EFFECTS OF CHINESE CHARACTER COMPLEXITY ON SHORT-TERM

CHARACTER RETENTION RATE

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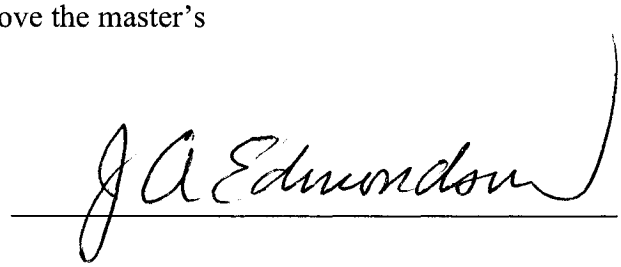

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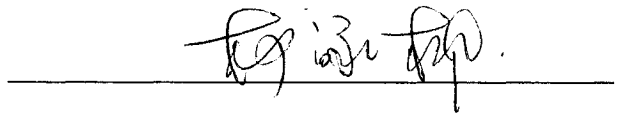

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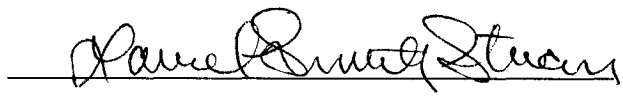

EFFECTS OF CHINESE CHARACTER COMPLEXITY ON SHORT-TERM CHARACTER RETENTION RATE

by

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Presented to the Faculty of the Graduate School of

The University of Texas at Arlington in Partial Fulfillment

of the Requirements

for the Degree of

MASTER OF ARTS IN LINGUISTICS

THE UNIVERSITY OF TEXAS AT ARLINGTON

August 2005

ACKNOWLEDGEMENTS

This paper, perhaps more than the average thesis, was written in isolated parts and "stitched" together, somewhat like Frankenstein's monster. That it did not similarly burst free of its restraints and wreak uncontrolled havoc is due to the generous assistance I received from many people at all stages of its assembly.

Foremost acknowledgement must certainly go to Courtney Gillett, who volunteered to write the software programs necessary for the experiment and data analysis after hearing of my research ideas during a Lingua Student Forum (Macaraeg 2003) – and then actually doing it. The attentive reader will immediately recognize the importance of her contribution. I have had the benefit of interacting with a talented and insightful group of linguists as both colleagues and friends, including Ziwo Lama, Wenhua Jin, and Ian Connally at UTA; Ric Powell, Tokyo; Antoine Tremblay, Canada; Tatiana Nikolaeva, Moscow; and the entire "Real World" family from Kuala Lumpur 2002. Special attention goes to Wi-vun Taiffalo Chiung and Pete Unseth who both shared their own work on scripts and script reform. I am likewise grateful to the many non-linguist friends of mine whose constant encouragement helped get me through this ordeal. Amisha Mulji and Raju Totloor need mention for fixing the bar graph in Appendix H. To all of them I offer my gratitude and hope that the final product was worthy of their input.

November 22, 2004

ABSTRACT

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Publication No. _____

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This experiment was the first attempt to quantify claims that simplified Chinese characters are acquired and retained with greater ease than their standard counterparts, on the assumption that the reduced graphical complexity of simplified characters facilitates memorization. Fifty subjects having no background in reading Chinese (a necessary prerequisite in order to avoid practice effects) were randomly assigned to simplified or traditional test conditions and given a set of 30 characters with their English glosses to memorize in a 10 minute controlled time interval. Afterward, they performed a computer-based recall test which sequentially presented 50 characters from

their respective lists and prompted them to provide the corresponding English gloss. The number of correct responses for each subject was reported as a percentage score, and the means of subjects in each test condition were averaged and compared via t-test, $p<0.05$. Implications of the results and suggested modifications for related future experiments were discussed.

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CHAPTER 1

INTRODUCTION

1.1 Toward a Quantification of Chinese Script Reform Assessment

Chinese writing has always excited the imagination of scholars because it is widely believed, even among many linguists, to provide a more direct connection between a linguistic sign and its corresponding mental representation than does phonemic writing. According to this view, the character bypasses the phonemic level of linguistic processing and connects directly to its referential concept on the strength of its iconic features. Certainly it is true that the way Chinese writing engages the linguistic faculty is different than the way phonemic writing does, but its alleged superiority is a matter of great controversy.

Whatever one's opinions are on the relative worth of written Chinese as a medium of linguistic representation, it is universally acknowledged that acquiring literacy in Chinese is substantially more difficult than doing so in languages employing phonemic writing systems. Recognition of this fact has fueled the efforts toward Chinese script reform, because mass literacy is a recognized need among modern Chinese speakers in mainland China, Taiwan, and elsewhere, a large proportion of whom struggle with even basic reading and writing tasks. Among various proposed reform measures, the institution of simplified characters in the People's Republic of China is the most significant, being the only one to have achieved official acceptance at

the national level and have effected corresponding widespread popular usage in that country's printed literature.

Has simplification produced the intended results? Do Chinese speakers learn and retain written Chinese better with simplified characters than they do with traditional characters? Again, it is a matter of controversy, and the linguistic debate is complicated (some might say contaminated) by the addition of political, aesthetic, and other considerations. While nearly every theoretical linguistic argument has been adduced to support one position or another, little has been done in the way of controlled quantitative study. Clearly, more methodical consideration than that which has previously been given is required.

The need for quantification in the assessment of Chinese script reform is obviated by even the most cursory review of the primary literature. Beginning with the earliest calls for language reform during the twilight years of the Qing Dynasty (late 19^{th}-early 20^{th}c.), the initiative to modify Chinese writing to suit the needs of mass literacy had been provided by political activists. While they recognized the insufficiency of existing literacy models and the pedagogical institution that supported it (i.e. the Confucian system of education based on texts in Classical Chinese), they did not have an awareness of linguistic issues which could profitably inform any decision about script reform. It should be borne in mind also that modern linguistics itself was in its formative stage during this period; Ferdinand de Saussure, whose work was instrumental in establishing the basic concepts of present linguistic science, was delivering the lectures which were to become his seminal *Cours de Linguistique*

Générale at the same time progressive scholars in the new Republican government in China were agitating for writing reform. Indeed, the 白话 *Báihuà* or "Plain Language" movement in writing became a national force in 1917 (DeFrancis 1984:243), only a year after Saussure's *Cours* was published. So being the case, it would have been impossible anyway for these early reformers to avail themselves of linguistic research (as we know it) to guide their efforts.

This pattern of political discourse directing language policy has been the defining characteristic of Chinese language reform ever since. Of course, this is probably true of all language reform programs pursued by government agencies – programs are developed in response to the perceived needs of a government's constituents. However, as with so many other things, the situation in China is unique because the nature of the writing system itself and its sociolinguistic relation to its community of users present difficulties unlike those faced by any language planning scenario anywhere else in the world. This uniqueness also encompasses the way in which the success of reform measures is accounted.

Historically, Chinese writing has been regarded as an aesthetic expression with virtues beyond the mere conveyance of semantic information. Thus, attempts to reform the script have been met with demands to preserve this aesthetic standard; such conservatism, being based on strong cultural identity dynamics, presents a significant non-linguistic obstacle to more radical reform proposals (specifically, Latinization). Separating these non-linguistic factors from the purely linguistic matter of script

efficiency in and of itself is one of the major challenges the present study hopes to address.

In order to determine the effects of any particular reform measure after implementation, an experimental model must be developed which demonstrates a causal relationship between the reform measure as the independent variable and the intended result as the dependent variable. In this case, the reform measure is the simplification of Chinese characters (vis-à-vis standard characters) and the intended result is improved acquisition and retention rate in the learning of Chinese characters. Because this dependent variable can be operationalized in quantifiable terms through systematic tests, it is theoretically possible to quantify the feasibility of character simplification itself as an effective method of script reform. This straightforward conceptualization of the Chinese script reform debate in experimental terms invites researchers to pursue the quantified comparison of simplified versus traditional characters in order to arrive at a meaningful appraisal of the simplification program as the optimal course toward mass literacy in China, as the Chinese government believes.

That no such experimental studies have been done is somewhat surprising given both the determination with which the simplification program has been carried out as well as the existence of other experimental work done on the perceptual and cognitive processing of reading in general and Chinese reading in particular. This lack of attempted experimental verification of the success of the simplification program suggests a number of possibilities, the most important of which we will list here:

1. The rate of social and economic progress in China (the ultimate goal of mass literacy) has been sufficiently great to preclude any second-guessing of the current language policy, which is credited with that very progress.
2. Language planners in China are unaware of relevant studies employing experimental methods, or, if they are aware, they do not know how to apply them to the assessment of the assumptions underlying the character simplification program.
3. The existence of correlational information in support of current literacy achievements is misunderstood to be experimental in nature because of its use of statistics and other numerical data.
4. Language planners concede that non-linguistic considerations must be given greater priority over purely linguistic efficiency. This includes the aesthetics mentioned above, as well as the unity Chinese script is believed to afford in encompassing all of the spoken Chinese dialects, which serves an irredentist function by bringing otherwise disconnected speech communities under a single linguistic umbrella.

Mostly likely all of these factors are at work to some degree. Recognizing this, linguists addressing the problem of script reform quantification must be clear in emphasizing the empirical motivation behind subjecting the simplification program to scrutiny. It is hoped that the benefits of such quantitative studies can be appreciated for

what they offer: An objective, measurable assessment of the simplification program in terms of its own stated goal of improving literacy acquisition and retention.

1.2 Remarks on Terminology

Before proceeding to the body of this paper, it will be of benefit to clarify the major terms and concepts as they will be used herein.

1.2.1. Chinese Characters

Because Chinese characters are the objects of study in this paper, it is first necessary to discuss their relevant features. Characters (Modern Standard Chinese: 字 *zì*) represent morphemes, the basic unit of graphic representation in written Chinese. Contrary to popular belief among non-Chinese readers, they are not on the whole pictures or symbols for words; the vast majority are constituted of *phonetic* and *semantic* elements (the latter usually labeled the "radical") which together indicate the sound and meaning of a given character and make comprehension possible. Both phonetics and radicals have been largely established by convention rather than by clear, consistent principles of isomorphic correspondence to their target sounds and meanings, so a considerable degree of uncertainty in interpretation is present when facing unfamiliar characters.

For this reason, characters – unlike words represented in phonemic writing systems – can neither be phonologically nor semantically decoded uniquely with confidence from an analysis of their constituents and thus must be inferred from the suggestive parts and from information learned in formal schooling. This remains true even if one

memorizes hundreds of phonetics and radicals: Knowledge of these component parts does not ensure correct identification of the characters in which they occur, since these components are neither completely consistent nor additive. Though over time the process of memorizing characters does get easier because phonetic and radical constituents are re-used, the system as a whole never approaches the level of a fully abstracted phonological system where constituents can be analyzed and retrieved with absolute certainty..

Rather than learning a limited set of abstract symbols, then (as is the case with alphabetic and syllabic writing systems), a reader of Chinese must learn an entire lexicon of characters – tens of thousands of graphs – in order to approach a text with anything resembling functional literacy. This vast difference in minimal memory requirements can never be equalized, because a language will always have more morphemes than either phonemes or syllables. The truth of this is beyond dispute, and is accepted by even the staunchest defenders of character writing. The number of possible phones available to any language is a closed set limited by the range of articulations of the human vocal tract, while the number of possible lexical referents representable by morphemes or words is open and infinite. Even given the numerous and often unclear or inconsistent rules for letter combination in many alphabetic languages, the range of possibilities is still constrained and thus categorically smaller than the unconstrained range of possibilities for characters. Moreover, while users of alphabetic scripts do not add new letters to their inventories, Chinese users historically have added new characters; thus the already large and open-ended character set

continually grows. Yet if the imbalance in minimal graphic units necessary for literacy in Chinese cannot be overcome, it has been argued that the burden on memory can be reduced by reducing the graphic complexity of individual characters; this is the rationale behind simplified characters. The term "traditional characters" (*fantǐzì*) will be used to refer to characters in their unsimplified form, the form in which they are still used in Taiwan and other overseas Chinese communities.[1]

1.2.2 Character Simplification

The term *simplified characters* (Modern Standard Chinese: 简体字 *jiǎntǐzì*) denotes an official set of 2,238 Chinese characters adopted by the government of the People's Republic of China in 1958 for use in its published literature (Taylor and Taylor 1995). These simplifications are used to substitute for corresponding traditional characters under the assumption that they facilitate the acquisition, retention, and use of Chinese character writing as a whole because they, in one way or another, are "simpler" – a concept that is imprecise but which usually means that the simplification is composed of fewer constituent strokes.

Just as traditional characters do not follow exact rules regarding their composition and interpretation, simplification has not occurred with complete systematic regularity. However, certain general principles have been followed which form the basis for ongoing simplifications. The most productive of these are:

[1] Elsewhere they are referred to by such terms as "regular," "standard," or "complex."

1. Reducing the number of brush strokes of a character by either logical revision or the importing of ancient variant or obscure forms. (e.g. 葉 maps to 叶; 萬 maps to 万).[2]

2. Combining some complicated characters into one simpler character (known in technical terms as "Character Conflation"). e.g. 隻 (a measure word for animals) and 衹 (variant form of "only") conflate to 只. Note that the Traditional character 只 merely replaces two lesser used characters in Simplified.

3. Giving a new meaning to a traditional character with a small number of strokes. (e.g 丰(beauty) becomes used as 豐(richly) and 余(I) becomes used as 餘(remain)). This is especially common when the character with fewer strokes is very rare or is no longer used.

   (from http://en.wikipedia.org/wiki/Simplified_Chinese_character, visited 23 November 2003).

A fourth and very important way of simplifying is to introduce a phonetic element into a character, replacing one or more of the semantic constituents. More examples of simplifications and their corresponding traditional forms may be seen in Appendix B.

Most simplified characters have their origin in the shorthand used for complicated or frequent characters in handwritten personal manuscripts, which became conventionalized through repetition rather than any official policy promoted by pre-modern governments in China. Though the use of simplified characters in handwriting occurs to some extent in all Chinese-writing communities, simplification as the norm in print occurs only in mainland China.

A concise summary of the popular rationale for simplification is provided in Peng (1986):

[2] The following important qualifier is added in the text: "In rare instances, simplified characters actually became one or two strokes more complex than their traditional counterparts due to logical revision. An example of this is 搾 mapping to the previously existing variant form 榨. Note that the "hand" radical on

- To Make Writing Simpler and Faster: Most existing Chinese characters look "architecturally" cumbersome, and are made up of a number of components; from these many can be isolated as characters in their own right. Simplification would mean reducing the number of strokes by half or one-third in some instances. [...]
- To Aid Learning Efficiency: Chinese is a script that relies on memory – the more complicated the strokes the more difficult it is to remember, and efforts at learning can be greatly hindered. With simplification this no longer proves a handicap, and as a result more and more people can benefit from written Chinese.
- To Make Knowledge Accessible: Simplification of characters is a welcome development in the light of today's high-technology era and expanding frontiers of knowledge, where rapid retrieval and dissemination of information has become vital. The saving on time and energy is certainly significant (pp. 11-13).

1.2.3 Script Reform

By "script reform" we refer to measures undertaken by a political body to change the nature of written language within the population under its administration. This is rarely done of its own accord, but rather treated as a means to a sociopolitical end; so it is in China. Both the currently implemented script reform program, character simplification, and alternate proposals such as Latinization through *Hànyǔ Pīnyīn* are intended to promote mass literacy, the cornerstone of a social transformation which will enable China to meet present and future developmental challenges.

It is important to distinguish script reform from natural processes of script change. Scripts, like spoken languages, are diachronic entities which evolve over time, losing certain features and gaining new ones through attrition, contact with other scripts, and "mutations" (to make a biological analogy). Reform measures seek to disrupt the inertia of natural language change, accelerating it, reversing it, or – as with both

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the left (扌), with three strokes, is replaced with the "tree" radical (木), with four strokes. However, one

simplification and Latinization – altering it in a way that would not have been possible along a natural evolutionary trajectory, by imposing arbitrarily and artificially constructed features on it.

1.2.4 Literacy, Acquisition, and Retention

"A literate person is one who is able to read and write so as to function adequately in society" (Taylor and Olson 1995:vii). Literacy is not so much a single skill as a set of interrelated perceptual and cognitive skills (e.g. memory, recognition, decoding) supplemented by pragmatic cultural and contextual knowledge. The multifaceted nature of literacy has led to opposing cognitive models, treating it as either localized to a particular brain area or distributed across various regions according to specific processes.

However much or little a unitary function within the brain literacy is, its acquisition has traditionally been studied by isolating progress in its constituent skills. Acquisition of literacy refers to the mastery of the components of reading and writing to a degree whereby their correlated use allows a reader to process and generate written material on a consistent basis. As we saw above in Appendix A, those components can be enumerated with considerable intricacy.

Finally, retention is the preservation of both the content and processes of literacy for application in reading and writing tasks. Ideally retention is long-term and permanent, allowing for lexical items to be accessed through script without the need for excessively frequent exposure. Phonemic and syllabic scripts have a definite advantage

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of the primary goals of the character simplification is to reduce the number of strokes if possible."

here, in that once a limited set of graphemes and their combinations are learned they can be used to access an unlimited number of words through their phonological representations. Learning these sound-symbol rules, though, may initially be more difficult than learning a small set of character morphemes, and this topic has generated a number of relevant studies which will be reviewed in Section 2.4 below.

1.3 Chinese Literacy, Simplification, and the Visual Processing of Print

As even a cursory review of terminology demonstrates, literacy in Chinese is a complex issue with many areas unexplored in formal research. In the area of quantifying relative performance in learning traditional and simplified characters, the role of visual processing is particularly inviting for several reasons. As will be discussed later, most models of reading posit visual and phonological routes or modules by which print information is accessed by the brain. While there are certainly phonological aspects to Chinese characters, the difference between traditional and simplified forms is visual – they differ in graphic shape, not in aural or articulatory features.

Of special interest is the notion of simplicity itself as it is conceived in the process of character simplification. It is not simply a matter of reduced graphic complexity, since the reduction in constituent strokes for any given character can vary widely (one, several, or – as noted above – an actual increase in strokes for some). Most simplified characters are still graphically more complex than many common unsimplified (traditional) characters, meaning that even if the number of reductions in

strokes for simplifications were consistent the idea of a simplified character would still be relative.

There is no absolute measure for an optimal number of strokes – that is, an upper limit of graphic complexity. The primary argument for simplification has been that the excessive graphic complexity of many frequent characters hinders memorization and hence retention, but a counter-argument by traditionalists would seem to have equal weight: Complexity creates distinctiveness, which in turn promotes greater visual and lexical precision. They argue further that reducing graphic complexity runs the risk of confusion among similar characters without enough distinctive visual features to make their differences immediately apparent to the reader; fluent reading, then, is actually obstructed by simplification. Determining the point of diminishing returns after which graphic complexity becomes an impediment to character memorization is quite likely to be experimentally impossible, so again a systematic way to account for the absolute effects of stroke reduction is not available. (Even if determining this point were possible it would be functionally meaningless because, with only twelve constituent strokes, there could only be a small number of available configurations at that point, a number in no way equaling the number needed to represent enough morphemes for a fully functional language. Many more characters would have to have either a greater or smaller number of strokes than an "ideal" character would.)

Recall also that even though the net effect of nearly all simplifications is reduced graphic complexity, direct stroke reduction is only one principle by which

simplification is accomplished. In other cases – i.e. character conflation and substitution – it is not altogether clear what is responsible for the simplified characters' presumed simplicity. The implication, though, is that the greater familiarity of the conflated or substituted forms accounts for that simplicity, rather than their reduced graphic structure.

The matter is even more complicated with phonetic substitutions. Studies claiming higher retrieval rates for certain types of characters (to be reviewed in Chapter 2) credit either phonological cues or reduced graphic complexity, but in fact these two are difficult to separate in practice. Most often in simplification the substitution of a phonetic for a more complex graphic constituent in a character amounts to a net reduction of total strokes, so one is hard pressed to say if any resulting facilitation of recall is due to the higher prominence of the phonetic element or the overall reduced graphic complexity.

It must also be kept in mind that neither process – phonetic substitution nor stroke reduction – is an exact method in formal character simplification. Phonetic substitutions are usually partial (approximating the rime of the syllable) and rarely give indications to the proper tone. There is no systematic way to measure the accuracy with which phonetic components approximate the pronunciation of whole characters because there is no consistency in the use of phonetic components themselves for this purpose. (Indeed, if they were consistent, the character system would be a syllabary; semantic radicals would not be necessary because all the requisite phonological information would already be present.)

Underlying all these beliefs about the nature and effectiveness of simplification is the assumption that simplification – however it is defined – contributes to literacy by facilitating acquisition and retention of characters, and that this facility registers first and foremost in the visual-graphic mode. The experiment proposed by the present study, then, wishes to test this assumption quantitatively, by designing a controlled experiment in which the effects of character complexity are measured in terms of their influence on character retention rate.

1.4 Paradigms of Script Reform Quantification

Having expressed the need for quantification in the assessment of Chinese script reform, there yet remains the matter of determining what kind of quantification is most appropriate to the task. Observations on the nature of reading efficiency discussed in Macaraeg (2002a) and (2002b) bring three categories of experimentation to mind, each dealing with a different level of analysis in the reading process. These are:

1. Psychometrics - the correspondence of body-movement measurements to psychological processes;
2. Cognitive processing - the efficiency of processing information for recall and application; and
3. Longitudinal tracking - the measurement of effects over protracted lengths of time, with observations at regular intervals.

All three paradigms have their basis in experimental psychology, a field with an abundant research literature from which to derive models for a comparative study of the

relative efficiencies of different Chinese character scripts. We will briefly consider the advantages and disadvantages of each in order to prepare a conceptual framework for the present study.

1.4.1 Psychometrics

The first and most basic aspect of reading concerns those physical correlates directly involved in processing visual text. At its most concrete level, the act of reading involves movements both of the eyes and head for tracking across textual space and the vocal tract to articulate speech. Techniques for measuring these movements have been developed and used widely in experimental psychology, and their potential applications to the present line or research will be elaborated upon the literature review (Chapter 2).

A second category of psychometric experiments involve measuring response times to sensory stimuli. In relation to the comparison of alternate Chinese scripts, this would involve the speed at which prompts presented in one of the script styles are answered, and the proportion of which of those answers are correct. This particular research design is economical in defining the conditions of the independent and dependent variables as well as relatively uncomplicated to measure (by relying on computer software technology). Because the goal of the present work is merely to introduce the quantified experimental method into the script reform debate, rather than settle the debate itself, it is best to be simple and clear in setting operational precedents. The range of elaborations that can be derived from psychometrics will be discussed in later sections.

1.4.2 Cognitive Processing

Cognitive processing encompasses a variety of psychological tests involving the intake of sensory information and applying it to tasks such as recognition, recall, visual and verbal analogies, and comprehension. This format, in the form of standardized tests using selected-response (multiple-choice, matching, and/or true-or-false) questions, is widely used for the assessment of general reading ability in grade schools and universities, so relevant cognitive processing methodology is, *mutatis mutandis*, available to the researcher interested in quantified script assessment. A list of representative cognitive processing literacy tests and their corresponding targets is given in Appendix A.

Standardized tests are also used to diagnose reading disabilities, and typically consist of batteries of questions targeting individual cognitive skills contributing to emergent literacy. The Woodcock-Johnson Psychol-Educational Battery – Revised Tests Cognitive Battery (WJ-R Cognitive Battery), a popular test for dyslexia in children, consists of 21 different subtests and measures seven broad intellectual abilities (visual process, processing speed, long-term retrieval, short-term memory, auditory processing, comprehension knowledge, and fluid reasoning). Though defined somewhat differently, these are also recognized component skills of reading. As they apply to the performance of acquiring and retaining characters, diagnostics are particularly helpful in that they are correlated to isolated components of reading; should differences between traditional and simplified character performance be borne out in

such tests, they would help to quantify the strengths and weaknesses of character writing in general.

Appendix A lists reading-related cognitive processes and some characteristic tests performed to evaluate them from a popular model of reading acquisition.

1.4.3 Longitudinal Studies

Longitudinal experiments are comparatively rare in the research literature; aside from the slow rate of return of data, they incur greater expense and are subject to confounding variables that risk jeopardizing their research hypotheses. Still, because literacy itself is a longitudinal skill, longitudinal studies are an indispensable part of any thorough evaluation of reading acquisition and retention.

Such studies need not employ a qualitatively different format; a psychometric or cognitive processing test can be repeatedly administered at successive intervals. Hypotheses offered in a longitudinal design, however, must reflect the diachronic nature of the presumed effects – i.e. that a particular variable will demonstrate an increasingly visible effect on the acquisition and retention of literacy over time.

It is worth emphasizing that these three experimental formats are not necessarily mutually exclusive, and can become complementary with thoughtful design. Indeed, it is preferable that they be so, since literacy itself is a multivariate skill encompassing all three of these target areas. The present experiment represents a combination of psychometric and cognitive processing formats; potential longitudinal applications will be discussed in Chapter 4.

1.5 Motivation for the Present Study

1.5.1 Linguistic Motivation

Quantified assessment of any reformed Chinese script has yet to be done in linguistics, so this study will be the first to develop both the conceptual framework and the methodology to undertake such research. It is hoped that the work presented here will stimulate further refinement of concepts and techniques for quantified assessment of scripts in a variety of languages over which script choice debates currently rage.

At the same time, a precedent will hopefully be set whereby script performance issues can, as much as is possible, be separated from non-linguistic and sociolinguistic contextual factors. The author will be the first to admit that complete context independence is impossible, but the closer it can be approximated, the more validity any causal relationships demonstrated experimentally will have. If the present study helps to turn the Chinese script reform debate into a more properly linguistic one – that is, one framed within linguistics with points of contention decided by linguistic evidence – then it will have fulfilled its author's primary objective.

1.5.2 Social Implications of Script Reform Assessment

The importance of considering alternative script policies has become increasingly apparent in recent years because the Internet and other information resources are becoming accessible to China at an accelerating pace, and a socioeconomic gap is developing between those who (through functional literacy) can and cannot benefit from this information. It is already evident in the geographical split between the industrialized, urban eastern seaboard and the rural, agrarian hinterland.

Ironically, the very class division that China's socialist dialectic condemns is being reconstructed in part by a language policy designed specifically to overcome it.

It is difficult to overestimate the importance of language policy in this regard, because it is the very foundation of education and all the opportunities education provides. The very existence of a sizeable socioeconomic divide is itself a reason to pursue a more aggressive mass literacy policy than that which is currently in place. Whether the proper course for that program is continued and more comprehensive simplification of the entire Chinese character inventory or the wholesale replacement of the character writing system with a phonemic system can only be decided by quantified experimentation of the kind suggested by the present study. Either way, controlled, measurable testing of the efficiency of reading and writing ability with simplified characters is the only method by which such judgments can be made.

The outcome of any implementation based on a quantified assessment of script reform would have far-reaching effects on Chinese society. A demonstrated improvement in acquisition and retention through simplified characters would argue for a broadening and acceleration of the simplification program, with the government releasing longer lists of official simplifications with greater frequency (see Section 2.1 below). On the other hand, the lack of demonstrable advantages through simplification would support calls for more radical reform measures like Latinization. Such a change from character to phonemic script would entail a complete restructuring of the educational system. A significant proportion of educational time (both in terms of direct instruction in the classroom and out-of-class study by students) is presently

devoted to rote memorization of thousands of characters and their compounds. Were this time to become available for other subjects, it would allow the Chinese grade school curriculum to be vastly diversified. Either way, a firm decision on reading instruction would make literacy programs in general more efficient and hence more accessible to the masses.

CHAPTER 2

LITERATURE REVIEW

Many studies have been done over the past several decades in which perceptual and cognitive abilities related to literacy were tested between character (Chinese and Japanese) and phonemic (most often English) written languages. The following sections will review this body of literature to ascertain where the weight of current scholarly opinion falls regarding the relative ease of learning different script types.

As noted earlier, phonetic scripts and character scripts are so different that they cannot help but invite comparison. The major difference between the two may be described via the means by which they access their linguistic referents. Alphabetic scripts such as English and Hanyu Pinyin as well as syllabic scripts such as Japanese *Kana* and Chinese *Zhuyin Fuhao* provide cues to the sounds of linguistic referents (morphemes or words), which then allow access to the meanings of the concepts assigned to those sounds. Characters, at least in their most basic form, are understood to use some level of iconicity to refer to meanings, which are then matched to one or more corresponding sounds. While it is true that with Chinese the vast majority of characters include a phonetic component, the cues it provides are typically incomplete and do not allow precise mapping of sounds. Research shows that as learners of Chinese writing become progressively more proficient, they increasingly decode characters via access to visual and semantic features rather than through reliance on

imperfect or absent phonological information, treating characters as wholes rather than parsable units. Learners of alphabetic languages, as they become proficient readers, also increasingly perceive lexical units as wholes, progressively replacing segmental phonemic analysis with whole word recognition. But unlike learning to read Chinese characters, this is preceded by a period of internalizing grapheme-phoneme (i.e. letter-sound) correspondences (Taylor and Taylor 1995:95-96).

With these considerations in mind, this chapter will assemble and review information relevant to answering the following questions:

- Is there evidence that qualitative differences between script types affect measurable differences of performance in literacy-related skills and tasks?
- If so, can such relationships be conceptualized in terms of a visual processing model which is also applicable to the comparison between traditional and simplified characters?
- What can the more generalized visual processing of geometric shapes and other non-linguistic graphic stimuli tell us about the processing of Chinese characters? In particular, are there any indications that certain graphic features influence retention rates, and are any such features a consistent distinguishing trait between traditional and simplified characters?

2.1 Chinese Characters in Reading Disability Research

When reading disorders are investigated in alphabetic languages such as English, they often reveal a failure on the part of the learner to move from this formative stage of

segmental analysis on to more holistic perception of orthographic elements. Dyslexics, in particular, typify this deficit: Due to neurological impairments in their occipital lobes (the region of the brain responsible for receiving and interpreting visual information), they cannot process multiple visual cues and thus are unable to recognize sequences of graphemes to which they have been repeatedly exposed. Such being the case, they are forced to segmentally analyze even familiar words letter by letter, as if they were encountering them for the first time (Snowling 2000:14-28).

This definition of reading disability has led some (e.g., Makita 1968) to believe that readers of orthographies such as Chinese character writing, which presumably bypass phonological access routes, are largely immune to dyslexia and that dyslexia can be remediated through character-based pedagogy. Because dyslexia has mostly been defined as a phonological route deficiency, it should not surprise us that it is reported more frequently in scripts favoring phonemic representation. This phonological-deficit hypothesis was developed early in the research literature on dyslexia by Shankweiler and Liberman (1972) and expanded by subsequent studies until the early 1990s. Concurrent with this time interval, a number of works were published purporting to show successful intervention via characters where traditional alphabetic remediation had proven inadequate.

Rozin, Poritsky, and Sotsky (1971) conducted a much-discussed experiment in which eight second-grade children identified with "clear reading disability" were taught a set of 30 Chinese characters, which supposedly helped them to construct basic functional sentences where parallel tutoring in English had failed. While the

researchers themselves admitted several of the shortcomings in the study's design and control, they nevertheless published it with the sensational title of "American Children with Reading Problems Can Easily Learn to Read English Represented by Chinese Characters," ensuring the article's rather suspect conclusions would receive more credit than they likely deserved. Among the criticisms directed against it are that the characters chosen were all simple concrete terms, important grammatical distinctions in English were overlooked, and the character set was too small to make useful extrapolations about functional literacy (DeFrancis 1984:171-173; Hannas 1997:143-144). An even more serious critique is that the experiment was not double-blinded, risking the very real possibility that experimenter bias influenced the observed effect. Yet in spite of these concerns, it continues to be cited in support of character writing, especially in research advocating the use of Blissymbolics. As might be expected given their Chinese inspiration, the arguments in favor of Blissymbolics are generally equivalent to those employed for Chinese characters, and research on both vis-à-vis alphabets assume the same qualitative distinctions that have their ultimate basis in the orthographic determinist view discussed above.

Blissymbolics, originally known as Semantography, was the creation of Charles K. Bliss (born Karl Blitz). Though not a linguist by training, he was motivated to create his system from a belief, developed during wartime captivity in both Nazi Germany and Japanese-occupied Shanghai in World War II, that a writing system that allowed inter-language communication would help to promote world peace. As with many non-Chinese, Bliss believed that the Chinese writing to which he had been exposed could

access mental representations without utilizing sound, and resolved to create a productive set of symbols which could generate the lexical items of all languages, free of both the phonology and pragmatics constraining any specific language. After publication of an introductory work (Bliss 1965), Blissymbolics was taken up in the 1970s and 80s by a number of researchers –mostly oriented toward physically or mentally disabled children – and has been credited by them with notable successes in cultivating literacy at a rate significantly higher than through traditional alphabetic orthography.

Kates and McNaughton (1975), after three years of Blissymbolics training with non-verbal cerebral palsied children, concluded that the system provided benefits ranging from linguistic stimulation to higher scores on numerous behavioral-cognitive batteries. Harris-Vanderheiden, Brown, Reinen, MacKenzie, and Scheibel (1975) claimed an experiment on the same disabled population showed that "Blissymbols were effectively implemented as a means of respondent and limited expressive communication" (p. 36). Song (1979) reported success on the Peabody Picture Vocabulary Test by four severely mentally retarded but highly motivated adolescents using Blissymbols. House, Hanley, and Magid (1980) created 16 logographs and taught 10 illiterate mentally retarded adults to construct simple sentences from them. Testing 18 non-handicapped preschoolers aged between 4 and 6, Clark (1981) found significant differences in three logographic conditions (Blissymbols, Carrier symbols, and Rebus pictographs) versus alphabetic English in the learning of 15 new words. Muter and Johns (1985) reported "substantially and reliably better" (p.105) performance in

identification and semantic extraction through both Blissymbols and Chinese characters in comparison to English rendered in an unfamiliar alphabetic system.

Such studies, while generally consistent in the kinds of conclusions they reach (i.e. supportive of characters against alphabets), vary dramatically in the quality of their design and rigor. Accordingly, they have inspired a broad persuasiveness among literacy researchers at large. In addition, recent surveys of dyslexia across languages with differing levels of orthographic regularity have challenged the assumptions of the phonological deficit hypothesis. Aaron and Joshi (1989), summarizing research on dyslexia in countries with Latin scripts of differing grapheme-phoneme precision but reporting comparable levels of occurrence, remarked, "[E]ven though their incidence may vary, reading and spelling disabilities can be seen in all languages, regardless of the nature of their orthographies" (p. ix). This was found even in Chinese character-using populations in Taiwan and Japan, whose reported incidence of reading difficulties generally matched that in alphabetic American English (Stevenson, Stigler, Tucker and Lee 1982). These findings imply that reading disabilities are largely independent of orthographic type or a particular orthography's level of phonological regularity, and lend support to the notion that in scripts of all types, from highly precise phonemic alphabets to characters, skilled readers do much of their processing through graphic/visual channels. Such a conclusion would understandably please character advocates, who tout the virtues of a writing system such as Chinese which is significantly graphic in nature and (presumably) encourages visual acuity skills.

What might account for the relative equality of reading disability incidence if dyslexia is understood as a phonological deficit yet some scripts are less explicitly phonological than others? Castles and Coltheart (1993) label the traditional definition of dyslexia as phonological and identify a disorder of the opposite type – the impairment of lexical access with preservation of phonological ability – as surface dyslexia. This latter type, as might be expected, would be more apparent in a writing system such as Chinese with greater reliance on the lexical access route. Research from the mid 1990s has borne this out, and a number of studies revealing surface dyslexia in both Chinese and Japanese Kanji have been published, including Sakurai, Sakai, Sakuta, and Iwata (1995); Sasanuma (1995); Weekes and Chen (1999); Mochizuki and Ohtomo (2000); Sugishita, Otomo, Kabe, and Yunoki (2000); Ho and Elliot (2001); and Chen, Fu, Iversen, Smith, and Matthews (2002). The evidence on character utility for reading disorder remediation, then, is mixed, though there is some suggestion of benefit for the phonological type of dyslexia at the very earliest stages of intervention, involving small lexical inventories.

2.2 Chinese Characters in Neuroscience and Psychology

In addition to work on reading deficit, a number of studies have been done to compare character and phonemic writing among non-deficient readers. Functional Magnetic Resonance Imaging scanning of brain activity (fMRI) has been used to map correlations between neural regions and unique script types. Again, the results have been informative but not conclusive. Tan, Spinks, Gao, Liu, Perfetti, Xiong, Stofer, Pu,

Liu, and Fox (2000) reported strong left lateralization of the frontal and temporal cortices and right lateralization of visual systems, the parietal lobe, and the cerebellum in Chinese character reading. Tan, Liu, Perfetti, Spinks, Fox, and Gao (2001) compared Chinese and English semantic and homophonic decision tasks and concluded that brain systems were generally shared, though certain additional areas (Bas 47/45, 40/39, and the right visual system) were obliged to engage for character processing. Chen, Fu, Iversen, Smith, and Matthews (2002) used fMRI to contrast character and Pinyin on a word/pseudoword discrimination task and observed the activation of the same complex of systems, though different levels of activity were shown for specific regions depending on the script type (e.g., the fusiform gyrus for characters and the inferior parietal cortex for Pinyin). No hemispheric lateralization differences were found, only differences in relative regional activation within a common system. In the words of a forthcoming book, "It appears that broad networks of brain regions support various aspects of word reading, including semantics as well as phonology, and that simple function-structure mappings generally should not be expected."[3]

Chinese and English have been shown to differ in the frequency of saccadic eye movements while reading text, with Chinese requiring more saccades per line of print (Peng, Orchard, and Stern 1983). This was attributed to the graphic density of Chinese, which requires readers of that script to focus on units of orthography at a more precise level. (This is not to say that Chinese is read more slowly than alphabetic English,

[3] From "Cognitive Neuroscience Research on Reading," an extract from the in-press book Psychological Science Can Inform the Teaching of Reading by Keith Rayner, Barbara Foorman, David Pesetsky,

because graphic density is generally correlated with semantic density – more is contained in less orthographic space.) By contrast, ocular directional scanning was reported as similar between young Chinese readers with little or no alphabetic experience and older readers with formal schooling in written English; both groups showed a top-left to right-bottom scan (Chen 1981). In an experiment on visual acuity using horizontal and vertical arrays, Chinese-English bilinguals were able to spot random target letters with equal accuracy while English-only subjects had difficulty with vertical displays. The latter were able to identify target non-letters on vertical arrays with equal efficiency, though, which suggests that the perception of Chinese characters is in some ways more like geometric symbols than phonemic letters (Freeman 1980).

Biederman and Tsao (1979) found a greater Stroop interference effect (prompting for print color while the actual word printed names a different color) among Chinese subjects than English-reading ones, using their respective languages. Tzeng and Hung (1980) tested the Stroop effect on Chinese-English bilinguals, varying the stimulus and response languages, and reported interesting results. While interference was much higher in English-to-English than Chinese-to-Chinese conditions, it decreased from English-to-Chinese and increased from Chinese-to-English, respectively. The authors suggested that orthographic switching prevents the employment of the same perceptual mechanism that causes Stroop interference in single-language processing. Similar to Stroop interference, repetition blindness (the inability to detect the second occurrence of

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Charles A. Perfetti, and Mark S. Seidenberg. Available at

a visual item in rapid succession) provides insight into the mechanics of crossed systems of orthographic processing. Yeh and Li (2001) found repetition blindness effects at both the whole-character and component level, though in contrast to occurrences in English the Chinese results revealed a constraining effect attributable to graphic structure. The results support a submorphemic processing model of Chinese character recognition, and reiterate the importance of readily-identifiable constituents in fluent lexical access.

Zhang, Perfetti and Yang (1999) found that phonological interference effects were general across word frequency and independent of component phonology (i.e. at the whole word/character level) as well as among low-frequency characters requiring pronunciation judgments (the component level). They propose that phonological activation occurs at two levels of Chinese character reading, and that both semantics and phonology are automatically and autonomously engaged throughout the process. Tan and Perfetti (1999) have extended similar observations about phonological activation to supra-lexical character processing – multi-character Chinese words – using meaning-judgment and phonological consistency tasks. These results corroborate the Interactive Constituency Model developed by Tan, Perfetti, and their associates (Perfetti and Tan 1999; Tan et al. 2001; Perfetti, Liu, and Tan 2002; Perfetti, Zhang, and Berrent 2002). Applied to Chinese reading, it envisions a stimulus level fed by radicals that inputs to orthography; the orthography represents a node at which phonology is accessed dually, directly as well as through a semantic mediator. Note that, like earlier

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http://www.pitt.edu/~perfetti/Cognitive%20neuroscience.htm, visited 2 December 2003.

models of Chinese reading (e.g. Hoosain 1991), semantic activation precedes phonology, but the Interactive Constituency Model differs in making the semantic component non-obligatory for phonological activation. This view of phonology as a terminal rather than an intermediary stage of Chinese script processing is independently supported by Tzeng, Hung, and Wang (1977) and Tzeng and Hung (1980), reviewing research suggesting that phonological recoding is required in subsequent stages of reading beyond the initial decoding phase, particularly at the textual level.

We see, then, that there is a body of experimental evidence supporting the notion of quantifiable performance differences in component literacy skills when scripts of different structural type (character vs. phonemic) are compared. In order to complete our review of the research, it is also necessary to make some determinations about performance within the same structural type (traditional character vs. simplified character). Unlike the direct comparisons of alphabets against characters, much of what we glean from these latter studies must be inferential – especially with Chinese, as nothing in the way of direct quantified experimentation has been done.

Seidenberg (1985) found that Chinese readers could identify characters with phonetic components faster than those without any phonetic. Hue (1992) similarly found that the extent to which a character's phonetic component suggests its overall pronunciation increases the speed of recognition. Since, as noted in Section 1.5.1, modification of a complex character to include or emphasize a phonetic component is one of the primary methods of simplification, this is grounds for an experimental

hypothesis that simplified characters can be accessed more efficiently than traditional characters.

In addition to the influence of phonetic elements, there is also some support for facilitated recognition via reduction of graphic complexity, as found by Hoosain (1991). Studies by Flores d'Arcais (1992) and Cheng (1992) on activation of both semantic and phonetic sub-lexical components reinforce these findings. Thus, by easing the visual demands on character components, it may be possible to expedite lexical access either with or without phonological cueing. Together, this evidence constitutes grounds for an experimental hypothesis in which simplified characters can be expected to induce better retention rate than traditional characters among first-time learners.

2.3 Models of Textual Processing

While most researchers accept that there are both visual recognition and phonological rule-based routes to lexical access, there is disagreement as to how the two are related, whether they are both obligatory, and if they are language or orthography dependent. As discussed earlier in this section, most researchers comparing alphabetic and character orthographies prefer a serial interpretation of this dual-route model – alphabets use phonological coding to access the lexicon, while characters use visual recognition to select corresponding pronunciations. The opposing perspective views the routes as parallel, either complementary or independent (Seidenberg 1985: 1-4).

Some examples from both Chinese and English will help to illustrate the limitations of a serial interpretation and why – in addition to the aforementioned

problems of separating the simultaneous effects of phonology and visual recognition in simplification – a modified model would be more beneficial for conceptualizing the experiment at hand. If a serial model with primacy for phonological access were adopted, one would have difficulty explaining words whose phonetic construction matched imperfectly with their actual pronunciations: For example, applying the individual phoneme-grapheme correspondences of *Arkansas* do not yield the correct pronunciation /'arkŋsa:/. Even more troubling are homonyms such as *bow* (a weapon for shooting arrows) and *bow* (the front of a ship), which while of identical graphemic form do not yield identical pronunciations. These are of course disambiguated by skilled readers through context, but the ability to do so is subsequent to literacy acquisition and is of no relevance to pre-literates who cannot read in the first place. Similar but less obvious are numerous high frequency words in syntactically functional categories (such as the prepositions *to* and *for*) whose vowels are reduced to schwas in prosodic speech but are pronounced with long vowels in isolation ([tu:] and [fo:r]), the latter known as citational pronunciation.

If these are considered serious criticisms of isolated serial processing favoring phonology within alphabet systems, Chinese examples do no better in defending against them on behalf of characters. Several Chinese characters have multiple pronunciations, meaning that phonological processing for these homonyms must, as with alphabetic homonyms, be contingent on discourse context. The character 行, for instance, can be

read as *xíng*, *xìng*, *háng*, *hàng*, or *héng* in Modern Standard Chinese, and each of these have multiple meanings of their own.[4]

Assuming primacy for visual processing, as is done by many character advocates, also entails problems. The homonym phenomenon in both its phonetic and character manifestations can also be seen as a visual-route shortcoming, since the units under question remain ambiguous until phonological processing is complete. It is clear also that visual recognition does not occur in equal units of input (Seidenberg, Waters, Barnes, and Tanenhaus 1984). Alphabetic readers, depending on individual degrees of reading skill and word familiarity, can read text at levels anywhere from single letters ("sounding out" as is done in Phonics reading programs) to letter clusters (e.g. /f/ for {ph}) to whole words and even compound words (e.g. front shifting of stress for proper nouns, such as *white house* to *White House*).

Character readers face an additional unique problem when compounds have no apparent relationship to their constituents, and direct semantic information must be overridden to arrive at a proper interpretation. A famous example is 江湖 *jiānghú* 'the world of martial arts', which is formed from 江 *jiāng* 'river' and 湖 *hú* 'lake'.[5] A related and more salient challenge, one alluded to at the beginning of this paper, is in using characters to represent loan words of a scientific or technical nature. There is no

[4] The situation is even worse for Kanji – Chinese characters used to represent Japanese-language terms – because nearly all have separate *On* and *Kun* pronunciations, often together with one or more purely Japanese readings (Rogers 2005).

[5] The entire expression would literally read as 'rivers and lakes.' The origins of the phrase are obscure, and even if etymology or philology eventually reveals its source, it clearly has lost its overt literal connection in the minds of modern Chinese speakers. Some dictionaries give its translation as simply 'the world,' or relate it in varying degrees to organized crime.

established convention in print to determine the word boundaries of terms like 阿司匹林 *āsīpǐlín* 'aspirin' within an embedding text matrix, so a novice reader could easily mistake this string of graphemes as four independent (and semantically unrelated) units, especially when such terms are already unfamiliar.[6]

If a serial model with self-contained phonological and visual components is unfeasible, how would a parallel model fare better? It should be apparent that were fluent readers to rely on either route alone at any time during processing, natural writing systems would often fail them, replete as they are with ambiguities and false cues. Seidenberg (1985) proposed a time course parallel model in which both phonological rules and visual recognition are simultaneously accessible and used in combination to varying degrees, depending on the familiarity of the lexical item. In two experiments with Cantonese-speaking Chinese readers and English readers, he found that high frequency terms were processed rapidly and low frequency terms more slowly regardless of the amount of phonological cueing. This would suggest that fluent readers in these two different orthography types, character and alphabetic, follow essentially the same strategy when approaching texts.

Regarding the visual representation route, Seidenberg's results are important for the experiment here because it could be argued that simplified characters, being graphically less demanding, enter into familiarity more quickly than traditional characters and are thus more accessible to direct visual processing when required for recall tasks. On this basis, then, there is a legitimate graphic dimension to claims for

[6] There is an informal practice of underlining transliterated proper names, but names account for only a

simplified character's ease of learning, and the present experiment is well served by a design concentrating on the visual-semantic aspect of novel characters.

Furthermore, we do know that for every character in the experiment, the simplified version will have a smaller number of strokes than the traditional version; the differences, while not consistent in numbers of strokes per pair, will nevertheless be unambiguously categorical and more importantly will exactly represent the actual differences between traditional and simplified versions of a specific character. This reduces the experimental comparison to two conditions – control (the traditional form) and research (the simplified form).

We can for present purposes dismiss the phonological/rule-based aspect, since our subjects – non-Chinese speakers/readers – would not benefit anyway from improved sound cues (see Section 3.4 below). This is not to understate the importance of phonological route access for fluent literacy, but the phonological route does not permit direct quantified testing because it assumes prior familiarity with the lexical items which the present design specifically seeks to avoid.

2.4 Developments in Psycholinguistic Lexical Research

Another convergence of ideas is beginning to occur between fields of research centered on lexical representation and processing. The implications of this convergence are unclear at this early stage, but it is nevertheless worth mentioning because it deals

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small portion of unfamiliar, multi-character words encountered in modern printed texts.

directly with several of the conceptual issues explored throughout this paper and findings in this area will inevitably influence research into script reform assessment.

Models of literacy, as we saw above, assume modularity and that the cognitive mechanisms of literacy (routes of access) are bounded on both ends, by visual detection at the front and the lexicon at the end. A recent development among certain psycholinguists has been to take the lexicon from the margin and place it at the center of the reading process. This move was occasioned by developments which began in the late 1960s, with psychological researchers on word recognition shifting their focus from pattern recognition to language perception. As described by Henderson (1989):

> Within the previous tradition – pattern recognition – it could be said that task performance was, itself, the explicandum. Tachistoscopic report was a segment of the process of reading, in this view. "Word recognition" was construed as encompassing whatever the subject did to form a reportable percept of the written form.
>
> As word recognition came to be regarded as the marriage of the perceptual domain to the domain of language, it began to seem more appropriate to take the experimental task not as a model of what was to be explained, but rather as a diagnostic device, conveniently applied to certain purposes that were themselves entirely cast in theoretical terms. In consequence, an increasingly elaborate structure of assumptions was required to harness task performance to theoretical conclusions. Hence the lexical decision task was licensed by the supposition that it obliged the reader to journey exactly as far as the portals of the lexicon, to ring the bell and, if someone answered, to run home without further ado to report this happy domestic circumstance (pp. 357-358).

Right away we can recognize a number of features in this description of experimental views of literacy which we encountered in Section 3.1: Emphasis on diagnostic applications, the view of literacy as a domain-general mental process, and the ever-present difficulties in constructing theories around inferential objects of study. The lexicon is certainly one such inferential object, and by adopting it into their

perceptual and cognitive processing models experimental psychologists went further in proposing an interface system between a lexicon which acts as a repository for semantic and morphological information and sensory detection mechanisms which receive visual (and hence graphic) input.

Various experimental tasks were assumed to identify factors contributing to the stimulation of those mechanisms, commonly called *lexical detectors* in the literature. Pursuing this line of thought, Taft and Forster (1975) asserted that such lexical detectors in speech operated at the cognitive level of morphemes, and because of that the lexicon itself must be organized largely on morphological principles. By extension, the interface systems also must be attuned to morphemes, meaning that orthographic input is likely parsed into morphemic units by the initial perceptual-cognitive mental apparatus during the access phase of reading.

Linguists will certainly be compelled to compare this view of the lexicon with that offered by generative grammarians of the Chomsky mold, who posit a lexicon that contains no rule-forming information of its own; all the information it contains is acted upon by syntactic or phonological rules outside of it. Despite these similarities, researchers in both fields have until recently been slow to integrate their fields because of separate theoretical agendas:

> [T]o the extent that lexical representation and its possible role as a determinant of the access procedure have been attended to theoretically, this concern with representation has looked outward toward perceptual factors rather than inward toward linguistic factors. In sum, as far as extant work goes, the attempt to identify a central concern with lexical representation that is common to psychological and linguistic approaches amounts to the pursuit of a chimerical creature. (Henderson 1989: 364-365)

Morphemes are of course not all equal; some are roots while others are affixes. Moreover, affixes bind to roots (and each other) in various ways, and language-specific rules exist to constrain them. Generative linguists have tried hard to mark morphemes for the application of extra-lexical rules governing these affixation constraints, but experimental psychologists have for the most part not addressed these difficulties and simply have noted differences at the presumed interface access points to the lexicon.

All of this is of salutary interest to the researcher of Chinese scripts. If the morpheme is the primary unit of lexical representation and hence of visual reading access, this finding would be certain to encourage proponents of character writing in that Chinese characters are overwhelming morphemic. It is often said, somewhat misleadingly, that the isolating typology of Chinese has no morphology, all inter-morphemic relations being governed syntactically (Li and Thompson 1989). While this is not entirely accurate, it is true that most of the functions normally assumed by inflection or agglutination in other language typologies are dealt with syntactically in Chinese, making morphemes more "isolated" from their grammatical properties. Perhaps, character proponents might argue, a language whose morphemes are less structurally bound to other linguistic domains and thus more autonomous is better served by a writing system in which morphemes are likewise graphically more autonomous.

Even more suggestive is the idea of the BOSS (Basic Orthographic Syllable Structure) access code, which posits that the receiving visual-cognitive apparatus attends not to morphemic units but to salient orthographic shapes which are of

comparable size to spelled morphemes but which more often than not represent no linguistic unit; the shapes simply appear with some frequency and are thus attended to quickly. An example is the {cand-} in such morphologically unrelated terms as *candle*, *candid*, *candy*, and *candor* (Taft 1979).

The fascinating implication of this is that some aspect of the graphic perception system may be attuned to purely spatial representation properties; chains of lexical access thus may begin at least in part by primed recognition of graphic properties that have no linguistic significance of any sort, either semantic (the presumption with characters) or phonological (the presumption with alphabets and syllabaries). What might such a finding have to say about the potential for some components of Chinese characters, which may seem superfluous and irrelevant to the semantic or phonological content of a given character as a whole, have to contribute to the initial stages of activating the lexical recognition system? Furthermore, how might a particular set of character strokes, meaningless in themselves yet having a visual salience and relative frequency in print such as the{cand-}examples above, contribute to the accessibility of characters in which it occurs? The BOSS access code hypothesis has only been explored in alphabetic contexts, so its implications for Chinese character perception are open to speculation.

Smith (2004) argues that "[t]he secret of reading efficiently is not to read indiscriminately but to *sample* the text" (p. 87). That is, fluent reading is largely heuristic, attending only to salient graphic features. This is essentially the same idea as BOSS access, but on a larger scale – focused on whole text rather than individual

words. While not speaking with reference to Chinese character writing, this idea of selective attention agrees with the idea of adjusted saccadic lengths and directional scanning reported earlier, as both movements are correlated with script types and are apparently punctuated by structural features within characters. Once more, this research accentuates the fact that differences in the structural characteristics of graphic stimuli have consequences for the visual processing of print, an idea central to the concept of character simplification.

2.5 Control and Subject Selection

Let us reiterate the arguments of this chapter. Chinese character literacy is thought to differ from alphabetic literacy in the manner it accesses the lexicon; more specifically, it is thought to rely substantially less on phonological mediation, often bypassing it altogether. This indicates that graphemic features shoulder the burden of reading memory, and that the more "user-friendly" those graphemic features are the less that burden should be. Simplification of Chinese characters claims exactly that – to reduce the complexity of characters, making them easier to acquire and retain – so in such claims a ready-made test hypothesis is available.

An observation about the subjects used in the above experiments is required. Since most of the experiments discussed above compared character and alphabet readers in different languages and with different subject backgrounds (level of education, socioeconomic status, etc.), critics might argue that such studies reveal differences in culture more than in orthographies. Extended comparisons of this type may even be

desired by those favoring a strong orthographic determinist position. However, in order to assess the efficiency of a variety of scripts on their own merits, as we intend to do here, such extraneous subject differences must be controlled. Most importantly, prior experience in either traditional or simplified characters must be avoided, which amounts to the exclusion of native Chinese-language users for the present study. Emerging literates in Chinese-language communities are taught in either the traditional or simplified format, meaning that one condition will have enjoyed tremendous practice effects over the other for any subjects drawn from these populations.

For these effects to be negated, the present experiment required subjects with no prior experience with learning Chinese characters of either type to be recruited. Without knowledge of the Chinese language the sound cues provided by characters' phonetic components – a critically important facet of the writing system as a whole – becomes irrelevant, but we will adopt the position held by the time course model that words of high frequency and greater simplicity revert to a visual access route. It must be kept in mind, after all, that this study attempts to assess quantitatively the claims of those who wish to retain characters, because they believe characters provide a distinct graphic advantage; it is fitting that we should oblige their viewpoint and emphasize that graphic aspect here in this experiment.

CHAPTER 3

METHODOLOGY

3.1 Preliminary Remarks

> To begin with, it is probably wise to distinguish between methodology in the sense of a method of discovery (how one goes about it) and methodology in the sense of a method of validation (how one justifies what one has done). [...] [W]hat ones sets out to do depends on what one regards as worth doing, and how ones goes about it is determined at least in part by what one is looking for (O'Flaherty 1980:3).

The above remark was made with regard to the study of mythology, but is a valid admonition of the present study's considerations as well. What we are looking for is a way to substantiate the claims made on behalf of simplified characters for their ease of acquisition and retention relative to their corresponding traditional forms. This, of course, has been attempted before, but in adopting a quantified approach the present study departs from previous methodology (i.e. correlation and anecdote) and requires justification in itself.

The ultimate goal in research on script reform is to facilitate literacy in emergent readers and writers; thus, previous assessments of character simplification have tended to focus on those individuals and their accomplishments. To paraphrase the above quote, simplification has been pressed in large measure because its advocates have been looking to replicate individual successes achieved within a simplified-character literacy paradigm. However, this would seem to put the cart before the horse, in that particular

effects do not in themselves confirm particular causes without those causes having first been isolated (i.e. experimentally controlled).

Accepting that measured assessments must shift attention away from the performances of individual learners and toward averages of those performances within populations as functions of the scripts themselves entails further departures from previous methodologies. Establishing script types as independent variables requires the imposition of experimental controls which restrict the ways literacy can be measured. In essence, the composite concept of "literacy" must be reduced to selected component skills so that they too can be operationally defined and thus quantified. For present purposes, short-term retention rate has been selected as the component skill under investigation, due to the number of related studies and the relative economy of experimental design it affords, as well as its universally acknowledged importance for reading and the contentious place it occupies in current Chinese script reform discussions.

3.2 Variables

The independent variable in this experiment was Chinese character complexity, operationalized in two discrete conditions of traditional (the null condition) and simplified (the research condition). These conditions were taken directly from the lists

of approved simplifications and were not modified in any additional way by the experimenter.

The dependent variable was short-term character retention rate, operationalized as the ability to accurately recall the assigned meanings of 30 individual characters after having been given a 10-minute practice period. Accuracy was recorded as the percentage of correct responses from a total of 50 prompts per individual test.

Let us take this opportunity to elaborate on the choice of operationalized variables here. As has been repeatedly stressed throughout this paper, literacy is a complex set of context-dependent skills, all requiring interacting trajectories of development in order to reach a threshold level of minimal performance. This very complexity has defied attempts to define literacy as a single, scalar quantity; by extension, it has also defied attempts to operationalize literacy as a whole as an experimental variable.

A multivariate model of Chinese literacy would be preferable, but at least two things prevent it from being used experimentally. First, there is no general agreement about exactly which cognitive skills together constitute literacy. We made this point in Chapter 1, but with the above discussion about modularity it can be brought into sharper focus. Disagreement about the components of literacy is not just a matter of theory; all theories about literacy assume that the divisions it makes – either in terms of cognitive processes, neural networks, brain areas, or linguistic modules – are objective in some

sense: That is, they are mutually exclusive. Until such agreement is reached, a multivariate operationalized variable for literacy cannot be experimentally quantified.

Second, assuming a multivariate, quantified conceptualization of Chinese literacy were available, it would have to have been synthesized from an assortment of scalar, isolated component variables. Yet as we saw already, no such synthesis exists, because no consensus on the number and kind of components exists; a Catch-22 of sorts. How do we get around this problem?

While a comprehensive model of literacy has not yet been constructed, research does indicate that certain cognitive abilities directly contribute to literacy. One of these, as was discussed in Section 2.4.2, is the retention of visual information (i.e., graphic memory). Because all writing systems are composed of repeated graphic units, and memorization of these units is required for the system to be of any use, retention is undeniably a key factor in literacy. Since the present experiment must be formulated as a univariate design, retention offers itself as an attractive candidate to be that single independent variable.

An awareness of this need for reduction to single variables was understood obliquely as early as 1908, when Huey said:

> Perceiving being an act, it is, like all other things that we do, performed more easily with each repetition of the act. To perceive an entirely new word or other combination of strokes requires considerable time, close attention, and it is likely to be imperfectly done, just as when we attempt some new combination of movements, some new trick in the gymnasium or new "serve" at tennis. In either case, repetition progressively frees the mind from attention to details,

> makes facile the total act, shortens the time, and reduces the extent to which consciousness must concern itself with the process (Huey 1908:104).

In other words, as graphic information is assimilated, it frees mental space for the engagement of higher cognitive processes involved in literacy. This idea would not be elaborated until much later, with the emergence of automaticity theory in reading research:

> During the execution of a complex skill, it is necessary to coordinate many component processes within a very short period of time. If each component process requires attention, performance of the complex skill will be impossible, because the capacity of attention will be exceeded. But if enough of the components and their coordinations can be processed automatically, then the loads on attention will be within tolerable limits and the skill can be successfully performed. Therefore, one of the prime issues in the study of a complex skill such as reading is to determine how the processing of component subskills becomes automatic (LaBerge and Samuels 1974: 293).

Research in the automaticity framework eventually focused on aspects of complexity, as its relationship to cognitive storage capacity was recognized. However, these have referred to complexities in processing mechanisms themselves, not in the visual stimuli; the questions have been about explaining how automatized components – modules – functioned as a single unit for literacy (Stanovich 2000). The experiment proposed here avoids this problem by recasting the object of study as complexity within that stimulus – the character complexity of different versions of written Chinese – rather than as their theorized modular correspondences in the mind.

3.3 Materials

Materials in this study comprised two types. One was a set of printed documents distributed to each subject: A subject data sheet, a consent form, a character list (in two versions – traditional and simplified) and a feedback questionnaire. These documents appear in Appendices C, D, E, F, and G respectively.

The experiment itself was run and recorded on software programmed specifically for this study by Courtney Gillett of the University of Texas at Arlington as an .MDB file. The original program was subsequently modified by various other contributors to enlarge the size of the characters as they appeared on the screen display. During experimental testing this program was run on personal computers supporting Windows XP operating systems.

Mention needs to be made of the characters used in the program. The 30 characters employed in the memorization list were selected from a list of high frequency characters provided by website moderators at the MDBG Free Online Chinese-English Dictionary (URL: http://www.mdbg.net/chindict/chindict.php). The chosen characters appear in both traditional and simplified form in the website's Flashcard section; the individual images (30 in both forms for a total of 60) were uploaded onto the test software and constituted the image bank from which the program drew for its visual prompts during the experiment.

Though means were computed automatically by the testing program, statistical analysis and graph plotting were done using SPSS (Statistical Package for the Social Sciences) software, again on computers supporting Windows XP operating systems.

3.4 Subjects

Subjects in this study were 23 male and 27 female adults aged 18 to 65, none of whom had prior experience in the study of written Chinese. These participants were randomly assigned to one of the two test conditions, 25 in each; no subjects participated in both conditions.

The provision about no prior experience in written Chinese is a crucial one, and deserves some comment. In order to control for practice and exposure effects, which would have necessarily prejudiced a subject toward one or the other research condition, the subjects had to be screened for previous Chinese study. This is another example of the imposition of experimental control on a scientific study at the expense of naturalism, and a rather severe one at that. Let us spend some effort, then, in trying to understand why it must be done.

As we saw earlier, one of the hallmarks of science is its search for causal relationships between variables; changes in cause A need to be demonstrated as producing corresponding consistent and measurable changes in effect B, without the intervention of confounding variables C or D. Experimentally, this means removing

any other influences that might potentially act as confounding variables by exerting their own consistent and measurable changes on the effect under study. Were that to happen, it would be unclear exactly which cause (or combination of causes, or some outside cause) was actually producing the effect, and consequently we could not make a confident, quantified statement about any of the causal relationships involved.

Natural systems are multi-factorial and rarely if ever are they simple cases of one cause accounting entirely for one effect. This is all the more apparent for something as complex as the reading of Chinese script, which as we have already seen involves numerous perceptual and cognitive skills combined with several layers of environmental context. Isolating any single cause clearly would not account for all of the observed effect, and any experiment with such a design would be far removed from natural reality. However, without reducing the causal relationship to constituent factors, it would be impossible to make meaningful statements about any observed correlations between causes and effect.

In fact, recognition of this is what prompted this whole research project in the first place. A correlation between successive implementations of character simplification and rising literacy statistics[7] has without substantiation been reported as a causal relationship: "Character simplification helps improve literacy." Such a conclusion is unjustified, but to demonstrate why requires that we replace this

correlational argument with one based on causation – in other words, a quantitative scientific experiment. And to do that, we must first explore isolated causes before assembling the results of those studies into multivariate models that can account for causative effects on Chinese literacy in a more natural, less controlled way.

Returning now to the immediate question at hand – why it is necessary to select non-Chinese-literate subjects – we see that it must be done to achieve this experimental isolation. Individuals in native-language Chinese environments would have significant passive exposure to characters, and such exposure would provide practice which could not but have influence on their mental processing of characters, even if they had not seen the particular characters used in this experiment. More likely, they would have had extensive formal education in one of the two character systems (traditional or simplified), meaning that they would be well-versed in one version but unfamiliar with the other. Thus, practice would compete with character complexity as a causal explanation in measured differences between simplified and traditional experimental conditions. Because we wish to isolate character complexity to study its possible causal effects, we must eliminate all practice effects from the experimental design. Yet in order to do that, we must disqualify from participation anyone who might have had practice in reading or writing Chinese characters.

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[7] Note that we do not use the phrase "rising literacy" – recall the suspicions about reported literacy rates in Chapter 2.

This might appear to be exercising experimental control to an unacceptable degree, as the study is intended to provide information about the very people deemed ineligible for study (i.e., Chinese language speakers learning to read and write characters in China). Yet there is simply no other way to eliminate the practice effect confound other than to remove the influence of exposure to Chinese completely, because exposure to language and writing are inextricable parts of native culture experience in any social environment. The situation is not as bad as it may seem at first glance, though. Remember that our intent is to study emergent literates, so whether the subjects are pre-literate Chinese children or an English-speaking adults, both approach character learning from a baseline of no previous study. The operating principle and relevant research question are both still the same: Will these learners learn Chinese characters more efficiently when those characters are simplified, all else being equal?

3.5 Procedure

Before beginning the actual experiment, a pilot study was conducted in order to determine an optimal time interval for the practice period during which subjects would study their given set of 30 characters. Ten sets were distributed and the subjects receiving them were asked to report when they felt comfortable in having memorized them. The average reported time interval was 8.33 minutes, so a round interval of 10

minutes was decided on for the experimental procedure. The subjects used in this pilot study did not participate in the actual study.

For the test procedure, adult non-Chinese literates were recruited to perform a recall task. These subjects first completed a questionnaire which solicited information on age, gender, highest completed level of education, native and acquired languages, previous Chinese language education, and an estimate of the number of Chinese characters already known. Those who reported any formal Chinese language study were disqualified from participation. It was not unusual for subjects, even without formal study, to have learned a small number of characters; those who knew more than three were likewise disqualified from participation because the characters they knew were apt to have been high-frequency elements, there was a possibility of these characters being included in the experimental set. Further, assuming the three were among the characters included in the experimental set, they would constitute 10% of the total of 30, an unacceptably high proportion. The subject data sheet is given in Appendix C.

A subject population of 50 was selected, and arrangements were made on an individual basis to perform the experiment. Participants were randomly assigned to one of the two experimental conditions until 25 individuals were in each. They were only informed that they would be performing a recall test; they were told neither about the two conditions nor to which of the conditions they were assigned.

The following sequence of steps was enacted with each subject. The subject data sheet and consent form were completed and collected; these were numbered for reference. The subject was then given either a traditional or a simplified version of the character list to memorize. The following instructions were read aloud to him or her:

> Thank you for agreeing to participate in this experiment. The purpose of this study is to obtain data on the ability of individuals with no experience of reading in Chinese to retain the meanings of characters after a brief period of practice.
>
> You have been given a list of 30 unfamiliar Chinese characters and their English translations to memorize, and will be allowed 10 minutes of silent time in which to memorize them. After this silent time for practice, you will be given a recall test. This will consist of a series of multiple choice questions in which you will be shown a character from your list and be asked to select the corresponding English translation from a set of four choices.
>
> Once the test is complete, you will be shown your results and the test administrator will provide feedback on your performance. Any questions you may have had about the procedure will be answered at that time.
>
> Thank you again for your participation. Your silent study time will now begin.

The subject was then left undisturbed for the 10 minute duration, although he or she was visually monitored to ensure that the entire time was used for study.

At the end of the study period, the character list was collected and the subject seated at a computer station, whereupon the test program was run. Before beginning (i.e. while the subject was in silent study) the program was set to the test condition corresponding to the subject's character list. The program randomly pulled a character

from the image bank and displayed it with four selected-response options marked A through D: One correct and three incorrect. All four options were glosses of characters from the list, the three incorrect ones also being selected randomly. The placement of the correct response was varied randomly within the arrangement of the other three options.

The subject selected a response for each serially-presented character until all 50 prompts had been answered. Feedback as to the correctness of a response was not given during the test, but a display screen at the end of the test gave the subject's overall percentage of correct answers. It was felt that giving feedback on correct and incorrect responses during the test would influence subsequent responses.

Upon completion of the procedure, the subject was debriefed on the true design of the experiment and on his or her placement in one of the two test conditions. Questions were answered about the design, methodology, and other issues. The subject was then invited to complete a feedback questionnaire and offer any additional thoughts concerning the study. The form is given in Appendix G.

3.6 Data Collection and Statistical Analysis

The software used to conduct the experiment also recorded the answers from the participants and presented their individual scores as percentages (number of correct responses/total of 50 prompts). Once all 50 participants completed the recall test and

received a score, mean scores in both conditions were computed to arrive at performance values for each condition. These values were compared via *t*-test, $p<0.05$. Computations and graphing were performed using SPSS software. Results are shown in Appendix 8.

CHAPTER 4

RESULTS AND DISCUSSION

4.1 Results

The mean score for the null condition (traditional) was 24.80, n = 25, SD = 7.344. The mean score for the experimental condition (simplified) was 25.44, n = 25, SD = 6.806.

A two-tailed independent means *t*-test was used to compare these values; no significant difference was found at $p<0.05$.

Results are plotted in Appendix H.

4.2 Interpretation of Obtained Results

No significant difference was found between the performances of subjects in the two opposing conditions. At the very least, it can be said that this experiment did not support claims that character simplification yields a clear, systematic, or definite improvement in short-term acquisition of character retention rate. However, given the narrow scope of the study, we must be cautious about any conclusions drawn from these results.

What can be said with some certainty is that the effects of simplification on lexical access are not absolute – simplification does not unconditionally result in improved literacy in Chinese. While that would not ordinarily amount to much in an experimental research context, it is significant for the Chinese script reform debate,

since claims about the effects of orthographic properties have tended to be cast in absolute terms (in keeping with the absolute nature of orthographic determinism). This in itself should stimulate interested researchers to scrutinize the hitherto unsubstantiated assessments of the success of simplification in raising literacy among the general Chinese population, and insist on their quantification through controlled experimental methods.

4.3 Graphic Features and the Concept of Simplification Revisited

In Sections 1.2 and 1.3, we discussed several difficulties with the concept of simplification – what constitutes simplicity (or conversely, complexity), whether simplification is due to graphic reduction or other factors (e.g. familiarity, phonetic reduction), to what degree such factors act alone or in combination, and if it is possible to measure any of them. Later, in Section 2.3, we also discussed how a simplified character may act along two possible routes of access to the lexicon – phonological or visual – but that these routes do not necessarily map directly to phonological or visual (semantic/"radical") features of the character itself. In light of our study, has any insight been gained into these questions?

First and most importantly, we can reiterate our experimental findings and say that the category of "simplified characters" does not seem to have an absolute effect on the rate of short-term retention of characters. This could mean one of several things. The category itself may be artificial, in that the processes used to produce simplified characters are not systematic enough to generate quantifiable differences from

traditional characters. Given that the official list of simplifications was drawn from a stock of popular characters whose individual origins spanned nearly 2000 years, covered a vast geographic area, and involved multiple sociolinguistic strata, such a conclusion would not be surprising.

Alternatively, it might also be the case that simplification may be less consequential for visual/graphic processing, and that the phonological processing route may indeed have a greater role than hitherto acknowledged. Simplification, in other words, may somehow simplify phonological access rather than visual access. The degree to which this is separate from visual processes, however, still remains to be explained. A third possibility is that graphic simplification does not have significant effects at the level of short-term retention, but that such effects may become visible after repeated exposure over time. This, of course, is material for a longitudinal tracking study.

Another important point that emerges from both the experiment and the preceding literature review is that graphs – standardized symbols (e.g. letters, characters) used to encode units of linguistic analysis (e.g. phonemes, morphemes) – are fundamentally different from non-linguistic symbols in that they are a secondary symbol system. That is, while ordinary symbols encode mental concepts, graphs encode language units which themselves are symbols to encode mental concepts. That the "Chinese word-as-picture" belief still circulates cannot diminish this fact; even the most iconic of characters are still linguistic morphemes.

A feature of all true symbol systems, languages and orthographies included, is recursiveness – there is inherent redundancy in the system which gives it structure, organization, and predictability, allowing information to be compressed efficiently. Without recursiveness, the symbol system would be as large as the set of concepts of which it serves as an isomorphism; its purpose of being an efficient mediator of that set would be defeated. Alphabets encode recursions at the phonemic, morphophonemic, and word levels, to varying degrees in different languages.

Chinese characters also encode recursions, though it may not be as obvious. With the rise of the ink brush as the primary means of composition for written Chinese, all characters are now composed of the relatively limited set of 12 constituent strokes (Bjorksten 1994), which imposes a major constraint on the possible graphic forms a character can take. (This is a property not even observed in alphabets, which is why a Latin-based phonetic transcription alphabet such as IPA can constantly to add all sorts of odd new letters.) Above that level, characters portion the space in which they are composed in regular ways, through some division of a 3 x 3 array. Usually, these divisions mark the boundaries between radical semantic and phonetic components or between multiple semantic elements.

These sub-whole character components again have an internal structure both in terms of their composition (using the same 12 strokes) and of their semantic or phonetic reference. Starting with the "radicals" themselves, this set of 214[8] base semantic

[8] This number was established for use in Chinese dictionaries during the late Ming Dynasty (ca. 1615); this list was sanctioned in the great Kangxi Dictionary of 1716 which remains authoritative to this day. It

components represent bound categories of meaning that suggest an amount of lexical affiliation that helps (a little or a lot, depending on the character) readers make an identification. Chinese literates are in fact taught to think of characters in terms of their radicals, so that even if the radicals themselves do not naturally constitute classes of semantic organization they become such through imposed practice.

Similarly, phonetic components that are used with regularity represent a type of abstracted recursion. Like the radicals (though less standardized), they form a basis of organization for linguistic units of analysis – for phonological rather than semantic-lexical classes. Often, they indicate rimes.[9] As mentioned in Section 1.3, inclusion of a phonetic element has become one of the methods by which simplified characters are produced. As the phonetic usually substitutes for a semantic component of greater graphic complexity, we are again confronted with the problem of separating the respective influence exerted by phonological and semantic cueing in a simplified character. Simplifications in which whole characters are substituted with graphically simpler homophones would appear to be a variation of this same condition.

There is also recursion above the level of whole characters, in compounds. A number of characters are now used in Modern Standard Chinese as bound forms to indicate nouns. Examples of this are 子 *zi* in 狮子 *shī zi* 'lion' and 头 *toú* in 斧头 *fǔ toú* 'hatchet'. These appear to have a historical origin as means by which early modern

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should be noted, though, that this number is arbitrary and earlier work have identified as many as 540 radicals. Source: http://en.wikipedia.org/wiki/Chinese_radical

[9] It is curious that Chinese scholars of antiquity perceived the division of a Chinese syllable into onset vs. rime in *fangqie*, but syllabary systems such as *Zhuyin Fuhao* and Japanese *Kana* prefer to divide the syllable into morae consisting of onset and nucleus vs. coda.

Chinese compensated for a reduction in its tone and phoneme inventories. It is unclear if or how this type of recursion is related to that found within a character, but if, as is certainly possible, readers of Chinese scan text not only at the single character but also at sub- and supra-character levels they likely apply similar visual skills in the decoding task.

This discussion of sub- and supra-grapheme visual processing recalls the earlier discussion of BOSS code activation (Section 2.4) with its evidence suggesting that salient visual configurations, not necessarily related to any correlated unit of linguistic analysis, may play a prominent role in initial graphic detection. Should this prove to be significant, the idea of simplifying characters in the future may be better conceived not so much as a function of reducing graphic complexity as incorporating visual elements that are prone to BOSS-type detection. In such a case, simplified characters would be "simpler" by virtue of containing salient graphic features which are easier to visually detect. Since it is unknown at present what such features are, or indeed if they really do work in the manner that alphabetic BOSS code studies indicate, this determination must be reserved for future research projects.

If the ability to recognize recursiveness in characters is a critical factor in achieving literacy in Chinese, we might be able to reformulate our quantitative methodology in more precise terms. Does character complexity affect particular aspects of recursiveness in Chinese characters? Are any of the different types of recursiveness in Chinese characters measurable, and do they correspond in measurable ways to component aspects of literacy (including retention rate)? Are measurable forms of

character recursiveness interactive, and can their interactions be computed with quantitative analysis? These are important questions that force us to reevaluate the concept of simplification as a whole.

If the official position on the effects of simplification is that graphic simplicity alone facilitates memory capacity for characters and hence literacy, the findings of this experiment cast aspersions on this one-dimensional scenario. Now that the basic assumption of simplification has been quantitatively tested to no significant effect, it is more obvious than ever that such a scenario is greatly oversimplified and is a poor rationale for extended assumptions about the nature of literacy in characters. In addressing how such assumptions could have gained such wide currency and official sanction, it is helpful to evaluate the methodology that has been previously used to assess the effectiveness of the character simplification program since its implementation in the People's Republic of China in 1958.

4.4 Critique of Current Assessment Methodology in Chinese Script Reform

> The experience of Taiwan where the literacy rate approaches that of Japan and other developed countries, and where simplified characters are scrupulously avoided in print, shows that the old system can be taught and taught well. To a very large degree, it has simply been assumed that the wider use of simplified characters has simplified the learning process. Very little evidence has been properly documented. [...]
>
> To what extent have reform measures [i.e., simplification] made their precious hours of formal training more effective? Has the amount of time spent memorizing characters been lowered appreciably? How much has the reduction in the number of strokes that make up the characters made them easier to recognize and remember? These are questions that have never been explored in any systematic way (Ramsey 1987:150-1).

The above observations were made more than a decade ago, yet the quantification of script reform assessment remains an unrecognized necessity for language planners in China. Many of the reasons for this have been enumerated in the foregoing discussion; from the national government perspective, there is little motivation to question the status quo. The socioeconomic progress experienced by China in recent decades has mitigated the urgency with which the simplification program has been assessed. Yet the points raised above about how simplification was adopted should concern us, since the reasons for its implementation are not intrinsically valid and require confirmation. Granted, the manner of decision-making would be irrelevant if the current methodology of assessment were appropriate and could provide a meaningful accounting of the simplification program's contribution to improved literacy rates. It is with this thought in mind that we turn to a discussion of the methodology of assessment that has been employed by script reformers in China.

To determine the effect of any variable on another, a causal relationship must be established. The distinction between a causal and a correlational relationship must be appreciated, since the latter can very easily be confused with the former and mistaken as supporting evidence. Causation involves an effect being produced by the manipulation of a single cause, whereas correlation merely observes systematic related changes between variables. Only with a causal relationship can it be said that an effect was produced by a given cause, because a causal study is designed to

isolate out other variables that could potentially exert an influence on, and thus alternately account for, the observed effect.

Throughout the literature adduced as positive assessment of the character simplification program, only correlational evidence is presented. Even this is not collected in a standardized manner, and is usually designed to measure literacy or education generally and not simplification itself. These two conceptual errors – the failure to operationalize script complexity in measurable terms and to test for causal relationships – are at the core of the misunderstanding about the efficiency of literacy in simplified characters.

The most common validation of simplification has been to cite statistics showing the rapid rise in literacy rates from the time simplification was officially adopted in 1958. Ho (1997) is a typical example:

> Simplification is a boon for millions of people, particularly for those who are struggling to shake off illiteracy. This process has gone a long way toward helping alleviate illiteracy. Studies have found that the literacy rate in China has risen from 20-30% in the early 1950s to 80-90% in the 1990s (p. xiii).

In 1982, the State Statistical Bureau conducted a national census and arrived at a rate of 23.6% illiteracy among those aged 12 or above (235,820,002 of the total population of 1,008,175,288). Wang (2003) reports a 1995 illiteracy rate of 16.5% (145,000,000) at ages 15 and above. However, he considers this high and so sees no reason to attribute any success to simplification; indeed he goes on to say that "With such a high illiteracy rate, the population of China could be expected to (and does)

average fewer years of schooling and a lower rater of upper secondary completion than the peoples of Western developed countries" (p. 14).

Some make the claim even without reference to statistics and with only the most superficial exposure to China itself. Scribner (1982), reporting on the findings of a delegation of linguists to Chengdu in 1980, took at face value the claim of 86% literacy throughout China and pronounced that "China's commitment to universal literacy seems unquestionable and its progress toward this goal impressive" (p. 4). This was stated despite an earlier admission of having neither the time nor opportunity to conduct a meaningful evaluation of the simplification program.

James Lilley, former US Ambassador to China, spoke with the author during a visit to Dallas, TX, in March 2000 in which he offered the following similar assessment of simplification:

> Oh, there's no question that it's helped. Every time I go to China I see more magazines, more books; there's a lot more in print, because there's a lot more people to read it. The government reports that literacy rates keep going up, and I don't see how it could have been possible without simplifying the writing. Before, the difficulty of the writing was a way to keep the common people down, but now that they're trying to make it easier, people are picking it up faster than they ever have (Lilley 2000).

It would seem that at least one high-ranking Party cadre made a similar correlational argument for Latinization. In June 1960, addressing the National Conference of Outstanding Groups and Individuals in Socialist Construction in the Fields of Education, Culture, Health, Physical Culture, and Journalism, Central

Committee member and Vice-Chairman of the Standing Committee of the National People's Congress Lin Feng stated:

> Tremendous development has taken place in our country in the various fields of culture and education. In the educational field, over one hundred million illiterate people have become literate. The experiences of wiping out youth illiteracy during a comparatively short period in Wanjung Hsien of Shansi Province by using alphabetic script is an important matter in our country's cultural revolution (Fraser ed. 1965:377).

Aside from such correlational arguments, the only other form of evidence generally offered in support of script reform success through character simplification is anecdotal. The stories in support of Latinization by Mao Dun and Jo Wen have already been alluded to. To these we can add another pair furnished by Wu Yuzhang in a lecture entitled "Push Forward with the Work of Writing Reform in the Spirit of Seeking Truth by Verifying Facts," given at the Second National Exhibition of the Results of Teaching the Standard Vernacular on 27 August 1959. Note how successful reading fluency in the phonetic alphabet is measured against Putonghua speech rather than functional applications of literacy, and even less than against any quantified standard:

> The demonstrations show clearly that although the study of the standard vernacular is difficult for people in different dialect regions, if they apply themselves to it they can learn it. For instance, the peasant representative from Chaoyang, Guangdong Province, Chen Yingzhang, originally could not speak the standard vernacular at all. Last autumn he began to study the phonetic alphabet, and he used the phonetic alphabet in studying the standard vernacular; he attacked his studies with determination, and in a short while he could use the phonetic alphabet and had basically learned the standard vernacular. At this exhibition the first award to be given to a representative of the masses of workers and peasants was made. Chen Guilan of the Chakou commune in Yinxian, Anhui, is over fifty years old, and last year, after she had gotten rid of

> her illiteracy, she began the study of the standard vernacular; she labored hard at her studies, repeated what she learned after she went to bed at night, and now she has essentially learned the standard vernacular (quoted in Seybolt and Chiang eds. 1979: 303).

On the other side – in support of simplification – we again have the observation of Zhou Enlai, who made the following statement at the official adoption of simplified characters in 1958:

> When one old primary school teacher in Henan introduced the simplified characters to his students, he told them that from now on they would write the first character in feng shou 'good harvest' in its simplified form – three horizontal strokes and one vertical stroke. The children were very happy; they clapped their hands and cheered. A worker in Tientsin said that he had been trying to learn the three characters for jin 'all, entirely,' bian 'side, boundary,' and ban 'to do, handle, attend to' for a long time but he could never remember them; when he could simplify them to [the new forms], he could remember them immediately.... When Comrade Li Genglian sent a book of simplified characters to her brother, he was very happy and replied, "These new characters are much easier to learn," and he scolded his sister for not having sent the book to him sooner (Quoted in Ramsay 1987:151).

Personal testimonies such as this, while having strong rhetorical effect and emotional appeal, are difficult to verify, and do little to contribute to an assessment of script efficiency. Such anecdotes have been persuasive enough in the minds of language planners, though, and because they constitute a formidable obstacle to continued reform they must be addressed. The critical observer must point out that learners' own understandings of what accounts for their emerging literacy cannot be taken at face value, as they are probably unaware of the multiplicity of factors involved in any acquisition process, or how to weigh their proportional influence.

There is considerable pressure, as well, to provide answers in tandem with official policy. Even in recent times, when the former excesses of government control seen in previous decades have been ameliorated, the pressure to respond in a politically correct manner can be overwhelming for ordinary civilians. An incident reported by Stites (2001) while conducting ethnographic research on rural Chinese literacy is an excellent cautionary tale for the researcher:

> In one exceptional but telling case, the sudden appearance of my entourage caused one woman to panic. [...] Instead of answering [questions about household literacy practices] she turned to the member of the village party branch who was with us and asked what she had done wrong. He told her that we were conducting a 'social investigation' (shehui diaocha), an answer that only served to intensify her anxiety. Once finished serving the tea she again vanished to another room. After some uncomfortable moments and shouted requests for her to return she hesitantly edged back into the room just long enough to recite an account of the academic achievement of her sons, both of whom had graduated from senior middle school. My escorts had become very familiar with the sorts of questions that I was asking in each household and they began to give me answers to these for this household. In the meantime I was trying to establish some rapport with the increasingly distraught woman, a task made doubly difficult by my strangely accented Chinese and her refusal to make eye contact or speak directly to me. As she became more and more elusive my hosts became more demanding of her, virtually ordering her to speak to me. Eventually I insisted that they let her go and we moved on to the next household (pp. 186-187).

One can only imagine how much greater a factor such fear was in the more violent times of the Cultural Revolution, when there was considerable pressure from the central government to produce positive evidence for the success of its policies among the population, and when lack of such evidence could be construed as disloyalty. Cases of over-reporting agricultural and industrial productivity are well-

documented for this time period, and it is more than likely that literacy rates were vastly inflated as well.

Claims of advanced literacy rate must also be tempered by reports of relapse, which are rare yet must be considered an integral part of any fair assessment of the success of simplification as a remedy for illiteracy. Jan (1971), writing about this very time period (the Cultural Revolution), observed:

> Another serious deficiency in mass education in the communes was the tendency for peasants to lapse back into illiteracy because of their failure to practice their newly acquired skill. According to the statistics of Wan-jung County, of the 34,000 people who had received instruction in reading by October 1958, one-third had again become illiterate, and the other two-thirds were unable even to read newspapers. If this was generally true, the qualitative significance of the illiteracy-elimination program in the communes must be questioned (p. 141).

It is rather distressing to note that this is the same Wanjung County that, a decade earlier in 1960, Lin Feng had singled out as exemplary for having eliminated illiteracy through Latinization!

An obvious yet (perhaps deliberately) overlooked comparison is to be made between the use of simplified characters on the mainland and the retention of traditional characters in Taiwan. Do mainland Chinese, aided by an upbringing in simplified script, acquire literacy faster than their Taiwanese counterparts? In truth, socioeconomic factors largely confound any such comparison, but the mere avoidance of this comparison is revealing in itself. Taiwan, of course, does not use simplified characters. This is in part because it perceives itself as the conservator of

Chinese traditional culture against the Communist mainlanders' revolutionary idealism and social engineering, and in part because it is yet another way to refuse acknowledgement of its rival's official policies and legitimacy in general.[10] And while multiple intervening factors prevent direct comparison, it can at least be said that simplification exerts no absolute, overriding effect on literacy acquisition and retention, since literacy rates in Taiwan have always far exceeded those in mainland China.

To summarize, the assessment methodology currently applied to the simplification program suffers from several weaknesses. Chief among them is the correlational nature of supporting statistics reporting increased mass literacy, which are erroneously taken as causative and attributed to simplification as a script reform measure. To these are added anecdotal reports of individual success in reading acquisition, which are suspect on several counts. Even accepting these arguments, there is failure to account for the comparably much higher literacy rate among Chinese in Taiwan, who use the unsimplified traditional script.

Language reform policies rest on the assumption that specific language goals can be achieved at the popular level by the implementation of specific modifications to the language. This assumption is causal and empirical, yet till now the evidence informing it has not been. With the new theoretical model proposed here, a more appropriate and

[10] The revised edition of *Taiwan Today: An Intermediate Course* (a learner textbook of Chinese authored by Taiwanese professors), however, uses Pinyin: Teng and Perry (2000).

fruitful line of research can now be followed toward ultimately more effective policies of language reform.

4.5 Anticipating Responses to Empiricism in Script Reform Assessment

MacNealy (1999) lists four objections commonly voiced against empirical research into writing that are worth considering as they relate to the present study. The attentive reader will recognize that all of them have been alluded to throughout this work, but it will help to gather them here and make them explicit.

4.5.1 Distrust of Numbers

There is a common wariness of numerical information among non-scientists who don't work with it on a regular basis, composed in varying proportions of intimidation and disdain. Because numbers give the impression of precision, statistics when misused can easily appear convincing to those without the training to see past mistakes or deceptions (Huff 1954). In Chapter 2 we saw how statistics generated to support rapid rises in literacy among the Chinese population since the formal introduction of simplified characters are highly suspect (and quite likely wrong by a substantial margin). These questionable statistics, in turn, are set against the precedent of a pattern of over-reported progress in other areas of achievement wherever Chinese government programs are concerned. How then can a case for quantified script assessment be made when we simultaneously are encouraging our audience (Chinese

government language planners) to greet numerical studies with an attitude of skepticism?

The answer once more is to emphasize the strength and validity of our conceptual framework and methodology. In those cases when numerical data is misleading it is often due to faulty operationalized variables: The thing measured is not the thing intended for study. This seems to be the case, for example, with reports about literacy in China: They claimed to measure the effects of simplification, yet because no scientific framework was employed the conceptual dependent variable (literacy) was not properly defined. In effect, it was *de facto* operationalized as such unreliable correlates as self-reported writing ability. As we saw in Chapter 2, people not formally trained in linguistics or literacy research are typically unaware of what constitutes functional literacy and do not make for dependable sources of information about their own reading and writing skills. Combined with a further typical lack of training in statistical reasoning, such subject-centered self-reporting constitutes poor evidence when compared with the design strengths of proper experimental measurement.

4.5.2 Distrust of Researchers

Bound to the recognized potential of exploitative statistics is the idea of agenda-motivated research – research conducted so as to yield pre-determined results to buttress some ideological claim. Because the assessment of script reform subjects a government-implemented program to scrutiny, it is all the more sensitive; conclusions about the effectiveness of the program might be taken as attempts to solicit subject support for a particular opinion of the Chinese government.

On this issue the present study benefits from deriving much of its research framework from outside of the kinds of studies previously applied to Chinese script reform assessment (reviewed in Section 2.2), which do apparently suffer from research bias (as well as fail on methodological validity). It of course does have an applied social objective – the improvement of mass literacy through informed, accurate script policy – but this objective is not favored by either experimental condition.

Quantitative methodology, in itself, is no guarantee against research bias, so future studies derived from the framework offered in this paper will need to constantly reassert the intentions of their research – to determine the measurable effects of character complexity on the acquisition and retention of literacy in Chinese characters. Quantification does, however, force proponents of various views about the worth of Chinese characters to demonstrate their claims in substantive, meaningful ways.

4.5.3 Distrust of Empirical Methods

As related in Section 3.1, empirical methods exchange naturalism for control and multivariate correlation for univariate causality. While some will forever protest that experimental control invalidates scientific empiricism for research into social topics, they cannot argue with the fact that a scenario proposed in a causal, measurable way – "Simplification helps Chinese readers memorize characters" – can only be properly studied in a causal, measurable way, i.e. scientifically.

When empirical studies are aware of their limitations and make explicit what those limitations are as well as their consequences for interpreting their relevance to the conceptual research question, it is hardly fair to criticize them as artificial. Moreover,

as discussed in Chapter 3, empirical studies like all of science are inductive and hence cumulative – no empirical study provides a full answer to a complex research question, but the sum of ongoing empirical studies allows us to approach ever higher degrees of confidence in the causal relationships proposed.

4.5.4 High Cost of Empirical Research

In the present case, at least this last of the common fears identified by MacNealy was unjustified. This experiment was conducted with a minimum of expense, requiring only personal computers which are easily available for public access. Such will not always be the case, and increasingly complicated experimental designs involving more test subjects, more powerful test programs, or protracted time frames (longitudinal studies), as well as supplementary studies based in the field, will incur greater expense. Because the reliability of empirical studies of this sort – unlike the reliability of qualitative studies –improves with larger subject pools, they often require greater effort and involvement, which can translate as higher cost. Why opt for the more difficult or expensive option, especially when simpler and cheaper ones are already in place?

Such remonstrations have a simple rebuttal. The value of quantified methodology to inform the Chinese script reform debate should by now be obvious. Even if future quantified, empirical research should prove more costly on average, the investment will be far more productive than the previous anecdotal or correlational studies have been. The latter have failed to provide an effective methodological framework to gather relevant data, despite having been used to supposedly assess Chinese script reform since character simplification was first implemented. Of what

good, then, will it be to continue to support such unproductive work? Better to redirect research efforts toward a more appropriate framework, even at the price of potential greater expense. Whatever greater expenses might be incurred will certainly be offset by the efficiency in obtaining relevant and applicable data. The old saying "You get what you pay for" seems most fitting here.

4.6 Suggestions for Future Experimental Research

As this study was a pilot of sorts for quantified script assessment in Chinese, many of the experimental conditions were designated in a somewhat arbitrary manner – paying heed to previous studies, of course, but not being constrained by their chosen parameters. It was thought best to keep the design as simple as possible in order to provide a clear and unambiguous test hypothesis. Precisely because the present design was relatively uncomplicated, it invites elaboration by any number of modifications and additions to its basic format.

The use of small sets of characters for experimental tasks, as noted in Section 2.4, has been a major criticism of many earlier studies because these sets do not in any way approach the number of lexical items required to reach the threshold of functional literacy. Recalling that 3,500 was the number of characters thought necessary for basic literacy (Taylor and Taylor 1995:118), the thirty employed by this study, like the thirty used by Rozin et al. (1971) and certain of the Blissymbolics experiments, allow us to draw only the most preliminary of conclusions about the Chinese script system as a whole. That this is so is even more obvious when remembering that the majority of

modern Chinese words are multi-character compounds, meaning that the functional literate must know not only the basic 3,500 characters individually but also their various combinations – the latter being unquestionably a far larger set.

Expanding the set of characters for subjects to memorize in an experimental setting would require corresponding increases in the amount of time given to those subjects to memorize them; there is only so much subjects can reasonably be expected to memorize for any selected length of practice time. The more closely we would wish to approximate the memory capacity required for literacy, the more time would have to be allowed for practice, and after a certain point the controlled experimental format used in the present study would become unfeasible.

In Section 1.2 the importance of longitudinal designs was emphasized; the acquisition of literacy, after all, is itself a longitudinal process and no assessment of script efficiency can be considered complete without the measurement of long-term effects. As is well understood, there is a genuine loss in the amount of control, and a concomitant gain in the number and strength of confounding variables, when converting from an isolated ("laboratory") to a longitudinal format. One of the merits of the present study was its level of experimental control, which had not hitherto been exercised in studying Chinese script variations and which was deemed by the author a serious omission in the research literature to date. Yet even as the conceptual strengths of this study are acknowledged, their implications for informing its target issue – Chinese script reform – can only be fully appreciated in tandem with related

longitudinal designs. They form a complementary whole, exchanging rigor for diachronic naturalism.

Synchronic naturalism, too, is an important avenue of research, but again this can be done only at the expense of experimental control. It involves data collection which is more passive in nature, taken in ordinary rather than laboratory settings and tolerating the confounding variables that such natural environments likely contain (though these will always be less than those in longitudinal studies, which combine environmental with diachronic confounds). Important work in this format has been done by Chiung (2003). Addressing the same fundamental question as the present work – whether Chinese characters are an optimal route toward mass literacy – in the Taiwanese context, he collected responses from East Asian schools using three script types -- Characters and *Zhuyin Fuhao*[11] for Chinese in Taiwan and *Chu Quoc Ngu* Latinization in Vietnam – on tasks of reading comprehension, writing dictation, and oral reading. Though he obtained mixed results and his study was thus inconclusive on script efficiency,[12] it provides a model for a similar naturalistic study involving simplification.

Referring again to the types of quantified study described in Section 1.1, the above can be classified as cognitive processing experiments. It then remains for us to

[11] He refers to it as "Bopomo," after the set of labials commonly recited as the first part of the *Zhuyin Fuhao* mnemonic table. The author has observed that Taiwanese consistently prefer "Bopomo" to "*Zhuyin Fuhao*" as the name of this syllabary.

[12] Though I read his results as inconclusive, he himself is of the opinion that his findings are indicative of a clear advantage in both alphabetic *Pinyin* and syllabic *Zhuyin Fuhao*. Readers of the present paper are encouraged to decide for themselves; Chiung's dissertation and other related papers, in both English and Chinese, are available on his website in downloadable PDF format: http://mail.ncku.edu.tw/~uibun/download/index.html

suggest directions within the remaining category, psychometrics. Several psychometric studies were already encountered in Section 2.3, for example the fMRI mappings reported by Perfetti and Tan and their associates. The same designs could be employed to compare possible differences in neural activity between traditional and simplified characters on a multitude of component literacy tasks, and from those results extrapolations could be made as to which pedagogical techniques might better engage their respective brain regions for maximal instructional benefit. Similarly, Peng et al.'s (1983) findings on saccadic eye movement could with similar ease be adapted to a comparison of reading speed in traditional and simplified characters. The Stroop effect, whose applications in Chinese have been reported in Biederman and Tsao (1979) and Tzeng and Hung (1980), has generated an enormous body of literature in experimental psychology, and at the time of this writing the author is preparing a study to test the effects of character simplification on Stroop performance, using several Chinese color characters with simplified versions (Macaraeg 2004, forthcoming).

Just as methodological variables can be elaborated, the size and diversity of the subject pool can likewise been expanded. While the present study used adults, literacy studies are typically attuned to children and adolescents in various developmental stages of acquisition. The same procedure conducted here could just as easily be performed on different age groups or broadened to include multiple age groups.

The present study departed from prior literature in another important way: Subjects were recruited specifically for their lack of knowledge of Chinese characters. This was deemed necessary in order to eliminate the effects of prior exposure to either

traditional or simplified character writing, which would have prejudiced their responses in the direction of the one in which they had more practice. It would be interesting to know how other non-Chinese literates with experience of different scripts would perform on the same or similar tasks. How would the degree of phonemic specificity in the native language affect performance in character reading (e.g., does learned reliance on graphic cues to phonology make readers prefer phonetic over semantic components within individual characters)?

As we saw in the literature review, much insight has been gained from orthographic research into reading and other cognitive disabilities. While much of the relevant work was conducted to investigate the possibilities of remediation through character orthography, findings in this area reveal much about normal reading acquisition, and performance in remediation through simplified characters is another possibility. The numerous methodological concerns noted in 2.4.1, though, would need to be addressed first.

Scientists working in experimental psychology are in the habit of recording correlations for a plethora of subject variables – age, gender, level of education, and ethnicity, to name some of the more popular. These issues, while obviously relevant to performance issues of reading Chinese characters because they affect subject competence, may with some justification be regarded as tangential to the central issue of determining the utility of simplification as an optimal mass literacy program for China. Because such information should not be disregarded, it may be most productive from a research standpoint to incorporate them in multivariate experimental designs.

Again, recognizing the need to supplement experimental rigor with contextual naturalism, multivariate models offer yet another way to apportion the balance.

4.7 Non-Experimental Research

Empirical methods can also be used for non-experimental research procedures. MacNealy (1999) lists three others: Historical, descriptive, and meta-analytic. Like experiments, they are quantitative but have not been applied systematically to the problem of Chinese script reform assessment. A brief overview should suffice to reveal some of their potential for future study.

4.7.1 Historic

Historical empirical work involves observing trends in archival data and seeking correlations which evince the potential of causality. This is done largely to record the possible influence of some past influence in shaping contemporaneous or ongoing circumstances. This past influence may not be available, for any number of reasons, for effective operationalization as a test variable for the present experimenter, or perhaps the experimenter wishes to use the observations from historical trends to help formulate a current hypothesis. Obviously, work of this nature has been done – albeit without the necessary level of rigor – in the various reports of the rise in Chinese mass literacy after the implementation of simplification. Those reports failed to take note of the many likely confounding variables which could have aided the rise in literacy, but a more

nuanced review of the historical data may suggest clearer trends in the data and are worth conducting.

4.7.2 Descriptive

Descriptive empirical research is done in case-study format: A rare or unique circumstance in which a particular influence is known is recorded in exhaustive detail and the differences between the research case and documented ordinary cases are compared. Here the implication is that the unusual influence is responsible in large measure for such differences. Studies on reading deficit, many of which were reviewed in Section 2.4, are often conducted in this way, as reading-disabled subjects experience unique pre-intervention histories and subsequently receive intervention under unique circumstances. While such single-subject studies alone might have scant relevance to the assessment of Chinese script reform – a topic aimed a populations rather than individuals – observations of trends within sets of related such case studies may prove revealing.

4.7.3 Meta-analytic

This brings us to the last non-experimental form of empirical research, meta-analysis. This is a complex technique to weigh the relative strength of a particular independent variable that has been conceptualized and tested across several separate experiments. Indeed, it is hoped that the study presented here will stimulate related studies, all of which will be incorporated into a meta-analysis which will indicate the presence or absence of any significant proximal effect of simplification on the

acquisition and retention of Chinese characters, and of its extended, distal effect on literacy in Chinese characters.

4.8 Summary

This study was conceived in response to a recognition for quantified research assessing the success of the Chinese simplification program for mass literacy and the principles upon which it is predicated – most of all, the deterministic claim that character orthography offers inherent advantages over phonemic alphabets. Such success has been widely touted and largely taken for granted among nearly all interested and/or affected parties, but a review of arguments adduced as its evidence reveals only correlations and anecdotes – and unreliable ones at that. For a variety or reasons, Chinese governmental policymakers have had little motivation to question the official position, while at the same time cultural loyalties to character writing remonstrate against script replacement, a more radical but possibly more beneficial reform proposal.

Once the assumptions of success are called into doubt, and when this doubt is coupled with a concern for the rising developmental challenges facing China, the need for quantified assessment of mass literacy through character simplification becomes evident. That researchers have not done this before is not for lack of relevant studies; as we saw in Section 2.4, much has been learned in the areas of perceptual and cognitive psychology, literacy acquisition, learning disabilities, and pedagogical theory. Many of these were conducted to observe differences between alphabet and character scripts. Though interpreting the results is still a matter of debate, this is ample evidence that

different script types are processed in different ways in both psychometric and cognitive terms. The more vociferous of commentators have extrapolated these differences to form perspectives of orthographic determinism, attributing variations of culture to variations of script.

Collectively these studies provided a basis on which to construct a quantitative hypothesis comparing acquisition and retention in traditional and simplified characters. Following Seidenberg's (1985) time course model of script processing, lexical items move away from phonological mediation as they become progressively familiar, while in the same study, later supported by Hue (1992), results showed that increasing the weight of a character's phonetic component (as simplification often does) aids identification. Reduction of graphic complexity, another consistent feature of simplification, has also been shown to expedite recognition (Hoosain 1991; Flores d'Arcais 1992; Cheng 1992), so together a case could be made that simplification makes characters easier to learn and, by extension, facilitates literacy in a general sense.

Being the first of its kind, the present experiment chose frugality over complexity in design, realizing that subsequent research would be better served by clear operational precedents in the formative literature. A set of characters were distributed to non-Chinese reading subjects in traditional and simplified conditions to test for short-term retention. No significant difference was found, though this experiment alone is not enough to decide the issue. Its conclusions are contingent upon follow-up studies and will only become contextually meaningful as part of a large body of quantified character-complexity research. They are, however, suggestive of the possibility that

claims about the significant impact of character simplification on Chinese literacy rates are overstated, and that alternative script reform policies, such as Latinization, should be given serious consideration. Clearly, more quantified assessment of character simplification is required. The author is confident that such research as a whole can provide a definitive answer to the question of determining the optimal course for mass literacy among Chinese language users.

Taylor and Taylor (1995) remarked in exasperation that one good experiment would do more to answer the question of optimal script type for Chinese than a thousand armchair speculations. Hopefully this work has been something of that – a step in the right direction.

APPENDIX A

MEASURES OF IMPORTANT READING-RELATED COGNITIVE PROCESSES

Cognitive Process	Sample Tasks	Examples of Standardized Tests
letter identification	name single letters and/or give their sounds	Woodcock Reading Mastery Tests (WRMT) Letter Identification
phonological awareness	segment a spoken word into individual phonemes (phoneme segmentation); identify spoken words that begin with the same initial sound (alliteration); blend orally presented phonemes into a whole word (phoneme blending)	Lindamood Auditory Conceptualization Test (LAC); Test of Phonological Awareness (TOPA)
rapid naming	name as quickly as possible an array of letters, single digits, colors, or pictured objects	Rapid Automatized Naming (RAN) (Denckla & Rudel, 1976)
expressive vocabulary	name individually presented line drawings or pictures	Boston Naming Test (BNT)
receptive vocabulary	given a set of pictures, point to the correct one when the examiner names it	Peabody Picture Vocabulary Test (PPVT)
word decoding	read aloud out-of-context pseudowords (e.g., *taff*)	Woodcock or Woodcock-Johnson Word Attack
speed and fluency of reading	read words or paragraphs aloud under timed conditions; observations of ease and expression of reading are also made	Gray Oral Reading Test (GORT)
use of comprehension strategies	answer questions about use of strategies during reading (e.g., when comprehension fails, does the individual make use of strategies such as rereading?); observations of strategy use are also made	usually assessed informally
listening comprehension	listen to words, sentences, or paragraphs read aloud by the examiner, then point to a corresponding picture or answer verbally presented questions about the material heard	Wechsler Individual Achievement Test (WIAT) Listening Comprehension
reading comprehension	read a sentence or paragraph with a blank in it and fill in a word that makes sense (cloze format); answer questions about material the individual has read aloud or silently	Woodcock or Woodcock-Johnson Passage Comprehension (uses cloze format); Gray Oral Reading Test (GORT) and WIAT Reading Comprehension (both use question-answering format)

APPENDIX B

EXAMPLES OF SIMPLIFIED CHARACTERS

The Simplified script (a.k.a. Simplified Chinese) was officially adopted in the People's Republic of China in 1949[13] in an effort to eradicate illiteracy. The simplified script is also used in Singapore but the older traditional characters are still used in Taiwan, Hong Kong, Macau and Malaysia.

About 2,000 characters have been simplified in a number of different ways (the simplified characters are shown in red):

- many simplified characters are based on commonly used abbreviations

語语 見见 間间 銀银 飯饭 魚鱼 紅红

- others retain only one part from the traditional character

開开 飛飞 聲声 號号 從从 豐丰 雲云

- some replace the phonetic element of the traditional character with a simpler one that is pronounced in the same or in a similar way

畢毕 賓宾 燦灿 懲惩 遲迟 燈灯 遼辽

- in some cases, several traditional characters are represented by one simplified character

係 臺 發 復 乾 匯 矇
繫系 檯颱台 髮发 複覆复 幹干 彙汇 濛懞蒙

Recently the traditional characters have started to make a come back, particularly in southern China.

[13] Official adoption did not actually occur until 1958; see Section 2.1 below.

APPENDIX C

SUBJECT DATA SHEET

SUBJECT DATA SHEET

Thank you for agreeing to participate in this study. As is customary for this type of research, the questions below will collect certain information in order to examine the possibilities of correlations between subject variables and the experimental variable.

All information will be kept confidential, and this sheet itself will be kept anonymous. Should you have any questions regarding any aspect of this form, feel free to contact Ruel A. Macaraeg at ram9413@exchange.uta.edu.

Again, thank you for your participation in this study.

Please indicate the following:

1. Age: _____
2. Gender: _____
3. Highest education level attained: _____
4. Native language: _____
5. Other language(s): _____

Experience with the Chinese language:

1. Have you ever studied Chinese? _____
2. If so, approximately how many characters do you know? _____

APPENDIX D

SUBJECT CONSENT FORM

SUBJECT CONSENT FORM

I have been asked to participate as a subject in the research project studying the short-term acquisition of Chinese characters under the direction of:

Principal Investigator: Ruel A. Macaraeg
Supervising Committee: J. A. Edmondson, PhD; L. S. Stvan, PhD; W.-F. Or, PhD

I understand that there is minimal or no risk as the result of participating in this study. I understand that I will not receive any direct compensation or benefits by participating in this study.

1. The procedures in this project have been identified and explained to me in language that I can understand.
2. The risks and discomforts from the procedures have been explained to me.
3. The expected benefits from the procedures have been explained to me.
4. An offer has been made to answer any questions that I may have about these procedures. If I have any questions before, during or after the study, I may contact Ruel A. Macaraeg (ram9413@exchange.uta.edu).
5. I have been told that I may refuse to participate or stop my participation in this project at any time. All new findings during the course of this research, which may influence my desire to continue or not to continue to participate in this study, will be provided to me as such information becomes available.
6. If I am injured or have an adverse reaction because of this research, I should immediately contact one of the personnel listed in Clause #4 above. No additional compensation will be provided. Agreeing to this does not mean I am giving up any legal rights that I may have.
7. If I have any questions regarding my rights as a subject participating in this study or research-related injury, I may contact Dr. Marianne R. Woods, Assistant Vice President for Research / Director of the Office of Research, UT Arlington, at (817) 272-2105.
8. I have a right to privacy, and all information that is obtained in connection with this study and that can be identified with me will remain confidential as far as possible within state and federal law. However, information gained from this study that can be identified with me may be released to no one other than the investigators. The results of this study may be published in scientific journals without identifying me by name.

I voluntarily agree to participate as a subject in the above named project. I understand that informed consent is required of all persons in this project. I understand that I will indicate my agreement to all of the above conditions by signing below and I understand that I have given formal consent to participate in this study. I can obtain a copy of this consent form upon request.

Signature Date

APPENDIX E

CHARACTER LIST – SIMPLIFIED CONDITION

Character List

个	piece
来	come
难	difficult
为	act
国	country

这 this

发 dispatch

键 key

桥 bridge

驻 stop

干	oppose
悦	pleased
残	injure
讯	examine
还	yet

学 study

会 meet

电 lightning

无 not

请 ask

谱	list
裤	pants
时	time
于	on
过	pass

麽	tiny
宫	palace
说	say
没	drown
坛	altar

APPENDIX F

CHARACTER LIST – TRADITIONAL CONDITION

Character List

個	piece
來	come
難	difficult
爲	act
國	country

這 this

發 dispatch

鍵 key

橋 bridge

駐 stop

乾 oppose

悦 pleased

殘 injure

訊 examine

還 yet

學 study

會 meet

電 lightning

無 not

請 ask

譜	list
褲	pants
時	time
於	on
過	pass

麼	tiny
宮	palace
說	say
沒	drown
壇	altar

APPENDIX G

FEEDBACK QUESTIONNAIRE

Feedback Questionnaire

Thank you for your participation in this study. In order to assess the quality of this research from the subject's perspective, this form is provided for you to leave feedback about the procedure. Any questions or concerns are welcome. These forms will remain anonymous and confidential.

1. Was the procedure clearly explained to you before you were asked to begin?

2. Once you began, did any aspect of the procedure confuse you?

3. Did you feel you were able to complete the task asked of you?

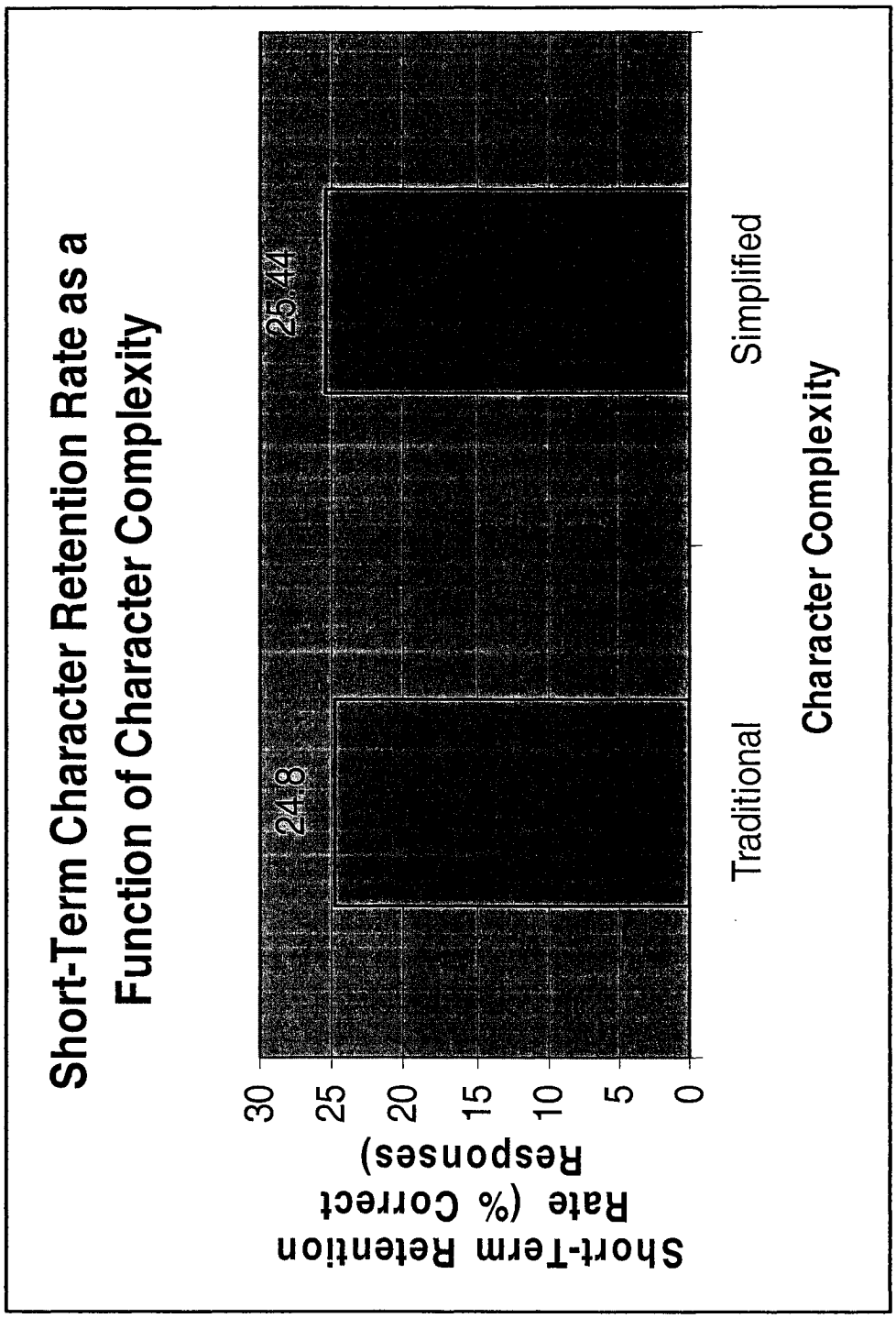
4. At any time during the experiment, did you experience any discomfort, duress, or other
inordinate stress? If so, please explain.

5. Were the purposes of the study clearly explained to you upon completion of the procedure?

Thank you again for your participation, and for completing this form. If you have further questions or comments, please contact Ruel A. Macaraeg at ram9413@exchange.uta.edu.

APPENDIX H

SHORT-TERM CHARACTER RETENTION RATE (PERCENT CORRECT) AS A FUNCTION OF CHARACTER COMPLEXITY (TRADITIONAL VS. SIMPLIFIED)



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BIOGRAPHICAL INFORMATION

Ruel Asanee Macaraeg was born in Lansing, MI on 24 November 1973. He received his BS in Biology (1995) and BA in Psychology (1997) from the University of Texas at Arlington, and became a certified elementary educator in 2002. During the academic year of 1997-1998 he taught English in China, an experience which exposed him to the research questions forming the basis of this paper. In 2000 he began his linguistics studies in order to pursue these issues in an academic context.

Aside from Chinese script reform, a number of other topics in linguistics have engaged his interest, on which he has presented lectures to universities across the United States and in South Africa, Malaysia, Russia, Canada, Scotland, and Taiwan. These include Renspeak, Scientific Babelism, the linguistic status of emoticons, and the interface of linguistics with the new statistical-probabilistic paradigms emerging in the sciences. This work has received a number of awards, among them induction into Who's Who among Students of American Colleges and Universities (2004) and receipt of the UTA Graduate School's Best Oral Presentation in Liberal Arts (2002). He has also lectured and conducted research in a variety of other fields, from science education to European military history to bellydance. These and other various research projects are described more fully at http://linguisticspage.homestead.com.