animate–inanimate (e.g., MANAGER LAYOFFS WORRIED), the percentage of passives was somewhat higher than when nouns were ordered inanimate–animate. This effect probably reflects a small tendency for subjects to match the order of constituents in their sentences to the order of words on the monitor. The ordering animate–inanimate corresponds to the order of constituents in the passive sentence *The manager was worried by the layoffs*.

No other effects were significant for percentage of passives (all $ps > .15$). When truncated passives were considered a correct response along with full passives, the pattern of results did not change. The percentage passives increased from 31 to 35% for theme-experiencer verbs, but remained at 4% for normal verbs.

Other responses (errors, omissions, and responses not categorizable as active or passive) were slightly more frequent with normal verbs (18%) than with theme-experiencer verbs (16%), but this effect was not reliable (both $ps > .15$). No other effects of response type were significant (all $ps > .25$).

Formulation times for active sentences were also analyzed. (Times for passive sentences could not be analyzed because of the large amount of missing data.) The only reliable difference among conditions was that actives were formulated more quickly when the nouns were semantically connected than when they were not (3445 ms vs 4122 ms), $F1(1,39) = 9.79$, $F2(1,39) = 19.52$.

It is also of some interest to compare formulation times for actives vs. passives, but the large amount of missing data for passive sentences makes the analysis somewhat tricky. Therefore, the analysis was done in

the following way: First, the dependent variable of response type (active vs. passive) was treated as an independent variable with two levels, with the dependent measure as formulation time for the two types of responses. Second, item means rather than subject means were used, because these generally contained fewer empty cells for the passive responses. Third, an overall mean for the active responses (collapsed over the eight experimental conditions) and an overall mean for the passive responses was computed. One item associated with no passive responses was eliminated from the analysis; thus, the data were analyzed over 39 items. Finally, the means corresponding to formulation times for the active and for the passive responses were analyzed using a t test (with items rather than subjects as the random variable). The results indicated that formulation times for the active and passive responses differed reliably, $t(38) = 3.10$, $p < .01$. The average formulation time for active responses was 3996 ms (SD = 970 ms), and for passives 4635 ms (SD = 1290 ms).

The results of this experiment can be summarized as follows: First, and most important, passives were more frequent (and, correspondingly, actives less frequent) with theme-experiencer verbs than with normal verbs. Second, semantic connectedness had no effect on sentence form but had some effect on the ease with which subjects could formulate a sentence. Third, speakers tended to produce structures in which the nouns in the sentence corresponded to the order in which they occurred on the monitor. Finally, subjects took less time to formulate an active than a passive sentence.

Experiment 2

In the first experiment, subjects produced passives more often with theme-experiencer verbs than with normal verbs. This finding suggests that speakers organize their sentences so that experiencers occur in subject position and themes in object position. However, another reason speakers in Experiment 1 may have produced passives with the theme-experiencer verbs is that the nouns differed in animacy, and speakers may have attempted to place the animate noun before the inanimate noun. This interpretation is consistent with the notion that different types of verbs elicit passives with different frequencies. However, this interpretation does not necessitate an explanation in terms of thematic roles, but instead can be explained as an effect of animacy. Experiment 2 was conducted to determine whether the theme-experiencer/passive effect was due entirely to the difference in animacy of the two participating nouns. The experiment was the same as Experiment 1, except that the two nouns in the sentence were both animate. Therefore, if the theme-experiencer/passive effect is obtained in this experiment, thematic structure must make some unique contribution to decisions affecting syntactic form.

One potential complication is that the thematic structure of theme-experiencer verbs is ambiguous when both arguments of the verb are animate. Consider the sentence *The hypnotist relaxed the dieter* (*relax* is a theme-experiencer verb). On the theme-experiencer reading, the hypnotist did not intentionally relax the dieter; instead, something about his or her manner or presence was inherently relaxing. However, the hypnotist could also intentionally relax the dieter, by, for example, using procedures for inducing a hypnotic state. On that interpretation, the hypnotist is an agent, not a theme, and so the verb becomes an agent-experiencer verb, not a theme-experiencer verb. This ambiguity works against the hypothesis I am testing here: Subjects should produce passives when they take the theme-experiencer reading of the arguments, but they should produce actives when they take the agent-experiencer reading. As will be seen, sub-

jects produced passives on 16% of trials in this experiment, indicating that they obtained the theme-experiencer reading a significant percentage of the time.

Method

Subjects. I recruited 72 subjects from the same subject pool as in Experiment 1.

Materials. A new set of 40 triples was constructed for this experiment (given in Appendix B). Each triple was of the form NOUN NOUN VERBED, with both nouns being animate. Across items, nouns were matched on frequency and syllable length, and order of the nouns was counterbalanced. As before, the verb was either normal or theme-experiencer. Across lists, the two types of verb were matched on frequency and syllable length. An example of a triple with a normal verb is DIETER HYPNOTIST TRUSTED and with a theme-experiencer verb DIETER HYPNOTIST RELAXED.

Procedure. The same procedure was used as in Experiment 1.

Design. The experiment had a 2×2 design: The first variable was whether the verb was normal or theme-experiencer. The second variable was the counterbalancing variable of noun order. Because the two nouns did not differ in length, frequency, or animacy, this variable was not expected to have any effect. The semantic connectedness variable was not manipulated in this or in the remaining experiments because Experiment 1 demonstrated that connectedness does not influence sentence form. Each subject saw one item in only one of the four experimental conditions, but across items subjects received all conditions of the experiment.

Data analysis. Data analysis procedures were the same as in Experiment 1, except for one difference. As will be seen under Results, passives were far less frequent in this experiment than in Experiment 1. Indeed, 23 of the 72 subjects produced no passives on any trial of the experiment. Therefore, analysis of the percentage data for passive responses included only the 49 subjects who produced at least one passive sentence during the experiment.

Results and Discussion

As was found in the previous experiment, full passives occurred more frequently with theme-experiencer verbs than with normal verbs, $F1(1,48) = 28.01$, $F2(1,39) = 68.78$. However, the difference was smaller than in the first experiment, with passives occurring on 16% of trials in the theme-experiencer verb condition and fewer than 1% of trials in the normal verb condition. The percentage of passives was the same in the two noun ordering conditions (10%), both Fs < 1, and there was no interaction between the two variables, both Fs < 1. When truncated passives and full passives were combined, passives occurred on 19% of trials given a theme-experiencer verb and again on fewer than 1% of trials given a normal verb. Noun order had no effect, and there was no interaction between noun order and verb type (all Fs < 1).

Responses categorized as *other* occurred on 9% of trials overall, and there were no differences in the occurrence of this response type across conditions (all ps $>$ .10).

Formulation time for active and passive sentences was analyzed as described in Experiment 1. Fifteen of the 40 items were eliminated from this analysis because those items were associated with no passive responses and therefore no passive formulation times. The time required for subjects to formulate an active sentence was 3683 ms (SD = 727 ms); the corresponding time was 3660 ms for passive sentences (SD = 1692 ms). This 23 ms difference (favoring the passives) was not reliable, $t < 1$. When the formulation times for active sentences were analyzed separately with a 2×2 ANOVA, no significant differences among conditions emerged, all ps $> .25$.

This experiment makes the important point that passives are indeed more frequent with theme-experiencer verbs than

with normal verbs. Therefore, this same finding obtained in Experiment 1 cannot be entirely attributed to the difference in the animacy of the two nouns. It appears that thematic structure itself affects the frequency of passive sentences. However, two qualifications must be made: First, some subjects produced no passives at all (23/72 in Experiment 2), and so gave no indication of being sensitive to the thematic structure variable. Second, comparison of the results of the two experiments suggests that thematic roles and animacy together influence whether a speaker produces an active or a passive sentence. The goal of the next experiment was to examine this second issue within the same experiment.

Experiment 3

To examine whether both thematic structure and animacy affect the likelihood of a speaker's producing a passive sentence, I conducted a third experiment. As before, the verb was either normal or theme-experiencer. The two nouns of the triple were either both animate, or one was animate and the other inanimate.

Method

Subjects. I recruited 64 subjects to participate in this experiment, drawn from the same pool as in the previous experiments.

Materials. Forty-eight experimental items were created (given in Appendix C). Each item was a word triple of the form NOUN NOUN VERBED. The two nouns were either both animate, or one was animate and the other inanimate. For example, the subject would see either COWBOY SHERIFF VERBED or COWBOY FRONTIER VERBED. Across items, the three different types of nouns were balanced on frequency and syllable length. As before, the verb was either normal or theme-experiencer. The order of the two nouns was counterbalanced. Thus, there were eight different versions of each item, as shown in Table 2.

Procedure. The same procedure was followed as in the previous two experiments.

Design. The experiment had a 2×2×2 design: the verb was either normal or theme-experiencer; the nouns were either both animate or one animate and the other inanimate; and the order of nouns was counterbalanced. Each subject saw one item in only one of the four experimental conditions, but across items received all conditions of the experiment.

Data analysis. Data analysis procedures were the same as those used in Experiments 1 and 2. As in Experiment 2, subjects who produced no passive sentences were eliminated from the analyses of passive responses (15/64). Thus, analyses of passive responses were based on data from 49 subjects.

Results and Discussion

Once again, passives were more common with theme-experiencer verbs than normal verbs, $F(1,48) = 75.84$, $F2(1,47) = 160.01$.

TABLE 2
Example Item in Each Experimental Condition, Experiment 3

Normal verb condition
COWBOY SHERIFF AVOIDED (both nouns animate, one noun order)
SHERIFF COWBOY AVOIDED (both nouns animate, other noun order)
COWBOY FRONTIER AVOIDED (animate noun followed by inanimate noun)
FRONTIER COWBOY AVOIDED (inanimate noun followed by animate noun)
Theme-experiencer verb condition
COWBOY SHERIFF CHALLENGED (both nouns animate, one noun order)
SHERIFF COWBOY CHALLENGED (both nouns animate, other noun order)
COWBOY FRONTIER CHALLENGED (animate noun followed by inanimate noun)
FRONTIER COWBOY CHALLENGED (inanimate noun followed by animate noun)

Subjects produced passives on 28% of trials with a theme-experiencer verb and 6% with a normal verb. In addition, there was a main effect of whether the nouns were both animate or differed in animacy: Passives occurred on 12% of trials in the first case and 21% in the second, $F1(1,48) = 37.78$, $F2(1,47) = 30.29$. As shown in Table 3, these two variables interacted, $F1(1,48) = 33.81$, $F2(1,49) = 19.89$.

The interaction can be described as follows: With normal verbs, the likelihood of a passive sentence was unaffected by animacy (and passives were highly unlikely). With theme-experiencer verbs, passives occurred more often when the nouns differed in animacy than when they were both animate. Thus, it appears that two factors determine whether a speaker produces a passive sentence: one is the thematic structure of the verb, and the other is the animacy of the two nouns serving as arguments of the verb.

When truncated passives were included with full passives in the analyses, the percentage of passives increased to 32% with theme-experiencer verbs but remained at 6% with normal verbs. The pattern of responding across conditions remained the same as with full passives alone.

The percentage of *other* responses overall was 6%. Verb type had a significant effect on the likelihood of an *other* response, $F1(1,63) = 5.17$, $F2(1,47) = 4.15$. With a theme-experiencer verb, other responses occurred on 7% of trials, and with a normal verb, on 5% of trials. No other effects were significant, all $ps > .15$.

TABLE 3
PERCENTAGE OF PASSIVE RESPONSES, EXPERIMENT 3

	Normal verb	Theme-experiencer verb	Mean
Nouns			
Both animate	5	19	12
One animate, other inanimate	6	36	21
Mean	6	28	

Formulation times for active sentences were also submitted to a separate 2×2×2 ANOVA. An effect of animacy was found, $F1(1,63) = 10.44$, $F2(1,47) = 6.58$. When both nouns were animate, formulation time was 3594 ms; when one noun was animate and the other inanimate, formulation time was 3982 ms. There was some tendency for formulation times to be longer given a theme-experiencer verb compared with a normal verb (3894 ms vs 3682 ms), but this difference only approached significance by subjects ($F1(1,63) = 2.74$, $.10 > p > .05$ and was not significant by items ($F2 < 1$).

In addition, there was a marginal interaction between verb type and animacy, $F1(1,63) = 3.06$, $.05 < p < .10$, $F2(1,47) = 2.31$, $p > .10$. With a normal verb, formulation time was 3636 ms in the condition in which the nouns were both animate and 3729 ms when the nouns differed in animacy; with a theme-experiencer verb, the corresponding times were 3553 and 4236 ms, respectively. Thus, the nature of the interaction seems to be that normal verbs are less affected by animacy than are theme-experiencer verbs, a pattern that is consistent with the percentage data (which showed that animacy only affected sentence form when the verb was theme-experiencer).

Formulation time for active vs passive sentences was analyzed with items as the random variable; all 48 items were included in the analysis. Formulation time for active sentences was 4088 ms ($SD = 883$ ms) and 5244 ms for passive sentences ($SD = 1522$ ms), $t(47) = 6.51$, $p < .01$.

The results of this experiment can be summarized as follows: First, passive sentences are more common with theme-experiencer verbs than with normal verbs. Second, animacy also affects the syntactic form of a sentence, but only if the verb is theme-experiencer. Third, with theme-experiencer verbs, passives occurred on 19% of trials when both nouns were animate and almost doubled in frequency when one noun was inanimate (the noun

that ended up as the object of the preposition in the passive by-phrase). This pattern is remarkably similar to that observed in the first two experiments: In Experiment 2, in which both nouns were animate, the percentage of passives was 16%; in Experiment 1, in which the nouns differed in animacy, the percentage of passives was almost twice as high (31%).

The data from formulation times suggest a similar pattern. Formulation time for active sentences with a normal verb was only about 100 ms faster when the two nouns were animate compared to the condition in which the nouns differed in animacy; in contrast, formulation time for active sentences with theme-experiencer verbs was almost 700 ms faster when both nouns were animate. Thus, it appears that thematic structure has a strong effect on sentence formulation processes: First, thematic structure influences whether a speaker produces an active or passive structure. Second, thematic structure appears to mediate the effect of animacy on sentence form. With normal agent-theme or experiencer-theme verbs, animacy has little effect on sentence form or on formulation time. But with theme-experiencer verbs, animacy strongly affects form and seems to have some effect on the time to construct that form.

However, before concluding that thematic structure indeed affects sentence formulation processes in the way I have outlined, one possible objection has to be considered. Recall that in all experiments, the verb presented in the word triple occurred with past tense marking. However, all verbs with this marking that were used in these experiments were ambiguous between their past tense and past participle forms. Furthermore, it is possible that the past tense marking is more associated with the past principle form for theme-experiencer verbs than for normal verbs, perhaps because of the greater frequency of passives (according to the results of this study) with theme-experiencer verbs. As a result, the production of passive sentences may be due not to the thematic structure of the verb per se, but may instead have been triggered by the association between the past tense marking, the past participle form of the verb, and the passive structure. To examine this possibility, a fourth experiment was run exactly like the third, except that the verb appeared in the word triples with no morphological marking.

Experiment 4

Method

The subjects were 48 undergraduates from Michigan State University who participated in the experiments in exchange for partial credit in their introductory psychology courses. All subjects were native speakers of American English and were naive with respect to the hypotheses of the experiment. The same materials were used as in Experiment 3, except that the morphological marking for tense was removed from all verbs. An example of a sample item would thus be COWBOY SHERIFF CHALLENGE.

The same procedure was followed as in the previous experiments, and the design and data analyses were the same as in Experiment 3. Data from seven subjects who produced no passives were eliminated from the analyses as well as data from one subject who produced only *other* responses. Therefore, analyses were based on 40 subjects.

Results and Discussion

The results from this experiment were essentially the same as in Experiment 3. Passive responses were more frequent with theme-experiencer verbs than with normal verbs (20% vs 2%), $F1(1,39) = 84.87$, $F2(1,47) = 93.46$. In addition, there was a main effect of animacy: Passives were less frequent when both nouns were animate compared with when one noun was animate and the other inanimate (9% vs 13%), $F1(1,39) = 6.54$, $F2(1,47) = 5.52$. The verb

and animacy variables interacted, $F1(1,39) = 5.58$, $F2(1,47) = 5.74$. The pattern is shown in Table 4.

As in Experiment 3, with a normal verb, animacy of the two nouns did not affect the frequency of passives; with a theme-experiencer verb, passives were more frequent when the nouns differed in animacy.

In addition, there was an interaction between the animacy of the two nouns and the noun order variable, $F1(1,39) = 5.70$, $F2(1,47) = 11.28$. The pattern can be described as follows: When both nouns were animate, ordering of the nouns did not affect the frequency of passives (11% in both ordering conditions). This finding of no difference makes sense: The nouns did not differ in animacy, frequency, or length, so there would be little reason to prefer one ordering over the other. (Recall also that in Experiment 2, which employed only animate nouns, no ordering effects were obtained.) When one noun was animate and the other inanimate, noun order had some effect: Passives occurred on 8% of trials given the ordering inanimate–animate and on 14% of trials given the ordering animate–inanimate. This result is similar to the one obtained in Experiment 1: Subjects have some tendency to structure their sentences so that the order of constituents follows the order of nouns on the computer monitor.

Very few truncated passives were produced in this experiment, and so inclusion of truncated passives with full passives did not change the means or overall pattern of results.

The percentage of *other* responses was 17%, which is higher than in Experiment 3. *Other* responses were more frequent with theme-experiencer verbs than with normal verbs (18% vs 15%), but this effect was significant only by subjects ($F1(1,46) = 5.24$) but not by items ($F2(1,47) = 2.06$, $p > .15$). The higher percentage of *other* responses in this experiment is most likely attributable to two factors: First, unlike the previous studies, subjects in this experiment had to retrieve the *-ed* ending to go with the appropriate past tense or past participle form. Quite likely, this process is subject to some error. Second, because the verbs did not occur with past tense endings, they were sometimes confusable with nouns. For example, consider COWBOY SHERIFF CHALLENGE. The word *challenge* is ambiguous between a verb and a noun, and indeed subjects tended to make responses in which they used the verb as a noun (one example was *The cowboy and the sheriff saw the challenge*).

TABLE 4
PERCENTAGE OF PASSIVE RESPONSES, EXPERIMENT 4

	Normal verb	Theme-experiencer verb	Mean
Nouns			
Both animate	2	16	9
One animate, other inanimate	2	23	13
Mean	2	20	

Formulation times for active sentences were somewhat faster when both nouns were animate compared with when the nouns differed in animacy (4722 ms vs 4978 ms). However, this effect was significant only by items ($F2(1,47) = 5.90$) and not by subjects ($F1(1,46) = 2.48$, $p > .10$). No other effects were significant, all $ps > .15$. Formulation times for active and passive sentences were analyzed with items as the random variable; one item was excluded from the analysis because it was associated with no passive responses. Subjects required 4851 ms ($SD = 1218$ ms) to formulate active sentences and 6247 ms ($SD = 2284$ ms) to formulate passive sentences, $t(46) = 4.26$, $p < .01$.

These results provide a satisfactory replication of Experiment 3. Each of the main findings of that experiment were supported here. First, passives were more common and actives less common with theme-experiencer verbs compared with normal verbs. Second, animacy did not affect sentence form when the verb was normal, but did have an effect when the verb was

theme-experiencer. The pattern is that passive sentences are more likely when the nouns differ in animacy than when they are both animate; conversely, actives are less likely when the nouns differ in animacy and more likely when the nouns are both animate. Thus, this replication of Experiment 3 using verbs without morphological endings indicates that the results of Experiment 3 cannot be attributed just to the use of associations between the *-ed* morpheme and syntactic forms.

Individual Subject Analyses

The results from the four experiments show a robust effect of verb structure on syntactic form. However, recall that in Experiments 2 through 4, some subjects did not produce a passive sentence at all, perhaps indicating some insensitivity to the verb structure variable. Therefore, to evaluate the consistency of the effect of verb type on passive structure across subjects, the responses of the 89 subjects in Experiments 3 and 4 who produced at least one passive sentence were examined. For each subject, the mean percentage of passive sentences in the theme-experiencer verb condition (collapsed across all other conditions and averaged over items) was examined, and compared with the mean percentage for normal sentences. This analysis showed that 84/89 or 94% of all subjects produced more passives with theme-experiencer verbs than with normal verbs; 3/89 showed the opposite pattern; and 2 subjects produced an equal percentage with both verbs. Thus, for the vast majority of subjects who produce passive sentences, choice of passive was strongly influenced by verb structure.

A similar analysis was conducted for the animacy variable. The mean for each subject in the condition in which both nouns were animate was compared with the mean in the condition in which the nouns differed in animacy. Recall from the results reported above that, averaged over subjects, passives were more likely when the nouns differed in animacy. The results for the individual subjects were as follows: 62/89 or 70% of subjects followed this pattern of more passives when the nouns differed in animacy; 21/89 or 24% showed the reverse pattern; and 6/89 showed no difference. The 62–21 split was reliable by a sign test, $z = 3.6$, $p < .01$. Thus, the animacy variable clearly affected the syntactic decisions of most of the subjects.

Analysis of Items with Proper Names

Although the nouns used in the four experiments were balanced on frequency and syllable length, it is possible that plausibility differences among the nouns used in the experiments can account in some way for the pattern of results obtained for active and passive sentences. For example, consider the item TEENAGER MURDERER TERRIFIED/RESISTED. Most teenagers are unlikely to terrify murderers but they are likely to resist them. Therefore, perhaps the choice of nouns in these experiments somehow caused the active form to be more plausible for the normal verbs and the passive form to be more plausible for the theme-experiencer verbs. Fortunately, the stimuli used in these experiments allow this concern to be addressed, because a subset of all the items were proper names, and names carry little semantic information. An example of such an item was PHIL TOM ALARMED (theme-experiencer verb) and PHIL TOM EXCUSED (normal verb). Therefore, if the effects described in this article are found for these items, they cannot be attributed just to plausibility.

Accordingly, I reanalyzed the data from Experiment 3, excluding all trials with common nouns. I selected Experiment 3 because that study used enough name trials to allow reliable testing (16 of the 48 items) and the number of name trials was a multiple of the number of conditions of the experiment (eight). ANOVAs were conducted as described in Experiment 3. This analysis replicated all the effects obtained previously: More passives occurred with theme-

experiencer verbs than with normal verbs (30% vs 3%), $F1(1,48) = 80.48$, $F2(1,15) = 75.00$, and more passives occurred when the nouns differed in animacy than when they were both animate (24% vs 10%), $F1(1,48) = 25.55$, $F2(1,15) = 35.24$. In addition, these two variables interacted, $F1(1,48) = 23.52$, $F2(1,15) = 29.46$: With normal verbs, the percentage of passive sentences was unaffected by animacy (3 and 4% in the same-animate and different-animate conditions respectively); with theme-experiencer verbs, the percentage of passives was higher when the nouns differed in animacy (43%) than when they were both animate (17%). These results indicate that the two main findings of the experiments—that passives occur more frequently with theme-experiencer verbs than with normal verbs, and more frequently when the participating nouns differ in animacy—cannot be attributed solely to the semantic content of the nouns used with the verb stimuli.

General Discussion

The purpose of this study was to examine whether the thematic structure of verbs would affect speakers' decision to construct an active or a passive sentence. More specifically, if prominence is defined by height in the thematic hierarchy, then sentences should be structured so that the highest thematic role occurs in subject position. Therefore, with a normal agent-theme verb such as *ordered,* speakers should generally produce active sentences, because the active structure positions the agent as subject and the theme as object. In contrast, with a theme-experiencer verb such as *worried,* subjects should have some tendency to produce passive sentences because the passive places the role higher on the thematic hierarchy (experiencer) in subject position.

The results of the four experiments support these predictions. With normal verbs, passives occurred on less than 6% of trials in all experiments; with theme-experiencer verbs, passives occurred on more than 15% of trials across experiments. Furthermore, analysis of the individual subject data showed that almost 95% of subjects who produced passive structures showed the predicted pattern. Passives occurred more often with theme-experiencer verbs than with normal verbs even when both arguments of the verb were animate, thus indicating that the effect is not due only to a semantic cue but instead seems to arise from the thematic role labels associated with the arguments. In addition, this pattern was found even when the participating arguments were proper names, indicating that the results cannot be explained solely in terms of the semantic biases of the arguments. It appears that sentences tend to be organized so that more thematically prominent entities occur in more syntactically prominent positions.

What might account for speakers' tendency to organize sentences so as to make agents and experiencers subjects? One possibility is that agents and experiencers are typically subjects because they tend to be animate, and speakers like to place animate entities in subject position. However, this idea would have to be elaborated to account for the results of Experiments 2 through 4, which demonstrated that speakers have a tendency to make the agent or experiencer the subject even when both arguments are animate. One might argue instead, then, that speakers seem to have a bias to place thematic roles *typically associated with animacy* in subject position. On this view, prominence in the thematic hierarchy reflects the likelihood that a particular thematic role is animate. When speakers in the experiments presented here were presented with a sequence such as COWBOY SHERIFF CHALLENGED, they could not simply adopt a strategy of making the animate noun the subject. Instead, speakers might place one of the nouns in subject position (e.g., COWBOY), assign it the role of experiencer because that is the

more prominent role (i.e., the one more associated with animacy), and then speakers would have to create a passive sentence to accommodate the theme-experiencer verb and the remaining argument. With the sequence COWBOY SHERIFF AVOIDED, speakers would again select one noun to be subject. The subject would be given the role of agent because the thematic structure of the verb *avoid* is agent-theme and agent is the more prominent role. An active structure would then be required to incorporate the verb and the remaining argument.

Another quite different idea is suggested by the work of Corrigan (1988), who examined subjects' attributions of causality in active sentences. Subjects were asked to indicate which entity was more responsible for the action described by the verb in a sentence. Verb types included experiencer-theme verbs, theme-experiencer verbs, and a heterogeneous class Corrigan labeled action verbs. Unfortunately, the pattern of data obtained with the action verbs was quite complex and differed from one experiment to another depending on the subjects' task. However, there was some tendency for subjects to attribute more causality to the theme than to the agent of these verbs, particularly when the theme was inanimate. The data for the other verb types was straightforward: For both experiencer-theme and theme-experiencer verbs, subjects attributed more causality to the theme than to the experiencer. The effect was again exaggerated when the theme was inanimate (and the experiencer animate) and the verb was of the experiencer-theme variety.

In general, then, Corrigan's data show a tendency for subjects to attribute more causality to the theme of an action than to other thematic roles. Therefore, another explanation of the results found in the present study is that speakers attempt to place the less causal thematic role in subject position, reserving the object position for the more causal role. At first glance it might seem odd to suggest that agents are less causally efficacious than themes in sentences such as *Mary kicked the table*. However, it is important not to conflate the initiator and cause of an action. In the above sentence, Mary is clearly the initiator of the action of kicking—Mary is the agent. But the table may be construed as responsible for the action that Mary had to undertake (at least under some circumstances), because something about the table caused Mary to want to kick it (e.g., it was in her way so that she bumped into it and hurt herself). If speakers have some tendency to demote the causally more responsible entity and if that entity tends to the theme of the action, then actives will tend to occur with normal verbs (so that the theme can be placed after the agent) but passives will tend to occur with theme-experiencer verbs (so that the theme can be placed after the experiencer).

The experiments presented here cannot decide between the animacy and causality accounts. And of course, it is quite possible that neither explanation will ultimately turn out to be correct. At this point, what does seem clear is that animacy alone cannot account for the results of the experiments. Any explanation of how speakers decide between the active and passive structure must appeal to the way in which the animacy of arguments and the meaning of verbs (whether in the form of thematic roles or some other type of semantic information) interact during sentence formulation. Furthermore, although the predicted increase in the number of passives with theme-experiencer verbs was observed in these experiments, it is important not to lose sight of the absolute numbers: Passives constituted the minority of responses in all conditions of the experiments. Clearly, factors other than the ones examined in this study influence decisions about sentence form (e.g., the need to maintain a particular discourse entity as topic; Tomlin, 1983). Given the strong preference for active sentences in English, it is possible that actives should be considered a kind of default structure, a default which can be overrid-

den to some extent by a variety of lexical and discourse factors.

Another important finding of the experiments is that the animacy variable affected the percentage of passive responses, but only when the verb was theme-experiencer, not when the verb was normal. In other words, speakers are as unlikely to say *Mary was found by Bill* as to say *The rock was found by Bill.* This finding could be attributed to a general floor effect for passives with normal verbs. Nevertheless, the result is somewhat surprising, because sentences with inanimate subjects are less common than sentences with animate subjects (Bates & MacWhinney, 1982; Bock, 1982; Bock et al., 1992; MacWhinney, 1977); therefore, one might have expected *The rock was found by Bill* to be less likely than *Mary was found by Bill.* However, the results of two experiments indicate that the two sentences are equally (un)likely.

This pattern is interesting because it is somewhat counterintuitive, and also to some extent complicates conclusions drawn from earlier research on the comprehension of the passive structure. In an often-cited study, Slobin (1966) compared *reversible* and *irreversible* passives; the former were passives with arguments matched on animacy (typically animate), and the latter were passives with arguments differing in animacy. Slobin found that passives were harder to comprehend than actives but only when the passives were reversible. Note, though, that Slobin's irreversible passives were sentences such as *The flowers were being watered by the girl.* According to the experiments reported in this article, this passive is unlikely to be produced because the verb *watered* is normal (i.e., agent-theme). Recall that in the present study, passives virtually never occurred with normal verbs, regardless of the animacy of the two arguments. Thus, whatever preference exists in sentence comprehension for irreversible over reversible passives with normal verbs is not mirrored in sentence production, where speakers' likelihood of producing a passive is extremely low and unaffected by animacy. This discrepancy between preferences for structures in comprehension and production suggests an interesting dissociation between the two language processing systems.

This dissociation is suggested further by results reported by Forster and Olbrei (1973). Forster and Olbrei argued that the Slobin results concerning reversible and irreversible passives were not convincing because they were obtained using the picture-sentence verification task, a task which they claimed is not a good measure of sentence comprehension. They instead used a task in which subjects had to decide as quickly as possible whether a string of words was a good sentence, and using this task they found no difference in comprehension times for reversible and irreversible passives (and passives were judged more slowly than actives). However, Forster and Olbrei did not just change the task; they also appeared to have changed the type of verb used in the sentences as well. In the example they provide, the critical sentences were *Some teachers were dismayed by the parents* and *Some teachers were dismayed by the essays.* Notice that the verb is theme-experiencer (e.g., *The lack of significance dismayed the researcher*). Therefore, either the difference in task or the difference in verb type could account for the difference in results between Slobin (1966) and Forster and Olbrei (1973). Furthermore, Forster and Olbrei found no difference in comprehension times between reversible and irreversible passives using theme-experiencer verbs. This finding is inconsistent with the findings of the present experiment, which demonstrated that speakers produce passives with theme-experiencer verbs more frequently when the nouns differ in animacy (irreversible) than when they are both animate (reversible). Thus, Slobin used normal verbs and found that processing times differed for reversible and irreversible pas-

sives, and yet passives of the two types are produced about equally frequently (and rarely); Forster and Olbrei appear to have used theme-experiencer verbs and found that processing times did not differ for reversible and irreversible passives, yet the former are less frequent than the latter. Of course, without examining the relevant variables and comparing results from comprehension and production in one rigorous study, it is difficult to draw any firm conclusions. Nevertheless, these results suggest a dissociation between the preferences of the comprehension and production systems (see Bock and Miller, 1991, for further evidence of a dissociation).

Up to this point, I have been discussing the passive structure with theme-experiencer verbs and with normal verbs as if the two structures were syntactically identical and differed only in the type of verb acting as head of the verb phrase. However, many syntacticians draw a distinction between two types of passives: lexical and adjectival (Levin & Rappaport, 1986; Wasow, 1977). An example of a lexical passive is *The girl was seen by the boy*; an example of an adjectival passive is *The girl was annoyed by the boy*. The first uses a normal verb and the second a theme-experiencer verb. Although not all adjectival passives employ theme-experiencer verbs (see Levin & Rappaport, 1986, for examples of adjectival passives with verbs other than theme-experiencer verbs), most passives with theme-experiencer verbs are adjectival passives. (The only exceptions are cases in which the theme-experiencer verb is used agentively to indicate an event, as in *The man was deliberately frightened by the woman.*) Thus, one way to describe the results of the present experiments is that speakers have a preference to produce adjectival passives over lexical passives. The two types of passives differ in their semantic properties—adjectival passives tend to describe states and lexical passives tend to describe events. According to the government and binding theory of syntax (Chomsky, 1981), they also differ in their syntactic properties: The lexical passive is created by moving a noun phrase in object position to subject position, and the movement operation leaves behind a trace in the original position of the noun phrase (i.e., *The girl was seen TRACE by the boy*). The adjectival passive, in contrast, is derived lexically and not through movement, and so does not contain a trace. Other theories of syntax do not distinguish these two passives syntactically—for example, lexical functional grammar (Bresnan, 1982) does not postulate the existence of movement operations or traces, and so the two structures are assumed to differ only in their semantic and not their syntactic properties.

In a recent study, MacDonald (1989) obtained evidence more consistent with the government and binding theory. She presented subjects with adjectival and lexical passives and, at the location immediately after the verb, gave subjects a prime for the subject. If a trace exists in the postverbal position, significant priming should be observed. MacDonald found such priming, but only for the lexical passives, indicating that lexical passives contain a trace but adjectival passives do not. This work on the differences in processing between the two kinds of passives suggests yet another potential reason that passives with theme-experiencer verbs are preferred to those with normal verbs—perhaps structures involving constituent movement are more difficult for speakers to produce, and so are avoided. This account is not inconsistent with the one I have offered appealing to a thematic and a grammatical hierarchy; it is possible that a tendency to line up the hierarchies and to avoid movement could both influence decisions about syntactic form. However, Bock et al. (1992) obtained evidence that language production does not involve constituent movement, thus rendering the avoid-movement account somewhat implausible. Therefore, it seems more likely that speakers prefer passives with theme-experiencer verbs because of the

tendency to line up the thematic and grammatical hierarchies.

Turning now to the formulation times, three of the four experiments presented here indicated that passive sentences take about one second longer to formulate than do actives. This result is not contaminated by differing amounts of time spent reading the word triples, because the two types of verbs were matched on syllable length and frequency, and formulation times did not show any overall effect of verb type. Therefore, it seems likely that the difference in formulation times for actives and passives cannot be attributed to time to encode the display. Although further work is necessary to establish this conclusion, it appears that the language production system might need more time to plan a passive sentence. This result is consistent with data from a series of experiments reported by Ferreira (1991) which showed that sentences of greater syntactic complexity (defined as number of nodes in a phrase structure tree) took longer to initiate than sentences of less complexity. That effect, however, could not be attributed to planning of the sentences' semantic and syntactic content, but instead was attributed to processes responsible for converting a semantic/syntactic structure to a prosodic representation (see also Ferreira, 1993). I argued that the more nodes to be converted, the longer the conversion process took. The present study indicates that a similar process may be occurring during syntactic planning. On virtually any theory of syntax, passive sentences contain more syntactic nodes than do actives (at the very least, the passive requires more nodes to incorporate the copula and the preposition *by*), and so these experiments suggest that more syntactic nodes require more time to be created during production.

However, this interpretation must be made cautiously, because the task used in both the Ferreira (1991) experiments and in the present set of experiments is clearly far removed from natural sentence production. Indeed, the longer time to formulate passive sentences in the present experiments could be the result of a somewhat different mechanism: Perhaps speakers always attempt an active sentence first, and then change it to a passive if it seems somewhat odd. (Levelt, 1989 has proposed that prior to articulation speakers covertly produce their utterances and edit them for any oddities or anomalies.) On this account, passives would take longer to produce than actives because passives are created in two stages and actives are created in just one. Under more typical circumstances, passives would be created directly and so would not take any longer to formulate than actives. These arguments are supported by the finding that formulation times for actives and passives did not differ in Experiment 2, in which both nouns were always animate. With both nouns animate, few sentences would be odd or anomalous in either an active or passive form, and so passives could be created directly. As a result, actives and passives would both be created in a single stage, and so speakers would take the same amount of time to formulate them. Further work is clearly necessary to determine whether this editing account or the account based on the greater syntactic complexity of passives is correct.

Based on the results of the four experiments presented here, I have argued that subjects' choices from among syntactic options are influenced by thematic structure. This study thus adds to the growing body of work demonstrating the importance of thematic structure for explaining many aspects of language processing, including parsing (e.g., Tanenhaus, Carlson, & Trueswell, 1989; Taraban & McClelland, 1988), text comprehension (Dosher & Corbett, 1982; Kintsch & van Dijk, 1978; Singer, 1979), and disordered language processing (Friederici & Frazier, 1992; Shapiro, McNamara, Zurif, & Lanzoni, 1992; Caramazza & Miceli, 1991). The influence of thematic roles on language production has been noted previously (e.g., Brown & Dell, 1987;

Lakoff, 1987), but the present study provides a specific mechanism to explain how speakers linearize thematic roles into sentences: Speakers attempt to place more prominent thematic roles (as defined by the thematic hierarchy) into the most prominent syntactic position—the subject.[3]

Appendix A

Stimuli Used in Experiment 1

All the nouns are on the left side of the two vertical bars and all the verbs are on the right side. The first pair of nouns represent the semantically connected condition and the second pair the less connected condition. The first verb is theme-experiencer and the second is normal.

conflict activist | favor activist || angered | protested
news dictator | sound dictator || alarmed | suppressed
insult fighter | order fighter || provoked | bellowed
massage athlete | pizza athlete || relaxed | requested
affair housewife | dancing housewife || shamed | shunned
lullaby baby | vegetables baby || soothed | booed
cake child | dirt child || tempted | crumbled
evidence detective | paper detective || troubled | transformed
lightning artist | guidebook artist || frightened | painted
jokes audience | wine audience || entertained | applauded
hairdo mother | wrapping mother || irritated | complimented
thunder children | birthday children || terrified | dreaded
theft judge | cow judge || disturbed | abhorred
image painter | motor painter || haunted | sketched
layoffs manager | toilet manager || worried | ordered
slayings citizens | subway citizens || shocked | loathed
gift mother | eggs mother || pleased | wrapped
sirens police | mower police || alerted | started
cave boys | lawn boys || scared | explored
T.V. student | kettle student || distracted | ignored
map explorers | plant explorers || guided | possessed
textbook student | scrapbook student || bored | xeroxed
cheesecake dieter | olive dieter || enticed | devoured
praise child | chant child || encouraged | awaited
tragedy family | outcome family || stunned | mourned
profits executive | cactus executive || impressed | insured
defeat troops | myth troops || demoralized | disregarded
championship team | refrigerator team || excited | secured
crime community | paint community || appalled | detested
fireworks child | photo child || thrilled | feared
delay customer | shampoo customer || annoyed | despised
toy child | steak child || amused | hurled
catcalls referee | anthem referee || enraged | ignored
puzzle genius | knitting genius || challenged | unraveled
play reviewer | rug reviewer || captivated | criticized
scandal politician | clothing politician || disgraced | denounced
phenomenon scientist | instruction scientist || intrigued | analysed
pimple teenager | poster teenager || embarrassed | camouflaged
belches socialite | folder socialite || disgusted | disguised
rumors queen | journals queen || offended | overlooked

[3] Consistent with Quirk et al.'s (1972) finding that passives occur frequently in expository discourse, 30% of the clauses in this article are in the passive voice.

Appendix B

Stimuli Used in Experiment 2

On the left side of the two vertical bars are the nouns used in the experiment and on the right side are the verbs. The first verb is theme-experiencer and the second is normal.

constituent politician || incensed | endorsed
ambassador correspondent || embarrassed | interviewed
conductor pianist || provoked | dazzled
publisher novelist || scandalized | exploited
cowboy sheriff || challenged | punished
sitter youngster || amused | indulged
doctor student || worried | approached
maiden vampire || frightened | ignored
critic actor || demoralized | disregarded
atheist clergyman || offended | converted
investor stockbroker || persuaded | telephoned
lifeguard swimmer || shocked | drowned
trainer boxer || thrilled | timed
interpreter supervisor || pleased | praised
corporal guerrilla || alerted | surrendered
administered undergraduate || discouraged | registered
superintendent investigator || baffled | misled
examiner competitor || encouraged | criticized
grandmother grandfather || upset | confused
hairdresser socialite || delighted | resented
journalist dictator || enraged | harassed
survivor rescuer || impressed | revived
inhabitant missionary || bored | blessed
performer spectator || entertained | applauded
instructor principal || annoyed | despised
murderer teenager || terrified | resisted
cop thief || frustrated | escorted
fisherman refugee || scared | freed
immigrant therapist || disturbed | counseled
dieter hypnotist || relaxed | trusted
Linda Rachel || distracted | assisted

Helen Judy || soothed | weighed
Ruth Ann || angered | disliked
Kathy Christine || awed | trapped
Susan Lucy || disappointed | misunderstood
Ray Max || stunned | mocked
Stephen Victor || shamed | mocked
Michael Herman || appalled | healed
Tom Phil || alarmed | excused
Truman Nelson || perplexed | beckoned

Appendix C

Stimuli Used in Experiments 3 and 4

Nouns are shown on the left side and verbs on the right side of the two vertical bars. The first two nouns are the animate pair and the second the animate/inanimate pair. The first verb is theme-experiencer and the second is normal. For Experiment 3, the verbs were presented as shown here, with the *-ed* ending. For Experiment 4, the ending was omitted.

constituent politician | legislation politician || incensed | endorsed
correspondent ambassador | interview ambassador || embarrassed | authorized
pianist conductor | symphony conductor || provoked | denounced
publisher novelist | computer novelist || scandalized | exploited
sheriff cowboy | frontier cowboy || challenged | avoided
sitter youngster | puzzle youngster || amused | appreciated
doctor student | office student || worried | approached
vampire maiden | duel maiden || frightened | ignored
critic actor | script actor || demoralized | disregarded
clergyman atheist | sermon atheist || offended | mistrusted
lawyer judge | document judge || persuaded | seized
lifeguard swimmer | seaweed swimmer || shocked | loathed
trainer boxer | match boxer || thrilled | timed
supervisor interpreter | translation interpreter || pleased | praised
corporal guerrilla | radio guerrilla || alerted | surrendered
administrator undergraduate | lecture undergraduate || discouraged | interrupted
superintendent investigator | corpse investigator || baffled | inspected
examiner competitor | contract competitor || encouraged | criticized
grandfather grandmother | finances grandmother || upset | analyzed
hairdresser socialite | charity socialite || delighted | resented
journalist dictator | newscast dictator || enraged | censored
rescuer survivor | gorge survivor || impressed | evaded
inhabitant missionary | ritual missionary || bored | blessed
performer spectator | burlesque spectator || entertained | applauded
instructor principal | schoolwork principal || annoyed | despised
teenager murderer | arrest murderer || terrified | resisted
thief cop | parade cop || frustrated | escorted
refugee fisherman | iceberg fisherman || scared | identified
therapist immigrant | omen immigrant || disturbed | heeded
hypnotist dieter | hypnosis dieter || relaxed | trusted
employer apprentice | compliment apprentice || excited | rejected
camper warden | incident warden || concerned | halted
Linda Rachel | riot Rachel || distracted | scorned
Helen Judy | talisman Judy || soothed | weighed
Ruth Ann | advertisement Ann || angered | disliked
Kathy Christine | pyramid Christine || awed | idealized
Lucy Susan | critique Susan || disappointed | misunderstood
Ray Max | jewel Max || stunned | concealed
Stephen Rose | ideology Rose || intrigued | embraced
Herman Michael | remedy Michael || appalled | blamed
Phil Tom | insult Tom || alarmed | excused
Truman Nelson | instructions Nelson || perplexed | disobeyed
Emma Bill | announcement Bill || bothered | dreaded
Paula Chris | artifact Chris || amazed | controlled
Mark Marjorie | sculpture Marjorie || tempted | scratched
Roger Harry | demonstration Harry || convinced | admired
Dean Pat | jar Pat || enticed | labeled
Albert Barbara | mansion Barbara || astounded | neglected

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