This is to certify that the

dissertation entitled

Association with Focus in Denials

presented by

Douglas Jeremy Davidson

has been accepted towards fulfillment
of the requirements for

Doctor of Philosophy degree in Psychology

Lore T. Tasks
Major professor

Date May 2, 2001

| DATE DUE | DATE DUE | DATE DUE |
|---|---|---|
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |

# Association with Focus in Denials

By

*Douglas J. Davidson*

A Dissertation

Submitted to
Michigan State University
in partial fulfillment of the requirements
for the degree of

Doctor of Philosophy

Department of Psychology

2001

# Abstract

## Association with Focus in Denials

By

*Douglas J. Davidson*

Prosody is usually understood to convey the distribution of focused and presupposed information: New information is accented, while old information is deaccented. For example, in question-answer pairs, the constituent corresponding to new information in an answer to a WH-question is commonly accented. Past phoneme-monitoring experiments suggest that listeners allocate more attention to new information, as listeners are faster to monitor for phoneme targets in the locations of new information in answers predicted by preceding WH-questions, for example.

Not all pitch accents mark new information, however. Narrowly focused denials can be focused in a variety of locations, and in addition, such denials have a more restrictive interpretation than broadly focused denials. Semantic theories in generative grammar have accounted for this by proposing that negation associates with focus, potentially activating a contrast set consisting of the affirmative form of the denial with the focused constituent replaced with a variable. Previous work has shown that listeners can use contrastive accent in imperatives to construct such a contrast set.

If listeners construct contrast sets during the interpretation of denials, they may use this information during the interpretation of counterassertions that follow the denial, analogous to the way that listeners interpret the relationship between a question and an answer.

A series of phoneme-monitoring experiments are reported demonstrating that listeners use an intonationally or syntactically-signaled focus in a denial to direct their attention to alternatives present in a counterassertion following the denial, at least with respect to early parts of the counterassertion. A judgment experiment demonstrated that the effect observed in the phoneme-monitoring experiments is not restricted to early portions of the counterassertion. The results of these experiments support the role of focus in denials in directing the attention of listeners to potential alternatives.

For my parents, Curt and Janet Davidson.

# ACKNOWLEDGMENTS

I would like to thank my committee, Rose Zacks, Fernanda Ferreira, Cristina Schmitt, and Alan Munn for the comments and criticism that they provided for this dissertation. Audiences at CUNY in Philadelphia, the Beckman Cognitive Science Group at UIUC, and the Cognitive Reading Group at MSU provided many valuable and helpful comments. I would also like to thank Kristina Pecora, Karl Bailey, Kate Arrington, Vicky Ferraro, and Sarah Burnett for lending their voices for the experiments reported here.

I would especially like to thank Rose Zacks for providing support and advice during my time in the Cognitive Aging Lab. I greatly admire her standards of professionalism and compassion for her students. I would also like to thank Fernanda Ferreira for sparking my interest in psycholinguistics, and for supporting me during my time in the Psycholinguistics and Visual Cognition Lab. Alan Munn and Cristina Schmitt introduced me to generative grammar, and I will always be thankful.

I am deeply grateful for the friendship of my fellow graduate students in the BBC, on both the cognitive and the neuroscience sides. It is safe to say that you would not be holding this dissertation in your hand if not for the support, council, and cheer of

Kate Arrington, Karin Butler, Carrick Williams, Richard Falk, and Colleen Novak. Karen and Carrick, in particular, have had to put up with having a psycholinguist for an office and lab mate (beware the psycholinguist asking for acceptability judgments). Kate and Richard kept me sane while I was writing my proposal, as well as providing one extremely well-timed pitcher of margaritas. Colleen's sense of humor saved me from despair on too many occasions to count. I thank them all.

Finally, I would like to thank my parents and family for their support. I could not have done this without them, and I dedicate this dissertation to them.

# Table of Contents

# List of Tables

# List of Figures

# 1 Introduction

By now it has been established that during sentence comprehension, the prosody of a spoken utterance is used during a variety of comprehension processes. A consensus of four reviews of the role of prosody in comprehension published in the last decade is that prosodic information is used during processes of speech segmentation, word recognition, syntactic parsing, and discourse integration (Shattuck-Huffnagel & Turk, 1996; Warren, 1996; Cutler, Dahan, & Donselaar, 1997; Cutler & Clifton, 1999). Although this work has shown that the use of prosody can affect lexical, syntactic, and discourse-level processing, less research has examined how prosodic information is used to convey semantic information. This dissertation aims to establish such a role by examining how a phenomenon known as *association with focus* operates to convey information structure.

The case with which we will be concerned is the association of a negative operator such as *not* with an intonational pitch accent, as in (1), where the accent is indicated by capitalization.

(1) John didn't call the CANDIDATE a liar.

The intuition many observers have about examples such as this is that something specific is being denied. A speaker producing (1) is denying that a person named John has called a certain candidate a liar, while leaving open the possibility that John called someone else other than the candidate a liar. While this observation is not a new one (within psycholinguistics, work such as Clark (1974), and Kintsch (1974) has suggested this in the past), it will be argued that there are important

implications of this phenomenon for how people use information structure during spoken language interpretation. Specifically, it will be argued that current accounts of how information structure is used during dialogue interpretation need to provide a role for association with focus in order to adequately account for how listeners allocate attention across utterances.

It should be noted at the outset that association with focus is a general grammatical relation. There are a variety of so-called focus sensitive operators, such as *only*, *even*, or *always*, that are similarly sensitive to focus placement. Also, this phenomenon is not specific to English, as it has been hypothesized in a variety of languages, and is expressed in a variety of grammatical constructions. As will become clear below, however, English denials are a particularly good candidate for this investigation because a significant body of work already exists detailing how negative sentences are understood.

The structure of the dissertation is as follows. Chapter 2 outlines historically important psycholinguistic research on intonational focus, negation, and information structure. This chapter starts with an outline of a general set of principles for semantic interpretation, more generally known as the "matching model" developed by Clark and his colleagues. This classical model underlies nearly all work that has followed it on negation, question-answering, and information structure in psycholinguistics –including the widely known given-new contract (Clark & Haviland, 1977). Following that, I will suggest that there is a problem with the conception of focus in the matching model, as it applies to denials. I will introduce a different view of focus interpretation that can handle this problem, adapted from Rooth's (1985, 1992)

theory of alternative semantics from the formal semantics literature in linguistics, and Cutler's (1976) psycholinguistic work on intonation and attention. Chapter 3 reviews the linguistic literature relevant to the matching model and to alternative semantics. The central idea of both of these chapters is that listeners use intonational accent to associate a focused constituent with negation, and also to construct an implicit contrast set where alternatives to the focused constituent are considered relevant to its interpretation. Four experiments are then reported that test various aspects of this claim. In the experiments, listeners monitored or made judgments about various sequences of assertions, denials, and counterassertions with varying prosody. The first three experiments use a task adapted from prior work by Cutler and Fodor (1979) originally used to investigate focus in question-answer pairs. These three experiments were designed to show that listeners can use a focus of a denial to make predictions about the type of replacement that could follow in a counterassertion, somewhat like the way that listeners can use the information in a question to make predictions about the type of answer that could follow. The fourth experiment was designed to provide converging evidence for the results of the first three experiments. It used a sentence judgment task where subjects judged whether a visually-presented sentence logically followed from two previous spoken sentences. This task was originally used by Johnson-Laird and Tridgell (1972) in a study of the difficulty in processing negation. Taken together, the experiments show that listeners selectively interpret focused denials based on where pitch accents are placed, and use this interpretation to direction attention to possible alternatives.

## 2 Background and Significance

It is worth considering the earlier example in more detail. Consider the same denial (2), repeated from (1), but without the focus.

(2) John didn't call the candidate a liar.

Without a narrow focus to pick out to what the negation is applying, there are multiple interpretations possible. The speaker might be suggesting that someone other than John called the candidate a liar. Or that John did not "call" the candidate a liar, but instead did something else to suggest this. Or that John called someone other than the candidate a liar. Or that John called the candidate something, but it was something other than a liar. In short, there are multiple states of the world that would be consistent with this negative sentence when there is no focus to determine to what the negation is applying. For example, (2) would be true in a model where John called the candidate a thief, or in a model where Mary called the candidate a liar, etc.

The same sentence, with narrow focus placed on one of its constituents, does not have as many possibilities.

(3) a. JOHN didn't call the candidate a liar... Mary did.

b. John didn't CALL the candidate a liar... he only suggested it.

c. John didn't call the CANDIDATE a liar... he called the press secretary a liar.

d. John didn't call the candidate a LIAR... but a thief.

With a narrow focus, the negation applies to a restricted part of the utterance, and there are fewer alternative expectations that one might have about what actually happened, in contrast to what has been denied. This selectiveness contrasts with the usual logical analysis of the meaning of negation, common to both model-theoretic semantics and cognitive psychology, in which negation is viewed as a simple operator that combines with a predicate (or sentence) to reverse its polarity or truth value.

However, the above observation is about representation, not processing. A psychologically adequate account of denials must describe how listeners process negation and focus, in addition to how they represent it. There are two major accounts that are directly relevant: The matching model account, developed by Clark; and an attentional shift account, developed by Cutler.

## 2.1 The Matching Model

The matching model (Clark, 1974; Clark & Haviland, 1977; summarized in Clark & Clark, 1977) is a general proposal about how listeners manage various information sources in contextualized utterances, including information about semantic content (e.g., a propositional representation), and information about how each utterance relates to the meanings of previous utterances (e.g., information structure). The matching model is important because it serves as the basis for nearly all models of negation processing, question answering, and information structure processing that have followed, including data from tasks such as sentence matching, question answering, and

sentence-picture comparison. The model proposes that there are three basic processing components involved in any situation where a listener hears an utterance and must respond to it, as in a dialogue. First, listeners identify several types of information in an utterance —the type of speech act encoded in the utterance, the propositional content of the utterance, and markers for information structure. Second, listeners search memory for information that matches given information in the utterance, based on the propositional content and the information structure. *Given* information, in this account, refers to information that has already been mentioned explicitly in the dialogue. *New* information is information that has not yet been mentioned. Depending on the speech act, listeners who are participating in a dialogue then perform different actions in response to the utterance. If the utterance is an assertion, for example, they might simply record the new information in memory in the context of the given information. If the utterance is a WH-question, they could retrieve the requested information and compose an answer. If the utterance is a request or an imperative, they may decide to carry out the action to comply with the request.

The "matching" aspect of this model has been the most heavily investigated. Experiments have shown that when immediate context provides an easily-matched antecedent for information marked as given in an utterance, sentences are more easily understood (Haviland & Clark, 1974). In cases where listeners must instead infer a relationship between information marked as given and what has been provided as context, listeners take longer to understand the utterance (e.g, when listeners have to decide that *the beer* refers to previously mentioned *picnic supplies*, (Haviland & Clark, 1974)). These data patterns follow from the matching model's assumptions

because memory search proceeds more quickly if antecedents are readily accessible (e.g., if a direct match is possible), compared to the case where the relationship must be inferred.

Note that if an utterance is an assertion, listeners might also reject it as mistaken, rather than simply recording the information. In this case, the matching model proposes that they search memory using the given information in the assertion, and compare what they have in memory with what has been asserted, and decide which is correct based on the match. Below, a more detailed description of this process is provided, including how the matching model applies to negation, as well as information structure in question-answering.

### 2.1.1 Negation

Current psycholinguistic accounts of how denials are understood are based primarily on the classic research on written negation conducted in the early 60's and 70's by Clark, Wason, and colleagues (Clark & Chase, 1972; Clark, 1974; Wason, 1959, Wason, 1965; Wason & Johnson-Laird, 1972; Just & Carpenter, 1976; Just & Clark, 1973; also Clark & Clark, 1977). This research has most often used tasks such as sentence truth-verification, sentence-matching, or sentence-picture matching to test how negative sentences are understood. In all of these tasks, a single sentence is presented, and the task is to decide whether the sentence is true or false based on common knowledge, another sentence, or whether the sentence matches a picture. One of the main results of this work is that both negation and truth value have effects on the time required to verify a statement: Negative sentences ($N$) take longer

to verify than affirmative sentences ($A$), and false sentences ($F$) are harder to verify than true ones ($T$). Also, many studies have observed an interaction between negation and truth value. Falsity increases response times for affirmative statements, but it decreases response times to negative statements. Thus, a ranking of verification times is usually observed: $TA < FA < FN < TN$. Theories of negation processing try to account for this ranking, and the success of the matching model rests on its ability to capture this pattern.

Clark's (1974) account is based on his principle of congruence (Clark, 1969). The principle states that for these tasks, people construct common-format semantic representations of the sentences and/or the pictures, and compare the two representations in order to make them congruent with each other. In tasks such as verification, this comparison process results in a value for a truth index, and subjects are assumed to use this truth index as input to a response mechanism for answering yes or no. In tasks such as question-answering, subjects use the result from the comparison operation to determine the answer.

The process of denial interpretation is divided into two parts, one concerning the negation itself, and one concerning the positive form of the negative expression (Clark's "supposition"). For example, in a denial such as *Jane didn't leave*, the negative component would be the negative operator *not*, and the supposition would be *Jane left*. In Clark's model, listeners are hypothesized to perform two steps (illustrated in Table 1). First, they compare the representation of the supposition to a representation of the comparison target (either another sentence, a picture, or semantic knowledge). This comparison is assumed to be between two propositional

1. Check whether the supposition matches a memory (or visual) representation of the target.
   a. If there is a match, the truth index stays 'true'.
   b. If there is a mismatch, change the truth index to 'false'.
2. Process the negation if present.
   a. If the supposition is true (case 1a), change the truth index to false.
   b. If the supposition is false (case 1b), change the truth index to true.

Table 1: Matching Model for Negation

representations (one of the sentence, and other of the picture or already-known semantic knowledge); if they mismatch, the truth index is changed. Then the negation (if it is present) is processed, so that the truth index is changed from whatever result was obtained in the first comparison. The basic assumption of the model is that it is computationally costly to change the truth index —either in response to a mismatch between representations, or in response to the negation. An additional assumption of the model is that the truth index is always initially true, by default.

The matching model accounts for the response time ranking in the following way. The assumption that the truth index is always initially true means that there will always be a fixed cost to processing negation because the truth index must always be changed in that case. This accounts for the observation that negatives generally take longer to verify than affirmatives on most tasks. False negatives will be faster than true negatives because in false negatives, the supposition is a true fact, and this is matched to a memory representation quickly, leaving negation as the only cost. In true denials, there is a mismatch between the false supposition and what a listener has in memory, and the resolution of this mismatch takes time. In both false negatives and true negatives, the truth index is changed by the negation, but in the $TN$s the

additional time necessary to overcome the mismatch of the false supposition and the contents of semantic memory takes extra time. This accounts for the ranking. Empirically, the cost of processing negation is large by most current experimental standards for reaction time studies. One estimate puts the cost of negation at over 1/2 s over affirmative-form statements, estimated from a set of similar picture- and sentence-matching tasks (Chase, 1978).

For present purposes, it is important to observe that Clark's model of denial interpretation is based on two principles: (i) in tasks such as verification or question answering, semantic representations are matched to each other, and mismatches are harder to resolve than matches, and (ii) negation itself is computationally costly.

There is at least one case, however, where the cost of processing an affirmative statement has been observed to be greater than processing a negative. Johnson-Laird and Tridgell (1972) had subjects listen to pairs of sentences such as (4) or (5), and decide what followed from the pair.

(4) Either John is rich or intelligent.

John is not rich.

(5) Either John is either rich or intelligent.

John is poor.

Subjects were faster to produce *John is intelligent* following (4) compared to (5), by approximately 1.5 s, on average. This result is striking, because it contrasts with the vast majority of the literature showing that negative statements take more time to process than affirmative-form statements. On closer inspection, however, the

data are consistent with the matching model. As Johnson-Laird and Tridgell (1972) pointed out, to understand that one statement denies another statement, the aim is to establish inconsistency between them. This is easiest when one statement is the explicit negation of the other, because the two statements can be easily matched, except for the negation. When the affirmative form of the denial is used, it is more difficult to compare the denial to the initial disjunction because there is less lexical overlap. Subjects must infer that *poor* corresponds to *not rich* for example, somewhat like the case where readers deduced that *the beer* corresponds to *picnic supplies* in Haviland and Clark's work on the given-new contract.

Johnson-Laird and Tridgell (1972) proposed that negation is easier to process in this case because the task corresponds to how negation is typically used: To deny a previous misconception or misunderstanding (Wason, 1965). Note that in a dialogue context, a denial would not normally appear by itself, as in the single-sentence judgment experiments, but would more likely appear in response to some previous assertion, as in Johnson-Laird and Tridgell (1972). This previous assertion would therefore correspond to the *supposition* in Clark's negation model. It would be present in memory, as a part of the dialogue record (similar to the task used in Johnson-Laird and Tridgell's study). Since it would be present in memory it would therefore correspond to *given* (e.g., already mentioned) information.

### 2.1.2 Information Structure

The term *information structure* has been used in a variety of ways to describe how utterances update the information state of listeners in dialogue processing or text

processing. Specifically, it has been used to describe the prosodic, structural, and semantic properties of utterances as they relate to the dialogue status of their context, the actual or attributed attentional states of the dialogue participants, and the participants' prior and changing knowledge, beliefs, intentions, expectations, etc.

The role of information structure in sentence processing can be most easily illustrated by considering how questions are interpreted. The basic components of question answering are basically agreed upon in the psycholinguistics literature. Singer's (1986) model for example, is representative, and includes components for parsing, propositional encoding, question-type categorization (i.e., the type of information or action requested), a memory-search process, a comparison process between retrieved information and the encoded proposition, and a response formulation component. In this model, listeners encode a question in propositional form annotated to identify information structure. The WH-term of a question is assumed to be represented as a variable and the rest of the question represents given information. So, for example, a question such as (6a) below would be represented as *Jane invited x to the party.* Once encoded, the part of the semantic representation marked as given is used as a memory retrieval query, and information corresponding to the *new* part of the utterance (the WH-term) is retrieved. A response is then generated based on what has been retrieved. This model is based primarily on the matching model, and has been shown to be empirically successful in a variety of experimental studies. Information structure plays the role of partitioning the question into given and requested information. Note that the relationship between a WH-question and its answer is semantic: The meaning of the WH-term and the structure of the question, as well as the relation-

ship between the two propositions in the question and the answer, determines what is given and what is new.

It is also known that prosody has a role in signaling information structure in question-answer pairs, particularly in indicating new information. In English, intonation can be used to highlight or make salient some part of an utterance by means of a pitch accent aligned with the stressed syllable of a word within a syntactic phrase. This use of pitch has been shown to affect the ease with which listeners interpret spoken utterances, and it does so in a way that is consistent with the matching model. For example, in cases where a speaker answers a question like (6a) with an answer like (6b), an accent will be placed on the constituent in the answer corresponding to the WH-questioned constituent in the question. Answers spoken with an accent on other constituents, like (6c), are judged to be infelicitous (Birch & Clifton, 1995).

(6) a. Who did Jane invite to the party?

b. Jane invited BILL to the party.

c. JANE invited Bill to the party.

New information carries novel information (not recoverable from a previous utterance), and a focused phrase reflects this status. As previous sections have outlined, Clark and Haviland (1977; also Haviland & Clark, 1974), suggested that listeners understand utterances by matching given information in an utterance to information already represented in memory, and adding the new information to this representation. Thus, the role of intonationally-signaled focus in this process is to designate

new information. In general support of this proposal, research has shown that comprehension is easier when new information is accented and given information is not accented (Nooteboom & Kruyt, 1987, Terken & Nooteboom, 1987). Focus can affect lexical retrieval (Blutner & Sommer, 1988) and enhance the relative accessibility of concepts (Gernsbacher & Jescheniak, 1995; Gernsbacher & Shroyer, 1989).

Later developments of Clark's matching model, based on an interpretation of work by Hornby (1972), provide a role for information structure in the processing of negatives, as well. Clark and Clark (1977) proposed that negation associates with new, but not given information in a denial. Their model is best described by considering how a listener would process a denial like (7).

(7) JANE didn't call Bill a liar.

In the revised Clark model, listeners are hypothesized to represent the denial as a supposition plus negation, as before, but also partition the supposition into given and new information. Clark and Clark assumed that emphasized or clefted constituents would be marked as new information.

(8) supposition: S=Jane called Bill a liar

negation: Neg(S)

new = Jane

given = $x$ called Bill a liar

During interpretation, memory is first searched for information matching the given information (e.g., *x called Bill a liar*; this is Clark's "antecedent"). In addition,

an expectation is formed about the value of the variable $x$ in this stored memory representation. The expectation is that the variable will have a value equal to what has been expressed in the denial itself (e.g., *Jane*). It is important to note that this expectation concerns the to-be-found representation stored in memory, as in (9), not the representation of the denial itself (which the listener is using as the basis for the memory query). [1]

(9) expect-to-find-in-memory: $x$ = Jane

If this value is found when memory search is completed, listeners then apply the negation to the new information in the representation of the sentence and record this negative information (10) in memory.

(10) $x \neq$ Jane

This development of Clark's model was intended to account for an intuitive observation about denials. Namely, denials are typically used to deny something that the person offering the denial thinks the listener already believes (e.g., is hearer-given), and not something the denier does not think the listener believes (Wason, 1965). For example, an utterance like *Seven isn't an even number*, while true, would usually be infelicitous in any context because it is implausible that anyone would believe seven *is* an even number. This is important for any general account of negation processing because it is precisely these cases that are difficult to process (e.g., true negatives).

[1] Recall that Clark's model assumes that listeners represent entire sentences during comprehension before making a comparison to what is stored in memory. So, a listener will comprehend the entire denial, represent it as a proposition, and *then* search memory for matching information. This is an odd assumption from a more modern point of view, where parsing and interpretation are viewed as incremental processes. Nevertheless, I have outlined the model as it was originally proposed.

Importantly, however, the revised Clark model for focused denials concerns de-contextualized denials, not denials that follow assertions, or denials that precede counterassertions. This is a problem for this account, as the next section will describe. This point is important because later work by Bock and Mazzella (1983) has specifically examined the role of focus in the processing of denials.

### 2.1.3 Problems with the Matching Model

So far, the role of focus has been discussed with respect to the marking of given and new information. There is a problem with this conception of focus-marking, however, when it is applied to sequences of utterances consisting of an assertion followed by a denial.

In a question-answer pair, the focus placed on the constituent corresponding to the answer signals that a part of the utterance is new information —not previously-mentioned. In an assertion-denial sequence, however, like those in (11-12) below, the denial literally repeats the content of the initial assertion, with the addition of the negation marker. There is no new information in the denial that follows the assertion, except for the negation. Nevertheless, there can be a focus in the denial on virtually any previously-mentioned lexical item —a pronoun in the case of (11), for example. Thus, the distribution of pitch accents in assertion-denial-counterassertion sequences is not completely accounted for by the notion of given and new information because the focus does not need to be on new information. If the focus in the denial had to be on new information, it would fall on the negation. Instead, there appears to be an additional function of the focus in the denials.

(11) A: You are calling me a LIAR. (assertion)

B: I'm not calling YOU a liar. (denial)

B: I'm calling JILL a liar. (counterassertion)

(12) A: You are calling me a LIAR.

B: I'm not calling you a LIAR.

B: I'm calling you a THIEF.

One could argue that in denials such as this, speakers do emphasize the negation. Speakers could express their attitude toward the truth value of a previous utterance by emphasizing the negation, for example. This is exactly what would be predicted on the view that speakers focus the "important" or "contrastive" information in an utterance (Bolinger, 1961). In fact, some speech production experiments lend support to this idea: O'Shaughnessy and Allen (1983) found that speakers asked to produce a (decontextualed) negative sentence such as *John has not studied his book* often produced an intonational peak on the negative operator.

However, while the negation is indeed new information, it is not *required* to be focused in the same way that the new information in an answer to a WH-question is required to be focused. A speaker can focus any term of the denial that he or she wishes to associate with the negation. Also, in conversations, it is the case that speakers do not accent the negation as often as they accent other terms. Two corpus studies of American and British English (respectively) have shown that speakers more often emphasize terms *other* than negation than the negation itself (Yaeger-Dror, 1985; Kaufmann, in press).

Importantly, however, in the *counterassertions* that follow the denials, the focus *is* applied to new information. The replacement in the counterassertion corresponds to information that has not been mentioned, and is therefore new. This use of focus in the counterassertion, like the use of focus in an answer to a WH-question, can be accounted for by assuming that speakers accent new information.

The role of focus in the denial appears to be different. Its role appears to be to associate negation with one of the constituents from the assertion. In the case of (11), Speaker B means to deny the assertion that he or she called Speaker A *a liar*, leaving open the possibility that Speaker B called someone else *a liar*. In the case of (12), Speaker B again denies that he or she called Speaker A *a liar*, but instead leaves open the possibility that he or she called Speaker A something else.

In (11) and (12), the focus in the denial signals the type of replacement that could be offered in the counterassertion. In effect, the focus in the denial is signalling the new information that could follow in the counterassertion, much like a WH-term in a WH-question signals new information in an answer that follows it. The focus in the denial itself, however, does not fall on new information.

Also, note that assertions themselves can be narrowly focused, but that this focus need not correspond to the focus in the denial that another speaker produces in response to that assertion. For example, in (11), Speaker A focuses *liar* in the assertion, but Speaker B focuses *you* in the denial. This follows from the function of the denial: Speaker B is denying a specific aspect of the initial assertion, independent of what Speaker A chose to emphasize. So, while there is a dependency between the focus of the denial and the counterassertion (produced by the same speaker), there

is no necessary dependency between the focus of the assertion and the focus of the denial.

If the above characterization is correct, focus appears to be playing a different role in the denial than as an identifier of new information within the denial itself. It is instead identifying the new information that could follow in a counterassertion. There is a large literature in generative linguistics on focus and focus-sensitive operators that suggests that focus during the comprehension of denials may serve to indicate that alternatives to the focused constituent are under consideration (Chomsky, 1972; Akmajian, 1973; Sgall, Hajičová, & Benesova, 1973; Chafe, 1976; Rooth, 1992). For example, Jackendoff (1972) proposed that operators such as *not* associate with focus, as in (13). Section 3 reviews some of this literature.

(13) I didn't stop SMOKING... I stopped drinking.

Recall that Clark and Clark (1977) proposed that negation associates with new, but not given information in a denial. But according to the argument above, the new information in a denial is not necessarily what is being focused. The denial literally repeats the assertion with the addition of negation, so by definition, the only new information is the negation. However, the negation is not necessarily emphasized. Rather, speakers focus a constituent of the denial in order to associate that constituent with negation, and to evoke alternatives to the focused expression.

In the revised Clark model, listeners were hypothesized to partition the supposition into given and new information. On the present view, listeners instead derive a representation of the denial that includes a negation of the assertion associated with

the focus, as well as a representation of the assertion with the focus of the denial replaced by a variable, as in (14). I will call this the alternative proposition.

On the face of it, the two representations in (8) and (14) appear to quite similar. However, there is an important theoretical consequence. In the representation proposed here, the negation does not have to associate with *new* information, but rather it associates with *focused* information. This proposed representation separates referential status —whether something is *given* or *new*, from focal status —whether a constituent carries a grammatical indicator of focus. In addition, there is an expectation that can be derived from the alternative proposition that the variable will be replaced by a new value.

(14) assertion: S=Jane called Bill a liar

negation: Neg(S)

focus = Jane

alternative-proposition = $x$ called Bill a liar

Because the focus does not have to associate with new information, the focus in the denial can associate negation with any constituent in the denial. Also, because the focus in the denial evokes alternatives of a specific form, this information can be used to predict the replacement in a counterassertion. These two aspects of denial processing were not predicted from the Clark and Clark model.

In processing terms, it is perhaps not so clear what is meant by "evoking alternatives" above. The distinction in (14) is a representational distinction, but does not say how listeners use the information to derive an expectation for alternatives. There

is another proposal in the literature, however, about how intonation is used to direct attention during sentence understanding, and this proposal can be seen as part of the solution to the problem with the matching model. The purpose of the next section is to describe this work.

## 2.2 Prosody and Attention

There is a sizeable literature regarding how listers use prosody to allocate attention while comprehending speech suggesting that intonation can have a powerful influence on where attention is deployed. Some of this work follows from studies of dichotic listening, an important early experimental task in the study of selective attention. In dichotic listening, two messages are presented to a listener simultaneously, one to each ear, and the task is to repeat one of the messages out loud (e.g., shadowing). This task has been used to understand the allocation of attention in tasks where listeners must allocate attention to both of the messages (Broadbent, 1953; Cherry, 1953; Kahneman, 1973; Treisman, 1969).

The influence of prosody during dichotic listening has been well documented (Darwin, 1975; Darwin & Bethell-Fox, 1977). Darwin (1975), for example, had listeners shadow one of two messages presented one to each ear. In one condition, the utterances switched ears in mid-sentence, so that the utterance that started in the right ear finished in the left ear, and vice versa (this resulted in a semantically anomalous sentence in the shadowed ear). In another condition, the content of the utterance stayed the same in a given ear, but the intonation contour switched, so that the contour

that started in the right ear switched to the left. In either condition, the instructions were to shadow only one ear, regardless of the content in that ear. Listeners were more likely to mistakenly switch their shadowing in the prosodic switch case than the semantic switch case, showing that listeners are willing to follow an intonation contour, even when it resulted in an anomalous interpretation. More recently, Darwin and Hulkin (2000) showed that prosody can override inter-aural difference times in listeners' perception of the source of a target word in a sentence played simultaneously with a distracter sentence. Also, listeners can use differences in fundamental frequency to separate a target sentence from distracting background speech (Brokx & Nooteboom, 1982; Bird & Darwin, 1997). Thus, there is a strong potential for intonation to direct attention.

More relevant to present concerns, however, researchers have also concentrated on the allocation of attention to the utterances of a single speaker. The goal of this work has been to determine whether listeners attend equally to all parts of an utterance, or alternatively, whether some parts are attended more closely than others.

### 2.2.1 Attentional Bounce Hypothesis

Shields, McHugh, and Martin (1974) suggested a very general proposal about the use of rhythm to modulate attention in speech processing, based on earlier work by Martin (1972). In this proposal, rhythmic events in speech are used to make predictions about the timing of speech events. Because it has been suggested that there is an alternating pattern of stressed and unstressed syllables (in English), listeners could potentially make predictions about *when* speech events such as the occurrence of stressed syllables

may occur. The successive stressed (and unstressed) syllables in continuous speech are hypothesized to form a metrical grid, and the temporal regularity from one stressed syllable to the next provides information about the timing of stressed syllables. The processing system could, in principle, capitalize on this pattern by predicting the future occurrence of stressed syllables (which would be perceptually clear segments) by locking into this rhythm. The allocation of attention could then be seen as varying from one stressed syllable to the next (an "attentional bounce"), and the role of prosodic information in this process is to indicate the timing of the stressed syllables in the speech stream. It is important to note that this hypothesis concerns lexical stress, not sentential stress, because the alternating stressed/unstressed pattern is derived from the occurrence of strong and weak syllables in lexical items, and not the location of pitch accents in the intonation contour.

In support of the attentional bounce hypothesis, Shields et al. (1974) showed that recognition performance in phoneme-monitoring is momentarily disrupted when experimental manipulations cause predictions based on stress to be wrong. They had listeners monitor for phoneme targets in nonwords embedded in real sentence contexts. The initial phonemes of the nonwords were detected more quickly when they were embedded in sentential contexts in which sentence rhythm predicts that the syllable containing the target will be accented. A control condition showed that the same words did not have faster detection times in a context that did not allow the prediction based on rhythm (list of nonsense syllables). Also, Meltzer, Martin, Mills, Imhoff, and Zohar (1976) showed that phoneme targets that were displaced from their predicted location in the speech signal (by the experimental deletion of

100 ms of signal prior to the target) are detected more slowly.

Not all studies support this idea, however. Pitt and Samuel (1990) only weakly replicated Shields et al's results with acoustically-controlled actual words embedded in natural sentence contexts. The effect did replicate in word lists that predicted the same rhythm. Mens and Povel (1986) also failed to replicate Shields et al (1976).

### 2.2.2 Sentential Accent

Unlike utterance rhythm, sentential stress concerns the placement of pitch accents and the projection of focus from that accent placement. However, sentential accent and lexical stress may be similar in one respect. Cutler (1976) has suggested that during the comprehension of focused constituents, listeners use the intonation contour within a sentence to direct attention to those parts of the sentence where there is greater stress or prominence. In the Shields et al. proposal, the value of anticipating a stressed syllable is that the stressed syllable would be perceptually clear. In the Cutler proposal, the value of predicting where an accent will fall with a sentential accent is that sentence accent will typically fall on (semantically) more informative words. If processing mechanisms can predict where more informative words will be in the speech stream, it may be more efficient to allocate more attention to those parts of a sentence, relative to others. Essentially, sentence processing mechanisms might use early portions of the prosodic contour of a sentence to predict where later accents will be, and direct attention to those locations, because these locations are likely to be more informative.

A series of studies using the phoneme-monitoring task have provided support

for this proposal. Cutler and Foss (1977) found that listeners are faster to detect phoneme targets on words bearing sentential accent, suggesting that listeners allocate more attention to those target locations. Acoustically, however, accented words have higher pitch, longer syllable duration, and higher amplitude. It could be that the faster time to monitor for targets predicted to be accented is due to the perceptual clarity of the accented target locations. Cutler (1976) provided evidence against this interpretation, however. She showed that response times to detect the initial phoneme of an acoustically-*neutral* word are faster when that word appears in a location that is predicted to receive an emphatic stress by the preceding intonation contour, compared to a sentential context that does not predict an accent. She compared sentences that were recorded where the target-bearing word had a contrastive accent to sentences where the contrastive accent was somewhere else in the sentence.

(15) a. That summer four years ago I ate roast DUCK for every meal.

b. That summer four years ago I ate roast duck for EVERY MEAL.

The target-bearing word was edited out of the stimulus sentences with accents, and replaced with a version from a third recording of the same sentence without an emphatic accent. Since there were no acoustic differences for the target location (e.g., *duck*) in the two versions of the sentence, Cutler interpreted the faster detection times at the location predicted to contain the accent as reflecting an active search on the part of the listener for the accent.

Cutler and Darwin (1981) determined that the effect in Cutler (1976) was probably not dependent on any particular prosodic dimension. They found a similar effect of

predicted accent location in sentences that were resynthesized with a monotonous intonation contour, or when the local timing of the phoneme target was changed (e.g., like the Meltzer studies reviewed earlier). However, the predicted-accent effect is eliminated when the sentence rhythm and the intonation contour are placed in opposition to each other (e.g., the rhythm suggests an accent on the target, but the intonation contour suggests an accent somewhere else). Thus, while the predicted-accent effect doesn't necessarily depend on a particular phonetic correlate of prosody, it is necessary that the different dimensions be consistent with each other in their prediction. To summarize, in studies of sentential accent, consistent and strong effects of sentence accent on monitoring times have been obtained. This is unlike the support for the attentional bounce hypothesis concerning lexical stress patterns, where support has been mixed.

Constituents can also be focused semantically. In semantic focus, semantic information is used to direct attention to different parts of the speech stream. For example, a WH-question is said to focus the constituent that replaces the WH-term in the answer. Semantic focus is more abstract than prosodic focus, in the sense that different grammatical constructions can be used to effect semantic focus. For example, gapping constructions, such as *It*-clefts and WH-questions can result in semantic focusing.

Support for semantic focusing comes from work by Cutler and Fodor (1979). They had subjects perform a phoneme-monitoring task while they listened to question-answer pairs. They found that subjects were faster to detect target phonemes in the answer when the location of the target corresponded to the constituent focused by the

question. Importantly, this occurred despite the fact that the answers had the same prosodic form regardless of the question preceding it (i.e., the answer was produced in monotone and did not have a focus that matched the question term). Cutler and Fodor (1979) thus demonstrated that the expectancy derived from the question was sufficient for improving phoneme detection in the answer, and that the phonolological pitch accent in the answer, at the target location, is not actually necessary for the improved detection performance.

This observation suggests a potential solution to the problem with the matching model introduced earlier. Recall that in the matching model of negation processing, it was assumed that prosodic emphasis indicated new information. The problem with this is that the focus in denials does not have to be placed on new information. Alternatively, however, it could be that listeners use the focus in denials as an indicator of abstract, semantic focus. It was suggested earlier that focus associates with negation, and is used to evoke alternatives (Jackendoff, 1972). Combining this (representational) claim with Cutler's suggestion that listeners use prosody to direct attention to locations within an utterance predicted to contain a focus, and the demonstration by Cutler and Fodor (1979) that this can occur across utterances, it can be predicted that listeners will use the focus in denials to make predictions about the forms of counterassertions that will follow. In particular, listeners should direct attention to those parts of the counterassertion that are predicted by the focused denial to contain the replacement information.

### 2.2.3 Phoneme-Monitoring Tasks and Attention

The phoneme-monitoring task used by Cutler and her colleagues has been used to investigate a wide variety of topics in spoken word and sentence processing. It was originally designed as a way of using a dual-task method to investigate spoken language comprehension, where an aspect of language itself is used as part of the task (Foss, 1998). Subjects in the task are asked to listen to and comprehend spoken sentences while monitoring for a target sound. In many uses of the task, target locations are arranged so that they fall on areas of the sentence that are hypothesized to have greater or lesser processing complexity (e.g., syntactic parsing complexity, or memory requirements). Subjects' response times to detect the target sound are taken to reflect the commitment of processing resources at the location of the target in the sentence (e.g., with greater resources required to parse a region of the sentence, it is sometimes hypothesized that subjects will be less able to allocate attention to phoneme-monitoring). In other instances of the task, like those described above, the task is used to study how subjects allocate attention to different regions of the sentence, rather than processing complexity. Subjects are hypothesized to allocate more attention to some regions of a sentence than others, for example, in cases where the prosody of the sentence would lead to a prediction about the location of sentential accent. In these cases, when a target appears in a location where subjects have allocated more attention, the prediction is that they will be faster to detect phoneme targets.

With the phoneme-monitoring task it is useful to distinguish top-down versus

bottom-up sources of attentional control. In many cases, the phoneme monitoring task has been used to study how priority is assigned to different locations within a sentence. In cases where the variable is manipulated *at the target location*, then a bottom-up, or exogenous influence would be expected. For example, the greater acoustic salience of an accented lexical item within a sentence could be seen as a bottom-up cue. In cases where the variable is manipulated in a location of the sentence *prior* to the phoneme target, then a top-down, or endogenous source of control would be implicated. For example, the effect of a question on attention allocation to an answer to the question could be seen as a top-down cue.

Because it has been widely used, phoneme-monitoring is a well-understood experimental task, and a variety of potential artifacts have been documented (see Ferreira & Anes, 1994; Connine & Titone, 1996). It has been found, for example, that the length, frequency, and number of syllables of both the target-bearing word, and the word preceding it can affect response times. Also, feature overlap between the target phoneme and the word-initial phoneme of the preceding word can influence RTs, as can the lexical stress pattern of the target word. The complexity of the word-initial target segment, and the length of the vowel following the target segment can also affect RTs. Other potential artifacts include the position of the target word in the sentence (early or late —esp. in the case where the target-bearing word is sentence-initial, because of the absence of co-articulatory information in that case), as well as the predictability, the plausibility, and the grammatical part of speech of the target-bearing word. The majority of these potential artifacts concern cases where experimental conditions require a comparison of responses across different tar-

get words, however. In some designs, like that of Cutler and Fodor (1979), the target is located in a carrier sentence that does not change across experimental comparisons. In this type of design, the influence of the prior sentence on monitoring performance is assessed, rather than the influence of some property located at the target location.

## 2.3 Summary and Overall Evaluation

This review has suggested that the interpretation of focused denials poses an interesting problem for models of spoken utterance interpretation that are based on the matching of given and new information. In the matching model, people are assumed to search memory for information matching given information in the utterance, based on the constituents that have been marked as given, and integrate the information marked as new with the given information. It has been suggested that in denials, a different type of representation may be necessary to model their interpretation, because the focus in denials is placed on constituents that are not necessarily new. A different representation has been proposed to handle this problem, based on work on association with focus, and it has been suggested that listeners may use this semantic focus to direct attention to new information found in counterassertions following the focused denial. The following sections describe the linguistics research related to this work, and four experiments that test this theoretical proposal.

# 3 Linguistic Accounts of Focus and Negation

Linguists have approached information structure from nearly all angles, including phonology, syntax, formal semantics, and discourse interpretation. Of these, two approaches are directly related to the experiments reported in this dissertation: Jackendoff's (1972) early work on association with focus (later elaborated by Rooth, 1985), and Vallduví's (1992) approach to information structure. The purpose of this chapter is to clarify the representation of denials discussed previously using the Jackendoff/Rooth analysis of negatives, and relate the general Clark model of given-new processing to Vallduí's account of information packaging.

## 3.1 Association with Focus and Alternative Semantics

The earlier discussion of information structure (Section 2.1.3) suggested that directly equating referential status (whether something is given or new) with the grammatical markers for information structure (assignment of accent or syntactic construction) is not sufficient to explain the function of accents in denials. It is natural to ask whether an alternative characterization of the representation of focus in denials is available to capture both the functions of evoking alternatives and of indicating new information. This section describes work from theoretical linguistics which can serve as the basis for this characterization. In particular, Rooth's (1992) work on focus provides a framework for characterizing the representation of focus in question-answer sequences, as well as denial-counterassertion sequences.

### 3.1.1 Jackendoff's Approach

Jackendoff (1972) was the first to propose a general rule system where focus *associates* with negation and other focus-sensitive particles. According to this account, a focused negative sentence has a composite meaning consisting of a both an assertion and a presupposition, and this division is a result of the interplay of rules from a variety of different domains. Pragmatically, the focus of a sentence corresponds to the information conveyed by the sentence that is assumed by the speaker not to be shared by him or her and the listener. This focused information is included in the assertion. The presupposition corresponds to the part of the sentence that is assumed to be shared, or under discussion, but does not necessarily include the negation. Syntactically, a syntactic feature termed an F-marker is assigned to the focused constituent. This F-marker is a feature of a syntactic phrase which relates to phonological and semantic rule systems. Phonologically, Jackendoff proposed an Emphatic Stress Rule, which simply states that to realize a focus, high stress is assigned to the stressed syllable of the head of the focused constituent. Jackendoff claimed that a typical type of accent indicating focus in a negative sentence is (what he termed) a *B* accent, or rising accent. This type of accent can also be described as a L+H* accent in Pierrehumbert and Hirschberg (1990) terms. Semantically, a Focus Assignment Rule was proposed to derive both the focus and the presupposition. In this rule, the semantic representation of a sentence corresponding to the surface structure material dominated by the F-marker is designated the Focus of a sentence. To derive a presupposition, the material associated with the focus is replaced by a variable, as in (16c).

Jackendoff also formulated a rule where an element such as negation is associated with a focus, and does not contribute to the meaning of the presupposition derived from the focus-assigned sentence.

(16) a. ANNE doesn't smoke.

b. Anne $\not\ni$ $\lambda$x (x smokes) (assertion)

c. $\lambda$x (x smokes) (presupposition)

There are important constraints on the application of these rules. Jackendoff (1972) pointed out that the association of negation with focus is optional, for example, as shown in (17).

(17) a. That isn't correct. Mary didn't take the CAR from Bill.

b. What didn't Mary take from Bill? Mary didn't take the CAR from Bill.

The sentence in (17a) suggests alternatives to *the car*, similar to the way that (16a) suggests alternatives. However, with the negative context question establishing the negation as part of the presupposition, the same sentence in (17b) shows that the negation can remain within the presupposition. The different presuppositions associated with the negative sentences in (17) are shown in (18):

(18) a. $\lambda$x (Mary took x from Bill)

b. $\lambda$x (Mary did not take x from Bill)

A related point is made by Moser (1992), who analyzed negation as a type of *relation*, extending the account of Horn (1989) to focused negative sentences. She showed that negation always relates different constituents within a sentence (similar to Horn's mode of predication), but that the different constituents do not necessarily correspond to foci. For example, the sentences in (19) show that negation may relate non-focal constituents as in (19a), may relate to an accented constituent that is not the main focus of the sentence as in (19b), or may remain within the presupposition as in (19c). [2]

(19) a. Mary didn't take the car.

b. It was the CAR that MARY didn't take.

c. It was the CAR that Mary didn't take.

This places important boundary conditions on the association of negation with focus, as it is apparent that the association is neither necessary or obligatory.

### 3.1.2 Rooth's Approach

Since Jackendoff (1972), a number of authors have elaborated on the basic proposal concerning association with focus. Rooth (1985; 1992) provided a similar analysis for a variety of focus-sensitive operators, and argued that the general function of focus is to evoke alternatives.

[2]Another important point of Moser (1992) is that association with focus cannot be equated with *metalinguistic negation* (Horn, 1989). Moser (1992) points out that focused denial-counterassertion sequences do not express literal contradictions as in the classic metalinguistic negation examples. Instead of metalinguistic negation, Moser (1992) analyzes simple focused negation denials as descriptive negation.

Importantly, Rooth showed how focus can have truth-conditional effects on the interpretation of sentences, clearly establishing the semantic relevance of prosodic focus. For sentences like in (20), for example, Rooth (1985) suggested that in situations where *John* introduces multiple people to *Sue*, and performs no other introductions, then (20a) is true, but (20b) is false. Conversely, if *John* introduces *Bill* to *Sue*, and makes no other introductions other than *Sue* to other people, then (20b) is true, and (20a) is false.

(20) a. John only introduced Bill to SUE.

b. John only introduced BILL to Sue.

Rooth (1985) proposed that focus can always be interpreted as involving some set of alternatives to the focused element in a sentence. In Rooth's approach, two semantic values are computed for focused expressions, an ordinary semantic value corresponding to the propositional content of the utterance, and a focus semantic value corresponding to the ordinary semantic value obtained from the ordinary value by replacing the interpretation of the focused element with a variable, as in Jackendoff (1972).

The focus semantic value can be thought of as background information, or a set of propositions which potentially contrast with the ordinary semantic value. A variety of pragmatic and semantic processes can reference this focus semantic value, and this leads to focus effects that are both semantic and pragmatic in nature.

For question-answer pairs, Rooth (1992) argues that a WH-question determines a *set* of possible answers much like other focus semantic values. The ordinary semantic

value of a question is a subset of the focus semantic value, rather than a single value. The function of the focus in the answer to the question is to signal that other propositions are potential answers in the context of the question.

For an utterance like (20a), the truth-conditional effects of focus are captured by equating the quantificational domain of the adverb *only* to a contextually-bound variable $C$, with the condition that $C$ be equated with the interpretation of the focus semantic value.

For the utterance in (20a), the ordinary semantic value corresponds to (21a), while the focused semantic value corresponds to (21b), and vice versa for (20b).

(21) a. introduce(Sue, Bill)

b. $\lambda$x (introduce(x, Bill))

A similar type of analysis holds for negation. Rooth (1996) also pointed out that focus does necessarily result in an existentially quantified variable. For example, a sequence like (22) shows that negation can apply to the interpretation of a constituent resulting in a sense of alternatives to the focused expression, but that this need to imply that any particular alternatives necessarily be assigned.

(22) a. BILL didn't arrive late. No one arrived.

If the focus in (22) results in a existential interpretation that *some* alternative to the focused expression instantiates the variable (e.g., a non-empty set of alternatives), then the follow-up would be predicted to be infelicitous, but it is not. In Rooth's analysis, then, focus has the uniform interpretation of indicating that alternatives

to the focused expression are under consideration, and that negation applies to the ordinary semantic value of the focused expression.

In summary, Rooth's account, extending Jackendoff's treatment of association with focus, can be seen as a general account of the meaning of focus. It covers both the meaning of focused negative sentences, as well as the relationship between the meanings of questions and answers.

## 3.2 Information Packaging

A number of authors have pointed out that information in a discourse does not consist of a randomly arranged set of propositions, but appears to be structured in various ways. The following quote from Chafe (1976) sums ups the basic idea:

> [The phenomena at issue] have to do primarily with how the message is sent and only secondarily with the message itself, just as the packaging of toothpaste can affect sales in partial independence of the quality of the toothpaste inside. (Chafe, 1976)

Many authors have attributed information structuring to an attempt by speakers to convey what they (the speakers) believe is mutually known, or what they expect their hearers to be thinking about:

> At all levels, the crucial factor appears to be the tailoring of an utterance by a sender to meet the particular assumed needs of the intended receiver. That is, information packaging in natural language reflects the sender's

hypotheses about the receiver's assumptions and beliefs and strategies.

(Prince, 1981)

There have been numerous attempts to capture the basic distinction between the informative part of an utterance, and the part of the utterance which is assumed to be already understood. The most common distinction is between *new* and *given* information, but other common distinctions include focus/ground, topic/focus, topic/comment, theme/rheme, contextually-bound/-nonbound, psychological subject/predicate, focus/presupposition (see Vallduví & Engdahl, 1996 for a summary of the literature).

### 3.2.1 Vallduví's Approach

Languages primarily realize information structure through the grammatical resources of prosody, word order and morphology. Vallduví (1992, 1993) and colleagues have proposed an account of information structure in grammar that attempts to capture these distinctions within a single framework. This approach is distinguished by its attempt to model information structure in a diverse set of languages (including English, German, Dutch, Swedish, Catalan, Hungarian, Turkish, and Japanese) using a small set of informational primitives, termed *instructions*. The basic differences between the languages are modeled as language-specific configurations of the instructions (Vallduví & Engdahl, 1996). This basic approach is similar in most respects to the psycholinguistic work by Haviland and Clark (1974), except that the proposed instructions are more detailed, and are applied to a wide variety of languages. Because it represents a cross-linguistic account of information structure, Vallduví's approach

represents an important set of hypotheses about how information structure is processed in languages other than English. In this section, however, I will suggest that Vallduví's approach inherits the same problem as Haviland and Clark (1974) with respect to its predictions regarding denials.

Vallduví (1994) describes the approach in terms of File Change Semantics. File Change Semantics (Heim, 1982) is a formal approach to semantics which views the meaning of a sentence in terms of its *context change potential*, the impact that an utterance has on the discourse of which it is a part. This approach gained popularity in the early 1980s for its solution to an outstanding problem involving binding, quantifier scope, and anaphora.

File Change Semantics models interpretation (in the formal sense of a mapping between linguistic expressions, logic forms, and possible worlds) as a process of keeping a set of file cards in a file. The logical form for a expression is assigned a file change potential based on file cards that are created or activated. File Change Semantics is intended to model how noun phrases are interpreted, and one of its main claims is that whether or not a new card is introduced is based on the definiteness of noun phrases. Indefinite descriptions such indefinite NPs and universally-quantified NPs introduce new file cards, while definite descriptions such as pronouns, definite article NPs, and demonstrative pronouns lead to the re-activation of pre-existing file cards.

As with Heim (1983), Vallduví (1994) assumes that file cards are used to represent discourse referents. Each utterance in a discourse is used to enter information onto file cards incrementally, as a discourse unfolds. File cards are created when indefinites

are processed, and they are re-activated when definite descriptions and proper names are processed. In addition, file cards are *updated* when information from a sentence is recorded on already-created cards. Vallduví's main claim is that information structure is used to manage file cards so that they are available at the appropriate times, and to add information to the cards.

Information structure approaches distinguish the part of a sentence which assumed by the hearer to be already known, and that part of the sentence which is informative in some way. Topic-comment approaches tend to emphasize what a sentence is about, while focus-ground approaches tend to emphasize the informative part of an utterance. Vallduví's account combines these traditional distinctions by using four basic primitives placed in a hierarchical arrangement: Sentence = {Focus, Ground}, further subdivided so that Ground = {Link, Tail}. The link corresponds to the *topic* in other approaches using the topic-comment distinction. Because of this arrangement, a sentence is divided into three parts: a Focus, a Link, and a Tail. The Link directs the hearer to a file card in his or her knowledge store, while the Tail signals a certain type, or mode, of information update. The Focus encodes the information to be added in the knowledge store at the appropriate location, and in the appropriate mode. These primitives combine to realize different instructions for information update.

The reason for distinguishing between the different parts of the Ground can be seen in the following examples (23-24).

(23) a. What about John. What does he do?

b. [John]$_{Ground}$ [drinks BEER]$_{Focus}$.

In (23b), *John* is part of the topic, and can be taken as presupposed. The noun phrase *beer* is the focus, and *drinks* is taken to be part of the comment in topic-comment approaches. In this case, topic-comment and focus-ground approaches provide the same partition of the utterance: *John* is both ground and topic, and *drinks beer* is both focus and comment.

(24) a. What about John? What does he drink?

b. [John drinks]$_{Ground}$[BEER]$_{Focus}$.

In (24b) however, the same utterance, with the same marker for focus as (23b), is partitioned differently. The noun phrase *beer* is still the focus, but now the ground includes *John drinks*, which can be taken to be presupposed because it was mentioned in the question. So, in cases like (24), the topic-comment and focus-ground approaches partition sentences differently. Vallduví (1992) combined these approaches into a single partitioning into Focus, Link, and Tail. In (24), the Ground would be partitioned in to a Link (e.g., *John*) and a Tail (e.g., *drinks*).

Schematically, in this approach, the information in some sentence $S$ is denoted $I_s$. The focus is roughly the amount of propositional information expressed by $S$, denoted by $\phi_s$, minus the information already in the hearer's model, $K_h$:

$$I_s = \phi_s - K_h$$

Vallduví proposes that $I_s$ is expressed by the focus, and that the ground has the

| *Type* | *Instruction* |
|---|---|
| Focus | UPDATE-ADD($I_s$) |
| Link-Focus | GOTO(fc)(UPDATE-ADD($I_s$)) |
| Focus-Tail | UPDATE-REPLACE($I_s$, record(fc)) |
| Link-Focus-Tail | GOTO(fc)(UPDATE-REPLACE($I_s$, record(fc))) |

Table 2: Informational Primitives in Vallduví's Approach.

role of "ushering" the $I_s$ to the appropriate location in memory. The Link within a sentence indicates *where* the information should go, and the Tail indicates *how* the information is to be added (e.g., via either an addition, or by replacing some other element).

In this approach, the only necessary primitive in any sentence is a Focus. Sentences can lack Links or Tails, so this provides four possible types of sentences, each associated with a different instruction type, as in Table 2. [3]

Here, *fc* stands for a file card, and *record* stands for a record or property that is on that file card. Essentially, the primitives are UPDATE-ADD, which adds information to the knowledge state, and GOTO, which is a lookup procedure to find a record in memory. The presence of a Tail changes UPDATE-ADD to UPDATE-REPLACE.

The core part of the instructions in any sentence is the UPDATE instruction, which is signalled by a Focus. UPDATE is an instruction to update the input file with $I_s$. This basic primitive is modified by other Ground elements present in the utterance.

The Link is part of the Ground. It associates with some previously-mentioned or

[3]Note that the types do not imply any arrangement of constituency or order. It would be more precise to say that Link-Focus-Tail is an unordered set such as {Link, Focus, Tail}, for example.

inferred referents, or set of referents. It serves to anchor the Focus, and is associated with the GOTO instruction. The target locations for the GOTO instructions are file cards. Note that Vallduví's approach is largely similar to Haviland and Clark (1974), with respect to the Focus and the Link.

The Tail is like a pointer to a specific record on a file card that already exists. It indicates how the record is to be modified by the $I_s$ of the sentence. Records are conditions on the file cards, corresponding to properties or attributes that have been ascribed to the referent associated with the card. If a Tail is present in an utterance, then the associated instruction type for the focus is changed from UPDATE-ADD to UPDATE-REPLACE —the presence of a tail triggers a switch in the mode of update.[4]

For a simple question-answer pair like (25), Vallduvií's approach works as follows.

(25) a. Who did Jane invite?

b. [Jane invited]$_{Link}$ [BILL]$_{Focus}$.

In (25b), the Ground consists of a Link that was established with the question in (25a), and the Focus corresponds to the accented name. Since this is a Link-Focus configuration, the associated instructions are GOTO(fc) and UPDATE-ADD($I_s$). The file card for the GOTO statement would be the file card for *Jane*, and the UPDATE-ADD instruction would add a reference to the file card for *Bill* onto the file card for *Jane*, at the location of the open statement *Jane invited x*. In this way, file cards,

[4]Distinguishing Links and Tails is not always straightforward, as others have pointed out (Moser, 1992). For the present discussion, the important distinction is between the Focus and the Link, which captures the basic Focus-Ground partition.

corresponding to entities established by noun phrases are associated with statements and cross-referenced to other entities. Essentially, the link provides the location for the update.

Vallduví (1994) provides the following analysis to illustrate how Links are realized.

(26) a. [Sue]$_{Link}$ [insulted CATHY]$_{Focus}$ and then [she HIT her]$_{Focus}$.

b. [Sue]$_{Link}$ [insulted CATHY]$_{Focus}$ and then [she]$_{Link}$ [hit HER]$_{Focus}$.

In cases where no Link is indicated, the currently most active file card is updated in this approach. In (26a), there is no Link in the second conjunct because the entire clause is Focused, so the file card for *Sue* is updated. Vallduví assumes that (in English), contrastive topics can be Links (e.g., see fn 6 in Vallduví, 1994), and he suggests that the presence of a L+H* (rising) accent on a topic is an indicator of a Link. He suggests that there is a L+H* accent on the pronoun *she* in (26b), indicating that it is a Link (this not shown by capital letters here because in Vallduví's approach the assignment of a L+H* accent is not required to be a Focus). Because it is a explicitly-signalled Link, listers do not take *she* to refer to *Sue*, and that the emphasis indicates that the locus of update should be a different file card, the card for *Cathy*.

### 3.2.2 Information Packaging in Denials

Vallduví has not offered an analysis of a denial following an assertion, but based on his analysis of contrastive statements in Vallduví (1994), an analysis like the following can be derived, as in the pair (27a-27b).

(27) a. Jane invited Bill.

b. [JANE]$_{Link}$ [didn't]$_{Focus}$ [invite Bill]$_{Tail}$

c. [JANE]$_{Focus}$ [didn't]$_{Tail}$ [invite Bill]$_{Link}$

In Vallduví (1994), L+H* accents are taken to be indicative of contrastive topics, so a denial following (27a) with a L+H* accent on the subject would be analyzed as (27b), where the Link corresponds to the traditional notion of (contrastive) topic. The instructions associated with Focus-Link-Tail, consisting of GOTO(fc), and UPDATE-REPLACE($I_s$, record(fc)) would then apply. The file card for *Jane* would be re-activated as the locus of update, and the information associated with the focus (e.g., the negation) would replace the positive polarity of the statement *invited Bill* on that file card.

This is the correct prediction about how this file card is updated, but problematically, it relies on assigning the negation-auxiliary the status of Focus. This is problematic because the negation-auxiliary complex is not accented in this case. Vallduví assumes that a L+H* accent on *Jane* is an indicator of a Link, but sentences like (27b) have traditionally modeled as association-with-focus constructions (e.g., Jackendoff, 1972). Also, this account does not predict why a denial with an accent on the auxiliary-negation complex would not interpreted in exactly the same way as (27b). There is a sense that alternatives to the subject in (27b) are relevant, but the same sense is missing if the negation-auxiliary is accented instead. Thus, this analysis does not predict the correct mapping between possible accent locations and possible interpretations.

There are at least two ways to handle this problem. One could argue that the accent in an emphasized denial is both a pragmatic and a semantic Focus, and provide a modification to Vallduví's account. If, for example,*Jane* is taken to be the Focus of the denial, as in Jackendoff (1972), shown in (27c), then the rest of the denial would be taken to be the Ground. The Ground would consist of both a Link (e.g., *invite Bill*), and a Tail (e.g., *didn't*). The associated instructions for a Focus-Tail-Link construction are GOTO(fc), and UPDATE-REPLACE($I_s$, record(fc)), where the file card argument for the GOTO instruction is the file card for the referent Bill. The presence of the Tail triggers the UPDATE-REPLACE instruction (rather than UPDATE-ADD). On the file card for *Bill*, a statement asserting *Jane invited Bill* already exists (hence the application of *record*), so the UPDATE-REPLACE must apply to the existing reference to *Jane*. However, there is nothing to replace on the file card, because *Jane* is already present. The information that needs to be added to the file card, the negation, could be added in addition, but it cannot be added without creating an inconsistency (e.g., *Jane invited Bill*, and *Jane didn't invite Bill* on the same file card). This may be the correct result, however, because the inconsistency between the two entries indicates the disagreement between the assertion and the denial. This forms the basis for the inference that the speaker of the denial is disagreeing with the speaker of the assertion. [5]

Alternatively, Vallduví and Zacharski (1994) have argued for separate treatments of the semantic phenomenon of association with focus and the use of accent to indi-

[5]Note that alternatively, if the auxiliary and negation are taken to be part of the Link, the instructions would be UPDATE-ADD. This would be problematic for Vallduví's account however, because the Focus in the denial is not (literally) adding information.

cate information focus. They argue that there is no necessary relationship between the focal accent indicating the pragmatic focus of a sentence and the focal accent indicating the semantic associate of a focus-sensitive particle. Either can be present in an utterance, but one does not uniquely determine the other. This latter approach is consistent with the argument advanced earlier, in Section 2.1.3. There it was argued that the function of focal accents in denials is to suggest alternatives to the denial, in addition to associating the negation with the interpretation of the focused constituent. This semantic function of focus is not necessarily linked to the referential status of any of the terms in the denial.

It should be emphasized that the main theme of Vallduví's approach is similar to the approach taken by Haviland and Clark (1974). Vallduví argues that information packaging provides a means of (a) designating a file card as a *locus* of information update, allowing listeners an efficient scheme for adding information to their knowledge store (because redundant entries are eliminated), and (b) identifying the information in a sentence and its relation to information already present in the hearer's model. The main types of relation that the approach captures are sequences of utterances where information is added or substituted.

However, in the case of denials, the function of focal accent appears to be better modeled as evoking alternatives, similar to the approach taken by Jackendoff/Rooth. The experiments described in the next section provide support for this function.

# 4 Association with Negation

There is experimental evidence that listeners are sensitive to the relationship between contrastive foci in understanding a counterassertion following a denial. Bock and Mazzella (1983) had listeners judge the acceptability of counterassertions following denials, and timed their judgments after the onset of the counterassertion. They manipulated the focus in the two utterances, comparing conditions where the focus in the counterassertion either matched or mismatched the focus in the denial. Their results showed that listeners were faster to judge counterassertions as acceptable when the (intonationally-signaled) focus in a counterassertion matched the focus in a preceding denial (as in 28a below), compared to the case where it mismatched (28b) or when there was no clear focus structure (e.g., a control condition, 28c). [6]

(28) a. GEORGE didn't kill Bill. ALFRED killed Bill. (-14; matching focus)

b. George didn't kill BILL. ALFRED killed Bill. (137; mismatching focus)

c. George didn't kill Bill. Alfred killed Bill. (143; monotone)

d. George didn't kill Bill. ALFRED killed Bill. ( 75; focus on replacement)

Subjects were over 150 ms faster to judge the second utterance in (28a) as acceptable than (28b). They were not faster to judge (28b) compared to the control condition (28c), but were faster to judge (28d) than either (28b) or (28c). Bock and

[6]On each trial in their experiment, Bock and Mazzella (1983) timed subjects' responses from the onset of the counterassertion, and then subtracted the duration of the counterassertion from the response time. In cases where subjects' responded before the counterassertion finished, this derived response time was negative. The average times shown in (28) are these derived times.

Mazzella (1983) accounted for the faster judgment times for the matching condition by proposing that listeners are following a given-new contract: They interpret an utterance like the counterassertions in (28) by using given information (the non-focused constituents) to access an antecedent in memory and then add the new information (the focused replacement constituent) to this antecedent representation, generally consistent with Clark and Clark's (1977) account.

As Section 2.2 pointed out, other work by Cutler and Fodor (1979; also Cutler, 1976), concerning focus in question-answer pairs, suggests a somewhat different, attention-directing function for focus. In their experiment, subjects listened to question-answer pairs and monitored for a target phoneme in the answer. Their detection times were faster when the question focused the target-bearing constituent in the answer. This result was obtained despite the fact that the answers always had the same prosodic form regardless of the question preceding it (i.e., the answer was produced in monotone and did not have a focus that matched the question term). Cutler and Fodor (1979) thus demonstrated that the expectancy derived from the question was sufficient for improving phoneme detection in the answer, and that the phonolological pitch accent in the answer is not actually necessary for the improved detection performance. This demonstrates that focus can be realized abstractly, and their result is consistent with the hypothesis that listeners use information structure to direct attention to focal targets. This has an important implication. It could be that the effect that Bock and Mazzella (1983) observed was due to the *expectancy* derived from the focus structure of the denial, rather than (or in addition to) the *match* between the phonological focus in the denial and the phonological focus in the

counterassertion. Bock and Mazzella's (1983) account suggests that upon hearing the focus in the counterassertion, listeners might check to see if the focused constituent would serve as a legal replacement for the focus in the previous denial. An alternative possibility is that listeners use the focus in the denial to predict the form of the replacement in the counterassertion, before even hearing it. These two possibilities are not exclusive, of course –subjects may have predicted the replacement in Bock and Mazzella's study, in addition to checking for a match. However, Bock and Mazzella's data do not provide unambiguous evidence that subjects predicted the replacement in the absence of a focus in the replacement. Their manipulations did not include a focus in a denial, followed by the absence of contrastive focus in the counterassertion (analogous to the question preceding the answer in Cutler & Fodor, 1979). Thus, it is an open question whether the contrastive focus on the replacement in the counterassertion is necessary, or if it is simply sufficient that some replacement constituent be present (i.e., even if it is not focused). The first proposed experiment addresses this question: Do listeners use the focus of the denial to predict the likely replacement in the counterassertion?

The following sequences illustrate the difference. The counterassertion in (29) contains a pitch-accent focus (indicated by capital letters), but the counterassertion in (30) does not.

(29) a. I'm not calling YOU a liar.

b. I'm calling BILL a liar.

(matching foci in denial and counterassertion)

(30) a. I'm not calling YOU a liar.

b. I'm calling Bill a liar.

(no contrastive focus on the counterassertion)

Usually, sequences like (29) are the norm because a focus (signaled by a pitch accent) in the denial matches the focus in the counterassertion (signaled by a pitch accent) the same way that a focus in an answer (signaled by a pitch accent) matches the WH-term from a question. However, the benefit observed by Bock and Mazzella (1983) could be due to the focusing effect of the accent in the denial denial alone, rather than the focus signaled by the accent in the counterassertion. To determine whether expectancy or matching is responsible for the effect they observed, the first experiment adapted Cutler and Fodor's design to denials, and examine whether listeners can effectively monitor for replacements in sequences like (30).

## 4.1 Experiment 1

In this experiment, subjects heard spoken denials followed by counterassertions, while performing a phoneme monitoring task. In phoneme monitoring, subjects listen to spoken sentences or words while monitoring for a pre-specified target word-initial phoneme, and press a response key as soon as they have detected the target. This task has been used to investigate a variety of issues in spoken sentence processing, including local syntactic processing difficulty and expectation-driven spoken word processing (see Foss, 1969 for the initial use of the task; Foss, 1998 for a recent overview; and Connine & Titone, 1996 for an evaluation of the technique). In the

present experiment, the task was to detect the target phoneme in a pair of sentences rather than a single sentence or a single word. In the experimental trials of interest, there was a denial followed by a counterassertion, and the target phoneme was present in the counterassertion. The target phoneme was specified before each trial, before the utterances were heard.

The main experimental manipulations were to change the location of the pitch accent signaling the focus in the denial, and the location of the replacement in the counterassertion that contained the phoneme target. Thus, there were two principle experimental factors arranged in a 3 x 2 factorial design: The location of the intonationally-signaled focus in the denial (early position, late position, or auxiliary-negation), crossed with the location of the target phoneme on the replacement of the counterassertion (early position, late position). Note that phonetically, for a given target location, only the intonation in the denial changed —there was not an emphatic pitch accent in the counterassertion indicating the replacement. Subjects were asked to detect either a /*b*/ or a /*k*/ target in the sequence of utterances. The utterances in (31) provide an example of the denials, and (32), the counterassertions (Note: The example target phoneme is /*k*/).

(31) LAURIE doesn't have a dog. (early focus)

Laurie doesn't have a DOG. (late focus)

Laurie DOESN'T have a dog. (auxiliary-negation focus)

(32) *K*athy has a dog. (early position target)

Laurie has a *c*at. (late position target)

The three forms of the denial focus either *Laurie*, *dog*, or *doesn't*. The replacement targets in the two counterassertions are *Kathy* or *cat*, respectively. Crossing the location of the focus in the denial with the location of the replacement in the counterassertion creates three kinds of trials: a case where the focus correctly predicts the location of the replacement (e.g., valid trials), a case where the focus predicts a location of the replacement not corresponding to the target (e.g., invalid trials), and a case where the focus is uninformative with respect to potential replacement locations (e.g., a baseline). Thus, *Kathy* replaces *Laurie* and should be expected in the early position focus conditions, but the replacement of *dog* with *cat* at the late position should be unexpected. In the late position focus conditions, the replacement of *dog* with *cat* should be expected, but the replacement of *Laurie* with *Kathy* should be unexpected. In the case where *doesn't* is focused, neither the replacement of *Laurie* or *dog* would be expected (or, alternatively, would be expected to be equally likely).

## 4.2 Method

### 4.2.1 Subjects

Thirty subjects performed the phoneme-detection task. These subjects were recruited from the undergraduate subject pool at Michigan State University, and from an ad placed in the campus newspaper. The subject pool is made up of students taking introductory psychology courses who participate in experiments for course credit. All subjects were native speakers of English (two were bilingual, with English listed as their first language). The average age was 19.6 years, with 13.5 years of formal ed-

ucation. The average vocabulary score (Shipley, 1940; maximum: 40) was 29.1. No major hearing problems were reported. Subjects were randomly assigned to counterbalancing conditions.

### 4.2.2 Materials

The experimental sentences consisted of 48 dialogue sequences, each composed of a denial followed by a counterassertion (see Appendix A). The materials for these sentences were constructed from 48 utterance frames with appropriate modifications of the location of the focus, or the location of the replacement. The median length of the denials was 5 words (median 7 syllables, average duration 2062 ms) and the median length of the counterassertions was 5 words (median 7 syllables, average duration 1907 ms).

In all cases, a contrastive accent indicating narrow focus was present in the denial, but not the counterassertion. Three versions of each denial were recorded, varying the location of the focus. One version had a focus in an early position in the denial (typically, but not always, the subject of a simple SVO clause), another version contained a focus in a later position (typically, but not always, the object), while another version contained a focus located on the auxiliary-negation complex. In all cases, the focus in an individual denial fell on either a content word or an auxiliary verb in the denial. Two versions of each counterassertion were recorded, one with the target-bearing replacement in an early position corresponding to the focused constituent in the early-position denial (e.g., typically subject), and another with the replacement in a later position corresponding to the focused constituent of the

| Denial Focus Position | Target Position |
|---|---|
| Early | Early |
| Early | Late |
| Late | Early |
| Late | Late |
| Aux-Neg | Early |
| Aux-Neg | Late |

Table 3: Experimental Conditions for Experiment 1

late-position denial (e.g., typically object). The target-bearing replacements began with either a /*b*/ or /*k*/. No other words in the counterassertion contained these segments before the replacement word, nor did the denials. There were an equal number of /*b*/ and /*k*/ targets (24 each). Thus, each utterance frame occurred in six possible forms, as shown in Table 3. The denials in (31) and counterassertions in (32) are examples. In all, there were eight such utterance sequences in each of the six experimental conditions.

The forty-eight experimental sentence frames were arbitrarily divided into groups of eight frames. Six lists of 48 sentence pairs were constructed; on each list the six conditions were equally represented, each sentence group occurring in one of the six conditions. The particular sentence group associated with a condition was rotated across the lists.

In addition to the experimental materials, there was a set of filler sequences consisting of 48 non-denial dialogue sequences. These fillers were intended to obscure the relationship between the denial-counterassertion pairs so that subjects do not adopt special strategies for predicting the replacements. The non-denial fillers consisted of question-answer pairs, or simple sequences of utterances that did not have any spe-

cial focus relationship. Twelve of these filler sentences did not have a target in the second sentence. The median length of the initial utterance of the filler pairs was 6 words, while the median length of the second utterance was 7 words. The same fillers were used in all six lists. In addition, there were 12 filler sequences (containing a phoneme target) that also contained a clear grammatical violation (e.g., number or gender agreement).

In the denial-counterassertion sequences, the replacement term in the counterassertion is always a new lexical item. Thus, the location of the target is perfectly correlated with the introduction of a new term in the utterance. Subjects could have decided (in principle) to respond simply when they detected a new term, ignoring the relationship between the sentences. While we could not prevent subjects from adopting this strategy, given the nature of denial-counterassertion sequences, we tried to identify those subjects who adopted it with the addition of denial-counterassertion catch trials. There were 12 such catch trials consisting of focused denial-counterassertion sequences with no phoneme target, but with a new term in the second sentence. If subjects were responding with a new-term heuristic, they should have false alarmed on these trials. It is assumed that only a few subjects adopted this strategy, if any, because subjects were required to respond to questions about the sentences periodically (see below) [7]. Also, the false alarm rate for these catch trials can be compared to the false alarm rates for the fillers that do not contain targets. More generally, even if subjects did not adopt this strategy, the catch trials should have also discouraged false alarms, and their addition should have also made

[7]The pilot data indicated this, and the results of the experiment also bear this out.

it more difficult for subjects to predict the likelihood of a target occurring based on how much of the sentence had been heard. As with the filler sentences, the same catch trial items were used on all six lists.

The order of the stimulus utterance pairs was arranged pseudo-randomly, with the constraint that roughly equal numbers of the six conditions occur in each quarter of the list, and that no more than three sentences of the same condition follow one another. Different pseudo-random orders were used for the experimental materials across the six lists.

The target-bearing words included nouns (including proper names), verbs, and adjectives. The frequency of the target-bearing words was tabulated from the CELEX lexical database (Baayen, Piepenbrock, & Gulikers, 1993). The average frequency of early position targets was 42.2/million, and the for the late position targets, 48.7/million. The average length of the early-position target-bearing word was 1.69 syllables (median 2), and the late-position target-bearing word, 1.52 syllables (median 1). Finally, because there is evidence that the (lexical) stress of the target phoneme can affect monitoring times (Shields et al., 1974), all target phonemes occurred in stressed syllables.

Ratings were also collected for written versions of the denial-counterassertion pairs. Recall that there are two versions of the pairs, one with the replacement in early position versus the replacement in late position. These versions were compared to ensure that they were equally acceptable sentences. Subjects rated the items on a seven point scale (1 = unacceptable, 7 = acceptable) via a web-based questionnaire. There were no differences between the ratings for the early-replacement denial-

counterassertion pairs (Ave. 5.53) and the late-replacement denial-counterassertion pairs (Ave. 5.47). Clearly ungrammatical foil sentences in this survey were given an average rating of 2.68. The participants who rated the denial-counterassertion pairs did not participate in the phoneme-monitoring experiment proper.

The materials were recorded and digitized by the author using a high-quality microphone and recording equipment. The sentences were recorded at a sampling rate of 25600 Hz, in 16 bit samples, with a low-pass filter with a cutoff frequency of 9 kHz during signal acquisition. A phonological analysis (using ToBI guidelines; Beckman & Ayers, 1994) was conducted on the experimental utterances to confirm the location and extent of the focus placement in the denials, as well as their prosodic phrasing. Measures of peak $F_0$, amplitude, and duration of the focused words were taken to ensure the stimuli had the desired properties. The analyses were conducting using the Praat system (Boersma & Weenink, 1996). Analyses of the counterassertions were also conducted to ensure that there are no appreciable differences with respect to these phonetic variables between target locations for the different replacements, beyond that of normal prosodic variation over the course of a simple declarative utterance.

Table 4 shows the average peak $F_0$ for the experimental materials. Note that in the auxiliary-negation conditions, early focus corresponds to focus on the auxiliary-negation complex. It shows that the average peak $F_0$ for the accents in the early (244.4 Hz) and the auxiliary-negation focus (233.0 Hz) conditions at the early sentence regions were comparable with the accent in the late focus (215.8 Hz) condition at the late sentence region, with a slightly lower peak $F_0$ for the late focus condition. This is

consistent with studies of listeners' perceptions of narrow late-focus (Pierrehumbert, 1979; Rump & Collier, 1996).

| | | Sentence Region | |
|---|---|---|---|
| | | Early | Late |
| Denial | Early-Focus | 244.4 | 116.1 |
| | Late-Focus | 170.4 | 215.8 |
| | Aux-Focus | 233.0 | 109.0 |
| Counterassertion | Early-Replacement | 157.0 | 133.1 |
| | Late-Replacement | 158.4 | 132.5 |

Table 4: Average Peak $F_0$ for the Experimental Materials in Experiment 1 (in Hz).

Figures 1-2 show the pattern of $F_0$ for the experimental materials. Each figure is a plot of $F_0$ for each item in the experiment, for each of the six experimental conditions, plotted on a common interval. The plots were obtained by pitch tracking each utterance, smoothing the resulting contour with a 10 ms window, interpolating the contour, and then smoothing again. The plots show the distribution of accents.

In each counterassertion recording, as well as in the target-containing filler materials, a marker (inaudible to subjects) was placed in the source file at the start of the target segment. This marker triggered the start of the response timer for the experiment software. It is known from previous studies that there is a small degree of error inherent in the placement of this marker, but this is expected, and should have been randomly distributed (and constant across the major comparisons of interest).

On approximately 30% of the trials, a comprehension question followed the sequences, to which subjects responded by providing an answer to the experimenter. These questions concerned content words from the utterances, including target words. For example, for a sequence from (31-32), a typical question might be *Who has a dog?*

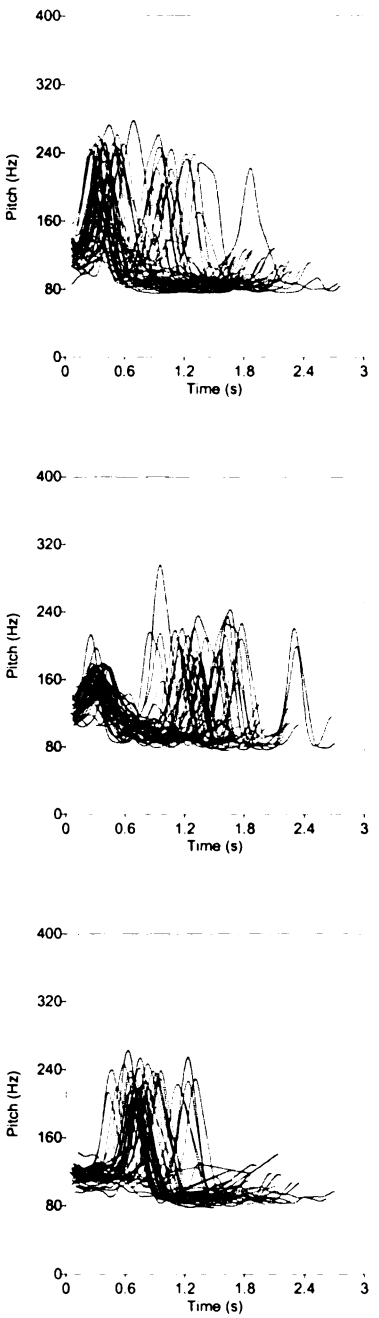


Figure 1: $F_0$ contours (smoothed and interpolated) for the early, late, and aux-negation focus denials.

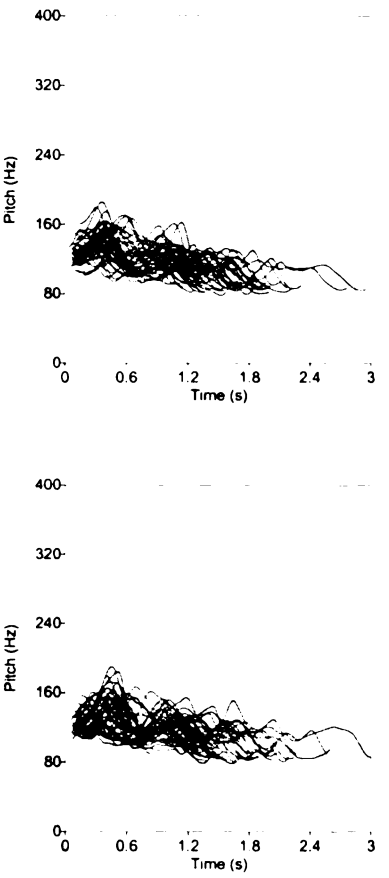


Figure 2: $F_0$ contours (smoothed and interpolated) for the early and late replacement counterassertions.

or *Who has a cat?*.

### 4.2.3 Apparatus

Subjects were tested one at a time in a quiet sound-proofed room with a personal computer, using headphones and a button-box response timer. The experimental materials were digitized for presentation, counterbalancing, and timing purposes. The utterance presentation was controlled by the computer, using software (Clifton, 1990) that presented the target phoneme (as a letter) on a monitor, played the utterance sequence through a soundcard and headphones, and timed subjects' responses using a special-purpose timing card. Response times were calculated from the onset of the target phonemes (determined by the placement of the marker in the audio file) to onset of the responses by the subjects.

### 4.2.4 Procedure

Each trial lasted approximately 5-6 seconds. Subjects started a trial by pressing a button. A target phoneme (in the form of the letters *B* or *K*) was presented on the screen, and subjects pressed a key to start the utterance sequence. There was a pause for 300 ms, then the utterances were presented through the headphones, and then as soon as the subject had responded and the utterance sequence ended, the computer presented feedback concerning detection accuracy (e.g., correct detection, correct rejection, miss, false alarm: this was presented for 1500 ms), and recorded the response time. If a comprehension question was presented, it followed the feedback. The questions were presented visually on the monitor, and remained on screen until

subjects answered and pressed a key.

Subjects were told that they would be participating in a task on sentence comprehension, and that the experimenter was interested in how attention was used for monitoring as comprehension takes place. The subjects' task was to try to understand the sentences, and at the same time monitor them for the occurrence of a word beginning with a target sound. Subjects were told to comprehend the utterance sequences as they normally would if they were listening to a conversation, and to respond as soon as possible (but with high accuracy) by pressing the response key after detecting the target sound. Subjects were told that there would be occasional trials where the target was not present in the sentences, and that also there would be periodic comprehension questions. When the comprehension questions were presented on screen, subjects were asked to answer by providing the experimenter with the answer (which was then written down by the experimenter).

There were 12 practice trials using utterances unrelated to the experimental materials to ensure that subjects understood the task and were well-adjusted to providing speeded responses. Three of the practice trials were catch trials with no target. Subjects were required to meet an 80% accuracy criterion with the practice trials to proceed to the experimental trials (all subjects met this criterion). If subjects responded before the target was presented, or missed a target, feedback was provided by the experiment running program. After the experiment has been completed, subjects were asked a series of questions about the task to determine whether they were aware of any relationship between the sentences (the initial questions were vague, with increasingly specific questions). Most subjects were aware of the repetition of

the sentences across the denial and counterassertion, and some subjects reported that they could predict that the target would be in the second sentence in such cases.

### 4.2.5 Data Analysis

The data consisted of subjects' decisions regarding whether the target phoneme was present in the utterances they monitored (either correct detection or incorrect), and their response times (RT) to make those decisions. For each experimental condition and for each subject, an error rate was calculated. Errors were defined as trials where subjects either responded before a target word has been presented (e.g., false alarm), responded when no target was been presented (also a false alarm), or failed to respond to a presented target (e.g., miss). The error rates were generally low across conditions, and in lieu of parametric statistical tests, the error proportions are simply reported.

The average RTs were analyzed using a repeated measures analysis of variance, with separate analyses based on subjects and items as random factors. Error RTs ($< 1\%$ of the data), as well as RTs less than 100 ms and greater than 1500 ms ($< .5\%$) were trimmed from the data without replacement. Histograms, boxplots, and quantile-quantile plots of the data were first examined to confirm that the assumptions required by the inferential tests held (no systematic deviations were found). In some cases, additional analyses of subject medians and item medians were carried out (results are only reported if the conclusions differ from those of the means analysis). In all cases, the conventional $\alpha$ level of 0.05 was adopted.

If focus serves to activate alternatives to the focused constituent, then there should be different types of alternatives activated when different constituents are focused in

the denial. Previous experiments (Bock & Mazzella, 1983) have shown an advantage for acceptability judgments of denial-counterassertion sequences when the foci of the denial and the replacement in the counterassertion match. However, even without contrastive focus on the replacement in the counterassertion, subjects should be faster in a phoneme-monitoring task to detect target-phonemes on the constituent that has been predicted to be replaced by the focused denial, and slower to detect targets that have not been predicted. Thus, there are several specific predictions for the present experimental task that follow. The first is a general hypothesis, based on the findings of the previous work reviewed earlier. The second two hypotheses concern the relative benefits and costs of subjects' predictions.

First, subjects should be faster to detect targets on constituents of the counterassertion when the focus of the denial preceding it has predicted the replacement of that constituent, compared to the case where the focus of the denial predicts that the replacement will be somewhere else. To test this hypothesis, two planned comparisons were carried out. At early position targets, the average detection times for the early-focus condition were contrasted with the times for the late-focus condition. The corresponding comparison between late- and early-focus conditions was calculated for the late position targets as well. The null hypothesis in both cases is that the contrastive focus will not lead to different expectancies, and thus no differences in average detection times. The alternative hypotheses are that monitoring latencies will be *faster* at predicted versus mispredicted target locations, for both early- and late-position targets.

Second, it can be predicted that subjects will be faster at predicted target locations

relative to a neutral baseline. The baseline adopted in this study is the case where the auxiliary-negation complex is focused in the denial. Two planned comparisons were carried out to test this hypothesis: At the early position target locations, the detection times for the condition where the corresponding early constituent of the denial was focused were contrasted with the condition where the auxiliary-negation was focused. The corresponding comparison was calculated for the late position targets as well (i.e., late-focus versus aux-negation focus). The null hypothesis in both cases is that subjects will not be any faster (or slower) when the replacement has been predicted, compared to the neutral baseline. The alternative hypothesis is that subjects will be *faster* in the predicted cases. Support for the alternative hypothesis would indicate a benefit for the validly-cued targets.

Finally, it can be predicted that subjects will be slower at target locations that have actually been predicted to be somewhere else in the sentence (via the prediction that the replacement would be somewhere else), relative to the baseline condition. Two planned comparisons will test this. At early position target locations, the detection times in the late-focus condition were contrasted with the times in the baseline condition. The corresponding comparison at the late position targets was carried out as well (i.e., early-focus versus aux-negation focus). The null hypothesis in both cases is that detection times will not be any slower (or faster) when the replacement has been mispredicted, relative to the baseline conditions. The alternative is that subjects will be *slower* in the mispredicted cases. Support for the alternative hypothesis in this instance would indicate a cost for invalidly-cued targets.

## 4.3 Results

### 4.3.1 Detection Times

Table 5 shows the average detection times for early and late targets in the counterassertions as a function of focus position in the denials. It shows that at the early position targets, subjects were faster (85 ms) to detect phoneme targets when the focus in the preceding denial was also early, compared to the case where the focus was late. The omnibus ANOVA for early position targets was significant by both subjects, $F_1(2,29) = 4.86$, $p < .001$, $MSE = 29742$; and items, $F_2(2,47) = 9.72$, $p < .001$, $MSE = 44592$. The difference between early (514 ms) and late (599 ms) focus conditions at the early target positions was signficant by both subjects, $F_1(1,29) = 10.49$, $p < .001$, $MSE = 29742$; and items, $F_2(1,47) = 18.99$, $p < .001$, $MSE = 44592$ analyses. There were no statistically significant differences between the different focus conditions at the late target positions.

| | | Target Position | |
|---|---|---|---|
| | | Early | Late |
| Denial Focus | Early | 514 (139) | 390 (122) |
| | Late | 599 (135) | 378 (134) |
| | Aux-Neg | 557 (122) | 375 (92) |
| | Ave. | 557 (100) | 381 (103) |

Table 5: Average RTs to Detect Target Phonemes (Standard Deviations in Parentheses).

Table 5 also shows that for early position targets, subjects were 43 ms faster on average to detect phonemes following early focus denials (514 ms) compared to the auxiliary-negation focus baseline (557 ms), suggesting a benefit. Planned comparisons

provide partial support for this difference: The difference was significant by items, $F_2(1,47) = 6.253$, $p = .008$, $MSE = 44592$; but marginal by subjects, $F_1(1,29) = 2.277$, $p = .07$, $MSE = 29742$. [8]

Also, subjects were 42 ms slower on average to detect phoneme targets following late focus denials (599 ms) compared to the auxiliary-negation focus baseline (557 ms), suggesting a cost. This difference was again significant by items, $F_2(1,47) = 4.194$, $p = .02$, $MSE = 44592$; but marginal by subjects $F_2(1,29) = 2.420$, $p = .07$, $MSE = 29742$.

For the late position targets, there appeared to be little difference in the average detection times across the different focus conditions, and there were no statistically significant differences between the different focus conditions compared to the baseline, by either subjects or items. In addition to the planned comparisons, another salient feature of the data is that the average detection times for late position targets were about 175 ms faster than early position targets. These faster detection times for later targets are consistent with past studies of phoneme-monitoring (e.g., Foss, 1969).

### 4.3.2 Error Rates

Table 6 shows the proportion of responses that were either correct or in error.

The false alarm rates and the miss rates were generally low and uniform across the target-present experimental conditions. There appears to be a small but systematic difference in the miss rates, such that misses were slightly more common in the early

[8] For what it is worth, an analysis of the subject medians for this comparison was significant, $F_1(1,29)=3.26$, $p = .04$.

| Focus-Target | Hits | Corr. Reject. | Misses | False Alarms |
|---|---|---|---|---|
| Early-Early | .96 | . | .04 | .00 |
| Early-Late | .97 | . | .01 | .02 |
| Late-Early | .93 | . | .06 | .01 |
| Late-Late | .98 | . | .00 | .02 |
| Aux-Early | .93 | . | .04 | .03 |
| Aux-Late | .98 | . | .00 | .02 |
| Denial-Catch | . | .99 | . | .01 |

Table 6: Proportion of Responses, by Condition.

target conditions. However, chi-square tests of independence provided no evidence that either the number of false alarms, $\chi^2$ (2) = 2.9, $p$ = .24, or the number of misses, $\chi^2$ (2) = 2.5, $p$ = .29, were dependent on the focus/target relationship. Table 6 also shows that subjects (correctly) rejected the catch trials sequences in nearly all cases.

## 4.4 Discussion

The results of this experiment support the hypothesis that listeners can use the information provided by a contrastive focus in a denial to construct a contrast set that can be used by them to predict the likely location of replacement information in a following counterassertion.

Subjects were faster to detect early position targets following early position denials, compared to their detection times at the same position following late position denials. This effect was predicted by the hypothesis, and is similar to the result obtained by Cutler and Fodor (1979). This effect shows that it is sufficient for the denial to contain a contrastive accent in order for the denial to have the effect of directing listeners' attention to the replacement part of the counterassertion.

A corresponding detection time advantage was not observed at later target positions following late denial focus. Subjects were equally fast at detecting targets later, and this is not consistent with the main hypothesis. On closer inspection of the data from Cutler and Fodor (1979), however, the results of the experiments appear to be quite similar. Cutler and Fodor (1979) found a relatively small advantage at late positions, suggesting that the attention-directing effect may be attenuated over the course of the target-containing sentence. The literature on the phoneme-monitoring task itself also suggests this, as the phoneme-target position within a sentence is known to affect detection times (e.g., later positions often have faster detection times in general; Connine & Titone, 1996).

A plausible reason for the lack of a late position effect is that in phoneme monitoring, sentence regions may intrinsically differ with respect to how informative they are concerning the likely location of a phoneme target. For example, early within a sentence, the (subjects' estimated) probability of a phoneme target appearing within the next instant is a function of how many total words are likely to appear within the current sentence. In many cases, this would not be estimable, because a listener cannot know the content or length of a sentence they have not yet heard. In the case of denial-counterassertion sequences like the present experiment, however, subjects may anticipate that the second sentence of the pair will be much the same length as the first because the counterassertion essentially echoes the denial. Therefore, a rough estimate (e.g., low or high) of the likelihood that a target will appear within regions of the second sentence could have been obtained (in principle). If subjects were able to do this, then early within the counterassertion, the likelihood of a target

appearing would have been (estimated to be) lower than later in the counterassertion, because as more of the sentence has been recognized, less of it remains to be heard (e.g., an increasing hazard function). Near the end of the sentence, the (estimated) probability of a target appearing within each next instant would approach 1.0, if a target was expected in the utterance. Subjects could have used this information in the early denial focus cases to prepare for a late target because once the early part of the counterassertion had been heard in that case, they could have anticipated that the target would appear soon after.

Note that this is purely a task consideration. Such likelihood estimates about the length and/or content of sentences during the comprehension of running dialogue may or may not operate during non-experimental settings (which would not ordinarily involve decisions about phoneme targets, obviously), but on the other hand may be an intrinsic property of processing serially-presented information that has discrete units and a bounded length.

The second main consideration in this experiment was whether the cueing effect of the focus in the denial is due to a cost of mis-predicting the likely location of the phoneme-target and/or a benefit of predicting the likely location correctly. The experiment found some support for both a cost and a benefit, as subjects were faster for validly-cued phoneme targets, compared to the baseline condition, and were (equivalently) slower to detect targets in invalidly cued locations. Only partial support was obtained, however, as the effects were marginal in the subjects analysis but significant in the items analysis. One can cautiously conclude, therefore, that the attentional cueing effect of the denial can result in both benefits and costs.

In sum, the basic hypothesis that contrastive focus in a denial is sufficient to direct attention to replacements in a counterassertion has been supported, and the results appear to be similar to closely related experiments conducted previously.

# 5 Cleft Denials

In Experiment 1, the counterassertions that followed the denials were essentially "echo" counterassertions, because they preserved the same syntactic form and most of the lexical items from the original denial. The data from Experiment 1 suggested that the intonational focus effect only occurred for the early target positions of the counterassertions. This finding is consonant with the data pattern (Cutler & Fodor, 1979) obtained for question-answer pairs, but a number of questions remain.

First, in at least one well-known view of information structure, the default arrangement of given and new information in a simple assertion is for given information to precede new, and the corresponding default location for focus is at the end of an utterance (e.g., Halliday, 1967; and the Praguean notion of Communicative Dynamism, Sgall, Hajičová, & Panevovă, 1986). If participants were expecting this default arrangement for the counterassertion, then the data pattern in Experiment 1 should have been opposite to what was actually obtained because participants should have expected the replacement in later positions rather than earlier. Thus, in this sense the results are counterintuitive, and warrant further investigation of the basis for the data pattern that was obtained. There are a number of potential explanations for the results.

First, participants may have adopted a linear position heuristic for the task (along the lines of the likelihood estimation process outlined earlier), expecting that if the focus in the denial is early, then the target would also be early. Such a heuristic would be sufficient to predict the data pattern found in Experiment 1, if participants were

(in addition) faster at later positions because the end of the sentence was predictable.

Second, for the majority of the items in the first experiment, the early target positions in the counterassertion coincided with subject position. It is potentially a problem (and/or interesting feature of the data) that the location of the target was usually confounded with grammatical position. Rather than simple linear position heuristic, participants may have been generally faster to detect targets in subject position when that position is predicted to be focused.

Finally, along the same lines, the location of the target was largely confounded with thematic role assignment. If the subject was denied, then the subject was replaced; but it was also also true that the Agent was replaced as well, as the role usually assigned to subject position was Agent. Rather than simple linear position or grammatical position, the matching thematic role assignment (for the subject-assigned roles) could have been responsible for the benefit observed.

To investigate these questions, two experiments were carried out using cleft sentences as denials. Both experiments examined how participants monitored for targets in simple counterassertions following *It*-cleft denials. In the first experiment, subjects heard cleft denials which denied either the subject or object, followed by counterassertions which replaced either the subject or object. The target phoneme appeared on the replacement in the experimental trials of interest. In the second experiment, subjects again heard cleft denials replacing either the subject or object. These were followed by counterassertions with the replacement of the subject or the object. However, the subject replacement case also included cases where the counterassertion was a passive sentence.

## 5.1 Experiment 2A

Like Experiment 1, the main experimental manipulations were to change the location of the pitch accent signaling the focus in the denial, and the location of the replacement in the counterassertion containing the phoneme target. However, in this experiment the denials were *It*-clefts. There were two types, either a subject- or an object-cleft. The utterances in (33) provide an example of the denials, and (34), the counterassertions (again, the example target phoneme is /*k*/).

(33) It isn't LAURIE who has a dog. (cleft-subject)

It isn't a DOG that Laurie has. (cleft-object)

(34) Kathy has a dog. (early position)

Laurie has a cat. (late position)

The rationale for using the cleft denials is that the linear position of the focused constituent is held constant at an "early" position. This allows for the comparison between subject and object denials on monitoring times for early position targets in the counterassertions[9].

Therefore, the design is a factorial within-subjects design with type of cleft denial (subject, object), and location of the target in the counterassertion (early, late) as factors. This provides four different experimental conditions total. The main combination of interest is the case where the focus in the cleft denial is the subject (e.g., *It isn't LAURIE who has a dog.*) and the target is found early in the counterassertion

[9]It also allows for a comparison at later position targets, but based on the results of the first experiment, a focus effect would not necessarily be expected there.

(e.g., *Kathy has a dog.*). If it is the grammatical (or thematic) role that participants are expecting to be the replacement, they should be faster to detect the target in this condition than the case where the focus in the cleft denial is the object (e.g., *It isn't a DOG that Laurie has.*). If subjects are simply responding based on linear position, no difference is expected.

## 5.2 Method

### 5.2.1 Subjects

The participants for this experiment were drawn from the same pool as Experiment 1. Sixteen subjects participated for either monetary compensation or course credit. All were native speakers of English. The average age was 20.6, the average years of formal education, 13.9, and the average vocabulary score (Shipley, 1940; out of 40) was 29.8. No subject reported difficulties with hearing. Participants were randomly assigned to counterbalancing conditions.

### 5.2.2 Materials

The experimental materials for this experiment were based on the materials from Experiment 1, with some of the items replaced so that subject- and object-clefts could be created (see Appendix B). The experimental sentences consisted of 40 dialogue sequences composed of a denial followed by a counterassertion. The materials for these sentences were constructed from 40 utterance frames with appropriate modifications of the cleft in the denial, or the location of the replacement in the counterassertion.

The average length of the denials was 8.5 words (Ave. 12.7 syllables, Ave. duration 2.487 s), and the average length of the counterassertions was 5.5 words (Ave. 7.5 syllables, Ave. duration 1.919 s).

The denials were constructed by forming a cleft from the basic declarative form of the sentences used in Experiment 1. Two versions of the denial were recorded, either denying the subject or the object. Two versions of each counterassertion were recorded, one with the target-bearing replacement in an early position, and the other with the replacement in a later position, as in Experiment 1. Also as in Experiment 1, the target-bearing replacements began with either a /*b*/ or /*k*/. No other words in the counterassertion contained these segments, nor did the denials. There were an equal number of /*b*/ and /*k*/ targets (20 each) in the experimental items.

Thus, each utterance frame occurred in four possible forms (see Table 7). The denials in (33) and counterassertions in (34) are examples. In all, there were ten utterance sequences in each of the four experimental conditions.

| Denial Focus | Replacement |
|---|---|
| Cleft-Subject | Subject |
| Cleft-Subject | Object |
| Cleft-Object | Subject |
| Cleft-Object | Object |

Table 7: Experimental Conditions for Experiment 2A

The forty experimental sentence frames were arbitrarily divided into groups of ten frames. Four lists of 40 sentence pairs were constructed; on each list the four conditions were equally represented, each sentence group occurring in one of the four conditions. The particular sentence group associated with a condition was rotated

across the lists. The order of the stimulus utterance pairs was arranged pseudo-randomly, with the constraint that roughly equal numbers of the four conditions occur in each quarter of the list, and that no more than three sentences of the same condition follow one another. Different pseudo-random orders were used for the experimental materials across the four lists. The same fillers from Experiment 1 were used in this experiment as well.

The utterances were recorded, analyzed and prepared for the experiment in the same manner as Experiment 1. On approximately 30% of the trials in the experiment, a comprehension question followed the utterance pair, as in Experiment 1.

### 5.2.3 Apparatus and Procedure

The apparatus and the experiment-running program for this experiment was the same as in Experiment 1. Likewise, the protocol and instructions were the same.

### 5.2.4 Data Analysis

The data were analyzed in the same manner as Experiment 1. Error RTs ($< 0.1\%$) and RTs less than 100 ms and greater than 1500 ms ($< 0.01\%$) were excluded from the analysis.

Essentially the same general hypotheses in Experiment 1 apply in this experiment as well, except that they apply in terms of cleft denials, and that there is no baseline condition. In the clefts used in this experiment, either the subject or the object was denied, and this should activate alternatives to either the subject or the object. Participants should expect that a counterassertion following the denial would replace

the corresponding subject or object, and direct their attention to that portion of the counterassertion.

A specific prediction is that subjects should be faster to detect phoneme targets on subject replacements in a counterassertion following cleft-subject denials, compared to cleft-object denials. Likewise, subjects should be faster to detect targets on object replacements in a counterassertion following cleft-object denials, compared to cleft-subject denials. These two hypotheses will be tested by planned comparisons, with the null hypothesis of no difference in detection times in both cases. The alternative hypothesis will be that subjects will be *faster* in the matching cases than the mismatching cases.

The alternative account of the detection time pattern in Experiment 1 is that participants responded in terms of a simple linear-position heuristic, expecting that if the focus in the denial was early then the replacement would also be early. This account predicts that there will be no difference between the subject- and object-cleft conditions at the early target locations.

## 5.3 Results

### 5.3.1 Detection Times

The average phoneme detection times are shown in Table 8. Like the first phoneme-monitoring experiment for early positions, participants were faster to detect targets at the subject replacement position when the preceding denial was a denial of the subject, compared to a denial of the object. Crucially, however, in both cases the

denied constituent is early. Also like the previous experiment, at the later target positions in the counterassertions, there was little difference due to the two focus conditions.

| | | Target Position | |
|---|---|---|---|
| | | Subject | Object |
| Cleft Denial | Subject | 419 (51) | 345 (60) |
| | Object | 537 (83) | 353 (93) |
| | Ave. | 482 (58) | 349 (69) |

Table 8: Average RTs to Detect Target Phonemes (Standard Deviations in Parentheses)

The planned comparisons support this description. The 111 ms faster average detection time following the subject-focused denials at the early target position was statistically significant for both subjects, $F_1(1, 15)=38.1$, $p < .0001$, $MSE=2950$; and items, $F_2(1, 39)=34.5$, $p < .0001$, $MSE=8932$. The $F$ statistics for the late position targets were both non-significant.

### 5.3.2 Error Rates

The proportions of the different response types are shown in Table 9. Participants were generally accurate and unbiased in target detection, the average hit rate at over 0.96, and the average false alarm rate at 0.01.

Chi-square tests of independence provided no evidence of dependence of the number of misses or false alarms on experimental condition.

| Focus-Target | Hits | Corr. Reject. | Misses | False Alarms |
|---|---|---|---|---|
| Subject-Subject | .96 | . | .03 | .01 |
| Subject-Object | .98 | . | .01 | .01 |
| Object-Subject | .92 | . | .07 | .01 |
| Object-Object | .99 | . | .00 | .01 |
| Denial-Catch | . | .99 | . | .01 |

Table 9: Proportion of Responses, by Condition

## 5.4 Discussion

This experiment showed that participants are faster to detect targets on the subjects of counterassertions following cleft subject denials compared to cleft object denials. This finding replicates the finding from Experiment 1 with the cleft construction. Also like Experiment 1 with the late position targets, there was little effect of the different cleft constructions on monitoring latencies for the object position targets.

This finding rules out the possibility that subjects were applying a linear position heuristic in this task, because this heuristic would predict no detection time difference for the subject versus object clefts (because both are "early" focus constructions). Instead, the evidence suggests that subjects are sensitive to the grammatical status of the focused constituent in the denial. This finding supports the original hypothesis that focus serves to activate alternatives to the focused constituent in denials, and that subjects use this information to attend to potential alternatives to the denied expression when processing counterassertions, even if the counterassertions themselves do not contain narrow foci.

While this experiment provides evidence against the linear position heuristic, it does not distinguish between an account where participants require the thematic role

in the replacement match the thematic role assigned to the denied constituent in the denial, versus an account where only the grammatical position is required to be the same (irrespective of the thematic role assigned). In the present experiment, as in Experiment 1, the thematic role assigned to the subject or object was also the same thematic role assigned to the replacement subject or object in the counterassertion. So, it remains a possibility that the match in thematic role is responsible for the benefit observed in Experiments 1 and 2A. The next experiment is designed to investigate this issue.

## 5.5 Experiment 2B

In Experiment 2A, the grammatical position and the thematic role assigned to the denied and replaced constituents were equated. If an Agent assigned to subject position was rejected in the denial, then an Agent assigned to subject position was replaced in the counterassertion[10]. It remains a possibility that the detection time benefit for (early) subject position targets observed in Experiments 1 and 2A are only obtained if the same thematic role is replaced in the denial and the counterassertion (e.g., only if Agent replaces Agent).

One way to disentangle grammatical position from thematic role is to use an alternation such as the passive to place a different thematic role in subject position. The present experiment used cleft denials, as before, and counterassertions that replaced

[10]Note that I am using the terms "subject position" and "object position" in a descriptive sense to refer to the underlying grammatical relation that, in a derivational framework, would be analyzed as a relation between the moved constituent in the cleft, its trace, and a position such as Spec, IP or Comp, VP. No particular theoretical status should be ascribed to the terms "subject" or "object".

the subject in either an active or passive utterance. This holds both the linear position and the grammatical position constant (at an early linear position, and at subject position), but changes the thematic role assigned to the subject in the counterassertion. The experiment also included late object position targets. The utterances in (35) and (36) provide examples (Note: Target phoneme is /*b*/).

(35) It wasn't MARIA who alarmed Lauren. (cleft-subject)

It wasn't LAUREN whom Maria alarmed. (cleft-object)

(36) Betsy alarmed her. (early position-active)

Betsy was alarmed. (early position-passive)

Maria alarmed Betsy. (late position-active)

Note also that the target-bearing term is the same in all locations, unlike the previous designs.

## 5.6 Method

### 5.6.1 Subjects

Like Experiment 2A, the participants for this experiment were drawn from the same pool as Experiment 1. Eighteen subjects participated for course credit. All were native speakers of English. The average age of the participants was 19.5, the average years of formal eduction, 13.9, and the average vocabulary score (Shipley, 1940; out of 40), was 29.3. No subject reported any hearing difficulties. As before, participants were randomly assigned to counterbalancing conditions.

### 5.6.2 Materials

The experimental sentences consisted of 48 newly-constructed dialogue sequences composed of a denial followed by a counterassertion (see Appendix C). The materials for these sentences were constructed from 48 utterance frames with appropriate modifications of the cleft in the denial, or the location of the replacement in the counterassertion and the voice of the counterassertion. So, unlike Experiment 2A, the counterassertions included passive-form sentences, and also, the target-bearing lexical items in this experiment were the same across all six conditions. The sentences all contained an Agent and either a Recipient or Patient thematic role, and all could be passivized. Note that passives were truncated passives, both because they sound more natural in the sequence, and because using them avoided the *by*-phrase, which allowed the use of /*b*/ targets, as in the previous experiments.

The experimental conditions for the experiment are shown in Table 10.

| Denial Focus Position | Counterassertion Type |
|---|---|
| Cleft-Subject | Subject-Active |
| Cleft-Subject | Subject-Passive |
| Cleft-Subject | Object-Active |
| Cleft-Object | Subject-Active |
| Cleft-Object | Subject-Passive |
| Cleft-Object | Object-Active |

Table 10: Experimental Conditions for Experiment 2B

The denials consisted of subject or object clefts of simple declarative utterances with the addition of negation in the cleft. Two versions of the denials were recorded, either denying the subject or the object. Three versions of each counterassertion

were recorded, one with the target-bearing replacement in subject position of an active counterassertion (typically assigned an Agent thematic role), another in subject position of a passive counterassertion (typically assigned a Patient thematic role), and the other with the replacement in object position of an active counterassertion (typically assigned a Patient thematic role). Also as in Experiments 1 and 2A, the target-bearing replacements began with either a /*b*/ or /*k*/. No other words in the counterassertion contained these segments, nor did the denials. There were an equal number of /*b*/ and /*k*/ targets (24 each) in the experimental items. The average length of the denials was 7.0 words (Ave. 11.2 syllables, Ave. duration 2.359 s), and the average length of the counterassertions was 3.5 words (Ave. 5.5 syllables, Ave. duration 1.4023 s). Thus, each utterance frame was presented in six possible forms (see Table 10). In all, there were eight utterance sequences in each of the six experimental conditions per subject.

Similar to the previous experiments, the forty-eight experimental sentence frames were arbitrarily divided into six groups of eight frames. Six lists of 48 sentence pairs were constructed; on each list the six conditions were equally represented, each sentence group occurring in one of the six conditions. The particular sentence group associated with a condition was rotated across the lists. The order of the stimulus utterance pairs was arranged pseudo-randomly, with the constraint that roughly equal numbers of the six conditions were present in each quarter of the list, and that no more than three sentences of the same condition followed one another. Different pseudo-random orders were used for the experimental materials across the lists. The same fillers from Experiments 1 and 2A were used in this experiment as well.

The utterances were recorded, analyzed and prepared for the experiment in the same manner as Experiments 1 and 2A. On approximately 30% of the trials in the experiment, a comprehension question followed the utterance pair.

### 5.6.3 Apparatus and Procedure

The apparatus and the experiment-running program for this experiment was the same as in Experiments 1 and 2A. The protocol and instructions were also the same.

### 5.6.4 Data Analysis

The data from this task consists of participants' decisions regarding the presence of the phoneme target in the utterance pairs, and their response times to make those decisions. The data were analyzed as in Experiments 1 and 2A. Prior to the inferential tests, trimming the error RTs resulted in the removal of $< 1.2\%$ of the data, while no data were removed by applying the criteria of 100 ms $>$ RT $>$ 1500 ms. There was one missing cell in the items analysis for this experiment (because of error responses in that cell —recall that there were three items per cell in the items analysis). A replacement mean for that item was calculated using the procedure described in Winer (1971).

As in Experiment 2A, the basic hypothesis is as it was in Experiment 1. Participants should expect the counterassertion to replace the focused constituent of the denial, and should be faster to detect a phoneme target that is present at the expected location (compared to unexpected locations). This experiment was designed to show whether or not the replacement must carry the same thematic role as it was in the

denial in order for the detection time advantage to materialize.

One planned comparison will contrast the average detection times following the subject-cleft denial, at the subject position targets in the active counterassertions versus the subject position targets in the passive counterassertions. The null hypothesis is that the detection times will be equivalent. Because these two counterassertions differ in the thematic roles assigned to the subject, if the detection time advantage depends on a matching thematic role assigned to the subject across the denial and the counterassertion, the alternative hypothesis is that participants will be *faster* to detect targets on subjects of active counterassertions.

Another planned comparison will contrast the detection times following the subject and object cleft denials at the subject position targets in the counterassertions (averaging across active and passive form). This comparison tests the same hypothesis as in Experiment 2A, and thus serves as a replication.

Finally, another planned comparison will contrast the average of the detection times at two subject position target locations (e.g., the active and passive counterassertions) with the detection times at the object target position. Unlike the previous experiments that had different lexical items at the early and late target positions, the present experiment allows the unambiguous test whether the later (object) target position is faster (the null hypothesis is no difference).

## 5.7 Results

### 5.7.1 Detection Times

The average detection times for the second cleft experiment are shown in Table 11. The same basic result obtained in the first cleft experiment was obtained for this experiment as well: Participants were faster to detect targets on subject replacements when the preceding denial was a cleft of the subject rather than the object, by approximately 31 ms (averaged over active and passive) in the present case. This difference was significant by both subjects, $F_1(1,17)=4.38$, $p=.03$, $MSE=41666$; and items, $F_2(1,47)=8.10$, $p=.003$, $MSE=19404$.

There was little evidence of a difference in detection times at the object position target across the two focus conditions.

| | | Target Position | | |
|---|---|---|---|---|
| | | Sbj-Active | Sbj-Passive | Obj-Active |
| Cleft Denial | Subject | 465 (86) | 481 (102) | 436 (79) |
| | Object | 502 (97) | 506 (102) | 441 (143) |
| | Ave. | 484 (70) | 494 (93) | 439 (104) |

Table 11: Average RTs to Detect Target Phonemes (Standard Deviations in Parentheses)

The main purpose of this experiment was to test whether the advantage in detection times observed in the previous experiments depends on the thematic role assigned to the replacement. As Table 11 shows, participants were approximately as fast detecting targets on replacements in subject position of an active counterassertion (465 ms) as in a passive counterassertion (481 ms), following the cleft-subject denials. A planned comparison for these two conditions showed that this 16 ms differ-

ence was not significant by subjects, $p = .38$, or items, $p = .42$. Because the thematic roles assigned to the two different types of counterassertions differ, this comparison provides no evidence that the detection time advantage depends on the thematic role assigned to the replacement.

Like the previous experiments, participants were faster to detect later targets in the counterassertions than earlier targets. In the previous phoneme-monitoring experiments, there were always different carrier words for the targets in early and late positions, ruling out a direct test. In the present experiment, the same target words were used in all target positions, so a comparison can be made. As the marginal means in Table 11 show, participants were approximately 50 ms faster to detect later (i.e., object) targets compared to the average of the earlier position targets (e.g., sbj-active & sbj-passive), and this difference was significant by both subjects, $F_1(1,17)=13.8$, $p=.002$, $MSE=41666$; and items, $F_2(1,47)=10.5$, $p=.002$, $MSE=19404$.

### 5.7.2 Error Rates

The error rates for the second cleft experiment are shown in Table 12.

| Focus-Target | Hits | Corr. Reject. | Misses | False Alarms |
|---|---|---|---|---|
| Subject-Sbj-Act | 0.98 | . | 0.01 | 0.01 |
| Subject-Sbj-Pass | 0.99 | . | 0.00 | 0.01 |
| Subject-Obj-Act | 0.96 | . | 0.00 | 0.04 |
| Object-Sbj-Act | 0.96 | . | 0.01 | 0.03 |
| Object-Sbj-Pass | 0.93 | . | 0.03 | 0.04 |
| Object-Obj-Act | 0.97 | . | 0.00 | 0.03 |

Table 12: Response Proportion by Type and Condition

It shows that participants were generally accurate in detecting the phoneme tar-

gets, and that the false alarm and miss rates were generally uniform across conditions. Chi-square tests for independence for the number of misses and false alarms provided no evidence of differences across experimental conditions.

## 5.8 Discussion

Participants were faster to detect targets in the subject positions following a subject cleft denial, compared to the object cleft denials. This pattern replicates earlier results in Experiments 1 and 2A, and thus offers support for the same basic hypothesis. One difference between the experiments is that the average difference in detection times between subject-cleft and object cleft-denial conditions at the subject position targets is smaller in this experiment (31 ms) than in Experiment 1 (85 ms) or Experiment 2A (111 ms), however. It is not immediately obvious what is responsible for this difference in magnitude, although it could be due to a difference in experimental materials. Most of the targets in the present experiment were (common) proper names, while in the other experiments a small proportion of the target-bearing items were proper names. In any case, the essential pattern of results is the same across the experiments, if not in magnitude. Also like in the previous experiments, there was little difference at the object position across the different clefts.

There was little evidence that the difference between subject and object cleft denial foci at the subject position targets depends on the thematic role assigned to it. Participants were about as fast to detect targets on Patient/Recipient-assigned subjects in the passive counterassertions as they were to detect Agent-assigned subjects

in the active counterassertions. A difference would be expected on the view that participants are expecting the thematic role rejected in the denial will be the role replaced in the counterassertion when they make the phoneme decision. An alternative explanation is that participants are expecting the same grammatical position to be replaced in the counterassertion as has been rejected in the denial. This explanation is discussed in detail in the (see Chapter 7).

This experiment also showed that the detection times at later (object) target positions are faster than earlier (subject) target positions, a pattern seen in all experiments thus far. Because the targets were the same in all positions in this experiment, it can be concluded that it is the position of the target within the utterance, and not the difference in target-bearing lexical items that is responsible for the faster detection times at later positions. An argument was already presented for why participants may be faster in later positions in the phoneme-monitoring task (see Section 4.4), so it will not be repeated here.

In sum, Experiment 2B supports the basic hypothesis that the focus of a denial (in this case signalled by a cleft construction) is sufficient to direct the attention of listeners to potential alternatives in a counterassertion. It offers no evidence for the hypothesis that listeners require the thematic role assigned to the rejected constituent in the denial match the role assigned to the replacement in the counterassertion for these sequences. Note also, that Experiment 2B replicates the finding from Experiment 2A that the focus effect can be found holding linear position constant. In both experiments, even though the focus was early, in a (surface) linear position sense, there was an effect of the grammatical position that was denied (e.g., either subject

or object). This finding argues against an account based on a simple linear position heuristic.

# 6 Denial Focus in Disjunctions

Experiments 1 and 2 provided persistent evidence of an effect due to focus in denials preceding counterassertions, but only at early target positions in the phoneme monitoring task. It is possible that the lack of a late position effect is an artifact of the phoneme monitoring task itself, suggesting the need to study the problem with a different experimental task. Also, the dual-task nature of the phoneme monitoring task (listeners must split attention between monitoring the phonological/phonetic properties of the utterances and interpreting them to answer questions) may limit the generalizability of the findings, because it remains a possibility that the cueing effect only emerges under dual task conditions.

To provide converging evidence for the results obtained earlier, this experiment will adapt a paradigm from Johnson-Laird and Tridgell (1972), discussed in Section 2.1.1, so that narrow focus can be manipulated in a case where a denial is heard in response to a disjunction like (37). The purpose of this experiment is to offer converging evidence for the conclusions of Experiment 1 using a different experimental task.

Johnson-Laird and Tridgell (1972) presented subjects with a pair of sentences, and asked them to produce a conclusion that logically followed from the pair. The first sentence was a simple disjunction like (37).

(37) John is intelligent or he is rich.

The second sentence was a denial, either an explicit denial, as in (38), or a denial in the form of an affirmative, as in (39).

(38) John is not rich.

(39) John is poor.

Johnson-Laird and Tridgell (1972) did not investigate the role of focus during denial processing, as the experiment was simply meant to support the earlier suggestion by Wason (1965), who himself had not investigated intonation. However, it is reasonable to hypothesize that intonationally-signaled focus would also play a role in the interpretation of the denials in this paradigm, and that processing the focused denial could have an effect similar to that hypothesized in Experiments 1 and 2.

Thus, this experiment will use a paradigm similar to Johnson-Laird and Tridgell (1972) to investigate how the narrow focus is used in denials to process counterassertions. Besides the addition of intonational focus in the denial, there were several other modifications to the paradigm. Subjects will hear an assertion like the disjunction in (37) produced by one speaker, and this was followed by a focused denial produced by another speaker, mimicking an overheard dialogue (examples are provided below). Also, rather than producing a logical conclusion, subjects will then see a short, visually-presented counterassertion and decide whether it *could* logically follow from what they have just heard. In all of the experimental trials of interest, the visually-presented counterassertion could logically follow from the sequence. On some trials in the task, however, items were presented such that the visually-presented counterassertion could not follow from the disjunction and denial. From the subject's perspective, the task is a comprehension task. Subjects' response times and accuracy rates to make a decision in response to the visually-presented sentence were the

primary dependent variables.

The key experimental manipulation in this paradigm was the introduction of a narrow focus in the denial. Note first that the initial assertion contains a pair of attributes in an "or"-disjunction, like *brown* or *grey* in (40) below.

(40) A: The car next to the van was either brown or grey.

The denial explicitly negated one of the pair from the disjunction, and on some trials there was an accent indicating narrow focus in the denial on that item (e.g., *brown*). On other trials the accent fell on an earlier constituent such as the grammatical subject (e.g., *the car*), which was not a member of the disjunction. The hypothesis (as in Experiments 1 and 2) is that the denial will be interpreted as restricted to the focused term, with the rest of the denial kept as a presupposition.

Here are four representative sequences. The first two, (41-42), are cases where the focus in the denial is a valid predictor of the replacement in the counterassertion. The second two, (43-44), are cases where the focus is a invalid predictor of the replacement.

(41) A: The car next to the van was either brown or grey (spoken)

B: The car wasn't BROWN ... (spoken, focus on object)

The car was grey. (visually presented)

(42) A: The car next to the van was either brown or grey (spoken)

B: The CAR wasn't brown ... (spoken, focus on subject)

The van was brown. (visually presented)

(43) A: The car next to the van was either brown or grey

B: The car wasn't BROWN ...

The van was brown.

(44) A: The car next to the van was either brown or grey

B: The CAR wasn't brown ...

The car was grey.

Subjects should be faster to respond to the cases where the focus in the denial is a valid predictor of the replacement (e.g., 41-42) than the cases where it is an invalid predictor (e.g., 43-44).

## 6.1 Experiment 3

There are two experimental factors in this design: location of narrow focus in the denial (early position, late position), and the type of replacement in the counterassertion (early position, late position). The early focus position and early replacement position was the grammatical subject of the sentences, while the late focus position and late replacement position was (most often) the grammatical object or predicate. The replacement in late position was a member of the disjunction. Both the location of the focus, and the location of the replacement were manipulated within subjects, so each subject will see items from each of the four conditions (never the same items in two conditions, however).

## 6.2 Method

### 6.2.1 Subjects

Sixteen subjects performed the task. These subjects were recruited from the same subject pool as Experiments 1 and 2. The average age was 19.8, the average education level, 14.4 years, and the average vocabulary score (Shipley, 1940; out of 40), 29.4. Subjects were randomly assigned to counterbalancing conditions.

### 6.2.2 Materials

The experimental materials consisted of 48 dialogue sequences consisting of a spoken assertion (the disjunction), a spoken focused denial, and a visually-presented counterassertion (see Appendix D). These sequences was constructed from sequence frames that alternate the location of the focus in the denial, and the location of the replacement in the counterassertion. Subjects saw 12 items in each condition.

The initial assertion was constant in each of the dialogue sequences. Each assertion set up a disjunction between two attributes (e.g., two colors) or objects, one of which was named in the denial that follows it. A counterbalancing factor was which of the two attributes is mentioned in the denial. Half of the items in each of the four conditions denied the first attribute, and half the second. This was counterbalanced so that half the subjects saw one version, and half the other.

For each utterance-sequence frame, a contrastive focus was present in the denial in the form of a L+H* pitch accent. Two versions of each denial were recorded, varying the location of the pitch accent indicating narrow focus. One version had a focus in

subject position in the denial, while the other version contained a focus in object or predicate position. In either case, the pitch accent fell on a content word.

| | | Sentence Region | |
|---|---|---|---|
| | | Early | Late |
| Denial | Early-Focus | 263.4 | 125.6 |
| | Late-Focus | 202.5 | 202.4 |

Table 13: Average Peak $F_0$ for the Experimental Materials in Experiment 3 (in Hz).

There were two versions of each counterassertion, one with the replacement in subject position, another with the replacement in object or predicate position of an attribute from the disjunction. Each of the utterances in the assertion and denial sequences was analyzed according to ToBI guidelines (Beckman & Ayers, 1994). Thus, each utterance-sequence frame was arranged in four possible forms (see Table 14). The utterance-sequence frames were arbitrarily divided into groups of 12. Four lists of 12 sentence pairs were assembled; on each list the four conditions were equally represented, each sentence group occurring in one of the four conditions. The particular sentence group associated with a condition was rotated across the lists. The average length of the assertions was 11.8 words; the average length of the denials was 5.4 words, and the average length of the visually-presented counterassertions was 4.8

| Denial Focus Position | Replacement Type |
|---|---|
| Subject | Subject |
| Subject | Object |
| Object | Subject |
| Object | Object |

Table 14: Experimental Conditions for Experiment 3

words.

In addition to the experimental materials, there were filler dialogues as well. There were 72 filler sequences in all, of various types. None of the fillers had a narrow focus within the sequence. Fifty-four of these fillers featured either conjunction, disjunction, or quantified statements. The other 18 fillers were modeled after the affirmative-form denials in Johnson-Laird and Tridgell (1972). These consisted of a disjunction followed by an affirmative form denial, followed by a consistent conclusion. Again, these sequences did not contain narrow focus.

Of the 54 regular fillers, 18 were consistent (subjects should have endorsed the counterassertion), while 36 of them were inconsistent (subjects should have rejected the counterassertion). Examples (45-46) are illustrative of a consistent and inconsistent sequence, respectively. All 18 of the Johnson-Laird and Tridgell (1972)-type fillers were consistent. The example in (47) illustrates this type of filler. Altogether, this means that there were 36 (consistent) filler sequences which subjects should endorse, and 36 (inconsistent) filler sequences which they should not endorse.

(45) The reaction requires both high temperature and high pressure

The temperature was low

The reaction did not occur.

(46) The traffic light was either red or yellow

The traffic light was red

The traffic light was yellow.

(47) John is either rich or intelligent.

John is poor.

John is intelligent.

### 6.2.3 Apparatus

Subjects were tested one at a time in a room with a computer, using headphones and a button-box response timer. The utterance presentation was controlled by a PC which also presented the visual display of the counterassertion sentence on a monitor. The PC played the utterance sequence through a soundcard, and timed subjects' responses using a timing card. The experimental materials were recorded in digital audio for presentation, counterbalancing, and timing purposes.

### 6.2.4 Procedure

Each trial lasted approximately 8 seconds. Subjects started a trial by pressing a button, and this was followed by a warning fixation cross presented on the monitor for 500 ms. The assertion and denial utterances were then played through headphones. At the offset of the denial, the counterassertion was presented on the center of the screen, and remained there until the subject responded. Subjects responded by pressing one button to indicate that the sentence logically followed from the two previous sentences, or another button to indicate that it did not. Accuracy feedback was provided for both correct and incorrect trials. There was a 1 second pause after the feedback, and subjects pressed a button to begin the next trial. The computer recorded the latency of subjects' responses calculated from the presentation of the

visual display to the onset of the subject's response. The utterance playback and the response took approximately 10 seconds per trial.

Subjects were told that they would be participating in a task on sentence comprehension, and that their task was to listen to a series of sentences and then respond to a visually-presented sentence by indicating whether it could logically follow from those that they had just previously heard. Subjects were told in the instructions that the intended meaning of the "or" in the disjunction is exclusive, so for example, if the initial assertion was *The car is either brown or blue*, then they were to take the statement to mean that it can *either* brown or blue, but not both. Otherwise, subjects were told to try to comprehend the utterance sequences as they normally would if they were listening to a conversation, and to respond as soon as possible, but with high accuracy.

There were 10 practice trials using different utterances than the experimental materials to ensure that subjects understood the task and were well-adjusted to providing speeded responses. Three of the practice trials were catch trials where the counterassertion did not follow from the sequence. Subjects were required to respond correctly to 6 out of the 10 practice trials to proceed to the experimental trials (a second practice period was provided for one subject). After the experiment was completed, subjects were asked about the task to determine whether they were aware of any relationship between the sentences, and whether they had adopted any particular strategies for responding.

### 6.2.5 Data Analysis

The data consist of subjects' decisions regarding the visually-presented counterassertions, and their response times (RT) to make those decisions. For each experimental condition and for each subject, an error rate was calculated. Errors were defined as trials where subjects make incorrect decisions about the counterassertion, and those trials where subjects responded too quickly (e.g., before 100 ms), or too slowly (e.g., after 4500 ms).

Incorrect decisions were defined as trials where subjects responded "no" to sequences where the counterassertion *could* follow from the assertion and denial sequence. For example, given a sequence such as (48), subjects should have responded by pressing the "yes" button, because it is logically possible for a van to be brown (i.e., the assertion and denial do not rule this out).

(48) A: The car was either brown or grey

B: The car wasn't BROWN ...

The van was brown.

Subjects should have respond by pressing the "no" button for sequences such as (49), because it is not possible for the car to be both brown and not brown, given the exclusive disjunction (and the instructions to treat it as such).

(49) A: The car was either brown or grey

B: The car wasn't BROWN ...

The car was brown.

Average RTs were calculated based on only correct decisions. The data was first examined to determine whether the assumptions of the inferential tests held, and any necessary transformations were made, or failing that, alternative nonparametric tests were adopted. Any missing cells in the design were estimated using procedures recommended by Winer (1971). Separate analyses based on subjects and items as random factors were conducted. Error rates were also analyzed.

If participants in this task use the focus in the denial to predict the type of counterassertion that will follow, then they should be faster to judge the counterassertion in cases where the denial focus matches up with the replacement in the counterassertion, compared to the case where it mismatches. For example, participants should be faster to judge a counterassertion that replaces a subject following a sequence including a denial that focuses its subject. Two planned comparisons were used to evaluate this hypothesis. For responses to sentences that replaced the subject, a contrast between the subject-focused denial condition and the object/predicate-focused condition was calculated. The null hypothesis is that of no difference in average judgment time. The alternative is that participants will be *faster* to judge the sentence in the subject-focused condition. A similar contrast was calculated for the object/predicate-focused condition, with the alternative hypothesis that participants would be faster in following the object-focused denials. Note that in both comparisons, the visually-presented counterassertion that participants are responding to is the same literal string. It is only the focus of the denial that changes across the comparison.

## 6.3 Results

### 6.3.1 Response Times

The average response times for judgments are shown in Table 15. Subjects were faster to endorse the counterassertions when the replacement in the counterassertion matched the focused term in the denial, compared to the cases when it mismatched. Unlike the phoneme-monitoring experiments reported previously, this held for both early and late positions.

| | | Replacement Position | |
|---|---|---|---|
| | | Early | Late |
| Focus Position | Early | 1286 (237) | 1147 (280) |
| | Late | 1441 (275) | 988 (247) |
| | Ave. | 1364 (240) | 1068 (256) |

Table 15: Average RTs to Endorse the Counterassertions (Standard Deviations in Parentheses)

The planned comparisons provided support for this pattern: The faster average endorsement time for matching early-position replacements (1286 v. 1441) was significant by subjects, $F_1$=10.7, $p < .005$, $MSE$ = 28894; and items, $F_2$=6.9, $p = .01$, $MSE$=81652; and the average endorsement times were also faster for matching late-position replacements (988 v. 1147), both by subjects, $F_1$=23.6, $p < .001$, $MSE$ = 9685; and items, $F_2$=17.5, $p < .001$, $MSE$=36308.

### 6.3.2 Error Rates

The average error proportions are shown in Table 16.

Subjects were more likely to reject the counterassertion with the subject replace-

| | | Focus Position | |
|---|---|---|---|
| | | Early | Late |
| Replacement Position | Early | 0.109 | 0.036 |
| | Late | 0.193 | 0.036 |
| | Ave. | 0.151 | 0.036 |

Table 16: Proportion of Counterassertions Rejected (Incorrectly)

ment following a late-position focus denial (Ave. 0.19) than a early-position focus denial (Ave. 0.11), based on a Wilcoxin signed rank test, $V = 17$, $p = .05$. There was no significant difference at the object replacement counterassertion.

Note that there also appears to be about a 12% difference between early and late replacements generally (averaging across focus position). The counterassertions were different in these cases, however, so the difference could simply be due to the different sentences.

## 6.4 Discussion

This experiment offers support for the hypothesis advanced in the previous experiments, but with a different experimental paradigm. Participants were faster to judge the counterassertions that replaced the focused constituent in the denial, compared to the counterassertions that replaced a different constituent. This result held for both early and late positions, unlike the results earlier with the phoneme monitoring task. Also unlike the phoneme monitoring task, there was no requirement that participants split attention to different properties of the stimulus sentences in the present task.

In this task, there was some variation in the error rates for the different focus conditions. In particular, subjects were more error prone (by approximately 8%) in

judging early replacement counterassertions following late position focus denials (e.g., the mismatching case), compared to early position focus denials (e.g., the matching case). Note that for late position replacements in this condition, subjects were both slower and more error prone, so one cannot conclude that the response time difference observed in these conditions is due to a speed-accuracy tradeoff. Also, there was no difference in the error rates in late focus conditions (in terms of either pattern or inferential test), arguing further against a speed-accuracy tradeoff.

In sum, this experiment offers converging support for the hypothesis that listeners use the focus in a denial to direct their attention to potential replacements in a following counterassertion, and that the focus in the denial itself is sufficient for this effect to occur. In the present experiment, the visually-presented counterassertion contained no indicator of focus to correspond or contrast with the focus signalled in the denial, but regardless, subjects were faster to respond to sequences where the replacement corresponded to the focus in the denial.

# 7 General Discussion

## 7.1 Summary of the Experimental Results

The experiments reported here have shown that listeners can use an intonational pitch accent placed within a denial (and in some cases, a cleft construction) to anticipate the type of counterassertion that would likely follow, and further, that the pitch accent on the denial alone is sufficient to direct their attention to the portion of the following counterassertion containing the replacement.

Three experiments demonstrated this finding via a phoneme monitoring task, where listeners heard a sequence consisting of a denial and a counterassertion, where the target phoneme was found within the counterassertion. Consistently across these experiments, listeners were faster to detect the targets when they appeared at locations within the counterassertion that corresponded to the focused constituent in the preceding denial, compared to the case where the target appeared in a location that did not correspond to the focused constituent. This result was obtained for targets that appeared in relatively early positions within the counterassertion only. The last experiment showed that subjects were faster at judging the consistency of a three-term series consisting of an assertion, a focused denial, and a (visually-presented) counterassertion when the focus in the denial corresponded to the replacement constituent in the counterassertion. This result was obtained for both early and late position replacements in the counterassertion.

## 7.2 Theoretical Impact

The existing literature on the interpretation of focus has, up until this point, suggested that focus has an attention-directing function during spoken language comprehension (Cutler & Fodor, 1979). In addition, previous work on information structure has investigated how listeners interpret denial-counterassertion sequences when the intonationally-signaled pitch accents on the denial and counterassertion either match each other or mismatch (Bock & Mazzella, 1983), with the conclusion that listeners find comprehension easier when the accents match. The work by Cutler and Fodor (1979) suggests that the attention-directing function of focus operates at an abstract level, not requiring the presence of an explicit indicator at the temporal location to which attention is directed (e.g., a question can direct attention to the part of an answer that contains "new" information, whether or not the answer location has a marker indicating that it is new).

A parallel argument is offered in the present work. An intonational pitch accent within a denial has the effect of indicating that alternatives to the interpretation of the focused constituent (and not to the interpretation of other constituents) are relevant to its interpretation (Jackendoff, 1972; Rooth, 1992). In addition, the focused denial (in cases of an explicit negative particle) has the restricted interpretation that the interpretation of the focused constituent is not a member of the set of things predicated of the ground, where the ground is modeled as lambda-abstracted proposition replacing the focus with a variable (e.g., Jackendoff, 1972; Moser, 1992). Listeners can use these two sources of information to calculate an expectancy about the type

of counterassertion that would likely follow that denial, and direct their attention to the portion of the counterassertion that provides the replacement to the denied constituent.

This argument is the not same as the one offered in Bock and Mazzella (1983). In that work, only the *match* between the pitch accent in the denial and the pitch accent in the counterassertion was evaluated. Crucially, the condition where the focus in the denial alone indicated the type of a replacement in a counterassertion was not investigated.

### 7.2.1 Matching Hypothesis

The reason that this comparison is important is that this function of pitch accent is somewhat unique, from the perspective of traditional accounts of information structure. As Section 2.1.2 discussed, traditional accounts equate the referential status of terms in an expression with the linguistic markers of information structure such as word order or accenting. Thus, given information is predicted to be de-accented while new information is predicted to be accented.

Denials are interesting in this regard because they are straightforward examples of expressions which contain all "given" information (excepting the negation). A denial made in response to some previous assertion can repeat most all of the terms of the original assertion, but the distribution of grammatically licit pitch accents is relatively free. Importantly, a pitch accent is not required on the negation of such a denial, even though the negation is the only new information in such cases. Because the focus serves to associate the interpretation of the denied constituent with negation (making

the denial more specific than an unfocused denial), an accent can be associated with whatever part of the prior assertion a speaker wants to deny.

This distribution of accents is not predicted by traditional accounts of information structure, such the account offered by Haviland and Clark (1974). In this account, new information is unambiguously associated with an accent. However, Bock and Mazzella (1983) suggested that listeners in their experiments processed the sequence according to the given-new contract, finding it easier to process the sequence when the accent on the counterassertion indicated which part of the counterassertion was new information. Their explanation is in line with the "matching" hypothesis advanced by Clark (1974), which forms the basis for nearly all work on information structure that has followed. In the matching hypothesis, comprehenders seek to establish a match between the expressions they are comprehending and what is already present in memory (that is, what has already been referenced in the discourse, or is present the visual world), using markers for information structure as cues to what should be expected to be found in memory (or the visual world) and what should be added to memory.

The matching hypothesis does not cover focused denials made in response to an assertion because the information is virtually all given information (e.g., already referenced in the discourse). So, its account of where an accent should be found within a denial, and what the function of the accent might be, is unclear. The matching hypothesis depends on the link between referential status and the markers for information structure such as accent. But in a denials, there is no necessary link, because the accent can be placed on whatever a speaker wishes to deny, irrespective

of its referential status.

### 7.2.2 Role of Denial Focus

The hypothesis advanced here is that the role of focus in a denial is to associate the interpretation of the focused constituent with negation and indicate that alternatives to the focused expression are relevant to its interpretation. Before the present work, this role for focus had not been demonstrated because the existing work by Bock and Mazzella (1983) did not investigate the case where a focused denial was followed by a counterassertion that itself did not contain a marker for information structure. The question is whether the focus of the denial is sufficient to direct the attention of listeners to the new information in the counterassertion (e.g., the replacement).

Experiments 1 and 3 suggest that it is. The benefit observed in early target locations for the phoneme monitoring task for early-focused denials in Experiment 1, and the benefit observed in the overall judgment times for the corresponding accent-to-replacement counterassertions in Experiment 3 strongly suggest that the focus is having an attention-directing effect. Because the target utterances themselves did not have corresponding markers for information structure that matched (or mismatched) the focus in the denials, we can conclude the focus in the denials was sufficient for the attentional effect. In addition, Experiment 1 offered some support to the suggestion that there may be both costs and benefits to this effect. Not only were listeners faster to respond to predicted target locations in phoneme monitoring, they were also slower (by approximately the same extent) to respond to non-predicted target locations.

Note that the argument here is that the focus in the denial is sufficient for the

attentional effect, but that this does not mean it is *necessary*, if there is a focus in the counterassertion. It is already known, for example, that the prosodic contour within an utterance can direct the attention of listeners to the location of the emphasis (Cutler, 1976; Cutler & Foss, 1977). There is little reason to doubt, therefore, that the focus in a counterassertion would direct the attention of listeners to the focused constituent. In the case of a focused counterassertion, however, the emphasis is on new information (e.g., the replacement), so this is already covered by traditional accounts of information structure.

## 7.3 Basis of the Attentional Effect

Given this result, it is natural to ask what the basis of this attentional effect is, and whether there are alternative accounts of the pattern of data found in Experiment 1, as this experiment provides the closest link between subjects' responses and the location of the replacements in the counterassertions. Experiments 2A and 2B offer evidence against two different alternative accounts, one based on simple linear order, and another based on thematic role assignment.

### 7.3.1 Linear Order

In the phoneme monitoring task, subjects could have adopted a linear position heuristic (or alternatively, an expectation of parallelism across the denial and counterassertion), where they could have simply partitioned the utterances into earlier versus later regions, and then predicted that if the intonational emphasis in the denial was early then the target would early as well. Likewise, if the emphasis was late, they may have

predicted that the target would be late as well. If subjects adopted this heuristic, the data pattern found in Experiment 1 would be explained for the early position targets because the target location was consistent with the early focus. The lack of an effect at later positions would explained by the difference in informativeness of the different regions of the sentence (see Section 4.4).

Experiment 2A provided evidence against this proposal by holding linear position constant, and observing the effects of two different foci, using cleft constructions. Listeners were faster to detect phoneme targets in subject position following a subject cleft denial, compared to an object-cleft denial. Because the denials were equated in terms of the linear position of the denied constituent (in the sense of a surface string), the application of a linear position heuristic should have resulted in no difference at the early target locations. This result argues against this account of the data from Experiment 1.

### 7.3.2 Thematic Role Assignment

In both Experiment 1 and Experiment 2A, it was the case that the thematic role that was rejected in the denial was also replaced in the counterassertion in the valid-predictor trials. So, for example, if the Agent was focused in the denial, then the Agent was also replaced in the counterassertion. Thematic role assignment could be a conditioning factor on the expectation for the replacement in the counterassertion, in that listeners may have required that the thematic role assigned to the focused constituent in the denial correspond to the same thematic role in the replacement in the counterassertion.

Experiment 2B tested this possibility by holding both linear position and grammatical position constant, and varying the thematic role assigned to the subject position of the counterassertion. Active versus passive counterassertions were used to vary whether the counterassertion assigned either an Agent role to the subject position of the counterassertion, or a patient (or recipient) role to the subject position. If listeners require that the focus of the denial and the replacement of the counterassertion carry the same thematic role, they should have been slower to detect phoneme targets in the case where the passive assigned a different role to the subject than the active denial. Experiment 2B provided no support for this difference, suggesting that listeners do not require the thematic role of the replacement in the counterassertion match that of the focus in the denial.

### 7.3.3 Grammatical Position

If the effect obtained in Experiment 1 is not due to a linear order heuristic, and subjects do not require that the thematic role in the denial be the same role in the replacement of the counterassertion, one might ask what the basis is for the cueing effect that was observed. How do listeners decide to attend the subject of a counterassertion following a cleft subject denial, but do not the subject when they have heard a cleft object denial, for instance?

The hypothesis advanced here is that subjects use an underlying grammatical representation of the denial that consists of an affirmative form of the denial with the focused constituent replaced with a variable. Listeners are essentially listening for a value for that variable. In the case of a focused denials like those used in

Experiments 1 and 3, the form of this representation is much like the original string in the denial except for the variable and the missing negation. In the case of the clefts used in Experiment 2, the underlying grammatical representation is itself not a cleft, but rather the matrix clause of the cleft.

How does this account for the results in Experiment 2B, where the counterassertion is a different grammatical structure (e.g., a passive)? In that experiment, there was little evidence of a difference between the passive counterassertion and the active counterassertion with respect to the target detection times at subject position. One might expect a difference if the underlying grammatical representation that listeners are using to direct their attention is an affirmative form of the original denial.

However, recall that subjects were making their decisions within (roughly) 400-500 ms of onset of the target phoneme. In many cases, this interval would only include the target-bearing lexical itself. Assuming that some portion of the detection time involves motor programming, it is reasonable to assume that subjects made their decision about the target (at most) after recognizing the target-bearing word, but before hearing much of the rest of the counterassertion utterance. So, in hindsight, it is perhaps not surprising that the change in grammatical structure from active to passive had little effect. By the time subjects were making their detection decision they most likely had not heard enough of the rest of the sentence to know (in principle) what theta role had been assigned.

Because listeners were faster to detect validly-cued subjects in the absence of thematic role information for that position, the match between thematic role assignments between the denial and counterassertion cannot be required for the cueing effect to

be obtained. Note that Experiment 2B does not rule out the possibility that a match of thematic role assignment would be required for other grammatical positions.

## 7.4 Conclusions

This dissertation has established that the focus in a denial is sufficient to direct the attention of listeners to potential replacements in a following counterassertion. This finding is theoretically significant because existing accounts of how information structure is processed do not provide such a role for how intonationally signalled focus is interpreted. A different account of the role of focus was supported, where focus serves to suggest alternatives, rather than new information.

# Appendices

# Appendix A: Experiment 1 Stimuli

Experimental Trial Items (48)

[1] **Target**: /b/
FRANK isn't growing a moustache. Bobby is growing a moustache.
FRANK isn't growing a moustache. Frank is growing a beard.
Frank isn't growing a MOUSTACHE. Bobby is growing a moustache.
Frank isn't growing a MOUSTACHE. Frank is growing a beard.

[2] **Target**: /b/
JILL isn't taking singing lessons. Barbara is taking singing lessons.
JILL isn't taking singing lessons. Jill is taking bass lessons.
Jill isn't taking SINGING lessons. Barbara is taking singing lessons.
Jill isn't taking SINGING lessons. Jill is taking bass lessons.

[3] **Target**: /b/
JACK wasn't reading a newspaper. Betty was reading a newspaper.
JACK wasn't reading a newspaper. Jack was reading a book.
Jack wasn't reading a NEWSPAPER. Betty was reading a newspaper.
Jack wasn't reading a NEWSPAPER. Jack was reading a book.

[4] **Target**: /b/
MICHAEL didn't play hockey in college. Ben played hockey in college.
MICHAEL didn't play hockey in college. Michael played baseball in college.
Michael didn't play HOCKEY in college. Ben played hockey in college.
Michael didn't play HOCKEY in college. Michael played baseball in college.

[5] **Target**: /b/
KAREN didn't have a girl. Karen had a BOY.
KAREN didn't have a girl. Betsy had a girl.
Karen didn't have a GIRL. Karen had a BOY.
Karen didn't have a GIRL. Betsy had a girl.

[6] **Target**: /k/
MARY didn't assault Greg. Kelly assaulted Greg
MARY didn't assault Greg. Mary assaulted Kelly.
Mary didn't assault GREG. Kelly assaulted Greg.
Mary didn't assault GREG. Mary assaulted Kelly.

[7] **Target**: /b/
JOHN didn't go to the office. Beckie went to the office.
JOHN didn't go to the office. John went to the beach.
John didn't go to the OFFICE. Beckie went to office.
John didn't go to the OFFICE. John went to the beach.

[8] **Target**: /k/
MATT didn't repair the monitor. Cory repaired the monitor.
MATT didn't repair the monitor. Matt repaired the keyboard.
Matt didn't repair the MONITOR. Cory repaired the monitor.
Matt didn't repair the MONITOR. Matt repaired the keyboard.

[9] **Target**: /b/
DENNIS wasn't drinking milk. Boris was drinking milk.
DENNIS wasn't drinking milk. Dennis was drinking beer.
Dennis wasn't drinking MILK. Boris was drinking milk.
Dennis wasn't drinking MILK. Dennis was drinking beer.

[10] **Target**: /k/
HENRY doesn't have a sister. Curt has a sister.
HENRY doesn't have a sister. Henry has a cousin.
Henry doesn't have a SISTER. Curt has a sister.
Henry doesn't have a SISTER. Henry has a cousin.

[11] **Target**: /b/
ARNOLD didn't lease a new car. Bart leased a new car.
ARNOLD didn't lease a new car. Arnold bought a new car.
Arnold didn't LEASE a new car. Bart leased a new car.
Arnold didn't LEASE a new car. Arnold bought a new car.

[12] **Target**: /k/
The PIPE wasn't made out of steel. The pipe was made out of copper.
The PIPE wasn't made out of steel. The casing was made out of steel.
The pipe wasn't made out of STEEL. The pipe was made out of copper.
The pipe wasn't made out of STEEL. The casing was made out of steel.

[13] **Target**: /k/
The PLAYERS didn't protest the foul. The coach protested the foul.
The PLAYERS didn't protest the foul. The players protested the call.
The players didn't protest the FOUL. The coach protested the foul.
The players didn't protest the FOUL. The players protested the call.

[14] **Target**: /k/
Randy didn't TIE the rope. He cut the rope.
Randy didn't TIE the rope. He tied the cord.
Randy didn't tie the ROPE. He cut the rope.
Randy didn't tie the ROPE. He tied the cord.

[15] **Target**: /k/
The DEBATE hasn't been planned. The concert has been planned.
The DEBATE hasn't been planned. The debate has been canceled.
The debate hasn't been PLANNED. The concert has been planned.
The debate hasn't been PLANNED. The debate has been canceled.

[16] **Target**: /k/
The SERGEANT isn't Protestant. The captain is Protestant.
The SERGEANT isn't Protestant. The sergeant is Catholic.
The sergeant isn't PROTESTANT. The captain is Protestant.
The sergeant isn't PROTESTANT. The sergeant is Catholic.

[17] **Target**: /k/
JENNIFER didn't get a job in Lansing. Casey got a job in Lansing.
JENNIFER didn't get a job in Lansing. Jennifer got a job in Kansas City.
Jennifer didn't get a job in LANSING. Casey got a job in Lansing.
Jennifer didn't get a job in LANSING. Jennifer got a job in Kansas City.

[18] **Target**: /k/
Alice didn't GO to the police. She called the the police.
Alice didn't GO to the police. She went to the counselor.
Alice didn't go to the POLICE. She called the police.
Alice didn't go to the POLICE. She went to the counselor.

[19] **Target**: /b/
MARVIN doesn't own the land. Burt owns the land.
MARVIN doesn't own the land. Marvin owns the building.
Marvin doesn't own the LAND. Burt owns the land.
Marvin doesn't own the LAND. Marvin owns the building.

[20] **Target**: /b/
Mary didn't PURCHASE the cake. Mary baked the cake.
Mary didn't PURCHASE the cake. Mary purchased the biscuit.
Mary didn't purchase the CAKE. Mary baked the cake.
Mary didn't purchase the CAKE. Mary purchased the biscuit

[21] **Target**: /b/
The man at the GROCERY wasn't wearing a hat.
...The man at the bakery was wearing a hat.
The man at the GROCERY wasn't wearing a hat.
...The man at the grocery was wearing a bow tie.
The man at the grocery wasn't wearing a HAT.
...The man at the bakery was wearing a hat.
The man at the grocery wasn't wearing a HAT.
...The man at the grocery was wearing a bow tie.

[22] **Target**: /b/
The woman from the STORE wasn't staring at Tim.
...The woman from the store was staring at Barry.
The woman from the STORE wasn't staring at Tim.
...The woman from the bar was staring at Tim.
The woman from the store wasn't staring at TIM.
...The woman from the store was staring at Barry.
The woman from the store wasn't staring at TIM.
...The woman from the bar was staring at Tim.

[23] **Target**: /k/
The plane from GERMANY didn't go down over the ocean.
...The plane from Canada went down over the ocean.
The plane from GERMANY didn't go down over the ocean.
...The plane from Germany went down over the canyon.
The plane from Germany didn't go down over the OCEAN.
...The plane from Canada went down over the ocean.
The plane from Germany didn't go down over the OCEAN.
...The plane from Germany went down over the canyon.

[24] **Target**: /b/
SHERYL wasn't stung by a wasp. Sheryl was stung by a bee.
SHERYL wasn't stung by a wasp. Beth was stung by a wasp.
Sheryl wasn't stung by a WASP. Sheryl was stung by a bee.
Sheryl wasn't stung by a WASP. Beth was stung by a wasp.

[25] **Target**: /b/
The TAXI driver didn't hit the pedestrian. The bus driver hit the pedestrian.
The TAXI driver didn't hit the pedestrian. The taxi driver hit the biker
The taxi driver didn't hit the PEDESTRIAN. The bus driver hit the pedestrian.
The taxi driver didn't hit the PEDESTRIAN. The taxi driver hit the biker.

[26] **Target**: /b/
The MANAGER didn't take a plane. The manager took a boat.
The MANAGER didn't take a plane. The band took a plane.
The manager didn't take a PLANE. The manager took a boat.
The manager didn't take a PLANE. The band took a plane

[27] **Target**: /k/
The man at the TABLE didn't order tea. The man at the counter ordered tea.
The man at the TABLE didn't order tea. The man at the table ordered coffee.
The man at the table didn't order TEA. The man at the counter ordered tea.
The man at the table didn't order TEA. The man at the table ordered coffee.

[28] **Target**: /k/
The submarine didn't follow the DESTROYER to the island.
...The submarine followed the carrier to the island.
The submarine didn't follow the DESTROYER to the island.
...The submarine followed the destroyer to the coast.
The submarine didn't follow the destroyer to the ISLAND.
...The submarine followed the carrier to the island.
The submarine didn't follow the destroyer to the ISLAND.
...The submarine followed the destroyer to the coast.

[29] **Target**: /b/
The watchdog didn't CHASE the doorman. The watchdog bit the doorman.
The watchdog didn't CHASE the doorman. The watchdog chased the busboy.
The watchdog didn't chase the DOORMAN. The watchdog bit the doorman.
The watchdog didn't chase the DOORMAN. The watchdog chased the busboy.

[30] **Target**: /k/
JANE didn't slice the celery. Carrie sliced the celery.
JANE didn't slice the celery. Jane sliced the carrots.
Jane didn't slice the CELERY. Carrie sliced the celery.
Jane didn't slice the CELERY. Jane sliced the carrots.

[31] **Target**: /b/
PAUL doesn't like turnips. Barney likes turnips.
PAUL doesn't like turnips. Paul likes beans.
Paul doesn't like TURNIPS. Barney likes turnips.
Paul doesn't like TURNIPS. Paul likes beans.

[32] **Target**: /b/
The chef didn't STEAM the spinach. He boiled the spinach.
The chef didn't STEAM the spinach. He steamed the beets.
The chef didn't steam the SPINACH. He boiled the spinach.
The chef didn't steam the SPINACH. He steamed the beets.

[33] **Target**: /k/
Nancy didn't leave the VAN by the entrance. She left the car by the entrance.
Nancy didn't leave the VAN by the entrance. She left the van by the curb.
Nancy didn't leave the van by the ENTRANCE. She left the car by the entrance.
Nancy didn't leave the van by the ENTRANCE. She left the van by the curb.

[34] **Target**: /k/
Shannon didn't open the WINDOW in the living room.
...She opened the window in kitchen.
Shannon didn't open the WINDOW in the living room.
...She opened the curtain in living room.

Shannon didn't open the window in the LIVING room.
...She opened the window in kitchen.
Shannon didn't open the window in the LIVING room.
...She opened the window in living room.

[35] **Target**: /k/
The SOUP wasn't hot. The soup was cold.
The SOUP wasn't hot. The casserole was hot.
The soup wasn't HOT. The soup was cold.
The soup wasn't HOT. The casserole was hot.

[36] **Target**: /k/
Cindy didn't FLY to Arizona. She came from Arizona.
Cindy didn't FLY to Arizona. She flew to Kansas.
Cindy didn't fly to ARIZONA. She came from Arizona.
Cindy didn't fly to ARIZONA. She flew to Kansas.

[37] **Target**: /k/
The terrorists didn't INJURE the negotiator. They kidnapped the negotiator.
The terrorists didn't INJURE the negotiator. They injured the captives.
The terrorists didn't injure the NEGOTIATOR. They kidnapped the negotiator.
The terrorists didn't injure the NEGOTIATOR. They injured the captives.

[38] **Target**: /k/
I didn't throw AWAY the ad from the paper. I kept the ad from the paper.
I didn't throw AWAY the ad from the paper. I lost the coupon from the paper.
I didn't throw away the AD from the paper. I kept the ad from the paper.
I didn't throw away the AD from the paper. I lost the coupon from the paper.

[39] **Target**: /b/
THOMAS didn't have a glass of wine. Thomas had a bottle of wine.
THOMAS didn't have a glass of wine. Beverly had a glass of wine.
Thomas didn't have a GLASS of wine. Thomas had a bottle of wine.
Thomas didn't have a GLASS of wine. Beverly had a glass of wine.

[40] **Target**: /b/
I'm not going to SELL the jar. I am going to buy the jar.
I'm not going to SELL the jar. I am going to sell the bowl.
I'm not going to sell the JAR. I am going to buy the jar.
I'm not going to sell the JAR. I am going to sell the bowl.

[41] **Target**: /b/
I didn't say he GAVE a good talk. I said he gave a bad talk.
I didn't say he GAVE a good talk. I said he botched a good talk.
I didn't say he gave a GOOD talk. I said he gave a bad talk.

I didn't say he gave a GOOD talk. I said he botched a good talk.

[42] **Target**: /b/
I don't like TOFU. I like beef.
I don't like TOFU. Bob likes tofu.
I* don't like tofu. I like beef.
I* don't like tofu. Bob likes tofu.

[43] **Target**: /b/
The CARD game wasn't a little mistake. The card game was a big mistake.
The CARD game wasn't a little mistake. The bet was a little mistake.
The card game wasn't a LITTLE mistake. The card game was a big mistake.
The card game wasn't a LITTLE mistake. The bet was a little mistake.

[44] **Target**: /b/
DOROTHY doesn't wear sandals. Dorothy wears boots.
DOROTHY doesn't wear sandals. Betty wears sandals.
Dorothy doesn't wear SANDALS. Dorothy wears boots.
Dorothy doesn't wear SANDALS. Betty wears sandals.

[45] **Target**: /k/
The OWL is not a rare species. The owl is a common species.
The OWL is not a rare species. The condor is a rare species.
The owl is not a RARE species. The owl is a common species.
The owl is not a RARE species. The condor is a rare species.

[46] **Target**: /k/
I didn't lose the LID for the dish. I lost the lid for the kettle.
I didn't lose the LID for the dish. I lost the spoon for the dish.
I didn't lose the lid for the DISH. I lost the lid for the kettle.
I didn't lose the lid for the DISH. I lost the spoon for the dish.

[47] **Target**: /k/
JEAN didn't have a diet Pepsi. Jean had a diet coke
JEAN didn't have a diet Pepsi. Kim had a diet Pepsi.
Jean didn't have a diet PEPSI. Jean had a diet coke.
Jean didn't have a diet PEPSI. Kim had a diet Pepsi.

[48] **Target**: /k/
LAURIE doesn't have a dog. Laurie has a cat.
LAURIE doesn't have a dog. Kathy has a dog.
Laurie doesn't have a DOG. Laurie has a cat.
Laurie doesn't have a DOG. Kathy has a dog.

Catch Trial Items (12)

[49] **Target**: /k/
Angela didn't get a PIRANHA. Angela got a goldfish.

[50] **Target**: /k/
The DOLPHINS didn't defeat the Lions. The Jets defeated the Lions.

[51] **Target**: /k/
The RED Wings didn't lose to the Islanders. The Stars lost to the Islanders.

[52] **Target**: /k/
HOUSTON didn't the get the foul. Philadelphia got the foul.

[53] **Target**: /k/
We didn't get the GREEN rug. We got the brown rug.

[54] **Target**: /k/
I didn't PROMISE to stay. I offered to stay.

[55] **Target**: /b/
I didn't ask them to LEAVE. I asked them to stay.

[56] **Target**: /b/
We weren't ARGUING about the contract. We were discussing the contract.

[57] **Target**: /b/
That wasn't just a GOOD finishing time. That was the fastest finishing time.

[58] **Target**: /b/
I didn't call YOU a liar. I called him a liar.

[59] **Target**: /b/
The commissioner doesn't deserve CREDIT. The commissioner deserves an award.

[60] **Target**: /b/
I didn't take a train. I took a car.

# Appendix B: Experiment 2A Stimuli

Experimental Items (40)

[1] **Target**: /b/
It isn't FRANK who is growing a moustache. Bobby is growing a moustache.
It isn't FRANK who is growing a moustache. Frank is growing a beard.
It isn't a moustache that Frank is growing. Bobby is growing a moustache.
It isn't a moustache that Frank is growing. Frank is growing a beard.

[2] **Target**: /b/
It isn't JILL who is going to sell the jar. Barbara is going to sell the jar.
It isn't JILL who is going to sell the jar. Jill is going to sell the bowl.
It isn't the JAR that Jill is going to sell. Barbara is going to sell the jar.
It isn't the JAR that Jill is going to sell. Jill is going to sell the bowl.

[3] **Target**: /b/
It isn't JACK who was reading a newspaper. Betty was reading a newspaper.
It isn't JACK who was reading a newspaper. Jack was reading a book.
It isn't a newspaper that Jack was reading. Betty was reading a newspaper.
It isn't a newspaper that Jack was reading. Jack was reading a book.

[4] **Target**: /b/
It wasn't MICHAEL who played hockey in college. Ben played hockey in college.
It wasn't MICHAEL who played hockey in college. Michael played baseball in college.
It wasn't HOCKEY that Michael played in college. Ben played hockey in college.
It wasn't HOCKEY that Michael played in college. Michael played baseball in college.

[5] **Target**: /b/
It wasn't KAREN who had a girl. Betsy had a girl.
It wasn't KAREN who had a girl. Karen had a boy.
It wasn't a GIRL that Karen had. Betsy had a girl
It wasn't a GIRL that Karen had. Karen had a boy.

[6] **Target**: /k/
It wasn't MARY who assaulted Greg. Kelly assaulted Greg
It wasn't MARY who assaulted Greg. Mary assaulted Kelly.
It wasn't GREG who Mary assaulted. Kelly assaulted Greg.
It wasn't GREG who Mary assaulted. Mary assaulted Kelly.

[7] **Target**: /b/
It wasn't JOHN who went to the office. Beckie went to the office.
It wasn't JOHN who went to the office. John went to the beach.
It wasn't the OFFICE that John went to. Beckie went to office.

It wasn't the OFFICE that John went to. John went to the beach.

[8] **Target**: /k/
It wasn't MATT who repaired the monitor. Cory repaired the monitor.
It wasn't MATT who repaired the monitor. Matt repaired the keyboard.
It wasn't the MONITOR that Matt repaired. Cory repaired the monitor.
It wasn't the MONITOR that Matt repaired. Matt repaired the keyboard.

[9] **Target**: /b/
It wasn't DENNIS who was drinking milk. Boris was drinking milk.
It wasn't DENNIS who was drinking milk. Dennis was drinking beer.
It wasn't MILK that Dennis was drinking. Boris was drinking milk.
It wasn't MILK that Dennis was drinking. Dennis was drinking beer.

[10] **Target**: /k/
It isn't HENRY who has a sister. Curt has a sister.
It isn't HENRY who has a sister. Henry has a cousin.
It isn't a SISTER that Henry has. Curt has a sister.
It isn't a SISTER that Henry has. Henry has a cousin.

[11] **Target**: /b/
It wasn't ARNOLD who used a shovel. Bart used a shovel.
It wasn't ARNOLD who used a shovel. Arnold used a backhoe.
It wasn't a shovel that Arnold used. Bart used a shovel.
It wasn't a shovel that Arnold used. Arnold used a backhoe.

[12] **Target**: /k/
It wasn't the PIPE that was made out of steel. The casing was made out of steel.
It wasn't the PIPE that was made out of steel. The pipe was made out of copper.
It wasn't STEEL that the pipe was made out of. The casing was made out of steel.
It wasn't STEEL that the pipe was made out of. The pipe was made out of copper.

[13] **Target**: /k/
It wasn't the PLAYERS who protested the foul. The coach protested the foul.
It wasn't the PLAYERS who protested the foul. The players protested the call.
It wasn't the FOUL the players protested. The coach protested the foul.
It wasn't the FOUL the players protested. The players protested the call.

[14] **Target**: /k/
It wasn't the SERGEANT who tied the rope. The captain tied the rope.
It wasn't the SERGEANT who tied the rope. The sergeant tied the cord.
It wasn't the ROPE that the sergeant tied. The captain tied the rope.
It wasn't the ROPE that the sergeant tied. The sergeant tied the cord.

[15] **Target**: /k/
It wasn't CINDY who went to the debate. Calvin went to the debate.
It wasn't CINDY who went to the debate. Cindy went to the concert.
It wasn't the DEBATE that Cindy went to. Calvin went to the debate.
It wasn't the DEBATE that Cindy went to. Cindy went to the concert.

[16] **Target**: /k/
It wasn't JENNIFER who got a job in Lansing. Casey got a job in Lansing.
It wasn't JENNIFER who got a job in Lansing. Jennifer got a job in Kansas City.
It wasn't in LANSING that Jennifer got a job. Casey got a job in Lansing.
It wasn't in LANSING that Jennifer got a job. Jennifer got a job in Kansas City.

[17] **Target**: /k/
It wasn't the HOSTESS who brought the wine. The cook brought the wine.
It wasn't the HOSTESS who brought the wine. The hostess brought the cake.
It wasn't the WINE that the hostess brought. The cook brought the wine.
It wasn't the WINE that the hostess brought. The hostess brought the cake.

[18] **Target**: /b/
It isn't MARVIN who owns the land. Burt owns the land.
It isn't MARVIN who owns the land. Marvin owns the building.
It isn't the LAND that Marvin owns. Burt owns the land.
It isn't the LAND that Marvin owns. Marvin owns the building.

[19] **Target**: /b/
It wasn't MARY who moved a knight. Bob moved a knight
It wasn't MARY who moved a knight. Mary moved a bishop.
It wasn't a knight that Mary moved. Bob moved a knight.
It wasn't a knight that Mary moved. Mary moved a bishop

[20] **Target**: /b/
It wasn't at the GROCERY that the man was wearing a hat.
...The man at the bakery was wearing a hat.
It wasn't at the GROCERY that the man was wearing a hat.
...The man at the grocery was wearing a bow tie.
It wasn't a HAT that the man at the grocery was wearing.
...The man at the bakery was wearing a hat.
It wasn't a HAT that the man at the grocery was wearing.
...The man at the grocery was wearing a bow tie.

[21] **Target**: /b/
It wasn't at the STORE that the woman was looking at Tim.
...The woman from the bar was looking at Tim.
It wasn't at the STORE that the woman was looking at Tim.
...The woman from the store was looking at Barry.

It wasn't at TIM that the woman from the store was looking.
...The woman from the bar was looking at Tim.
It wasn't at TIM that the woman from the store was looking.
...The woman from the store was looking at Barry.

[22] **Target**: /k/
It wasn't the plane from GERMANY that went down over the ocean.
...The plane from Canada went down over the ocean.
It wasn't the plane from GERMANY that went down over the ocean.
...The plane from Germany went down over the canyon.
It wasn't the OCEAN that the plane from Germany went down over.
...The plane from Canada went down over the ocean.
It wasn't the OCEAN that the plane from Germany went down over.
...The plane from Germany went down over the canyon.

[23] **Target**: /b/
It wasn't SHERYL that was stung by a wasp. Beth was stung by a wasp.
It wasn't SHERYL that was stung by a wasp. Sheryl was stung by a bee.
It wasn't by a WASP that Sheryl was stung. Beth was stung by a wasp.
It wasn't by a WASP that Sheryl was stung. Sheryl was stung by a bee.

[24] **Target**: /b/
It wasn't the TAXI driver who hit the pedestrian.
...The bus driver hit the pedestrian.
It wasn't the TAXI driver who hit the pedestrian.
...The taxi driver hit the biker
It wasn't the PEDESTRIAN that the taxi driver hit.
...The bus driver hit the pedestrian.
It wasn't the PEDESTRIAN that the taxi driver hit.
...The taxi driver hit the biker.

[25] **Target**: /b/
It wasn't the MANAGER who took the plane. The band took a plane.
It wasn't the MANAGER who took the plane. The manager took a boat.
It wasn't the PLANE that the manager took. The band took a plane
It wasn't the PLANE that the manager took. The manager took a boat.

[26] **Target**: /k/
It wasn't at the TABLE that the man ordered tea.
...The man at the counter ordered tea.
It wasn't at the TABLE that the man ordered tea.
...The man at the table ordered coffee.
It wasn't TEA that the man at the table ordered.
...The man at the counter ordered tea.
It wasn't TEA that the man at the table ordered.

...The man at the table ordered coffee.

[27] **Target**: /k/
It wasn't the DESTROYER that the submarine didn't followed to the island.
...The submarine followed the carrier to the island.
It wasn't the DESTROYER that the submarine didn't followed to the island.
...The submarine followed the destroyer to the coast.
It wasn't to the ISLAND that the submarine followed the destroyer.
...The submarine followed the carrier to the island.
It wasn't to the ISLAND that the submarine followed the destroyer.
...The submarine followed the destroyer to the coast.

[28] **Target**: /b/
It wasn't the POLICE who interviewed the doorman.
...The police interviewed the doorman.
It wasn't the POLICE who interviewed the doorman.
...The counselor interviewed the busboy.
It wasn't the DOORMAN who the police interviewed.
...The police interviewed the doorman.
It wasn't the DOORMAN who the police interviewed.
...The counselor interviewed the busboy.

[29] **Target**: /k/
It wasn't JANE who sliced the celery. Carrie sliced the celery.
It wasn't JANE who sliced the celery. Jane sliced the carrots.
It wasn't the CELERY that Jane sliced. Carrie sliced the celery.
It wasn't the CELERY that Jane sliced. Jane sliced the carrots.

[30] **Target**: /b/
It isn't PAUL who likes turnips. Barney likes turnips.
It isn't PAUL who likes turnips. Paul likes beans.
It isn't TURNIPS that Paul likes. Barney likes turnips.
It isn't TURNIPS that Paul likes. Paul likes beans.

[31] **Target**: /k/
It wasn't the VAN that Nancy left by the entrance.
...She left the car by the entrance.
It wasn't the VAN that Nancy left by the entrance.
...She left the van by the curb.
It wasn't by the ENTRANCE that Nancy left the van.
...She left the car by the entrance.
It wasn't by the ENTRANCE that Nancy left the van.
...She left the van by the curb.

[32] **Target**: /k/
It wasn't the WINDOW that Shannon opened in the living room.
...She opened the curtain in living room.
It wasn't the WINDOW that Shannon opened in the living room.
...She opened the window in kitchen.
It wasn't in the LIVING room that Shannon opened the window.
...She opened the curtain in living room.
It wasn't in the LIVING room that Shannon opened the window.
...She opened the window in kitchen.

[33] **Target**: /k/
It wasn't the AD that the salesperson saved from the newspaper.
...The salesperson saved the coupon from the newspaper.
It wasn't the AD that the salesperson saved from the newspaper.
...The customer saved the ad from the newspaper.
It wasn't the SALESPERSON that saved the ad from the newspaper.
...The salesperson saved the coupon from the newspaper.
It wasn't the SALESPERSON that saved the ad from the newspaper.
...The customer saved the ad from the newspaper.

[34] **Target**: /b/
It wasn't THOMAS who had a glass of wine. Beverly had a glass of wine.
It wasn't THOMAS who had a glass of wine. Thomas had a bottle of wine.
It wasn't a GLASS of wine that Thomas had. Beverly had a glass of wine.
It wasn't a GLASS of wine that Thomas had. Thomas had a bottle of wine.

[35] **Target**: /b/
It wasn't the CHAIRPERSON who make a little mistake.
...The board made a little mistake.
It wasn't the CHAIRPERSON who make a little mistake.
...The chairperson made a big mistake.
It wasn't a LITTLE mistake that the chairperson made.
...The board made a little mistake.
It wasn't a LITTLE mistake that the chairperson made.
...The chairperson made a big mistake.

[36] **Target**: /b/
It isn't DOROTHY who wears sandals. Betty wears sandals.
It isn't DOROTHY who wears sandals. Dorothy wears boots.
It isn't SANDALS that Dorothy wears. Betty wears sandals.
It isn't SANDALS that Dorothy wears. Dorothy wears boots.

[37] **Target**: /k/
It wasn't the PRODUCER that flew to Arizona. The contestant flew to Arizona.
It wasn't the PRODUCER that flew to Arizona. The producer flew to Kansas.

It wasn't to ARIZONA that the producer flew. The contestant flew to Arizona.
It wasn't to ARIZONA that the producer flew. The producer flew to Kansas.

[38] **Target**: /k/
It wasn't the LID for the dish that I lost. I lost the cover for the dish.
It wasn't the LID for the dish that I lost. I lost the lid for the kettle.
It wasn't the DISH that I lost the lid for. I lost the cover for the dish.
It wasn't the DISH that I lost the lid for. I lost the lid for the kettle.

[39] **Target**: /k/
It wasn't JEAN who had a diet Pepsi. Kim had a diet Pepsi.
It wasn't JEAN who had a diet Pepsi. Jean had a diet coke
It wasn't a diet PEPSI that Jean had. Kim had a diet Pepsi.
It wasn't a diet PEPSI that Jean had. Jean had a diet coke.

[40] **Target**: /k/
It isn't LAURIE who has a dog. Kathy has a dog.
It isn't LAURIE who has a dog. Laurie has a cat.
It isn't a DOG that Laurie has. Kathy has a dog.
It isn't a DOG that Laurie has. Laurie has a cat.

# Appendix C: Experiment 2B Stimuli

Experimental Items (48)

[1] **Target**: /b/
It wasn't EDWARD who deceived Marion. Bobby deceived her.
It wasn't EDWARD who deceived Marion. Bobby was deceived.
It wasn't EDWARD who deceived Marion. He deceived Bobby.
It wasn't MARION whom Edward deceived. Bobby deceived her.
It wasn't MARION whom Edward deceived. Bobby was deceived.
It wasn't MARION whom Edward deceived. He deceived Bobby.

[2] **Target**: /b/
It wasn't LINDA who avoided Amy. Barbara avoided her.
It wasn't LINDA who avoided Amy. Barbara was avoided.
It wasn't LINDA who avoided Amy. Barbara was avoided.
It wasn't AMY whom Linda avoided. Barbara avoided her.
It wasn't AMY whom Linda avoided. Barbara was avoided.
It wasn't AMY whom Linda avoided. She avoided Barbara.

[3] **Target**: /b/
It wasn't MARIA who alarmed Lauren. Betsy alarmed her.
It wasn't MARIA who alarmed Lauren. Betsy was alarmed.
It wasn't MARIA who alarmed Lauren. She alarmed Betsy.
It wasn't LAUREN who Maria alarmed. Betsy alarmed her.
It wasn't LAUREN who Maria alarmed. Betsy was alarmed.
It wasn't LAUREN who Maria alarmed. She alarmed Betsy.

[4] **Target**: /b/
It wasn't MICHAEL who confronted Irene. Ben confronted her.
It wasn't MICHAEL who confronted Irene. Ben was confronted.
It wasn't MICHAEL who confronted Irene. He confronted Ben.
It wasn't IRENE who Michael confronted. Ben confronted her.
It wasn't IRENE who Michael confronted. Ben was confronted.
It wasn't IRENE who Michael confronted. He confronted Ben.

[5] **Target**: /b/
It wasn't DEAN who dated Emily. Bill dated her.
It wasn't DEAN who dated Emily. Bill was dated.
It wasn't DEAN who dated Emily. She dated Bill.
It wasn't EMILY whom Dean dated. Bill dated her.
It wasn't EMILY whom Dean dated. Bill was dated.
It wasn't EMILY whom Dean dated. She dated Bill.

[6] **Target**: /k/
It wasn't MARY who assaulted Greg. Kelly assaulted him.
It wasn't MARY who assaulted Greg. Kelly was assaulted.
It wasn't MARY who assaulted Greg. She assaulted Kelly.
It wasn't GREG whom Mary assaulted. Kelly assaulted him.
It wasn't GREG whom Mary assaulted. Kelly was assaulted.
It wasn't GREG whom Mary assaulted. She assaulted Kelly.

[7] **Target**: /b/
It wasn't JOHN who complemented Leonard. Beckie complimented him.
It wasn't JOHN who complimented Leonard. Beckie was complimented
It wasn't JOHN who complimented Leonard. He complimented Beckie.
It wasn't LEONARD whom John complimented. Beckie complimented him.
It wasn't LEONARD whom John complimented. Beckie complimented him.
It wasn't LEONARD whom John complimented. He complimented Beckie.

[8] **Target**: /k/
It wasn't MATT who followed Ed. Cory followed him.
It wasn't MATT who followed Ed. Cory was followed.
It wasn't MATT who followed Ed. He followed Cory.
It wasn't ED whom Matt followed. Cory followed him.
It wasn't ED whom Matt followed. Cory was followed.
It wasn't ED whom Matt followed. He followed Cory.

[9] **Target**: /b/
It wasn't DENNIS who fought Ian. Boris fought him.
It wasn't DENNIS who fought Ian. Boris was fought.
It wasn't DENNIS who fought Ian. He fought Boris.
It wasn't IAN whom Dennis fought. Boris fought him.
It wasn't IAN whom Dennis fought. Boris was fought.
It wasn't IAN whom Dennis fought. He fought Boris.

[10] **Target**: /k/
It wasn't ERIN who frightened Leah. Curt frightened her.
It wasn't ERIN who frightened Leah. Curt was frightened.
It wasn't ERIN who frightened Leah. She frightened Curt.
It wasn't LEAH whom Erin frightened. Curt frightened her.
It wasn't LEAH whom Erin frightened. Curt was frightened.
It wasn't LEAH whom Erin frightened. She frightened Curt.

[11] **Target**: /b/
It wasn't ARNOLD who cheated on Maria. Bart cheated on her.
It wasn't ARNOLD who cheated on Maria. Bart was cheated on.
It wasn't ARNOLD who cheated on Maria. She cheated on Bart.
It wasn't MARIA who Arnold cheated on. Bart cheated on her.

It wasn't MARIA who Arnold cheated on. Bart was cheated on.
It wasn't MARIA who Arnold cheated on. She cheated on Bart.

[12] **Target**: /k/
It wasn't MELANIE who divorced Darren. Candice divorced him.
It wasn't MELANIE who divorced Darren. Candice was divorced.
It wasn't MELANIE who divorced Darren. He divorced Candice.
It wasn't DARREN whom Melanie divorced. Candice divorced him.
It wasn't DARREN whom Melanie divorced. Candice was divorced.
It wasn't DARREN whom Melanie divorced. He divorced Candice.

[13] **Target**: /k/
It wasn't the PLAYERS who outraged the official. The coach outraged the official.
It wasn't the PLAYERS who outraged the official. The coach was outraged.
It wasn't the PLAYERS who outraged the official. The official outraged the coach.
It wasn't the OFFICIAL whom the players outraged. The coach outraged the official.
It wasn't the OFFICIAL whom the players outraged. The coach was outraged.
It wasn't the OFFICIAL whom the players outraged. The official outraged the coach.

[14] **Target**: /k/
It wasn't the SERGEANT who interrogated the private.
...The captain interrogated him.
It wasn't the SERGEANT who interrogated the private.
...The captain was interrogated.
It wasn't the SERGEANT who interrogated the private.
...He interrogated the captain.
It wasn't the PRIVATE whom the sergeant interrogated.
...The captain interrogated him.
It wasn't the PRIVATE whom the sergeant interrogated.
...The captain was interrogated.
It wasn't the PRIVATE whom the sergeant interrogated.
...He interrogated the captain.

[15] **Target**: /k/
It wasn't CINDY who deserted Lawrence. Carlos deserted him.
It wasn't CINDY who deserted Lawrence. Carlos was deserted.
It wasn't CINDY who deserted Lawrence. She deserted Carlos.
It wasn't LAWRENCE whom Cindy deserted. Carlos deserted him.
It wasn't LAWRENCE whom Cindy deserted. Carlos was deserted.
It wasn't LAWRENCE whom Cindy deserted. She deserted Carlos.

[16] **Target**: /k/
It wasn't JENNIFER who abandoned Leroy. Casey abandoned him.
It wasn't JENNIFER who abandoned Leroy. Casey was abandoned.
It wasn't JENNIFER who abandoned Leroy. She abandoned Casey.

It wasn't LEROY whom Jennifer abandoned. Casey abandoned him.
It wasn't LEROY whom Jennifer abandoned. Casey was abandoned.
It wasn't LEROY whom Jennifer abandoned. She abandoned Casey.

[17] **Target**: /k/
It wasn't the HOSTESS who embraced the butler. The cook embraced him.
It wasn't the HOSTESS who embraced the butler. The cook was embraced.
It wasn't the HOSTESS who embraced the butler. She embraced the cook.
It wasn't the BUTLER whom the hostess embraced. The cook embraced him.
It wasn't the BUTLER whom the hostess embraced. The cook was embraced.
It wasn't the BUTLER whom the hostess embraced. She embraced the cook.

[18] **Target**: /b/
It isn't MARVIN who insulted Lynn. Burt insulted her.
It isn't MARVIN who insulted Lynn. Burt was insulted.
It isn't MARVIN who insulted Lynn. She insulted Burt.
It isn't LYNN whom Marvin insulted. Burt insulted her.
It isn't LYNN whom Marvin insulted. Burt was insulted.
It isn't LYNN whom Marvin insulted. She insulted Burt.

[19] **Target**: /b/
It wasn't LEAH who paid Eileen. Bob paid Eileen.
It wasn't LEAH who paid Eileen. Bob was paid.
It wasn't LEAH who paid Eileen. Eileen paid Bob.
It wasn't EILEEN whom Leah paid. Bob paid Eileen.
It wasn't EILEEN whom Leah paid. Bob was paid.
It wasn't EILEEN whom Leah paid. Eileen paid Bob.

[20] **Target**: /b/
It wasn't EDDIE who attacked Richard. Bennet attacked him.
It wasn't EDDIE who attacked Richard. Bennet was attacked.
It wasn't EDDIE who attacked Richard. He attacked Bennet.
It wasn't RICHARD whom Eddie attacked. Bennet attacked him.
It wasn't RICHARD whom Eddie attacked. Bennet was attacked.
It wasn't RICHARD whom Eddie attacked. He attacked Bennet.

[21] **Target**: /b/
It wasn't the SUPPLIER that overcharged the owner.
...The bar overcharged him.
It wasn't the SUPPLIER that overcharged the owner.
...The bar was overcharged.
It wasn't the SUPPLIER that overcharged the owner.
...He overcharged the bar.
It wasn't the OWNER that the supplier overcharged.
...The bar overcharged him.

It wasn't the OWNER that the supplier overcharged.
...The bar was overcharged.
It wasn't the OWNER that the supplier overcharged.
...He overcharged the bar.

[22] **Target**: /k/
It wasn't the plane from ISRAEL that invaded Iran. Canada invaded Iran.
It wasn't the plane from ISRAEL that invaded Iran. Canada was invaded
It wasn't the plane from ISRAEL that invaded Iran. Iran invaded Canada.
It wasn't IRAN that the plane from Israel invaded. Canada invaded Iran
It wasn't IRAN that the plane from Israel invaded. Canada was invaded.
It wasn't IRAN that the plane from Israel invaded. Iran invaded Canada.

[23] **Target**: /b/
It wasn't RENEA who intimidated Diane. Beth intimidated her.
It wasn't RENEA who intimidated Diane. Beth was intimidated.
It wasn't RENEA who intimidated Diane. She intimidated Beth.
It wasn't DIANE whom Renea intimidated. Beth intimidated her.
It wasn't DIANE whom Renea intimidated. Beth was intimidated.
It wasn't DIANE whom Renea intimidated. She intimidated Beth.

[24] **Target**: /b/
It wasn't the TAXI driver who hit the pedestrian. The bus driver hit him.
It wasn't the TAXI driver who hit the pedestrian. The bus driver was hit.
It wasn't the TAXI driver who hit the pedestrian. He hit the bus driver.
It wasn't the PEDESTRIAN whom the taxi driver hit. The bus driver hit him.
It wasn't the PEDESTRIAN whom the taxi driver hit. The bus driver was hit.
It wasn't the PEDESTRIAN whom the taxi driver hit. He hit the bus driver.

[25] **Target**: /b/
It wasn't the MANAGER who met the producer. The band met the producer.
It wasn't the MANAGER who met the producer. The band was met.
It wasn't the MANAGER who met the producer. He met the band.
It wasn't the PRODUCER who the manager met. The band met the producer.
It wasn't the PRODUCER who the manager met. The band was met.
It wasn't the PRODUCER who the manager met. He met the band.

[26] **Target**: /k/
It wasn't the PRESS agent who told the reporter. The candidate told her.
It wasn't the PRESS agent who told the reporter. The candidate was told.
It wasn't the PRESS agent who told the reporter. She told the candidate.
It wasn't the REPORTER whom the press agent told. The candidate told her.
It wasn't the REPORTER whom the press agent told. The candidate was told.
It wasn't the REPORTER whom the press agent told. She told the candidate.

[27] **Target**: /k/
It wasn't the DESTROYER that evaded the submarine. The carrier evaded it.
It wasn't the DESTROYER that evaded the submarine. The carrier was evaded.
It wasn't the DESTROYER that evaded the submarine. It evaded the carrier.
It wasn't the SUBMARINE that the destroyer evaded. The carrier evaded it.
It wasn't the SUBMARINE that the destroyer evaded. The carrier was evaded.
It wasn't the SUBMARINE that the destroyer evaded. It evaded the carrier.

[28] **Target**: /b/
It wasn't the POLICE who contacted the doorman. The busboy contacted him.
It wasn't the POLICE who contacted the doorman. The busboy was contacted.
It wasn't the POLICE who contacted the doorman. He confronted the busboy.
It wasn't the DOORMAN whom the police contacted. The busboy contacted him.
It wasn't the DOORMAN whom the police contacted. The busboy was contacted.
It wasn't the DOORMAN whom the police contacted. He confronted the busboy.

[29] **Target**: /k/
It wasn't JANE who offended the officials. Carrie offended them.
It wasn't JANE who offended the officials. Carrie was offended
It wasn't JANE who offended the officials. They offended Carrie.
It wasn't the OFFICIALS whom Jane offended. Carrie offended them.
It wasn't the OFFICIALS whom Jane offended. Carrie was offended.
It wasn't the OFFICIALS whom Jane offended. They offended Carrie.

[30] **Target**: /b/
It wasn't RANDY who praised the choir. Barney praised them.
It wasn't RANDY who praised the choir. Barney was praised.
It wasn't RANDY who praised the choir. They praised Barney.
It wasn't the CHOIR whom Randy praised. Barney praised them.
It wasn't the CHOIR whom Randy praised. Barney was praised.
It wasn't the CHOIR whom Randy praised. They praised Barney.

[31] **Target**: /k/
It wasn't the VAN that smashed the bus. The car smashed it.
It wasn't the VAN that smashed the bus. The car was smashed.
It wasn't the VAN that smashed the bus. It smashed the car.
It wasn't the BUS that the van smashed. The car smashed it.
It wasn't the BUS that the van smashed. The car was smashed.
It wasn't the BUS that the van smashed. It smashed the car.

[32] **Target**: /k/
It wasn't MOLLY who suspended Laura. Carol suspended her.
It wasn't MOLLY who suspended Laura. Carol was suspended.
It wasn't MOLLY who suspended Laura. She suspended Carol.
It wasn't LAURA whom Molly suspended. Carol suspended her.

It wasn't LAURA whom Molly suspended. Carol was suspended.
It wasn't LAURA whom Molly suspended. She suspended Carol.

[33] **Target**: /k/
It wasn't the ASSISTANT who found the salesperson. The customer found them.
It wasn't the ASSISTANT who found the salesperson. The customer was found.
It wasn't the ASSISTANT who found the salesperson. They found the customer.
It wasn't the SALESPERSON whom the assistant found. The customer found them.
It wasn't the SALESPERSON whom the assistant found. The customer was found.
It wasn't the SALESPERSON whom the assistant found. They found the customer.

[34] **Target**: /b/
It wasn't NEAL who punched the guard. The boxer punched him.
It wasn't NEAL who punched the guard. The boxer was punched.
It wasn't NEAL who punched the guard. He punched the boxer.
It wasn't the GUARD whom Neal punched. The boxer punched him.
It wasn't the GUARD whom Neal punched. The boxer was punched.
It wasn't the GUARD whom Neal punched. He punched the boxer.

[35] **Target**: /b/
It wasn't the CHAIRPERSON who called the advisor. The board called her.
It wasn't the CHAIRPERSON who called the advisor. The board was called.
It wasn't the CHAIRPERSON who called the advisor. She called the board.
It wasn't the ADVISOR whom the chairperson called. The board called her.
It wasn't the ADVISOR whom the chairperson called. The board was called.
It wasn't the ADVISOR whom the chairperson called. She called the board.

[36] **Target**: /b/
It isn't LYDIA who likes Owen. Betty adores Owen.
It isn't LYDIA who likes Owen. Betty is adored.
It isn't LYDIA who likes Owen. Owen adores Betty.
It isn't OWEN whom Lydia likes. Betty adores Owen.
It isn't OWEN whom Lydia likes. Betty is adored.
It isn't OWEN whom Lydia likes. Owen adores Betty.

[37] **Target**: /k/
It wasn't DANIEL who pinched Larry. Colin pinched him.
It wasn't DANIEL who pinched Larry. Colin was pinched.
It wasn't DANIEL who pinched Larry. He pinched Colin.
It wasn't LARRY whom Daniel pinched. Colin pinched him.
It wasn't LARRY whom Daniel pinched. Colin was pinched.
It wasn't LARRY whom Daniel pinched. He pinched Colin.

[38] **Target**: /k/
It wasn't WENDY who suggested Drew. Colleen suggested him.
It wasn't WENDY who suggested Drew. Colleen was suggested.
It wasn't WENDY who suggested Drew. He suggested Colleen.
It wasn't DREW whom Wendy suggested. Colleen suggested him.
It wasn't DREW whom Wendy suggested. Colleen suggested him.
It wasn't DREW whom Wendy suggested. He suggested Colleen.

[39] **Target**: /k/
It wasn't JEAN who slapped Rodney. Kim slapped him.
It wasn't JEAN who slapped Rodney. Kim was slapped.
It wasn't JEAN who slapped Rodney. He slapped Kim.
It wasn't RODNEY whom Jean slapped. Kim slapped him.
It wasn't RODNEY whom Jean slapped. Kim was slapped.
It wasn't RODNEY whom Jean slapped. He slapped Kim.

[40] **Target**: /k/
It wasn't the dog that bit the child. The cat bit him.
It wasn't the dog that bit the child. The cat was bit.
It wasn't the dog that bit the child. It bit the cat.
It wasn't the child that the dog bit. The cat bit him.
It wasn't the child that the dog bit. The cat was bit.
It wasn't the child that the dog bit. It bit the cat.

[41] **Target**: /b/
It wasn't the SPURS who defeated the Knicks. The Bulls defeated them.
It wasn't the SPURS who defeated the Knicks. The Bulls were defeated.
It wasn't the SPURS who defeated the Knicks. They defeated the Bulls.
It wasn't the KNICKS whom the Spurs defeated. The Bulls defeated them.
It wasn't the KNICKS whom the Spurs defeated. The Bulls were defeated.
It wasn't the KNICKS whom the Spurs defeated. They defeated the Bulls.

[42] **Target**: /b/
It wasn't the REALTOR who questioned the couple. The bank questioned them.
It wasn't the REALTOR who questioned the couple. The bank was questioned.
It wasn't the REALTOR who questioned the couple. They questioned the bank.
It wasn't the COUPLE whom the realtor questioned. The bank questioned them.
It wasn't the COUPLE whom the realtor questioned. The bank was questioned.
It wasn't the COUPLE whom the realtor questioned. They questioned the bank.

[43] **Target**: /b/
It wasn't the RANGER who stopped the campers. The Boy Scouts stopped them.
It wasn't the RANGER who stopped the campers. The Boy Scouts were stopped.
It wasn't the RANGER who stopped the campers. They stopped the Boy Scouts.
It wasn't the CAMPERS who the Ranger stopped. The Boy Scouts stopped them.

It wasn't the CAMPERS who the Ranger stopped. The Boy Scouts were stopped.
It wasn't the CAMPERS who the Ranger stopped. They stopped the Boy Scouts.

[44] **Target**: /b/
It wasn't the STATE who sued the carmaker. The Bureau sued them.
It wasn't the STATE who sued the carmaker. The Bureau was sued.
It wasn't the STATE who sued the carmaker. They sued the Bureau.
It wasn't the CARMAKER whom the State sued. The Bureau sued them.
It wasn't the CARMAKER whom the State sued. The Bureau was sued.
It wasn't the CARMAKER whom the State sued. They sued the Bureau.

[45] **Target**: /k/
It wasn't the TRAIN that left the tourists. The cab left them.
It wasn't the TRAIN that left the tourists. The cab was left.
It wasn't the TRAIN that left the tourists. They left the cab.
It wasn't the TOURISTS whom the train left. The cab left them.
It wasn't the TOURISTS whom the train left. The cab was left.
It wasn't the TOURISTS whom the train left. They left the cab.

[46] **Target**: /k/
It wasn't the LAWYER who married the engineer. The caretaker married him.
It wasn't the LAWYER who married the engineer. The caretaker was married.
It wasn't the LAWYER who married the engineer. He married the caretaker.
It wasn't the ENGINEER whom the lawyer married. The caretaker married him.
It wasn't the ENGINEER whom the lawyer married. The caretaker was married.
It wasn't the ENGINEER whom the lawyer married. He married the caretaker.

[47] **Target**: /k/
It wasn't the GIANTS who routed the Bears. The Cowboys routed them.
It wasn't the GIANTS who routed the Bears. The Cowboys were routed.
It wasn't the GIANTS who routed the Bears. They routed the cowboys.
It wasn't the BEARS whom the Giants routed. The Cowboys routed them.
It wasn't the BEARS whom the Giants routed. The Cowboys were routed.
It wasn't the BEARS whom the Giants routed. They routed the cowboys.

[48] **Target**: /k/
It wasn't the US who beat Japan. Cuba beat them.
It wasn't the US who beat Japan. Cuba was beat.
It wasn't the US who beat Japan. They beat Cuba.
It wasn't JAPAN whom the US beat. Cuba beat them.
It wasn't JAPAN whom the US beat. Cuba beat them.
It wasn't JAPAN whom the US beat. They beat Cuba.

# Appendix D: Experiment 3 Stimuli

Experimental Items (48)

[1]
The car next to the van was either green or blue.
The car wasn't {green,blue}
The {car,van} was {blue,green}

[2]
The dog chasing the cat was either brown or black.
The dog wasn't {brown,black}
The {dog,cat} was {black, brown}

[3]
The fruit that came with the vegetables was either red or yellow.
The fruit wasn't {red, yellow}
The {fruit was,vegetables were} {yellow,red}

[4]
The region bordering that nation is mostly either forest or grassland.
The region isn't {forest, grassland}
The {region, nation} is {grassland, forest}

[5]
The trim around the door must be either plastic or wood.
The trim isn't {plastic,wood}
The {trim, door} is {wood, plastic}

[6]
The hallway leading into the kitchen is either carpeted or tiled.
The hallway isn't {carpeted,tiled}.
The {hallway, kitchen} is {tiled, carpeted}

[7]
The picture that came with the frame is either square or rectangular.
The picture isn't {square,rectangular}.
The {picture, frame} is {rectangular,square}.

[8]
The student of the professor wrote either the article or the chapter.
The student didn't write the {article,chapter}.
The {student, professor} wrote the {chapter, article}

[9]
The director who the producer hired had written either a play or a movie.
The director hadn't written a {movie,play}.
The {director, producer} had written a {play,movie}.

[10]
The plaque next to the sculpture was made of either granite or marble.
The plaque wasn't made of {granite,marble}.
The {plaque, sculpture} was made of {marble, granite}

[11]
The telescope equipped with a camera had either a scratched or a broken lens.
The telescope didn't have a {scratched, broken} lens.
The {telescope, camera} had a {broken, scratched} lens.

[12]
The advertisement for the store displayed either a sweater or a coat.
The advertisement didn't display a {sweater,coat}.
The {advertisement, store} displayed a {coat,sweater}.

[13]
Mary's little brother wanted either a puppy or a kitten.
Her brother didn't want a {puppy, kitten}.
{Her brother, Mary} wanted a {kitten,puppy}.

[14]
Helen's sister wore either a dress or a suit.
Her sister didn't wear a {dress, suit}.
{Her sister, Helen} wore a {suit,dress}.

[15]
Paul's mother was reading either a book or a magazine.
His mother wasn't reading a {book, magazine}.
{His mother, Paul} was reading a {magazine,book}.

[16]
Carl's friend was drinking either a beer or a soda.
His friend was not drinking a {beer, soda}.
{His friend, Carl} was drinking a {soda, beer}.

[17]
The Andersons' neighbors are either divorced or separated.
Their neighbors are not {divorced,separated}.
{Their neighbors, The Andersons} are {separated,divorced}.

[18]
The hikers that the rangers were trying to find either starved or drowned.
The hikers didn't {starve,drown}.
The {hikers,rangers} {drowned,starved}.

[19]
The electrician that the secretary called either repaired or replaced the cable.
The electrician didn't {repair, replace} the cable.
The {electrician, secretary} {replaced,repaired} the cable.

[20]
The woman with the little girl was either blonde or brunette.
The woman wasn't {blonde,brunette}.
The {woman, girl} was a {brunette,blonde}.

[21]
The potatoes that were served with the carrots were either baked or microwaved.
The potatoes weren't {baked, microwaved}.
The {potatoes, carrots} were {microwaved,baked}.

[22]
The chicken that we ordered instead of the duck was either grilled or roasted.
The chicken was not {grilled, roasted}
The {chicken, duck} was {roasted, grilled}.

[23]
The patient that the doctor examined is either nearsighted or farsighted.
The patient wasn't {nearsighted, farsighted}.
The {patient, doctor} is {farsighted, nearsighted}

[24]
The handle of the container was painted either yellow or orange.
The handle wasn't painted {yellow, orange}.
The {handle, container} was painted {orange, yellow}.

[25]
The onions that were tossed with the garlic were either chopped or peeled.
The onions weren't {chopped,peeled}.
The {onions, garlic} were {peeled, chopped}

[26]
The workers that the contractor hired went to get either paint or wallpaper.
The workers weren't getting {paint, wallpaper}.
The {workers, contractors} was getting {wallpaper, paint}.

[27]
The salesman that Greg was talking to was looking at either chairs or tables.
The salesman wasn't looking at {chairs, tables}. {The salesman, Greg} was looking at {tables, chairs}.

[28]
The couple next to the truck driver ordered either soup or salad.
The couple didn't order {soup, salad}.
The {couple, truck driver} ordered {salad, soup}.

[29]
The reinforcements that the general ordered should get there either in the morning or the afternoon.
The reinforcements won't get there in the {morning, afternoon}.
The {reinforcements, general} will get there in the {afternoon, morning}.

[30]
Charlie's cousin missed either the beginning or the middle of the movie.
His cousin didn't miss the {beginning, middle}.
{His cousin, Charlie} missed the {middle, beginning}.

[31]
One of the students in the group has to prepare either a presentation or paper.
A student doesn't have to prepare a {presentation, paper}.
{A student, the group} has to prepare a {paper, presentation}

[32]
Mark's father lost either his glasses or his contacts.
His father didn't lose his {glasses, contacts}.
{His father, Mark} lost his {contacts, glasses}.

[33]
The owner sitting next to the chairman is either a liar or a cheat.
The owner isn't a {liar, cheat}.
The {owner, chairman} is a {cheat, liar}.

[34]
Susan's mother brought either a hat or a scarf.
Her mother didn't bring a {hat, scarf}.
{Her mother, Susan} brought a {scarf, hat}.

[35]
Sandy's friend sent either flowers or a card.
Her friend didn't send {flowers, a card}.
{Her friend, Sandy} sent {a card, flowers}

[36]
The party after the ceremony is either on Friday or Saturday.
The party isn't on {Friday, Saturday}.
The {party, ceremony} is on {Saturday, Friday}.

[37]
The promotion for the show starts either Monday or Tuesday.
The promotion doesn't start on {Monday, Tuesday}.
The {promotion, show} starts on {Tuesday, Monday}.

[38]
The congressman sitting next to the president is flying to either Michigan or Minnesota.
The congressman isn't flying to {Michigan, Minnesota}.
The {congressman, president} is flying to {Minnesota, Michigan}.

[39]
The meeting before the debate will be in either the union or the auditorium.
The meeting won't be in the {union, auditorium}.
The {meeting, debate} will be in the {auditorium, union}.

[40]
The cabinets next to the chairs are available in either oak or walnut.
The cabinets aren't available in {oak walnut}.
The {cabinets, chairs} are available in {walnut, oak}.

[41]
The printer connected to the computer is either broken or unplugged.
The printer isn't {broken, unplugged}.
The {printer, computer} is {unplugged, broken}.

[42]
The model for the photographer was either tall or short.
The model wasn't {tall, short}.
The {model, photographer} was {short, tall}.

[43]
The election to be held after the primary is either on a Thursday or a Friday.
The election isn't on a {Thursday, Friday}.
The {election, primary} is on a {Friday, Thursday}.

[44]
Bill's uncle had surgery on either his ankle or his foot.
His uncle didn't have surgery on his {ankle, foot}.

{His uncle, Bill} had surgery on his {foot, ankle}.

[45]
Alison's daughter caught either a cold or the flu.
Her daughter didn't catch {a cold, the flu}.
{Her daughter, Alison} caught {the flu, a cold}.

[46]
The booklet that came with the video is either missing or checked out.
The booklet isn't {missing, checked out}.
The {booklet, video} is {checked out, missing}.

[47]
The exterminator that the inspector called sprayed for either the termites or the ants.
The exterminator didn't spray for the {termites, ants}.
The {exterminator, inspector} sprayed for {ants, termites}.

[48]
The exam after the review will be on either Wednesday or Friday.
The exam won't be on {Wednesday, Friday}
The {exam, review} will be on {Friday, Wednesday}.

# References

# References


Akmajian, A. (1973). The role of focus in the interpretation of anaphoric expressions. In S. R. Anderson & P. Kiparsky (Eds.), *A festschrift for Morris Halle* (Pp. 215–226). New York: Holt, Rinehart, & Wilson.

Baayen, R. H., Piepenbrock, R., & Gulikers, L. (1993). *The CELEX Lexical Database (Release 2)[CD-ROM].* Philadelphia, PA: Linguistic Data Consortium, University of Pennsylvania [Distributor].

Beckman, M., & Ayers, J. (1994). *ToBI Guide* (Tech. Rep.). The Ohio State University.

Birch, S., & Clifton, C. J. (1995). Focus, accent, and argument structure: Effects on language comprehension. *Language and Speech, 38*, 365–391.

Bird, J., & Darwin, C. J. (1997). Effects of a difference in fundamental frequency in separating two sentences. In A. R. Palmer, A. Rees, A. Q. Summerfield, & R. Meddis (Eds.), *Psychophysical and physiological advances in hearing.* London: Whurr.

Blutner, R., & Sommer, R. (1988). Sentence processing and lexical access: The influence of the focus-identifying task. *Journal of Memory and Language, 27*, 359–367.

Bock, K., & Mazzella, J. R. (1983). Intonational marking of given and new information: Some consequences for comprehension. *Memory and Cognition, 11*, 64–76.

Boersma, P., & Weenink, D. (1996). *Praat: A system for doing phonetics by computer, v. 3.4.* (Software) Available at www.praat.org.

Bolinger, D. (1961). Contrastive accent and contrastive stress. *Language, 37*, 83–96.

Broadbent, D. E. (1953). The role of auditory localization in attention and memory span. *Journal of Experimental Psychology, 47*, 191-196.

Brokx, J. P. L., & Nooteboom, S. G. (1982). Intonation and the perceptual separation of simultaneous voices. *Journal of Phonetics, 10*, 23–36.

Chafe, W. L. (1976). Giveness, contrastiveness, definetness, subjects, topics, and point of view. In C. N. Li (Ed.), *Subject and topic* (Pp. 25–55). New York: Academic Press.

Chase, W. G. (1978). Elementary information processes. In W. K. Estes (Ed.), *Handbook of learning and cognitive processes: Human information processing* (Vol. 5, Pp. 19–90). Hillsdale, NJ: Lawrence Erlbaum Associates.

Cherry, E. C. (1953). Some experiments on the recognition of speech, with one and with two ears. *Journal of the Acoustical Society of America, 25*, 975–979.

Chomsky, N. (1972). *Studies on semantics in generative grammar.* Mouton: The Hague.

Clark, H. H. (1969). Linguistic processes in deductive reasoning. *Psychological Review, 76,* 387–404.

Clark, H. H. (1974). Semantics and comprehension. In T. A. Seobok (Ed.), *Current trends in linguistics* (Vol. 12, Pp. 1291–1498). Mouton: The Hague.

Clark, H. H., & Chase, W. G. (1972). On the process of comparing sentences against pictures. *Cognitive Psychology, 3,* 472–517.

Clark, H. H., & Clark, E. V. (1977). *Psychology and language.* New York: Harcourt Brace.

Clark, H. H., & Haviland, S. E. (1977). Comprehension and the given-new contract. In R. O. Freedle (Ed.), *Discourse production and comprehension* (Pp. 1–40). Norwood, NJ: Ablex.

Clifton, C. (1990). *PC-EXPT.* (Software)

Connine, C. M., & Titone, D. (1996). Phoneme monitoring. *Language and Cognitive Processes, 11,* 635–645.

Cutler, A. (1976). Phoneme-monitoring reaction time as a function of preceding intonation contour. *Perception and Psychophysics, 20,* 55–60.

Cutler, A., & Clifton, C. J. (1999). Comprehending spoken language: A blueprint of the listener. In C. M. Brown & P. Hagoort (Eds.), *The neurocognition of langauge* (Pp. 123–166). Oxford: Oxford University Press.

Cutler, A., Dahan, D., & Donselaar, W. van. (1997). Prosody in the comprehension of spoken language: A literature review. *Language and Speech, 40,* 141–201.

Cutler, A., & Darwin, C. J. (1981). Phoneme-monitoring time and preceding prosody: Effects of stop closure duration and of fundamental frequency. *Perception and Psychophysics, 29,* 217–224.

Cutler, A., & Fodor, J. A. (1979). Semantic focus and sentence comprehension. *Cognition, 7,* 49–59.

Cutler, A., & Foss, D. J. (1977). On the role of sentence stress in sentence processing. *Language and Speech, 20,* 1–10.

Darwin, C. J. (1975). On the dynamic use of prosody in speech perception. In A. Cohen & S. G. Nooteboom (Eds.), *Structure and process in speech recognition* (Pp. 178–193). Berlin: Springer-Verlag.

Darwin, C. J., & Bethell-Fox, C. E. (1977). Pitch continuity and speech source attribution. *Journal of Experimental Psychology: Human Perception and Performance, 3*, 665–672.

Darwin, C. J., & Hulkin, R. W. (2000). Effectiveness of spatial cues, prosody, and talker characteristics in selective attention. *Journal of the Acoustical Society of America, 107*, 970–977.

Ferreira, F., & Anes, M. (1994). Why study spoken language? In M. A. Gernsbacher (Ed.), *Handbook of psycholinguistics* (Pp. 33–56). Academic Press.

Foss, D. J. (1969). Decision processes during sentence comprehension: Effects of lexical item difficulty and position upon decision times. *Journal of Verbal Learning and Verbal Behavior, 8*, 457-462.

Foss, D. J. (1998). Two strands of scholarship on language comprehension: Phoneme monitoring and discourse context. *Journal of Psycholinguistic Research, 27*, 191–201.

Gernsbacher, M. A., & Jescheniak, J. (1995). Cataphoric devices in spoken discourse. *Cognitive Psychology, 29*, 24–58.

Gernsbacher, M. A., & Shroyer, S. (1989). Signaling importance in spoken narratives: The cataphoric use of the indefinite this in spoken narratives. *Memory and Cognition, 17*, 536–540.

Halliday, M. A. K. (1967). Notes on transitivity and theme in English, Part 2. *Journal of Linguistics, 3*, 199–244.

Haviland, S. E., & Clark, H. H. (1974). What's new? Acquiring new information as a process in comprehension. *Journal of Verbal Learning and Verbal Behavior, 13*, 512–521.

Heim, I. (1982). *The semantics of definite and indefinite noun phrases.* PhD dissertation, University of Massachusetts at Amherst.

Heim, I. (1983). File change semantics and the familiarity theory of definiteness. In R. Bäuerle, C. Schwarze, & A. von Stechow (Eds.), *Meaning, use, and interpretation of language* (Pp. 250–269). De Gruyter, Berlin.

Horn, L. R. (1989). *A natural history of negation.* Chicago: University of Chicago Press.

Hornby, P. A. (1972). The psychological subject and predicate. *Cognitive Psychology, 3*, 632–642.

Jackendoff, R. (1972). *Semantic interpretation in generative grammar.* MIT Press.

Johnson-Laird, P. N., & Tridgell, J. M. (1972). When negation is easier than affirmation. *Quarterly Journal of Experimental Psychology, 24*, 87–91.

Just, M. A., & Carpenter, P. A. (1976). Eye fixations and cognitive processes. *Cognitive Psychology, 8*, 441–480.

Just, M. A., & Clark, H. H. (1973). Drawing inferences from the presuppositions and implications of affirmative and negative sentences. *Journal of Verbal Learning and Verbal Behavior, 12*, 21–31.

Kahneman, D. (1973). *Attention and effort.* Englewood Cliffs, NJ: Prentice Hall.

Kaufmann, A. (in press). Negation and prosody in British English: A study based on the London-Lund Corpus. *Journal of Pragmatics.*

Kintsch, W. (1974). *The representation of meaning in memory.* Hillsdale, NJ: Lawrence Erlbaum Associates.

Martin, J. G. (1972). Rhythmic (hierarchical) versus serial structure in speech and other behavior. *Psychological Review, 79*, 487-509.

Meltzer, R. H., Martin, J. G., Mills, C. B., Imhoff, D. L., & Zohar, D. (1976). Reaction time to temporally displaced phoneme targets in continous speech. *Journal of Experimental Psychology: Human Perception and Performance, 2*, 277–290.

Mens, L., & Povel, D. (1986). Evidence against a predictive role for rhythm in speech perception. *The Quarterly Journal of Experimental Psychology, 38A*, 177–192.

Moser, M. (1992). *The negation relation: Semantic and pragmatic aspects of a relational analysis of sentential negation.* PhD dissertation, University of Pennsylvania.

Nooteboom, S. G., & Kruyt, J. G. (1987). Accents, focus distribution, and the perceived distribution of given and new information: An experiment. *Journal of the Acoustical Society of America, 82*, 1512–1524.

O'Shaughnessy, D., & Allen, J. (1983). Linguistic modality effects on fundamental frequency in speech. *Journal of Acoustic Society of America, 74*(4), 1155–1171.

Pierrehumbert, J. (1979). The perception of fundamental frequency declination. *Journal of Phonetics, 66*, 363–369.

Pierrehumbert, J., & Hirschberg, J. (1990). The meaning of intonational contours and the interpretation of discourse. In P. R. Cohen, J. Morgan, & M. E. Pollack (Eds.), *Intentions in communication* (Pp. 271–312). Cambridge, MA: MIT Press.

Pitt, M. A., & Samuel, A. G. (1990). The use of rhythm in attending to speech. *Journal of Experimental Psychology: Human Perception and Performance, 16*, 564–573.

Prince, E. (1981). Topicalization, focus movement, and Yiddish movement: A pragmatic differentiation. In *Proceedings of the Seventh Annual Meeting of the Berkeley Linguistics Society* (Pp. 249–264). Berkeley, CA.

Rooth, M. (1985). *Association with focus.* PhD dissertation, University of Massachesetts, Amherst.

Rooth, M. (1992). A theory of focus interpretation. *Natural Language Semantics, 1,* 75–116.

Rooth, M. (1996). Focus. In S. Lappin (Ed.), *The handbook of contemporary semantic theory* (Pp. 271–297). Cambridge: Blackwell.

Rump, H. H., & Collier, R. (1996). Focus conditions and the prominence of pitch-accented syllables. *Language and Speech, 39,* 1–17.

Sgall, P., Hajičová, E., & Benesova, E. (1973). *Topic, focus, and generative semantics.* Scriptor Verlag GmbH.

Sgall, P., Hajičová, E., & Panevovă, J. (1986). *The meaning of the sentence in its semantic and pragmatic aspects.* Praha: Academia.

Shattuck-Huffnagel, S., & Turk, A. E. (1996). A prosody tutorial for investigators of auditory sentence processing. *Journal of Psycholinguistic Research, 25,* 193–247.

Shields, J. L., McHugh, A., & Martin, J. G. (1974). Response times to phonome targets as a function of rhythmic cues in continuous speech. *Journal of Experimental Psychology, 102,* 205–255.

Shipley, W. C. (1940). A self-administered scale for measuring intellectual impairment and deterioration. *Journal of Psychology, 9,* 371–377.

Singer, M. (1986). Answering WH-questions about sentences and text. *Journal of Memory and Language, 25,* 238–254.

Terken, J., & Nooteboom, S. (1987). Opposite effects of accentuation and deaccentuation on verification latencies for given and new information. *Language and Cognitive Processes, 2,* 145–163.

Treisman, A. (1969). Strategies and models of selective attention. *Psychological Review, 76,* 282–299.

Vallduví, E. (1992). *The informational component.* New York: Garland.

Vallduví, E. (1993). *The informational component.* PhD dissertation, University of Pennsylvania.

Vallduví, E. (1994). The dynamics of information packaging. In E. Engdahl (Ed.), *Integrating information structure into constraint-based and categorial approaches* (Pp. 1–26). Amsterdam: ILLC.

Vallduví, E., & Engdahl, E. (1996). The linguistic realization of information packaging. *Linguistics*, *34*, 459–519.

Vallduví, E., & Zacharski, R. (1994). Accenting phenomena, association with focus, and the recursiveness of focus-ground. In P. Dekker & M. Stokhof (Eds.), *Proceedings of the Ninth Amsterdam Colloquium* (Pp. 683–702). Amsterdam, The Netherlands: Universiteit van Amsterdam.

Warren, P. (Ed.). (1996). *Prosody and parsing: Special issue of language and cognitive processes.* East Sussex: Psychology Press.

Wason, P. C. (1959). The processing of affirmative and negative binary statements. *British Journal of Psychology*, *52*, 133–142.

Wason, P. C. (1965). The contexts of plausible denial. *Journal of Verbal Learning and Verbal Behavior*, *4*, 7–11.

Wason, P. C., & Johnson-Laird, P. N. (1972). *Psychology of reasoning: Structure and content.* London: B. T. Batsford.

Winer, B. J. (1971). *Statistical principles in experimental design.* (2nd ed.). New York: McGraw-Hill.

Yaeger-Dror, M. L. (1985). Intonational prominence on negatives in English. *Language and Speech*, *28*(3), 197–230.