Improving coherence in written communication*

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1. Preamble

The theme connecting the chapters in this volume is that coherent communication conveys the message that a speaker or writer intended to convey; incoherent communication does not. Because we are cognitive psychologists, we will state this theme in terms of mental processes and mental representations. We propose that coherent communication enables the reader or listener to build a mental representation of what the writer or speaker intended to convey. In this chapter, we describe the cognitive processes that we propose enable writers to produce coherent texts. In doing so, we present a series of experiments that were aimed at improving the cognitive processes and representations that writers employ while producing and revising their texts.

2. Writers often produce incoherent texts

Our own experiences, as well as empirical research, document that readers do not understand written texts as well as the writers of those texts believe they will (Schriver, 1984, 1987, 1992; Traxler and Gernsbacher, 1992). Primary, secondary, and university students have difficulty expressing themselves in writing (Bartlett, 1981; Bridwell, 1980; Hayes, Flower, Schriver, Stratman and Carey, 1987; Stallard, 1974). Even professional writers, with years of experience, often write texts that their intended audience cannot understand (Duffy, Curran and Sass, 1983; Swaney, Janik, Bond and Hayes, 1981). These findings suggest that something goes wrong

when people write. What goes wrong?

Writers' difficulty conveying their ideas to readers cannot be attributed to lack of effort. While inadequate effort may cause some failures in written communication, inadequate effort cannot be blamed for all problems, because communication breaks down even when writers try hard to communicate effectively. Further, skilled writers continually evaluate whether their words convey their intentions (Hayes, 1988; Scardamalia and Bereiter, 1983), and yet they often fail to communicate effectively.

Similarly, writers' difficulty conveying their ideas to readers cannot be attributed to a lack of comprehension skill on the readers' part. Adults are just as good at comprehending written text as they are at comprehending spoken messages (Gernsbacher, Varner and Faust, 1990). If lack of comprehension skill causes written communication to fail, then people should have just as much trouble communicating in conversation as they have communicating in writing. In fact, research demonstrates that people can convey ideas effectively in conversation (Anderson, 1992; Clark and Schaeffer, 1987a; Clark and Wilkes-Gibbs, 1986; Isaacs and Clark, 1987).

If writers and readers expend reasonable effort producing and comprehending texts, and if people who fail to communicate effectively in writing can communicate effectively using spoken communication, perhaps something specific to written communication makes it so difficult. So, comparing conversation and written communication should yield some clues as to what makes written communication more difficult.

3. Spoken communication is typically more successful than written communication

Collaboration between speakers and listeners, shared control of the direction and pace of conversation, and a constant exchange of explicit and back-channel feedback (e.g., "mmm-hmmm" noises, smiles, nods, frowns, puzzled looks) between speaker and listener keeps oral communication on track (Anderson, 1992; Clark and Schaeffer, 1987a; Clark and Schaeffer, 1987b; Clark and Wilkes-Gibbs, 1986; Isaacs and Clark, 1987; Schober and Clark, 1989). Speakers can detect problems in spoken communication with considerable ease because conversation is collaborative: Speakers and listeners actively interact — they collaborate — to establish mutual representations. Collaboration between speakers and listeners allows listeners to request clarification when they do not understand speakers. Likewise, speakers can solicit responses from listeners to determine when listeners do not understand what speakers say. In this way, speakers realize when their listeners' mental representations do not match what they intended to convey. Speakers rapidly detect when listeners misinterpret their utterances, and they rapidly and efficiently repair their utterances to bring listeners' interpretations back into line.

Collaboration between speakers and listeners has a number of beneficial effects. For example, Clark and Wilkes-Gibbs (1986) demonstrated that collaboration between speakers and listeners greatly streamlines reference-making in conversation. In these experiments, one group of students (directors) described a set of twelve geometric figures to another group of students (matchers). The directors' task was to get the matchers to rapidly and accurately identify the figures they described. Directors and matchers were separated by an opaque screen, but could converse freely. The experiment comprised six trials. Directors described (and matchers selected) the same set of twelve geometric figures on all six trials. Over the course of the experiment, speakers greatly decreased the number of words spoken per figure and the number of conversational turns taken per figure. Thus, this experiment demonstrated that collaboration between speakers and listeners makes communication more efficient.

Listeners who collaborate with speakers comprehend speakers' utterances much better than listeners who do not collaborate with speakers (Schober and Clark, 1989). These experiments closely resembled those in Clark and Wilkes-Gibbs (1986). That is, directors described a set of 12 geometric figures to matchers, and directors and matchers conversed freely. A third participant (an overhearer) listened to the conversation between a director and a matcher and also tried to identify the figures described by the director. However, overhearers were not allowed to converse with directors. Even though overhearers heard every word of the conversations between directors and matchers, overhearers were less accurate than matchers at identifying the geometric figures described by the directors. Thus, collaboration between speakers and listeners greatly affects how effectively speakers convey meaning to listeners.

Speakers and listeners who collaborate more actively communicate better than speakers and listeners who collaborate less actively (Anderson, 1992). In this series of experiments, directors described paths on maps to matchers. The directors' task was to get the matchers to rapidly and accu-

rately draw the same path on their maps as the directors had on their maps. The directors' and matchers' maps resembled each other closely, but some landmark features appeared on only one of the maps. In other words, some landmarks that appeared on the directors' maps did not appear on the matchers' maps, and vice-versa. These experiments demonstrated that speakers and listeners who elicited more extensive collaboration from their partners (by asking questions, for example) communicated more effectively (as evidenced by greater similarity of matchers' paths to directors' paths).

4. Writers must form mental representations when producing and revising their texts

In our recent work, we (Traxler and Gernsbacher, 1992, 1993) have suggested that successful written communication requires that writers build mental representations. One mental representation is of the ideas the writers want to convey; another mental representation is of the text as it is written. We joined Sommers (1980) and Hayes and Flower (1986) in proposing that writers revise their texts when they perceive a mismatch between what they wanted to convey and what they think their texts did convey.

However, we further proposed that building and comparing only these two representations is insufficient for writers to convey their ideas successfully. Writers must build a third representation; they must envision the mental representation that their readers will build from their text, they must compare this representation to their representation of the ideas they wanted to convey, and they must revise their texts until those two representations match.

Finally, we suggested that writers have difficulty figuring out how readers will interpret their texts, because this requires them to take a naive perspective. If writers already know what they want to convey, they have already formed the interpretation that they want their readers to form. Forming it again — from their readers' perspective — is difficult.

When writers build mental representations of how their readers will interpret their texts, they may draw upon several sources. Writers may have some information about their readers' world knowledge. If writers know what their readers do and do not know about the world, then they will most likely make reference to concepts to which their readers have ready access, and explain in more detail those concepts to which their readers do not have ready access. Writers, as members of a culture, have some information about linguistic convention within that culture. That is, they have at least a rudimentary understanding of how the language works — how to put together grammatical sentences, how members of the culture use words and phrases. Writers most likely have some information about their intended readers' intellectual sophistication. Writers may use any or all of this information to predict how their readers will interpret words, sentences, paragraphs, and entire essays. Further, writers who have more complete information about readers' world knowledge and comprehension skill, linguistic convention, and task demands, will predict more accurately how readers interpret their texts.

5. Feedback helps writers more accurately build their mental representations

Previously, we have suggested that collaboration aids oral communication because it gives speakers accurate information about the representations listeners build from their utterances. If speakers accurately envisioned how listeners interpreted their utterances (before the speakers received any feedback from listeners), then feedback from listeners should not affect oral communication in any way. However, feedback between speakers and listeners affects communication profoundly. Thus, we can conclude that speakers (prior to receiving feedback) do not always accurately envision how listeners interpret their utterances and receiving feedback from listeners causes speakers to understand better how listeners interpret their utterances.

Unfortunately, writers and their readers (unlike speakers and their listeners) normally do not enjoy the luxury of collaborating to establish mutual representations. Readers are typically absent when writers encode their messages, and writers are typically absent when readers decode those messages. Do writers fail to communicate effectively because they fail to envision accurately how readers interpret their texts (the same way speakers sometimes fail to envision accurately how listeners interpret their utterances)? We have no *a priori* reason to believe that people are better at envisioning their audiences when they write than they are when they speak. Thus, writers' failure to accurately envision readers interpretations of their texts constitutes a plausible explanation for writers' failure to produce

coherent text. Further, if feedback from readers affects writers the same way feedback from listeners affects speakers, then we might conclude that writers' problems stem from their failure to envision accurately how readers interpret their texts. What effect does feedback from readers have on writers?

Adult writers communicate more effectively when they receive feedback from readers (Hayes, 1988; Schriver 1984, 1987, 1992; Swaney, Janik, Bond and Hayes, 1981; Traxler and Gernsbacher, 1992). In one series of experiments (Swaney et al., 1981), researchers employed think-aloud feedback to guide their revision of a text.[1] Professional document designers, who did not employ think-aloud feedback, had previously failed to improve this same text (in fact, their revisions made the document less understandable than the original). Results of a comprehension test showed that revisions made with the aid of think-aloud protocols made the document more understandable than the original version. So, in this case, feedback from readers allowed writers to successfully revise a text where other methods failed.

Other research demonstrates that writers who receive feedback from readers over a series of texts detect more problems in subsequent texts (Schriver, 1984, 1987, 1992). In these experiments, a group of college students examined texts (written by someone else) and tried to predict which parts readers would have difficulty understanding. After making their predictions, students examined think-aloud protocols collected from people who read those texts. Thus, students could compare their predictions against readers' actual responses. Another group of college students were taught to anticipate readers' needs through audience-analysis heuristics, peer-critiquing, and role-playing. Students who were exposed to think-aloud protocols made better predictions than the other students. Thus, feedback from readers on one set of texts helps writers better envision how readers interpret subsequent texts.

6. Minimal feedback improves coherence in written communication

We recently examined (Traxler and Gernsbacher, 1992) the effects of "minimal" feedback on writers' success in conveying ideas to readers. In our first experiment, we asked one group of university students, whom we called *writers*, to write descriptions of several Tangram figures. The Tan-

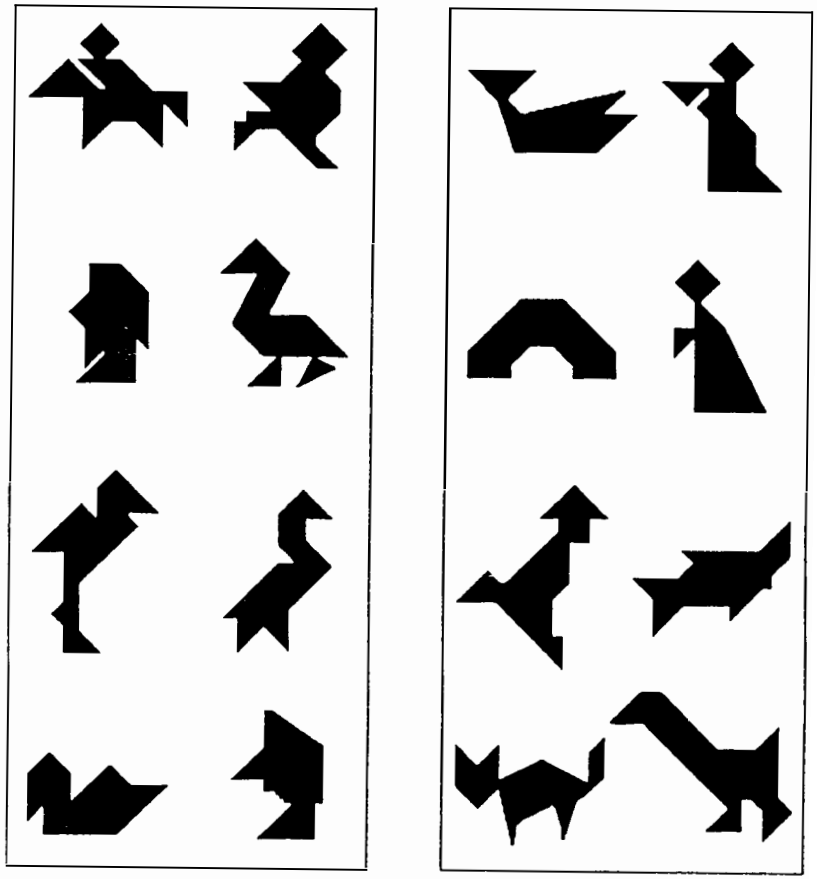

Figure 1. Experimental stimuli: Eight target figures in sets A (left) and B (right).

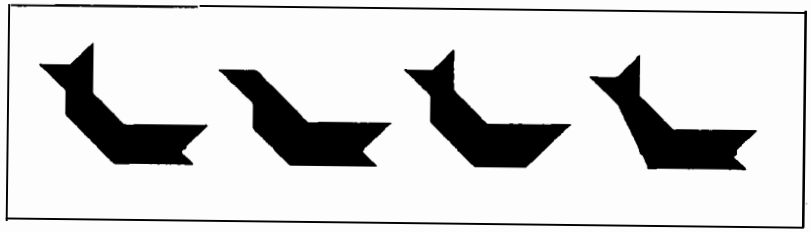

Figure 2. Example target figure and its three distracters.

gram figures were based on those used by Clark and his colleagues (e.g., Clark and Wilkes-Gibbs, 1986; Schober and Clark, 1989). They were solid black, geometric shapes, as shown in Figure 1. Each writer wrote descriptions of one set of eight figures, either Set A or Set B. After the writers described the eight figures, another group of university students, whom we called *readers*, read each description and tried to select each "target" figure from three distracter figures. An example target figure and its three distracters are shown in Figure 2. Each reader read descriptions written by two writers: one writer who would subsequently receive feedback, and one writer who would not. In this way, each reader contributed data to both the feedback and no-feedback conditions. Furthermore, of the two writers whose descriptions each reader read, one writer had described the figures in Set A, and the other had described the figures in Set B.

There was a first writing session, during which writers wrote descriptions of eight figures, and a first reading session, during which readers read the eight descriptions and selected each target figure from its distracters. The events of these two sessions are summarized in Figure 3. Performance during the first reading and writing sessions provided a baseline from which we could compare performance during two more writing and reading sessions.

The next week, a second writing and reading session occurred. At the beginning of the second writing session, half the writers received feedback on how well their readers had used their initial descriptions to select the figures, and half of the writers did not receive this feedback. The feedback was simply a number for each of the eight figures indicating how many readers (none, one, or both) were able to successfully select that figure from its distracters. During the same time that the writers who received feedback were evaluating this "minimal" feedback, the writers who did not receive feedback estimated how many of their readers selected the correct figure. So, both groups of writers spent the same amount of time reviewing the figures and their descriptions of those figures. Then, both groups of writers revised their descriptions. Later that week, the same readers read the revised descriptions and again tried to select each target figure. The events of this second writing and reading sessions are summarized in Figure 3.

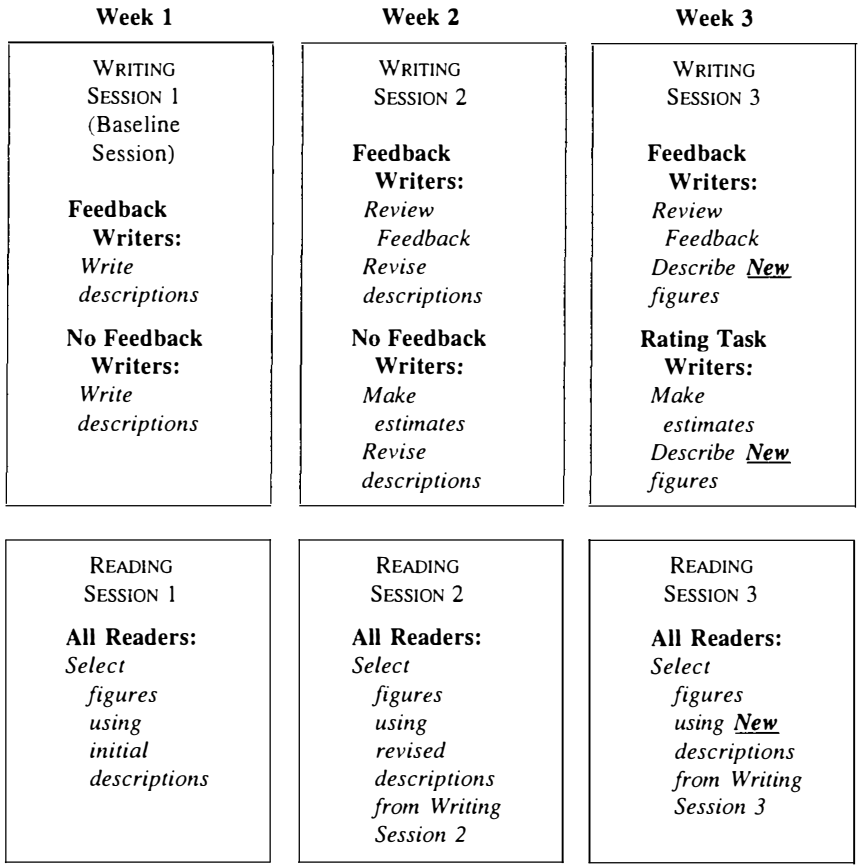

Figure 3. Summary of events during Experiment 2 (Traxler and Gernsbacher, 1992).

The next week, a third writing and reading session occurred. At the beginning of the third writing session, the writers who had previously received feedback again received feedback: They were told how well their

readers had used their revised descriptions to select the figures during the second reading session, and they were reminded how well their readers had used their initial descriptions to select the figures during the first reading session. The other half of the writers did not receive feedback, but they again performed the estimation task. Then, both groups of writers again revised their descriptions. In a final reading session, readers read these (re-) revised descriptions.

Thus, there were three writing and reading sessions. Our dependent measure was how many figures the readers correctly selected during each of the three reading sessions. As mentioned before, performance during the first sessions provided a baseline against which we could compare performance during subsequent sessions. The first writing and reading sessions provided a baseline because at this point none of the writers had received any feedback, and none of the readers had seen any figures. The change in performance between the baseline and the subsequent two sessions illustrated the effect of feedback on the writers' ability to revise their descriptions.

We predicted that feedback would improve writers' descriptions because feedback should help writers envision the mental representations that their readers formed from their descriptions. If, while writing and revising their descriptions, writers hold a representation of the information they want to convey, a representation of what they have actually written, and a representation of how their text will be interpreted by their readers, then providing writers with this type of feedback should allow them to form better representations of their readers' interpretations. In other words, feedback — even this minimal form of feedback — should help writers envision the mental representations that their readers form. Writers who do not receive feedback should be disadvantaged in this respect.

Our results, shown in Figure 4, supported our prediction. Figure 4 presents improvement scores, which we computed by subtracting performance at the second and third reading sessions from performance at the first session. The hashed bars represent the readers' improvement when they selected figures using descriptions revised by writers who received feedback; the unfilled bars represent the readers' improvement when they selected figures using descriptions revised by writers who did not receive feedback. Consider the two bars on the left in Figure 4; they represent the amount of improvement from the baseline session to the second reading session. As these two bars illustrate, the descriptions revised by writers who

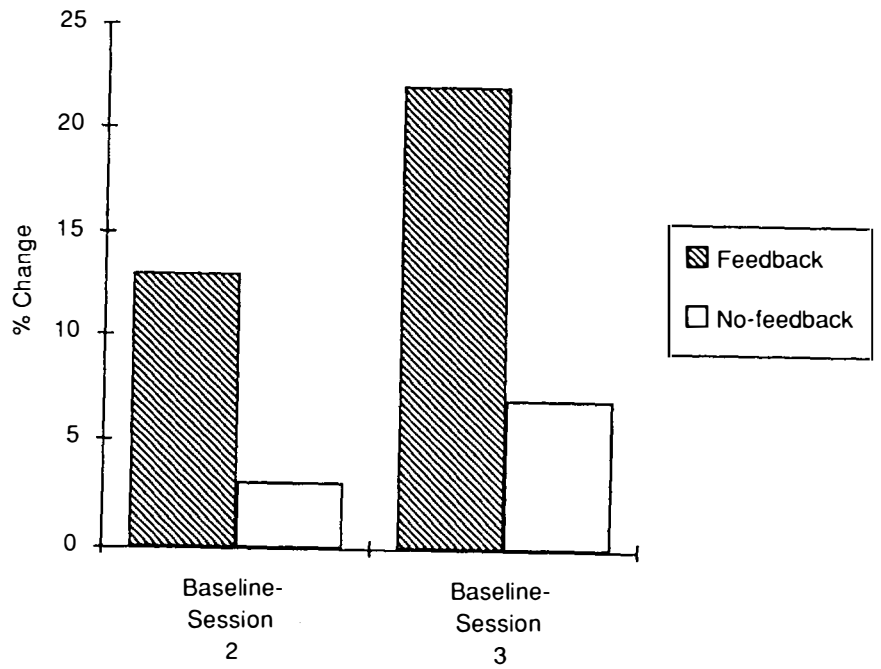

Figure 4. Subjects' mean improvement in selection during Experiment 1 (Traxler and Gernsbacher, 1992).

received feedback led to improvement in readers' selection performance. In contrast, the descriptions revised by writers who did not receive feedback did not lead to improvement in readers' selection performance.

Now, consider the two bars on the right of Figure 4; they represent the amount of improvement from the baseline to the third reading session. Recall that the descriptions used by readers at the third reading session had been revised twice. Thus, writers who received feedback had received two treatments of feedback, and these two treatments should have lead to even more improvement. And indeed, as the hashed bar illustrates, the descriptions re-revised by writers who received feedback lead to even more improvement than we observed at the second reading session (after the writers received only one treatment of feedback). In contrast, consider the descriptions re-revised by writers who did not receive feedback (the rightmost, unfilled bar). Descriptions re-revised by writers who did not receive

feedback did lead to much less improvement than that provided by the feedback writers' descriptions. These results demonstrate that feedback — even minimal feedback provided by numbers representing readers' selection performance — improved university students' ability to revise written texts.

In our second experiment, we investigated whether feedback would continue to improve university students' written communication when they faced a new writing task. If feedback enables writers to envision their readers' mental representations, then this improved perspective should continue — even when the writers describe novel stimuli. In contrast, if the beneficial effects of feedback that we observed in our first experiment were due solely to the writers becoming aware of specific problems in their previously written texts, then we should not observe any benefit of feedback when the writers describe novel stimuli.

During the first two writing and reading sessions of our second experiment, we followed the same procedure that we followed in our first experiment. During the first writing session, one group of subjects wrote descriptions of the eight Tangram figures in either Set A or Set B, and during the first reading session, another group of subjects read the descriptions and selected each target figure from its distracters. As in our first experiment, performance during this first session provided a baseline. Also as in our first experiment, at the beginning of the second writing session half the writers received feedback, and half did not. Both groups revised their descriptions, and during the second reading session, readers read the revised descriptions.

The third writing session also began like our first experiment: Half the writers received feedback on their readers' success using their revised descriptions, while the other half only estimated their readers' success. Then, the critical difference between our first and second experiments occurred. To test whether the beneficial effects of feedback would transfer to a new writing task, all writers were given a new set of figures to describe: If they had previously described the figures in Set A, then their task was to describe the figures in Set B; similarly, if they had previously described the figures in Set B, then their task was to describe the figures in Set A. Thus, the feedback writers had received feedback on only their descriptions of one set of figures; now their task was to describe a new set. If feedback enables writers to better envision the mental representations formed by their readers, then feedback should have improved the writers' descriptions of the new set of figures.

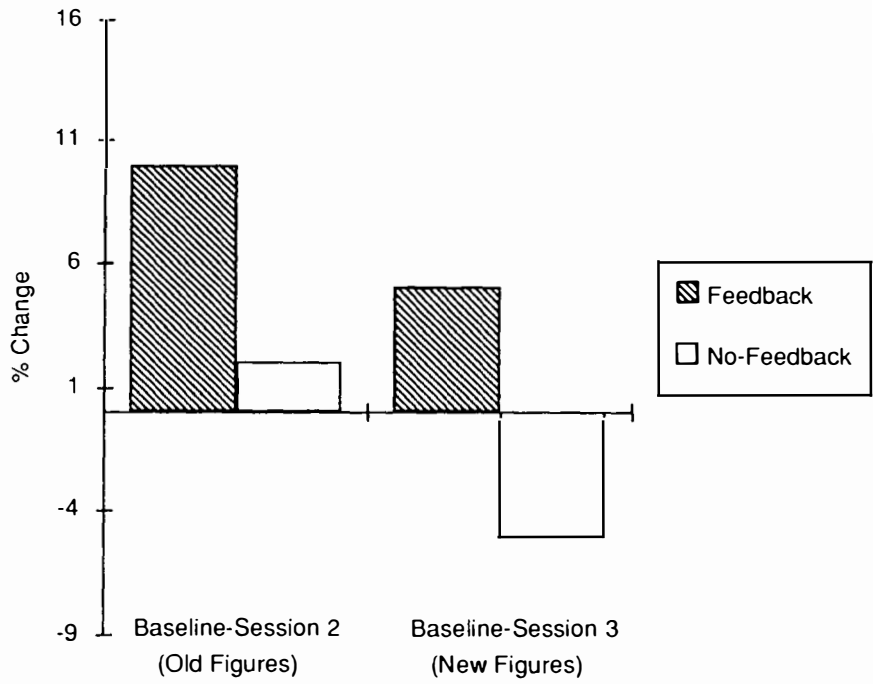

Figure 5. Subjects' mean improvement in selection during Experiment 2 (Traxler and Gernsbacher, 1992).

Our results, shown in Figure 5, supported our prediction. Similar to Figure 4, Figure 5 presents improvement scores, which we again computed by subtracting performance during the second and third reading sessions from performance during the first, baseline session. The hashed bars represent the readers' improvement when they selected figures using descriptions written by writers who received feedback; the unfilled bars represent the readers' improvement when they selected figures using descriptions written by writers who did not receive feedback.

First, examine the two bars on the left in Figure 5; they represent improvement from the baseline session to the second reading session. As these two bars illustrate, the descriptions revised by writers who received feedback led to a reliable amount of improvement. In contrast, the descriptions revised by writers who did not receive feedback did not lead to a reliable amount of improvement.

The novel results of Experiment 2 are illustrated by the two rightmost bars in Figure 5. Those two bars represent improvement from the baseline to the third reading session. Recall that the descriptions read during the third reading session were about novel stimuli; neither the feedback nor the no-feedback writers had ever received feedback on those particular descriptions. However, as Figure 5 illustrates, the descriptions of the new stimuli that were produced by writers who had previously received feedback led to above baseline performance (49% correct); indeed, the amount of improvement was not reliably less than that observed at the second reading session. In contrast, the descriptions of the new stimuli produced by writers who had never received feedback led to below baseline performance (42% correct), and the amount of improvement was reliably lower than the amount of improvement provided by descriptions written by writers who had previously received feedback. These results demonstrate that the benefits of feedback — even minimal feedback provided by numbers representing readers' selection performance — transfers to a novel writing task.

These two experiments demonstrate that providing university-student writers with minimal feedback from their readers helps them improve their texts. In our first experiment, writers who received feedback improved the texts on which they received feedback. In our second experiment, writers who received feedback on one set of texts wrote better new texts. We suggest that feedback gave the writers a better sense of how their texts were interpreted by their readers. Because our feedback identified only which texts were problematic — it did not identify what the problems were or how they could be solved — the writers had to rely on internal information to improve their texts. We suggest that the internal information on which the writers relied was a mental representation of how their readers interpreted their texts.

Why did our minimal feedback encourage the writers to consult their mental representations? We know that writers frequently overestimate how clear their texts are, and they have difficulty pinpointing where their texts are unclear (Bartlett, 1981; Hayes, 1988; Hayes et al., 1987). In our experiments, the writers who did not receive feedback also overestimated how clear their texts were, and they unsuccessfully predicted which of their texts were less clear. More specifically, in our first experiment, the writers who did not receive feedback estimated (on the average) that their readers had selected the correct figure 63% of the time, using their initial descriptions, and 74% of the time, using their revised descriptions. In reality, the readers

were successful only 48% and 51% of the time, respectively. Furthermore, in our first experiment, the correlation between the no-feedback writers' predictions of how many readers would select each figure correctly and how many readers actually selected each figure correctly was almost zero.

Therefore, the writers who did not receive feedback mis-estimated their readers' success. Therefore, our minimal feedback probably informed the writers (who received feedback) that they were not communicating as well as they thought they were. In other words, our minimal feedback gave the writers a better sense of how well their texts were interpreted by their readers.

Our minimal feedback also identified which texts were less clear. However, if the improvement engendered by our feedback was caused only by writers remediating their less successful texts, then the benefits of feedback would not have transferred to the new writing task (as they did in our second experiment). Instead, we suggest that the writers who received feedback were able to more accurately assess how well their texts communicated their intended message; they were able to compare which texts were more versus less successful, and then they took steps to improve their communication.

Our and others' (notably, Schriver's 1984, 1987, 1992) experimental results suggest that feedback from readers helps writers do more than detect problems in texts on which they receive feedback. Rather, these findings suggest that feedback helps writers envision how readers interpret their texts. If feedback only helped writers detect problems in texts for which they received feedback, then writers who received feedback in our second experiment should *not* have outperformed writers who did not receive feedback. Likewise, if feedback from readers does not help writers envision how readers interpret texts, then Schriver's subjects should not have made more accurate predictions about texts for which they had not yet received feedback.

7. Perspective taking improves coherence in written communication

Communication theorists have long argued that writers must consider their audiences to communicate effectively (Aristotle, ca 330 B.C./1963; Berkenkotter, 1981; Booth, 1970; Ede, 1984; Gage, 1986, 1987; Hayes and Flower, 1986; Kroll, 1978; Pfister and Petrik, 1980; Plato, ca 386 B.C./

1952; Sommers, 1980). In fact, the ability to consider one's audience when forming an utterance marks a milestone in cognitive and linguistic development. Piaget (1955), Flavell, Botkin, Fry, and Wright (1968), Glucksberg and Danks (1975), and others argue that children often communicate ineffectively because they suffer from *cognitive egocentrism*: They fail to recognize that other persons' perspectives differ from their own. Instead, children "often act as if everyone can see and know everything that they see and know" (Glucksberg and Danks, 1975, p. 201).

Surely adult writers realize that others do not see or know everything that they see and know. Still, adults consistently fail to communicate effectively in writing. Even though these writers recognize that their audiences' perspectives differ from their own, perhaps they still cannot accurately envision how their texts will affect their audiences. Indeed, if writers seek to communicate effectively, and if writers accurately envision how their texts affect their readers, then they should not write texts that their readers cannot understand.

The proposition that writers often have difficulty forming a "naive representation" is supported by the following finding: Writers are worse at detecting problems in their own texts than they are at detecting problems in other people's texts. For instance, fifth-grade writers can detect approximately half the problems detected by their teachers in texts *written by other students*. But they detect only one-tenth of those problems *in their own texts* (Bartlett,1981). Freshman college writers are also relatively unsuccessful at detecting problems in their own texts; they tend to focus on sentence-level problems while ignoring equally serious problems at other levels, such as lack of organization and focus. Even the sentence-level problems they detect are few and minor (Hayes, 1988; Hayes et al., 1987).

If, as we have proposed, successful written communication requires that writers build accurate mental representations of how their readers will interpret their texts, and if writers' inability to take a naive perspective decreases the likelihood that writers can build accurate mental representations of how readers will interpret their texts, then a treatment that forces writers to take their readers' perspective should lead to more effective communication. In a recent series of experiments (Traxler and Gernsbacher, 1993) we explored the effects of perspective-taking manipulations on written communication.

These experiments began as the two experiments we described above: During a first writing session, one group of subjects (writers) described one

set of figures. And during a first reading session, another group of subjects (readers) read descriptions and tried to select the figures that had been described by the writers from similar-looking distracters. However, the beginning of the second writing session differed from our previous experiments: At the beginning of the second writing session, half the writers performed the selection task; in other words, they performed a task that gave them their readers' perspective. They performed the selection task on a set of figures that they had not seen before. While half the writers were performing the selection task, the other half of the writers performed a control task. That control task familiarized the writers with the other set of figures and their distracters as much as the selection task did. The control task involved ranking each target figure and its three distracters along several dimensions (e.g., "Which figure has the largest area?," or "Which figure is more angular?"). Thus, all writers were exposed to one of two treatments: They were either placed in their readers' shoes (i.e., they performed the selection task), or they performed a ranking task that familiarized them with the figures and the distracters but did not give them as thorough a sense of the task faced by their readers.

Then, both groups of writers revised their descriptions of the original set of figures (the figures they originally described, not the figures they selected or ranked). If gaining a better perspective of the readers' task helps writers more clearly convey their ideas, then writers who performed the selection task should have improved their descriptions on revision. Likewise, writers who did not take their readers' perspective should have shown little or no improvement on revision.

Our results, shown in Figure 6, supported our predictions. In this experiment, writers who took their readers' perspective improved their texts, while writers who did not take their readers' perspective did not. We suggested that the perspective-taking treatment improved writers' texts because it enabled them to envision accurately the mental representations readers would build from their texts.

In our second experiment, we modified the perspective-taking treatment to give writers an even better idea of the difficulty their readers faced. In our first experiment, writers who performed the readers' (selection) task were not told how well they performed that selection task. We know from our previous research (Traxler and Gernsbacher, 1992) that writers are overly optimistic when they predict how many target figures their readers will select correctly. Thus, we suspected that the writers who performed the

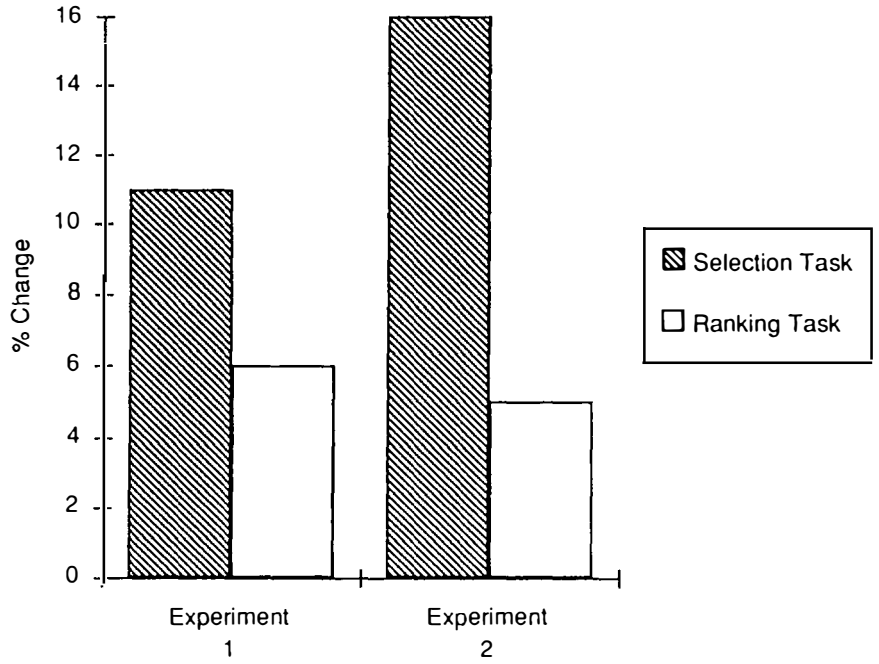

Figure 6. Subjects' mean improvement in selection during Experiments 1 and 2 (Traxler and Gernsbacher, 1993).

selection task in the last experiment were overly optimistic about their success at that task (i.e., writers believed the selection task was easier than it actually was).

Therefore, in this second experiment we gave the writers who performed the selection task feedback about how accurately they performed the selection task. We predicted that this feedback would further improve writers' ability to envision their readers' task, and, therefore writers who performed the selection task would further improve their descriptions when they revised them.

The results of this experiment, also shown in Figure 6, writers who performed the selection task (and who were told how well they performed the selection task) improved their descriptions, while writers who did not perform their readers' task did not improve their descriptions. So, Experiment 2 replicated Experiment 1. In both experiments writers who performed the selection task improved their descriptions, while writers who performed the

ranking task did not. However, in both experiments, writers who performed the selection task read example descriptions, whereas writers who performed the ranking task did not. Perhaps writers who performed the selection task improved merely because they were exposed to a set of example descriptions.

We tested this alternative explanation in Experiment 3. In this experiment, both groups of writers were exposed to example descriptions. One group read the example descriptions and performed the selection task, and the other group read the example descriptions and rated them on a ten-point scale according to different qualities (e.g., "How much information did the description contain?" "How clear was the description?" "How graphic was the description?" "How well were you able to form a mental picture of what the author was describing?" "Overall, what was the quality of the description?") Writers who performed the rating task were also asked to evaluate the example descriptions by answering the following question: "What could this writer do to improve the quality of his or her descriptions?" If the improvement we observed in Experiments 1 and 2 was due merely to the selection-task.writers being exposed to a set of example descriptions, then writers who performed the rating task in Experiment 3 should also have improved their descriptions. Our results, displayed in Figure 7, confirmed our predictions. In this experiment, writers who performed their readers' task improved their descriptions, while writers who rated sample descriptions did not.

Our data suggest that writers communicate more effectively when they take their readers' perspective. In all three experiments, writers who performed a task similar to their readers' task improved their texts when they revised them (as indicated by readers' improved selection-task performance). What accounts for this improvement?

We propose that writers fail to communicate effectively whenever they fail to envision accurately how readers will interpret their texts. Thus, to communicate effectively, writers must detect instances when their intended meaning differs from their readers' interpretation of their text. To detect instances when their intended meaning differs from their readers' interpretations, we propose that writers must build accurate representations of how readers will interpret their texts and writers must compare those representations with their intended meaning. Writers should revise whenever they detect a difference between their representations of what they intended to convey and their accurate representations of how readers will interpret their texts.

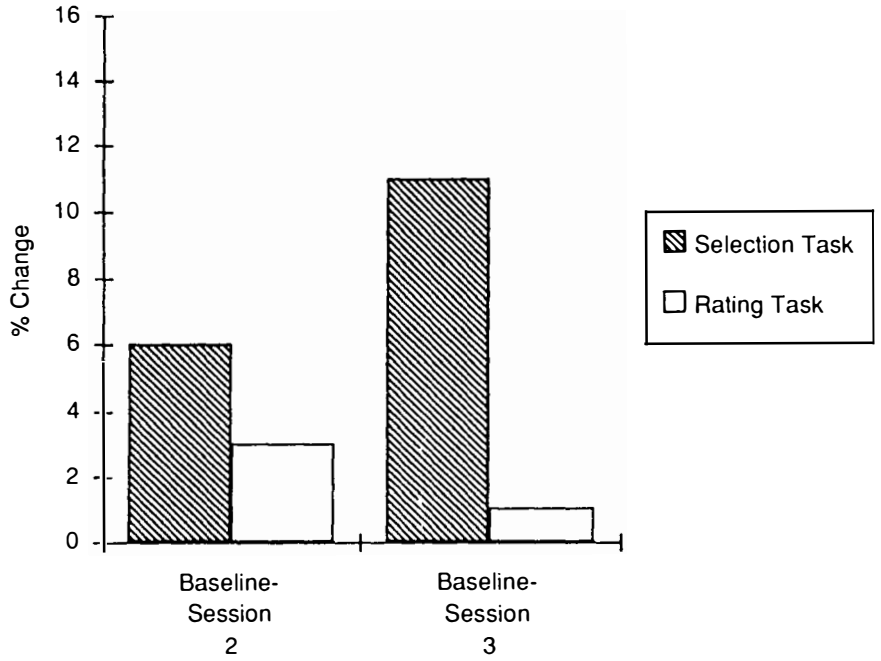

Figure 7. Subjects' mean improvement in selection during Experiment 3 (Traxler and Gernsbacher, 1993).

We propose that perspective-taking causes writers to improve their texts because it helps them build more accurate representations of how readers interpret their texts. Before writers experience their readers' task, they might have difficulty "de-centering" (Flower, 1979) or viewing their texts from an outsider's perspective. After writers take their readers' perspective (by becoming readers themselves, in our experiments), they "de-center" and build more accurate representations of how readers interpret their texts. Writers who take their readers' perspective make better choices when they revise their texts, because they have a better idea of how particular choices will affect their readers' interpretations.

In these three experiments, prior to performing their readers' task, writers had little useful knowledge to use when they chose a general strategy for their composing efforts, decided what information to include in their descriptions, and determined how much detail to include in their descriptions before they performed a task that compelled them to take their

readers' perspective. After they experienced their readers' task, writers could more accurately assess how their revision choices would ultimately affect their readers because their representations of how readers interpreted their texts more closely resembled their readers' actual interpretations. In other words, the writers had taken one major step toward producing more coherent texts.

NOTES

* This research was supported by NIH Research Career Development Award KO4 NS-01376, Air Force Office of Sponsored Research Grants 89-0258 and 89-0305, Army Research Institute, Grant DASW0194-K-004 (all awarded to the second author), and a grant from the Keck Foundation (awarded to the Institute of Cognitive and Decision Sciences at the University of Oregon). We thank Caroline Bolliger, Sara Glover, Estee Langpre, Maureen Marron, Jeff McBride, Mike Stickler, John Shaw, and Marlaina Watkins for help in testing our subjects, Tari Hugo, Kevin Kono, Cindy Ly, and Mike Stickler for help in transcribing the written descriptions, and Jennifer Deaton, Julie Foertsch, Jennifer Freyd, Tom Givón, Dick Hayes, Daniel Kimble, Peter Kruley, Michael Posner, Peter Wason, and anonymous reviewers for their feedback on previous manuscripts. As always Rachel R.W. Robertson contributed to every facet of our research.

1. Think-aloud protocols are the comments readers make when instructed to "think aloud" while reading a text (Ericsson and Simon, 1980; Olson, Duffy and Mack, 1984; Swarts, Flower and Hayes, 1984)

REFERENCES

Anderson, A.H. (1992) "Negotiating coherence in dialogue". Paper presented to the Interdisciplinary Conference on Coherence in Spontaneous Discourse, University of Oregon, Eugene, OR.

Aristotle (ca 330 BC./ 1963) *The Philosophy of Aristotle*, edited by R. Bambrough, transl. by A.E. Wardman and J.L. Creed, New York: Mentor.

Bartlett, E.J. (1981) *Learning to Write: Some Cognitive and Linguistic Components*, Washington, DC: Center for Applied Linguistics.

Berkenkotter, C. (1981) "Understanding a writer's awareness of audience", *College Composition and Communication*, 31:213-20.

Bond, S., J.R. Hayes, C. Janik and J. Swaney (1982) *Introduction to CMU TOPS-20*, Pittsburgh, PA: Carnegie Mellon University.

Bridwell, L.S. (1980) "Revising strategies in twelfth grade students: Transactional writing", *Research in the Teaching of English*, 14:107-22.

Clark, H.H. and E.F. Schaeffer (1987a) "Collaborating on contributions to conversation", *Language and Cognitive Processes*, 2:19-41.

Clark, H.H. and E.F. Schaeffer (1987b) "Concealing one's meaning from overhearers", *Journal of Memory and Language*, 26:209-25.

Clark, H.H. and D. Wilkes-Gibbs (1986) "Referring as a collaborative process", *Cognition*, 22:1-39.

Duffy, T., T. Curran and D. Sass (1983) "Document design for technical job tasks: An evaluation", *Human Factors*, 25:143-60.

Ede, L. (1984) "Audience: An introduction to research", *College Composition and Communication*, 35:140-54.

Ericsson, K.A. and H.A. Simon (1980) Verbal reports as data. *Psychological Review*, 87:215-251.

Flavell, J.H., P.J. Botkin, C.L. Fry, Jr. and J.W. Wright (1968) *The Development of Role-taking and Communication Skills in Children*, New York: John Wiley.

Flower, L.S. (1979) "Writer-based prose: A cognitive basis for problems in writing", *College English*, 41:19-37.

Gage, J.T. (1986) "The teaching of writing: Theory and practice", in A.R. Petrosky and D. Bartholomae (eds) *The Teaching of Writing, Eighty-fifth Yearbook of the National Society for the Study of Education*, pp. 8-29, Chicago, IL: University of Chicago Press.

Gage, J.T. (1987) *The Shape of Reason: Argumentative Writing in College*, New York: Macmillan.

Gernsbacher, M.A., K.R. Varner and M. Faust (1990) "Investigating differences in general comprehension skill", *Journal of Experimental Psychology: Learning, Memory, and Cognition*, 16:430-45.

Glucksberg, S. and J. Danks (1975) *Experimental Psycholinguistics: An Introduction*, Hillsdale, NJ: Erlbaum.

Hayes, J.R. (1988) "Writing research: The analysis of a very complex task", in D. Klahr and K. Kotovsky (eds) *Complex Information Processing: The Impact of Herbert A. Simon*, pp. 209-34, Hillsdale, NJ: Erlbaum.

Hayes, J.R. and L.S. Flower (1986) "Writing research and the writer", *American Psychologist*, 41:1106-13.

Hayes, J.R., L.S. Flower, K.A. Schriver, J. Stratman and L. Carey (1987) "Cognitive processes in revision", in S. Rosenberg (ed.) *Advances in Psycholinguistics, Volume II: Reading, Writing, and Language Processing*, pp. 176-240, Cambridge, England: Cambridge University Press.

Isaacs, E.A. and H.H. Clark (1987) "References in conversation between experts and novices", *Journal of Experimental Psychology: General*, 116:26-37.

Kroll, B.M. (1978) "Cognitive egocentrism and the problem of audience awareness in written discourse", *Research in the Teaching of English*, 12:269-81.

Olson, G.M., S.A., Duffy and R.L. Mack (1984) Thinking-out-loud as a method for studying real-time comprehension processes, in D.E. Kieas and M.A. Just (eds) *New Methods in Reading Comprehension Research*, pp. 253-286, Hillsdale, N.J.: Lawrence Erlbaum Associates Inc.

Pfister, F.R. and J.F. Petrik (1980) "A heuristic model for creating a writer's audience", *College Composition and Communication*, 31:213-20.

Piaget, J. (1955) *The Language and Thought of the Child*, Transl. by M. Gabian, New York: New American Library.

Plato (ca 386 B.C./1952) *Gorgias*. Transl. by W.C. Helmbold, Indianapolis, IN: Bobbs-Merrill.

Scardamalia, M. and C. Bereiter (1983) "The development of evaluative, diagnostic, and remedial capabilities in children's composing", in M. Martlew (ed.) *The Psychology of Written Language: A Developmental Approach*, New York: Wiley.

Schober, M.F. and H.H. Clark (1989) "Understanding by addressees and overhearers", *Cognitive Psychology*, 21:211-32.

Schriver, K.A. (1984) *Revising Computer Documentation for Comprehension: Ten Lessons in Protocol-aided Revision*, Pittsburgh, PA: Carnegie Mellon University, Communication Design Center, Tech. Rep. No. 14.

Schriver, K.A. (1987) "Teaching writers to anticipate the reader's needs: Empirically based instruction", Unpublished doctoral dissertation, Pittsburgh, PA: Carnegie Mellon University.

Schriver, K.A. (1992) "Teaching writers to anticipate readers' needs: A classroom-evaluated pedagogy", *Written Communication*, 9:179-208.

Sommers, N. (1980) "Revision strategies of student writers and experienced adult writers", *College Composition and Communication*, 31:378-87.

Stallard, C. (1974) "An analysis of the writing behavior of good student writers", *Research in the Teaching of English*, 8:206-18.

Swaney, J.H., C.J. Janik, S.J. Bond and J.R. Hayes (1981) *Editing for Comprehension: Improving the Process through Reading Protocols*, Carnegie Mellon University, Document Design Project. Tech. Rep. No. 14.

Swarts, H., L.S. Flower and J.R. Hayes (1984) Designing protocol studies of the writing process: An introduction, in R. Beach and L.S. Bridwell (eds) *New Directions in Composition Research*, pp. 53-71, New York: NY: Guilford.

Traxler, M.J. and M.A. Gernsbacher (1992) "Improving written communication through minimal feedback", *Language and Cognitive Processes*, 7:1-22.

Traxler, M.J. and M.A. Gernsbacher (1993) "Improving written communication through perspective-taking", *Language and Cognitive Processes*, 8:311-334.