

The Effect of Thematic Roles on Pronoun Use and Frequency of Reference Continuation

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Goal and source thematic roles have been shown to influence pronoun resolution, an effect that has been linked to the reader's tendency to focus on the consequences of the event (Stevenson, Crawley, & Kleinman, 1994). Using a story continuation experiment, I show that speakers also tend to use pronouns more often for goal entities than source entities. Furthermore, the experiment and a corpus analysis reveal that speakers tend to refer more frequently to goal entities than source entities overall. I use the parallel findings about pronoun use and frequency of reference continuation to argue that referent accessibility is influenced by the comprehender's estimate of the likelihood that a referent will be continued in the discourse.

Pronoun comprehension has been argued to be influenced by the accessibility of potential referents in the discourse representation, which is driven by a number of factors (see Arnold, 1998, for a review). One such factor that has received attention is the thematic roles of discourse referents (e.g., Garnham, Traxler, Oakhill, & Gernsbacher, 1996; Garvey & Caramazza, 1974; McDonald & MacWhinney, 1995; Stevenson, Crawley, & Kleinman, 1994). For example, the pronouns in (1a) and (1b) are more naturally interpreted as coreferential with the stimulus referent; that is, the entity that occurs in the stimulus role in the first clause, in this case, John.

- | | | | | |
|------|-------------|---------|-------------|------------------|
| (1a) | John | amazed | Bill | because he . . . |
| | stimulus | | experiencer | |
| (1b) | Bill | admired | John | because he . . . |
| | experiencer | | stimulus | |

This bias toward *John* has been attributed to the *implicit causality* of the verb. That is, *John* is implicitly understood as the cause of the event denoted by the verb (e.g., Au, 1986; Brown & Fish, 1983), which influences the interpretation of the ambiguous pronoun *he*. In addition to thematic role biases, studies have consistently shown a tendency for the referent of the subject or first-mentioned noun phrase (NP) to be more accessible than other entities (Arnold, 1999; Arnold, Eisenband, Brown-Schmidt, & Trueswell, 2000; Gernsbacher, 1990; Gordon, Grosz, & Gilliom, 1993; Hudson-D’Zmura & Tanenhaus, 1998; McDonald & MacWhinney, 1995; Stevenson et al., 1994).

There are several questions that arise from this line of research. First, do thematic roles also influence the speaker’s choice in reference form (i.e., pronouns vs. more explicit referring expressions)? In this article, I focus on goal and source roles in verbs of transfer, like *give* or *receive*, and show that the rate of pronoun use rises for reference to goal entities, in particular for the referents of nonsubject NPs.

More important is the second question: Why do thematic roles influence referent accessibility in the way they do? Previous research on implicit causality and thematic role biases has left this question relatively unanswered. Most researchers have accounted for pronoun biases in sentences like Example (1) in terms of readers’ interpretations of the implicit cause of the event (e.g., Garvey & Caramazza, 1974; McDonald & MacWhinney, 1995). However, implicit causality primarily impacts pronoun resolution when the following clause is introduced with a *because* connector. Therefore, an implicit causality account is not a general explanation.

Stevenson and colleagues (Stevenson et al., 1994; see also Stevenson, Knott, Oberlander, & McDonald, 2000; Stevenson & Urbanowicz, 1995, 1999; Wilson & Stevenson, 1998) provided a more sophisticated account of thematic role biases, suggesting that with verbs that denote events, the default focus is on the consequence of the event. This account capitalizes on the dynamic nature of language, suggesting that the initial verb biases can be enhanced or reversed in the presence of connectors like *because* or *so*.

In this article I build on previous accounts, proposing a general explanation of how and why thematic role information influences referent accessibility. I present results from a story continuation experiment and a corpus analysis that suggest that the biases toward goals and the referents of subject NPs are linked to a more general tendency for speakers to frequently refer to goal entities. I propose that this results in a relatively high probability that the goal referent will be mentioned again, which impacts the activation of the representation for that entity.

The results I present here support the idea that thematic role effects are partial and probabilistic.

My account is based on a model of language processing in which the comprehender's mental representation of the discourse includes representations of individual entities, and the activation of these entities rises and falls dynamically as the discourse progresses (cf. MacDonald, Pearlmutter, & Seidenberg, 1994; Trueswell & Tanenhaus, 1994; van den Broek, Risdén, Fletcher, & Thurlow, 1996). My discussion centers around the question of how discourse participants (who may be speakers or listeners, or both) perceive the accessibility of referents in the discourse, based on how referents have been mentioned in the prior discourse.

GOAL AND SOURCE IN VERBS OF TRANSFER

The studies in this article investigate goal and source roles in transfer verbs. These verbs are advantageous because there are some verbs in which the subject is the source (e.g., *send*) and some verbs in which the subject is the goal (e.g., *receive*). This feature is important because research has shown that referent accessibility is highly sensitive to the grammatical role of the antecedent, such that the referents of subject NPs are more accessible than the referents of object NPs. Therefore, the effect of other characteristics such as thematic roles may only be observable when grammatical role is controlled.

In this study, I am concerned with how referent accessibility is influenced by the thematic roles played by discourse entities in the preceding discourse. Therefore, I am interested in how speakers choose referring forms for entities that were the goal or the source of the preceding clause. To refer to these entities, I use the terms *goal referent* or *source referent*. Similarly, I use the terms *subject referent* or *object-of-PP* (prepositional phrase) *referent* to refer to those same entities in terms of the grammatical function of the last phrase used to refer to them.¹

Past research suggests that goal referents are more accessible than source referents (Stevenson et al., 1994; Stevenson & Urbanowicz, 1995; Wilson & Stevenson, 1998). The participants in Stevenson et al.'s (1994) sentence completion study interpreted ambiguous pronouns as referring to goal referents more often than to source referents, and in the condition in which the pronoun was not supplied, participants referred to the goal more than to the source. Wilson and Stevenson (1998) replicated these findings, and also showed that pronouns referring to goal entities are read faster than pronouns referring to source entities.

¹The subject referent bias in the preceding examples can also be described as a first-mention bias (e.g., Gernsbacher, 1990). Both characterizations are equally appropriate for the studies described here (and for most examples in English), but I use the subject versus object-of-PP distinction for the sake of presentation.

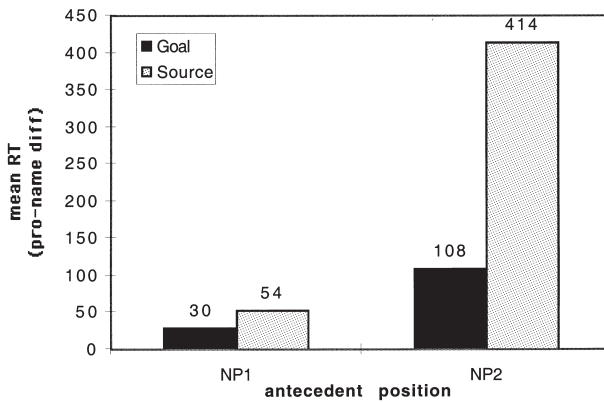


FIGURE 1 The extent to which reading times were shorter for names than pronouns, in ms. (Calculated from data in Tables 2 and 4 in Stevenson & Urbanowicz, 1995).

Further support comes from Stevenson and Urbanowicz's (1995) self-paced reading experiment, in which they recorded the time it took participants to read clauses containing either pronouns or full name anaphors with goal or source referents. Although their discussion did not focus on the difference in reading times for pronouns and full names, their results suggested how names and pronouns are read differently. By comparing the average reading times for pronouns and names in their experiment, we can see that participants read names faster than pronouns in all conditions (displaying a name advantage), but that the relative advantage varied according to both the position and thematic role of the referent. Using their data, I calculated the difference between the reading times for pronouns and names ([average reading time for pronouns]–[average reading time for names]), such that a positive difference indicates a shorter reading time for names. Figure 1 presents these differences separately for NP1 antecedents (i.e., subject antecedents) and NP2 antecedents (object-of-preposition antecedents). Although this comparison is only suggestive, as it was calculated from cell means with no significance testing, it shows that there was a greater name advantage for source referents than goal referents for both NP1 and NP2 antecedents. Put another way, pronouns were read relatively faster for goal referents than source referents, suggesting that the goal referent was more accessible. At the same time, thematic role appears to interact with grammatical function, such that the advantage for goal referents appears stronger for object-of-PP referents.

Thus, there is good reason to think that goal referents are more accessible than source referents at the moment that referring forms are encountered, in particular for object-of-PP referents. Why does this pattern exist? The following experiment and corpus analysis investigate whether speaker choices of referring forms are influenced by thematic role and whether such effects can be explained in terms of more general patterns of reference continuation.

EXPERIMENT: GOALS AND SOURCES

Method

Participants. Sixteen native speakers of English from the Stanford community participated in this and another experiment in exchange for \$7. The approximate time needed to complete both experiments was 45 min. Native speaker was defined as having started learning English by 5 years of age.

Design and procedure. The methodology used in this experiment was an oral story continuation conducted in the language laboratory at Stanford University. Each participant sat in a cubicle outfitted with a tape recorder and headset with a microphone and earphones. The stimuli were provided in written form, with several spaces between each item to prevent participants from reading the following item while completing the current one. The first two sentences in each stimulus item set the context for the story; the last sentence contained a verb with goal and source arguments. Examples are in (2) and (3).

- (2) There was so much food for Thanksgiving, we didn't even eat half of it. Everyone got to take some food home. Lisa *gave* the leftover pie to Brendan. . . .
- (3) I hate getting sick. It always seems like everyone gets sick as soon as it's vacation. Marguerite *caught* a cold from Eduardo two days before Christmas. . . .

Participants were asked to read these stories aloud into a tape recorder and add a natural continuation sentence to the story at the end.

This method combines comprehension and production processes. Although the task was to produce an utterance, it required participants to comprehend the stories before providing a continuation. Of particular importance is that their responses were made on the basis of the mental representations they developed while reading the story. In that sense, their responses reflect the accessibility of discourse entities that resulted from their comprehension of the story.

This method allowed me to investigate several things. First, participants were not restricted in the type of continuation they added, except that it had to be a new sentence, rather than a continuation of the last one. This freedom meant that their responses provided information about how they would tend to continue the story and allowed me to investigate which character they would mention first. Second, I could analyze whether participants used pronouns more often for goal or source characters.

A third question that I asked in this study was how the participants' continuations would be influenced by the relation between their continuation sentence and the stimulus story. That is, did participants produce continuations that expressed

the cause of the preceding event, a subsequent event, or something else? I considered the participants' continuation to be an indicator of their mental representation as it was at the end of the stimulus story. Therefore, if a participant provided a causal continuation, it signaled that the causal relation was most activated at the end of the stimulus story.

The method I used had other advantages as well. Because the task was oral rather than written, participants did not have the opportunity to reflect on the story and their continuations, so their continuations reflected their initial processing biases more than the written version of this task. Also, in contrast with rating questionnaires, this method makes it possible to exclude an item when it is clear that the participant had not understood the story as intended (e.g., when a name was interpreted with a different gender than the one intended).

Materials. Each stimulus item consisted of a three-sentence story like (2) and (3). The first two sentences provided the context and did not contain individual references to either of the characters introduced in the third sentence. Although the inclusion of two context sentences made it difficult to control every aspect of these discourses, it provided the far greater advantage of creating a somewhat more natural discourse. The third sentence included either a goal–source verb or a source–goal verb; all the verbs used are listed in (4).

- (4a) *Source–Goal verbs:* bring, give, hand, loan, offer, pass, pay, rent, sell, send, show, teach (used twice), tell, throw, toss
- (4b) *Goal–Source verbs:* accept, borrow, bought, catch (used twice), get (used twice), grab, hear, inherit, learn, purchase, receive, rent, snatch, take

All verbs appeared in a prepositional frame. Source–goal verbs are commonly used in both prepositional and double-object constructions (“Cynthia taught the lambada to Sean” or “Cynthia taught Sean the lambada”), but I only included prepositional constructions. This was to maintain consistency with the goal–source verbs, in which the source argument must appear as an object of preposition, as in “Annette caught a ride from Scott.” This consistency was particularly important because the choice between the double-object and prepositional constructions is partly driven by the discourse status of the referents (Arnold, Wasow, Losongco, & Ginstrom, 2000).

In the third sentence of each story, two human characters were introduced by first names. These two characters filled the source and goal roles in the event. The names used were ones almost always associated with only one gender. In all cases, the two characters were of opposite gender. The theme argument was always inanimate. In half the items, the theme argument occurred as a definite NP, and in the other half as an indefinite NP.

Unlike other implicit causality studies, this study did not include any conditions with overt connectors like *because* or *so*. Their absence meant that the relation of the continuation sentences was driven by other factors. The purpose of this study was not to discover exactly what those were. Instead, I just wanted to know whether participants would choose to refer to source or goal referents more often, depending on the role of the continuation sentence.

A total of 16 sentences were constructed with each type of verb. Each participant saw all 32 items (see Appendix). They were combined with 24 items belonging to another experiment (Arnold, 1999, Experiment 2), such that items for each experiment served as distracters for the other. The items from the other experiment also had three sentences and used proper names but followed a different structure from the current experimental items.²

Results

The continuations for each item were tape-recorded and transcribed. Thirty continuations were excluded from the analysis. Reasons for exclusion included continuing the last sentence rather than beginning a new one ($n = 8$), adding a nonsensical or ambiguous continuation ($n = 4$), saying nothing at all ($n = 3$), error in the stimulus ($n = 8$), or interpreting the name of one of the characters with the unintended gender ($n = 6$). For example, the name *Ali* was intended as a female name, but some participants read it as a male name, with an accent on the second syllable. Examples of scorable participant continuations are shown in Table 1. I was only interested in the frequency of referring to the goal and source characters, so references to other people or things were not included in the analysis. This left 340 continuations that could be analyzed.

For each item, I only considered the first continuation sentence, coding three things. First, I identified which character or object from the previous utterance was referred to first, if any. Second, I looked at how this character was referred to—with a pronoun or with a name. The rationale behind this procedure was to determine which of the two characters was considered more relevant to the following discourse, and to see how that character was referred to. I also looked at a third factor: type of continuation sentence. Following Stevenson et al. (1994), I coded each response in terms of its contribution to the discourse: (a) specifying the cause, (b) discussing the endpoint of the previous event,³ or (c) other. Table 2 shows examples of each type.

The results were coded by the author and a naive coder to answer three questions. First, in what percentage of cases did people refer to the source referent and

²An example filler sentence is: "Ron was looking through his address book, trying to make up his mind. He had an extra ticket to the opera, but he didn't know which friend to invite. At last he decided on Fred."

³Stevenson et al. (1994) used the term *consequences* to refer to the following conditions of an event. Here I use the term *endpoint* to include both true causal consequences and narrative continuations, both of which discuss the following conditions of the transfer event (cf. Stevenson et al., 2000).

TABLE 1
Example Responses From the Story Continuation Experiment

Stimulus: There was so much food for Thanksgiving, we didn't even eat half of it. Everyone got to take some food home. Lisa gave the leftover pie to Brendan.

- Brendan loved pie and cakes and all manner of sweet things but didn't know how to bake.
- He needed it the most since he was living off campus and didn't have access to food.
- I got the turkey and the stuffing, yum!
- She gave all the leftover turkey to me, and I asked if I could have the stuffings too, but she said don't be greedy, she gave the stuffings to her sister.

Stimulus: I hate getting sick. It always seems like everyone gets sick as soon as it's vacation. Marguerite caught a cold from Eduardo two days before Christmas.

- Unfortunately, Marguerite was sick on Christmas day.
- She was headed for the Bahamas, and it was tough.
- Eduardo gave it to me . . . and so I was sick over the entire holiday.
- And they were both in bed for the holiday.

TABLE 2
Examples for Each Category of Relation Between the Continuation Sentence and Previous One

| <i>Relation</i> | <i>Example</i> |
|-----------------|--|
| Cause | The U2 concert was sold out a week before the show. Scalpers were selling tickets for ridiculous prices. Fortunately Rafael got a ticket from Gabrielle. <i>Gabrielle's friend Phil couldn't make the concert.</i> |
| Endpoint | I hate getting sick. It always seems like everyone gets sick as soon as it's vacation. Marguerite caught a cold from Eduardo two days before Christmas. <i>It kind of put a damper on the Christmas festivities.</i> |
| Other | The professors in the music department were all in a good mood. The first day of music lessons had gone unexpectedly well. Melora taught a sonata to Mike in an hour and a half. <i>That is really fast.</i> |

Note. Participant continuation is italicized.

in what percentage to the goal referent? Second, what was the rate of pronoun use for each type of referent? Third, how was the choice to talk about the goal or the source influenced by the choice of how the continuation sentence would relate to the rest of the story? Intercoder agreement was 91% for Question 1, 99% for Question 2,⁴ and 85% for Question 3. The significance of each result was tested with a stepwise logistic regression using SPSS 9 (1999). The contribution of each factor is measured in terms of the ratio of the log likelihood of a model with that factor and a model without that factor. The models can be built using either a step-

⁴Only items where we agreed on who was being referred to were included in the agreement measurement for how reference was achieved.

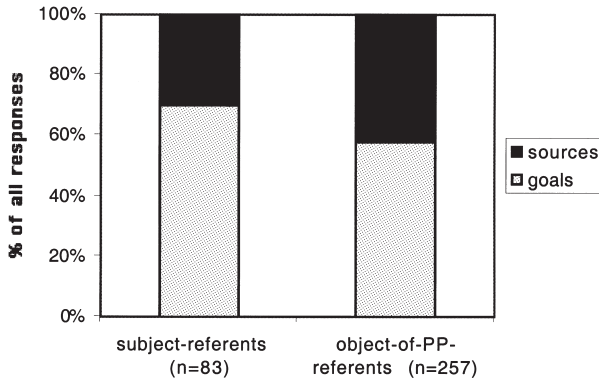


FIGURE 2 Distribution of references to goals and sources over the set of items referring to subject referents and object referents.

up or step-down procedure; in each case I performed both analyses and found the same results.

Did participants begin more often with goal or source referents? The first question I asked was, Who was referred to first? Here I was interested in whether participants would begin their responses more often with references to goal or source referents. However, I expected that grammatical functions would interact with any effect of thematic roles. I therefore looked at the rate of referring to goal and source referents separately for subject and object-of-PP referents, calculating the proportion of references to goal and source referents for each category. The results are shown in Figure 2. The results revealed a goal bias, in that the rate of reference to subject referents was sensitive to verb type (goal–source vs. source–goal), $-2*\text{Log LR} = 21$, $df = 1$, $p < .001$.⁵ For both subject and object-of-PP referents, they were more likely to be the first referent of the continuation sentence if they were also the goal.⁶

The primary reason for considering *who* was referred to more often was to compare goal continuations with source continuations. In this regard, the experiment produced the expected results. However, a secondary, unexpected result was also observed: Participants continued the discourses more often with the object-

⁵These statistics represent an analysis that included three additional variables: (a) participant identity, (b) definiteness of theme NP, and (c) connection type. Participant identity was included to account for individual variation among participants; this factor proved to account for a significant portion of the variation ($-2*\text{Log LR} = 35.8$, $df = 15$, $p < .006$). Definiteness of theme NP also reliably accounted for a significant portion of the variance ($-2*\text{Log LR} = 3.9$, $p < .05$), in that participants were more likely to begin with a reference to the goal referent when the theme NP was definite. The motivation for including connection type is explained later.

⁶For comparison I also performed an analysis that included all references to the goal or source arguments, not just the first one, and the results followed a similar pattern.

of-PP referent ($n = 257$) than the subject ($n = 83$). This result was surprising because it goes against the finding that naturally occurring discourses are more likely to be continued with reference to subject referents than other entities (Arnold, 1998, 1999). In an analysis of spoken discourse, I found that subject referents were the first thing continued in the following utterance in 43% of my sample utterances, but object or oblique referents were the first thing continued only 18% of the time. Similarly, in an analysis of written texts, I found that subject referents were continued 73% of the time, but object or oblique referents were continued only 27% of the time. Given these findings, and the more general tendency for subject referents to be more accessible than object referents (e.g., Arnold, Eisenband, et al., 2000; Gordon et al., 1993; McDonald & MacWhinney, 1995), I hypothesize that the object-of-PP bias in the experiment is a task-specific finding. It is possible that this second-mention bias is a recency effect, perhaps because of the demands of continuing the story orally. Another possibility is that participants feel motivated to justify the introduction of the second character to the story. The corpus analysis, described later, provides an important test of whether the object-of-PP bias is a true effect or a side effect of the experimental methodology.

Were pronouns used more for goal or source referents? I now turn to the second question, which concerns *how* goals and sources were referred to. I looked at four different categories of referent: subject/goal referents, subject/source referents, object-of-PP/goal referents, and object-of-PP/source referents. For each category, I tabulated the percentage of cases in which pronouns were used, out of the total number of references to a referent of that type. The results, presented in Figure 3, showed that pronouns were used at a higher rate for goals than sources, but the effect is most prominent for object-of-PP entities.

The data in Figure 3 reveal two patterns. First, the use of pronouns was far greater for subject referents ($-2*\text{Log LR} = 82$, $df = 1$, $p < .001$). Second, pronouns were used more for goals than sources. However, this effect occurred primarily for object-of-PP referents, as indicated by the reliable interaction between grammatical function and thematic role ($-2*\text{Log LR} = 7.96$, $df = 1$, $p < .005$).⁷

The relation of continuation sentences to the story. As I mentioned earlier, the stimuli contained no overt connectors to bias the relation of the continuation sentence to the rest of the story. Instead, the types of continuations that people produced were the result of their reaction to other aspects of the stimuli. As participants read the stimulus story, they had to form a mental model of the characters and actions, and these mental models were influenced by the form and meaning of the three stimulus sentences.

⁷As in the previous analysis, participant identity was entered into the logistic regression to account for individual variation among participants. This factor contributed significantly to the model ($-2*\text{Log LR} = 67$, $df = 15$, $p < .001$).

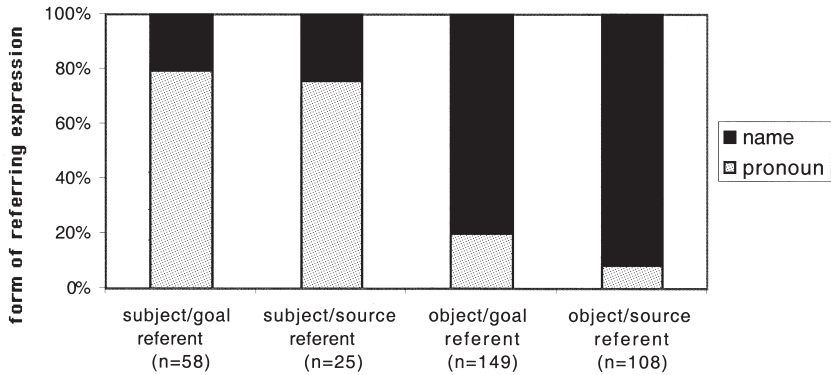


FIGURE 3 Percentage pronominal references (out of all references) by referent type.

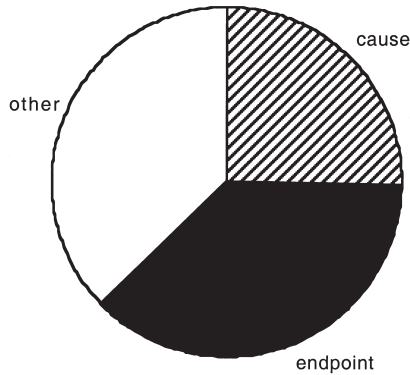


FIGURE 4 Percentage of all responses corresponding to each continuation type.

Because this was an oral task, it was also performed at a rate that is close to normal speaking. Participants' responses therefore reflect the accessibility of referents as they reach the end of the stimulus sentence. In particular, they reflect the cognitive status of the discourse referents and the participants' assumptions about where the discourse is going. For example, participants may focus on a causal continuation for the story, a specification of a subsequent event, or some other type of continuation. Although the data do not reveal why they focus on one type of continuation rather than another, their responses do indicate what the type of continuation was.

Therefore, as I mentioned earlier, I coded each continuation sentence for continuation type. Figure 4 shows the distribution of responses across the three continuation types, considering the entire set of responses. These data show that more continuations provided information about the endpoint of the event (37%) than the cause (25%) but that neither accounted for the majority of responses.

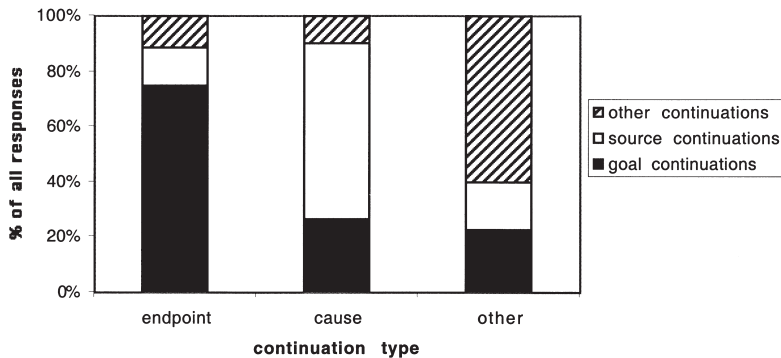


FIGURE 5 Proportion of goal and source continuations in each category of thematic role and clause relation.

Figure 5 shows the distribution of goal and source continuations across each of the four continuation types, which indicate that goal continuations are most common in responses that focus on the endpoint. This factor contributed significantly to the logistic regression model for who was referred to first ($-2 * \text{Log LR} = 35.8$, $df = 3$, $p < .002$).

Discussion

The results from the thematic roles experiment showed that participants tended to use pronouns more often for goal referents than source referents, but that this goal advantage only showed up for object-of-PP referents. This interaction between grammatical function and thematic role is consistent with the data from Stevenson and Urbanowicz's (1995) reading time experiment. Furthermore, the results showed that participants tended to refer more often to goal referents than source referents, a finding that is consistent with Stevenson et al.'s (1994) written sentence completion task. This suggests that the accessibility of goal referents is linked to a more general discourse pattern in which speakers more often focus their discourses on goals than sources.

At the same time, the results showed that the tendency to refer more to goals was stronger for some conditions than others. Specifically, when participants chose to explain something about the endpoint of the event, they tended to talk about goal referents more than source referents. However, they did not always focus on the endpoint, and when they did not, the rate of reference to the goal referent declined.

Thus, the goal bias for continuations about the endpoint matched the goal bias in the full sample of continuations. The continuations about endpoint were also more frequent than any other type of continuation. Therefore, the goal bias observed in the full sample may have occurred because of a bias toward focusing on the endpoint of the stimulus event. In this sense, the results are consistent with

Stevenson et al.'s (1994) claim that comprehenders tend to focus on the endpoint of an event more than any other single aspect of the event.

However, my results are not consistent with Stevenson et al.'s (1994) suggestion that verb biases lead people to focus on the endpoint of the event (unless a subsequent connector modifies this focus). In a task like this one, in which there were no connectors, their account would predict that the large majority of responses should focus on the endpoint. Contrary to this prediction, more than half of the responses did not. This finding highlights the idea that factors other than verb bias and connecting words influence the perception of how two clauses relate to each other. This is an issue I return to later.

In sum, the data from the experiment showed two general patterns. People referred more to goal than to source referents, especially when they focused on the endpoint of an event. They also used pronouns more often for goal than source referents. However, the results were also perplexing in one aspect: Participants continued the stories with the nonsubject referent more often than the subject referent. This contradicts the known accessibility of subject referents and the finding that subject referents are more likely to be referred to again than nonsubject referents (Arnold, 1998, 1999). This issue was further investigated in a corpus analysis, described in the following section.

CORPUS ANALYSIS: THEMATIC ROLES

The purpose of this corpus analysis was to investigate patterns of discourse with respect to goal and source referents. Do people refer more often to referents that have played certain thematic roles?

Method

A sample of 174 sentences was extracted from the 1986 Aligned–Hansard corpus. This corpus is a collection of transcripts from the Canadian Parliament, so the discourse it represents is natural and communicative, albeit formal. I extracted samples of sentences containing the verbs listed in (5).

- (5) Verbs used in the corpus analysis:

| <u>Source–goal verbs</u> | | <u>Goal–source verbs</u> | |
|--------------------------|-----------------|--------------------------|-----------------|
| Verb | No. of Examples | Verb | No. of Examples |
| give | 22 | get | 20 |
| send | 20 | accept | 18 |
| teach | 1 | receive | 25 |
| offer | 21 | buy | 2 |
| pay | 20 | take | 20 |
| | | learn | 5 |
| Total | 84 | | 90 |

I only included instances in which the verbs were used with both a source and a goal argument. As in the experiment, I limited the study to verbs used in the prepositional frame.

For each sentence in my sample, S1, I identified the next “independent” utterance, S2. I defined an independent utterance as a clause that is finite, not a sentential complement of the matrix clause, and not a relative clause. I then found the first expression in S2 that referred to something from S1, if there was one, and coded whether this expression referred to the goal referent, source referent, or other referent from S1. Examples are shown in (6).

(6) Examples from the thematic roles corpus analysis.

| First referent | Example |
|------------------------|--|
| goal (subject) | S1: <u>We</u> will buy what we want offshore from the United States or elsewhere. S2: <u>We</u> do not have to care whether . . . |
| source (subject) | S1: <u>She</u> ought to offer her services as a consultant to the province. S2: She says there is no impact on the province. |
| goal (object of PP) | S1: Mr. Speaker, I rise today to pay special homage to <u>a truly vibrant and magnificent lady</u> on her sixtieth birthday. S2: <u>She</u> has always had a reputation for congeniality and fairness toward all mankind. |
| other | S1: I will hasten to send <u>this good message</u> to the Quebec Minister of Finance. S2: <u>It's</u> a comment which, I think, he will appreciate. |

Results and Discussion

The results of this corpus analysis were tabulated separately for goal–source verbs and source–goal verbs. For each verb type, I counted the number of references to subject referents, object-of-PP referents, other referents from S1, and no referents from S1. Note that for goal–source verbs, the subject referent was also the goal referent, and for source–goal verbs, the object-of-PP referent was also the goal referent.

The results (Figure 6) show that overall there were more goal continuations than source continuations, $\chi^2(1, N = 89) = 38, p < .01$.⁸ Because the Aligned–Hansard corpus consists of speech in face-to-face settings, half of the utterances included first person (I or we) or second person (you) referents for either goal or

⁸The χ^2 analysis was performed over verb type (goal–source vs. source–goal) and referent type (subject vs. object-of-PP).

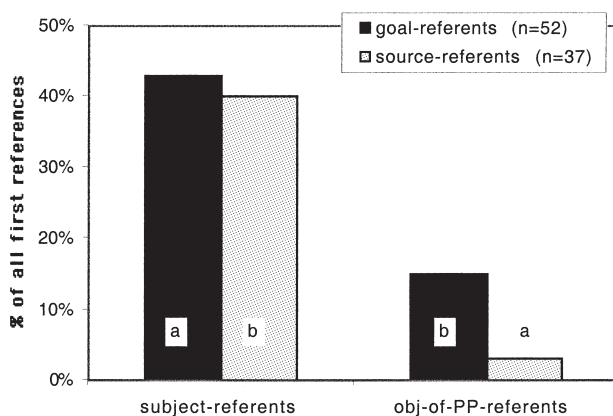


FIGURE 6 Corpus analysis results: Percentage of first references for all items of a given verb type (only references to goal or source referents are shown). a = goal–source verbs, b = source–goal verbs.

source arguments. However, the same pattern of results obtains, regardless of whether we consider just those utterances containing third person referents, $\chi^2(1, N = 45) = 19, p < .001$, or just those utterances containing one or more first or second person referents, $\chi^2(1, N = 44) = 20, p < .001$.

These data show three patterns. First, there was a large effect of grammatical function; that is, speakers referred to subject referents more often than any other given referent type. This is consistent with my findings elsewhere that subject referents are referred to more often than others (Arnold, 1998, 1999). It also suggests that the object-of-PP bias in the thematic roles experiment was the result of the experimental task and was not indicative of a tendency to focus on objects of prepositions with this type of verb.

Second, there was an effect of thematic role. This effect is largest for the object-of-PP category, in which there were more references to the goal referent than the source referent. This supports my hypothesis that the accessibility of goal referents is linked to the tendency for speakers to refer more often to entities that have played the role of goal. More specifically, the referents that play the role of goal are somewhat more likely to be referred to in the following utterance.

Third, there was an interaction between grammatical functions and thematic roles. That is, for subject referents, it did not matter whether the referent was also a goal or not. However, for object-of-PP referents, it mattered a great deal: Goal-object referents were referred to again far more than source-object referents. To test the reliability of this interaction, I considered the items with subject referents and object-of-PP referents as separate samples, and asked whether the proportion of goal referents was different in each of these two groups. I computed the *z* statistic for comparing two proportions and found that goal status indeed had more of

an effect when the referent was also a prepositional object than when it was a subject ($z = -2.05, p < .05$). This interaction is consistent with the findings about pronoun use in the experiment, as well as with Stevenson and Urbanowicz's (1995) reading time data for names and pronouns, presented in Figure 1.

GENERAL DISCUSSION

The results of the experiment and corpus analysis show that two generalizations can be made about verbs of transfer. First, speakers tend to talk more often about the goal than the source referent. Second, speakers tend to use pronouns more often to refer to the goal than the source referent. In the following sections I use these parallel findings to argue for a new framework for understanding how thematic roles influence referent accessibility and pronoun use.

Problems With Past Accounts

As described earlier, past research on thematic roles and referent accessibility has focused on two factors: verb bias and overt connector words like *because*. There are two limitations with these accounts that I would like to address. First, much of this work suggests that verbs contain an inherent bias toward either the cause or the consequences of an event. In the case of transfer verbs, Stevenson et al. (1994) suggested that readers focus on the following conditions of the event, except when a following connector word modifies this focus. This seems to suggest that verb bias effects should be more homogeneous than they actually are when connecting words are absent. As shown in Figure 4, 63% of the responses in the story completion experiment did not provide information about the endpoint of the event.

The second problem with past accounts concerns the role of connector words. Connector words do play a role, but their influence is neither categorical nor invariant. Rather, it is one of many constraints on the interpretation of how two clauses relate to each other. As comprehenders interpret a discourse, they build representations of the entities, relations between them, and events described by the discourse. In addition, they also need to build representations of how the propositions in two consecutive clauses relate to one another. Although connector words can provide strongly constraining information about what these relations are, they are not always present. Furthermore, even when they are present, they do not provide categorical information about clause relations. For example, the conjunction *and* can have many interpretations (Schmerling, 1975), some of which are in (7).

- (7a) Temporal: I wrote my dissertation and filed it.
- (7b) Causal: It was cold and she put on her jacket.
- (7c) Simultaneous: I listened to music and looked out the window.

Other connectors, like *because*, more strongly indicate the speaker's intentions. However, even *because* is ambiguous to the extent that it can signal cause in one of three domains, as in (8).

from Sweetser (1990, p. 77)

- (8a) Cause of real-world action: John came back because he loved her.
- (8b) Cause of speaker's knowledge: John loved her, because he came back.
- (8c) Cause of speech act: What are you doing tonight, because there's a good movie on.

In sum, the relation between thematic roles and referent accessibility cannot be fully described in terms of default verb biases and overt connector words.

A Multiple-Constraints Framework

In this section I outline a new framework for thinking about thematic roles and referent accessibility. Here I am taking a multiple-constraints approach that has been developed to explain speech and sentence processing (e.g., MacDonald et al., 1994; Marslen-Wilson, 1990; Trueswell & Tanenhaus, 1994) and applying it to the explanation of discourse phenomena. Under this approach, I am assuming that language use is a dynamic process, whereby discourse referents become more or less accessible as the result of various sources of information. I use the metaphor of partial activation to describe varying levels of accessibility, in which the level of activation represents the level of referent accessibility (cf. van den Broek et al., 1996).

My proposal is centered around understanding how thematic role information can be used by comprehenders to infer how important a given referent is to the discourse. How does the comprehender know which referents the speaker considers more topical? Which referents are most likely to be referred to again? This inference is necessary for speakers and comprehenders to coordinate their individual models of referent accessibility in the discourse. When speakers know that comprehenders are likely to have a sufficiently activated representation of a given entity, they also know that reference resolution will be facilitated for the comprehender. When comprehension is facilitated, speakers are licensed to use underspecified forms of reference like pronouns.

Underlying this proposal is the idea that language processing involves unconscious hypotheses about where the discourse is going and that these hypotheses influence the activation of discourse referents. The listener's predictions about the discourse flow are neither conscious nor categorical. Rather, certain referents are activated probabilistically, for a short period of time, as various kinds of information become available. Activation is influenced by many sources of information, including the thematic roles of referents in the preceding clause.

Pronoun use and frequency of reference continuation. The experimental results showed that speakers use pronouns more frequently to refer to goal referents than source referents, especially for object-of-PP referents. This finding, which is consistent with previous results about pronoun resolution (Stevenson & Urbanowicz, 1995), suggests that goal referents are more accessible than source referents at the point when they are referred to. What explains this accessibility? My proposal is based on the finding that speakers refer more frequently to goal referents than source referents. This indicates that from the comprehender's point of view, it is more probable that the speaker will refer to the goal referent than the source referent.

Based on this finding, I propose that the accessibility of a given referent, which can be modeled in terms of activation of its representation, is driven by the likelihood that it will be referred to again in the following discourse (either directly or through a bridging inference). When a referent is likely to be referred to again, it behooves comprehenders to instantiate a relatively activated representation of that referent in their model of the discourse. Then, if the speaker does refer to that entity again, comprehension will be facilitated.

How do comprehenders estimate the likelihood that a referent will be continued in the discourse? Here I have shown that thematic role information can be useful. Elsewhere, I have also shown (Arnold, 1998, 1999) that factors like grammatical function, parallelism, recency, and focus constructions also provide information about the likelihood for a given referent to be continued in a discourse.

Furthermore, the data in this article suggest that thematic roles interact with grammatical function. In the corpus, the increased likelihood for goals to be mentioned again occurred primarily for object-of-PP referents, and in the experiment, the pronoun preference for goals also occurred primarily for object-of-PP referents. This interaction can be explained under a multiple-constraints framework: Discourse participants can calculate the likelihood that a given referent will be mentioned again based on both thematic roles and grammatical function (and other sources of information). The tendency for subject referents to be continued is so reliably high that thematic role biases do not greatly influence their accessibility. In contrast, the accessibility of object-of-PP referents can be pushed around more by their thematic role.

In addition, the experimental data suggest that the likelihood for goals to be continued is influenced by the type of continuation, supporting Stevenson et al.'s (1994) findings that goals are most accessible when comprehenders focus on the endpoint. These facts suggest that (a) thematic role biases are relatively weak; and (b) they are contingent on other factors, like the perceived contribution of the next utterance. Other factors are also likely to play a role. For example, the stimulus sentences in the experiment were always embedded in context sentences, such that the discourse topic (to the extent that one can be identified) was always some character other than the goal or source characters. This may have dampened the accessibility of these characters, perhaps diminishing the goal bias in the experimental results (see Arnold, 1999, for related results).

There are several ways in which the comprehender might estimate the increased probability of reference to goal entities. It might be that through experience and observation of language use, people learn that other people tend to refer to goal referents more often than source referents, thereby learning that thematic roles are a reliable source of information about reference continuation. In this case, information about the probability of reference continuation would become activated whenever a goal referent is encountered. Alternatively, it may be that comprehenders infer this probability through a more complex evaluation of the current discourse and the particular speaker's goals.

Either way, when the comprehender can estimate a relatively high probability that a particular referent will be mentioned, this probability can be translated into a higher activation for that entity, and therefore a higher level of accessibility. If the speaker does refer to that entity, comprehension should be facilitated. In this condition, the speaker can use less specified forms of reference, like pronouns. For referents that are relatively less likely to be mentioned, their representations will receive a lower level of activation, so speakers will need to use fuller forms, like names, to refer to those entities.

There are two ways that this probability may influence the subsequent interpretation of pronouns. Some researchers have presented thematic role effects in terms of focusing (the focusing account): As comprehenders determine the role of a referent in a particular event, that information influences the cognitive status of the referent, making it more or less accessible (e.g., Stevenson et al., 1994). During the comprehension of the next clause, referent accessibility influences the interpretation of referring expressions. Other researchers have claimed that thematic role effects only come into play later, during either anaphor resolution or the integration of the anaphor with the discourse (the resolution/integration account), and do not influence the representation of discourse entities beforehand (Garnham et al., 1996; McDonald & MacWhinney, 1995; Stewart, Pickering, & Sanford, 2000). Under either account, the discourse patterns observed in the corpus analysis could play a role. Under the focusing account, the higher probability of goal referents to be mentioned again can be interpreted in terms of anticipatory activation on the representations of goal entities, before the pronoun is encountered. Under the resolution account, the activation of highly probable entities would not occur until after the anaphor has been encountered.

Clause relation as a multiple-constraints process. As in prior work, my data suggest that the effect of verb bias is mediated by the way in which comprehenders perceive two clauses as relating to each other, which is built up dynamically during the comprehension process and does not occur at any single point in time. In contrast with previous work, I suggest that it can be influenced by many constraints, of which connectors and verb biases are only two.

I propose that the representation of clause relations, like referent representations, can be thought of in terms of partial activation over representations of rela-

tion types. At the beginning of a given clause, several relation types might be partially activated. As the comprehender receives additional information over time, one relation will become fully activated, and the others will lose activation. Eventually only one relation type will be selected.

What determines which relation types are activated? As discussed previously, connector words are strongly constraining, but even they do not provide completely categorical information. The influence of connector words can therefore be best understood as partial, probabilistic constraints. That is, a connector like *because* might signal a high probability that the following clause will contain causal information, and would therefore highly activate a causal interpretation. A connector like *and*, on the other hand, weakly activates several different relations. By providing less constraining information, *and* leaves the listener to interpret the relation on the basis of other factors.

Other constraints that may play a role include discourse genre, tense, or aspect. For example, (9a) may be more likely to be followed by another event than (9b).

- (9a) John raked the lawn. (Then he went inside.)
 (9b) John rakes the lawn. (But I never do.)

Even though both (9a) and (9b) use the same verb, the use of the past tense in (9a) makes it more likely to be perceived as part of a narrative, in which case it is more likely that the speaker will follow up with a description of a subsequent event. In contrast, the simple present tense in (9b) turns it into a proposition about John's habits, which may be less likely to be followed by a description of a subsequent event.

There are several advantages to thinking of clause relations as partial, probabilistic, and dynamic representations that are built out of several sources of information. First, it explains why participants in my experiment did not always (or even primarily) focus on the endpoint of an event when no connectors were present. Second, it explains why Stevenson et al. (1994) found thematic role biases even for sentences with no connector, without relying on the assumption (as they did) that the sentential break is interpreted as an implicit causal connector. Third, it explains why the goal bias in my data was strongest when participants focused on the endpoint of the stimulus event. With no connector present, participants were influenced by other aspects of each sentence, such as the tense, aspect, genre, or, as Stevenson et al. suggested, type of verb.

CONCLUSIONS

The proposal outlined in this article suggests that the accessibility of goal referents over source referents is tied to a more general tendency for speakers to talk more about goals than sources. I suggested that referent accessibility is driven by

the comprehenders' estimation that a given referent will be continued in the discourse, based on their knowledge about the frequency of continuation of goal referents versus source referents and of subject referents versus nonsubject referents. This proposal is consistent with two recent themes in the psycholinguistic literature.

First, my proposal links referent accessibility to the perception of regularities in linguistic input, which has been increasingly shown to play a role in language learning and use. Babies as young as 8 months old pay attention to the statistical distribution of speech sounds for the purpose of segmenting words (Aslin, Saffran, & Newport, 1998; Saffran, Aslin, & Newport, 1996; Saffran, Newport, & Aslin, 1996). For adults, the comprehension of lexical ambiguities is driven by the frequency with which a given word occurs with a given meaning (Rayner & Duffy, 1986; Simpson, 1984), and the comprehension of syntactic ambiguities is influenced by the frequency of a word appearing in a given frame or structure (MacDonald, 1993, 1994; Spivey-Knowlton & Sedivy, 1995; Trueswell, 1996). The data presented here also suggest that at the discourse level, discourse participants pay more attention to types of entities that are frequently continued in the discourse; thus, linking accessibility to regularities in referential patterns at the discourse level.

Second, the data presented here are broadly consistent with repeated findings that people tend to pay attention to the goals and intentions of speakers, actors, and events in a number of domains. Babies as young as 6 months old attend to the goals of human actors (Woodward, 1998), and toddlers pay attention to the goals of adults for the purpose of learning new words (Tomasello & Barton, 1994). When adults read narratives, a component of building situation models involves generating superordinate goal inferences (Graesser, Singer, & Trabasso, 1994; Long & Golding, 1993). During language comprehension, the interpretation of syntactic ambiguities is influenced by the listener's perception of the speaker's goals (Chambers, Tanenhaus, Eberhard, Carlson, & Filip, 1998; Chambers, Tanenhaus, & Magnuson, 2000). These repeated findings about the importance of goals provide a possible explanation for why speakers refer to goals more often than sources; that is, people tend to care about the outcome of events, so they tend to comment on them, especially in narrative genres. Similarly, the results from the experiment reported here show that people tend to focus on goals in two ways. In terms of the narrated event, they focus on the character associated with the goal of the transfer event. At the communicative level, referent accessibility is influenced by the perceived relation between two clauses, which is one component of assessing the communicative goals of the speaker.

Although these two themes in the psycholinguistic literature are consistent with one another, the fact that people tend to focus on goals raises a question about the proposal that the goal bias falls out of regularities in referential patterns. Why not simply say that the accessibility of goals comes from a tendency for comprehenders to focus on goals, rather than pay attention to distributional patterns?

Although this account is possible, it would have to be combined with a second, independent account of the accessibility of subject referents. As the data show, the effect of thematic roles is relatively weak compared with stronger factors like the subject bias. Both the experiment and the corpus analysis also revealed an interaction, such that the effect of thematic roles on pronoun use and reference continuation is greatest for object-of-PP referents. The advantage of the framework described herein is that the bias toward both subjects and goals can be linked to the frequency of referring to these entities (as can biases coming from other sources of information; Arnold, 1998). Because the probability that the subject referent will be continued in the discourse is much higher than the probability that the goal referent will be continued, the subject bias is stronger, so thematic roles affect referent accessibility only when other factors (i.e., subject effects) are less constraining.

Although there are many details to be worked out, this approach makes predictions about how other thematic roles should impact reference processing: I predict that in cases in which speakers are more likely to refer to entities that have played certain thematic roles, both speakers and comprehenders should find pronouns more natural than fuller forms of reference to refer to these entities.

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APPENDIX

Stimuli From the Story Continuation Experiment

Goal–Source Verbs

1. I hate getting sick. It always seems like everyone gets sick as soon as it’s vacation. Marguerite caught a cold from Eduardo two days before Christmas.
2. My physics class gets out at 7 p.m. and it’s already dark then. A lot of people have trouble getting home. Annette usually catches a ride from Scott.

3. The U2 concert was sold out a week before the show. Scalpers were selling tickets for ridiculous prices. Fortunately Rafael got a ticket from Gabrielle.
4. My high school friends really try to keep in touch with each other. It's a lot easier now that we have e-mail. Today Gladys got three e-mails from Carlos.
5. Getting a telegram always scares me. It has to be either great news or awful news. Juan received a telegram from Claire when their mother died.
6. No one was supposed to know about the layoffs in our company. Of course, everyone did anyway. Jennifer heard the news from Pablo.
7. The high school prom was around the corner. The whole senior class had agreed to do a performance of the "Macarena." Sonia quickly learned the steps from Allen.
8. The day before the exam, my whole study group was in a panic. It was 3 a.m., and no one could figure out Problem 3. Elizabeth had to borrow the notes from Art.
9. Anyone who's anyone in Washington should be seen at the presidential inauguration. It's also really important who your date is. Courtney accepted an invitation from Bruce.
10. Our class presentation went okay, but not great. No one in our group is a good speaker, but some are better than others. Craig should take some lessons from Pam.
11. Yesterday was probably the most exciting football game in the high school's history. A fight broke out, but not among the players—it was among the cheerleaders. It started when Blaire grabbed the megaphone from Ed.
12. My little brother and sister got into a big fight the other day. They both wanted the last piece of Halloween candy. The fight ended when Greg snatched the candy from Linda.
13. Summer weekends are the perfect time to get away. There are many ways to travel besides cars. Last summer, Mimi rented an old bicycle from Victor.
14. It's funny how people like to point out how kids resemble their parents. But in fact it's often really striking. In my family, for example, Nick inherited big feet from Christine.
15. The amateur art show was held yesterday at the local high school. Some of the items were even for sale. Dan purchased a painting from Barb.
16. It's amazing the things you can buy used at Stanford. You can get things really cheap, especially at the end of the year when everyone is leaving. Last year Ryan bought a stereo from Delia for \$50.

Source–Goal Verbs

1. It was the final game in our company's softball tournament. The game was tied and everyone was on the edge of their seats. Fred threw the ball to Ginny.
2. The whole office was busy getting ready for the big presentation. It seemed like they would never be done. Finally Christopher handed the report to Stacy.

3. Yesterday we had our annual church picnic. We had a great game of “Toss the Egg.” The best part was when Brett tossed the egg to Cathy.
4. The drama club was worried that no one would come to the opening performance of their play. Everyone agreed to try to get all their friends to come. Erin sent an invitation to Bill.
5. Information travels fast in my school, especially gossip. When Jan and Andy broke up, everyone knew when, why, and how within days. It started when Marie told the story to Rick.
6. Yesterday our dorm’s intramural basketball team played in the last game of the season. It was a big deal, because this game determined who would go to the finals. With 30 seconds to go, Holly passed the ball to Jason.
7. The students in my English class had to decide what order to give our presentations in. It was hard, because no one wanted to go last. Tina offered the first slot to Matt.
8. The Jacksons had no trouble getting their beach house taken care of while they were on sabbatical. Lots of people offered to look after the place for them. However, Eloise had already rented the house to Andy.
9. Everyone pitched in to get the neighborhood party off the ground. Lots of people brought burgers and chicken patties. Phyllis loaned a barbecue to Wiley.
10. The professors in the music department were all in a good mood. The first day of music lessons had gone unexpectedly well. Melora taught a sonata to Mike in an hour and a half.
11. I’ll never forget the Christmas party this year. Even the shy people were dancing. Cynthia taught the lambada to Sean.
12. Everyone was shocked when the Cowan family got into a car wreck. Everyone wanted to do something to show their sympathy. Sam brought flowers to Ali in the hospital.
13. There was so much food for Thanksgiving, we didn’t even eat half of it. Everyone got to take some food home. Lisa gave the leftover pie to Brendan.
14. The Donaldsons recently moved to India. They had to get rid of everything before they left. Anna sold the couch to Frank.
15. The art museum was packed when the fire broke out. Everyone can remember exactly what they were doing when the alarm sounded. Ray was showing a Van Gogh to Betty.
16. There are lots of opportunities for teenagers to make money in part-time jobs. It’s possible to make quite a bit of money by babysitting. Phil paid \$200 to Emily for a full weekend.