
SINO-PLATONIC PAPERS

Number 21

December, 1990

Two Cross-Cultural Studies on Reading Theory

- a. Cross-orthographic Stroop Research: One Study in Context
- b. The Composing Process of a Bilingual Novice Writer

by
Philippa Jane Benson

Victor H. Mair, Editor
Sino-Platonic Papers
Department of East Asian Languages and Civilizations
University of Pennsylvania
Philadelphia, PA 19104-6305 USA
vmair@sas.upenn.edu
www.sino-platonic.org

SINO-PLATONIC PAPERS is an occasional series edited by Victor H. Mair. The purpose of the series is to make available to specialists and the interested public the results of research that, because of its unconventional or controversial nature, might otherwise go unpublished. The editor actively encourages younger, not yet well established, scholars and independent authors to submit manuscripts for consideration. Contributions in any of the major scholarly languages of the world, including Romanized Modern Standard Mandarin (MSM) and Japanese, are acceptable. In special circumstances, papers written in one of the Sinitic topolects (*fangyan*) may be considered for publication.

Although the chief focus of *Sino-Platonic Papers* is on the intercultural relations of China with other peoples, challenging and creative studies on a wide variety of philological subjects will be entertained. This series is **not** the place for safe, sober, and stodgy presentations. *Sino-Platonic Papers* prefers lively work that, while taking reasonable risks to advance the field, capitalizes on brilliant new insights into the development of civilization.

The only style-sheet we honor is that of consistency. Where possible, we prefer the usages of the *Journal of Asian Studies*. Sinographs (*hanzi*, also called tetragraphs [*fangkuaizi*]) and other unusual symbols should be kept to an absolute minimum. *Sino-Platonic Papers* emphasizes substance over form.

Submissions are regularly sent out to be refereed and extensive editorial suggestions for revision may be offered. Manuscripts should be double-spaced with wide margins and submitted in duplicate. A set of "Instructions for Authors" may be obtained by contacting the editor.

Ideally, the final draft should be a neat, clear camera-ready copy with high black-and-white contrast.

Sino-Platonic Papers is licensed under the Creative Commons Attribution-NonCommercial-NoDerivs 2.5 License. To view a copy of this license, visit <http://creativecommons.org/licenses/by-nc-nd/2.5/> or send a letter to Creative Commons, 543 Howard Street, 5th Floor, San Francisco, California, 94105, USA.

Please note: When the editor goes on an expedition or research trip, all operations (including filling orders) may temporarily cease for up to two or three months at a time. In such circumstances, those who wish to purchase various issues of *SPP* are requested to wait patiently until he returns. If issues are urgently needed while the editor is away, they may be requested through Interlibrary Loan.

N.B.: Beginning with issue no. 171, *Sino-Platonic Papers* has been published electronically on the Web. Issues from no. 1 to no. 170, however, will continue to be sold as paper copies until our stock runs out, after which they too will be made available on the Web at www.sino-platonic.org.

Cross-orthographic Stroop Research: One Study in Context


Philippa Jane Benson

Department of English, Carnegie Mellon University

OVERVIEW

This paper reviews studies done during the last decade in one small area of cross-language research, that of cross-orthographic Stroop interference tests. By critiquing one of the first cross-orthographic Stroop studies in the context of related studies, this paper describes how cross-orthographic Stroop studies have been used to explore cognitive mechanisms involved in reading and explores the possibility that those mechanisms might be constrained by the orthography of a language. Stroop studies have been a useful tool for inquiry into possible differences in cognitive processing of visually distinct written languages in two particular ways. First, many studies have yielded provocative results indicating that different orthographies may indeed invoke different cognitive processes in readers. At the same time, these studies have contained conceptual and methodological flaws that underscore the difficulty in empirically verifying hypotheses about how humans make meaning from and with written language. In essence, the studies themselves warn that, until our understanding of language processing is more complete, we should take their results with a sizable pinch of salt. Despite their faults, however, these studies do provide evidence that readers of different orthographies may invoke different cognitive processes at the base of their reading strategies.

WHAT IS "STROOP INTERFERENCE?"

The original version of the Stroop test, developed by J. R. Stroop in 1935 (Stroop, 1935), was done with a color-naming/word-naming task to study cognitive processing mechanisms for visual and verbal stimuli. In the original test by Stroop, subjects were presented with incongruent color words, for example BLUE printed in red ink (i.e., **blue**), and were asked either to name the color (in this case "red") or read the word (in this case "blue"). The original version of the Stroop test revealed that subjects took longer and made more errors when naming colors than when reading color names printed in black (i.e., **BLUE**) or naming the color of color patches (i.e., ). Experimenters measured the time difference between the presentation of the color-word and the subject's response to a color-naming or word-reading instruction and called the measure that of "Stroop interference" or the "Stroop effect" [Note: If this paper has been duplicated, the two examples above that should be printed in red ink: may not have been duplicated in color.]

The theory behind the test was that to respond to a Stroop stimuli, in which visual and verbal material are presented together but are not congruent, subjects may need to go through a series of cognitive steps such as encoding verbal stimuli, encoding visual stimuli, comparing the visual and verbal material, selecting a response, and executing the response. Because the tests consistently showed that there were significant differences between the response times of subjects in color-naming and word reading tasks, researchers hypothesized that there may be some kind of interference between the

processing of the visual and the verbal information. The ensuing questions were where and why does the interference take place, and what do the answers to those questions tell us about human information processing.

Since 1935, researchers have conducted studies using Stroop interference tests both to look for answers to questions about the processes behind the Stroop effect and to explore other cognitive processes. (For a review of the first three decades of work, see Jensen and Rohwer, 1966.) Stroop himself hypothesized that the interference occurs when a subject is in the process of selecting a response to a prompt to name a color or word. More recently, Keele (1972) supported the hypothesis that the interference takes place during the response process, when he found his subjects exhibited a Stroop effect both when they responded to Stroop stimuli physically (by pressing a key) as well as when they responded verbally. Seymour (1974) discussed the possibility that the interference may occur in the comparison stage if incongruous visual/verbal stimuli cause the subject to judge the "truth" of the match between the semantic meaning in a visual display and the display itself. For example, if "Above" is printed above "Above," the match is true; however, if "Below" is printed above "Above," the match is false. ABOVE BELOW
ABOVE ABOVE

Seymour's intention was both to give additional evidence of the locus of Stroop interference and to use that evidence to further the understanding of the cognitive processes involved when readers are comparing sentences and pictures.

Another example of the application of the Stroop paradigm is the study of hemispheric lateralization by Morikawa (1981), who compared the Stroop effect of Japanese reading ideographic and syllabic Japanese characters with identical pronunciation. Because there were significant differences in the amount of Stroop effect subjects exhibited when reading these different kinds of characters, Morikawa placed the locus of Stroop interference in the encoding (perceptual) process and used his results to support the hypothesis that different cerebral hemispheres are responsible for processing different kinds of stimuli. In addition to the studies mentioned above, researchers have used Stroop tests to explore other areas of language processing such as automaticity of word recognition (Liu, 1973; Samuels, 1976; Schandler and Thissen, 1981) and speech recoding in reading (Martin, 1978; Naish, 1980). Many of the Stroop studies have had the dual purpose both of developing understanding of the processes and furthering the effort to pinpoint the locus of Stroop interference.

A COMPARISON OF CROSS-ORTHOGRAPHIC STROOP STUDIES

Along with single language Stroop studies, cross-language (and in particular cross-orthographic) Stroop studies have been used for a number of different research goals, ranging from exploring specific cognitive processes, such as Morikawa's (1981) hemispheric lateralization study, to promoting more general hypotheses, such as the idea that reading different types of scripts might activate different kinds

of cognitive processes (e.g., Fang et al, 1981; Hung and Tzeng, 1981). Researchers using variations of the original Stroop test to study the cognitive processes of readers of different orthographies have studied

- logographic languages such as Chinese,
- languages represented by the Roman alphabet such as English and Spanish, and
- languages that are represented by combinations of orthographies, such as Japanese, which uses both logographs [kanji] and phonetic symbols for syllables [kana]¹, and Korean, which uses logographs, a phonetic syllabary [hangul], and romanization.

One of the first Stroop studies to compare a logograph language (Chinese) with an alphabetic language (English) was by I. Biederman and Y. Tsao in 1979. In their study, the authors found that their Chinese subjects exhibited significantly greater Stroop interference in naming the color of incongruent color words than did native English speakers in an equivalent English version of the same test. The differences between the Chinese and English subjects were unexpectedly large, in both the experimental *and* the control conditions. Biederman and Tsao speculate that their Chinese subjects had larger Stroop effects because "there may be some fundamental differences in the perceptual demands of reading Chinese and English which can have widespread implications for human information processing" (p.125). Specifically, they suggest that because both the perception of color and the recognition of meaningful patterns (i.e., logographs) are processes attributed to the right cerebral hemisphere, the large Stroop effect exhibited by their Chinese subjects may have been due to competition for the same perceptual capacity.² (Generally, language processing is attributed to the left hemisphere.)

Although these explanations are provocative enough in themselves, Biederman and Tsao suppose yet further that Chinese readers may automatically activate configurational processing of logographs when reading, unlike readers of English who, according to Biederman and Tsao, automatically activate an abstract sound-to-grapheme rule system when reading. To support their hypothesis that there may be fundamentally different perceptual demands in the reading of logographic and alphabetic languages, Biederman and Tsao also cite a "widespread belief" that Chinese characters might provide more direct access to meaning than English words, quoting W.S. Wang's well-known article on the Chinese language:

To a Chinese the character for "horse" means horse with no mediation through the sound "ma." The image is so vivid that one can almost sense an abstract figure galloping across the page (Wang, 1973).

Biederman and Tsao finally suppose that their Chinese subjects exhibited such large Stroop effects in both experimental and control conditions because the predisposition of logographic readers toward visual imaging of printed information may be the "more natural."

Although subsequent researchers have acknowledged that Biederman and Tsao's hypotheses are

¹Written Japanese is increasingly incorporating alphabetic symbols in daily use, but far from the extent that it is a necessity for literacy. For more information on this topic, see Saint-Jacques, 1987.

² For evidence of this, Biederman and Tsao primarily cite studies of Japanese aphasics, e.g., Sasanuma, 1975, 1977.

intriguing, most are quick to point out the flaws in the study and to underscore that there is no support for a cognitive base to the claim that, for normal readers, Chinese language provides more direct access to meaning than does English. In the following sub-sections, I review the Biederman and Tsao study in the context of related research, specifically focusing on the selection of test materials, the bilingualism of subjects, and issues of phonological recoding in reading.

SELECTION OF TEST MATERIALS

Like many cross-orthographic researchers, Biederman and Tsao did not control for the equivalence of their test stimuli across languages. (I am presuming that if the authors did not mention a specific control factor in their report, then the factor was indeed not controlled for.) An obvious lack of equivalence, for example, is in syllable length of words: two of the color words they choose are bisyllabic in English (yellow and purple) and monosyllabic in Chinese ("huang" and "zi"). Biederman and Tsao also claimed that the color words they selected, blue and green along with yellow and purple, have equal "focal" status in Chinese and English, a supposition for which they gave no evidence and which is questionable at best. Consider, for example, the cultural differences in the symbolism of "yellow": in China, yellow is the color of royalty; in America, yellow is more often associated with the idea of "cowardliness." Another example is that of the color "green": to Americans "green" is quickly associated with the notions either of "Earth" or perhaps of jealousy, or money, while in China it is the symbolic color for young people and youth.

Another absence in the Biederman and Tsao was the lack of control for the size of the test stimuli used in the experimental conditions. This variable should be mentioned at the very least considering results of research in readability and document design that support the relationship between legibility of print and the ability of readers to comprehend text (Smith, 1979; Rehe, 1981). The basic gist of this research (which comes from investigations of human factors and document design rather than reading research) is that information printed in small type sizes is more taxing to read and is not remembered as easily or accurately as information printed in easily legible type. Putting issues of automatic word recognition in the background for a moment, in the case of these cross-orthographic studies one could argue that it might take *any* reader a few milliseconds longer to recognize the traditional character for blue (藍 - 18 strokes) than to recognize "BLUE" or even to recognize the character for red (紅 - 9 strokes) than to recognize "RED." In addition, using a variation of the original Stroop stimuli, Besner and Coltheart (1979) have shown that skilled readers of English use different mechanisms to read number and words and that these mechanisms seem to be affected by the physical size of presented stimuli but only when the numbers are presented logographically (e.g., 1, 2 2), not alphabetically (e.g., one ONE, two TWO). Considering that there is evidence suggesting that subject responses to ideographic stimuli in Stroop conditions may be affected by the legibility and size of the characters, the lack of mention of the size of test stimuli somewhat weakens Biederman and Tsao's hypotheses.

Many cross-orthographic researchers have avoided this weakening factor by at least attempting to control for equivalence in cross-language test materials (for examples see Chu-chang & Loritz, 1977; Fang et al., 1981; Chen & Ho, 1982; Zhang & Simon, 1985). Many of these subsequent studies include examples of the actual Chinese logographs used as stimuli and/or specify the size of the characters that were presented, thus avoiding possible rival hypotheses about legibility of complicated characters. In attempting to control for as many factors as possible to make test stimuli equivalent, researchers also began to acknowledge the difficulty in truly controlling for linguistic, semantic, or other levels of equivalency; for example, even if a single character Chinese word appears to be monosyllabic, it is so only "in nature" because Chinese words have tone which either lengthens or shortens their articulation (Fang et al., 1981). Though variations in visual complexity, number of syllables, and "focal status" of words in cross-orthographic Stroop studies may not have profound affects on results, controlling for them can reduce the potential for a study's results to be questioned on these grounds.

BILINGUALISM AND STROOP EFFECTS

Another deficit in the Biederman and Tsao study is the lack of sufficient discussion of the bilingualism of their subjects. Biederman and Tsao briefly consider bilingualism as a possible explanation for the differences of the Stroop results of their Chinese and English subjects but rule it out by showing similarities between their results and data from other cross-language (but not cross-orthographic) Stroop studies (Preston & Lambert, 1969; Dyer, 1973) and by showing how various statistical analyses could smooth out the unusually large differences between the results of the Chinese and English subjects. Their explanations did not, however, touch upon a number of facets of bilingualism which, if considered, might show bilingualism as a significant cause of the unusually large Stroop effect exhibited by Chinese subjects.

For example, in their report Biederman and Tsao note only that their Chinese subjects were "native speakers of Chinese" from Taiwan; they do not specify that their subjects are all native speakers of Modern Standard Mandarin, the language in which the experiments were almost surely conducted. Although generally all Chinese students on the graduate level can speak and understand Mandarin Chinese, it is very likely that some of the subjects may be native speakers of one of the several Taiwan topolects (e.g., Fujianhua) rather than Mandarin; Mandarin then would be the second language for these subjects, and English the third. Some part of the strong latency in the Chinese data may reflect interference between the subject's encoding of the experimental and control stimulus first in their native dialect and then transposing it into Mandarin, almost certainly the requested language for the experimental response.

Hung and Tzeng (1981) commented on the lack of adequate attention to the issue of bilingualism in the Biederman and Tsao study, but say only that the study should be replicated with a more general subject population. In a follow-up study to his 1981 paper on Stroop effects with Japanese readers,

Morikawa (1987) explored reasons why Biederman and Tsao's Chinese subjects had such dramatic Stroop effects in both experimental and control conditions -- but did so by testing a more specific rather than a more general subject population. Morikawa supposed that one possible reason the Biederman and Tsao bilinguals had such high interference measures might be because they were not in their native language environment. To test this idea, Morikawa conducted Stroop tests with Koreans reading alphabetic, syllabic, or logographic versions of their language. Half the subjects were Korean university students in Korea, the others Korean students in Japan. When Morikawa found no significant difference between his two subject groups he discounted the possibility that environment could be an influencing factor in the Biederman and Tsao results and took his investigation of that point no further.

In a related study of bilingualism, Fang et al. (1981) conducted modified Stroop color-naming tests with Chinese-English bilinguals in which the stimulus and response languages were either the same or different. Their purpose was to see whether bilinguals would exhibit as much Stroop effect if the written forms of the two languages they were switching between were orthographically similar (i.e. English and Spanish, both alphabetic) or different (i.e. English and Chinese, Chinese being logographic). Their results showed not only that subjects had greater within language interference than between language interference but also that there was an inverse relationship between amount of interference and degree of similarity between the orthography of the two languages. In other words, the findings of Fang and his colleagues showed that the more similar the orthographies of the two languages of a bilingual, the more interference he or she is likely to exhibit in processing incongruent color words. Fang and his colleagues did suggest that there may be fundamental differences in the processing mechanisms of logographic and alphabetic languages, but their conclusions seemed considerably more constrained than Biederman and Tsao's and, therefore, more credible because they did not inflate their claims to suggest that one orthography may be "more natural" than another or may be capable of triggering specific kinds of cerebral processing.

Another aspect of bilingualism not addressed by Biederman and Tsao was taken up by Chen and Ho (1986) in their study of reverse Stroop effects. In their review of bilingual Stroop studies, Chen and Ho note that the longer subjects have been working in a second language environment, the less Stroop interference they exhibit with materials in their first language and the more interference they show with materials in the second language they are acquiring. If one inspects the Biederman and Tsao data, it seems quite possible that their subjects may have differed widely in their degrees of bilingualism not only because they specifically mention that their subjects were bilingual "to varying degrees" but also because there was a wide distribution of response times within their Chinese subject group, with only six of 16 subjects equally distributed around the mean. Therefore it seems possible that Biederman and Tsao's subjects may have differed so widely in their response times to Stroop stimuli because of different levels of adaptation to working with alphabetic language materials and/or individual differences in degree of proficiency in Mandarin Chinese.

SPEECH RECODING, SHORT TERM MEMORY (STM), AND THE STROOP EFFECT

Biederman and Tsao's interest was whether the "application of a system where the names were directly associated to the configuration of the stimuli, as in Chinese, would result in more Stroop interference than the application of an abstract sound-to-grapheme rule system," as we have in English. Prior to Biederman and Tsao's study, however, several researchers had already investigated the relationship of sound-to-grapheme in various orthographies and implications of those relationships to visual information processing (Chu-Chang & Loritz, 1977; Erickson et al., 1977; Tzeng et al., 1977). These earlier investigations all explored speech or phonetic "recoding" in reading. Biederman and Tsao, however, touch upon the notion of speech recoding only as a rhetorical step in their argument that there may be fundamental differences in the perceptual demands of reading Chinese and English. They do not take up the issue of speech recoding nor the possibility that Chinese readers may rely--to some degree at least--on the recoding of print information into sound en route to meaning. Clearly, the acknowledgement of this possibility would have suggested that Biederman and Tsao reconsider their hypothesis.

When Biederman and Tsao wrote their 1979 article, the investigations of speech recoding by cross-language researchers had yielded some strong evidence that was counter to their argument of the primacy of visual encoding in the processing of logographic characters. For example, independent studies with native readers of Japanese (Erikson et al., 1977), Chinese and Spanish bilinguals (Chu-chang & Loritz, 1977), and Chinese alone (Tzeng et al., 1977) together provided strong evidence that proficient readers of these orthographies use phonetic mediation in reading, though the readers' *awareness* of their use of phonetic recoding differed. These studies all tested subjects' recall of homophonic and non-homophonic words, finding that subjects recalled non-homophonic words better than homophonic sets of words regardless of orthography, indicating that sound as well as sight plays a part in storing the word sets in memory of written language.

Specifically, these studies linked phonetic activity in reading to the functioning of short term or "working" memory (STM). For example, Erikson and his colleagues (1977) theorized that readers use a phonetic storage in STM to hold information while other linguistic processes are going on. This phonetic "buffer" or "workspace" in memory may be necessary as a place "in which a representation of a sentence can be stored and updated during the course of linguistic processing" (p. 394). Chu-chang and Loritz (1977) proposed a two-stage model of reading proficiency, suggesting that at earlier stages of learning to read, STM representation of written material is primarily visual, while at more developed stages STM for written material becomes primarily phonological. On the other hand, Tzeng and his colleagues (1977) cautioned against exaggerated interpretations of cross-orthographic data supporting theories of phonological recoding in reading, pointing out that phonological recoding may be just one of several strategies readers may use to access the meaning of a linguistic symbol and that other factors such as difficulty of material and reader purpose may effect a reader's reliance on phonemic recoding. Yet, at the

same time, Tzeng and his colleagues also suggest that the data from experiments may indicate similarity rather than difference in the visual processing of Chinese characters and English words and that "both processes involve phonetic recoding of visually presented symbols" (p. 626).

In addition to the studies mentioned above, a more recent study by Zhang and Simon (1985) supports the role of phonetic recoding in working memory. In a series of studies designed to reconcile two competing hypotheses about the capacity of STM, Zhang and Simon used homophonic and non-homophonic Chinese radicals and characters to test STM span. Their results showed both that Chinese readers made a substantial number of homophone errors in recall of stimuli (that is, their memory of logographic stimuli was phonetically correct but graphemically incorrect) and that the STM span for unnamed radicals and homophonic characters was about half of that for characters and radicals with distinct names. Their conclusion, similar to those of the authors mentioned above, is that STM utilizes both acoustic and non-acoustic encodings. Zhang and Simon remark

These results with Chinese language materials are especially interesting because it has often been claimed that Chinese readers, unlike readers of alphabetic languages, encode the ideographic characters directly from visual to semantic without going through an intermediary acoustic encoding. The high rate of homophonic intrusion in Experiment 1 and the low measured span of nonacoustic STM make this claim dubious. It would appear that the oral language is an essential intermediary in the extraction of meaning from both kinds of texts."

(Zhang and Simon, 1985)

In light of the research that had already been done about the issue of speech recoding in the reading of Chinese characters, the lack of citations of these works by Biederman and Tsao makes it appear that perhaps the authors had not done their homework particularly well.

In all, it seems clear that Biederman and Tsao did not adequately address a number of important variables that undermine both their findings and their ideas about the "widespread implications" of their data. On the other hand, other studies support Biederman and Tsao's notion that there are some differences on some level between readers' abilities to perceive visual and verbal information. Perhaps the best way to reconcile the disparate mixture of data indicated by these studies is to investigate more vigorously the possible models for how meaning of written information might be mediated through a combination of visual and the acoustical routes. At the same time, it is unfortunate that more cross-orthographic Stroop research has not emphasized the quest for the locus of Stroop interference, for such evidence could address the question of whether the differences in Stroop effects shown by ideographic and alphabetic readers are due to fundamental differences in human information processing mechanisms or to differences in the learned patterns of attention to features of language by readers. If the latter is indeed the case, it could in turn lead to further work, initially to capture and describe how first language perception and production might affect the learning of reading and writing skills in second languages and then to develop teaching methods that incorporate an understanding of those differences in the teaching of second languages, particularly when the languages are represented by different orthographies.

REFERENCES

- Besner, D. & Coltheart, D. (1979). Ideographic and alphabetic processing in skilled reading of English. *Neuropsychologia*, 17, 467-472.
- Biederman, I. & Tsao, Y. (1979). On processing ideographs and English words: some implications from Stroop test results. *Cognitive Psychology*, 11, 125-132.
- Chen, H. & Ho, C. (1986). Development of Stroop interference in Chinese-English bilinguals. *Journal of Experimental Psychology: Learning Memory, and Cognition*, 12, 397-40.
- Chu-Chang, M. & Loritz, D. (1977). Phonological encoding of Chinese ideographs in short-term memory. *Language Learning*, 27, 344-352.
- Davelaar, E., Coltheart, M., Besner, D. & Jonasson, J. (1978). Phonological recoding and lexical access. *Memory and Cognition*, 6, 391-402.
- Dyer, F. (1971). Color-naming interference in monolinguals and bilinguals. *Journal of Verbal Learning and Verbal Behavior*, 10, 297-302.
- Erickson, D., Mattingly, I. & Turvey, M. (1977). Phonetic activity and reading: An experiment with kanji. *Language and Speech*, 20, 384-403.
- Fang, S., Tzeng, O. & Alva, E. (1981). Intralanguage vs. interlanguage Stroop effects in two types of writing systems. *Memory and Cognition*, 9, 609-617.
- Hung, D. & Tzeng, O. (1981). Orthographic variations and visual information processing. *Psychological Bulletin*, 90, 377-414.
- Jensen, A. & Rohwer, W. (1966). The Stroop color-word test: a review. *Acta Psychologica*, 25, 36-93.
- Keele, S.W. (1972). Attention demands of memory retrieval. *Journal of Experimental Psychology*, 93, 245-248.
- Liu, A. (1973). Decrease in Stroop Effect by reducing semantic interference. *Perceptual and Motor Skills*, 37, 263-265.
- Martin, M. (1978). Speech recoding in silent reading. *Memory and Cognition*, 6, 108-114.
- Morikawa, Y. (1981). Stroop phenomena in the Japanese language: the case of ideographic characters (kanji) and syllabic characters (kana). *Perceptual and Motor Skills*, 53, 67-77.
- Morikawa, Y., and Kashiwazaki, H. (1987). Stroop phenomena in the Korean language: the case of hangul, Chinese characters and romanization. *Perceptual and Motor Skills*, 64, 299-308.
- Naish, P. (1980). Phonological recoding and the Stroop effect, *British Journal of Psychology*, 71, 395-400.
- Preston, M. & Lambert, W. (1969). Interlingual interference in a bilingual version the Stroop color word task. *Journal of Verbal Learning and Verbal Behavior*, 8, 295-301.
- Rehe, R.F. (1981). *Typography: How to make it most legible*. Carmel, IN: Design Research International.
- Saint-Jacques, B. (1987). The Roman alphabet in the Japanese writing system. *Visible Language*, Winter, 88-105.
- Samuels, S.J. (1976). Models of word recognition. In H. Singer and R.B. Ruddell (Eds.), *Theoretical models and processes of reading*. Newark, Del; International Reading Association.
- Schandler, M., & Thissen, D. (1981). The development of automatic word recognition and reading skills. *Memory and Cognition*, 9, 132-141.
- Sasanuma, S. (1977). Kana and Kanji processing in Japanese aphasics. *Brain and Language*, 15, 563-568.
- Sasanuma, S., Itoh, M., Mori, K., & Kobayashi, Y. (1977). Tachistoscopic recognition of kana and kanji words. *Neuropsychologia*, 15, 547-553.
- Seymour, P. (1974). Stroop interference with response, comparison and encoding stages in a sentence-picture comparison task. *Memory and Cognition*, 2, 19-26.
- Smith, S. (1979). Letter size and legibility, *Human Factors*, 21, 661-670.
- Stroop, J.R. (1935). Studies of interference in serial verbal reaction. *Journal of Experimental Psychology*, 18, 643-661.
- Tzeng, O., Hung, D. & Wang, W. (1977). Speech recoding in reading Chinese characters. *Journal of Experimental Psychology Human Learning and Memory*, 3, 621-630.
- Wang, W.S. (1973). The Chinese language. *Scientific American*, 228, 50-60.
- Zhang, G. & Simon, H. (1985). STM capacity for Chinese words and idioms: chunking and acoustical loop hypotheses. *Memory and Cognition*, 13, 193-201.

The Composing Process of a Bilingual Novice Writer

Philippa Jane Benson, Department of English, Carnegie Mellon University, Pittsburgh, PA

(An earlier version of this paper was presented at the session on Applied Psycholinguistics of the Second Annual Northeast Conference on Chinese Linguistics held at the University of Pennsylvania, May 4, 1990.)

INTRODUCTION

Research over the past decade has produced some understanding of the relationship between the cognitive patterns of two types of readers and writers: those who use languages that employ phonetically-based alphabetic writing systems (e.g., English) and those who use languages that employ ideographic writing systems (e.g., Chinese). However, the emerging picture is still incomplete; although we have learned enormous amounts about how readers decode and encode alphabetic and ideographic scripts, we can say little about the similarities and/or differences in the processes engaged by users of different scripts as they produce and revise written texts. Yet, it seems clear that if we persist in our explorations, we can bring more precise elements of the relationships into focus, and perhaps in turn move closer to understanding the kinship between language and thought.

BACKGROUND TO THE STUDY

Over the past decade, researchers from a surprising range of disciplines have applied a multitude of research tools to investigate bilingualism. The angles from which bilingualism have been dissected have included, for example

- inquiry into the suspicion that the two types of languages are processed by different cerebral hemispheres (Hardyck, Tzeng & Wang, 1978),
- tracking and modeling of eye movement and other reading processes (Bernhardt, 1986; Just & Carpenter, 1987),
- modeling effects that different orthographies have on reading speed and comprehension (Bernhardt, 1986; Hung & Tzeng, 1981; Muter & Johns, 1985; Tzeng & Hung, 1981)
- formulating the relationship between form, sound, frequency, and memorizability of linguistic symbols (Park & Arbuckle, 1977; Zhang & Simon, 1985).

During this same decade, another area of inquiry has been opening in the field of writing research: the cognitive processes of writing (Emig, 1971; Flower, 1979; Hayes & Flower, 1980). Since its birth, researchers and teachers have vigorously debated the notion that writing can be better studied and better taught from a cognitive rather than a romantic or traditional perspective. Researchers from a variety of disciplines have raised questions about both the use and validity of verbal reports as data and about the potential of such data to yield accurate models of cognitive processes involved in creating and revising text. In large part, these objections have come from camps in the humanities that, by nature, are not fond of empirical studies of any kind. Regardless of objections, cognitive models have nonetheless proven valuable: researchers have found in them new paths for study and teachers have found in them new classroom tools.

To date, however, few studies have merged research perspectives from studies of bilingualism and of composition to investigate the cognitive processes employed by bilinguals when they write. This study is an effort to show the potential value in combining these perspectives and methods.

PURPOSE

This case study explores the composing process of a bilingual novice writer. Specifically, the goal of the study was to capture aspects of the subject's behavior that characterized her as a novice writer and also as a bilingual writer faced with the task of generating text in English. Of particular interest was the question if, when, and how the subject relied on her initial native language to aid her in the process of composing text in her "second" language. (Although the subject was a true bilingual, for the purposes of this study I refer to the first language learned by the subject as her "initial" language.) If during a writing task some sort of switching between the two languages was observed, the goal was then to develop a model of the subject's patterns (if any) of switching between the two languages.

METHOD

Subject: The subject was a 16-year-old freshman student at Carnegie Mellon University whom I will refer to as Jin. Jin is a true bilingual: She speaks both the language of her parents, Fujianhua, and English as a native speaker in terms of her pronunciation, intonation, vocabulary, grammar, and usage.

Although Jin was born in the United States, her initial language (i.e., the first language she learned) was the Taiwan dialect, Fujianhua, spoken by her parents. Jin spoke only Fujianhua until she entered the American school system at age five. In school, Jin learned English and used it during school time through graduation from high school. During this time, however, she continued to speak only Fujianhua with her parents at home. Jin spent most all of her free time with her family, and so developed and used her English almost exclusively in school.

In addition to her American schooling, from ages 7 to 14 Jin also attended a special school for Chinese one afternoon each week. During this time, Jin was taught to speak Modern Standard Mandarin (MSM, i.e., Putonghua) and was taught character writing as well as Pinyin (the romanized spelling of Putonghua words). When Jin entered high school, she stopped her formal study of Chinese language for two years, but resumed it again as part of her regular curriculum during the last two years of high school.

According to self-report, in high school Jin scored above average in her math and science classes but average or below in language arts. At the time of the experiment, Jin's English writing abilities were poor, but she could construct simple narrative passages with no mechanical errors.

Materials: In the actual experiment, Jin was given two instruction sheets. The first sheet supplemented the verbal explanation of think-aloud protocols (explained below). The second instruction sheet was headed "Task One":

Please write about five paragraphs in English describing a time you went to an American restaurant and had a good meal. Imagine your reader is an American person you know.

Procedure: One week before the experiment, Jin practiced doing think-aloud protocols while writing. During this practice session, think-aloud protocols were first verbally explained to Jin. She was told that think-aloud protocols are a research method in cognitive psychology in which the subject voices her ideas as she works her way through a task. The purpose is to capture a portion of the thinking that a person does when she is understanding and solving a problem of some kind. After this explanation, Jin was asked to write a short essay while talking aloud and being recorded. She was instructed to speak in whatever language she felt comfortable.

During this preliminary session, Jin was verbally prompted to speak if she fell silent for more than 10 seconds. During the actual experiment, rather than a verbal prompt, a pencil was tapped on a table to remind Jin to resume speaking if she stopped. Sound rather than speech was used to prompt Jin in order to avoid influencing her to resume speaking in any particular language. Jin took approximately 45 minutes to write her essay.

ANALYSIS

Translation and Transcription: During the experimental protocol, Jin spoke in English, Fujianhua, and an occasional phrase in MSM (Putonghua). She intertwined the languages by inserting words, phrases, or sentences of English in the midstream of speaking Fujianhua or by speaking a word or two in Fujianhua in the middle of speaking English. Since the focus of this study is on the switching between English and Chinese, switches between Fujianhua and Putonghua are not attended to in this analysis.

In this study, Pinyin transcriptions of MSM are used instead of the written transcription of the spoken Fujianhua (which is substantially different from MSM). This method was chosen in order to make the translation available to a wider number of readers. Since the focus of this study is the language switching, the translation of Fujianhua into Putonghua transcription does not substantially affect the results. However, to assure the accuracy of the data, two measures were taken to assure that the transcriptions and translations were fully accurate. First, the translation was done by a native speaker of Fujianhua who was also fluent in reading, writing, and speaking Putonghua (including Pinyin) and English. Second, after the transcriptions and translations were complete, Jin listened to the tape of her protocol and read the translations to verify that the translations accurately reflected her original speech. In addition to the translations of the Fujianhua into a Pinyin transcription of Putonghua, the transcribed protocols included markers of the pauses Jin made during the protocol.

Pauses times were included to highlight that there was often no pause between Jin's speaking of English and Chinese; she moved from one to another without a breath.

Coding: The transcribed protocols were coded into episodes, with each episode reflecting a distinguishable set or sequence of thoughts or actions (i.e., text production, rereading) that could be interpreted as a distinct unit of cognitive processing. The definition used here is looser than that used by Newell and Simon (1972, p. 284) because in writing tasks it is not particularly useful to define episode boundaries as points at which subjects face a problem "of doing something that is not obvious." Rather, the coding used here reflects more simply a change in strategy.

In the protocol, Jin had several types of thinking and writing behaviors that can be characterized as falling into four major kinds of episodes:

- UT** **Understand task**
Rereading or remembering instructions;
Searching for a schema that will match the instructions.
- PE** **Plan Essay**
Searching for or selecting *topic* for essay as a whole;
Constructing *structure* for essay.
- PC** **Plan Content**
Searching for, finding, evaluating, and selecting subtopic
or related details as part of sentence generation.
- W** **Write**
Speaking sentence parts to test them as text;
Writing sentences or sentence parts;
Evaluating spoken or written sentences or sentence parts;
Revising written sentence parts.

Episodes ranged in length from very short utterances to long sequences of generating text. The two codings for understanding the task (UT) and planning the essay (PE) were made to illuminate the intimacy of the processes of understanding a writing task and the process of internally representing a plan for approaching that task. A separate coding for "understanding" is also useful for tagging Jin's periodic return to basic requirements of the task, that is, to "write five paragraphs." Once she selected the primary topic, it is reasonable to assume that the idea of "five paragraphs" is integrated with the notion of the topic of the those paragraphs.

Jin exhibited two additional kinds of behavior during the experiment, rereading and self-interrogation, which were coded as part of the process of generating text, either as planning content (PC) or as writing (W). Rereading was coded according to the material that was being reread. For

example, Jin reread text she had already generated before, during, and sometimes after she began planning a new subtopic; this kind of rereading was coded as part of content planning. She also frequently reread sentence parts or a full sentence after she had completed composing them; this kind of rereading was coded as part of the writing task.

Episodes that began with self-interrogations (e.g. "What should I write about now?") were coded as planning, because without exception they indicated the commencement of the search for content matter. This self-interrogation will be discussed at greater length later.

Results of coding: List 1, below, shows the number of occurrences of each of the four types of episodes.

List 1: Number of episodes by type

Understand Task (UT)	=	6
Plan Essay (PE)	=	4
Plan Content (PC)	=	12
Write (W)	=	14

Seq.#	UT	PE	PC	W
1.	•-----	•-----		•
2.	•-----	•-----		•
3.	•-----	•-----		• English
4.	•-----	•		Only
5.	•-----	•-----		•
6.		•-----		•

7.			•-----	•
8.			•-----	•
9.			•-----	•
10.			•-----	• Switching
11.			•-----	• (English/
12.			•	Fujianhua)
13.			•-----	•
14.	•-----		•-----	•
15.			•-----	•
16.			•-----	•

Chart 1: Sequences of Episodes

Chart 1, at left, shows the sequences of episodes in the protocols. This sequencing reveals that during the first six sequences, Jin spoke only English when she concentrated on representing the task to herself (UT) and decided the topic and basic structure of her essay (PE). After make these decisions about the framework for her essay, Jin began attend to planning and generating sentences (PC and W) and then began to switch between English and Fujianhua.

List 2, below, shows the number of of self-interrogation in each type of episode. The list clearly shows that the vast majority of these probes occurred during the generation of sentences. List 3 describes the interrogations in the content planning (PC) episodes in more detail.

List 2: Self-interrogations by episode type

Understand Task (UT)	= 0
Plan Essay (PE)	= 5 (English)
Plan Content (PC)	= 4 (English)
	16 (Chinese)
Write (W)	= 1 (English)

List 3: Interrogations in PC episodes

Total 20 PC interrogations
 9 of 12 PC episodes begin with interrogations.
 3 of 9 interrogations begin in English, immediately switch to Fujianhua:
 4 of remaining 6 interrogations begin directly in Fujianhua.
 Remaining 2 interrogations in Fujianhua in the midst of content planning

DISCUSSION

Jin's behavior during the protocol characterizes her both as a novice writer and as a bilingual. In this analysis, I describe her behavior as a novice writer and as a bilingual writer separately, without directly considering what interaction the two variables may possibly have; such a task is beyond the scope of this analysis. However, research into the interactions of the behavior of novice writers and the writing processes of bilinguals is an area that bulges with promise. Such studies could provide information about possible commonalities in writing processes across languages and could inform methods of teaching writing that would be viable in any language.

Jin as a novice writer: Much of Jin's behavior is typical of a novice writer: she does relatively little planning, she does not actively consider rhetorical aspects of the task such as audience or purpose, and she does relatively little revising. As captured in the coding, Jin concentrates on planning content (PC) and actually producing written text (W) after forming a relatively simple representation of her task.

As Jin represents her task to herself in the first several sequences of episodes, it is difficult to distinguish whether she is, in fact, instantiating the instructions or actually planning her essay. Typical of novice writers, it seems she does not separate the two and instead does both at the same time: She represents the task to herself by retrieving a schema from memory that instantiates the instructions for her, thus allowing her to make meaning from the instructions. [Note: In the following boxed examples from Jin's protocol, if Jin spoke English, English alone is provided in plain text on the left. If she spoke Fujianhua, Pinyin transcriptions of the Fujianhua are provided in italic on the right and an English translation is given on the left. If she inserts an English word or phrase while speaking Fujianhua, the English is marked in boldface within the Fujianhua

transcription on the right. In the transcriptions, English text that is underlined and marked beginning with “w)” is text that Jin is writing. Text that begins with “r)” is text that Jin has already written and is rereading.]

UT

five paragraphs, an American restaurant, OK, thinking of the time,
of the times that I've went to an American restaurant that I
had a good meal.

PE

What restaurant have I been to, been to Sage, Georgia's Diner, Bluebay Diner.

I think I'll write about Sage-- no, I'll write about Georgia's Diner...

W

w) Georgia's Diner

r) Georgia's Diner

UT

five paragraphs in English

PE

um, let's see, what should I talk about

5 sec pause

What should I write about, OK, the restaurant that

I went to, should I describe where it was or

4 sec pause

what should I write, which...

r) in describing a time at an American restaurant.

Example 1. First sequence of episodes from protocol

However, Jin spends relatively little time either working to understand the task or to plan the essay. The protocol reveals that, again typical of a novice writer, Jin quickly focuses on a simple plan for the essay, in this case the notion of "five paragraphs" as a driving concept for the task. Throughout the task Jin attends only to the goal of producing those five paragraphs rather than some more rhetorically complex notion. This is particularly noteworthy considering that the instructions explicitly direct her to consider rhetorical aspects of the task, e.g. the audience ("*Imagine the reader*"), and even provides some prompting information for imagining the reader ("*an American person you know.*")

Jin also behaves as a novice writer in that she does almost no revision. The revision she does concerns minor changes in wording with no hint of reconsideration of her task or plan. Together, the lack of rhetorically based revision and the more general disregard for considerations of audience characterize Jin, unquestionably, as a novice writer.

Jin as a bilingual writer: Jin exhibits three primary characteristics that capture bilingual aspects of her writing behavior: first, she readily switches between languages; second, she usually does that switching when she is involved in the process of planning and generating the content of the essay;

third, she usually begins her content planning episodes with a self-interrogation.

As discussed earlier, Jin began the protocol by representing the writing task to herself and making the outline plans for the essay. During these first six episode sequences, she spoke only in English. She did not begin switching into Fujianhua until she had selected the main topic and written enough to instantiate the topic for herself (e.g., Georgia's Diner).

After she had selected her topic, Jin began to plan the content of her essay. With but one exception during the remainder of the protocol, Jin switched into Fujianhua only when she was planning the content of the essay, that is looking for subtopics and other details related to Georgia's Diner about which to write. The exception is when she speaks in Fujianhua while looking for a way to express an idea in her language to express an idea ("xiaoqi") that a moment before (PC7) she could articulate only in English. Note that there are no pauses in this sequence of episodes.

PC7	
...When my friends and I go out, I like to order more expensive things than they do. I don't want to look like I'm cheap..."	...Wo he wo pengyou chuqu, wo dou ai jiao gui de dongxi kanqilai bu hui nemma cheap..."
r) Hamburgers are what I usually order when I go to dinner with my friends I like to...	
[immediately followed by writing- W10]	
W10	
w) <u>order something expensive so I don't</u>	
look....so that so I don't look stingy	Na yang wo bijiao bu hui kanqilai xiaoqi
r) I like to order something expensive so I don't	
w) <u>seem so cheap</u>	
so cheap, seem so cheap	

Example 2. Only example of Fujianhua outside of content planning episodes

This could be interpreted to be an example of Jin's need to instantiate ideas for herself in her initial language before she could feel settled on a form of it in English. In addition to the fact that Jin automatically turned to her first language when searching for content for her text, it is also interesting to note that as in most of the content planning episodes, Jin began with a self-interrogation:

PC1	
What should I think about?	Wo yao xiang shemma?
I don't know what to write about.	Wo bu zhidao yao xie shemma.
It's probably OK to say that I eat with friends.	Keneng keyi shuo he pengyou chi.
What do I want to write, I don't know...	Wo yao xie shemma, wo bu zhidao...
I could talk about the inside of a restaurant....eating.... decoration or.....ummmm	shuo nei ge canguan de litou....chi.....
It's OK to say I go with my friend	Keyi shuo he wo de pengyou qu
no, I don't need to say that	bu yong shuo
r) Georgia's Diner is in Queens New York....It's a very good restaurant, it's a very, very good restaurant.	

Example 3. The first Plan Content episode, which begins with self-interrogation in Fujianhua.

As in most of her content planning, Jin's initial interrogation leads quickly to potential subtopics: eating with friends, details inside of a restaurant, eating, and decoration. In a retrospective comment, Jin said "decoration" in English because she didn't know any Fujianhua or Putonghua that meant decoration in the same sense as "decoration in a restaurant" in English. Note also the novice writer behavior in these episodes, as Jin does almost no evaluation of the relative merit of ideas before going on to select one and form it into text.

The twelve episodes of planning contain a total of twenty interrogations, sixteen of which are spoken in Fujianhua. Of the twelve content planning episodes, nine begin with interrogations. In three of these Jin begins questioning herself in English, but immediately switches into Fujianhua:

PC2

OK, what should I talk about. I don't know-- ummm

4 sec pause

What should I think about?

I don't know, don't know what to say.

Probably I want... probably I should write about the food I have eaten.

Talk about the inside of the restaurant, how's that?

Probably I should write it like this...

Wo yao xiang shemma?

Wo bu zhi dao, bu zhidao yao jiang shemma.

Keneng wo yao...keneng wo yao xie chi shemma dongxi

Shuo nei ge canguan litou, hao bu hao?

Keneng yao xie zhei yangzi....

[Followed directly by writing episode]

PC5

mm, what should I write?

don't know what to write,

probably want to say --Agh!

bu zhidao yao xie shemma

keneng yao shuo --ya!

[Followed directly by writing episode]

PC11

What color is the rug...carpet? Is there a carpet?

I can't remember. I think there is. Uh, I don't remember, ummm

I can't remember

What color is the carpet inside?

Let's see, probably, probably it's OK to

write about the booth seating

No, maybe

I'll write, I'll write, I'll write about the color of the walls

Wo bu jide

litou you shemma yansi carpet

Ni kan, keneng, keneng wo keyi xie nei ge

zhuozi zhang

Wo xie, wo xie, wo yao xie qiangbi di yansi

[Followed directly by writing episode]

Example 4. Examples of Plan Content Episodes that begin with self-interrogation in English and switch to Fujianhua.

These examples indicate that Jin was only able to retrieve the information she needed in order to begin generating text in her initial language, that is, in Fujianhua. As soon as she finds the information she needs, she immediately returns to the language of the text, that is English. It seems reasonable to propose here that Jin began her search for information in English, could not access information in English, and so switched into Fujianhua.

In four of the remaining six episodes of content planning, Jin begins directly with self-interrogations in Fujianhua. During these episodes, she again quickly finds her way to enough information to resume writing. For example:

PC6

Ok, I've got that down, but what am I going to say next?

What's been good when I've gone there?

Probably it'd be better if I write about hamburgers--

OK, I'll write that down

ummm, what should I write

r) The food there is very good no matter what you order.

r) I have eaten fish, chicken, steak, and pasta several times before.

4 second pause

the, the, hamburgers?

Hao. Wo yao xie chulai, danshi wo yao shuo shemma?

Nei tian shemma bijiao hao?

Keneng wo xie hambao bijiao hao--

Hao, wo xie chulai

ummm, yao xie shemma

PC8

What should I write? I don't know

I'm thinking I want to write about food and write about that waitress

Wo yao xie shemma. Wo bu zhidao

Kan xiangyao xie chi wo xie nei ge

xiaojie nali

Example 5. Plan Content episodes that begin with self-interrogation in Fujianhua.

The remaining two of twelve planning episodes both contain but do not begin interrogations spoken in Fujianhua. However, these probes are like the other content planning episodes in that they are asked in the midst of formulating ideas.

PC4

7 second pause

Say, say I've eaten hamburgers many times,

No, don't need to say that.

What should I write, I don't know what to write, don't know...

Shuo, shuo chi hambao hen duo ci, bu yong jiang.

Yao xie shemma, bu zhidao yao xie shemma, bu zhidao...

PC10

Umm.

the smoking section

is bigger than

is bigger than the non-smoking section so

What should I write?

the smoking section is bigger than, the smoking

section is bigger than the non-smoking section....

bijiao

Wo yao xie shemma?

Example 6. Plan Content Episodes that contain, but do not begin with, self-interrogation in Fujianhua.

Again, one might suppose that Jin needed small bits of information that she could only access through initial language in order to formulate the ideas in English. The midstream insertion of Fujianhua, then, might be viewed as an indication of her probe into memory.

CONCLUSION

A detailed inspection of the protocol coding reveals that, for the most part, Jin turns to her initial language when she is trying to find and retrieve content (i.e., specific semantic information) from memory. The following diagram, displaying Jin's writing process, is based on the coded protocols and previous analysis of Jin's talk-aloud protocols.

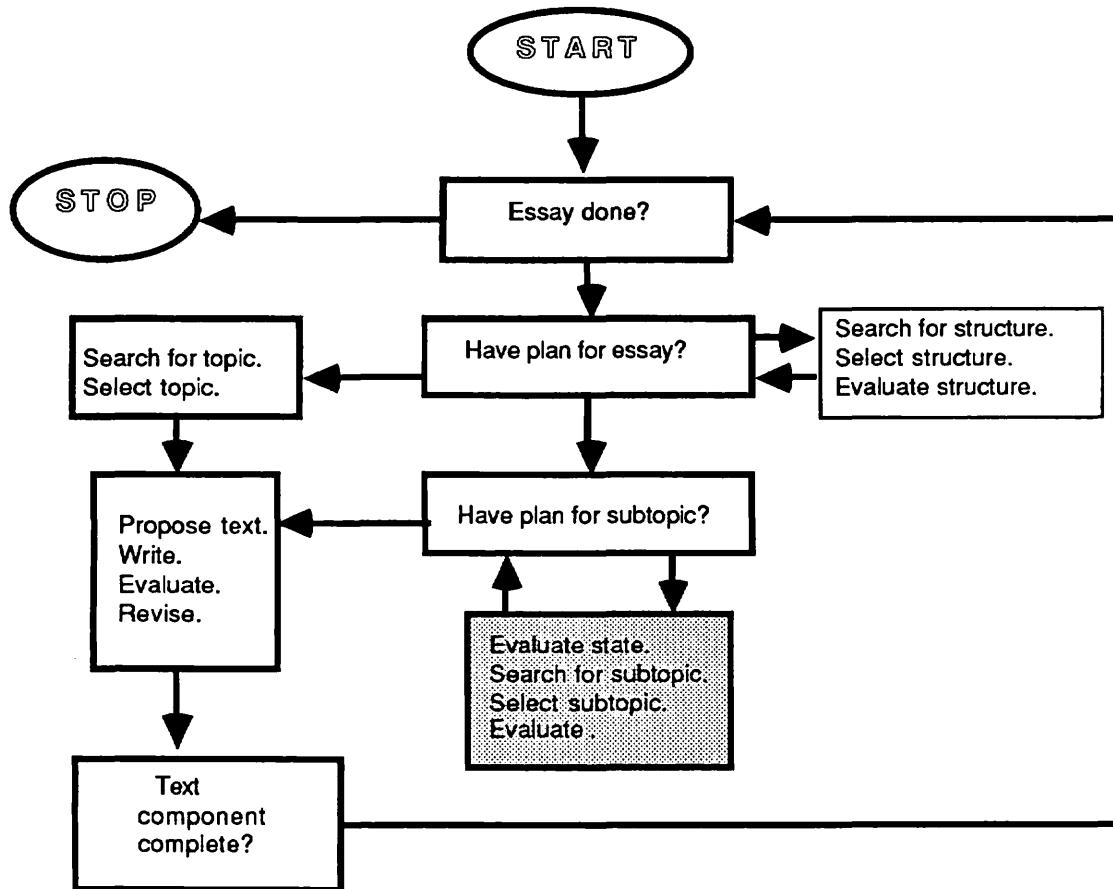


Figure 1: The Composing Process of a Bilingual Novice Writer. The shaded box indicates subprocesses where language switching takes place.

The basic flow of this chart is modeled after a schematic representation of the process of composing written sentences proposed by Kaufer, Hayes, and Flower (1986). In building their model, Kaufer, Hayes, and Flower note that they

...observed that prior knowledge of meaning and prior knowledge of syntax appear to operate independently in facilitating sentence construction. Therefore, we propose that there are two distinguishable processes involved in proposing sentence parts: selecting a meaning to be expressed and selecting a surface form in which to express the meaning. We have assumed that the interrogations we have observed during sentence composition are associated with selecting meaning....

The shaded area of Figure 1 can be seen, then, as representing the part of the process in which writers probe memory for specific content matter, that is, when they engage in the process of selecting meaning that they will, in turn, convert to text. When Jin's composing process is laid over this suggested model, we find that she switches into her initial native language when she engages in this process of finding and making meaning. In other words, the shaded area then also represents where the subject of this study, a bilingual novice writer, engages in language switching in the midst of the process of creating written discourse.

My slicing into Jin's behavior seems strongly to suggest that when writing in English, Jin tends to use her initial language to retrieve specific semantic information while writing. In other words, Jin does much of her finding and making of meaning in the most deeply embedded and automated parcel of her language abilities, that of conceptualizing in and with her initial native language.

I present these findings with no firm conclusions, per se. Clearly the data hold potential implications for psycholinguistic studies that are concerned with, for example, the structure of language memory or with the prompts and processes involved in language switching by bilinguals and perhaps by other second language learners. My primary purpose here, however, is to point out that the study suggests that protocol analysis of bilinguals while they perform language-based, problem-solving tasks (particularly writing tasks) can capture insightful information about dual-language behavior. In turn, data from such studies might afford researchers with a productive route to investigate how different languages are stored and activated.

REFERENCES

- Bernhardt, E. (1986). *Cognitive processing in L2*. Unpublished manuscript, Ohio State University.
- DeFrancis, J. (1984). *The Chinese language: Fact and Fantasy*. Honolulu: University of Hawaii Press.
- Emig, J. (1971). *The composing processes of twelfth graders*. Research report number 13, NCTE Committee on research. Urbana, Ill: National Council of Teachers of English.
- Ericsson, K., & Simon, H.A. (1980). Verbal reports as data. *Psychological Review*, 87, 215-251.
- Ericsson, K., & Simon, H.A. (1984). *Protocol analysis: Verbal reports as data*. Cambridge, MA: MIT Press.
- Flower, L. (1979). Writer-based prose: A cognitive basis for problems in writing. *College English*, 41, 19-37.
- Hardyck, C., Tzeng, O., & Wang, W. (1978). Cerebral lateralization of function and bilingual decision processes: Is thinking lateralized? *Brain and Language*, 5, 156-71.
- Hayes, J.R., & Flower, L. (1980). Identifying the organization of writing processes. In L. Gregg and E.R. Steinberg (Eds.), *Cognitive processes in writing* (pp. 3-30). Hillsdale, NJ: Erlbaum.
- Hayes, J.R., Flower, L., Schriver, K., Stratman, J., & Carey, L. (1987). Cognitive processes in revision. In S. Rosenberg (Ed.), *Advances in applied psycholinguistics, Vol.2, Reading, writing, and language learning* (pp. 176-240). NY: Cambridge UP.
- Hung, D., & Tzeng, O. (1981). Orthographic Variations and Visual Information Processing. *Psychological Bulletin*, 90, 377-414.
- Hoosain, R. (1984). Lateralization of bilingual digit span functions. *Perceptual and Motor Skills*, 58, 21-22.
- Just, M.A., & Carpenter, P.A. (1987). Cross-linguistic comparisons: reading in Chinese and English. In M.A. Just and P.A. Carpenter (Eds.), *The psychology of reading and language comprehension* (pp. 305-314). Boston: Allyn and Bacon.
- Kaufer, D., Hayes, J.R., & Flower, L. (1986). Composing written sentences. *Research in the Teaching of English*, 20, 121-141.
- Muter, P., & Johns, E. (1985). Learning logographs and alphabetic codes. *Human Learning: Journal of Practical Research and Applications*, 4, 105-125.
- Newell, A., & Simon, H.A. (1972). *Human problem solving*. Englewood Cliffs, NJ: Prentice.
- Park, S., & Arbuckle, T. (1977). Ideograms versus alphabets: Effects of script on memory in "biscriptual" Korean subjects, *Journal of Experimental Psychology: Human Learning and Memory*, 3, 631-642.
- Swartz, H., Flower, L., & Hayes, J.R. (1984). Designing protocol studies of the writing process: An introduction. In R. Beach & L. Bridwell (Eds.), *New directions in composition research* (pp. 53-71). NY: Guilford.
- Tzeng, O., & Hung, D. (1981). Linguistic determinism: A written language perspective. In O. Tzeng & H. Singer (Eds.), *Perception of print: Reading research in experimental psychology* (pp. 237-251). Hillsdale, NJ: Erlbaum.
- Zhang, G., & Simon, H. A. (1985). STM capacity for Chinese words and idioms: chunking and acoustical loop hypotheses, *Memory and Cognition*, 13, 193-201.

Since June 2006, all new issues of *Sino-Platonic Papers* have been published electronically on the Web and are accessible to readers at no charge. Back issues are also being released periodically in e-editions, also free. For a complete catalog of *Sino-Platonic Papers*, with links to free issues, visit the *SPP* Web site.

www.sino-platonic.org