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Phrasal Ordering Constraints in Sentence Production: Phrase Length and Verb Disposition in Heavy-NP Shift

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Heavy-NP shift is the tendency for speakers to place long or "heavy" noun phrase direct objects at the end of a sentence rather than in the canonical postverbal position. Three experiments using several task variations confirmed that length of the noun phrase influenced the ordering of the noun phrase and prepositional phrase during production. We also found that heavy-NP shift was strongly constrained by the "shifting disposition" of individual verbs. Verbs that do not require their complements (e.g., sentential complements) to appear in an adjacent position yielded more shifting during production than did verbs that more frequently appear adjacent to their complements. Analyses of decision/preparation times suggested that shifted and unshifted structures competed for selection. These findings point to the simultaneous activation of lexically derived syntactic representations and ordering options in sentence planning. A multiple constraints framework provides a means of reconciling the existence of competition among ordering options with incremental sentence construction.

In the novel *Animal Farm,* George Orwell gave this description of the activities of the pig Snowball during the animal takeover of the farm: "Snowball had found in the harness-room an old green tablecloth of Mrs. Jones's" (Orwell, 1946, p. 38). This sentence is an example of the phenomenon that Kimball (1973) termed "heavy-NP shift," in which a long or "heavy" direct object noun phrase (NP), such as *an old green tablecloth of Mrs. Jones's,* appears in clause-final position, separated from the verb by some intervening material, in this case the prepositional phrase (PP) *in the harness-room.* "Shifted" sentences such as Orwell's contrast with "unshifted" or "basic order" sentences, in which the verb and NP direct object are adjacent, as in *Snowball had found an old green tablecloth of Mrs. Jones's in the harness-room.* Most speakers of English find both the shifted and basic order structures to be acceptable when the direct object NP is long, as it is in Orwell's sentence. When the direct object NP is short, however, speakers have a strong preference for the basic order (e.g., *found a tablecloth in the harness-room*), and shifted structures (e.g., *found in the harness-room a tablecloth*) are typically judged to be very awkward or ungrammatical. Whereas Ross (1967) pointed to NP complexity and Kimball (1973) pointed to NP length as the key factor in speakers' preferences for the alternative structures, Hawkins' (1994) analysis of a small text corpus suggested that

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the *relative* length of the NP and the other material in the verb phrase (such as a PP) was a better predictor of structure choice than properties of the NP alone. Hawkins found that, independent of NP length and complexity, NPs did not shift much until they exceeded the length of the other material by at least four words.

The heavy-NP shift phenomenon poses interesting problems for researchers in language production. If speakers choose shifted vs basic order structures based on the relative length of the phrases in the verb phrase (Hawkins, 1994), then they would appear to have rather detailed quantitative information concerning the phrasal contents of to-be-uttered sentences during the stages of production in which syntactic structures are chosen. Investigations of heavy-NP shift during on-line speech production could therefore be very revealing about the nature and time course of production operations. This paper presents three experiments exploring several factors that may constrain the use of heavy-NP shift during production.

Why Shift?

A wide variety of hypotheses in the linguistic and psycholinguistic literature have been offered concerning the reasons why heavy-NP shift should exist. A number of researchers have assumed that shifting is triggered by a syntactic property of the long NP, such as its length or relative length in number of words (Kimball, 1973; Hawkins, 1994), or its syntactic complexity (Ross, 1967). Alternatively, shifting may be motivated by syntactic–prosodic interaction rather than by strictly syntactic processes. Zec and Inkelas (1990) suggest that heavy NP shift is an instance of a class of phenomena in which reordering of constituents yields better prosodic contours. Other theorists have argued that shifting is not a syntactic phenomenon at all. For example, Firbas (1966) suggested that long NPs are shifted to the end of the sentence because they tend to contain more new information than do shorter NPs, and thus shifting satisfies pragmatic constraints favoring the given–new ordering of information in English.

A related controversy concerns whether movement phenomena such as heavy-NP shift are motivated by accommodation to the needs of the hearer or by constraints on speaker performance (Wasow, 1997). Miller and Chomsky (1963), Bever (1970), Kimball (1973), and Frazier (1985) have formulated different versions of the idea that it is difficult for comprehenders to process long and/or complex constituents in the middle of a sentence. Shifting is thus hypothesized to accommodate the needs of the comprehender—it moves the difficult material to the end of the sentence, where it is easier to process. Hawkins (1990, 1994) has proposed a more elaborate processing efficiency account in which speakers order constituents in verb phrases to maximize the proximity of the heads of all constituents to the verb.

Other evidence favors the view that shifting is a product of production constraints. Arnold, Wasow, Losongco, and Ginstrom (1997) found that constituent ordering was influenced by production difficulty, as measured by speech disfluencies, suggesting that shifting is, at least in part, a strategy invoked when the production process is particularly difficult or the shifted item is less accessible. Of course, it is possible to develop a hearer-centered interpretation for these data (one shifts in order to delay the error-prone segments for the hearer), and in general it is difficult to distinguish clearly between inherent performance constraints and strategies induced by concern for the hearer. One solution is to propose that listener accommodation is really a by-product of a speaker's comprehension of her own speech (Levelt, 1989). Another is to argue that speakers do not take listener needs into account during the initial planning of an utterance (Brown & Dell, 1987; Horton & Keysar, 1996; V. Ferreira & Dell, 1996). To the extent that heavy-NP shift is motivated by altruistic concern for the hearer per se, it will be less revealing of fundamental sentence construction processes (see Bock, 1990). Therefore, our bias is to assign NP shift to these fundamental processes, and to consider listener accommodation only if this account fails.

Sentence Production

Much research on production has been conducted within the framework of models that identify three major stages in sentence produc-

tion: conception, formulation, and articulation. In addition, there are two distinct substages in sentence formulation (Bock & Levelt, 1994; Fromkin, 1971; Garrett, 1975, 1976, 1984, 1988; Levelt, 1989). The first substage is comprised of *functional processes*, which include the mapping of conceptual representations onto grammatical roles such as subject, predicate, and object. These processes entail the retrieval of major content words such as nouns and verbs (Bock, 1987b, 1990; Bock, Loebell, & Morey, 1992; Levelt, 1989). The second substage comprises *positional processes* which associate grammatical roles with particular syntactic structures preparatory to phonological encoding and articulation. Heavy-NP shift is not directly addressed in these models but, as we shall see, it makes sense to conceive of it as a late functional or early positional process. The distinction between functional and positional processes is largely based on analysis of speech errors. In general, errors involving whole word and phrase exchanges are ascribed to the functional substage: They arise as a result of misassigning entities such as nouns and noun phrases to equivalent syntactic roles. For example, two nouns are exchanged in the sentence *I left the briefcase in my cigar* (Garrett, 1980), and two NPs are exchanged in the sentence *I got into this guy with a discussion* (Garrett, 1980).

In the models of language production, the order of major syntactic constituents may often be determined in the mapping from conceptual to functional representation in an incremental fashion (Bock, 1982, 1987b; Bock & Levelt, 1994; De Smedt, 1990, 1994; Kempen & Hoenkamp, 1987; Levelt 1989), such that words that are more accessible during the utterance-planning stage by virtue of their semantics, frequency, or some other factor, will be the first to be incorporated into the speech plan and will therefore tend to appear earlier in the sentence. De Smedt (1994) has applied this approach to ordering phenomena in general, hypothesizing that shorter phrases as well as more conceptually accessible ones tend to become available for sequencing before longer phrases during the production process. Applied to heavy-NP shift, longer NPs should tend to appear after more readily accessible PPs. De Smedt's approach suggests that accessibility is affected by the number of words in the phrases, but an incremental accessibility account could also be developed for some of the other approaches discussed above. For example, more complex prosodic or syntactic structures may be less accessible than simpler structures, and new information may be less accessible than old information. However, Wasow's (1997) English corpus analyses revealed numerous examples of heavy-NP shift that are not predicted by some or all of the accounts sketched here, in that some shifted NPs were not longer than the PP, were not syntactically complex, were not phonologically complex, and did not appear to contain new information. Wasow concluded that shifting is not triggered by any single factor, suggesting to us that a multifactor theory may be required.

Studies of Word Order

To our knowledge, there have been no experimental studies of heavy-NP shift, so that the most relevant production research is provided by studies that have examined the ordering of words rather than whole phrases (e.g., Bock, 1986, 1987a; Bock & Warren, 1985; Kelly, Bock, & Keil, 1986). For example, McDonald, Bock, and Kelly (1993) investigated both semantic and phonological influences on word order in several constructions. They manipulated the animacy, length, and stress pattern of the nouns in active and passive sentences such as *A farmer purchased a refrigerator*/*A refrigerator was purchased by a farmer*, in conjunctive phrases within sentences, *The key and the manager were nowhere to be found*/*The manager and the key were nowhere to be found*, as well as in isolated phrases such as *manager and key*/*key and manager*. They examined the order of the two nouns in recall of the sentences or phrases and found robust effects of animacy, especially in the active/passive sentences where the choice of phrase order affected the assignment of grammatical roles. That is, participants tended to place animate before inanimate nouns in recall. However, animacy had little effect on the ordering of nouns within a conjunctive

phrase when the phrase was part of a sentence. McDonald et al. concluded that animacy had little or no effect on word order choices that did not entail grammatical role assignment.

In contrast to animacy, the length and stress patterns of the nouns had very little effect on the order of recall in any of the conditions, but McDonald et al. did find some sensitivity to length effects in an acceptability rating task. For example, participants judged conjoined NPs to be more acceptable when a shorter noun preceded a longer noun (e.g., *book and refrigerator*) than when this order was reversed, consistent with other length effects found in acceptability judgments (Cooper & Ross, 1975; Pinker & Birdsong, 1979). In production tasks, however, semantic effects such as animacy appear to play a role in the choice of word order, especially if order entails assignment of grammatical roles, but there seems to be only a very restricted role for phonological effects such as word length.

Though word and phrase ordering are not necessarily guided by the same production mechanisms, these studies of word ordering yield several implications for heavy-NP shift. First, there are clear effects of noun accessibility, including accessibility modulated by animacy, on word and phrase ordering choices that entail grammatical role assignment, but not on word ordering choices that do not affect role assignment. As heavy-NP shift is the rare case of phrase ordering that does not affect grammatical role assignment (i.e., the direct object NP retains this role whether shifted or not), we predicted that shifting would not be sensitive to animacy effects. Second, word length effects are weak or nonexistent in studies of word ordering. The evidence that word length has little effect on word order in sentences and phrases seems, on the face of it, to be inconsistent with heavy-NP shift, which by definition involves a substantial role for phrase length or relative phrase length in the choice of shifted vs basic syntactic structure (Hawkins, 1994; Kimball, 1973; Wasow, 1997). However, the processes involved in weighing the "heaviness" of phrases need not include an assessment of the length of individual words. In their proposed prosodic account of NP shift, Zec and Inkelas (1990) stipulate that full phonological information is not available to the decision-making process. Likewise, Sternberg, Monsell, Knoll, and Wright (1978; see also Wright, 1990; F. Ferreira, 1991) found that the number of words in a speech plan, rather than the length of the words, determined production latency, and Wheeldon and Lahiri (1997) showed that initiation time for short prepared sentences of fixed length is determined by number of phonological words (see Nespor & Vogel, 1986). Thus, the ordering of phrases within a sentence may be sensitive to phrase length defined in word or phonological word units, even though the order of words within phrases is not sensitive to the length of those units. Clearly, there is a need for production data on phrase ordering processes in heavy-NP shift to illuminate the relation of this case to previous phrase length and word order studies.

Verb Disposition

Our goal is not merely to capture heavy-NP shift in the laboratory, but to manipulate factors that modulate it and so provide some constraints on interpretations of the effect. Given our expectation that animacy should not strongly influence the effect, we turned to the comprehension literature for guidance. In recent sentence comprehension research, argument structure properties of verbs have been accorded increasing importance in ambiguity resolution and sentence interpretation (F. Ferreira & McClure, 1997; Garnsey, Pearlmutter, Myers, & Lotocky, 1997; MacDonald, 1994; Trueswell, Tanenhaus, & Kello, 1993). On this basis, we developed the hypothesis that argument structure properties of verbs similarly affect production processes and, specifically, heavy-NP shift.

Our approach relates most directly to lexical constraint-based theories of ambiguity resolution (see MacDonald, Pearlmutter, & Seidenberg, 1994; Tanenhaus & Trueswell, 1995, for reviews), which have emphasized that it is not strictly the number of alternative argument structures but rather the relative frequency of use of the alternatives in the language that influences the difficulty of sentence processing

(e.g., Garnsey et al., 1997; MacDonald, 1994; Trueswell et al., 1993). The constraint-based approach argues for detailed lexical representations that encode a wide variety of frequency-sensitive information. There is some uncertainty in the current literature concerning whether the same lexical representations are used in production and comprehension (e.g., Bock et al., 1992; Bock & Levelt, 1994; Butterworth, 1989; Dell, Schwartz, Martin, Saffran, & Gagnon, 1997; Dell & O'Seaghdha, 1994; Levelt, Roelofs, & Meyer, in press), but even if these representations are separable, the frequency of their use and their experience should be strongly correlated. Therefore, production phenomena such as heavy-NP shift are likely to be influenced by some of the same lexical properties that have been identified in studies of comprehension. For example, both comprehenders and speakers should make use of lexical information concerning the frequency with which verbs tend to participate in particular syntactic constructions. Thus, when a verb is selected during the production process, frequency-weighted lexical information will become activated and could constrain the choice of a syntactic structure.

Following this reasoning, we developed a *verb disposition hypothesis,* which states that individual verbs carry with them information on the history of their participation in shifted structures and that this history influences the likelihood of their allowing heavy-NP shift. Thus, for heavy-NP shift sentences such as Orwell's *Snowball had found in the harness-room an old green tablecloth of Mrs. Jones's,* a speaker's activation of the verb *found* should partially activate both the shifted and the basic syntactic ordering options for the direct object and location arguments of the verb. Furthermore, the degree of activation of each option should be a function of the frequency with which *found* has previously participated in the alternative structures. Thus one component of our hypothesis is that verbs that have previously been deployed in shifted verb phrases (VPs) will be more likely to appear in shifted VPs in the future. Second, a verb's shifting disposition is hypothesized to be a function not only of previous shifting but also of previous experiences in certain other structures that share a crucial feature with heavy-NP shift. We identify these other structures as ones in which the verb and its complement are nonadjacent.

One nonadjacent structure is the verb–particle construction in English, in which a particle such as *in, up, out,* or *on* may intervene between a verb and its direct object NP, as in *throw out the trash,* and *cut up the vegetables.* Linguists have long noted the similarity between the verb–particle construction and heavy-NP shift in that the alternative phrase orders Verb–Particle–NP and Verb–NP–Particle are strongly determined by the length of the NP (Hawkins, 1994; Wasow, 1997). Thus a verb's frequent participation in Verb–Particle–NP sequences, in which the particle intervenes between the verb and the NP, may leave the verb more disposed to participate in heavy-NP shift structures.

A second nonadjacent construction that may affect shifting disposition involves sentential complements (S-complements), typically introduced by *that,* such as *Mary said that Bill would sing,* or *Mary learned that she would be allowed to go hiking.* Whereas each S-complement is adjacent to its verb in these two examples, it is typically nonadjacent when the verb is modified by a PP or an adverb, as in *Mary said in a loud voice that Bill would sing,* or *Mary learned yesterday that she would be allowed to go hiking.* These sentences avoid ambiguities and sound much more natural than in an alternative order in which the verb and S-complement are adjacent, as in *Mary said that Bill would sing in a loud voice* and *Mary learned that she would be allowed to go hiking yesterday.* By virtue of these frequent constituent orderings [V PP S-complement] and [V adverb S-complement], verbs that take S-complements frequently occur in nonadjacent structures. We propose that participation in nonadjacent S-complement structures will increase a verb's disposition to participate in heavy-NP shift structures.

In sum, we posit that prior "syntactic experiences" with any of three nonadjacent constructions can increase a verb's disposition to shift: (1) prior heavy-NP shifting, (2) prior participation in verb–particle constructions, and (3) prior participation in S-complement con-

structions. In the experiments, we chose to investigate the effect of the S-complement construction. Undoubtedly, the S-complement construction and the other syntactic patterns that might affect shifting disposition are associated with certain prosodic, semantic, and/or discourse representations that could affect shifting, but we will not initially explore those here. Our goal in Experiment 1 is simply to determine whether there is any variation in verb shifting disposition that can be traced to participation in the S-complement construction. Many verbs that participate in S-complement structures can also take NP direct objects. For such verbs, often termed "NP/S" verbs, participation in S-complements provides a number of opportunities to appear nonadjacent to their complements. Therefore, and all else being equal, NP/S verbs should more readily accommodate heavy-NP shift than do verbs that do not take sentential complements. In a corpus analysis of the Penn Treebank data, we found support for the hypothesis that NP/S verbs have a higher shifting frequency than do verbs that do not take sentential complements (MacDonald, Stallings, & O'Seaghdha, 1998). To test the verb disposition hypothesis in production, we constructed stimuli manipulating NP length, PP noun animacy, and the type of verb so that it was either an NP/S verb like *found* or *revealed*, or it was a verb that does not take sentential complements, such as *transferred* or *delayed*. We will term the latter type of verb an "NP-only" verb, indicating that it can take NP direct object complements, but not S-complements.

The idea that verb disposition is a frequency sensitive parameter has several important implications. First, the verb disposition hypothesis naturally entails the possibility that syntactic production processes, in addition to having an incremental component, have a *competitive* component whereby the alternative structures compete for selection (Bates & Devescovi, 1989; MacWhinney & Bates, 1989). For the case of heavy-NP shift, we go further to argue that competition is intrinsic to the choice of ordering options. That is, given that NP-first is clearly dominant in short NP sentences, but that the probability of NP shift increases as a function of NP length and a variety of more subtle considerations (Wasow, 1997), there should be situations where the default and shifted constructions are roughly equipotent and therefore compete with one another. This argument does not deny that many syntactic structure decisions may be effected incrementally (De Smedt, 1990, 1994; V. Ferreira, 1996) or that many NP placements are decided incrementally. We claim only that where syntactic ordering options are in question, competition should occur in at least some proportion of "tough decision" cases.

A second issue concerns how and why the record of nonadjacency should be generalized over such different syntactic structures as heavy-NP shifted sentences, verb–particle constructions, and nonadjacent S-complement sentences. Recent comprehension work shows that comprehenders have acquired distributional information over a number of different "grains" of detail, from simple lexical and structural frequencies to far more complicated combinatorial constraints, such as the frequency of a word in a particular syntactic structure in a particular discourse context (MacDonald, 1997; MacDonald et al., 1994; Tabor, Juliano, & Tanenhaus, 1997). A system that can represent contingent frequency information across these varied grains could encode nonadjacency information while also encoding specific information about each syntactic structure. It might do so because the structures that we posit as contributing to shifting disposition share important properties. In addition to the property of nonadjacency itself, these structures share the property of being active rather than passive, and they all have postverbal complements. Most important, from the point of view of production, the nonadjacency property is relevant to the always pressing question "What comes next?"

Experiment Overview

Because long and complex sentences are necessary to elicit heavy-NP shift, we were reluctant to use the recall paradigm common to many of the word order studies reviewed above. We therefore developed a variant of a sentence construction procedure used by Dell and O'Seaghdha (1992) to begin our exploration of

shifting. In pilot work, participants read sentence fragments on a computer screen and formed a plan for producing the complete sentence. More specifically, they indicated by pressing one of two keys whether they intended to produce a [Subject–Verb–NP–PP] or [Subject–Verb–PP–NP] sequence. We manipulated NP length and animacy of the noun in the PP and found that the former but not the latter influenced the probability of shifting. Having established that heavy-NP shift occurs in the task, we manipulated the same factors in Experiment 1, plus the key factor of the type of verb heading the verb phrases. Experiment 2 simplified the task by removing the requirement to make an explicit choice prior to speaking. Experiment 3 examined whether shifting obtains in a recall paradigm similar to that used in the word order literature, and showed, in conjunction with the findings of Experiments 1 and 2, that our initial reluctance to use a recall task was unfounded.

EXPERIMENT 1: VERB DISPOSITION, NP LENGTH, AND PP NOUN ANIMACY

This experiment was designed to investigate the effects of verb disposition, noun phrase length, and animacy of the noun within a prepositional phrase on choice of basic [NP–PP] or shifted [PP–NP] order of these phrases. Participants constructed sentences from phrases appearing on a computer screen, choosing either the basic order in which a verb and direct object NP were adjacent and a PP followed the NP [S–V–NP–PP] or the shifted order in which the PP intervened between the verb and the direct object NP [S–V–PP–NP]. A second group of participants participated in a ratings task in which they reported the relative acceptability of shifted and basic order structures. The use of the rating task for comparison with the production task was prompted by McDonald et al.'s (1993) findings of different effects of word length and animacy in rating and production tasks.

Our first goal in the production experiment was to assess the effect of a manipulation of NP length (2 vs 10 words) in this task. We expected participants to choose the shifted structure more often in the long NP condition than in the short NP condition.

The PPs contained animate or inanimate nouns (e.g., *to John* vs *at lunch*). We will term this variable *PP animacy*, recognizing that it is not the PP itself that is animate but rather the concept represented by the noun within the PP. According to production theory (e.g., Bock, 1987b; Garrett, 1984; Levelt, 1989), animacy affects accessibility of words and influences processes such as grammatical role assignment that occur relatively early in sentence formulation. Heavy-NP shift does not affect grammatical role assignment, but speakers may have a tendency to put PPs with animate nouns earlier in a verb phrase and so produce more shifted structures. Of course, because we did not expect short NPs to shift, any effect of animacy should be stronger in the long NP conditions.

As discussed in the introduction, the key manipulation was verb disposition, operationalized as the effect of verb type (NP/S or NP-only). The verb disposition hypothesis states that experience with nonadjacent structures affects the extent to which shifting will be observed and, as reviewed above, NP/S verbs have had more nonadjacent experiences than NP-only verbs. We therefore predicted that NP/S verbs would appear in more shifted structures than NP-only verbs. Shifting should be largely confined to long NPs, yielding an interaction of NP length and verb type in the structure choice data.

In addition to choice of structure, we measured both decision time to make the choice and sentence initiation time following a cue to begin speaking. The competition view we propose states that decision times should be longer when two alternatives are activated to roughly the same degree (see e.g., Kawamoto, 1993). In contrast, strictly incremental structure building can only benefit from the flexibility of having more options (e.g., V. Ferreira, 1996) and so should not care about relative activation levels. Because more shifting should occur in the NP/S conditions, we predicted that decision times should be longer for the NP/S conditions than for the NP-only conditions. And because most shifting should occur in the long NP conditions, there should be an interaction between verb type

TABLE 1

Example Materials for Experiment 1

Condition	NP & NP/S verb pair	PP	NP
Animate short	transferred/revealed	to Leigh	the graphs
Animate long	transferred/revealed	to Leigh	some more specific plans for a brand new defense plant
Inanimate short	transferred/revealed	at dawn	the graphs
Inanimate long	transferred/revealed	at dawn	some more specific plans for a brand new defense plant

Note. The subject NP for this item was *Janet.*

and length in the decision latencies. In addition, because it may take longer to activate a shifted alternative in the face of competition from the more common basic order, longer choice times for shifted than for basic order choices could be diagnostic of competition between alternative phrase orders.

In keeping with previous evidence that the complexity of prepared utterances affects initiation time (F. Ferreira, 1991; Sternberg et al., 1978), we predicted that voice initiation times would reflect overall sentence complexity. That is, we expected initiation latencies to be longer in the long NP than in the short NP conditions. Because they reflect plan implementation rather than plan selection, initiation latencies should not be sensitive to verb type. Beyond that, prediction is difficult. If initiation latencies are primarily sensitive to the structural complexity of some portion of the beginning of a complex sentence (F. Ferreira, 1991), latencies to begin shifted S–V–PP–NP sentences might be relatively fast. Note that this would also be compatible with the view that shifting is motivated by a strategy of deferring the more complex long NP constituent to ease the processing burden (see Wasow, 1997). However, because we do not know how the sentences in this experiment may be partitioned for production and because the working memory commitment of tracking a displaced NP in our paradigm may increase initiation latencies, we cannot test more specific hypotheses.

Method

Participants. Ninety-six University of Southern California undergraduates were either paid or received extra credit in psychology courses for their participation. Half of the participants served in the production experiment and half in the ratings task. All were native speakers of English.

Materials. We constructed 40 experimental items, each consisting of three components: a subject and verb, a noun phrase, and a prepositional phrase. An example is shown in Table 1, and all items are listed in the Appendix.

Each of the 40 subject–verb phrases was 2–3 words in length (e.g., *Julie displayed, The contractor presented*). We selected 20 verb pairs for the subject–verb phrases. Each pair contained one NP-only verb and one NP/S verb (e.g., *transferred* and *revealed,* respectively). We excluded alternating datives such as *give,* because these verbs can participate in phrase orders other than those that were under investigation here. The two groups of verbs were matched for length in syllables. The NP-only verbs had a frequency of 36 occurrences per million in the Francis and Kucera (1982) corpus, and the NP/S verbs had a frequency of 47, a nonsignificant difference, $t < 1$. A subject NP, two direct object NPs manipulating length, and two PPs manipulating animacy, were written for each pair. Short direct object NPs were two words long and contained 2–4 syllables. The long direct object NPs (10 words and 13 syllables) in Experiment 1 contained only prenominal adjectives and prepositional phrases.

In the animate prepositional phrases, the preposition was always *to,* expressing a Goal thematic role, as in *to Mary.* The prepositions in the inanimate condition, including *at, on, in, with,* and *by,* expressed Time, Location and

Manner roles, as in *at ten, in person,* etc. A few of the Manner items, such as *very quickly,* were adverbial phrases.

The animate and inanimate prepositional phrases were matched as closely as possible in number of words and syllables with the short NP for each item. In the animate condition, there was no difference between the length of the NP and the PP in the short condition. In the long condition, the difference was 8 words and 9–11 syllables. In the inanimate condition, there was a 0 word and 1–3 syllable difference in the short condition and no less than an 8 word and 8 syllable difference in the long condition.

Design and procedure. The production task involved four two-level factors: NP length (2 vs 10 words), verb type (NP/S or NP-only), screen position (NP top vs NP bottom), and animacy of the PP noun. PP animacy was manipulated between participants and the others were manipulated within.

The task employed a variation on a constrained production paradigm in which participants prepared and then uttered sentences using phrases presented on a computer screen (Dell & O'Seaghdha, 1992; F. Ferreira, 1994; V. Ferreira, 1996). On each trial, three left-justified phrases appeared at top, center, and bottom screen locations. We instructed participants to put the phrases together to form a sensible sentence, informing them that some sentences would make more sense with the phrase order MIDDLE–TOP–BOTTOM and others would work better with the order MIDDLE–BOTTOM–TOP. With the exception of possessive apostrophes, there was no punctuation. The subject–verb phrase was always in the center position. It was underlined to indicate that it constituted the beginning of the sentence. The position of the other two phrases was counterbalanced across participants and items.

Ten practice and 37 filler items were constructed so that only one ordering of the top and bottom phrases yielded a grammatical sentence. For 60% of these items, the phrase order MIDDLE–TOP–BOTTOM was the grammatical one, and for the remaining 40% the order MIDDLE–BOTTOM–TOP was grammatical. This ratio was adopted to counteract a tendency observed in pilot work to favor the order MIDDLE–BOTTOM–TOP.

Participants pressed a key to initiate each trial. The three phrases appeared on the screen. Participants read the phrases and then pressed one of two keys to indicate in which order they intended to say them, the MIDDLE–TOP–BOTTOM order or the MIDDLE–BOTTOM–TOP order. In this way, we obliged participants to choose explicitly between the alternative orders at a definable moment. We did this because we were interested both in the choice of order and in the difficulty of the choice, as indexed by decision latency. In addition, we wanted to avoid the possibility that participants would initiate speech before fully reading the displays.

Following the keypress, the screen was blanked for a 1 s interval. The word GO then appeared in large font in the center of the screen. At the GO prompt, the participant uttered the sentence aloud into a microphone linked to a voice key that recorded the time to initiate the sentence. The voice initiation time was measured from the appearance of the GO prompt to the start of the participant's utterance. Because participants had already decided on the order of production, latency to respond should index plan complexity and not the planning process. Triggering the voice key also caused the screen display of the sentence fragments to reappear. Participants thus did not have to memorize the entire sentence verbatim but only had to remember the first several words and the chosen order of phrases. Once a participant finished uttering the entire sentence, the experimenter recorded the participant's choice of phrase order with a key press; equipment errors were recorded by hand. Following the 10 practice items, the 40 experimental and 37 filler items were presented in random order. Participants completed this portion of the experiment without a break in a 15–20 minute session.

Rating task. For the rating task, a second group of 48 participants received the same 40 experimental items as in the production task, fully counterbalanced across subjects for NP length, verb type, animacy, and left/right page position of shifted and unshifted items. Shifted and unshifted structures appeared side by side

on the page, as shown below, and participants circled a number between 1 and 7, indicating their judgment of which order seemed the more "natural" way to express the thoughts in the sentences. Ten items appeared on each page of the questionnaire, and page order was randomly assigned for each participant. Conditions appeared in random order on each page, except that two pages contained only items in which the shifted structure was on the left, and the other two pages contained items in which the shifted structure was on the right.

Don introduced at brunch a couple of old college friends and a math teacher.	1 2 3 4 5 6 7	Don introduced a couple of old college friends and a math teacher at brunch.

Results and Discussion

Three dependent variables were analyzed in the production experiment: (1) the percentage of shifted [PP NP] orders that participants chose, (2) decision times in choosing a phrase order, as measured from the initial presentation of the three phrases to the participant's keypress indicating a choice of order, and (3) time to initiate the utterance, as measured from the GO prompt. These data were analyzed as a function of length, verb type, animacy, and screen position (NP top vs NP bottom). Except where noted, screen position had no effect. In the following analyses, 1.2% of the trials were excluded due to short phrase order decision times (<500 ms), and 1.8% were excluded due to inconsistency between the initial choice of phrase order and the order subsequently produced.

Phrase order choice. As shown in Fig. 1, there were clear effects of both length and verb type. Participants shifted about four times as often in the long NP condition as in the short NP condition, $F_1(1,46) = 50.81$, $p < .001$; $F_2(1,39) = 94.60$, $p < .001$. Participants also shifted more than twice as often with the NP/S verbs as with NP-only verbs, $F_1(1,46) = 50.77$, $p < .001$; $F_2(1,39) = 38.84$, $p < .001$. The verb disposition by length interaction shown in Fig. 1 was also reliable, $F_1(1,46) = 16.28$, $p < .001$; $F_2(1,39) = 20.36$, $p < .001$, reflecting the concentration of the verb type effect in the long NP conditions. These data clearly support our main hypothesis that NP/S verbs should be associated with more heavy-NP shifts than NP-only verbs. There were no effects of animacy, Fs < 1, and this factor did not interact with any others.

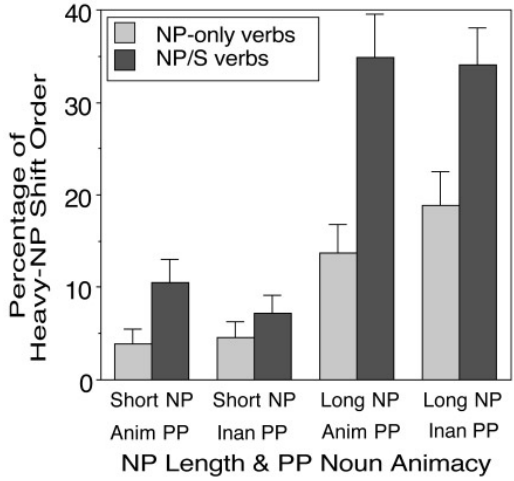

FIG. 1. Production of heavy-NP shifted structures as a function of animacy, length, and verb disposition in Experiment 1.

Although we did not expect a strong effect of animacy, we were concerned that the argument/adjunct status of PPs was correlated with animacy, as some syntactic ordering choices are influenced by thematic structure (F. Ferreira, 1994). We conducted a post hoc analysis to determine whether the effect of verb type and the absence of an effect of animacy were related to variations in the argument/adjunct status of PPs across the conditions. For each item with each verb and PP combination, we coded the PP as an argument or an adjunct respective to its corresponding NP-only and NP/S verbs.[1] All of the inanimate items were adjuncts.

[1] We adopted semantic selection criteria (Dowty, 1982) such that argument status was assigned to those PPs that were entailed by their verbs. Otherwise, adjunct status was assigned. Thus, "to Leigh" is an argument of the verb "transfer," since transferring a document requires a recipient. We examined two separate argument codings: a strict argument interpretation in which questionable arguments were coded as adjuncts and a looser interpretation in which questionable arguments were coded as arguments. We presented the data from the looser coding in the text because that coding yields the larger number of arguments, but the pattern of results did not change with the stricter coding.

TABLE 2

Decision (Experiment 1) and Ready Response (Experiments 2–3) Times in ms (with Standard Deviations), as a Function of Order, NP Length, and Verb Type

	Experiment 1				Experiment 2				Experiment 3			
	NP-Only		NP/S		NP-Only		NP/S		NP-Only		NP/S	
	Short	Long	Short	Long	Short	Long	Short	Long	Short	Long	Short	Long
Basic	3883	4969	4416	5458	3618	5109	3851	6083	3643	12923	4070	13124
	(1754)	(2576)	(2019)	(2907)	(1570)	(2390)	(1606)	(3908)	(1053)	(7391)	(1592)	(9012)
Shifted	4881	6678	5374	6107	4082	5333	3928	6701	4499	18051	4408	18860
	(3750)	(4026)	(4572)	(3654)	(2034)	(2822)	(1678)	(4494)	(1561)	(13662)	(1315)	(13199)
Overall	3925	5097	4448	5628	3625	5281	3829	6263	3643	13130	4062	13618
	(1767)	(2788)	(2111)	(2806)	(1584)	(2437)	(1500)	(4038)	(1040)	(7647)	(1586)	(8395)

* The overall means are reported from analyses that collapse over order.

Of the animate items, those with NP-only verbs contained 16 arguments and 4 adjuncts, while items with NP/S verbs had a very similar pattern, 15 arguments and 5 adjuncts. To determine whether argument status affected shifting rates, we reanalyzed the shifting data for items in the animate condition with argument status as a factor and found that it had no effect on shifting. Argument and adjunct PPs showed very similar shifting rates—15.4 and 17.5% respectively, $F_2(1,38) = 1.47$, $p > .20$. The argument status factor did not interact with any others in this analysis. In sum, phrase order choice was affected by NP length and by verb disposition, but not by the animacy of nouns in prepositional phrases.

Decision times. Table 2 shows the phrase order decision times presented, for informational purposes, according to whether participants chose the basic or shifted orders. Due to the infrequency of shifting, the mean shifted choice times are calculated over a large number of empty cells and must be viewed with caution. Therefore, we collapsed over structure choice in the main analysis of decision times. As expected, decision times were longer in the long NP conditions (5362 ms) than in the short NP conditions (4187 ms), $F_1(1,46) = 53.52$, $p < .001$; $F_2(1,39) = 74.61$, $p < .001$. This effect is at least partly attributable to the fact that participants took longer to process the material in the long NP condition. More interestingly, there was also a main effect of verb disposition, such that decision times were longer for sentences containing NP/S verbs (5038 ms) than for those containing NP-only verbs (4511 ms), $F_1(1,46) = 22.57$, $p < .001$; $F_2(1,39) = 10.71$, $p < .005$. However, there was no interaction of verb type and NP length, Fs < 1. Consistent with the choice evidence, there was no effect of animacy on decision time, and animacy did not interact with the other factors, Fs < 1.

An analysis of the basic order choice times tells a similar story. Decision times were longer in the long NP conditions (5304 ms) than in the short NP conditions (4149 ms), $F_1(1,46) = 58.10$, $p < .001$; $F_2(1,39) = 31.20$, $p < .001$ and for sentences containing NP/S verbs (5006 ms) than for those containing NP-only verbs (4447 ms), $F_1(1,46) = 33.86$, $p < .001$; $F_2(1, 39) = 7.27$, $p < .01$. Furthermore, there was no effect of animacy on decision time and there were no interactions (Fs < 1).

One interpretation of the effect of verb type is that the longer decision times for NP/S verbs simply reflect longer reading times for these sentences. This pattern could be due to the added complexity of having to resolve the argument structure ambiguity inherent in NP/S verbs, in contrast to the unambiguous NP-only verbs. Alternatively, the effect may lie in the decision process, such that decision times are longer when there is greater competition between alternative phrase orders. The frequent participation of NP/S verbs in constructions that involve a nonadjacent complement would yield

partial activation of both alternative structures and competition between them, slowing response times, whereas the NP-only verbs should have much less activation of the nonadjacent structure and thus little competition.

However, the competition hypothesis makes specific predictions concerning decision times conditionalized on choice of the basic vs the shifted structure. When the basic order is chosen, decision times should be shortest when there is little activation of the shifted structure. Thus, decision times for the basic order should be shorter for sentences with rarely shifted verbs than for frequently shifted verbs. Similarly, the competition account predicts that a decision in favor of the shifted structure should be made more quickly in at least some cases when there is substantial activation of the shifted structure, that is, with frequently shifted verbs, than when there is little activation of this structure, as with rarely shifted verbs. With so few instances of shifting for NP-only verbs, it is impossible to analyze decision times in an analysis of variance with Decision (basic vs shifted) and Verb type as factors. Instead, we used correlational analyses to examine the relationship between shifting frequency and the latency to decide on basic and shifted structures. For each experimental item with each verb (recall that each item appeared with two different verbs), we counted the number of times the item was uttered in shifted form. These frequencies are shown in the Appendix. The range of shifting frequencies was 0–11, (mean = 3.9) out of a total of 24 presentations (12 of which were in the short condition, for which shifting was very rare). Most, but not all, frequently shifted items contained NP/S verbs, and the items that shifted with moderate frequency (i.e., 4–5 times) contained about equal numbers of NP-only and NP/S verbs.

We correlated the shifting frequencies with decision times in the long NP condition for the basic order and for the shifted order. For choices in favor of the basic order, we found a robust positive correlation between shifting frequency and decision time, $r\ (79) = .33$, $p < .005$. This pattern is the one predicted by the competition hypothesis: The more frequently shifted an item, the longer the decision time in favor of the unshifted, basic order. The competition hypothesis predicts a correlation in the opposite direction for choices for the shifted order: The more frequently shifted items should tend to have shorter decision times than rarely shifted items. The correlation turned out to be a small negative one, $r\ (72) = -.19$, $p = .11$. The relative weakness of this correlation may be due to the fact that, because the basic order is the default, the decision to shift may involve competition on individual trials even for many of the most frequently shifted verbs. The important point is the difference between the shifted and basic order correlations rather than the exact values of the coefficients. The contrast between the negative correlation between shifting disposition and shift latency and the positive correlation between shifting disposition and nonshift latency is consistent with the existence of a competitive process.

Following this reasoning, we tested whether the two correlations were significantly different from one another. The Z_1* statistic (Steiger, 1980) is appropriate for this case, in which the two correlations share one factor (shifting frequency), and independence between the correlations cannot be assumed. The test showed that the two correlations were indeed significantly different, $Z_1^* = 2.94$, $p < .005$. Overall, the correlational analyses support the competition hypothesis, suggesting that both the shifted and unshifted orders are partially activated and compete with one another in our production task. To the extent that such results generalize to spontaneous production, they argue against strictly incrementalist accounts of phrase ordering and potentially against strongly incrementalist accounts of sentence construction in general.

Voice initiation times. Table 3 shows voice initiation times corresponding to the decision times in Table 2. Trials on which the voice key failed to register the participant's voice or where the RT was greater than 3000 ms were excluded (an additional 2.9% of the trials). Analysis of variance showed a main effect of NP length, such that participants took longer to begin speaking in the long condition (744 ms) than in the short condition (699 ms), $F_1(1,46) =$

TABLE 3

Voice Initiation Times in ms (with Standard Deviations), as a Function of Order, NP Length, and Verb Type for Experiments 1–3

	Experiment 1				Experiment 2				Experiment 3			
	NP-Only		NP/S		NP-Only		NP/S		NP-Only		NP/S	
	Short	Long	Short	Long	Short	Long	Short	Long	Short	Long	Short	Long
Basic	685	732	708	758	711	708	687	730	530	655	539	672
	(220)	(236)	(259)	(277)	(239)	(240)	(235)	(240)	(141)	(196)	(126)	(210)
Shifted	768	752	798	725	808	729	845	759	889	666	521	617
	(382)	(390)	(527)	(268)	(666)	(259)	(657)	(282)	(158)	(480)	(137)	(175)
Overall	687	739	711	750	714	707	706	707	532	657	539	660
	(222)	(226)	(261)	(246)	(243)	(219)	(244)	(238)	(143)	(204)	(123)	(180)

* The overall means are reported from analyses that collapse over order.

8.25, $p < .01$; $F_2(1,39) = 5.1$, $p < .05$. There were no effects of animacy or verb disposition on initiation time, except for a small uninterpretable interaction between verb disposition and screen position in the participants analysis only.

The NP length effect is consistent with other evidence that initiation time is sensitive to utterance complexity under conditions where the utterance is maximally prepared (e.g., F. Ferreira, 1991; Sternberg et al., 1978). In the present context, it provides useful confirmation that, although participants knew that the sentence ingredients would be redisplayed following utterance initiation, they genuinely planned the sentences before beginning to speak. It seems likely that participants were committed to producing the SV phrase in all conditions; beyond that, the overall complexity of the utterance (defined by whether or not it contained a long NP) rather than the order of phrases determined initiation time. The evidence does not allow us to conclude whether this is a general characteristic of planning for this kind of sentence or whether it is due to the fact that participants knew that the NP and PP would be redisplayed following sentence initiation.

Rating data. Figure 2 shows the rating data, in which higher ratings indicate greater preference for the shifted order. Consistent with the production data, there were main effects of both verb disposition and length. Participants preferred the shifted order more when the sentence contained an NP/S verb (2.84) than when it contained an NP-only verb (2.55), $F_1(1,46) = 21.22$, $p < .001$; $F_2(1,39) = 10.98$, $p < .005$. Likewise, they preferred the shifted order more in the Long NP condition (3.59) than in the Short NP condition (1.80), $F_1(1,46) = 106.25$, $p < .001$; $F_2(1,39) = 390.58$, $p < .001$.

As in the production study, there was no main effect of animacy. There was a small interaction between animacy and length, reliable only in the items analysis, $F_1(1,46) = 2.90$, $p > .05$;

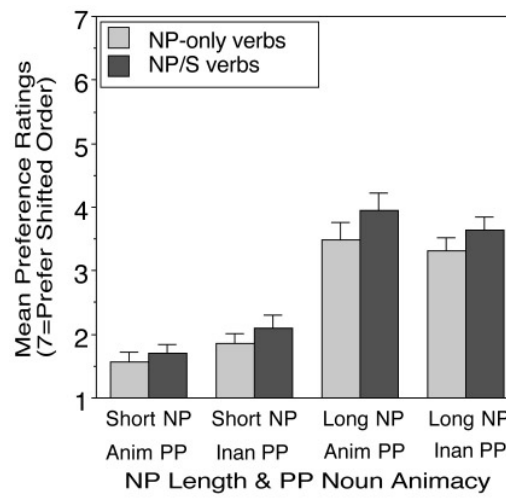

FIG. 2. Mean acceptability ratings for heavy-NP shifted structures as a function of animacy, length, and verb disposition in Experiment 1.

$F_2(1,39) = 10.12$, $p < .005$. However, the nature of the interaction was not consistent with our theoretical expectations: In the short NP condition, shifted animates were *less* preferred (1.63 mean rating) than shifted inanimate items (1.98 mean rating), and there was no effect of animacy in the long NP condition. Thus, this weak interaction does not provide evidence in support of the idea that PP animacy increases preference for shifted NP sentences. In contrast with McDonald et al.'s (1993) finding that people preferred animate words early even though they did not produce them earlier, it seems that PP animacy has little or no effect on preference for the shifted vs basic syntactic structure.

Conclusions. Experiment 1 demonstrated a clear effect of NP length on shifting and, more importantly, showed that the length effect is modulated by verb type. Participants uttered shifted structures more, and rated shifted structures as being more acceptable, when the sentence contained an NP/S verb than when it contained an NP-only verb, especially in the long NP conditions. Thus our task demonstrated sensitivity to the heavy-NP shift phenomenon, and the experiment provides preliminary support for the verb disposition hypothesis. Decision times were also sensitive to verb disposition but not to its interaction with NP length. However, this might be because of a mixture of easy and difficult decisions in the long NP conditions. A correlational analysis confirmed this conjecture by uncovering evidence of competition in the decision process: decisions in favor of the basic order were slower and decisions to shift were relatively fast for more frequently shifted verbs. No effect of PP noun animacy obtained, replicating findings in McDonald, Bock, and Kelly (1993) that animacy does not influence ordering in structures where grammatical role assignment is unaffected. Therefore, we dropped the manipulation of animacy in the following experiments.

Before discussing more general implications of our findings, it is important to consolidate our experimental grasp of heavy-NP shift. In Experiment 1, we endeavored to capture the heavy-NP shift phenomenon and its competitive implications by obligating participants to choose the order of phrases before beginning to speak. A drawback of this procedure is that it is somewhat artificial, perhaps forcing a degree of competition and shifting that does not occur in natural speech. Specifically, the explicit decision about order can be viewed as exaggerating the role of a metalinguistic order preference and possibly obscuring the incremental nature of unrestricted production. The task therefore may reflect comprehension and judgment processes more than the production processes we wished to capture. To address these concerns, we varied the procedure in Experiments 2 and 3.

EXPERIMENT 2: READINESS TASK

This experiment was very similar to Experiment 1 except for the following modifications. First, because animacy of the prepositional phrase noun had no effect in Experiment 1, we used only the inanimate items in Experiment 2. Second, because the rating data mirrored the choices in Experiment 1, we did not collect additional ratings. Most importantly, we removed the explicit order choice decision from the production task. In Experiment 2, participants were required only to indicate readiness to speak, not to commit to a particular order of phrases before beginning to produce the sentences. In general, because the number of inconsistencies between order decisions and actual productions in Experiment 1 was very low (1.8 % of all trials), we expected largely similar outcomes in this experiment. We investigated three specific issues: (1) whether the effects of NP length and verb disposition observed in Experiment 1 were artifacts of the explicit choice required in that experiment; (2) whether preparation time before indicating readiness, which provides a more indirect measure of competitive processes underlying sentence production, would still be sensitive to verb disposition; and (3) whether relaxing the requirement to commit to a sentence production plan would reduce the effect of sentence complexity on initiation times.

Method

Participants. Twenty-four University of Southern California undergraduates were either paid or received extra credit in psychology

courses for their participation. All were native speakers of English.

Materials and procedure. The materials were the same as the inanimate items from Experiment 1. The procedure was similar to that of Experiment 1 except that participants were not required to indicate their choice of phrase order with a keypress. Instead, they were instructed to read the phrases, prepare to produce them in a sensible order, and press a key when ready to begin speaking. Following the keypress, the screen was blanked for 1 s until the GO prompt appeared, cueing the participant to begin to utter the sentence. The participant's voice triggered the timer connected to the microphone and caused the sentence fragments to reappear on the screen. The session lasted about 20 minutes.

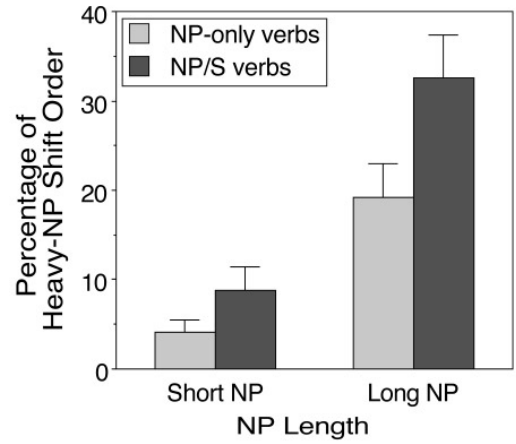

FIG. 3. Production of heavy-NP shifted structures without explicit decision component as a function of animacy, length, and verb disposition in Experiment 2.

Results and Discussion

As in the previous experiment, there were three dependent variables. The first, percentage of shifted [PP–NP] productions, and the third, voice initiation time, were the same as in Experiment 1. The second dependent variable, time to indicate readiness to speak, was a less explicit measure of decision time than the choice required in Experiment 1. In the following analyses, 2.3% of the trials were excluded because time to read the phrases and press the key was less than 500 ms.

Phrase order choice. As shown in Fig. 3, there were clear effects of both length and verb disposition on participants' choice of phrase orders. As in Experiment 1, participants uttered sentences with a heavy-NP shift structure about four times as often in the long NP condition as in the short NP condition, $F_1(1,23) = 21.77$, $p < .001$; $F_2(1,39) = 54.84$, $p < .001$. The effects of verb disposition were also replicated; participants shifted almost twice as often with the NP/S verbs as with NP-only verbs, $F_1(1,23) = 9.48$, $p < .005$; $F_2(1,39) = 15.84$, $p < .001$. Finally, though the NP/S–NP-only difference was larger in the long NP condition, the verb type by length interaction was marginal, $F_1(1, 23) = 3.86$, $p < .10$; $F_2(1,39) = 3.15$, $p < .10$. Overall, the data replicate the theoretically important results of Experiment 1, showing that those findings were not due to the explicit choice requirement.

Ready responses. Although the removal of the explicit choice requirement could make preparation time less sensitive to the processes involved in sentence formulation, the same factors should influence preparation time in this experiment as choice time in Experiment 1. In general, the pattern for mean latencies of ready responses was similar to that of Experiment 1 (see Table 2). As before, we analyzed the overall data, judging the shifted data to be unstable. Preparation time was, of course, longer in the long NP (5772 ms) than the short NP conditions (3727 ms), $F_1(1,23) = 32.38$ $p < .001$; $F_2(1, 39) = 79.32$, $p < .001$. More importantly, verb type also had a significant effect. As in Experiment 1, participants took longer to prepare sentences containing NP/S verbs (5046 ms) than to prepare sentences containing NP-only verbs (4453 ms), $F_1(1,23) = 5.01$ $p < .05$; $F_2(1,39) = 5.82$ $p < .05$. There was also a nonsignificant tendency to interaction between length and verb type, $F_1(1,23) = 3.12$, $p < .10$, $F_2 = 2.33$, $p = .14$. Assuming that the verb type effect reflects the same configuration of decision-making difficulty uncovered in our correlational analysis of Experiment 1, this suggests that competition of the kind we discussed in relation to Experiment 1 was also at work here.

Voice initiation time. Although the structure choice and preparation time findings with the choice and ready procedures were very similar, we expected that relaxation of the explicit choice requirement might reduce the effect of sentence complexity (length) on voice initiation times. Long voice RTs (>3000 ms) and microphone errors were excluded from the voice initiation time data (1.5% of trials). Inspection of Table 2 suggests a rather dramatic difference in behavior in the basic and shifted conditions. However, because the shifted data are based on too few observations, we concentrate here again on the overall data.[2]

In contrast to Experiment 1, there was no main effect of length in the analysis of variance on the overall data. It appears that participants did engage in sentence formulation, as indicated by the sensitivity of "ready" latencies to verb type, but that they were not as committed to an explicit sentence production plan as were the participants in Experiment 1. It may be that participants were committed only to production of the SV phrase at the moment of voice initiation. If so, this gives some support to the idea that the choice procedure of Experiment 1 forced participants to be more committed and less incremental in their planning than they would freely elect to be. Despite this, however, the outcomes in terms of choice of phrase order were remarkably consonant in Experiments 1 and 2. This suggests that the determination of phrase order may occur at a point in sentence formulation at which speakers are only partly committed to the implementation of the resulting structure, a conclusion that is compatible with most sentence production theories (see e.g., Bock & Levelt, 1994).

Though the task in Experiment 2 was less restrictive than that in Experiment 1, it differs from the still less restrictive cued recall procedure of most word-order studies (e.g., McDonald et al., 1993). We were initially disinclined to use a cued or immediate (e.g., F. Ferreira, 1991) recall task to investigate heavy-NP shift, because the difficulty of remembering very long NPs could bias speakers against shifting. However, there is good evidence that even immediate recall captures many of the processes of spontaneous sentence generation (e.g., Potter & Lombardi, 1990). Therefore, to provide a better comparison to other work in the literature, we decided to try a recall task in Experiment 3.

[2] There was again a small interaction between verb type and screen position in this experiment. However, it was in the opposite direction to that observed in Experiment 1. Thus, we judge both effects to be spurious. No interaction with position occurred in Experiment 3.

EXPERIMENT 3: PROMPTED RECALL

This experiment was designed to investigate the effects of length and verb disposition in a cued recall task. Participants again read the phrases on a screen and pressed a button when they were ready to speak. They then received the subject and verb (SV) phrase (e.g., *Janet revealed* from Table 1) as a signal to begin speaking, but the NP and PP had to be recalled from memory. This is quite a difficult task, especially in the long NP conditions, and we did not expect error-free recall. Rather, we were primarily interested in whether the NP or PP immediately followed the SV prompt. Given the robust effects in the previous experiments, we again predicted effects of NP length and verb type on shifting. Note that in this procedure, however, participants could well decide on the fly whether to produce the NP or the PP first, even though they were instructed to plan the order of phrases. The heavy memory demands of the recall task could promote heavy-NP shift by making long NPs more difficult to retrieve, or work against it by shrinking the length of the NPs held in memory. We also expected preparation time to be influenced by verb type and especially by NP length. The prediction for voice initiation time was less clear. On one hand, this experiment required participants to prepare the sentence to be produced more than either of the others. On the other hand, the recall cue is the initial SV part of the sentence. Knowing that this would be available as a prompt could desensitize voice initiation latencies to the degree or nature of preparation.

Method

Participants. Twenty-four University of Southern California undergraduates were either paid or received extra credit in psychology courses for their participation. All were native speakers of English.

Materials and procedure. The same inanimate items as in Experiment 2 were used in this experiment. The stimulus displays and sequence of events in a trial were similar to those of the previous experiments up to the point where participants indicated readiness to speak. At the start of each trial, three phrases appeared on the screen, arranged as in the previous experiments. Participants were instructed to read the phrases, arrange them in a sensible order, and prepare to produce the resulting sentence from memory when cued to speak. Participants pressed a key to indicate when they were ready to begin speaking. As in previous experiments, this keypress was followed by a 1 s blank interval, which was in turn followed by a prompt to begin speaking. However, unlike in the previous experiments, the speaking prompt was not the word GO but rather the Subject–Verb phrase of the sentence, which reappeared in its midscreen location. When participants saw this cue, they were to say the entire sentence from memory as accurately as possible. As soon as participants began speaking, the Subject–Verb phrase disappeared and they completed the sentence as best they could. None of the phrases reappeared on the screen once the prompt disappeared, and the screen remained blank until the experimenter pressed a key recording the order (basic or shifted) in which the sentence had been uttered. The sessions were tape-recorded for later transcription and lasted between 30 and 45 minutes.

Results and Discussion

In addition to the usual dependent variables, we also analyzed the participants' utterances for number of words produced across conditions, based on transcripts of the recorded experimental sessions. In the following analyses, 1.5% of the trials were omitted because time to read the phrases and press the key was less than 500 ms.

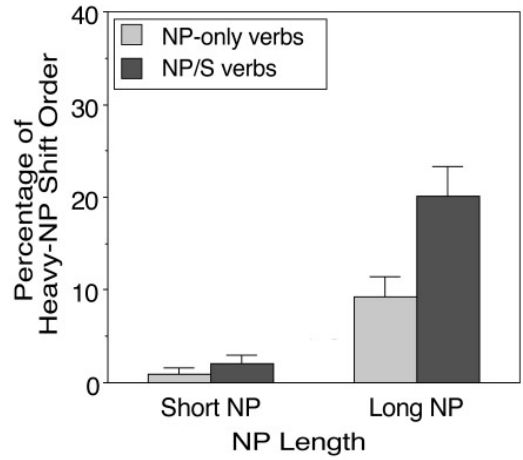

FIG. 4. Production of heavy-NP shifted structures in a prompted recall task as a function of animacy, length, and verb disposition in Experiment 3.

Due to the nature of the task, participants sometimes changed, deleted, or added words to the original stimulus items. In 2.9% of the trials, participants failed to recall any words in one of the constituents (either the PP or the NP). These trials, as well as an additional two trials in which participants produced sentential complement constructions, were excluded from the analyses. Moreover, due to failure of the tape recorder, some trials were not recorded during the testing of some participants, resulting in the loss of an additional 5.6% of the trials in the analyses that were based on the transcripts.

Phrase order choice. As shown in Fig. 4, the overall rate of shifting was lower than in previous experiments, but the pattern of results closely replicated the pattern in the previous studies. Participants shifted about 15% of the time in the long NP condition as opposed to just over 1.5% of the time in the short NP condition, $F_1(1,23) = 25.3$, $p < .001$; $F_2(1,39) = 29.56$, $p < .001$. The effect of verb type also replicated; participants again shifted about twice as often with the NP/S verbs as with NP-only verbs, $F_1(1,23) = 15.06$, $p < .005$; $F_2(1,39) = 8.9$, $p < .01$. Most importantly, the verb disposition by length interaction shown in Fig. 4 was also reliable, $F_1(1,23) = 11.13$, $p < .005$; $F_2(1,39) = 5.03$, $p < .05$.

Number of words produced. The number of

TABLE 4

Experiment 3. Mean Number of Words Produced in the NP (with Standard Deviations), as a Function of the Order Produced, NP Length, and Verb Type

	Short NPs (2 words)		Long NPs (10 words)	
	NP-only verbs	NP/S verbs	NP-only verbs	NP/S verbs
Basic	2.00 (.04)	2.01 (.06)	8.54 (.99)	8.46 (1.21)
Shifted	2.00 (0)	2.00 (0)	8.80 (1.99)	8.77 (1.60)

words produced in each condition was calculated from the transcripts and is shown in Table 4. Corrections, hesitations, and repetitions were not included in word counts. As shifting is strongly influenced by length, we were less concerned with whether the phrases were recalled perfectly accurately than with the number of words that were uttered. For example, for the NP *thirty paintings*, accurate reproduction of this NP would be counted as a two-word NP utterance, as would the slightly inaccurate *twenty paintings*, and *about thirty paintings* was scored as a three-word NP. Participants' productions of the PPs were extremely accurate. Production of short NPs was also very accurate, but long NP production was less so. The table shows that speakers produced a mean of 8.6 words in the long (10 word) NP conditions. This result suggests that the lower rate of shifting in this study may have been influenced by the somewhat shorter NPs actually produced in the long conditions. Importantly, however, these data provide no evidence that the effect of verb type on structure choice is due to the number of words produced in each sentence, as there was no difference in the number of words produced for NP-only and NP/S verbs, F's < 1. As always, the means for the shifted conditions reflect very few observations and should be viewed with caution.

Ready responses. The striking feature of the readiness response data is the very long preparation times in the long NP conditions (see Table 2). These long RTs are evidently due to the additional memory requirements of the procedure, and this pattern yielded a strong effect of NP length, $F_1(1,23) = 48.41$, $p < .001$; $F_2(1,39) = 365.47$, $p < .001$. In addition, there is some evidence of a verb-type effect in the participants analysis, such that ready responses were longer with NP/S than NP-only verbs, $F_1(1,23) = 4.52$, $p < .05$; but $F_2 < 1$. There was no interaction of NP length and verb type, Fs < 1.

Voice initiation time. In this analysis, five trials were excluded due to long voice RTs (>3000 ms) or microphone errors. Initiation times (see Table 3) were generally shorter in this study compared to the previous ones, probably because the first words of the sentence were presented as the recall cue. The short RTs also suggest that speakers were strongly committed to producing the sentence they had formulated and did not take advantage of the possibility of using the SV prompt as a delaying tactic. In addition, participants took longer to initiate speaking in the long conditions (659 ms) than in the short conditions (535 ms), $F_1(1,23) = 32.75$, $p < .001$; $F_2(1,39) = 71.92$, $p < .001$. There was no effect of verb disposition on initiation time, and there were no interactions, Fs < 1. These results thus replicate the effect of length on voice initiation times in Experiment 1 and are consistent with our suggestion that the failure to find this effect in Experiment 2 was due to a lesser degree of explicit planning in that experiment. Experiment 1 ensured extensive planning by having participants make an explicit structure choice prior to speaking, and the present experiment forced planning by requiring that the participants report the sentences from memory, but Experiment 2 had neither of these features. However, as we argued above, this does not mean that participants in Experiment 2 did not engage in the processes leading to determination of phrase order prior to speaking. Rather, it means only that they did not incur the memory commitments con-

sequent on the phrase order decision, relying instead on the reappearance of the phrases to help implement it.

Conclusions. Our reservations about the feasibility of using a sentence recall task to study heavy-NP shift appear to have been unfounded. We again observed separate and interactive verb disposition and length effects on choice of phrase order. The effect of verb disposition on preparation time was not strong, at least by items, in this experiment. However, there was a clear effect of NP length on voice initiation time, indicating that participants were strongly committed to what they would produce on receiving the SV prompt.

GENERAL DISCUSSION

Our findings can be summarized rather straightforwardly. First, the experiments confirmed that the choice of the heavy-NP shifted vs basic order (NP–PP) structure during speech production is constrained by the length of the NP in the verb phrase. Because we manipulated the length of only the NP, our findings do not speak to the issue of whether it is NP length or relative NP–PP length that is important. We merely note that the corpus analyses of Hawkins (1994) and Wasow (1997) favor the latter view. Second, we found that the probability of heavy-NP shift was conditioned by the "shifting disposition" of verbs. Shifting disposition, in turn, appears to be determined by the frequency with which a particular verb has previously been used in structures in which the verb and its complement are not adjacent. Third, decision latencies were sensitive to the shifting frequencies of verbs: Frequently shifted items in Experiment 1 yielded longer decision times in favor of the basic order and relatively short decision times in favor of the shifted order, compared to rarely shifted items. This result suggests that the alternative structures competed for activation during sentence formulation. Fourth, voice initiation times reflect the complexity of an explicit plan for sentence production and the degree of commitment to this plan. Initiation times were longer when the sentences contained long NPs (Experiment 1) and especially when participants knew that they would have to reproduce these long NPs from memory (Experiment 3), but not when an explicit commitment to produce the NP in a particular sentence position was not required (Experiment 2). Fifth, the animacy of the noun in the prepositional phrase had little or no effect on the choice of phrase order or on preference for shifted vs unshifted structures in the rating task (Experiment 1). This is consistent with McDonald et al.'s (1993) conclusion that animacy influences grammatical function assignment but not word order per se.

A remarkable feature of the data is their consistency across several different task variations. The determinants of shifting were the same, independent of whether speakers committed in advance to producing the NP and PP in a particular order (Experiment 1), merely indicated readiness to speak the sentence (Experiment 2), or prepared to reproduce the NP and PP from memory (Experiment 3). In addition, rated preferences for shifted and unshifted sentences (Experiment 1) patterned like the production data. This consistency can be interpreted in two ways. It can be argued that all of the tasks reflect a late "postsyntactic" editing process of a kind that is likely to be exercised in deliberate writing more than in spontaneous speech. Alternatively, it can be argued that all of the tasks reflect the processes that give rise to heavy-NP shift in spontaneous production. In this view, heavy-NP shift is not a mere stylistic nicety but instead reflects fundamental processes of sentence formulation. Although we acknowledge that both interpretations are currently sustainable, we suggest that to the extent that the verb disposition hypothesis is supported, the balance of plausibility favors the fundamental process view. This is because there is no obvious mechanism in the postsyntactic editing account that could account for the kind of detailed sensitivity to the history of prior use that is implied by the verb disposition hypothesis. We now discuss some of the more salient outcomes and implications of our findings in more detail.

Word and Phrase Order

We observed a strong effect of NP length on the probability of choosing the shifted PP–NP

phrase order. In contrast, McDonald et al. did not find effects of word length on word order. This seeming discrepancy is not surprising, however, if word and phrase length effects arise at different stages of production, as indeed they appear to do. In standard theories of sentence production, phrase ordering should occur at an early stage, before the phonological properties of words become fully available, so that it should be sensitive to aspects of syntactic–prosodic planning that precede retrieval of word phonology. Earlier we suggested that the most likely locus is late in the functional or very early in the positional substage of grammatical encoding (e.g., Bock & Levelt, 1994), and certainly preceding determination of word order and phonological encoding. This implies that the "heaviness" of a long noun phrase must be assessed in terms of conceptual, syntactic, or prosodic complexity rather than in terms of the length in phonological units of the words that comprise it. In support of this conclusion, initiation times of prepared utterances are sensitive to complexity as indexed by number of words, but not to word *length* per se (see Sternberg et al., 1978). Further, when utterance length is held constant, number of phonological words rather than length in units below the level of the phonological word determines initiation time (Wheeldon & Lahiri, 1997). Thus, to paraphrase Ross (1967) and McDonald et al. (1993), word and phrase ordering may pertain to different parts of the syntactic world.

Verb Disposition

The claim that speakers have access to information concerning how frequently a verb has appeared in a syntactic structure is broadly compatible with current approaches to production in which sentence construction is lexically driven (e.g., Bock, 1987b; Bock & Levelt, 1994; Levelt, 1989), but it has not been explored in detail in the production literature. By contrast, contingent frequency information—the frequency with which a word appears in a particular syntactic context—has become increasingly important in theories of sentence comprehension (MacDonald et al., 1994; Tanenhaus & Trueswell, 1995). For example, MacDonald et al. (1994) suggested that the representations of verbs include information about how frequently a verb has appeared in different environments, including alternative tenses, active vs passive voice, and alternative argument structures such as taking an NP complement vs an S-complement. They assumed that the frequency information is represented via weighted links to representations in the lexicon, (e.g., a verb that is typically used in the active voice would have a strong link to the "active" representation and a weak link to the "passive" representation, whereas a verb that is used more often in both voices would have more even links to each representation of voice). The weights on these links determine the extent to which alternative interpretations, such as active and passive, will be activated when a verb is encountered.

Although properties of individual verbs have not received much attention in the production literature, the work presented here is part of a growing body of research that investigates the effects of verbs on choice of syntactic structure (e.g., F. Ferreira, 1994; V. Ferreira, 1996). These other studies differ from the present one in that they interpret effects as a function of whole classes of verbs, such as alternating datives (V. Ferreira) and theme-experiencer verbs (F. Ferreira), whereas we have suggested that an individual verb's history influences production. At this point, our data are still open to a verb-class explanation: There could be something special about NP/S verbs as a class that makes them more likely to shift than NP-only verbs. For example, the fact that NP/S verbs have multiple argument structures (taking both NPs and S-complements) might somehow make these verbs more amenable to shifting, or perhaps the fact that NP/S verbs form a coherent semantic class, typically expressing cognition or communication of knowledge, might cause these verbs to shift more than NP-only verbs. Hypotheses of this sort would not entail any claim that the frequencies of syntactic configurations into which they enter are represented with individual verbs. Conversely, previous results that have been interpreted to indicate verb class effects (F. Ferreira, 1994; V. Ferreira, 1996) could be given an individual-verb interpretation. Additional research is necessary to

determine which alternative is preferable for any of these findings.

Assuming for now that structural frequency is represented with individual verbs, it will be important to account for why some verbs tend to occur more often in nonadjacent structures than others. There may be several different explanations for these frequency differences. These include the increased opportunities that NP/S verbs have to appear in nonadjacent structures, compared with NP-only verbs. Moreover, some verbs may tend to appear with long NPs, or prosodically prominent NPs, or NPs that typically convey new information, so that they have participated in heavy-NP shift more than other verbs. Ultimately, we would like to be able to provide a complete account of the factors that promote shifting in the majority of environments. However, our current proposal merely states that whatever these factors may be, the history of nonadjacent structure usage is represented with individual verbs, and this history affects the extent to which a verb will engage in heavy-NP shift. The fact that these preferences, acquired in other contexts, were expressed in our experiments even though participants were provided with sentence ingredients and therefore knew they were dealing with an NP structure, appears to be rather strong evidence of the force of the verb effects. This, in turn, suggests that knowledge of what constituents may be deferred, regardless of the reason, is of vital interest to speakers. Heavy-NP shift may provide a particularly sensitive test of the verb disposition hypothesis because it involves an ordering preference independent of syntactic role assignment, so that verb preferences may be less constrained than in other contexts.

Our claims for the importance of nonadjacency bear some similarity to Wasow's (1997) observations concerning collocations between verbs and PPs. Wasow suggested that the frequency of shifting rests in part in the frequency of V–PP phrases such as *keep in mind* and *take into account.* In other words, Wasow proposed a frequency-based account focusing on the adjacency of the verb and PP, in contrast to our nonadjacency hypothesis. We do not doubt that the frequency of co-occurrence of adjacent phrases plays an important role in production; for example the frequent production of collocations such as *keep in mind* could make the PP *in mind* quite accessible when the verb *keep* is readied for production. There also appears to be a definite role for nonadjacency in shifting, however. A simple adjacency approach predicts that optionally intransitive verbs, such as *run, move, walk, drive,* etc., which frequently occur adjacent to PPs such as *to the store,* should have a disposition to shift by virtue of the frequent V–PP co-occurrence. The nonadjacency account does not make this prediction, because the V–PP sequences in intransitive sentences such as *Mary walked to the store* do not contain the requisite nonadjacent verbal complement. In other corpus based work (MacDonald et al., 1998), we have found that optionally intransitive verbs appear in shifted structures extremely rarely, suggesting that the mere co-occurrence of verbs and adjacent PPs does not fully determine a verb's shifting disposition.

Competition in Production

While we do not deny the important role of accessibility of constituents such as NPs in the choice of syntactic structure, our data point to a clear competitive component in the ordering of constituents as well. The competition in this case is tied to individual verbs, specifically the frequency with which each verb participates in the adjacent-complement and nonadjacent complement structures. On this view, verbs that rarely appear in nonadjacent structures engender little competition between alternatives, whereas verbs that more frequently appear in nonadjacent structures should engender partial activation of the alternative structures and the potential for competition among them. Competition should have two results: (a) effects on decision times and (b) greater sensitivity to contextual factors that might promote one or the other structure. We see (a) in the effects of verb disposition on preparation time, especially in Experiment 1, where verbs with stronger shifting dispositions yielded longer decision times for the basic order and relatively short decision times for the shifted order compared to verbs with weaker shifting dispositions. One can see

result (b), greater sensitivity to context, in the interaction between verb disposition and NP length in our choice data and also in F. Ferreira's (1994) data. The theme-experiencer verbs tested in Ferreira's study have a higher frequency usage in the passive voice than simple transitive verbs. The manipulation of another factor, subject NP animacy, had a greater effect on choice of active vs passive syntactic structure for the theme-experiencer verbs than for the simple transitive verbs. We attribute the theme-experiencer verbs' sensitivity to animacy to the partial activation of the active and passive voice for these verbs. The simple transitive verbs, by contrast, have little activation of the passive voice and therefore the animacy manipulation did little to promote the use of passive structures with these verbs. This result is strongly reminiscent of verb–context interactions in language comprehension, in which the degree to which contextual manipulations, such as noun animacy, affect syntactic ambiguity resolution varies as a function of the ambiguous verb in the sentence, specifically the frequency with which the verb participated in alternative syntactic structures (Garnsey et al., 1997; MacDonald, 1994; Trueswell, Tanenhaus, & Garnsey, 1994).

The evidence of competition also makes predictions for two different kinds of speech error. Analyses of speech errors (e.g., Garrett, 1975, 1988) have generally operated within the framework of canonical phrase orders and so provide little guidance in theorizing about the specific case of heavy-NP shift. However, Arnold et al. (1997) have plausibly suggested that speech disfluencies may be diagnostic of sentence formulation difficulties that could result in heavy-NP shift. In addition, our verb disposition findings make a specific prediction for another well known class of speech error, whole word exchanges. Exchanges between same category words (e.g., nouns, adjectives, etc.) should be proportionate to the degree of competition between the phrases to which they belong in syntactic planning. For example, exchanges between NP and PP nouns should be more frequent following the frequently shifted NP/S verbs than following NP-only verbs. A similar suggestion has recently been made by V. Ferreira (1996), who analyzed experimental errors predicted by incremental and competitive processes. Although V. Ferreira concluded that the error patterns did not favor the competition view, we note that there were very few errors in his dative alternation experiments. In addition, the syntactic choices in V. Ferreira's experiments involved role assignment, not the role-independent phrase ordering that is the hallmark of heavy-NP shift. Therefore, it remains to be seen whether our conjecture finds support in existing speech error corpora and in future experiments.

In conclusion, we suggest that the emphasis on incrementalism in some recent theorizing on sentence production may need to be tempered by a clearer recognition of the role of competition at the level of structure selection and phrase ordering in sentence planning. We believe that this role is important, but exactly how important remains to be seen. It is possible that heavy-NP shift, by virtue of its independence from syntactic role assignment, is especially sensitive to competition between relatively free syntactic phrases for insertion into syntactic plans. Thus, other syntactic choices may not engender competition to the extent that heavy-NP shift appears to do. Focus on the properties of individual verbs, rather than, or in addition to, properties of entire verb classes, will be essential in further refining our understanding of the extent to which competitive mechanisms contribute to syntactic processes in production. Finally, though our findings suggested that word and phrase ordering occur at different stages of syntactic planning, our analysis also points to a more general conclusion with implications for between-language comparisons: The need for competitive processes at the syntactic level of production should be a direct function of the extent to which the order of both words and phrases is free.

APPENDIX

The following items include the subject NP, the NP-only and NP/S verbs, the long (and short) NPs, and the animate/inanimate PPs, respectively. Each verb pair was used in two sentences. The set of numbers following each item correspond to the amount of shifting that occurred when the item was presented with the NP-only verb and with the NP/S verb, respectively.

1. The manager presented/exhibited the new line of bright summer beach and resort fashions (the styles) to Jill/at noon. 4/4

The contractor presented/exhibited the plans for a lagoon and waterfall with red clay (the display) to Jamie/in July. 3/3

2. Mary returned/mentioned the used car ad for a Chevrolet with low mileage (the ads) to Frank/at tea. 1/8

Mark returned/mentioned the flyers for some lectures and slide shows on campus (some flyers) to Julie/very quickly. 2/11

3. The dealer transported/demonstrated a brand new speedy silver sports car with chrome bumpers (a car) to Kate/at ten. 2/3

The manager transported/demonstrated the new sports line of running shoes and bicycling gear (sports gear) to Jim/at three. 3/3

4. Robert relinquished/proposed one round trip plane ticket from New York to Atlanta (plane tickets) to Lizzy/last semester. 2/3

Donald relinquished/proposed some great front row center seats for the last performance (the drafts) to Cole/with joy. 4/8

5. Jake released/explained all of the facts for the import and export taxes (the figures) to Carol/on Friday. 2/6

Brian released/explained all of the answers on the twenty point English quiz (the quiz) to Ralph/at lunch. 3/6

6. Alex described/indicated each of the key points of conflict in an interview (the offer) to Curtis/in detail. 11/7

The woman described/indicated the best routes to the Santa Monica beach and pier (the route) to Tom/by phone. 3/9

7. The lawyer distributed/acknowledged each piece of the evidence in the tax fraud cases (the dividends) to everyone/with confidence. 4/6

The editor distributed/acknowledged the first drafts of a long article and book review (the details) to Bonnie/at supper. 1/0

8. The president introduced/announced the new vice chair of the first corporate finance group (the captain) to Simon/on Monday. 1/6

The teacher introduced/announced some hard math concepts for the one hundred point final (the test) to Kim/with care. 3/7

9. Judy delivered/suggested a gorgeous red and black silk dress with sparkling sequins (a dress) to Ann/in March. 2/3

Todd delivered/suggested a large package with lots of presents for small children (the gifts) to Al/at once. 4/7

10. Shelly carried/disclosed top secret plans for a large fleet of defense missiles (the notes) to Bev/in May. 3/3

The woman carried/disclosed the birth and school records of the three young children (the records) to Nina/in August. 2/3

11. David furnished/reported the facts on the strange bank robbery crimes in Utah (the facts) to Will/with hesitation. 1/4

Jessica furnished/reported the awful news of the refugees in the Far East (the news) to Kris/last summer. 0/3

12. Steven addressed/communicated a seven page letter with many details of the trip (a letter) to Leslie/during break. 2/5

Raymond addressed/communicated a five page plan of withdrawal for the allied troops (a memo) to Sarah/very loudly. 3/3

13. Sam donated/recommended an old treasure chest with some silver and gold trinkets (a treasure) to Alan/on Sunday. 1/5

The generous man donated/recommended some used toys, winter clothing, clean linens, and snow boots (some clothes) to Keith/in person. 0/8

14. Janet transferred/revealed some more specific plans for a brand new defense plant (the graphs) to Leigh/at dawn. 1/4

Bobby transferred/revealed the short documents to the old mansion on the hill (the deeds) to Joe/at dusk. 1/5

15. Kathy recited/dictated all three verses from an old and famous French poem (the poem) to Peter/last night. 1/0

Mike recited/dictated the words to a popular country song in the South (the words) to Ron/last year. 2/3

16. Amy forfeited/broadcasted the high school girl's state swimming title in New York (the game) to Jan/last week. 0/4

Jason forfeited/broadcasted all of the winnings for the past seven horse races (the race) to Jeff/with glee. 0/5

17. Josh dispatched/conveyed a short mes-

sage on the dangers of the current storm (a message) to Michelle/at breakfast. 1/3

Brad dispatched/conveyed the instructions for the safest route to the old town (the thoughts) to Luke/at nine. 3/2

18. The teacher narrated/confessed each of the series of events in the secret case (the events) to Rachel/with caution. 5/7

Matthew narrated/confessed the whole story on the defects in the new Mazda (the story) to Kenny/in secret. 2/9

19. Tim contributed/stated the small reward for helpful clues on a recent crime (the reward) to Kelly/with reluctance. 4/9

Bob contributed/stated the earnings of the five winners in the poker games (the earnings) to Ian/with pleasure. 3/8

20. Ed entrusted/muttered a script for a suspense film with a giant budget (a script) to Fran/at brunch. 1/1

Angie entrusted/muttered the plan for the biggest poster in the science fair (the plan) to Mel/with hope. 5/9

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