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AMOS VAN GELDEREN and RON OOSTDAM

EFFECTS OF FLUENCY TRAINING ON THE APPLICATION OF LINGUISTIC OPERATIONS IN WRITING

ABSTRACT. In this article we report the results of a classroom experiment in grades 5 and 6 of primary education directed at improving children's writing skills. Our theoretical assumption is that increased fluency in the use of linguistic operations facilitates students' attention to the meaning level of their texts, resulting in better comprehensibility. We discriminated four conditions for improving linguistic fluency: (1) implicit instruction with attention to linguistic forms, (2) explicit instruction with attention to linguistic forms, (3) implicit instruction with attention to meaning, and (4) explicit instruction with attention to meaning. The experiment consisted of a post test-only design with randomised assignment to experimental groups within a classroom. Effects of instructional conditions on children's ability to use linguistic operations were explored in writing tasks with *less constraints* (LCT) or *more constraints* (MCT) on the translation process. Results show that the students in the experimental conditions performed better in the semantic application of linguistic operations in the LCT task, but not in the MCT task, compared to the control group. This result supports our theoretical assumption that increased fluency results in a better control of the semantic consequences of linguistic operations and therefore in better writing.

KEY WORDS: explicit instruction, focus-on-forms, focus-on-meaning, implicit instruction, linguistic fluency, primary education, writing, writing instruction, writing process

1. INTRODUCTION

The translation of conceptual ideas into linguistic form is a main component of the writing process (cf. Flower & Hayes, 1980). Cognitive models of writing distinguish between the processes of planning and translating (cf. Alamargot & Chanquoy, 2001; Bereiter & Scardamalia, 1987; Hayes, 1996; Hayes & Flower, 1980; Kellogg, 1996; Van Gelderen & Oostdam, 2004). Translation is part of a complex integration of conceptual and linguistic resources, characterised by Flower and Hayes (1980) as a process of juggling constraints. Writers keep in mind the conceptual message together with their rhetorical objectives and at the same time appeal to linguistic knowledge to express their ideas correctly and appropriately. During the translation process meaning and form aspects compete for working memory capacity. This may lead to restriction of attention to avoid cognitive overload,

especially in the case of young writers not experienced in translating ideas to written form. Lexical and syntactic decisions in formulating may therefore prevent these inexperienced writers to pay attention to the meaning they intend to communicate (Chenoweth & Hayes, 2001; Kellogg, 1996; McCutchen, 1996; McCutchen, Covill, Hoyne & Mildes 1994; Schoonen et al., 2003; Van Gelderen & Oostdam, 2004). Fluent writers retrieve relatively large 'chunks' of language, resulting in a more efficient and less attention absorbing translation process (cf. Anderson, 1995; Chenoweth & Hayes, 2001). Therefore, fluent writers are able to pay more attention to the meaning level of the sentences they produce.

Linguistic fluency, defined as the ability to produce language at a fast rate (Schmidt, 1992), can be distinguished from language proficiency, because aspects of syntactic correctness, coherence and appropriateness are excluded in the definition of fluency (Chenoweth & Hayes, 2001). In the context of *writing*, we define linguistic fluency as the efficient access to a rich linguistic knowledge base and retrieval of (provisional or transcribable) utterances (Van Gelderen & Oostdam, 2002). Thus the ability to carry out varied linguistic operations – producing various word combinations and sentence structures – is an essential characteristic of writing fluency.

Our definition implies that internal mental processes determine fluency. Therefore, in contrast to spoken language, written products can only be regarded as an indirect indication of writing fluency. For example, fluent writers may not transcribe any of their – mentally represented – provisional utterances, but only a final proposition resulting from elaborate internal review. In contrast, non-fluent writers may transcribe many words per minute, but process no more than one provisional utterance per sentence – namely the first one that comes to mind without any review. This suggests that linguistic fluency facilitates not only the attention writers spend on communicated meaning but also the reviewing process at large because fluent writers are able to access linguistic tools needed for repair (Van Gelderen & Oostdam, 2004).

L1 curricula for primary and secondary education in the Netherlands separate the teaching of writing from teaching linguistic skills. Linguistic skills are taught in discrete parts: for instance, knowledge of traditional grammar and exercises in formulating isolated sentences. In such exercises learners' attention focuses exclusively on correctness of forms¹. In contrast, writing education focuses on writing whole texts with learners' attention first

¹ We speak of forms instead of form, following Long (1991) to discriminate grammar-based approaches of language learning (formS) from meaning based approaches that direct students' attention in special instances to *a* form, tuned to their level of linguistic proficiency.

focused on meaning (first draft and revising) and only later, attends to language forms (editing). No effort is made in the L1 curriculum to connect writing in meaningful contexts with linguistic skills learned in other parts of the curriculum. There are, however, several reasons for assuming that this connection is useful.

The first reason is theoretical, based on the role of linguistic fluency in writing described above. If linguistic fluency helps young inexperienced writers focus attention on the meaning of their text, then connecting the training of specific linguistic structures and writing in meaningful contexts is promising. The meaningful context may provide a sounder motivational basis for acquiring writing fluency than exercises with isolated sentences. In addition, the transfer of the linguistic skills to communicative writing is more likely to occur when students' practice takes place in textual contexts.

Second, learning linguistic structures in meaningful contexts has proven effective in the context of L2 learning (Doughty & Williams, 1998; Norris & Ortega, 2000; Van Patten & Cadierno, 1993). Although L2 research focuses mainly on learning basic grammatical issues in second language acquisition, the process of fluency acquisition in L1 writing may have much in common with L2 acquisition. Children who start to express their ideas in written form learn a different – more constrained – form of communication in their L1, compared to the oral medium they normally use (Chafe, 1986; Van Gelderen & Oostdam, 2004). Hence, the structures they use in L1 writing can be compared to the structures in a (related) second language: in some ways familiar but in other ways strange.

The third reason connecting fluency training with meaningful writing addresses children's lack of cognitive tools for improving their translation processes. Several studies of children's writing suggest that students' resources for applying linguistic operations to make their texts comprehensible are severely limited. A general finding in these studies is that spontaneous revision on the level of text meaning seldom occurs (Fitzgerald, 1987). In general, children rarely revise, but if they do it is on the level of forms (syntactic or orthographic aspects) and not on meaning, although such improvements are often warranted (Bereiter & Scardamalia, 1987; McCutchen & Perfetti, 1982). This general finding may be explained by assuming that insufficient linguistic fluency plays a role in avoiding meaning level revisions. Graham (1997, p. 232) demonstrated the problems students with learning and writing difficulties (5th and 6th grade) faced when they tried to repair detected problems in the sentences they produced. Most efforts resulted in sentences that were – syntactically and semantically – as bad or worse than the original.

In a study of normally achieving students in the 5th and 6th grades, Van Gelderen (1997) showed that these students demonstrated the same

problem. Although able to detect and even resolve problems in a constructed text – presumably easier than solving problems in one’s own text – the revised text often contained a variety of new problems. The end products could often not be regarded as improvements over the original. Perhaps the students lacked linguistic fluency for finding better formulations to express the intended ideas. Even for better writers in the sample – children aware of meaning level problems and able to remove some of them – Van Gelderen (1997) concluded: “On the linguistic level, revision poses high demands on vocabulary and linguistic flexibility to be able to precisely define the linguistic elements that had better be replaced and find the elements to replace them” (p. 380). Training translation skills directed at certain linguistic operations in writing may thus be a promising way to help young writers’ to produce more comprehensible texts.

Although many reasons exist for studying the effect of fluency training on (meaningful) L1 writing, few recent studies have addressed the problem. Most training studies we found concerned operations of sentence combining and were carried out in the 1970s. The studies show a variety of approaches and designs and provide some information about the gains that can be expected by fluency training in linguistic operations on the sentence level. We also consulted studies directed to L2 learning because they provide a theoretical basis for the instructional conditions in which fluency gains can be achieved.

In a relatively recent study directed to L1 writing, Van de Gein (1991) compared a course for teaching children (grade 4) sentence construction skills (based on the generative rhetoric by Christensen and Christensen, 1978) with a course teaching direct writing and with a course teaching traditional grammar. The courses lasted about half a school year. The experimental teaching concentrated on relationships between meaning and structure by familiarizing students with grammatical sentence patterns. The focus was on adding information to existing sentences and distinguishing syntactically incomplete and complete sentences. The research found no significant effects on global text quality, T-unit ratio (a proxy of writing fluency), or conciseness. The only effect on writing quality found was on a measure of ‘sentence ratio’, indicating that experimental children produced better sentences than other students. Interestingly, this effect was not found on a test specifically designed to measure sentence awareness (discriminating syntactically complete from incomplete sentences). The disappointing results may indicate that the competing courses also had powerful effects on the students’ fluency and writing skill.

Many older L1 studies into the effect of training linguistic operations, mainly sentence combining exercises (e.g., Mellon, 1969; O’Hare, 1973), have shown improvement on measures of writing fluency, indicating that trained students use more complex sentences than the controls (Hillocks, 1986; Schuurs, 1990; Van de Gein, 1991; Wesdorp, 1983). In a review of the

sentence combining literature, Wesdorp (1983) observed that most studies show positive effects even on global text quality. He concluded: "It seems as if the increased 'flexibility' on syntactic level allows the student to pay more attention to other aspects of the composition, thereby increasing the global text quality" (p. 104, translation from Dutch by the authors).

Snellings, Van Gelderen and De Glopper (2004) continued this line of thinking in a training study directed at L2 lexical retrieval of English as a foreign language. Enhancing retrieval fluency of relatively familiar words and word combinations in five 50-min sessions using a computerized training for speeding reaction times resulted in transfer to narrative writing of the students. The students used the trained words more frequently in their texts. Evidence that the training benefited the expression of narrative contents also emerged. However, no significant effects on global text quality were found. This result seems to indicate that the influence of skills, such as planning, organizing, selecting and revising on global text quality, remained unchanged because teaching fluency occurred in a relatively short and limited time and was limited to specific lexical entries (some 70 words or word combinations).

The literature on L2 learning is of interest here because many studies focus on the instructional conditions for learning linguistic structures in classroom contexts. Although most L2 studies focus on learning spoken structures, writing is also an important issue. From the 49 studies into the effect of L2 instructional conditions that Norris and Ortega (2000) included in their review, 12 contained a 'free response' measure as dependent variable, which refers to oral interviews or written compositions that do not require the use of target operations. Of the 49, 36 studies included a measure of more constrained response, requiring the use of target operations orally or in written form.

Two central dimensions can be identified in the L2 studies: instructional focus (on forms or meaning) and instructional explicitness (with or without explicit rules). Instructional focus addresses the question concerning whether learning linguistic operations requires that students' attention be systematically directed to the target forms, or whether it is sufficient that students use the forms repeatedly while their attention is focused on the meaning of their texts. In the first case we speak of stimulated *noticing of forms* (cf. Schmidt, 1993), because students are led to a conscious perception of the structure, while they construct a meaningful text. The second case involves no stimulated noticing of forms; student attention is exclusively directed at making text interesting and comprehensible. This condition, based on Krashen's (1982) research, suggests that a focus solely on the meaning of language is sufficient for becoming fluent in the second language. This position has been criticized for neglecting the risk of engraving linguistic errors in the acquisition process (Long, 1991; Long & Robinson, 1998; Schmidt, 1993).

The second instructional dimension refers to the degree students learn explicit meta-linguistic rules for the explanation of sentence structures. Some theories maintain that fluency is acquired implicitly through repeated encounters with the same linguistic operations, with no explicit rules for explanation. Other theories assign an important role to explicit rule knowledge of linguistic structures and argue for the application of explicit rules in teaching for fluency (cf. Anderson, 1982; DeKeyser, 2001; Ellis, 1996; Hulstijn, 2001; Robinson, 1997; Squire, 1992; Willingham, Nissen & Bullemer, 1989). Although a growing body of literature on the effects of implicit (no rules) and explicit (with rules) conditions for learning L2 structures exists, the debate on the effectiveness of each has not been resolved (DeKeyser, 1997; Ellis & Laporte, 1997; Norris & Ortega, 2000; Robinson, 1997; Sanz & Morgan-Short, 2004).

There are indications that the effectiveness of explicit instruction depends on the difficulty of the rules (DeKeyser, 1995; Reber, 1989; Robinson, 1996). Difficulty of the target structures constitutes another important variable. Easy structures may readily be acquired implicitly, while difficult structures may require more explicit explanation. However, it is not always possible to decide levels of difficulty of rules and structures in advance, irrespective of learner characteristics and contexts. Norris and Ortega (2000) found in their review of research into L2 instruction that explicit instruction was more effective than implicit instruction and that focus on form(s) instruction was more effective than focus on meaning. There are however several reasons for questioning these results. First, the authors themselves doubt the generalizability of the results because of the unsystematic research designs and lack of experimental rigor. Second there was a dominance of studies with constrained dependent measures, such as metalinguistic questionnaires and multiple choice answering formats. It is quite possible that these measures lead to an exaggeration of effects of explicit instruction and focus on forms. Less constrained measures such as fill-in-the-blanks, sentence construction, text revision and open text production formats, may lead to different conclusions about the instructional conditions and effects.

Given the uncertainty about the best conditions for training linguistic fluency, we explore the effects of four instructional conditions, expressing the roles of both explicitness and focus of instruction: (1) implicit/focus on forms, (2) explicit/focus on forms, (3) implicit/focus on meaning, (4) explicit/focus on meaning. In the implicit focus on forms condition no explicit linguistic rules are given. Students learn linguistic structures by manipulating as many exemplars as possible, while their attention is focused on the syntactic forms (stimulated noticing without explicit linguistic rules). In the explicit focus on forms condition the manipulation of linguistic structures is supported by explanation of linguistic rules (stimulated noticing with rules).

In the implicit focus on meaning condition no linguistic rules are given and students are instructed to attend only to meaning related issues in formulation (no stimulated noticing of linguistic forms and no rules). In the explicit focus on meaning condition rules are given, but students are instructed to attend to the meaning in the same way as in the previous condition (explicit linguistic rules but no stimulated noticing).

2. RESEARCH QUESTIONS

Our study explores whether the training of linguistic fluency in meaningful contexts in four specified instructional conditions has demonstrable effects on post-test writing in terms of frequency and quality of usage of target operations. Frequency of usage may increase because the training improves linguistic fluency for these operations. It is, however, also possible that fluency gains are not expressed in a more frequent usage of target structures, but in increased attention to the meaning produced, as our theory predicts, and/or to syntactic aspects (especially in the conditions with stimulated noticing of forms). In that case, only quality gains in target operations may result, such as better semantic and syntactic expression of ideas.

In addition, this study explores whether the effect of teaching fluency depends on the degree of constraint or, conversely, translation freedom given to the students. The more translation freedom a writer has, the higher the appeal on linguistic fluency. Therefore, it is of interest to find out whether effects of fluency training can be demonstrated in writing tasks with varying degrees of translation freedom.

We situate the different roles of form and meaning in written text production in a model that distinguishes three interactive mechanisms: the planner, the translator and the reviewer (Van Gelderen & Oostdam, 2004) (see also Bereiter and Scardamalia, 1987; Hayes & Flower, 1980). The two post-test writing tasks constructed for this study are based on this model. They allow different degrees of freedom for the translator, while keeping the tasks of the planner and reviewer constant. Both writing tasks require no invention, selection, or organization of content, thereby excluding planning processes. In both tasks the function of reviewer is the same: combining the criteria of form and meaning in the transcribed composition. The tasks differ in the burden on translation processes. In the more constrained translation task (MCT) the translator provides the tools for the revision of sentences already written in a text format. In the less constrained translation task (LCT) the translator forms new sentences out of content phrases and interconnects these sentences into text.

Finally, we investigate age-related differences in the use of linguistic operations because they may have important educational implications. Some studies (Hillocks, 1986; Hunt, 1970) suggest that the use of linguistic operations depends on 'syntactic maturity'. Because it is unknown whether this maturity concerns specific operations, such as the ones we train, or a general tendency towards more complexity, we included the age variable in our design to explore its influence on the results of the training.

In summary, the research questions are as follows

1. Does training of linguistic fluency in meaningful contexts result in more and/or better application of the trained operations in writing tasks with more (MCT) or less (LCT) constraints on the translation process, in comparison to a control group?
2. Are any of the four instructional conditions (focus on forms/implicit, focus on forms explicit, focus on meaning/implicit, focus on meaning/explicit) more effective in fostering application of the learned operations in the post-test writing tasks?
3. Is the effectiveness of the training of linguistic fluency dependent on the age of the trained children?

3. METHOD

3.1. *Design of the Study*

The experiment consists of a post test-only design with randomized assignment to experimental groups within a class. The control group consisted of two complete classes (one grade 5 and one grade 6) comparable to the classes of the experimental children in terms of language background. The control group received normal instruction according to the school schedule.

3.2. *Participants*

In total 247 children (133 boys and 114 girls) from grades 5 and 6 divided over 11 classes from five different elementary schools in Amsterdam and surroundings participated in the study. A questionnaire administered in advance of the experimental treatment provided data about the students' age and language background. Most children were 10, 11 or 12 years old. A group of 18 children was older (13–14). A small majority (56%) of the students had learned Dutch as their first language, 42% first learned another language; 3% were bilingual.

3.3. *Treatment*

The treatment consisted of four 45-min lessons. The lessons were directed at adding and deleting parts of sentences demonstrated below:

- Lesson 1: Adding² commentary to parts of a sentence (kernels); [The *handsome* boy with the *black hair* has the *red ball that Ilse is looking for.*]
- Lesson 2: Adding subordinate clauses to main clauses; [The ball *that Paul is looking for*, is in the pond.]
- Lesson 3: Coordinating sentences; [The teacher wears a *beautiful, warm* coat. Instead of: The teacher wears a coat. The coat is beautiful and warm.]
- Lesson 4: Using anaphora. [He goes to Australia for a holiday. I would like to do *that* too.] [Paul and Mary have worked all day. Now *they* are tired.]

This choice of operations was guided by the need to focus on operations that are already part of the children's linguistic knowledge. Because fluency gains for new (or very complicated) structures seem unattainable in a short time span, we selected lesson contents from textbooks in use in the Netherlands and Flanders for grades 5 and 6. The main issues in these books related to linguistic fluency are vocabulary, collocations and sentence structures (Jacobs & Van Gelderen, 1997). From these, we selected exercises requiring syntactic abilities closely related and sufficiently simple to warrant the expectation of fluency gains in a relatively short time period. Another criterion for selection was that the structures could be trained with and without explicit linguistic rules.

In all conditions, sentences were presented in meaningful textual contexts, (Gatbonton & Segalowitz, 1988; Hulstijn, 2001). Students were instructed to read texts thematically organized in the following way. Lesson 1 consisted of texts about snowboarding; lesson 2, a sea elephant; lesson 3, inkfish, and lesson 4, extra-terrestrial life forms. From a pedagogical point of view it seemed sensible to start with relatively easy (receptive) exercises and move to more demanding (productive) exercises towards the end of each lesson. Therefore, for each lesson we moved from receptive (observation of sentences and answering multiple choice questions about the sentences) to more productive practice (filling in gaps in sentences, first in a closed format, later in a more open format).

² Although, we speak only of “adding”, the reverse (deleting) is also intended. Students were confronted with sentences that contained too much or too little information. They decided whether words or phrases had to be added or deleted.

The two form conditions required at least *noticing* the linguistic forms. The forms exercises, therefore, required that students attend to syntactic correctness of the linguistic operations carried out. In the two meaning conditions, however such attention to forms was not required. Instead, meaning-level problems became the focus of attention. The two explicit conditions included rules explaining the operations. The rules contained meta-linguistic terminology for defining the structural phenomena (e.g. “A kernel is a part of a sentence that you cannot leave out”) or explained how to use the structures correctly for formulation (e.g. “You can add commentary to a kernel”).

The two implicit conditions did not contain such rules and terminology. Instead, the students were instructed to use the same operations, but in common language, such as “add parts to sentences ” (forms) or “add interesting information to sentences” (meaning). Also, students in the implicit conditions were asked to observe which parts could be deleted from a sentence without making it syntactically incomplete (forms) or “which parts of a sentence are interesting or not” (meaning). Appendix A gives an overview of the beginning of lesson 1 in the four experimental conditions.

Each lesson consisted of a workbook with texts about the theme and exercises and an answer book containing correct responses to the exercises. The students were encouraged to ask for explanations for erroneous responses. For the explicit conditions the workbook also contained the explanation of the rules for the linguistic operations.

3.4. *Procedure*

The experiment, including testing, took place over the course of 3–4 weeks. Experimental students in each classroom were grouped according to their randomly assigned condition. They worked through their booklets individually. Two trained instructors (from a team of six) supervised the four experimental groups in each class. They made sure that students worked properly and used their answer books only after they finished each exercise. They also answered questions about the exercises and the responses in the answer books.

3.5. *Measuring Instruments*

3.5.1. *Linguistic Knowledge*

First, a test for linguistic knowledge was administered. The scores on this test served as a covariate for our analyses. The test measured the children’s relevant grammatical knowledge related to the lesson contents. We distinguished five domains as conditional for the use of the linguistic operations in the lessons. The knowledge in these domains determined whether the participants were able to execute the target operations correctly. The domains

(and their operationalizations) in the test were as follows: (1) gender of article (select the correct article); (2) sentence concept (discriminate a syntactically complete sentence from an incomplete one); (3) word order in main and subordinate clauses (discriminate correct from incorrect orders); (4) cutting sentences (which parts of a sentence can and cannot be separated); (5) using conjunctions (discriminating sentences in which conjunctions are used correctly or incorrectly). The test consisted of 85 two-choice questions.

3.5.2. *Writing Tasks*

The fluency training was limited to specific operations; hence, experimental effects were measured with writing tasks specifically designed to elicit the application of the target operations. The first post-test task (LCT) was called, "Washing cars for the school library". Children were instructed to write two paragraphs following a set of guideline statements for guiding the content. These statements were constructed to allow children to apply the linguistic structures practiced in the lessons for building sentences and avoiding unnecessary repetition of words or phrases (see Appendix B).

The second post-test task (MCT) was called "Miss or master wanted". In this task children had to improve a complete text by removing redundant information and making the text more readable. The text consisted of five paragraphs to be rewritten separately. The sentences required using operations practiced in the lessons (see Appendix C).

Both tasks were new to the experimental students; that is, the lessons contained no writing assignments in which connected text had to be produced or revised. The students were not allowed to add new content because we wanted to exclude planning processes like idea generation and selection to interfere with the writing. The most important difference between the tasks is the different requirement of translation fluency. The less constrained translation task (LCT) left more translation freedom and therefore required choosing from several options. The more constrained translation task (MCT) consisted of revising sentences in a complete text, leaving fewer translation options open.

3.6. *Scoring of Linguistic Operations*

The application of the linguistic operations in the two writing tasks was scored. First we identified whether a textual change had taken place in comparison to the original phrases (task 1) or the original text (task 2). If changes were made, we determined whether they involved one of the target operations. Below, we give examples of operations the children could apply for the following phrases in task 1 (LCT):

Phrases:

- school must buy new books
- books are for the school library

Operations:

- Adding commentary to a kernel: The school must buy new books *for the school library*.
- Adding a subordinate clause to a main clause: The school must buy new books, *which are meant for the school library*.
- Coordinating sentences: The school must buy new books, *because the school library needs them*.
- Using anaphora: The school must buy new books. *They* are for the school library.

In order to make the scoring as objective as possible, we developed a set of rules. We ignored punctuation in the children's texts because knowledge about punctuation conventions is not well developed in this age. Therefore, we used only word order to determine the nature of the operations.

In addition, in relation to the research questions, it was relevant to score syntactic and semantic correctness of the operations. Children in the forms conditions may produce operations with a better syntactic quality because they have been taught to notice forms. However, all experimental children were expected to make fewer semantic errors because increased fluency in using the operations allowed them to direct more attention to the meaning level. Therefore, each operation was scored for syntactic and semantic correctness. For syntactic correctness only word order was decisive. Errors of spelling and conjugation were ignored. For semantic correctness the sentence had to express the meaning related to the purpose of the writing task and be logically consistent.

Finally, we discriminated between operations of different 'types' within the *same* category. For example, it was possible to receive a high score on the category 'anaphora' by repeatedly using a word like "they" with the same referent (the children, see task 1). However, it was also relevant to attend to the flexibility in using operations. This flexibility was better expressed by scoring one "type" of operation only once, although it occurred identically several times. Hence, a higher score resulted only when different examples of a certain operation occurred – such as using the word "they" but with a different referent.

The following dependent measures were directly derived for further analysis from the above scores for each child – the number of: (1) operations, (2) syntactically correct operations, (3) semantically correct operations, (4) types of operations (syntactically *and* semantically correct). The above are straightforward measures of the frequency of application of the

learned operations. The more frequently a student applies the target operations, the higher the scores on each measure. Errors (syntactic or semantic) were expressed in some of the frequency measures.

For a better estimation of the *quality* of the application of operations, we constructed measures expressing the balance between correct and incorrect operations by subtracting incorrect from the correct applications. These measures took into account the risk of making semantic or syntactic errors. Students frequently applying operations with relatively few errors received higher scores on these measures than students who made more errors. The following measures resulted: (1) difference between standardized number of syntactically correct and syntactically incorrect operations; (2) difference between standardized number of semantically correct and semantically incorrect operations; and, (3) difference between standardized number of types and syntactically incorrect operations, (4) difference between standardized number of types and semantically incorrect operations.

Although we used a precise scoring procedure and objective scoring rules, the complexity of the scoring task made it difficult to prevent individual coders from missing operations. Consequently, both investigators scored all texts – without knowing the condition for producing each text. Differences between scores were resolved through discussion.

3.7. *Analysis*

Means and standard deviations were computed for the test for linguistic knowledge, each category of operations per task (LCT and MCT), as well as for the total number of linguistic operations, syntactic and semantic correct operations, and different types of operations. To explore the effects of the experimental and control conditions we conducted MANCOVA analysis on each of the eight dependent variables in the two post-test tasks simultaneously. Stevens (1996, p. 227) warns that including too many dependent variables compromises statistical power. In addition, interdependence between the measures within each task led to excluding different measures from one task in the same MANCOVA. Therefore, eight MANCOVAs were carried out, one for each dependent measure in both tasks, with condition (1–5) and age-group (1–4) as independent factors. The factor age group consisted of the levels 10, 11, 12 and 13–14 years. The covariate in all analyses was the test for linguistic knowledge. The multivariate effect of this covariate was highly significant in all analyses ($P < .000$), indicating its usefulness as a covariate. To check on assumptions for MANCOVA we carried out Levene's test for equality of error variances of the dependent variables and Box's test for homogeneity of the co-variances (Stevens, 1996). We found no discrepancies with the assumptions.

TABLE 1

Mean numbers and standard deviations (between brackets) for scored operations.

	Task 1 (LCT) <i>n</i> = 227	Task 2 (MCT) <i>n</i> = 228
Combining kernel/commentary	1.15 (1.04)	.82 (1.20)
Using subordinate clauses	.60 (.87)	1.67 (1.41)
Coordinating sentences	2.07 (1.84)	3.14 (2.42)
Using anaphora	4.22 (3.27)	6.25 (3.70)
Total number of operations	8.05 (4.88)	11.87 (6.08)
Syntactically correct	7.52 (4.59)	10.97 (5.82)
Semantically correct	6.86 (4.56)	10.56 (5.92)
Types correct	4.71 (3.00)	8.75 (4.85)

4. RESULTS

Of the 247 participants, four dropped out during the experiment. In addition, we excluded the results of 10 participants because their Dutch language proficiency was too low to meet the requirements for the experiment. They were beginning learners of Dutch as L2 or had severe learning problems. Finally, 5 (task 2) and 6 (task 1) participants were absent during the post-tests. As a result, for the analysis of linguistic operations 227 (task 1) or 228 (task 2) participants remained.

Table 1 reveals the mean numbers of operations used in the two writing tasks (LCT and MCT) along with the standard deviations. The first four rows concern the four categories of operations that were taught. The mean numbers indicate that coordinating sentences and using anaphora occur most frequently as operations for both translation tasks. Of course, the number of operations used is related to text length in the two tasks. Task 1 (LCT) consists of two paragraphs. Task 2 (MCT) is considerably longer (five paragraphs). Therefore, it is not surprising that the mean number of operations is higher in task 2. The fifth row of Table 1 indicates that the students use on average, a considerable number of operations (8–12) in both tasks. We conclude that both tasks successfully elicit the learned operations, although relatively few kernel/commentary and subordinate clause operations were used.

Table 1 also contains the mean frequencies of the syntactically (row 6) and semantically correct (row 7) operations. The last row of table 1 contains the number of 'types' of operations carried out in the two post-test tasks.

From the difference between the total number of operations and the syntactically or semantically correct numbers it can be inferred how many errors the participants made. For both tasks the number of syntactic errors is less than one on average (.53 in task 1 and .90 in task 2). The average

number of semantic errors is somewhat higher (1.19 and 1.31, respectively). The frequency of both types of errors is relatively low in comparison to the average number of operations. In task 1 (LCT), however, the proportion of semantic errors was higher than in task 2 (MCT), given that fewer operations were carried out in the first task. This difference is explained by the fact that the less constrained translation task (task 1) required formulating new sentences, making it harder to avoid semantic problems.

The test for linguistic knowledge consisting of 85 two-choice items, was moderately difficult for participants as indicated by a mean of 65.66 and a standard deviation of 7.73 ($n=227$). The reliability of the test was acceptable (Cronbach's $\alpha = .79$).

MANCOVA analysis was carried out on the sample of 227 participants that qualified for the experiment and for whom all data were available. Their distribution over the five conditions was 49, 44, 50, 48, 36, respectively. For the four age groups the distribution was 24, 93, 92, 18, respectively. Of the eight MANCOVA's carried out on our dependent measures, only two analyses yielded differences that were multivariately significant. We concentrated only on these multivariately significant results to avoid the risk of chance capitalisation from the many univariate tests carried out. The two analyses yielding a significant multivariate effect had the following as dependent measures: (1) difference between the standardized number of semantically correct and semantically incorrect operations (F (based on Wilk's lambda) = 2.07; $P = .038$) and (2) difference between the standardized number of types and semantically incorrect operations (F (based on Wilk's lambda) = 2.32; $P = .019$). In both analyses there was a significant univariate main condition effect on the two semantically corrected measures for task 1 (LCT). The effect of the difference between standardized number of semantically correct and semantically incorrect operations in task 1 was significant with $F=4.01$; $P=.004$. The effect of the difference between standardized number of types and semantically incorrect operations in task 1 was significant with $F=4.40$; $P=.002$. No significant effects emerged for task 2 (MCT). In addition, the effects of the factor age group nor the interaction between age group and condition were significant in either task.

Post hoc comparison of the differences between conditions was carried out with Bonferroni adjustment for multiple comparisons, a conservative strategy that corrects for the effects of multiple testing. The results show that only the difference between students in condition 1 (forms/implicit) and condition 5 (control) reached statistical significance in both analyses. All other comparisons between groups were not statistically significant, given the adjustment procedure.

The results in Tables 2 and 3, however indicate that for task 1, all the experimental groups scored considerably higher than the control group. This

TABLE 2

Means (corrected for the covariate) and standard errors of the difference between standardized number of semantically correct and semantically incorrect operations.

Post-tests	Condition	Mean	SE	95% Confidence interval	
				Lower bound	Upper bound
Task 1 (LCT)	1. Forms/implicit	.881	.355	.182	1.581
	2. Forms/explicit	-.059	.224	-.501	.382
	3. Meaning/implicit	.120	.220	-.314	.553
	4. Meaning/explicit	.010	.221	-.426	.446
	5. Control	-.808	.260	-1.320	-.295
Task 2 (MCT)	1. Forms/implicit	.164	.385	-.594	.922
	2. Forms/explicit	.111	.243	-.368	.589
	3. Meaning/implicit	.111	.238	-.359	.581
	4. Meaning/explicit	-.149	.240	-.622	.323
	5. Control	-.038	.282	-.594	.517

suggests a better control of semantic content while applying the linguistic operations in task 1 (LCT). We can also see in these tables that no such systematic difference exists between conditions in task 2 (MCT). The means of conditions in task 2, are very close to another and their 95% confidence intervals overlap for the greatest part. The picture is very different for task 1. The mean scores of the control group in task 1 are almost a standard deviation (.81 for operations, see Table 2 and .98 for types, see Table 3) below the total group mean (which is zero for standardized scores). Comparing the upper bounds of the 95% confidence zones of the means for the control group in task 1 with the lower bounds for the means of the experimental groups shows only a small overlap in most cases. This indicates that the difference between the scores of the control group with most experimental groups is rather large. On the other hand, although students in condition 1 (forms/implicit) received the highest mean scores for the semantically corrected measures in task 1, the 95% confidence interval considerably overlaps with the intervals for the experimental conditions 2–4. Therefore, the differences between the conditions 1–4 are relatively unimportant.

5. DISCUSSION

In this experiment, we studied the effect of fluency training on applying linguistic operations in writing. The first research question asks whether training of linguistic fluency in meaningful contexts results in more and/or better application of the trained operations in writing tasks with more

TABLE 3

Means (corrected for the covariate) and standard errors of the difference between standardized number of types and semantically incorrect operations.

Post-tests	Condition	Mean	SE	95% Confidence interval	
				Lower bound	Upper bound
Task 1 (LCT)	1. Forms/implicit	.756	.364	.004	1.473
	2. Forms/explicit	-.088	.229	-.541	.364
	3. Meaning/implicit	.086	.225	-.358	.531
	4. Meaning/explicit	.054	.227	-.393	.501
	5. Control	-.981	.267	-1.507	-.455
Task 2 (MCT)	1. Forms/implicit	.274	.394	-.503	1.050
	2. Forms/explicit	.145	.249	-.346	.635
	3. Meaning/implicit	.079	.244	-.403	.561
	4. Meaning/explicit	-.162	.246	-.647	.322
	5. Control	.029	.289	-.567	.572

(MCT) or less (LCT) constraints on the translation process compared to a control group. The results show the following pattern. On both post-test writing tasks (less and more constrained translation tasks) no significant training effects on frequencies of operations used occurred. Also, no significant differences were found in frequencies of correct operations (syntactically or semantically). Evidently, the experimental treatments did not result in an increased use of the operations nor in a higher number of correctly used operations for both writing tasks.

However, for task 1 (LCT), we found a significant difference between experimental groups and the control group in the balance between semantically correct and incorrect operations such as logical contradictions and propositions contrary to the purpose of the text. Students in the experimental groups produced proportionally more semantically correct operations. This was true for the number of operations carried out and for 'types' of operations (ignoring repeats of an operation with the same linguistic tools). Thus, although the experimental children did not apply the learned operations more often, they made proportionally fewer semantic errors while using the operations. This finding supports our assumption that increased fluency in using the operations in writing frees working memory space to attend to the meaning level of the text (McCutchen, 1996; McCutchen et al., 1994; Snellings, Van Gelderen & De Glopper, 2004; Van Gelderen & Oostdam, 2004).

For task 2 (MCT) however, we found no significant effects of training on the application of operations. In this more constrained translation task, the experimental and control groups did not differ in the number of operations

used. Neither did students in the experimental conditions have a better balance between semantically correct and incorrect operations in the MCT task. The fact that control and experimental students did not differ in their use of linguistic operations quantitatively and qualitatively means that they are equally able to apply the operations in this task and at the same time, avoid semantic errors. This can be attributed to the lower risk of making semantic errors in the more constrained translation process. With the greatest part of the text staying unchanged, discrepancies of logic and purpose are not likely to occur. The constrained translation process consists of combining elements from given sentences and deleting unnecessary parts. Even when writers do not attend to the intended meaning, the risk of introducing semantic errors is relatively low as long as more radical changes in syntactic structure or vocabulary are avoided.

In contrast, the less constrained translation task (task 1) required constructing sentences from incomplete syntactical structures. The resulting freedom of syntactic structuring increases the risk of meaning-level problems and places a larger burden on working memory resources, thus making it more likely for the writer to make semantic errors. This explanation is supported by the higher proportion of semantic errors found in the LCT task in comparison to the MCT task. The fact that the experimental children had a better balance between semantically correct and incorrect operations than the control students in the LCT task but not in the MCT task can thus be explained by the fact that in the former task the translation process is more attention absorbing and risky. Therefore, linguistic fluency – more specifically efficient application of linguistic operations – is more important to keep track of the semantic demands of the task.

The literal linguistic forms of operation in the post-test tasks differed from those the children encountered in the lessons. In addition, while children practiced operations in individual sentences, the application of these operations in the post-test writing tasks required them to take the complete texts into account. Hence, a twofold transfer must have occurred for the training to result in a more fluent application of the linguistic operations in the LCT task. Given the exploratory nature of our study, further study – and replication – of the effects on LCT and MCT writing tasks is needed to support the explanation given and to provide evidence that this transfer from training linguistic operations indeed occurs.

The second research question focused on whether any of the four instructional conditions (focus on forms/implicit, focus on forms/explicit, focus on meaning/implicit, focus on meaning/explicit) would prove more effective in stimulating application of the trained operations. Our results indicate no significant differences between the experimental conditions. All four conditions seem to be equally effective in achieving the effects described above, although the effect was the clearest for condition 1 (forms/implicit).

In order to evaluate this result, it is appropriate to point to other results from our experiment, published previously. In a separate analysis of the experimental results (Van Gelderen & Oostdam, 2002), we focused on the content level of the texts produced by the students instead of on the linguistic operations. On this level, significant effects of the experimental conditions were demonstrated for both post-test tasks. Students in the four experimental groups were able to formulate sentences while keeping a better balance between relevant content elements and unnecessary repetitions of words and phrases than the students in the control group. This result gives additional support to our assumption that the trained students learned to use the linguistic operations with less effort, freeing working memory space to attend at the meaning level. Similarly, analysis on the content level did not show significant differences between the four experimental conditions.

No significant differences between conditions in the two separate analyses, however, does not necessarily mean the conditions are equally effective – although it could be one possible explanation. If the conditions are equally effective, there is good reason to model fluency instruction using the ‘meaning/implicit’ condition. The advantage of that condition is that it requires no additional efforts from the students such as noticing of forms and acquisition of explicit rule knowledge. However, before we can make this choice, further research is needed into the role played by stimulated noticing of forms and the effects of explicit rule knowledge on the application of linguistic operations in writing.

The forms conditions in our study may have failed to evoke a sufficiently different focus by students. Students in the forms conditions worked on meaningful texts as did the students in the meaning conditions. The forms instruction may therefore have not resulted in a sufficiently strong focus on forms.

It is possible that the explicit conditions were not more successful, because the students did not master the concept of a syntactically complete sentence (Van de Gein, 1991; Van Gelderen & Oostdam, 2002). In that case, additional teaching for acquiring this concept will be necessary to observe stronger effects of explicit rule knowledge. It is also possible that the positive effect of explicit rule knowledge, demonstrated in L2 acquisition contexts (Ellis, 1993; De Graaff, 1997; DeKeyser, 1995; Robinson, 1997), can only be expected with unfamiliar operations. While in L2 acquisition contexts many linguistic structures are new to the learners, in L1 contexts, this is not the case. Students in our study are more or less familiar with the target operations (at least in reading and listening) and are able to carry them out, as the control group (no experimental training) demonstrated. Therefore, given familiar linguistic operations these students may rely on practice rather than abstract rules.

Finally, as Long and Robinson (1998) argue, it is possible that the effect of explicit knowledge for consolidating linguistic production processes can only be demonstrated over an extended period of time. In that case it is necessary to give students more opportunity for gradually integrating explicit rule knowledge in the process of producing linguistic operations.

The third research question inquired into the effectiveness of the training of linguistic fluency as dependent on age. Given that no multivariate significant interactions were found between condition and age group in our analyses, this question can be answered negatively. Moreover, the multivariate analyses show that students in the ages of 10–14 carried out the linguistic operations with no significant differences in frequency and quality. The selected operations for writing can thus be considered part of the linguistic repertory of students in this age group. The results of this experiment are therefore clearly educationally relevant given the positive effect of fluency training found on using operations and on the content level of the writing tasks. Fluency gains in the trained operations appear to help students in the entire age range of this study to pay attention to meaning in producing their written texts.

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6. APPENDIX A

Overview of parts 1 and 2 of the first lesson in four conditions

Title of Lesson:

“Making Sentences shorter and Longer” (forms Conditions)

“Snowboarding is a nice sport” (meaning conditions)

Part 1: INTRODUCTORY ASSIGNEMENT

explicit/forms and explicit/meaning: knowledge of rules

Rule: Sentences consist of sentence parts. [Omar/ walks/on the street] Each part of a sentence always has a kernel. You cannot leave it out. In the next sentence the parts consist of kernels only. You cannot delete any word. [The boy/has/the ball] You can however extend the parts. [The *handsome* boy *with the black hair* has the *red* ball *that Ilse is looking for*] The

italicized pieces do not belong to the kernels. You can leave them out. But they give more information about the kernel. They give a *commentary* on it. So, the commentary says more about the kernel but can be deleted. Commentary can be placed before or behind the kernel. [Before: *handsome* boy; after: ball *that Ilse is looking for*]

implicit/forms: exercise in discriminating long and short sentences

implicit/meaning: exercise in selecting words related to snowboarding

PART 2: RECEPTIVE EXERCISE

all four conditions:

[Two texts about snowboarding; sentences of text 1a contain only kernels; sentences in text 1b contain kernels and commentary. After completion students check their own answers in separate booklet.]

Text 1a

Did you know that snowboarding is a sport? It is the sport of Bianca de Wit. This girl intends to become a champion. Sliding on a board from a slope is what she likes. Et cetera

Text 1b

Did you know that snowboarding is a *very exciting* sport? It is the *favorite* sport of Bianca de Wit, *a thirteen-year-old girl with blond tresses and hefty calves from Rotterdam*. This girl, *now already the top-best of her age*, intends to become a *real* champion. Sliding on a *narrow* board *as fast as she can* from a *steep* slope, is what she likes *best on her winter holiday*. Et cetera.

Condition specific instructions:

Implicit/forms	Explicit/ forms	Implicit/meaning	Explicit/meaning
Check the pieces that have been added in text 1b. [Although noticing is not stimulated, students may see that some pieces of a sentence can be deleted, while the sentence remains correct.]	Check the pieces that are commentary in text 1b. Commentary can be placed before or after the kernel.	Why are the italicised pieces in text 1b interesting? Check one of the following answers: (a) extra information about snowboarding, (b) it helps to understand the text, (c) it is fun to read.	Why are the commentaries in text 1b interesting? Check one of the following answers: (a) extra information about snowboarding, (b) it helps to understand the text, (c) it is fun to read.

7. APPENDIX B

Task 1 (LCT); Translation from Dutch: Washing cars for the school library

Your school needs new **books** for the school library. The old books are dull and worn-out. In order to collect money for new books students are going to wash cars. **But** who wants to **pay** for it? You are going to write a letter to people who live and work in the neighborhood of the school. The letter is given here. Some pieces have already been written. You write the two remaining pieces. You must use the blocks A and B. They tell you what to write about. Take into account the **text that already is written**. Make your pieces easy to read! **The people must understand immediately what you are going to do**. You decide for yourself how you are going to say everything. **Don't** add new things.

Block A

Give the following information about the **books**:

- school must buy **new books**
- books are for the **school library**
- books must be **fun**
- books must be **exciting**
- library has **mainly old** books
- everybody **already knows** old books

Block B

Say **where** and **when** it is going to happen:

- students come to school **Saturday next week**
- students get **buckets** and **sponges** at school
- students wash the cars **at the peoples' homes**
- people have filled in the **reply form**
- students **begin at 10 o'clock**
- at 10 o'clock the students **come at the peoples' homes**
- students stop at 3 o'clock

Letter (to be completed)

Amsterdam, May 30, 2000

Dear parents, local residents and entrepreneurs,

We, students of theschool ask your kind attention for the following.

Insert Block A

We want to earn minimally 1000 guilders for the school by washing and vacuuming cars. It costs 10 guilders for an ordinary car and 15 guilders for a van. The school will buy more books and magazines if we earn more than the minimum.

Insert Block B

We hope that you will participate in our action. It is for a good purpose. Please complete the reply form down here. You can send it to our school.

Yours sincerely,

The students of the booklet action

8. APPENDIX C

Task 2 (MCT); Translation from Dutch: Miss or master wanted

First read the assignment below carefully

There is a shortage of misses and masters at school. The students are making a website calling people to become miss or master. A first draft has been written for the website. That text is printed below. The text **really** needs improving. It is unpleasant to read and has too many repetitions.

- Make the text more pleasant to read
- Remove unnecessary repetitions
- Take care that everything is clear

There are five pieces. Improve the pieces 1–5 separately.

Miss or master wanted

1. We have a big problem at our school. It is an annoying problem. The big problem at our school is that children often cannot have lessons. The children often cannot have lessons, because the miss is ill. If the miss is ill, there are no more people to replace her. There are no more people to replace the miss, because there are not enough misses and masters.
2. There are no people any more who want to become miss or master. The people that do not want to become miss or master, are going to look for other jobs. A master or miss does not earn enough money. A master or miss must work too hard.
3. Misses and masters have rather nice work. It is exciting work. It is important work. Misses and masters enjoy very much to engage with children every day.
4. Don't you want to become master or miss? Do you know someone perhaps who wants to become miss or master? If you know people that want to become miss or master, please pass their telephone number. If you pass their telephone number we can ask the masters or misses whether the masters or misses perhaps want to give lessons at ours.
5. We hope that soon the children at our school will not be sent home any more. If soon the children will not be sent home any more the children can do nice things in the classroom. The fact is the children don't like it at all.

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