Although more people speak Chinese than any other language on Earth, proficiency in Chinese is largely confined to the people who live in or adjacent to the Chinese Mainland and Taiwan, and to the ethnic Chinese inhabitants of the various “Chinatowns” in countries around the world. Despite its allure, many people find Chinese a hard language to learn, including a considerable number of children who learn it as mother tongue.

The basic units of written Chinese are ideographic symbols called characters; and the meaning and pronunciation of each character is determined by the tone attached to it by the speaker. Facing the very large number of Chinese characters and words, it seems impossible for learners, regardless of their native language, to master the language other than via rote memorization. The attempt to facilitate the route to proficiency in Chinese has understandably attracted the attention of numerous psycholinguistic researchers and educators.

Using the Theory of Variation as the primary learning framework, the authors of this book conducted a number of large-scale and robustly-designed studies to investigate the relationship between the learning and teaching of Chinese, mostly among native speakers. However we believe that the results are applicable to the learning of Chinese as a second language. Studies into ways of understanding the phonological and orthographical acquisition of characters are reported; ways of helping learners come to terms with reading Chinese, a textual language that does not always correspond word-for-word with the spoken discourse, are explained; and the implications of the evidence for Chinese curriculum and syllabus design are pointedly addressed by the contributors.

The authors believe that there are effective ways to become skilled in Chinese and that learning Chinese can be pleasurable and interesting. They provide empirical evidence for educators, parents, policymakers and readers interested in Chinese language education. They also illuminate the path to the mastery of Chinese in schools and how Chinese should be taught in today’s world.
On the Learning of Chinese
On the Learning of Chinese

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Increased interest in China from those outside has led to a corresponding interest in
the study of Chinese. Spoken by one-fifth of the world’s population, Chinese is one
of the official languages of the United Nations and the most widely used language
in the world.

Notwithstanding its popularity, Chinese is often considered as one of the most
difficult languages to learn by many language learners. Two major difficulties often
perplex learners: (1) the basic writing units of Chinese are semantic-phonetic com-
pounds called characters, and each of them has its own meaning and pronunciation;
and (2) word meanings of homophones in Chinese are distinguished specifically by
lexical tones. Due to the very large number of Chinese characters and words, it
seems impossible for learners, regardless of their native languages, to master the
language by rote memorization. The acquisition and processing of the Chinese
language, thus, have provided interesting fields of study in psycholinguistic research.

Although originally developed by Swedish scholar Ference Marton, the Theory
of Variation has been shown to be particularly useful in understanding and promoting
learning and teaching in Chinese by a large body of research. Essentially, the theory
describes learning and teaching from the perspectives of learners: to learn about
something implies that learners must discern that something from its background.
If there is no variation, then there is no discernment. The goal of teaching and
learning of Chinese, therefore, is to help learners identify and contrast patterns
of variation and invariance of different aspects of the Chinese language, from
components of individual characters, to daily communication and even compre-
hension of literature.

Using the Theory of Variation as the primary framework—or at least relating to
it—the authors of this book have conducted a number of rigorously-designed studies
to investigate the relationship between learning and teaching of Chinese, starting
from understanding the phonological and orthographical acquisition of characters,
to developing a comprehensive curriculum. Each of the study presented in this
book represents long-term sedulous efforts of all the contributors.

Our thanks go to all authors for their excellent contributions, and for their
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We sincerely hope that this book will provide empirical reference for educators,
parents, policymakers, and readers who are interested in Chinese language education,
as well as illuminate the path for Chinese language pedagogy and curriculum
development.

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1. CHINESE AND THE LEARNING OF CHINESE

INTRODUCTION

Chinese is spoken by one-fifth of the world’s population (Li, Tan, Bates, & Tzeng, 2006) and is one of the official languages of the United Nations. Today, Chinese is the most widely used language in the world and has become an increasingly popular second language amongst the people in the Western world (Weber, 1997). From 2000 to 2004, the number of students in England, Wales and Northern Ireland taking Advanced Level exams in Chinese increased by 57% (Ramzy, 2006). About 117,660 non-native speakers took the Chinese Proficiency Test in 2005 alone, an increase of 26.52% from 2004 (Xinhua News Agency, 2006). Currently, over 3,000,000 people are studying the Chinese language, and Chinese language courses can be found in more than 2000 universities around the globe.

Despite its popularity, many language learners, particularly those whose native language is an Indo-European language, often consider Chinese as a very difficult language to learn as it differs significantly from most Indo-European languages and offers unusual features in its orthographic, phonological, lexical, and syntactic structures. The traditional approach to teaching and learning Chinese of repeatedly copying words and dictation seems to be less than helpful in addressing these differences. Nevertheless, by understanding the specific properties of the Chinese language, as will be demonstrated in this chapter, innovative pedagogy can be developed and effective teaching and learning can be made possible.

OVERVIEW OF THE PROPERTIES OF THE CHINESE LANGUAGE

Unlike English and many Indo-European languages, Chinese is a tonal and logographic language. Instead of using alphabetic letters as the basic writing unit, Chinese uses logograms, more conventionally referred to as characters, which are written within imaginary rectangular blocks. These characters are morphemes independent of phonetic change. For example, both yi1 in Mandarin and jat1 in Cantonese share an identical character “—” and mean the number “one”. Therefore, compared with a written word in English, a Chinese character has a stronger association with its meaning. Phonologically, tones are used to distinguish meanings of characters. Orthographically, characters are often composed of both phonetic and semantic components. Morphologically, words are formed by agglutination of these characters and have only one grammatical form. It is indecipherable about the total number of
Chinese characters from past to present, as new ones continue to be developed. The latest Zhonghua Zihai (Dictionary of Chinese Characters), published in 1994, records a staggering 85,568 single characters (Leng & Wei, 1994). However, generally, knowledge of about 2,500 characters is needed for basic literacy in Chinese (National Education Commission & National Language Construction Committee, 1993; Ministry of Education, PRC, 2001).

**Phonology**

A distinctive characteristic of Chinese characters is that each of them corresponds to one syllable that carries a particular tone. All varieties of spoken Chinese use tones, but the number may vary from dialect to dialect. For example, Mandarin has four main tones, with the first tone having flat or high level pitch; the second tone having rising or high-rising pitch; the third tone having low-dipping pitch; and the fourth tone having high-falling pitch (Chao, 1948). In contrast, Cantonese has six contour tones: (1) high level; (2) high rising; (3) mid level (4) low level; (5) low rising; and (6) low falling, although it is often said to have nine as people usually treat the three tones used for characters that end in a stop consonant — upper entering one (which is similar to upper level tone); upper entering two (which is similar to upper departing tone); and lower entering (which is similar to lower departing tone) — as separate tones.

Unlike most Western languages, in which tones are only used to express emphasis or emotion, lexical tones in Chinese serve to provide contrast in word meanings. In fact, Chinese has a large number of homophones, which are only distinguishable by tones (Institute of Linguistics, The Academy of Social Sciences, 1985). For instance, even though all of them correspond to the syllable “wan”, the meanings of the characters “溫” (sound: wan1, upper level tone); “穩” (sound: wan2, upper rising tone); “搵” (sound: wan3, upper departing tone); “雲” (sound: wan4, lower level tone); “允” (sound: wan5, lower rising tone); and “暈” (sound: wan6, lower departing tone) in Cantonese are “warm”, “stable”, “find”, “cloud”, “allow”, and “dizzy”, respectively. Therefore, for speakers of non-tonal or intonation languages, in which the meanings of words do not change with tone, tone has presented great difficulty as well as ambiguity in learning the language. Processing of Chinese characters, therefore, may require a cognitive system that differs in essential ways from that of English and other intonation languages.

Indeed, as pointed out by Ki, Marton, and Pang in Chapter 3 of this book, speakers of intonation languages, although equally well-equipped to sense tone patterns in speech sounds, often view these patterns as if they belong to the sentence rather than to the syllables. They also tend to see the tone and semantic features of characters as two separate units instead of one integral part. Drawing on Phenomenography and the Theory of Variation, the authors discuss some possible strategies to help speakers of intonation languages restructure the way they attend to meanings in speech sounds and achieve more effective learning experiences of Cantonese.
Orthography

The majority of Chinese characters are composite characters assembled from more than one multi-stroke component fit into the square space. Xu Shen identified 540 components in his *Shuo Wen Jie Zi* (Explaining simple and analyzing compound Chinese characters, as cited in Honorof & Feldman, 2006), a classic work on Chinese characters. Sometimes characters can differ by as few as one stroke, and non-Chinese readers may find two characters with roughly the same number of strokes. Even so, the arrangement of internal components within a character can be rather obvious to fluent readers of Chinese, as individual components are written in a highly constrained order. Generally speaking, four rules guide the writing of Chinese characters: (1) components are written top-left to bottom-right, (2) horizontal strokes are written before vertical strokes, (3) center components are written before their embellishments, and (4) small strokes are often written last (Honorof & Feldman, 2006).

Some components of more complex characters can indeed stand on their own as characters and function to provide information about the meanings and pronunciations of the larger characters in which they appear (Honorof & Feldman, 2006; Ki et al., 2003). According to Lee (1989), approximately 90% of modern Chinese characters are made up of a combination of at least two components: semantic radicals, which carry important clues about the meaning indicated by the full character; and phonetic radicals, which contribute to the general sound of the larger character as a whole. For instance, the characters “奡” (daughter); “娘” (mother); “姑” (sister of father); and “姥” (maternal grandmother); all share the same invariant semantic radical “女” (female) and represent different kinds of females. Meanwhile, the variants “愛” (sound: oi3); “良” (sound: loeng4); “古” (sound: gu2); and “老” (sound: lou5) on the right are phonetic radicals that contribute to the sounds of “奡” (sound: oi3); “娘” (sound: noeng4); “姑” (sound: gu1); and “姥” (sound: lou5), respectively. “女”, “愛”, “良”, “古” each can stand of their own but taking different function in indicating the meaning and sound of a character. Because of these part-whole properties of many Chinese characters, learners with substantial knowledge of Chinese characters are sometimes able to guess the meaning and pronunciation of an unfamiliar character from its components (Zhang, 1987). However, many of these radicals are themselves compound characters, which consist of two or even more components (a part-part relation). Moreover, these individual components of radicals often have nothing to do with the whole character and may be confusing for beginning learners trying to understand Chinese characters.

To facilitate the learning of Chinese, it is essential to develop a pedagogy and curriculum which are based on the needs of learners and subsequently increase their orthographic awareness to distinguish the similarities and differences among different characters. In Chapter 4, Lam investigates the progressive development of children’s orthographic knowledge of the part-whole and part-part relations of Chinese characters, as well as suggesting some effective ways to enhance their orthographic awareness. Armed with this knowledge, in Chapter 5, Tse, Marton, Ki, and Loh introduce a perceptual approach to the learning and teaching of
Chinese characters by utilizing a learner’s own language. In this approach, characters are taught in contexts which are meaningful to learners and in relational clusters. Special attention is paid to their structural features, written forms and pronunciations. Similarities and variations among related characters in these clusters are highlighted, and crucial aspects of Chinese characters and words are emphasized. The approach was shown to be effective in an investigation in three primary schools in Hong Kong.

*Morphology and Vocabulary*

While many Chinese characters are single-syllable morphemes and can stand alone as individual words, in modern Chinese, they more often agglutinate with one another to form multi-syllabic words. Chinese words can thus consist of more than one character-morpheme, usually two, but words with three or more characters are also not rare. Words such as “筆” (pen, sound: bat1), “蛋糕” (cake, sound: daan6 gou1), and “東張西望” (look around, sound: dung1 zoeng1 sai1 mong6) are examples of words formed by one, two, and multiple characters, respectively. Studies on the teaching and learning of Chinese words often focus on foreign language learners and word identification, due to the fact that in written Chinese text words are not separated by spaces as in English and in many other languages (e.g. Chen & Liu, 1992; Ge, Pratt, & Smyth, 1999, Lin, 2000).

In order to explore the relationship between the teaching and learning of words in native speakers of Chinese, in Chapter 6, Chik, Leung, and Marton report the results of the different word teaching strategies used by two different Primary Two Chinese language teachers in Hong Kong in teaching their classes. The findings reveal that the students’ perception of what they had learnt was closely related to what was made possible for them to discern by the pattern of variation and invariance of words and their context of usage enacted in lessons. Students who were able to discern different aspects of words were also found to have outperformed their counterparts in the written task. These findings indeed have very important implications for developing reading and writing skills in Chinese learners and improving existing language pedagogy.

**TEACHING AND LEARNING CHINESE IN CLASSROOMS**

Reading and writing, unlike spoken language, almost never develop without formal teaching (Adams, 1990; Stanovich, 2000). This is especially true in the case of Chinese (Li & Rao, 2000). Enhancing students’ ability to read and write Chinese has thus been one of the key objectives in the Curriculum Reform in Hong Kong (Curriculum Development Council, 2001). Traditionally, practices in the classroom are heavily dictated by commercially produced textbooks and teaching guides which contain a great number of independent short passages or simplified Chinese literature. The lack of cohesion in the themes and writing styles of these passages have imposed obstacles for both teachers and students as it often leads to difficulty in perceiving the focus of lessons.
Aware of the deficiencies of existing practices in schools in Hong Kong, in Chapter 7, Tse, Marton, Loh, and Chik developed an innovative one-year curriculum which focused on novels, both fiction and non-fiction, for Secondary One students in three schools. The use of novels instead of a number of independent short passages allowed students to engage in studying the materials over a longer period of time and to receive a degree of continuity over lesson content. Fiction and non-fiction novels were contrasted to illustrate various language applications and the uses of different reading and learning strategies. Sharing of opinions and interpretations of particular episodes in the novels were encouraged among students through an on-line discussion forum. Compared with their peers who were taught in similar fashion, but received the conventional input of Chinese passages to study, students who experienced the new curriculum scored significantly higher on tests of reading comprehension and expressive writing. These findings support the conclusion that Chinese literacy can be fostered by a more coherent curriculum and guided discernment of the variation among different texts and interpretations.

However, merely enhancing the literacy of Chinese language learners is not enough. It is also essential to enhance the creativity of students and teachers. All scholars of creativity seem to agree that creativity has to do with opening up, providing space for the individual to move around freely. We look at creativity as a certain way of handling Chinese writing and teaching. Chapter 8 and Chapter 9 illustrate how creativity can possibly be enhanced in the classroom through the systematic use of variations and invariance in the teaching of Chinese writing.

In Chapter 8, Cheung, Marton, and Tse look at creativity from a pedagogical point of view and try to enhance creativity in Chinese writing by applying the Theory of Variation. They carried out a quasi experimental trial within the framework of Learning Study in Primary Three classes for one year. Teacher participants discerned the capability of writing creatively in lesson planning and then used the creative writing strategies developed to teach writing skills to the student participants. It was found that students in the target group significantly outperformed those in the comparison group in the creativity score. The enhancement of creativity in Chinese writing was to a significant extent associated with the teachers’ awareness of the role of variation and invariance for learning as demonstrated in their method of conducting the lessons.

Teachers also play an important role in boosting creativity in Chinese teaching. In Chapter 9, Lee, Marton, and Tse show how creative teaching was implemented in a Chinese Language lesson of a pre-service teacher after having attended Creative Teaching Training. The theoretical framework of the Theory of Variation was employed to analyse one of her lessons, discerning key characteristics of her teaching in order to demonstrate possible qualitative differences in teaching of potential relevance for the fostering of creativity in students.

**CONCLUSIONS**

While it is impossible to represent all the exciting research in the field of Chinese language education in one book, this book provides a serviceable view of the
application of the Theory of Variation in the teaching and learning of the Chinese language. From the learning of tones, shapes, and semantics of Chinese characters, to fostering creativity in both Chinese learners and teachers, the topics of the chapters are diverse as well as comprehensive. It is our genuine hope that this book provides a valuable reference for educators and policymakers, as well as serving as a catalyst for further research in the field.

NOTES

1 Mandarin examples are given in the Romanization scheme, known as Hanyu Pinyin, introduced in 1956 by the People’s Republic of China, in which tones are numbered from 0 to 4. Cantonese examples are given in the Romanization scheme developed by Wong Shik Ling (also known as S. L. Wong), in which tones are numbered from 1 (high level) to 6 (low level). The online edition of S. L. Wong’s Chinese Syllabary is available at http://humanum.arts.cuhk.edu.hk/Lexis/Canton/.

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CHINESE AND THE LEARNING OF CHINESE


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2. CHINESE PEDAGOGY AND A PEDAGOGY FOR LEARNING CHINESE

INTRODUCTION

Two things the chapters in this book have in common are that (i) they are concerned with the learning and teaching of Chinese, as a first or second language, and (ii) they are underpinned by the same theory of European origin.

Stigler and his research colleagues (Stigler et al., 1999; Stigler & Hiebert, 1999) argue that teaching may be regarded as a cultural activity. In particular, they point out that there are noticeably similar patterns of educational beliefs and practice among schools in the same country, and that these often differ markedly from educational practice in other countries. If their reasoning is correct, it may be possible to discern a distinctive pattern of pedagogy in Chinese schools, which leads Chinese students to perform so well in international comparisons of performance on attainment tests of literacy and numeracy. The pedagogy Chinese students typically encounter in their schooling might indeed in large part help explain why they perform so well. In this chapter we outline a Western theory of learning that identifies some necessary conditions of learning; then refer to a number of international comparison surveys of attainment in which Chinese learners excel. If Chinese students are so good at learning, it seems reasonable to presume that the prevailing Chinese pedagogy they have experienced has been able to supply the necessary conditions specified by the theory. We go on to argue that this is actually the case and point out how elements of a Western theory are remarkably congruent with a Chinese pedagogy and cultural philosophy rooted in ancient times. From our studies of the learning of Chinese, we show how a theory of learning operates that is conceptually and, in practice, harmonious with the Chinese pedagogy observed in Chinese classrooms.

THE THEORY OF VARIATION

The “Theory of Variation” casts light on how teachers can help students learn. Learning is an experience known to everyone, so we first turn to what the “person in the street” takes learning to be. A very widely shared belief about learning is captured in the ancient proverb: “repetitio est mater studiorum” (repetition is the mother of learning). Equally well known is the proposition that “practice makes perfect”. In Chinese, “practice” is a component of the word “learning 學習”: the first character “學” having the meaning of “learn” and the second “習” meaning “practice” in the sense of “doing something again and again” - a synonym for “repetition”.

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When learning and teaching are discussed in educational circles today, there seems to be less emphasis on the amount of practice and more on the purpose and meaningfulness of the practice. Relevance, motivation, participation, interaction and so on are stressed, but so too is the notion that a certain element of repetition is usually essential. We are not suggesting that learning will inevitably ensue and endure simply from the mechanical repetition or recitation of unconnected items of information; nor will it ensue if everything varies simultaneously so that an abundance of information is presented and learners are confused. Learning endures when there is carefully planned repetition and systematic variation of information input.

The basic idea of the “Theory of Variation” is that in order to grasp the meaning of something you must notice how it differs from other things. Also, in order to notice the ways in which the target phenomenon differs from other things, there must be a difference in that respect, a difference which the learner can discern against the background of invariance in all other respects.

Learning, Discernment, Variation and Simultaneity

Learning is in general a process in which people become capable of doing things in new ways. When people engage in learning, they act in ways in accordance with the given situation and what is to be achieved in that situation. To be able to act in a certain way, in turn, calls for the learner to experience things in a certain way. When we come across an object in the real world, we are frequently exposed to many aspects of that object at the same time. However, as suggested by Miller (1956), our capacity for holding information in mind in the short-term is limited, meaning that it is impossible for us to be focally aware of and retain all aspects of the object simultaneously. Rather, we pay attention to, and thereby discern, aspects of the object in the forefront of our awareness, and take less notice of other aspects in the background. Often the background is ignored, skimmed over or taken for granted. In other words, the discerned aspects and aspects which are taken for granted constitute a sort of figure-ground relationship. Such relationship helps define the structure of the object and allow the learner to attach meaning to it.

Learning to experience a phenomenon in a certain way is governed by the dynamics of discernment and those aspects that come to the fore of the learner’s awareness at the time. Research studies into the phenomenographic approach to learning since the 1970s consistently show that people understand the same thing (phenomenon) in the same situation in qualitatively different ways; and that such differences reflect different aspects of the phenomenon that different learners are aware of at the time (Marton & Booth, 1997). Bowden and Marton (1998) further point out that discernment presupposes variation in the aspects that are held in the learner’s focal awareness and are experienced as varying by the learner.

When some aspect of a phenomenon or an event varies while another aspect or other aspects remain invariant, the varying aspect will be discerned. In order for this to happen, variation must be experienced by the learner as variation (p. 35).
For example, in order to discern the taste of sweetness, one must have experienced tastes which are not sweet, such as bitterness or saltiness. If everything in the world tasted sweet in the same way, people may not have the concept of taste. On the other hand, when people have experienced different tastes and are aware of such difference at the same time, they are able to discern the concept of “taste”. Here, “taste” constitutes “a dimension of variation”, and sweetness, bitterness, saltiness and so on are “values” along that dimension.

Discernment may occur in two different ways. As noted above, an attribute may be discerned (sweetness) and at the same time a dimension of variation (taste) in which the attribute is a value may also be discerned. In the other case, a phenomenon (a whole) may be discerned from a context and parts of the phenomenon may be discerned from each other and from the whole as well. Taking the example of a deer in a wood given by Marton and Booth (1997), in order to see a deer in a wood, we need to have discerned its contour among the trees. In so doing, we may also have seen its parts, such as eyes and nose, and how these relate to the body. Once the whole (contour of the deer) is discerned from the background context (the woods), the meaning of the parts (e.g., eyes and nose) and their relationships with each other and to the whole may become clear. Once a part (e.g., eyes) is discerned, its relationships with other parts (e.g., nose, body) and with the whole may also become clear. The whole contour of the deer may hence stand out.

However, having learners face the same situation does not imply that the relationship between parts and wholes will be discerned in the same way by all. Säljö (1982) carried out a study of how people came to understand a text about learning and found that Swedish adults tended to comprehend it in two distinct ways. One way was to see the text as being about forms of learning (main theme) with the different forms illustrated by different examples (sub-themes). From this perspective, the text was conceptualised in terms of a hierarchical structure. The structure perceived by the other group was linear in the sense that it was thought to be about different things: first about learning followed by different events and discrete cases. It was not seen as consisting of subordinate examples supporting a superordinate theme or concept (in this case, forms of learning). Those adults who understood the text in the hierarchical way were able to grasp the gist of the text more in line with its author’s intentions than those who understood the text as being linear in structure. Although the same elements in the text were identically present, members of the two sub-groups had structurally different perspectives reflecting the differences in the positions and functions of those elements, and hence, the meaning they thought the text presented (Marton & Booth, 1997).

Inspired by Säljö’s study, Chik (2006) used the Theory of Variation to analyse the outcomes of Chinese language lessons taught in contrasting ways. Three pairs of Chinese language lessons were studied, with teachers presenting the same subject matter to students at the same level of studying. In each pair of lessons, structural differences comparable to the hierarchical and sequential ways of responding to the text in Säljö’s study were observed. For example, in two Grade 2 Chinese language lessons, the teachers used the same text, the objective in each lesson being to help the students learn a number of new words in the text.
However, they organised the lesson differently so that the new words in the text were focused on in different ways during the lesson. In one lesson the teacher focused on the overall construction of the whole text, particularly the gist of the passage, the paragraphs and sentences, the words and their characters. Throughout the lesson, she drew the students’ attention to part-whole relationships between the linguistic elements, housing them in a hierarchical structure: characters are made up of components and radicals; characters are the component parts making up words; words are component parts of sentences; and sentences are component parts of paragraphs which, in turn, contribute to the central theme of the text. In contrast, her colleague organised the teaching of the new words stressing three attributes of the words, form, pronunciation and meaning, dealing with each attribute separately. Post-lesson individual interviews with students uncovered different understanding gained by the students in the two classes and how these had affected learning of the target words. The patterns of the students’ understanding of the target words clearly reflected what the teacher had brought to their attention in the lesson. Chik (2006) attributed differences in students’ understanding to the different learning possibilities opened up for students and the differing opportunities for the simultaneous discernment of different aspects of the target words focused upon in each type of lesson (see also Chapter 6).

Similar observations have been presented in a study reported in Chapter 8. Here, two groups of teachers teaching at the same level, worked together to plan the teaching of creative narrative writing in Chinese language lessons in a primary school. Stress was deliberately placed on using the Theory of Variation in the lesson planning stage, with a researcher guiding the target group; the other group, the comparison group, worked alone. It was found that even within the two classes in the target group, remarkable differences were observed in the students’ creativity in Chinese writing, in terms of fluency of expression and number of original ideas shown in their writings collected throughout the year. Further investigation revealed differences in the organisation of teaching content of the lessons experienced by the two classes. In one class, teaching content had been hierarchically structured highlighting part-whole relationships in various aspects critical to narrative writing; in the other, teaching content was sequentially organised with lessons consisting of isolated and discrete items covered by the teacher one after another. Students’ creativity in Chinese writing was found to have developed impressively during the year in the former class, but not noticeably so in the other class.

The meaning learners acquire about a certain object in a particular situation depends very much on their way of experiencing it, and their way of experiencing the object is in part governed by which aspects they see as relevant or available for them to see and keep in focus when encountering the situation. It also pertains to how the aspects are related or structured for their discernment. In other words, there is a “relevance structure” in each learning situation that draws the learner’s attention to particular aspects and the relationships between those aspects considered critical, in consequence bringing about certain qualities in the learning (Marton & Booth, 1997: p. 143). More powerful ways of experiencing are then pertinent
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to the simultaneity of critical aspects; that is, the number and relationships of aspects critical to achieving a certain aim, which are in focus and also discerned at the same time (Chik & Lo, 2004).

Bransford, Brown and Cocking (2000), discussing studies about the nature of expertise in specific domains (chess, for instance), conclude that the difference between experts and novices rests with the higher sensitivity of the former to the relevance of information available (such as interpretation of configurations on the chessboard) when they are dealing with situations or problems. To put it in a slightly different way, experts and good learners are capable of grasping simultaneously critical aspects and their interrelationship and, unlike novice learners, are able to capitalise on this ability to achieve objectives in given situations. Chase and Simon (1973) report that chess masters can simultaneously keep in mind seven or eight pieces in every configuration or move on the board and interpret a great number of possible lines of attack or defence and their consequences; and such ability is critical for mastering chess at an advanced level. This is similar to an extent to the situation in classrooms where students show different levels of understanding of the same lesson taught by a teacher. Students who can see clear relationships between critical aspects (of what is being taught), and between these aspects and the whole presentation of the lesson, are more capable of comprehending the lesson than fellow students who cannot. Thus, it is important to plan lessons in such a way that the discernment of critical aspects of the lesson, their relationship to each other and to the lesson as a whole are made possible through highlighting pertinent patterns of variation and invariance (Marton, Runesson, & Tsui, 2004).

This also calls for teachers to consider the content and constitution of specific topics so that they can be presented in such a way that learning is facilitated for the student.

The Object of Learning

“The object of learning” refers not simply to “content” in the Theory of Variation, but also to capability to do something with that content. Capabilities as such, according to Marton et al., (2004), consist of two aspects: the “general” aspect, referring to what the learner is capable of doing with the content, “the act-side of learning”, such as remembering, interpreting, grasping or viewing something in certain ways; and the “specific” aspect, the content of learning, which refers to what is acted upon, such as formulae, engineering problems, simultaneous equations, World War II and Kafka’s literary heritage. Whereas the specific aspect concerns what the learner is supposed to become able to handle (the direct object of learning), the general aspect concerns how the learner is supposed to become capable of handling the “what” (the indirect object of learning) (Marton & Booth, 1997). In the case of learning to comprehend text through interpreting the meaning embedded in the text, the meaning of the text is the direct object of learning, and making use of that meaning (for retelling the text, using it for making sense of every-day situations and so on) is the indirect object of learning.

The “object of learning” often has different meanings and importance in the eyes of the teacher and the eyes of the students. Teachers usually have clear ideas
about the subject matter they hope students will learn, be it appreciation of modern poetry, how to calculate the area of a triangle or the concept of the water cycle. They will also have considered what they hope students will be able to do with such knowledge, for example how to analyse aspects of modern poetry such as rhythm and syllabic arrangement. All these make up what Runesson and Marton (2002) refer to as the “intended object of learning”, which “may sometimes be used synonymously with others such as learning objectives, learning goals or targets” (Pong & Morris, 2002: p. 16).

Teachers frequently have to make instant adjustments during the course of lessons in response to real and dynamic classroom situations, which may end up in a deviation from, or enrichment of, what they had originally intended. Hence, while the intended object of learning specifies what the lesson is supposed to be about and how it will come to the fore of students’ awareness, the possibility for learning is also shaped by what aspects of a particular object of learning are highlighted, how they are related and made available for the students’ discernment in the classroom setting. This possibility for learning is referred to as “the enacted object of learning” (Runesson & Marton, 2002) and is often described from the researcher perspective, especially in terms of what patterns of variation and invariance are present in the object of learning; in other words what might vary, what might be invariant and how these might interact to generate learning.

The subject matter the teacher presents for learning may in many instances differ from what the students actually end up learning. Students may have focused on and discerned aspects of subject matter the teacher had not thought students would pay attention to and learn. With this in mind, Marton et al., (2004) introduce the concept of “the lived object of learning” to describe what the students might actually focus on and discern.

The distinction between the intended, enacted and lived objects of learning may be regarded as representing three different perspectives on a specific object of learning. The intended object of learning is very much taken from the teacher’s perspective and reflects his or her understanding of the subject matter and what they plan students will focus on and manipulate in the lesson. The enacted object of learning describes the researcher’s perspective of what constitutes the actual conditions for the learning and how the object of learning may have brought to the students’ awareness. The lived object of learning is derived from the students’ perspective of what they actually focused on and discerned, and how they made sense of what was being taught in the lesson. In short, by focusing on the object of learning intended and enacted by the teacher and lived by the students, we are actually looking at the process by which the intended object of learning is actualized into the enacted object of learning and reflected in the lived object of learning.

This model has been used as the launch-pad for a number of research studies linking learning and teaching in the classroom. For instance, Lo and Ko (2002) studied two Grade 1 English language lessons in Hong Kong, the intended object of learning for the two lessons being the same - to be able to relate ones’ daily activities. One of the teachers kept using the pronoun “I” as the subject throughout the lesson. The other teacher varied the pronoun between “I”, “he”, “she” and “it”.

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This variation in pronoun thus allowed the learners to see how the form of the verb in third person singular contrasted against the form in first person singular. Lo and Ko found that the students who had experienced the variation in pronoun performed better than their counterparts in terms of their use of proper verb forms in relation to subject-verb agreement. In a study reported in Chapter 6 and mentioned earlier, a close relationship was also revealed between the different patterns of variation and invariance constituted in the focused aspects in the two Chinese language lessons about learning new words in a text and the corresponding students’ learning outcomes. For instance, in one of the lessons, the words were kept invariant while the three attributes and the usage of each word varied in terms of linguistic context (e.g., the meaning of a word as it appeared in a sentence). This pattern of variation and invariance provided students with the simultaneous experience of the word attributes and usage, and this contributed to the superior achievement of this class in using the words actually taught in both classes to complete a short passage.

It is, however, not our intention to suggest here that there can be a one-to-one correspondence between teaching and learning detected by merely focusing on how objects of learning are experienced by students in the classroom. Other aspects such as the forms and approaches to teaching are also important. Nor do we want to give the impression that introducing variations in lessons and teacher presentations necessarily implies higher achievement by students or good quality of learning. What we want to point out is, as Marton and Morris argue, that among proximal factors (i.e., factors that operate in the very classroom), how the objects of learning are dealt with is “the most potent source for accounting for differences in learning achievement between classrooms” (2002, p. 133).

In fact, what students are supposed to learn is not always synonymous with the actual learning outcomes. As Nuthall (2004) noted, while differences in the outcome of learning are frequently seen in the professional culture of teachers as something hard to explain, they can actually be traced back to what happens during the lesson and how students experienced those events. We believe that the nature of the relationship between teaching and learning can be characterized in terms of the object of learning as it is enacted, on the one hand, and as it is lived, or experienced, on the other hand.

The Enacted Object of Learning and Patterns of Variation and Invariance

As illustrated earlier, the kind of learning focused on here is taken as a function of discernment of the critical aspects of the direct object of learning. It presupposes certain experienced patterns of variation and invariance in these critical aspects. Thus, in the classroom situation, when the teacher and the students, or the students among themselves, interact around a specific object of learning, patterns of variation and invariance are constituted, or enacted. In such enactment, some aspects of the object of learning remain invariant while other aspects vary. The resulting enacted patterns of variation and invariance in the object of learning afford different possibilities for learning. Depending on how the patterns of variation and invariance
are enacted, i.e., depending on what “the enacted object of learning” is like, certain aspects are brought to the students’ focal awareness and hence, discernment of those aspects and their relationship is on offer to the students.

Marton (Marton & Runesson, 2003; Marton et al., 2004; Lo & Pong, 2005) identifies four types of pattern of variation and invariance, each carrying particular functions in the light of what is being focused on in relation to a specific object of learning. He refers to four types of function that a pattern of variation and invariance may serve: contrast, generalisation, separation and fusion.

Contrast comes into play when variation is introduced between different values or features in a dimension of an object, concept, or phenomenon. It helps to facilitate the discernment of what makes the feature in focus distinct, e.g., the colour of red as distinct from the colours of yellow, brown and so on. Here the focus is on a particular “value” (red) in a “dimension of variation” (colour). In addition to the focused value, there is at least one other value in the same dimension (blue), while other potential dimensions of variation (e.g., shape) between the two (or more) objects are invariant.

Separation occurs when the learner’s attention is focused on the dimension of variation between objects, concepts, or phenomena. As such, it is the dimension that is discerned by the learner. For instance, the concept of “colour” can be separated from other aspects (which are kept invariant) by focusing attention on the variation between colours. Juxtaposing two or more objects that vary in a certain dimension affords both contrast (e.g., red versus blue) and separation (e.g., the dimension of variation in colour), depending on the learner’s focus (on the colour of “red” or the concept of “colour”).

If one wants to separate a particular value (e.g., red) from the object (or objects), one has to keep that value invariant (i.e., one has to compare red objects), while there is variation between the objects juxtaposed in other dimensions (e.g., shape, size). This is called generalization by Marton and is the most frequently used pattern of variation and invariance in educational contexts.

Fusion takes place when the learner’s attention is focused on several aspects of an object, a concept, or a phenomenon which vary at the same time. Fusion may bring out the relationship between the varying aspects and the object of learning as a whole. For example, exposing students to simultaneous variation in demand and supply helps them to consider both at the same time. This helps cement the relationship between the two concepts (Marton & Pang, 2006).

The pedagogy developed based on the Theory of Variation can be characterized by a focus on the object of learning and the use of patterns of variation and invariance to maximize the opportunity for students to discern part-part and part-whole relationships within the object of learning, on the one hand, and critical differences between instances of the object of learning, on the other. Since 2000, this pedagogy has been used to improve teaching and learning in the context of single lessons through “Learning Study” (Holmqvist et al., 2009; Lo, 2006; Lo et al., 2004; Lo et al., 2005; Marton, 2006; Marton & Pang, 2006). It has also been used to design sequences of lessons which aim to enhance students’ general capability in learning, for example the attempt by Marton and the Chinese Language Research Team
“Learning study” takes its inspiration from collaborative and interactive procedures in studies of teachers in China (Ma, 1999) and the Japanese Lesson Study (Stigler & Hiebert, 1999), and is grounded on a conceptual framework based on the learning Theory of Variation. In each learning study, teachers form subject-based groups and meet regularly among themselves and with university researchers to develop a number of “research lessons”. For each research lesson, they carefully study the object of learning and its critical aspects, taking into account the students’ varying understanding of the subject matter, ascertained in pre-test and/or pre-lesson interviews with the students. Together they then develop ways to structure the lesson using patterns of variation and invariance in the identified object of learning. Next, teacher members take turns to teach the lesson while the whole team observes. Evaluation of each lesson and modifications to the use of patterns of variation and invariance are made in a post-lesson conference with reference to the lesson observations and student learning outcomes ascertained in post-test and/or post-lesson interviews with students.

ON THE APPARENTLY PARADOXICAL EXCELLENCE OF LEARNERS FROM CONFUCIAN HERITAGE CULTURES

The stereotypical view held by some educators in the West of pedagogical practices in Confucian heritage cultures and of ways of teaching and learning in China is that they focus on repetitive drill and rote learning. Such practices do not seem conducive to learning, especially in creating the necessary conditions for learning as set out in the theory presented in the previous section. As is obvious in what is reported below, learners from the Confucian heritage cultures excel when compared to learners from other cultures. Thus there is a paradox indicated by Marton, Dall’ Alba & Tse (1996) and Marton, Wen and Wong (2005): how can seemingly adverse pedagogy yield such good learning? This paradox is addressed in the section that follows and an attempt is made to show that Chinese pedagogical practice is grossly misrepresented. Repetition is frequently the reiteration of certain elements and the variation of others. Hence variation is just as much a cornerstone of Chinese pedagogy as is repetition. But let us first look at some international comparisons of educational attainment.

From the 1990s, international school attainment comparison studies have attracted considerable scholarly discussion. These include TIMSS 1995, involving third to eighth grades and TIMSS, 1999 and 2003 involving fourth and eighth grades’ mathematics and science prowess; PISA, 2003 involving 15-year-old students’ reading, mathematical and scientific literacy; and PIRLS, 2006 dealing with fourth graders’ reading comprehension. In these studies, attainment data of students from a number of countries have been collected, analysed and compared. The results consistently show the superior performance of students from Confucian Heritage countries such as China/Hong Kong, Singapore, Japan and South Korea in the subject areas concerned when compared with their Western counterparts. The findings of such
international comparisons not only pose a serious challenge to the stereotype that students in Asian countries learn in harsh and inflexible educational settings, with large class size, lengthy periods of direct teaching and limited resources other than chalkboards and textbooks. They also provoke the curiosity of some researchers to examine the cultural differences in respect of classroom teaching and learning, with the aim of revealing what underlines the excellent performance of learners from Confucian Heritage countries in international comparisons.

Stigler and his research colleagues carried out a follow-up video study of TIMSS 1995 on eighth-grade mathematics classrooms sampled from the USA, Germany and Japan (Stigler et al., 1999; Stigler & Hiebert, 1999). They noted a remarkable difference in the way the teachers habitually focus on and handle the content of teaching: USA teachers, for example, tended to focus on teaching procedures and skills via the learning of terminology and practising of procedures, whereas the Japanese teachers focused on teaching conceptual understanding by means of structured problem solving. Similar observations were also made in other studies, for example by Rohlen and Le Tendre (1996) who compared Japanese and USA mathematics teaching in Grades 1 and 5; and by Ma (1999) who compared mathematical understanding among the USA and Chinese elementary school teachers in relation to their classroom practice. In these studies, lessons taught by Japanese/Chinese teachers were found to have transcended seemingly undesirable whole-class teaching to achieve many of the educational ideals voiced by the USA educators, and their students did so better than students in the USA in terms of their grasp of conceptual and procedural understanding.

Research in Chinese classrooms suggests that, despite the large class size and the predominance of whole-class direct teaching, Chinese students are regularly and purposely subjected to thought-provoking tasks and questioning (Bruce & Bruce, 1997; Cortazzi, 1998; Cortazzi & Jin, 2001). This is believed to enhance students’ conceptual understanding and to contribute to their excellent performance in international comparison studies (Stevenson & Lee, 1997). Other researchers characterize the Chinese style of teaching by its emphasis on the knowledge and personal qualities of the Chinese teachers themselves, the teacher as a “virtuoso” (Paine, 1990) and by the teachers’ assiduous attitude to meticulous lesson planning (Cheng, 1992). Stigler and his colleagues note that Japanese teaching is characterised by a conscious and continuous attention to careful and systematic analysis of practice, and a determination to reflect on and improve practice in every lesson (Hiebert et al., 2002; Stigler & Hiebert, 1999). This kind of intense and thorough lesson planning and evaluation is less common in some Western countries.

Other studies have found that the seemingly non-conducive pedagogical approaches favouring the use of memorization among students in Confucian-heritage cultures do not necessarily imply that the students engage exclusively in rote learning, recitation and repetition; there is a good measure of reflection, understanding and conceptualization of what has been covered in their learning by memorization (Biggs, 1996; Lee, 1996; Marton et al., 1996). In other words, repetition and understanding are regarded as two intertwining processes in learning by learners in Confucian-heritage cultures (Marton et al., 2005). This view is not shared by most
learners in Western classrooms. Dalhlin and Walkins (2000, cited in Watkins & Biggs, 2001) compared the views of Chinese and Western secondary school students about repetition and understanding and found that, unlike Chinese students who considered repetition as a means of developing full understanding of a certain problem through revisiting it piece by piece in repetition, Western students regarded repetition simply as a tool for them to reinforce memory, understanding being more of “a process of sudden insights” (Watkins & Biggs, 2001: p. 6).

The above discussion indicates significant cultural differences between the East and the West in terms of beliefs about pedagogy and the nature of lasting learning. Two major features characterize Asian classrooms: the focus on the subject content during lesson planning and delivery, and the emphasis on the teachers’ directive role in engaging students in learning tasks in lessons. It is suggested that these two features contribute in large part to the different achievement levels of students from the East and the West in international comparison studies. This is in line with a range of academic publications that suggests that the teachers’ subject knowledge, perceived role in teaching and the way they engage students in learning are crucial to how students encounter and experience their learning; in turn, this influences what they learn in lessons (Fishman & Davis, 2006; Kilpatrick et al., 2001; Muijs & Reynolds, 2000; Nuthall, 2004, 2005; Wenglinsky, 2000).

**Chinese Pedagogy and the Theory of Variation**

In the previous section we looked at an apparent paradox: according to the stereotypical view of Chinese pedagogical practice, lessons are characterized by adverse conditions of learning and the over-incidence of repetition and rote learning. Despite this, Chinese learners do very well indeed when compared with learners from other countries. We attempt to resolve this paradox in this section by arguing that Chinese pedagogical practices are misrepresented, and that they actually highlight strong features related to systematic variation rather than concentrating on monotonous repetition.

In the second part of this chapter, we elaborated on key notions of the Theory of Variation, referred to so often in this book. Unlike theories of learning that focus on learning in a broad sense, the Theory of Variation deals with how the learner comes to experience what to learn (the object of learning) in order to achieve certain aims in given situations. Acquiring knowledge, according to this theory, is not a progression from basics (or parts) to more complex and advanced forms (or wholes). Rather, it moves “from an undifferentiated and poorly integrated understanding of the whole to an increased differentiation and integration of the whole and its parts…” (Marton & Booth, 1997, p. viii). Learners need to discern the component parts and relate these to the greater whole if they are to arrive at an understanding of a given situation where the parts and the whole blend with each other.

A focus on the object of learning and how it is experienced by the learner in a given situation or context in part-whole relationships is a distinctive feature of Chinese pedagogy. Phillipson (2007) reviewed the literature on the learning approaches of students in Confucius Heritage cultures and concluded that Chinese
students and teachers tend to pay attention to “the field (whole) within which an object is found”, whereas Western students and teachers tend to focus more on the properties (parts) of the object (p. 10).

Besides an emphasis on the object of learning, the pedagogy informed by the Theory of Variation focuses on the use of patterns of variation and invariance as a guiding principle of lesson design. This theory-driven pedagogy concurs with Gu’s (1991, 1994) conceptualization of a long prevailing feature of mathematics teaching in the Mainland into a theory of mathematics teaching in China - Bianshi [變式], which literally means “pattern or form of variation”. According to Gu, good mathematics teaching involves two forms of “variation”, namely “conceptual variation” and “procedural variation”. Gu et al.,’s (2004) concept of “conceptual variation” resembles the kinds of variation that function to generalize the invariant concept in focus (e.g., “non-coplanar line”), by varying concrete examples (e.g., students’ daily sensory experience of visual models), and contrasting the invariant concept or figure with counter-examples (of what it is not) (e.g., non-standard versus standard geometrical figures). Below we show that a close resemblance can also be delineated between good teaching practice in Chinese language lessons and the use of variation and invariance in the Theory of Variation.

Teaching and learning of Chinese language

Ko (2002) studied what constitutes exemplary pedagogical practice in China by focusing on Special Rank Teachers in Chinese language (winners of a state conferred teaching award). Ko and Marton (2004) employed the Theory of Variation to examine in depth a sample Chinese reading lesson on semantics by a Special Rank Teacher. The teacher was seen to be constructing the lesson in a highly systematic and sophisticated manner, emphasizing the use of context and the students’ own experience. For example, one of the objectives of the lesson was to help students establish different semantic relations between words: (a) homonyms, the same words with different meanings; (b) synonyms, different words expressing the same meaning; and (c) antonyms, words of opposite meanings. Instead of presenting linguistic knowledge directly, the teacher made use of a story to illustrate that the meaning of the same word can vary according to the context. This helped students grasp the semantic relation between words that are homonymous.

The story:

Afanti was a hairdresser. There was one customer, Ahung, who always went to Afanti’s place to have his hair cut but never paid for the service. This made Afanti very angry. He wanted to play a trick on Ahung. One day Ahung came to Afanti’s again. Afanti first cut Ahung’s hair. Then, he began to shave Ahung’s face, and asked, “Do you want your eyebrows?” Ahung replied, “Of course! Why ask!” Then, quick as a flash, Afanti shaved off Ahung’s eyebrows and said, “You wanted your eyebrows, so I will give them to you!” Ahung was too mad to say anything, because he had indeed said he “wanted” his eyebrows. Meanwhile Afanti asked, “Do you want your beard?” Ahung had
a beautiful beard, and he immediately said, “My beard? No, no! I don’t want my beard!” But again Afanti proceeded to shave off his beard. Ahung stood up and saw an egg-like head in the mirror. Furiously, Ahung reproved Afanti, “Why did you shave off my eyebrows and beard?” “I was only following your orders, sir!” Afanti answered calmly. There was nothing Ahung could say to that! (translation adapted from Ko & Marton, 2004, pp: 46–47)

After telling the story, the teacher asked the students how Afanti had played a trick on Ahung. In response, the students pointed out that Afanti played a trick by exploiting the ambiguity of the meaning of the word “want” [要, yao], which can mean “give [给, gei]” or “keep [留, liu]”. Intentionally, Afanti first used the word “want” to mean “give” when Ahung meant to “keep” his eyebrows. He then used the word “want” to mean “keep” when Ahung interpreted it as to “give” his beard. As a result, Ahung lost both his eyebrows and beard. In the teacher-led discussion, the students, without knowing the technical terminology, became aware of the semantic concept of homonyms, words that can vary in meaning according to the context.

Later in the lesson, the teacher introduced another kind of semantic relationship between words that express the same meaning: synonyms. He did so by first making a contrast with the concept of homonyms that had been developed using the story about Afanti and Ahung. She then asked the students for examples of this from their daily experience. Using the examples provided by the students, she went on to discuss with the students that synonymous words, though expressing the same meaning, are often used in different contexts. For example, “father” is used in a formal situation, whereas “pa” and “daddy” are used in informal situations; “sodium chloride” is a chemical term whereas “salt” is usually a non-technical word; and “wrinkly old fellow” is an impolite form of addressing an elderly male person compared with the label “Grandpa”. The teacher then drew on the students’ own experience and solicited words that have contrastive meanings, thus bringing out the semantic relation between words that have opposite meanings, antonyms.

Ko and Marton analyzed the patterns of variation and invariance used in this lesson. They noted that the teacher was actually making a purposeful, systematic and sophisticated use of variation and invariance, while highlighting the importance of context and students’ experience in the complexity of the meaning of words. For example, when she introduced the concept of homonyms, she purposefully made use of the story of Afanti and Ahung and kept the word “want” invariant while having the students focus on its varying meanings of “give” and “keep” in the given context. This then made it possible for the students to see a separation between word and meaning, with the latter being reliant on the context. The subsequent contrast between the concepts of homonyms and synonyms enabled students to discern the complexity of the meaning of words by varying the semantic relations between them. By having the students offer examples of synonymous words (what varies) but express the same meaning (what remains invariant), the teacher helped the students discern the concept of synonyms by the generalization of what was invariant. Thus, she brought to the students’ awareness the notion of synonyms by
commenting on the appropriateness of the synonymous words that varied with the context. The simultaneous variation of both the synonymous words and the context in which each should be used then led to fusion, contributing to students’ deeper understanding about the relationship between the meaning and the usage context of those words.

The above study and the large-scale research over a long period on mathematics education in China described earlier add weight to the proposal that the systematic use of variation and invariance is a distinctive feature underlying effective Chinese pedagogy.

THE ROLE OF VARIATION AND INVARIANCE IN THE CHINESE CULTURE

As proposed above, the systematic use of variation and invariance is a characteristic of good practice in teaching mathematics and Chinese language in China. Interestingly, this kind of systematic use of variation and invariance is central to the ancient ways of learning and teaching the subjects in the country. For instance, about 2000 years ago, *Jiu Zhang San Shu* (九章算書, Nine Chapters on Mathematics) was one of the leading and most influential mathematics classic. It was formally included in the official curriculum of mathematics for preparing students for the state examination in the Tang Dynasty, considered the most established system at the time and serving as a model for later dynasties to comply with or improve on (Siu, 2004). Each chapter of this classic began with the introduction of a topic focusing on a particular concept or phenomenon (for example, excess and deficit), then followed this by a set of problems which were structured in such a way that, within the same context (for example, joint purchase), each problem was drawn upon to contribute to a new aspect of the topic dealt with (for example, one of the four possible cases of excess and deficit) (Ma, 2000). This way of teaching mathematics is still common in Chinese mathematics classrooms today and is noticeably different from the Western approach in which, according to Hägglund (2008), problems following the introduction of a new topic simply form a set of unrelated problems of the same kind.

Another historical example of the use of variation and invariance can be seen in the ancient Chinese way of learning and teaching children basic reading literacy. One of the most widespread and influential ancient texts to-date has been *Qian Zhi Wen* (千字文, Thousand Character Text) by Zhou Xin Si in the Liang dynasty (A.D. 502–557) (Pan, 2007). It was composed of 1000 different characters (in traditional form) showing clear part-whole relationships in the Chinese language, with every four characters forming a sentence, two sentences forming a pair, and four sentences forming a cluster focusing on particular themes. With such a rigid construction, the text affords highly sophisticated patterns of variation and invariance in different aspects of Chinese language and encompasses a wide range of lexical items, structures and phonology. This helps make the learning of key language aspects available. To illustrate this, we focus on how a pair of sentences in the text reproduced and translated in Table 2.1 below can enhance the learning of Chinese word semantics by means of systematic variation.
Table 2.1. Example of a Chinese word semantics

<table>
<thead>
<tr>
<th>Original:</th>
<th>性</th>
<th>靜</th>
<th>情</th>
<th>逸</th>
</tr>
</thead>
<tbody>
<tr>
<td>Direct translation:</td>
<td>nature</td>
<td>calm</td>
<td>feelings</td>
<td>relaxed</td>
</tr>
<tr>
<td>Interpretation:</td>
<td>With a calm nature, people are relaxed in their feelings.</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Original:</th>
<th>心</th>
<th>動</th>
<th>神</th>
<th>疲</th>
</tr>
</thead>
<tbody>
<tr>
<td>Direct translation:</td>
<td>temper</td>
<td>restless</td>
<td>spirit</td>
<td>weary</td>
</tr>
<tr>
<td>Interpretation:</td>
<td>With a restless temper, people are weary in spirit.</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The above two sentences, typical for the construction of text, are identical in structure, both being composed of words, in this case, four single-character words that are syntactically and semantically comparable across sentences. For example, the first two characters in the two sentences “性 nature” and “心 temper” form a pair of nouns and represent different aspects of people qualities; the next two characters “靜 calm” and “動 restless” are two adjectives depicting opposite states that something or someone is in; “情 feelings” and “神 spirit” are two noun words, referring to different aspects of people’s internal states; and “逸 relaxed” and “疲 weary” constitute another pair of adjectives that indicate differing people conditions. Each pair of characters thus constitutes a dimension of variation in which each character is a value and contrasts with another to show its own specific meaning in that dimension or semantic category. It also facilitates separation of the semantic category, i.e., the dimension of variation (e.g., “people qualities”) from its values (e.g., “nature” and “temper”) when the learner focuses on the dimension in which the values appears. When looking at the two sentences at phrase level, it can be seen that the paired phrases, each consisting of two single characters, actually carry contrasting meanings in the same category: “性靜 calm nature” and “心動 restless temper” denote opposite qualities of people; and “情逸 relaxed in the feelings” and “神疲 weary in the spirit” show distinctive states people are in. In turn, these phrases jointly give meaning to the sentences: With a calm character, people are relaxed in their feelings; with a restless temper, people are weary in spirit.

The construction of the Thousand Character Text (and probably, texts of similar kind, such as San Zi Jing 三字經, Three Character Classics written later in the Song dynasty, A.D. 420–479) provide a rich opportunity for the ancient Chinese to teach children vocabulary. Central to such a construction has been the systematic use of “pairs” between characters of opposite meanings (e.g., “靜 calm” and “動 restless”, “逸 relaxed” and “疲 weary”) or similar meanings (e.g., “性 nature” and “心 temper”, “情 feelings” and “神 spirit”) in the same category. Put in a slightly different way, the construction of Chinese classical texts can be characterised by the systematic use of variation and invariance that helps contrast the meanings of specific characters/words (variant) and separate these characters/words from the semantic category (invariant) in which they appear.
The use of “pairs”, more commonly referred to as *dui ou* (對偶, antithesis), has also been a longstanding feature of ancient Chinese poetry and rhapsodies, the most prevalent types of text in ancient China. Usually, there are one to two antitheses in each Chinese ancient poem or rhapsody. In terms of content and structure, an antithesis consists of two consecutive lines which are parallel in structure, use comparable characters in the same category, and together contribute to a central idea, image or message. Table 2.2 below shows an antithesis used in a poem by Wang Wei, a famous poet in the Tang dynasty.

**Table 2.2. English translation of the poem adapted from Yang (2009)**

<table>
<thead>
<tr>
<th>Original:</th>
<th>明 月 松 間 照</th>
<th>Direct translation:</th>
<th>bright moon pines through shining</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interpretation:</td>
<td>The bright moon is shining through the pines.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Original:</th>
<th>清 泉 石 上 流</th>
<th>Direct translation:</th>
<th>limpid stream stones over gurgling</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interpretation:</td>
<td>The limpid stream is gurgling over the stones.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

As with the example quoted from the Thousand Character Text, the two lines of the antithesis show a neat arrangement of characters/words and phrases that are comparable in syntactic functions and semantic category. At the character/word level, characters/words in pairs are **contrasted** in the same category, contributing to the differentiation of the specific meanings of the paired characters. For example: “明 bright” and “清 limpid” are adjectives describing “clarity” in different senses; “月 moon” and “泉 stream” are different nouns representing varied scenery in nature; “松 pines” and “石 stones” are different noun objects in nature; “間 through” and “上 over” are different prepositions denoting different “positions”; and “照 shining” and “流 gurgling” are verbs portraying “movement” in different forms. Similar **contrasts** can also be noted when the same set of characters/words are coupled in various phrases: “明月 bright moon” and “清泉 limpid stream” are two noun phrases denoting the scenery in nature at night, whereas “松間照 shining through the pines” and “石上流 gurgling over the stones” are verb phrases depicting certain movement that can be noticed in a peaceful surrounding. Together, these phrases contribute to the main theme of the antithesis: the scenery in nature on a peaceful night.

Seen in this light, reading to understand antitheses in an ancient Chinese poem or rhapsody necessitates a simultaneous awareness of, at least, semantic and syntactic aspects of the language. This may relate to the characteristics of the Chinese language that is monosyllabic and has flexible word compounding and order that are semantically driven. How well these aspects specific to the Chinese language have been dealt with in forming an antithesis in a poem or rhapsody represents a good indicator of the literacy prowess of the author. This may be one of the many reasons why writing poetry and rhapsodies has been a component in state examinations in
ancient China, legendarily believed to have started in the Sui dynasty (A.D. 581–618) and historically afforded great importance from time to time since the reign of Emperor Gao Zong (高宗, A.D. 628–683) in the Tang dynasty.

The above examples support the use of variation and invariance to facilitate the learning and teaching of basic literacy in ancient China. Specifically, the use of “pairs” or antitheses in ancient texts, poetry and rhapsodies embraces a simultaneous variation implicit in the dimensions (or aspects critical to learning the language) in which different linguistic parts are paired. Interestingly, a similar way of dealing with literacy learning and teaching has been shown by Xia Mian Zun and Ye Sheng Tao, two great language educators in the early 19th century, who provided a lively discussion of various topics they had learnt and used to teach Chinese in the form of a story book in 1935. Learning vocabulary is one such discussion. Through reflections of one of the main characters, Xia and Ye pointed out that the essence of learning vocabulary and being able to use it precisely in writing is systematically to compare words that can be associated with one another in the same semantic category (e.g., “怒 angry”, “憤 resent”, “動氣 irritated”, “火冒 rage”, “不高興 unhappy” in the category of negative emotion) in terms of ways that they differ (e.g., tone, scope of meaning, and context of usage). Thus, what seems to have characterised the way Xia and Ye learnt and taught Chinese words and their usage in writing is the drawing attention to differences between specific words based on sameness in the semantic category. This follows the same line by which ancient texts were constructed for learning words and, as pointed out earlier, the antithesis was used in ancient poetry and rhapsodies. This, in turn, supports our speculation that a systematic use of variation and invariance is inherent in Chinese pedagogy.

On Some Features of Ancient Chinese Thought

As suggested above, the idea of variation and invariance as depicted in the Theory of Variation is not only largely shared by the characterization of what constitutes good contemporary teaching in mathematics and Chinese language in the Mainland. There also seems to be a tendency to focus on how things differ and not only on how they are alike, even when they are alike, in traditional Chinese learning and teaching. This tendency is consistent with Hansen’s distinction between how European and Chinese classics see meaning in language. According to Hansen (1989), language plays a descriptive role in representing absolute reality in classical European thought, whereas it is primarily functional in classical Chinese thinking so as to guide behaviour that is believed to be morally good and worth pursuing. Hansen claims that Chinese thinkers do not worry so much about what is the true state of affairs, e.g., “What is X?” “What is Y really?” “What is the essence of Z?” What they care about is “Is it better to do X, Y or Z?” In order to answer such questions, they do not so much worry about what X, Y or Z are, but about how we can tell X, Y and Z apart. Following this line of reasoning, language is about making distinctions in Chinese, rather than about producing propositions as in European languages. The lines below are quoted from the Book of Lao Zi (老子), or Tao Te
CHIK AND MARTON

Ching (道德經), one of the earliest Chinese classics, seemingly lending support to this claim.

The whole world recognizes the beautiful as the beautiful, yet this is only the ugly; the whole world recognizes the good as the good, yet this is only the bad.

Thus, Something and Nothing produce each other; the Difficult and the Easy complement each other; the Long and Short offset each other; the High and the Low incline towards each other; Note and Sound harmonize with each other; Before and After follow each other.

(Tao Te Ching, Chapter 2)

The lines quoted above actually illustrate a relativist epistemology: to be able to understand something (e.g., the concept of “beautiful”) one must be able to differentiate between what something is (i.e., being beautiful) and what it is not (i.e., being ugly). The prevalent use of antithesis in ancient Chinese texts, as noted above, reflects such a relativist view in the ancient Chinese way of thinking by stressing a neat arrangement of characters/words that are comparable in certain categories (Yu & Li, 2006).

While there may be evidence leading to our speculation that the systematic use of variation has been fundamental to the ancient Chinese’s way of thinking, it is beyond the scope of this chapter to substantiate all the claims implied in the chapter. Our aim has been to offer ideas we find interesting rather than presenting a substantial and academically-grounded argument. What we are suggesting is that focusing on sameness and focusing on differences may constitute two different pedagogical strategies, and that one (focusing on differences) is more powerful than the other (focusing on sameness). In fact, the combination of both may be better than either alone. Furthermore, it is argued that there is a distinct Chinese pedagogy, a pedagogy of Confucian Heritage countries, characterized by the systematic use of variation and invariance, a pedagogy which seems very powerful.

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