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Writing Expertise and Second Language Proficiency:
Algorithms and Implementations?

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Anderson (1987) argues for a fundamental distinction between algorithmic and implementation levels of cognitive processing, as well as specific research methods to investigate them. The process-tracing study reported here (summarizing Cumming 1988) confirms the relevance of Anderson's distinction in a naturally occurring instance of human performance: more and less expert writers composing on different tasks in their second language. The results of the study are also consonant with theories distinguishing intelligent central processing from informationally-encapsulated knowledge of language (Fodor 1983, Chomsky 1988) or suggestions that literate expertise develops as a unique core intelligence (Gardner 1983, Bereiter & Scardamalia 1987).

Educated adults writing in their second language display a natural disjuncture between (1) the higher orders of planning, heuristic searches, and uses of complex representations which characterize expert thinking and (2) a greater or lesser facility for the rapid, non-deliberative processing of language, depending on their proficiency in the second language. They show differentiation between higher and lower orders of cognitive processing of the kind Anderson (1987) describes as algorithms and implementations. This differentiation is more visible with mature learners than in conventional studies of cognitive development which have focused on children, whose processes of linguistic, conceptual, maturational, and social development are necessarily interconnected.

Interestingly, though, greater writing expertise or second language proficiency appear to lead to enhanced writing performance in a second language -- suggesting there is a value for learning at (in Anderson's terms) either the algorithmic or implementation level. Knowledge at both levels seems necessary for optimal performance in this domain. However, writing expertise appears to be knowledge which is not tied to the domains of a first or second language. Characteristics of writing expertise appear to be enacted in similar ways across people's first and second languages, irrespective of their levels

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of second language proficiency (Arndt, 1987, Edelsky, 1986, Gaskill, 1986, Jones & Tetroe, 1987).

APPROACH

Evidence of these distinctions was obtained by analyzing the performance of 23 young adults writing 3 composition tasks in their second language (an informal letter, an expository argument, and a summary of a popular science booklet). Participants were carefully selected to represent: 3 levels of writing expertise in their mother tongue (5 professional writers, 8 average students, and 10 basic writers); 2 levels of proficiency in their second language (11 at intermediate and 12 at advanced levels of English); a common mother tongue and cultural background (French-Canadians raised in Quebec); common levels of education (first and second years of university); and common motivations for learning their second language (all had moved to the same English-French bilingual university in Ontario to improve their English). These characteristics were verified through evaluation of participants' writing in their mother tongue, self-ratings of literate abilities, background questionnaires, and interview tests.

Three aspects of writing performance were assessed using a 3 (writing expertise) X 2 (second language proficiency) X 3 (tasks) factorial design. Qualities of the texts produced were rated for the effectiveness of their content, discourse organization, and language use. Decision statements were extracted from think-aloud protocols then analyzed in two ways. One, problem solving behaviors used to control writing processes were analyzed for the extent to which participants used heuristic search strategies. Two, the decision statements were analyzed to establish whether participants were attending to one, two or more aspects of their writing while making decisions. Aspects of writing were defined as gist, language use, discourse organization, intentions, or procedures for writing (following Scardamalia & Paris, 1985). Inter-rater and intra-rater reliability on these analyses ranged from .7 to .9.

DISTINCTIONS IN LEVELS OF COGNITIVE PROCESSING

Multivariate analyses revealed large main effects for the factors of writing expertise and second language proficiency on the ratings of text qualities and problem solving behaviors. Interestingly, there were no interactions between the factors. This suggests that writing expertise and second language

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proficiency are psychologically distinct, supporting theories of different levels of cognitive processing or mental modularity. Participants had developed writing expertise and/or second language proficiency to different extents, each of which made separate contributions to their writing performance in the second language.

For the qualities of the compositions produced, a repeated measures MANOVA revealed main effects for writing expertise ($F(2, 16) = 25.1, p < .0001$) and second language proficiency ($F(1, 16) = 53.8, p < .0001$), without any interactions between the two factors. A similar analysis of decision making behaviors using heuristic searches (to resolve problems encountered while writing) also showed separate main effects for writing expertise ($F(2, 16) = 29.0, p < .0001$) and second language proficiency ($F = 5.2, p < .04$), without any interactions. Across tasks, performance on the more cognitively demanding argument and summary tasks consistently differed significantly from performance on the less cognitively demanding letter task. With increased writing expertise or second language proficiency, people tended to produce more effective compositions, make more extensive use of heuristic search strategies, and do this to a greater extent on more demanding tasks.

The complexity of mental representations people used for decision making was analyzed by contrasting the extent of references they made to either 1 or 2 (or more) aspects of their writing in protocol statements. A repeated measures MANOVA showed a main effect for writing expertise ($F(2, 16) = 8.4, p < .003$), non-significant effects for second language proficiency, and an interaction between the two main factors ($F(2, 16) = 4.7, p < .03$). More expert writers tended to refer to 2 or more aspects of their writing while making decisions, while inexperienced writers tended to consider only 1 aspect. The interaction effect appeared to arise for people without high or low levels of writing expertise (i.e. the average students). Average students with lesser levels of second language proficiency acted like the inexperienced writers, attending mainly to 1 aspect of their writing while making decisions. Average students with higher levels of second language proficiency acted like the expert writers, attending mainly to 2 aspects of their writing while making decisions.

Qualitative analyses of the think aloud protocols indicated that second language proficiency did not visibly affect the processes of composing in the second language. No consistent differences could be discerned between the reported thinking processes of people with greater or lesser second language proficiency. This confirms the widespread claim that people have little conscious access to knowledge of their second language (Krashen, 1982, Seliger, 1983, Carroll, 1985). It also lends credence to Anderson's (1987) argument about the limitations of research at the "implementation" level of cognitive processing.

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Obvious differences were evident, however, in the approaches to composing displayed by the more and less expert writers. These differences appeared regardless of participants' second language proficiency. They correspond to findings in previous research on the cognitive processes of mother tongue writing (de Beaugrande, 1984, Bereiter & Scardamalia, 1987, Flower & Hayes, 1980). Expert writers displayed well-differentiated approaches to planning their discourse (as emergent or advance planning), using rhetorical scripts and goals to guide their writing, transforming their thinking flexibly to solve problems, and concerning themselves persistently with the qualities of their word choices.

In contrast, less expert writers displayed little control over their writing processes. They tended to plan in small, constrained units -- frequently asking themselves what to say next, because they had little sense of how to proceed with their overall discourse. Alternatively, they simply wrote down everything that came to mind, without assessing its value or quality. They displayed little concern for word choices.

OF WHAT VALUE IS THIS DISTINCTION?

Characteristics of expertise at the "algorithmic" level were reportable, consistently evident in think aloud protocols, and distinguished from processing at the linguistic level. This suggests they represent a level of cognitive knowledge which differs qualitatively from the lower levels of language "implementation". As such, they appear amenable to reflective awareness, self-regulation, learning, modelling, and instruction, as Anderson (1987) proposes, and others have demonstrated for the learning of higher-level literate behaviors (Bereiter & Scardamalia, 1987, Brown, Palincsar and Armbruster, 1984, Cumming, 1986). This knowledge might be called intelligent processing, in view of Gardner's (1983) definitions of literate knowledge as a specialized core intelligence.

In contrast, knowledge of a second language was largely beyond the awareness of individuals' attention during task performance. It is knowledge that participants had acquired over time and social interactions, correlating closely with their length of residence in the English speaking environment (.9 p <.001). As theories of second language acquisition suggest, people develop such knowledge through purposeful use of the language, progressively matching their behaviors and interpretations to standards salient in their social environment (McLaughlin 1987). But, as Fodor (1983) claims, such linguistic knowledge appears modularized and encapsulated -- and thus not amenable to much conscious manipulation. Nonetheless, expert writers obviously use their knowledge of a second language as they write, in much the same way as they do their first language.

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For education, this distinction indicates that quite different learning curricula would be appropriate to foster the development of writing expertise and second language proficiency. For research into cognitive processing and knowledge, there is evident value in assessing adult performance on complex tasks in a second language. The natural disjuncture which adults display between their analyzable control over their expert thinking and their implicit second language proficiency make them suitable subjects to validate theories of modularity, levels of cognitive processing, and self-regulation.

WHERE DO THE LEVELS INTERACT?

Claims for distinctions in levels of cognitive processing beg the question of how such levels interact psychologically. A clue to how this might occur appeared in the persistent word searches and evaluations which characterized the thinking of more expert writers. This behavior -- also observed by Butler-Nalin (1984) in a comparison of second language and mother tongue students writing -- entailed simultaneous attention to language use, gist, and discourse structures; cross-linguistic comparisons; evaluations of alternatives; and finally resolution of a right choice:

A model to... Ah, un modèle à analyser. A model to study.
Not model. A very interesting... Not kinds. Very interesting...
Not style. A very interesting... Ah, c'est pas un modèle.
Cats are among others, a, un très intéressant, a very interesting... Ah, cats are a very interesting... Ah, case to study.

This pervasive behavior demonstrated the kinds of schematic searches, evaluations, retaggings and consolidations which Case (1985) claims are the main regulatory processes leading to intellectual development. Moreover, in doing this, expert writers were progressively verifying the truth correspondences between their thinking and language, a process which Johnson-Laird (1983) and Davidson (1984) claim are integral to human learning and intentionality. In order to generate alternative cross-linguistic word choices, it is necessary to make a priori equations across semantic, discursal, and linguistic categories (Lipski 1978). In this way, expert writers appear able to integrate their knowledge of writing, their second language, and their mother tongue -- while at the same time learning from writing in their second language.

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Without requisite levels of literate knowledge, people may not be able to engage effectively in this kind of integrative learning, as research on minority-language children by Cummins (1984) suggests.

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