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THE USE OF MULTIMEDIA MATERIAL IN TEACHING MATERIAL IN TEACHING CHINESE AS A SECOND LANGUAGE AND PEDAGOGICAL IMPLICATIONS

A Thesis Presented

by

ZHONGYUAN C. WILLIAMS

Submitted to the Graduate School of the

University of Massachusetts Amherst in partial fulfillment

of the requirements for the degree of

MASTER OF ARTS

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Asian Languages, Literatures & Cultures

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DEDICATION

To my supportive families: my loving husband Roger Williams, dear mother Shuhua Sun and dear sons Allyn Williams and Euan Williams.

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ABSTRACT

THE USE OF MULTIMEDIA MATERIAL IN TEACHING CHINESE AS A SECOND LANGUAGE AND PEDAGOGICAL IMPLICATIONS

FEBRUARY 2013

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The use of Multimedia materials has been widely accepted as an useful and effective tool in the field of second language acquisition (SLA). Many studies and researchers have examined multimedia material's effectiveness from a number of aspects, including four skills of language learning: listening, speaking, reading (including vocabulary comprehension) and writing. However, the effectiveness of multimedia material from the aspect of L2 grammar comprehension hasn't been well explored.

This study examines the effectiveness of multimedia material in teaching second language grammar comprehension among beginning and intermediate-level Chinese learners. In particular, it investigates the relative efficacy of three different modes used in teaching an important Chinese grammar, directional complements: text alone, text with a still picture and text with video clips. The study's focal issue is to determine which mode or modes — text alone, text with still picture or text with dynamic video clip — is most effective in aiding grammar acquisition in both short-term and long-term.

The study employed an immediate post-test and a delayed post-test. The participants were 53 college students, beginning level Chinese language learners who had studied Chinese for a half year, and were naturally assigned to one of the three parallel groups. The three groups differed as to the use of the different mode used to present the teaching material: text-only, text-picture, and text-video.

Analysis of the collected data yielded three main findings. First, learners who received text-video material outperformed those who received text-picture; and learners who received text-

picture material outperformed those who received text-only. Secondly, learners who received text-video had significantly better long-term comprehension than the other two groups. Finally, the performance advantage of text-video treatment was particularly significant with more complex target forms.

The results demonstrate that multimedia material can help L2 learners' grammar comprehension. Text-picture and text-video were more effective than text-only, and text-video material was more effective than text-picture.

TABLE OF CONTENTS

Page

ACKNOWLEDGEMENTS v

ABSTRACT vi

LIST OF TABLES x

LIST OF FIGURES xi

CHAPTER

1 INTRODUCTION 1

1.1 Statement of the problem 1
1.2 Purpose of the study 1

2 REVIEW OF THE LITERATURE 3

2.1 What is 'Multimedia'? 3
2.2 Cognitive perspective 4

2.2.1 Dual-coding theory 4
2.2.2 The generative theory and second language acquisition 6
2.2.3 Cognitive load theory 7

2.3 Second language acquisition (SLA) perspective 8
2.4 Sociocultural Perspective 12
2.5 The four skills of language learning 14

2.5.1 Listening comprehension 14
2.5.2 Speaking comprehension 16
2.5.3 Reading comprehension 16
2.5.4 Writing comprehension 20

2.5.4.1 Student attitudes 21
2.5.4.2 Textual properties 22
2.5.4.3 Revision strategies and accuracy concerns 22
2.5.4.4 Planning 22
2.5.4.5 Email exchanges 22

2.5.5 Teaching Chinese characters 22

2.5.5.1 The role of multimedia in teaching Chinese characters 23

2.6 The theoretical basis for the current study 25

3 METHODOLOGY 27

3.1 Research questions 27
3.2 Participant selection 28
3.3 The target forms 29
3.4 Treatment task 30

3.4.1 Text-only treatment 31
3.4.2 Text-Picture treatment 31
3.4.3 Text-Video treatment 32

3.5 Assessment and scoring procedure 33
3.6 Data collection and analysis 33

4 RESULTS AND ANALYSES 35

4.1 Immediate-test result 35
4.2 Delayed-test result 37
4.3 Comparison of the effects between groups for simple and complex DC 42

5 DISCUSSION 45

5.1 Q1: Short-term effects of text, text-picture and text-video 45
5.2 Q2: Long-term effects of text, text-picture and text-video 47
5.3 Q3: The effects of text, text-picture and text-video on complexity 48

6 CONCLUSION 51

6.1 Significance of the study 52
6.2 Theoretical implications 52
6.3 Pedagogical implications 53
6.4 Methodological implications for research 54

APPENDICES

A. IMMEDIATE-TEST ON DIRECTIONAL COMPLEMENTS 55
B. DELAYED-TEST ON DIRECTIONAL COMPLEMENTS 56

BIBLIOGRAPHY 57

LIST OF TABLES

Table Page

2.1 The two systems that serve memory.....5

2.2 Simplified version of Gass's model of IIO, applied to multimedia..... 10

2.3 Pictophonetic composition of Chinese characters..... 24

3.1 The six types of directional complement constructions.....30

4.1 Means and standard deviations of Immediate-test 35

4.2 ANOVA on Immediate-test 36

4.3 Bonferroni multiple comparisons test on Immediate-test..... 36

4.4: Kruskal-Wallis test on Immediate-test 37

4.5 Means and standard deviations of Delayed-test 37

4.6 One-way ANOVA on Delayed-test.....38

4.7 Bonferroni multiple comparisons test on Delayed-test 38

4.8: Kruskal-Wallis test on Delayed-test.....39

4.9 Two-way ANOVA on group and time.....41

4.10 Wilcoxon matched-pairs signed rank test by group over time..... 41

4.11 Tukey-Kramer multiple comparisons test of simple DC in Immediate-test..... 43

4.13 Tukey-Kramer multiple comparisons test of complex DC in Immediate-test.....44

LIST OF FIGURES

Figure Page

3.1 DC that indicates speaker's position 31

3.2 DC that indicates the direction of the verbs 32

3.3 Two types of DC in one sentence 32

3.4 Video treatment 32

4.1 Means of Immediate-test by group 35

4.2 Means of Delayed-test by group 38

4.3 Change in means of groups over time 40

4.4 Change in frequency distribution of groups over time 40

4.5 Mean of simple and complex DC in Immediate-test by group 42

4.6 Mean of simple and complex DC in Delayed test by group 42

4.7 Comparison of mean scores for Intermediate and Delayed-tests 43

CHAPTER 1
INTRODUCTION

1.1 Statement of the problem

Technology has become an integral part of our life in the past half decade. 'Machines have social origins, and they emerge from the needs of society...Teachers need technologies relevant to the teaching-learning situation' (Cakir, 2006). According to Wright (1976) many media and many styles of visual presentation are useful to the language learner. That is to say that multimedia materials are useful to language learning and teaching when they are presented at the right time and place.

Among the concerns often raised in the domain of Computer Assistant Language Learning (CALL) is how to use the potential of the new technology to enhance the language learning process and how to use different media types in teaching and learning. The concern has been narrowed to the investigation of the efficacy of presenting information using multiple modalities, such as text, audio, still picture, and dynamic videos in the field of SLA. Researchers have been exploring this issue — the effectiveness of using multiple modalities — from different aspects of second language learning, such as in vocabulary learning, reading, writing, listening, speaking and even in one of the unique feature of Chinese language: Chinese character. However, the effectiveness of multimedia on grammar comprehension, a core of L2 learning, hasn't been explored extensively.

1.2 Purpose of the study

This study investigates the relative efficacy of three different modes used in grammar teaching in the context of second language grammar acquisition: text alone, text with a still picture and text with video clips. The study's focal issue is to determine which mode/modes is more effective in aiding grammar acquisition.

This paper will first summarize the important role that multimedia materials play from a cognition perspective, a Second Language Acquisition (SLA) perspective, and a sociocultural perspective, then review the researches have been done over the years on the impact of multimedia material usage on second language acquisition from the areas of four basic second language learning skills: listening, speaking, reading and writing. Next, the issues haven't been explored in multimedia in L2 grammar acquisition will be discussed, together with its outcome and implications. Finally, suggestions for further research on the matter will be offered, and some pedagogical implications and practical techniques about the ways teachers can use multimedia material inside and outside of their Chinese language classrooms most effectively will be discussed

CHAPTER 2
REVIEW OF THE LITERATURE

A brief overview will be given of the theories of multimedia materials in second language learning and the previous researches on multimedia in second language learning from the perspectives of its four basic skills and Chinese unique feature: Chinese characters. The review will focus on three issues: the values of multimedia in second language teaching, the effectiveness of multimedia materials (still pictures and video clips) in second language teaching and especially the effectiveness of using multimedia in teaching Chinese characters. Related theories such as generative theory and dual-coding theory will be discussed. The results of the existing empirical studies and the assumptions and theories they embody, along with the assumptions of the foregoing theories, constitute the theoretical basis for this study.

2.1 What is 'Multimedia'?

Multimedia must be regarded as more than simply using more than one medium, but instead the integration of multiple forms of media. In second language teaching and learning, multimedia most commonly involves the use of computers to present text, graphics, video, animation, and sound in an integrated way.

Modern multimedia teaching methods are largely a product of the last decade, the Internet era. While in 1992, multimedia was still a "rapidly developing new technology" that educators were told to approach with caution (Head, 1992), by 2001 multimedia had become virtually synonymous with electronic media and the new Internet technology. Formally defined as any technology that combines different media (sound, text, photographs or videos) in one presentation format, multimedia is now associated with networked computers and their media capabilities, as graphically delivered to users via the World Wide Web.

It is most useful to consider multimedia as a process, rather than as a thing. Collins and colleagues, for example, define multimedia broadly as "a way of presenting material (often learning material) which involves three or more of the following media" (Collins et al, 1997):

- speech or other sound
- drawings or diagrams
- animated drawings or diagrams
- still photographs or other images
- video clips
- text (printed word).

The medium can be sound for oral language and music, images for still pictures, films, painting and even writing, movement for dance, mimicry and body expression, or several media linked together (e.g. talking movies, television, multimedia computer).

Multimedia is widely acknowledged to be a useful tool for second language learning and teaching, but what are the linguistic theories explaining how and why it can help second language learning and teaching? Let us examine this from the Cognitive, Second Language Acquisition (SLA), and Sociocultural perspectives.

2.2 Cognitive perspective

Several cognitive theories are used to explain the value and effect of multimedia presentations in language learning environments. The most prominent is the generative theory of multimedia learning proposed by Mayer (1997), which draws on Wittrock's generative theory and Paivio's dual-coding theory. In addition, Sweller's cognitive load theory (2005) is used to explain the phenomenon of learner overload.

2.2.1 Dual-coding theory

Dual-coding theory (Paivio, 1969, 1971, 1978, 1990, 1991, 1986) is the foundation for later multimedia learning and multimedia language learning theories. Paivio and Begg (1981) assumed that memory and cognition are related to the sensory modality as explained in Table 1. It hypothe-

sizes that the two systems are served by two independent but interconnected coding systems: one specialized in dealing with verbal information and the other with nonverbal information. The verbal system, deals with non-visual codes such as words, speech, language, or semantic codes; the other system, the visual system primarily deals with visual codes, such as images, pictures, concrete objects, or events. In the learning process, the human mind creates separate verbal and visual mental representations ("encoding") for incoming information using each of the systems. Although the two systems work independently, they are interconnected: representations in one system can activate those in the other. For instance, objects can be named, and words can evoke the images of the objects in mind. The relationship of the two systems has been shown to have positive effects on recall.

The dual-coding theory holds that when learners use both systems to encode information, they will learn and retain the information better than when they use only one system. Generally, each of the systems functions independently, but most information processing requires connections and reinforcement verbal and visual systems, and hence the probability that they are retained in working memory and retrieved later from long-term memory is higher than when the presentation contains verbal information alone (Kobayashi, 1986).

Table 2.1 The two systems that serve memory

Sensory Modality	Symbolic Systems	
	Verbal	Nonverbal
Visual Auditory Tactual Kinesthetic	Printed words Speech sounds Braille Motor feedback from writing	Picture or objects Environmental sounds Feelable objects Motor feedback from haptic exploration of objects

From Pavio & Begg (1981, p.68)

The dual-coding theory has recently received supporting evidence from research in neural sciences. By examining the scanned brain images of learners who were studying German vocabulary items, Fliessbach, Weis, Klaver, Elger, and Weber (2006) found that an anterior region in the

precuneus — a bilateral region of the brain responsible for processing visual contents — was more strongly activated during the intentional encoding of concrete, more imageable words as compared to abstract, less imageable words. Such a finding implies that the visuospatial systems in the brain are involved in processing vocabulary, thus lending support to the dual-coding theory.

2.2.2 The generative theory and second language acquisition

The application of the generative theory of multimedia learning to second language is based upon the dual-coding theory, the assumption that learners of a second/foreign language have two separate verbal systems (L1 and L2) and a common imagery system. There is a suggestion that translations of words via simultaneous verbal and visual presentations would not only link the two verbal systems, but that this storage in the second verbal system would also have an additive effect on learning (Paivio & Desrochers, 1980).

Mayer's (1997, 2001, 2002) cognitive (generative) theory of multimedia learning is probably the most influential theory for L2 learning via multimedia in the past ten years, and has been referred to as a theoretical basis by many studies (e.g. Al-Seghayer, 2001; Jones & Plass, 2002; Jones, 2003; Chun & Payne, 2004). The theory takes a step beyond dual-coding theory in modeling the detailed learning process in a multimedia environment. According to the theory, such a process contain three subcomponents: (a) selecting relevant verbal and visual information from the multimodal input, (b) organizing the selected information into the verbal and visual mental representations, and (c) integrating the resulting verbal and visual representations with each other (Mayer, 1997, 2001). Learning is therefore more likely to occur when learners can build meaningful connections between the verbal and visual mental representations. Many design principles for effective multimedia learning have been proposed on the basis of this theory, such as presenting relevant verbal and visual information simultaneously (a principle that is applied in the design of many multimedia Computer Aided Assessment (CAA) materials), reducing cognitive load (e.g. Mayer & Moreno, 2003; Moreno, 2004), and taking learner differences into consideration (e.g. Moreno & Duran, 2004).

2.2.3 Cognitive load theory

Processing information in different modes and coordinating the processes relies on the availability of sufficient cognitive capacity, as processing resources are not unlimited at any given time. An excessive demand on available capacity can produce an overload effect making it more difficult or impossible for a learner to process the information or reintegrate it into a coordinated entity. The success of the learner relies not only on the availability of sufficient resources but also on the manageability of the resources. Cognitive overload can be caused by processing tasks which are irrelevant for learning, in which case the manageability of processing can be secured or restored by reducing the extraneous load. This component of the cognitive theory of multimedia learning is known as the cognitive load theory (Sweller, 2005).

"Cognitive load" refers to the total amount of mental activity imposed on working memory at an instance in time (Cooper, 1998). There are three types of cognitive load: intrinsic, extraneous, and germane (Sweller, 2007). Cognitive load is intrinsic if it is incurred by the nature of the incoming stimulus. In other words, intrinsic cognitive load cannot be altered by instructional interventions because the complexity of the information is intrinsic. Extraneous cognitive load is generated by instructional manipulations. Extraneous cognitive load is undesirable and can be controlled by the instructor. The last and preferable type of load is germane cognitive load, which occurs when working memory resources are engaged in learning via schema acquisition and automation. This process is essential to learning and is generally under the control of the instructor. The three types of cognitive loads are additive; hence, the aim of Cognitive Load Theory (CLT) is to reduce extraneous cognitive load as far as possible and devote the freed working memory resources to germane cognitive load (Sweller, 2007).

Based on the idea of separate working memory subsystems for the processing of visual and auditory information, it can be assumed that the audiovisual presentation of learning materials produces less extraneous cognitive load than the visual-only presentation of the same materials. The reason is that materials presented in audiovisual format (i.e. pictures and narration) can be processed both in the visual and phonological subsystem of the working memory. If the same ma-

terial is presented in a visual mode only (i.e. pictures and written text), it has to be processed in the visual subsystem which imposes a high cognitive load on this system. Multimedia material allows learners to simultaneously process information through different modes.

Learning of a foreign language learning is inherently different from learning other subjects, since during foreign language learning, students have to manage both content and linguistic knowledge simultaneously, which can impose a very heavy working memory load. Multimedia material can reduce such working memory load and effective instructional design that supports learning is of great importance to language learners. In multimedia learning environment, when the multimedia materials are designed or used considering cognitive loading, the visual material can reduce second language learner's cognitive load and lead to effective learning.

2.3 Second language acquisition (SLA) perspective

Among SLA theories, "The best under peer scrutiny and actual pedagogical application is the Input-Interaction-Output (IIO) theory" (Block, 2003). And among the several extant versions of this model, Gass's (1988, 1997) version is the most developed. I'm going to discuss why multimedia material can be effective in language learning and teaching in the process of SLA by exploring the core concepts in Gass's IIO model: **Input, Comprehension Input, Noticing, Intake, Integration** and **Output** (see Table 2).

"**Input**, the target language available to the learner, is considered the most important factor in SLA" (Gass 1997). Language learners only will produce "output" when they got enough "input"; so obviously, rich "input" is the basic criterion of SLA.

Much work has been done in identifying the characteristics that good input material should have (Krashen, 1982). These characteristics do not describe the material per se but the kind of criteria that should apply when selecting material for use in class. Materials which allow "input" are likely to be strong on affective appeal; they are chosen because of their interest value to the learners rather than the type of structure or vocabulary they contain; they are not grammatically sequenced; at the same time, they are not likely to be much beyond the level of the pupils; finally

they provide a lot of contextual support to facilitate comprehension. Carefully selected multimedia materials can satisfy all these requirement, and should be used as a rich and valuable resource.

Krashen (1985) emphasizes the importance of "**comprehensible input**", the language that the learner is able to comprehend. He contends that students learn in stages that require the more capable speaker of the target language to provide input just beyond the learner's current level (Ellis, 1994). It is "comprehensible output, the learner's attempt to make himself/herself understood, that leads to language growth" (Swain, 1985). We know that deficiencies in vocabulary can make even a simple task very difficult to understand for students. Multimedia material makes meaning clearer by illustrating relationships in a way that is not possible with words alone. Also, students are different, so the same input resource will not be comprehensible to all the students in the same way. Teachers should satisfy these diverse needs by providing a diverse range of resources. Multimedia material is one of the perfect ways to do this; multimedia material can be comprehensible to a variety of students because of the rich context it provides and its visual features which can help students comprehension in a way that other resources can't. Furthermore, it's important to remember that it is the learner who determines what the input is after all. Comprehensible input alone does not guarantee learning; as learners exhibit "input preferences", choosing to pay attention, or not pay attention, to input based on perceived value or need (Beebe, 1985). When teachers make the lesson more interesting and enjoyable, this helps promote comprehension. Multimedia presentations are attractive, challenging, and stimulating as long as they are chosen carefully and used properly.

The next stage is **Noticing** and **Intake**. Noticing is very important in language learning process. The tradition way to teach a second language is to correct learners' errors; however, recent research has found that language learners need to correct their errors by "noticing" them themselves, otherwise no matter how many times you correct them, they will make the mistake again and won't be ready for "intake". One way for multimedia technology to help learners notice their own errors is to replay video clips taken when they produce the error-containing output.

Table 2.2 Simplified version of Gass's model of IIO, applied to multimedia

INPUT

Negotiation of meaning Native speaker modification of input

COMPREHENDED INPUT
Comprehension of meaning for immediate communicative purposes
Comprehension of syntax for longer-term learning

NOTICING

INTAKE

Hypothesis formation	Hypothesis testing	Hypothesis confirmation/ rejection/ modification

Integration

New language integrated into existing knowledge Restructuring of interlanguage system

OUTPUT

Finally, learners process comprehended input, match it against existing knowledge, and intake, then integrate the input, either storing it for future reference or using it for immediate production — **output**. Usually, language learners need to be "pushed" to produce output. They need a reason to produce output, and they need a topic to produce "output" about. Carefully selected multimedia material can provide an interesting topic and the teacher can "push" language learners to produce output by designing related activities.

Atkinson (2002) (quoting Lave & Wenger) notes that "learning involves the construction of identities". SLA involves the whole person. Multimedia materials can show us something near the integrality of spoken and interactive discourse and they can do this in extremely stimulating and entertaining ways. The association between multimedia and entertainment also contributes enormously to motivation and good relations in a classroom: what Krashen (1982) calls "the low-

anxiety, tension-free atmosphere". "Being a rich and valuable resource, video is well-liked by both students and teachers" (Hemei, 1997). Multimedia materials allow all the elements in communication to be illustrated, including relationships, reactions, moods, place, personae, etc., while other media are more limited in this regard. They provide a rich and valuable resource for both language learning and teaching. They can show language in context, they can engage attention and they have strong motivational features. They are an excellent form of input and can contribute to subconscious language acquisition processes.

Numerous studies have examined the relationship between multimedia input and language acquisition. Duquette and Painchaud (1996), looking at previous research on the influence of visual media on learning, concluded that "learning vocabulary in context is facilitated when the text contains contextual cues… and when… prior knowledge is activated" (p. 144). In their research, prior knowledge included both a relationship between L1 and L2 words and a familiarity with the subject matter. They found that both video and audio cues, including extralinguistic cues, were effective in supporting the learning of new vocabulary; however, video led to greater gains. Price's (1983) early work with captioned TV and its positive effects on understanding and vocabulary acquisition has been confirmed by others, including Neuman and Koskined (1992), who found that the combination of text and visuals had the strongest effect.

Other studies have explored the relationship of the multimedia environment to learning and comprehension (Brett, 1997; Grezel & Sciarone, 1994). Pearman and Lefever-Davis (2006) found that CD-ROM storybooks improved reading comprehension for schoolchildren.

Vanderplank (2009), in a review of research on multimedia in the second language classroom setting, accepts that new technologies can have a general benefit on comprehension. Finally, Herron, York, Corrie, and Cole (2006) compared two foreign-language classes: one that used a packaged curriculum with a video component as its primary means of teaching new material, and a second course that relied on a more traditional textbook with supplementary media enrichment. Students in the first group made greater gains in both listening comprehension and grammar. Re-

search confirms that repetition of comprehensible information, delivered in varying forms, multimedia environment, is associated with greater rates of measurable learning and comprehension.

Plass and Jones (2005) identified a connection between Mayer's cognitive theory and the interactionist perspective of SLA theories — the former emphasizes the means to enhance meaningful input through dual presentation of words (aural and/or written) and pictures (static and/or moving), while the latter addresses the importance of comprehensible input (Krashen, 1982, 1985) to SLA. By virtue of the connection, they created an integrated model of SLA with multimedia which intertwines ideas from both sides. In such a model, L2 learners process multimodal input by first selecting useful verbal and visual information (apperception) and organizing this information into comprehensible verbal and visual mental representations (comprehension). They then develop the mental representations respectively into verbal and visual model (intake) which eventually become integrated in their linguistic systems (integration).

Plass and Jones' model theorizes the input-based L2 learning process in a multimedia environment and implies that the provision of additional visual information in parallel with the effectiveness of the modes of input in interaction with learners' cognitive and metacognitive processing for comprehension (Jones, 2006a). In this respect, the model is in line with the information-processing theory which claims that, because comprehension and production draw on the same underlying knowledge source, input-based learning will facilitate both (VanPatten, 2007).

2.4 Sociocultural Perspective

"Neither language acquisition nor language use — nor even cognized linguistic knowledge — can be properly understood without taking into account their fundamental integration into a socially-mediated world" (Atkinson, 2002). It has been widely accepted that culture is an indispensable element of foreign and second language learning. In fact, because human thought and ideology is an integral part of culture, and because language is our primary medium to convey thought, language is inseparable from culture.

Studies in foreign language teaching from the perspective of sociolinguistics reveal that communicative competence is what a learner should finally achieve in the course of foreign language learning. According to Hymes (1971), communicative competence refers to "the relationship and interaction between grammatical competence, or knowledge of the rules of grammar, and sociolinguistic competence, or knowlege of the rules of language use". Canale & Swain (1980) outline three components of communicative competence — grammatical, sociolinguistic and strategic competence — in their theoretical framework of communicative approach to second language teaching. This framework puts an emphasis on the importance of rules of language use in a given culture. When and how to apply these rules requires a comprehensive knowlege of the culture in which the language is used. Even though some rules are perhaps universal (for example, rules of politeness proposed by Lakoff, 1973), the orders of precedence of these rules at work in different cultures may not be the same. Therefore it is essential to increase students' awareness of behavioral patterns in the target culture and to cultivate their sensitivity to sociocultural rules of usage when learning the target language. Helping students develop their knowlege of the target culture is very important for all levels of language learners. Multimedia material can illustrate the target language culture visually without requiring a high level of grammatical skill, and can do so in a way that words can't explain completely.

River (1981) explains that multimedia clearly contributes to the understanding of another culture by providing vicarious contacts with speakers of the language, though both audio and visual means. Multimedia material brings "real life" into the classroom. Multimedia materials show students how people behave in the culture whose language they are learning by bringing into the classroom a wide range of communicative situations. Fries (1945) proposed that the most effective materials are those that are "based upon a scientific description of the language to be learned, carefully compared with a parallel description of the native language of the learner". While comparative linguistics has been found to be of limited use in SLA, it's still clear that multimedia materials provide an effective way for students to easily and clearly compare their own culture with

that of the target culture, by actually seeing it. This is useful for both advanced language learners and novices.

2.5 The four skills of language learning

Research confirms that repetition of comprehensible information, delivered in varying forms, especially video, is associated with greater rates of measurable learning and comprehension. Multimedia is being widely used across the curriculum, it offers special advantages for foreign language classrooms, where teachers are confronted with challenge of teaching four language skills: listening, speaking, reading and writing.

2.5.1 Listening comprehension

In the first half of the 20th century there was a shift in emphasis in foreign language teaching from written to spoken language. Educators and researchers argued that language is spoken, in the first place, and that written language is therefore indirect, incomplete and abstract. The fact that in those days people had virtually no access to sound reproduction equipment made students very dependent of their teachers; but this problem was partly resolved when language laboratories were introduced in the fifties, and when audiocassettes appeared on the scene and sound reproduction equipment became cheaply available the problem was dispelled altogether. At the same time research was proving that in the initial stages it is more effective for the learner to listen to the foreign language than to speak it.

Most of today's language learning labs are centered around the delivery of material through audio and video. However, the current trend has been on delivering interactive multimedia with a combination of video, audio, text and graphics. For listening activities, the computer is better than audio or video media because a student can listen as many times as he or she wants with just a click without clumsy rewinding or trying to find the same spot on the CD. Insofar as listening is the basis of oral language acquisition, computer-assisted language learning (CALL) software can provide significantly more input than any other medium, with far more student control.

One of the major factors that researchers have shown to enhance listening comprehension is visual support for texts. Carrell (1982) found that the provision of relevant context picture and title preceding the text facilitates reading comprehension, particularly for upper-intermediate ESL groups. Video selected for listening use also plays a critical role in information processing. Rubin (1990) found that the listening comprehension of upper-introductory Spanish students who watched dramas on video improved significantly over students who received no video support for their listening training.

More recently available interactive video technologies can efficiently serve as a learning unit in classes and in self-access centers. Computer technology allows the delivery of digital video and audio in the same interface as written text. This advance, which provides listening tasks, language input and feedback on task success via the computer screen, helps develop listening skills. Due to the complexities of visual and verbal relationships in each media implemented in listening comprehension and related cognitive processes (Metallinos, 1994), research into the effectiveness of audio- and video-mediated instruments will present different gains in lexical items, structures or listening comprehension.

Listening comprehension is a particularly difficult skill to acquire when the student is removed from the foreign language environment. Formal or classroom instruction typically does not provide enough time for the learning event to take place spontaneously. The learning that does occur may be marked by artifacts of the teaching environment, such as dependency on the instructor's voice, and artificially slow rate of speech, or support from a written script. Listening comprehension tapes offer a marked improvement over text-based learning, but many students are unable to use recorded material effectively, complaining of boredom, fatigue, and lack of meaningful interaction.

The development of listening comprehension can be achieved more successfully by means of video. "Learners need to be exposed to natural speech in context" (Ur, 1981). Learning and teaching materials should be authentic; and multimedia materials provide not only sample materials which approximate what students find in real life, but also help students to develop their compre-

hension skills by drawing on "all the extra-linguistic, non-vocal elements present in any communicative situation".

Jones and Plass (2002) tested listening comprehension with four modes of multimedia aids: listening with no annotation, with only written annotations, with only pictorial annotations, and with both written and pictorial annotations. On the vocabulary translation and free recall post-tests, the students with both types of annotations outperformed other groups. Pictorial annotations had a larger impact on the written type of annotation. This study provides additional evidence for Mayer's generative theory of multimedia learning (Reed, 2006).

Herron, York, Corrie, and Cole (2006) compared two foreign-language classes: one that used a packaged curriculum with a video component as its primary means of teaching new material, and a second course that relied on a more traditional textbook with supplementary media enrichment. Students in the first group made greater gains in both listening comprehension and grammar. In addition to affirming the effectiveness of video as comprehensible input, their study also "suggests the importance of a narrative structure to the video" (p. 295).

2.5.2 Speaking comprehension

When people speak and interact with each other, they always have a purpose and a topic within the context of their situation. "When students don't share the same view of and reaction to an event, topic, situation or person, there is the basis for dispute, disagreement and therefore discussion" (Klippel, 1984). The creation of such "gaps" in class is made much easier for students to solve by the use of the screen, where complex, ambiguous life-situations can be illustrated in detail. Multimedia materials provide a topic for students to discuss, provide a reason for students to speak, and provide a context of the situation to help students gain a richer understanding of the dialog and avoid unnecessary confusion.

2.5.3 Reading comprehension

A particularly fruitful area in SLA research has been the study of the effects of multimedia annotations on reading comprehension (Al-Seghayer, 2001; Chun & Plass, 1996a, 1996b).

Chun and Plass (1996a) explored micro- and macro-processes (bottom-up and top-down) in reading comprehension of an authentic L2 text in a multimedia environment by college-level students. The results showed significant positive effects for a dynamic visual advance organizer (top-down or macro level) on comprehension as measured by idea units mentioned in recall protocols, and for multimedia (visual and verbal) annotations (bottom-up or micro level) on vocabulary acquisition.

Yoshii and Flaitz (2002) examined the effects of three vocabulary annotation types — text only, picture only, and a combination of the two — on incidental vocabulary acquisition in a multimedia reading environment. By employing a between-subjects design, the researchers divided 151 ESL learners into three reading groups, treated each group with one annotation type, and measured learners' vocabulary gains via immediate and delayed vocabulary post-tests. The results of the study indicated that the group using combined text and picture annotations outperformed the other two groups in both vocabulary learning.

The role of video multimedia in conjunction with reading texts may not seem an obvious use of the medium; but the main role for video here is to provide a contextual framework. As some commentators (Grellet, 1981; Alderson, 1984) have put it, "a high interest level in a text's content can overcome the expected 'linguistic difficulty' of a text or the reader's lack of familiarity with a topic". It's easier for students to read if the students have some background knowlege and interest in the material. If we can succeed in interesting the students in the content of a text, they are likely to find it more accessible. What better way of introducing a reading text than to show a parallel text on video, a short excerpt dealing with the theme or topic contained in the reading text, and ideally containing similar vocabulary and linguistic structures? Teachers can use video in this way to help students understand the background of the reading; and can interest students and keep their motivation by choosing kinds of materials that interest them.

In an early study, Leffa (1992) compared the effectiveness of a traditional dictionary with an electronic glossary to aid the comprehension of an authentic text for beginning level learners. The task used as the reading comprehension measure was the translation of the English text to Portu-

guese. The results revealed that the subjects who had access to electronic glosses did not only take significantly less time to read the text but also performed significantly better on the reading comprehension task.

Knight (1994) considered an important variable (i.e. verbal ability) in her investigation of the effect of annotations on reading comprehension. 105 intermediate students were divided into high and low verbal ability groups. She found a substantial relationship between reading comprehension and access to annotations for low verbal ability group ($r = 0.68$), however, the relationship was low for high verbal ability group ($r = 0.17$). This suggests that low verbal ability learners may benefit more from annotations.

Omaggio (1997) investigated the effect of various types of visuals as context in the reading comprehension of a French text. The results suggested that providing visual contexts effectively enhance the recall of factual knowledge. Students also demonstrated better performance in reading comprehension than their counterparts who received only the text.

Lomicka (1998) found that participants in full glossing condition (i.e. L1 translations, L2 definitions and pronunciations, images, references and questions) scored significantly higher in reading comprehension than participants in limited glossing (i.e. L1 translation and L2 definitions) and no glossing conditions.

A relatively large body of similar research has also been conducted with native speakers on different types of learning in a multimedia learning environment. Since the present study draws heavily on Mayer's generative theory of multimedia learning, a brief review of similar research conducted by Mayer and his colleagues is provided here.

Ko (2005) investigated the effectiveness of the language of annotations on reading comprehension. 106 Korean undergraduate students read an English text under three conditions: no gloss, L1 gloss, and L2 gloss. Qualitative analysis revealed that both types of glosses made reading comprehension smoother and faster. On the other hand, quantitative analysis indicated that only L2 glosses affected student' reading comprehension. Moreover, 62% of leaners favored L2 glosses for their reading material. However, as Taylor (2006) suggests, the results might be attrib-

uted to the level of the learners. That is, glossing could have differential effects on reading comprehension depending on the level of the learners.

Other studies have explored the relationship of the multimedia environment to reading comprehension (Brett, 1997; Grezel & Sciarone, 1994). Pearman and Lefever-Davis (2006) found that CD-ROM storybooks could support reading comprehension for schoolchildren. Their work explored the use of the classroom computer; most relevant to the current research is the opportunity a CD-ROM provides to hear individual words in a text. Video presents not only images but "real language that is not simplified and is spoken at a normal speed with genuine accents" (Burt, 1999, p.2). It also provides "genuine accents" (Burt, 1999, p.2). It also provides "contextualized information, including non-verbal cues and non-lexical cues such as stress and rhythm" (Bello, 1999, p. 20). Fazey (1999) affirmed the accessibility and interest of video, with its rich context, for poor or beginning readers.

Chun and Plass (1996b), Hong (1997), Lomicka (1998) found that in-text vocabulary annotations enhanced by pictures, videos, or audio were effective in aiding overall reading comprehension; moreover, these annotations outperformed traditional text glosses (Chun & Plass, 1996b; Lomicka, 1998). For example, Lomicka (1998) found that learners looking up multimodal vocabulary annotations composed of L1 and L2 texts, images, references, questions, and word pronunciation produced more causal inferences — an indicator of high level comprehension — in think-aloud protocols than those who only used traditional L1 and L2 text glosses.

Chun & Plass (1994) found the text links (definitions in German) the least helpful, probably due to the difficulties in understanding the German rather than to the type of link. On the other hand, picture and movie links were ranked as the most helpful links, students showed a definite preference for the picture and movie links. This suggests that although the quality of the links was uneven across types of links, the more important factor appears to be type of link. (In terms of the effectiveness of the different types of links for learning vocabulary words, there was a positive, though not significant, relationship between type of link chosen and whether the word was learned correctly).

2.5.4 Writing comprehension

'Contextual supports help considerably' when coming to writing (Widdowson, 1983). The writing task is easier for students when they know more information about it. It's much easier to write about the people you have actually seen and about whom you have formed some impressions, to write about places that you can imagine yourself as having visited, to describe events that you have actually witnessed rather than simply imagined. Multimedia materials can provide the topic in context, in details, and give more background informations for writers to consider. It's not only easier for students to write, because there is more first-hand experience in what they are writing about, but it builds confidence and helps them to write better.

To study the amount of language produced in the traditional (aural) classroom setting versus the more innovative use of discussion through network computers, Kern (1995) collected data showing that Computer Mediated Communication (CMC) promotes interaction within the foreign language classroom setting at a much greater rate than is seen in the "computerless" learning environment. All students participated in the discussion and averaged more messages each when communicating via computers than in the traditional classroom. The students presumably experienced less evaluation apprehension when using the computer, which boosted their confidence and fostered greater acquisition of knowledge; students were not as afraid to make errors when interacting with classmates via the computer program than when they were interacting face-to-face with their peers and teacher in the classroom setting.

Although there are disagreements about whether the use of a computer for L2 writing should be considered as multimedia, it is clear that the use of a computer as a writing tool provides certain advantages for second language learners beyond its obvious utility for writers in general.

2.5.4.1 Student attitudes

Many studies conducted with L2 writers report positive attitudes associated with word processing (e.g. Neu & Scarcella, 1991; Pennington & Brock, 1992; Phinney, 1991; Phinney & Mathis, 1990). Akyel and Kamisli (1999) report that the use of the computer improved student attitudes toward writing and built up their confidence. In a longitudinal investigation of a group of

mature ESL writers in Hong Kong who were able to use the computer as much as little as they wished in their written work for a course (Rusmin, 1999), the majority of the students were positive toward the computer and adopted it for their writing from the beginning of the term or increasingly as the course progressed.

2.5.4.2 Textual properties

Also related to attitude is self-consciousness. The student writer working in a computer medium is led to write in a less self-conscious way and with greater engagement, thus writing with a freer mind and less "rewriting anxiety." As a result, the student's greater involvement may lead him or her to write for longer periods of time and produce longer texts. In some cases, computer-produced text represents an unfinished, intermediate work that given sufficient time for continued development will result in a high-quality product (Pennington, 1996b, 1996c).

2.5.4.3 Revision strategies and accuracy concerns

L2 writers have been found to revise more when writing with a computer than when writing by traditional means (Chadwich & Bruce, 1989; Li & Cumming, 2001; Phinney & Khouri, 1993), to revise more dynamically and continuously (Phinney & Khouri, 1993), and to spend more time revising in a computer context, where they may "continue revising after planned changes have been made" (Phinney & Khouri, 1993, p.271). The computer sets a low barrier for multiple revisions, feedbacks, and sharing.

2.5.4.4 Planning

In pen-and paper composing, writers often spend a lot of time in intensive planning before writing to avoid making mistakes or changing their minds about what they want to say and then having to undertake the tedious chore of rewriting or recopying text already written down. The automated text-generation and revision tools provided on computer, coupled with the malleability of text on screen or disk, encourage a very different computer-based writing mode (Bernhardt, Edwards, & Wojahn, 1989; Haas, 1989; Williamson & Pence, 1989). Instead of writing to fit a plan, computer writers plan as they're writing (Haas, 1989), an effect also documented for L2

writers (Akyel & Kamisli, 1999; Li & Cumming, 2001). Planning thus becomes more of a middle stage than a beginning stage activity, and the time and intensive cognitive activity that would have been involved in pre-planning is instead involved in writing itself. The sharp division of composing into the three stages of planning, writing, and revising breaks down in a computer context, in which planning as well as revision occurs as part of the writing process. In the computer-engendered approach to writing, cognitive effort is distributed throughout the writing process and writing is developed more on the basis of concrete text already generated than on an abstract plan; this procedure would seem to be especially valuable for L2 writers, who have less cognitive capacity available for writing than do L1 writers.

2.5.4.5 Email exchanges

With a university-wide network, L2 students can be linked to L1 partners or more experienced L2 students on campus (Nabors & Swartley, 1999). With internet access, L2 students can participate in information exchange with sister classes and email partners overseas (Sayer, 1989; Slater & Carpenter, 1999; Woodin, 1997). Woodin (1997) points out that in providing an opportunity for real communication one-on-one with speakers of the target language, email functions "as a bridge between the language classroom and the natural setting. There is the opportunity for contact with a variety of native speakers, but from within the safety of one's own environment" (p.31). In either type of partnering arrangement, the email contact may allow writers to obtain information or input from a real audience in relation to their written assignments. Or the contact with other communicators over a network may itself function as stimulation for students' writing.

2.5.5 Teaching Chinese characters

Chinese is considered to be one of the most difficult languages for non-native speakers to learn (Lin et al, 2008; Wu & Miller, 2007). One of the basic challenges for learners is learning to write Chinese characters (Everson, 1998), and teaching Chinese characters is usually the biggest challenge for Chinese teachers. To learn a Chinese character, one must learn its shape as well as its sound and meaning. Written characters are composed of several strokes, and to learn them effectively the learner must learn to write each stroke in the proper order. In Chinese education,

learning the stroke order has traditionally been regarded as a critical step in mastering the writing of Chinese characters. Unfortunately, because of time limitations in Chinese learning classrooms, instructors tend to focus on the sound and meaning of each character. Regarding the visual form, instructors are limited to demonstrating once or twice how to write the character. Moreover, the process of learning to write Chinese characters is tedious for many learners, and learning materials are limited. Zhan (2002) noted that while learning materials for non-native speakers focused on pronunciation and conversation, listening, reading and writing; materials devoted to writing characters with a focus on stroke order have, by comparison, undergone much less development.

2.5.5.1 The role of multimedia in teaching Chinese characters

Multimedia contributions in teaching Chinese characters would be invaluable for teachers to use as a tool in teaching, for students to use as a way to learn, and for the researcher to use as a method to develop more useful theories and teaching approaches for the teachers and learners.

In Chung's (2008) experiments with Chinese characters, Chinese learners were provided with two different modes of character presentation. The mixed mode presented the Chinese characters visually and their corresponding pinyin and English words aurally. The visual mode presented all the characters and their associated prompts only visually. The purpose of this investigation was to compare the effects of pinyin and English translation prompts presented in different visual and auditory formats during the learning of the characters. The study was carried out in two experiments with learners of varying abilities in the target language. The findings suggested that the mixed format of character presentation was effective for more experienced learners both in word meaning and pronunciation learning. Moreover, the results were in contrast to those of the beginners for whom the visual-only format brought about a better effect and less mental load on word meaning, but not on pronunciation.

The argument, then, is that the optimal method of learning characters is not simply a function of the instructional format, but also of the learner's characteristics (Chung, 2008). Additionally, useful information may have negative effects if it overloads working memory, which is probable in the case of novices. The same information may have positive effects if it can be processed,

which is more likely with increases in expertise. These interactions again provide examples of the expertise reversal effect.

Many Chinese characters are pictographs standing for objects, or pictographs with certain markings added to indicate more abstract concepts (Shuwenjiezi, 100, Weiger 1911; Hung & Tseng 1981). Research shows that at an early stage in the learning of Chinese characters, the learner tends to remember characters as distinct pictures (Chuang 1975). In one earlier project on software for learning Chinese characters carried out by the team (lam 1993), computer animation was used to relate the written form of some Chinese characters to their pictorial origins. Preliminary evaluation indicated that such presentation is motivational as well as effective in helping young learners to remember the written form as well as the meanings of the characters.

Most Chinese characters are composite logographic forms (Shuwenjiezi, 100). In these "compound characters", two or more major components are combined to fill an imaginary square block. The methods of composition are highly regular. In general, the components contribute to the sound or the meaning of the compound character they form (Ann 1982). In some cases, the components are themselves characters, and the meanings of these simple characters add together to form the meaning of the compound character.

In other case, one component represents the meaning while the other component the sound of the compound character. This is the so called pictophonetic composition. Over 70% of Chinese characters are compositions of this sort.

Table2.3 Pictophonetic composition of Chinese characters

清	晴	请
clear	fine weather	invite
The characters have similar sounds. The component 青 contributes to their sound. The other components contribute to their meanings.		

"Visually specific information is retained in memory from previously attained objects in natural scenes" (William & Henderson, 2001). Recent researchers have examined the effects of mul-

timedia on Chinese character learning, and have taken advantage of learning through visual and mind mapping in the development of new approaches to teaching Chinese characters by using multimedia as a tool. Two examples of these projects are described below.

In Honggang (2006), 100 college students from mainly three orthographic backgrounds: European, East Asian, and South Asian participated. All subjects performed a recall task immediately after viewing 36 Chinese characters displayed either on a computer with various types of presentations: radicals, strokes, pinyin or printed on paper with pinyin and English translation. The result shows that the multimedia presentation performed better than printed media. And within the same multimedia performance, radical presentation performed the best, followed by stroke presentation, and finally pinyin. Multimedia not only contributes as a useful tool to help students learning inside of the classroom but also helps researchers outside of the classroom in developing their theories of Chinese Character learning from a cognition learning process perspective.

In another project, researchers used multimedia to developed an approach called Interactive Chinese Character Learning System (Low, Wong, Han, Kim, Jung, & Yang, 2008) to help children, who often become frustrated by the conventional approach to learning Chinese characters through visual recognition and continuous practice. This new interactive method for learning Chinese character is based on their origins of creation, using one algorithm for both sketched image and word matching instead of two different matching mechanisms based on the concept of shortest path similarity. This system is aimed at easing learning and creating fun in learning, as learning Chinese character has proven to be a difficult task, especially as involves the memorization of each character.

2.6 The theoretical basis for the current study

Overall, existing empirical studies and the assumptions and theories they embody have shown that multimedia material can be a useful tool in L2 from various perspectives. The current study is based on Mayer's (2001) cognitive theory of multimedia learning, which states that the

ability to review information more than once allows for multiple retrieval routes to the information and reinforces students' learning (Chun & Plass, 1996a, 1996b). Since learners rely on different modalities to learn efficiently in different ways (Plass et al., 1998; Reinert, 1976), providing them with an opportunity to choose the mode of information they prefer may help them better learn and comprehend the material presented. L2 multimedia environments that provide pictorial and written modes of information may be most effective for L2 learning because students can choose the mode that best suits their needs and preferences (Plass et al., 1998).

Specifically, this study explores the extent to which meaningful connections between verbal and visual modes provided by multimedia material affect L2 grammar comprehension.

CHAPTER 3
METHODOLOGY

3.1 Research questions

Researches haven consistently shown the positive effects of using multiple modalities from different aspects of second language learning, such as in vocabulary learning, reading, writing, listening, speaking and even in one of the unique feature of Chinese language: Chinese character. However, grammar learning at the core of L2 learning hasn't been explored. In response to the lack of studies on aspects of second language grammar comprehension, the present study attempts to address one specific aspect: comparing different modality of multimedia materials in the context of second language grammar comprehension; specifically, comparing the efficacy of different types of pictorial teaching materials. No investigation has been done on the difference between the relative effects of static pictures and video on grammar comprehension. Therefore, this study was designed to investigate the relative efficacy of three different modes used in grammar teaching — text alone, text with a still picture, and text with video clips — and to compare the efficacy of printed text with still pictures as opposed to video on the micro scale.

The study's focus is to determine which mode or modes — text alone, text with still picture or text with dynamic video clip — are more effective in aiding L2 grammar acquisition. Due to the contextual richness, meaningfulness, facility of recall, and cultural authenticity of video, this paper hypothesized that video is a more effective tool to foster the acquisition of grammar in a foreign language. It was anticipated that video material would be more effective in teaching unknown grammar than still picture material. Consequently, it was anticipated that the participants' performance on the grammar test would be significantly higher for those had been treated with video clips than those had been treated with pictures.

Research question 1: Among three types of second language grammar teaching materials — text, text-still picture, and text-video clips, which one is the most effective teaching method for grammar acquisition for Chinese intermediate learners in a short term?

Research question 2: Among three types of second language grammar teaching materials — text, text-still picture, and text-video clips, which one is the most effective teaching method for grammar acquisition for Chinese intermediate learners in a long term?

Research question 3: Among three types of second language grammar teaching materials — text, text-picture, and text-video clips — which is the most effective teaching method for acquisition of more complex grammar by Chinese intermediate learners? Is multi-modal multimedia material more effective than text alone? Is text-video material more effective than text-picture material?

Hypothesis 1: Learners who received text-pictures and text-video would perform better in a short term than those who received text-only treatment. Learners who received text-video treatment would perform better than those who received text-pictures treatment in a short term.

Hypothesis 2: Learners who received text-pictures and text-video would perform better in a long term than those who received text-only treatment. Learners who received text-video treatment would perform better than those who received text-pictures treatment in a long term.

Hypothesis 3: Text-Video and text-picture would perform better than text-only on the more complex grammar, and text-video will be more effective than text-picture.

3.2 Participant selection

To test the aforementioned hypothesis, a convenient sample set was selected from 54 Chinese language learners enrolled in the Chinese language program at a public university in Massachusetts. They were divided into three groups (of 20, 19, and 15 students) on the basis of enrollment in three sections of the discussion classes. Three parallel discussion classes were all in the second semester of an intensive course. The students had taken placement tests before they were placed in these three beginning level classes to make sure they were at the same level and were suited to

the current course's curriculum. This study didn't include a few students who attended one post-test but not the other. The study was based on the premise that none of them had previously been instructed on the directional complement structure.

3.3 The target forms

Chinese directional complement (DC) is one of the most difficult grammars for English speaking learners to acquire because of its syntactic complexity. Chinese language teachers are fully aware of the challenges that DC constructions present to L2 learners. Talmy's (1985, 1991, 2000) typological classification of motion events—to investigate how second-language (L2) Chinese learners come to express motion events in a targetlike manner. Fifty-five U.S. university students and 20 native speakers of Chinese participated in the study. A controlled composition task and a picture-cued written task were administered to elicit learners' knowledge and degree of mastery of Chinese spatial morphemes, also known as directional complements (DCs). Analysis of learners' interlanguage data shows that the difficulties came from the syntactic complexity of the target DC patterns and from the typological features of Chinese as a serial-verb language.

The syntactic complexity of DCs is reflected in two dimensions of variation: that of the number of constituents and associated word order, and that of DC type. The two dimensions yield a six-type classification of DC pattern that can be used to describe a motion event. The linguistic facts are summarized in Table 3.1, following Chao (1968), Cheung et al. (1994), Liu et al. (1983), Lu (2002), Peyraube (2006), and Yao and Liu (1997).

Table 3.1 The six types of directional complement constructions

Type	Example
1. Simple DCs	*ta zou* ***dao*** *le* 她 走 到 了。 he walk **to** Perf. "He arrived."
2. Complex DCs	*ta zou* ***jin lai*** *le* 她 走 进 来 了。 he walk **into hither** Perf. "He walked in [hither]."
3. Simple DCs with Object NPs	*ta ban* ***chu*** *le* ***yi-zhang-da-zhuozi*** 她 搬 出 了 一张大桌子。 he move out Perf. **a-Cl.-large-table** "He moved out a large table."
4. Simple DCs with Place NPs	*ta zou* ***hui sushe*** *le* 她 走 回 宿舍 了。 he walk **back dormitory** Perf. "He walk back to the dormitory."
5. Complex DCs with Object NPs	*ta ban* ***chu yi-zhang-da-zhuozi lai*** *le* 她 搬 出 一张大桌子 来了。 he move **out a-Cl.-large-table hither** Perf. "He moved out a large table [hither]."
6. Complex DCs with Place NPs	*ta zou* ***hui sushe lai*** *le* 她 走 回 宿舍 来 了。 he walk **back dormitory hither** Perf. "He walked back[hither] to the dormitory."

Directional words such as 上 (up), 下 (down), 进 (in), 出 (out), 回 (back), and 过 (cross over) are usually used after the verbs indicates the motion direction of the verbs; and there are two verbs which can indicate the speaker's positions: 来 (to come) describes an action moving towards where the speaker is and 去 (to go) which describes an action moving away from where the speaker is. 来 (to come) and 去 (to go) are used to combine with the first groups of DCs to form a complex directional complement structure.

3.4 Treatment task

The experiment took place during regular class periods. Since the three classes were parallel discussion classes for the same Chinese course, the participants received the treatment on the

same day since the three discussion classes had their regular classes at different times on the same day. The first group (n=19) received their treatment with text-only; the second group (n=20) received their treatment with text-picture; and the third group (n=15) received their treatment with text-video clips.

3.4.1 Text-only treatment

Treatment for the text-only group only used slides with text only to explain the grammar matter. 来 (to come) /去 (to go) were first explained in text and then the instructor had the class practiced the example sentences in group. Then 上 (up), 下 (down), 进 (in), 出 (out), 回 (back), and 过 (cross over) were explained by the instructor followed by a group practice time. Finally, the combination of 上 (up), 下 (down), 进 (in), 出 (out), 回 (back) and 过 (cross over) + 来 (come) / 去 (go) were explained by the instructor followed by a group practice time.

3.4.2 Text-Picture treatment

Treatment for the text-picture group used text and still pictures. The order of the grammar forms are the same as the text-only group.

来 (to come) /去 (to go) were first explained using the combination of text and pictures. "来 (to come) /去 (to go) are used to indicate the action of the moving, whether it's toward the speaker or away from the speaker." was shown to the students on the slides along with the picture in Figure 3.1. Then group practice time was provided.

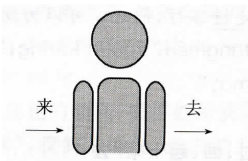

Figure 3.1 DC that indicates speaker's position

Then 上 (up), 下 (down), 进 (in), 出 (out), 回 (back), 过 (cross over) were explained by the instructor. The explanation was typed in text on the slides along with the pictures in Figure 3.2.

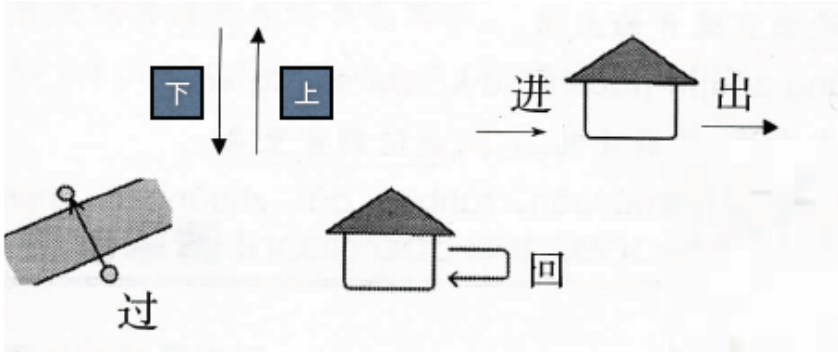

Figure 3.2 DC that indicates the direction of the verbs

Finally, the combination of two types of DCs were explained and practice sentences were provided with text and pictures.

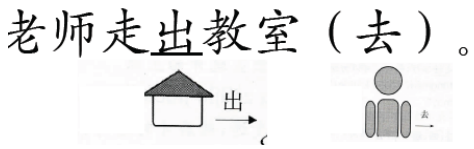

Figure 3.3 Two types of DC in one sentence

3.4.3 Text-Video treatment

In the text-video group, two types of simple DCs and complex DC were explained with text explanation and video clips. The order of the DC structures were introduced was the same as the other two groups. Video clips were used to explain the grammar and to allow students to practice target sentences.

Figure 3.4 video treatment

3.5 Assessment and scoring procedure

The participants in all three groups received two grammar post-tests: an immediate post-test and a delayed post-test. The immediate test was administered right after the treatment; the delayed test was administered two weeks after the the treatment, with no advanced notice, and measured the grammar comprehension on Chinese DC structures. This study used a two-week span, following similar studies (Chun & Plass, 1996; Kost etal., 1999; Yoshii & Flaitz, 2002). Each post-test contained three parts:

- fill-in-gap tasks (four simple DC questions and three complex DC questions)
- a translation task (the correct answer can be either a simple or complex DC sentence)
- making a sentence according to a given picture (can be either a simple or complex DC sentence)

The format of the immediate test and delayed test are the same. The test contains a total of ten questions divided into three parts. The first part contains seven questions: four questions are filling-in-gap questions with one gap (simple DC), the other three questions of the first part are filling-in-gap questions with two gaps (complex DC); the second part includes one question in which the participants are assigned to translate a sentence from English into Chinese; and the third part of the test includes one question in which the participants are asked to make a directional complement structure sentence based on a provided picture.

The participants received one point for each of the four simple DC questions, two points for each of the three complex DC questions, and five points for both the translation question and the sentence construction, yielding a possible total of 20 points for correct answers.

Both the immediate post-test and delayed post-test have the same format. Samples of the tests are provided in Appendices A and B.

3.6 Data collection and analysis

Each research question was analyzed by means of ANOVA (Analysis of Variations) tests. A 3x3 ANOVA (type of materials x groups) was performed on students' scores on the immediate

tests and the delayed tests. The data were examined in terms of the effect of the type of teaching material (text alone, text with still picture, and text with video clips) in the aspect of grammar comprehension. Post hoc analyses were applied to further examine the differences between the groups.

A mixed model ANOVA was also conducted in order to get an overall picture of the effects of teaching material types and the changes that occurred between the immediate and delayed post-tests. This analysis involved one between-subjects (the type of teaching material) and one within-subjects (immediate and delayed) test. The analyses involved the investigation of group differences on the immediate and delayed tests. They also investigated whether the differences among the groups changed over time between the immediate and the delayed post-test. Alpha level was set 0.05 for all analyses. When significant differences emerged, the contrasts between the pairs of least square means of the groups were evaluated.

CHAPTER 4
RESULTS AND ANALYSES

4.1 Immediate-test result

Analyses of the participants' performance on the immediate post-test indicated that the text-video teaching material was the most effective for Chinese DC grammar comprehension. Table 4.1 shows the mean scores and standard deviations on the immediate post-test.

Table 4.1 Means and standard deviations of Immediate-test

Group	N	Mean	Standard deviation
Text-only	19	10.0	4.58
Text-Picture	20	14.0	4.22
Text-Video	15	16.6	3.27

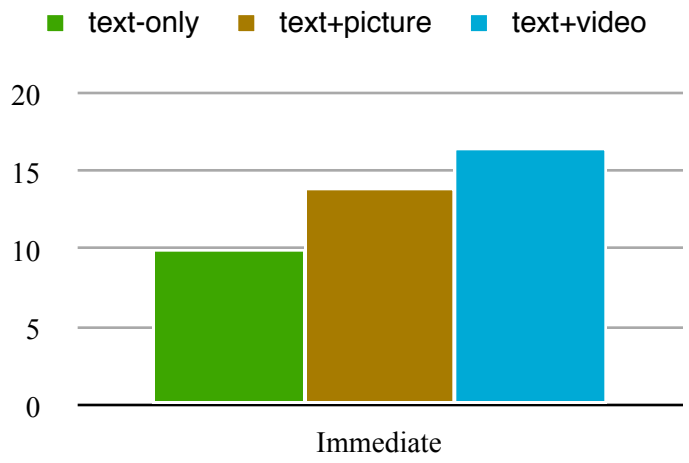

Figure 4.1 Means of Immediate-test by group

Figure 4.1 illustrates the difference between the mean scores of the three groups on the Immediate test: Text-Video (16.6) > Text-Picture (14.0) > Text-only (M=10.0).

A one-way ANOVA was performed to further determine the difference among the three types of teaching materials (Table 4.2).

Table 4.2 ANOVA on Immediate-test

Source	Degrees of freedom	Sum of squares	Mean square	F
Treatments	2	376.1	188.04	11.066*
Residuals	51	866.6	16.99	

*$p < 0.05$

The one-way ANOVA results indicated that *P* is 0.0001, considered extremely significant.Variation among treatments is significantly greater than expected by chance. The ANOVA test revealed that the effectiveness of the the three types of teaching material on grammar comprehension was significantly different in the immediate post-test.

Further analysis was conducted to compare pairs: text-only (T) group and text-picture (TP), T and text-video (TV), and TP and TV. A Bonferroni multiple comparisons test was performed, with the results shown in Table 4.3. If the value of t is greater than 2.475, then the *P* value is less than 0.05, indicating a significant difference.

Table 4.3 Bonferroni multiple comparisons test on Immediate-test

Comparison	Mean difference	t	*P* value
TP vs. T	3.95	2.99	$p < 0.05$
TV vs. T	6.57	4.62	$p < 0.001$
TV vs. TP	2.63	1.86	$p > 0.05$

The test revealed a significant difference between the text-only group and both the text-picture (TP) and text-video (TV) groups. However, a less significant difference was observed between the TP and TV groups. That is, the multimedia groups outperformed the text-only group, but both multimedia groups performed similarly in the Immediate-test.

Because the Bonferroni test is very conservative and sometimes results in false negatives (i.e. indicating no significant difference where one does in fact exist), a non-parametric ANOVA (Kruskal-Wallis test) was subsequently performed on the descriptive data (Table 4.4) as a cross-check of the results in Table 4.3.

Table 4.4: Kruskal-Wallis test on Immediate-test

Group	Number of points	Sum of ranks	Mean of ranks
Text-only	19	331.0	17.42
Text-Picture	20	581.5	29.08
Text-Video	15	572.5	38.17

The results of the non-parametric ANOVA showed a extremely significant group effect (KW=14.954, *P*=0.0006). This analysis consistently supports the result from the one-way ANOVA test, i.e. the effectiveness of the the three types of teaching material on grammar comprehension is significantly different.

In summary, both the one-way ANOVA test and the non-parametric ANOVA (Kruskal-Wallis) test confirmed that the effectiveness of the three types of teaching material on grammar comprehension was significantly different. Both tests showed that there is a significant difference in Immediate-test performance between the text-only group and the two multimedia (text-pictures and text-video) groups. However, while text-video is somewhat more effective than text-pictures, this effect is less significant.

4.2 Delayed-test result

Analyses of the participants' performance on the delayed post-test indicated that the text-video teaching material was the most effective for Chinese DC grammar comprehension. Table 4.5 shows the mean scores and standard deviations on the delayed post-test.

Table 4.5 Means and standard deviations of Delayed-test

Group	N	Mean	Standard deviation
Text-only	19	10.4	4.94
Text-Picture	20	11.7	5.70
Text-Video	15	16.1	3.38

Figure 4.2 illustrates the difference between the mean scores of the three groups on the Delayed test: Text-Video (16.1) > Text-Picture (11.7) > Text-only (M=10.4).

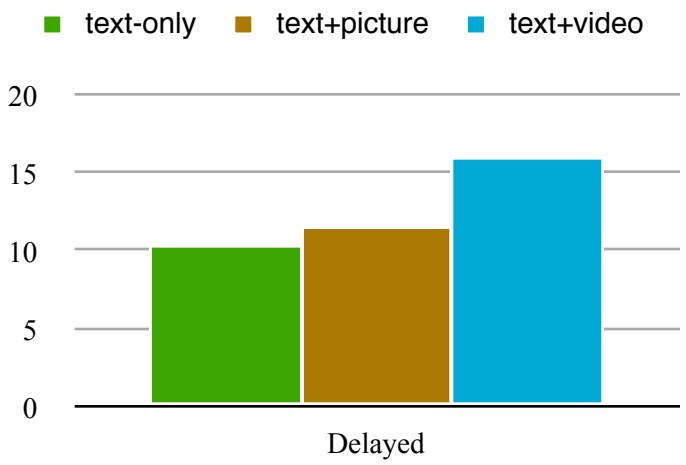

Figure 4.2 Means of Delayed-test by group

A one-way ANOVA was performed to further determine the difference among three types of teaching material (Table 4.6). The results indicated that the *P* value is 0.0047, considered very significant.

Table 4.6 One-way ANOVA on Delayed-test

Source	Degrees of freedom	Sum of squares	Mean square	F
Treatments	2	284.4	142.20	5.957*
Residuals	51	1217.5	23.87	

*$p < 0.05$

Further analysis was conducted to compare pairs: text-only (T) group and text-picture (TP), T and text-video (TV), and TP and TV. A Bonferroni multiple comparisons test was performed, with the results shown in Table 4.7. If the value of t is greater than 2.475, then the *P* value is less than 0.05, indicating a significant difference.

Table 4.7 Bonferroni multiple comparisons test on Delayed-test

Comparison	Mean difference	t	*P* value
TP vs. T	1.23	0.78	$p > 0.05$
TV vs. T	5.62	3.33	$p < 0.01$
TV vs. TP	4.39	2.63	$p < 0.05$

The test revealed a significant difference between the text-only (T) group and the text-video (TV) groups. However, no significant difference was observed between the text-pictures (TP) and text only group. That is, in the Delayed-test only the text-video multimedia group outperformed the text-only group, while the text-pictures multimedia group performed similarly to the text-only group.

A non-parametric ANOVA (Kruskal-Wallis test) was subsequently performed on the descriptive data (Table 4.8).

Table 4.8: Kruskal-Wallis test on Delayed-test

Group	Number of points	Sum of ranks	Mean of ranks
Text-only	19	396.0	20.84
Text-Picture	20	512.5	25.63
Text-Video	15	576.5	38.43

The results of the non-parametric ANOVA showed a very significant group effect (KW=10.971, P=0.0041). This analysis consistently supports the result from the one-way ANOVA test, i.e. the effectiveness of the the three types of teaching material on grammar comprehension is significantly different.

In summary, both the one-way ANOVA test and the non-parametric ANOVA (Kruskal-Wallis) test confirmed that the effectiveness of the three types of teaching material on grammar comprehension was significantly different. Both tests showed that there is a significant difference in Delayed-test performance between the text-only group and the text-video multimedia group. However, in contrast to its performance measured in the Immediate-test, the text-pictures group is no longer significantly different than the text-only group.

Across the post-tests (Figure 4.3), there was little change (either increase or decrease) in mean scores between the immediate and delayed tests for the text-picture and text-video groups, but the mean scores of the text-picture group declined noticeably. This is consistent with the findings of the preceding section.

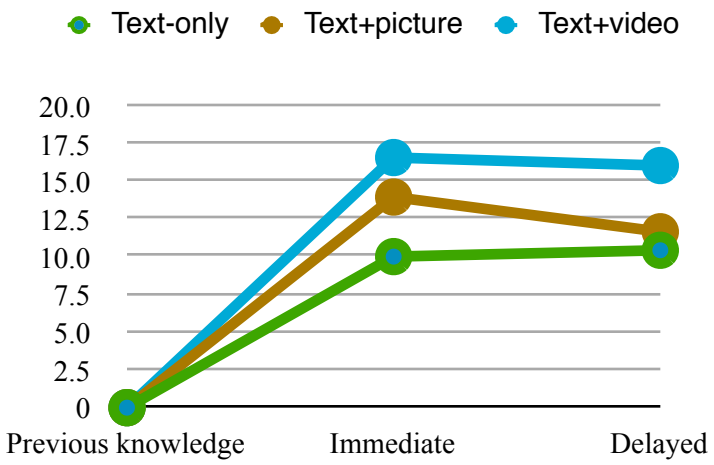

Figure 4.3 Change in means of groups over time

The statistical explanation for the decrease in mean scores of the text-pictures group can be seen in the comparative frequency distribution of the three groups over time shown in Figure 4.4. While the distributions of the text-only and text-video groups remain fairly constant over time (standard deviations of 4.58 to 4.94 and 3.27 to 3.38, respectively), the lower end of the text-pictures group distribution spreads out significantly (4.22 to 5.70), indicating that a significant number of participants performed poorly on the delayed test compared to the immediate.

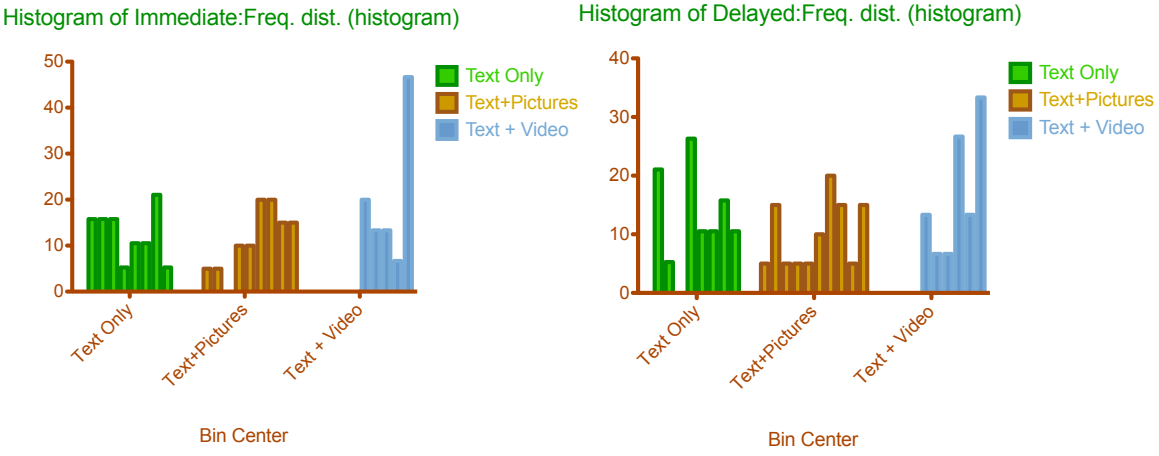

Figure 4.4 Change in frequency distribution of groups over time

A two-way repeated measures ANOVA was performed to further quantify the difference among three types of teaching material over time (Table 4.9).

Table 4.9 Two-way ANOVA on group and time

Source	Degrees of freedom	Sum of squares	Mean square	F	*p*
Time x Treatment	2	37.12	18.56	2.80	0.07
Time	1	17.19	17.19	2.59	0.11
Treatment	2	623.40	311.70	9.10	0.0004
Subjects (matching)	51	1746	34.23	5.16	
Residual	51	338.30	6.63		
Total	107	2764			

This analysis yielded significant main effect for treatments, but neither significant main effect overall for time, nor a significant interaction between time and treatment.

(Treatment accounts for 23% of the total variance, and P=0.0004. This effect is considered extremely significant. In comparison, time accounts for only 0.6% of the total variance, and with P=0.11, this effect is not considered significant. Similarly, interaction between time and treatment accounts for 1.3% of the total variance, and with P=0.07, this effect is not significant either.)

A Wilcoxon matched-pairs signed rank t-test of each group over time (Table 4.10) confirms the behavior illustrated in Figures 4.3 and 4.4. This shows that time has a very significant effect on the text-pictures group (P=0.031), but no significant effect on the text-only or text-videos groups (P=0.913 and P=0.592, respectively). Thus, although the two-way ANOVA indicates an insignificant effect of time *overall*, the text-pictures group uniquely shows a very significant effect of time.

Table 4.10 Wilcoxon matched-pairs signed rank test by group over time

Delayed vs. Immediate	P	Sum of signed ranks (W)	Pairing P
Text-only	0.913	6.0	0.0002
Text-Pictures	0.031	92.0	0.0003
Text-Video	0.592	13.0	0.0148

4.3 Comparison of the effects between groups for simple and complex DC

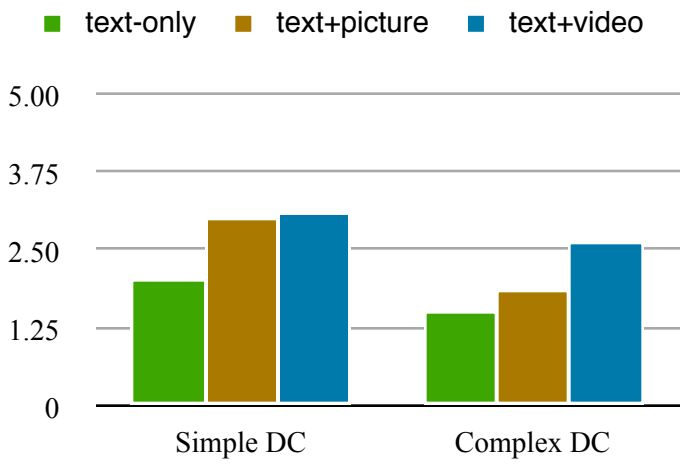

Figure 4.5 Mean of simple and complex DC in Immediate-test by group

As shown in Figure 4.5, in both parts (simple and complex directional complements) of the immediate post-test, both the text-picture and text-video groups performed significantly better than text-only. However, while text-video performed significantly in the *complex* DC part of the test than either the text-only or text-pictures groups; in the *simple* DC part of the test, the text-video group did not perform significantly better than the text-picture group.

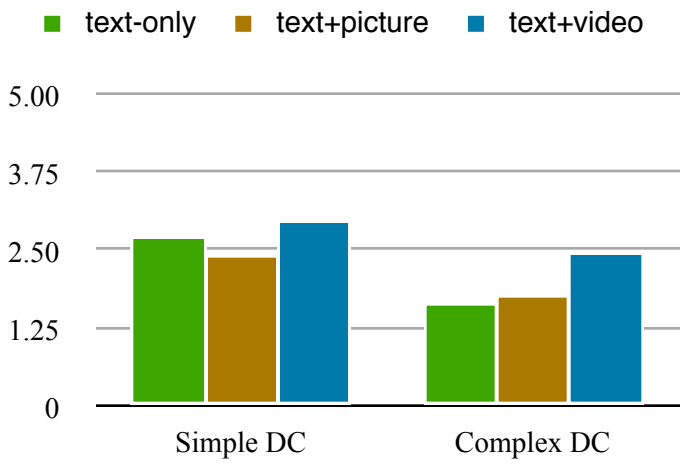

Figure 4.6 Mean of simple and complex DC in Delayed test by group

Figure 4.6 shows the behavior for the delayed post-test. In this case, all three groups performed nearly the same (i.e. the text-only group has "caught up") for the simple DC part of the test, with the text-pictures group now having the lowest performance. However, for the complex

DC part of the test, only the text-video group shows significantly better performance than the other groups.

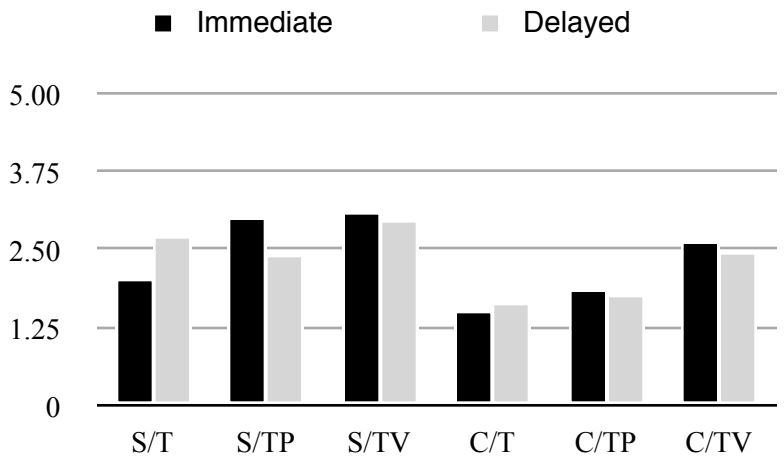

Figure 4.7 Comparison of mean scores for Intermediate and Delayed-tests

Mean scores for the simple and complex DC parts of the immediate and delayed post-tests for the groups are compared in Figure 4.7. This illustrates that both text-picture and text-video group had a performance loss over time, but unexpectedly there is actually a *gain* (especially significant for simple DC) for the text-only group between the immediate and delayed post-test. This suggests that at least some students in the text-only group may have received some additional treatment (e.g. remedial study or tutoring) between the two tests.

Because of the fact that the text-only group might have been exposed to additional treatment before the delayed post-test, one-way ANOVA analyses of performance on simple and complex DCs was conducted using only the data from the immediate post-test. The ANOVA for the simple DC case returned a very significant P value of 0.0055, so a Tukey-Kramer multiple-comparisons test was performed, with the results shown in Table 4.11.

Table 4.11 Tukey-Kramer multiple comparisons test of simple DC in Immediate-test

Comparison	Mean difference	q	P value
TP vs. T	1.00	4.37	$p < 0.01$
TV vs. T	0.95	3.85	$p < 0.05$
TV vs. TP	0.05	0.21	$p > 0.05$

The inference is that both text-picture and text-video have a similar beneficial effect compared to text-only treatment in simple Chinese DC grammar comprehension. Since no significant difference is found between text-video and text-picture groups, text-video is not necessarily more effective in the short-term than text-picture in teaching simple DC grammar.

Similarly, the ANOVA for the complex DC case returned a very significant P value of 0.007, so a Tukey-Kramer multiple-comparisons test was performed, with the results shown in Table 4.12.

Table 4.13 Tukey-Kramer multiple comparisons test of complex DC in Immediate-test

Comparison	Mean difference	q	P value
TP vs. T	0.35	2.06	$p > 0.05$
TV vs. T	0.91	5.02	$p < 0.01$
TV vs. TP	0.57	3.15	$p > 0.05$

There was a significant effect found only between the text-only and text-video groups. This indicates that text-video treatment has a significant short-term effect on the performance of Chinese complex DC grammar comprehension. Text-Picture treatment was somewhere between text-only and text-video performance, without a greatly significant difference to either.

In summary, the text-video group performed the best in both the immediate and delayed tests for both simple and Complex DC forms. While text-pictures also had good performance for simple grammar, text-video is clearly a better tool to use for more complex grammatical forms.

CHAPTER 5
DISCUSSION

In this chapter, the results of the empirical study are discussed with respect to the research questions proposed in chapter 2. In that chapter, the hypothesis was put forth that multimedia materials have a beneficial effect on second language acquisition. Further, because of the contextual richness, meaningfulness, facility of recall, and cultural authenticity of video, this paper hypothesized that text combined with video is a more effective teaching tool to foster the acquisition of grammar in L2 learning. It was anticipated that text combined with video would be more effective in teaching grammar than text combined with still pictures. Even though the results largely support that hypothesis, there are some results which qualify that hypothesis in several respects.

5.1 Q1: Short-term effects of text, text-pictures and text-video

The first research question asked which, among three types of second language grammar teaching materials — text, text-picture, and text-video clips, is the most effective teaching method for grammar acquisition for Chinese intermediate learners in the short term? The hypothesis was that the learners who receive instruction with the help of text-pictures and text-video will comprehend better in the short term than those who receive text-only treatment; and learners who receive instruction with text-video will comprehend better than those who receive instruction with text-pictures.

The results from this study bear out this first hypothesis, showing that participants presented with text-video scored higher (mean score=16.6) than the participants in the text-pictures group (mean score=14.0), who in turn scored significantly higher than the text-only group (mean score=10.0). That is to say that learners have the best short-term grammar comprehension when instructional text is combined with pictures or video. However, even though both multimedia

(text-pictures and text-video) groups had significantly higher mean scores than the text-only group, there was a less-significant difference between the two multimedia groups.

This suggests that multimedia material is useful when it provides meaningful context and a memory aid to the learner. The results are consistent with Plass and Jones (2005) who discussed the applications that Mayer's (1997, 2001, 2002, 2005a, 2005b) generative theory has for SLA, which propose a model based on the cognitive theory of multimedia learning (CTML) and on an interactionist model of SLA in which attention must be paid in order for learning to take place. In their view, multimedia contexts facilitate the provision of meaningful input, foster interaction, and provide opportunities to elicit output in the L2. Along the same lines, in the present study, there was a significant difference between text-video and text-only group.

The results of the study also support CLT, whose aim is to reduce extraneous cognitive load as far as possible and devote the freed working memory resources to germane cognitive load (Sweller, 2007). On the basis of the idea of separate working memory subsystems for the processing of visual and auditory information, it can be assumed that the audiovisual presentation of learning materials produces less extraneous cognitive load than the visual-only presentation of the same materials. The reason is that materials presented in audiovisual format (i.e. pictures and narration) can be processed both in the visual and phonological subsystem of the working memory. If the same material is presented in a visual mode only (i.e. pictures and written text), it has to be processed in the visual subsystem which imposes a high cognitive load on this system. Multimedia material allows learners to simultaneously process information through different modes. Directional complement, as a very difficult grammatical form for Chinese learners, can impose a very heavy working memory load for processing and comprehension. Multimedia material can reduce such working memory load, so effective instructional design is potentially of great importance to language learners. In multimedia learning environments where the materials are designed or used with cognitive loading as a consideration, the visual material can reduce L2 learners' cognitive load and lead to more effective learning. Compared with text-picture, text-video provides more contexts, more meaningful input, and fosters better interaction and more opportunities for

learning. This study didn't observe a significant short-term difference between text-video and text-picture groups, indicating that both multimedia materials have a similar advantage over text alone material.

5.2 Q2: Long-term effects of text, text-picture and text-video

Question two enquired as to which of the three types of second language grammar teaching materials — text, text-picture, and text-video — is the most effective teaching method for grammar acquisition for Chinese intermediate learners in the long term. The hypothesis was that learners who received text-pictures and text-video would perform better in the long term than those who received text-only treatment; and learners who received text-video treatment would perform better than those who received text-pictures treatment.

With regard to this hypothesis, the results from the current study are positive, but mixed. Results showed that participants presented with text-video not only scored significantly higher than the participants in the text-only and text-pictures groups immediately, but retained this comprehension over time better than the text-pictures group. The mixed result is that the mean scores of the text-only group unexpectedly rose slightly between the immediate and delayed post-tests, giving rise to the suspicion that some members of this group may have received additional tutoring on the grammar being tested.

The results provide support for Mayer's cognitive theory of multimedia learning (Mayer, 2001; 2005b) and its SLA conceptualization (Plass & Jones, 2005) that accounts for differences channels to process textual and pictorial input. As suggested by the present results, it is when both channels are engaged that better comprehension of reading occurs.

The results also provides support for Kobayashi (1986), each of the systems functions independently generally, but most information processing requires connections and reinforcement verbal and visual systems, and hence the probability that they are retained in working memory and retrieved later from long-term memory is higher than when the presentation contains verbal information alone (Kobayashi, 1986). When the information of L2 grammar were received in

both verbal and visual systems (text-video), the probability that they are retained in working memory and retrieved later form long-term memory is higher than when the presentation contains verbal information alone (text-only).

Results also revealed significant differences in interaction between types and time, indicating that the scores for three types (text-only, text-picture and text-video) do change differently over time. Participants presented with text-video had no significant decrease in comprehension over time, compared to the text-pictures group, whose mean scores dropped by 16% between the immediate and delayed post-tests. The mixed result is that the mean scores of the text-only group rose by 4% between the immediate and delayed post-tests, giving rise to the suspicion that some members of this group may have received additional tutoring on the grammar being tested.

In general, the results of the current study consistently support previous studies that the combination of text and visualized material provides more benefit to L2 learners — text-video outperformed other two groups.

5.4 Q3: The effects of text, text-picture and text-video on complexity

The third research question asked which is the most effective teaching method for acquisition of more complex grammar by Chinese intermediate learners? The hypothesis was that text-video and text-picture would perform better than text-only on the more complex grammar, and text-video will be more effective than text-picture.

The results revealed that for simple grammar, both types of multimedia material (text-pictures and text-video) performed equally well, significantly better than text-only. However, for more complex grammar, text-picture had only a small performance effect over text-only, while text-video had a very significant performance improvement.

These results are consistent with the Sweller's cognitive load theory (CLT) (2005), which states that processing information in different modes and coordinating the processes relies on the availability of sufficient cognitive capacity, as processing resources are not unlimited at any given time. An excessive demand on available capacity can produce an overload effect making it more

difficult or impossible for a learner to process the information or reintegrate it into a coordinated entity. The aim of CLT is to reduce extraneous cognitive load as far as possible and devote the freed working memory resources to germane cognitive load (Sweller, 2007). Multimedia material can reduce such working memory load by providing multiple modalities for learners to process through different modes. Simple DC is less complex than Complex DC, meaning that simple DC requires less available capacity of L2 learners than Complex DC. When the grammar is not as complex, both types of multimedia material (text-pictures and text-video) performed equally well, significantly better than text-only. However, when the grammar is more complex, it requires more available capacity of L2 learners and the extraneous cognitive load needs to be reduced to a greater extent. In that case, text-video performs significantly better than text-picture, indicating that text-video is more effective at reducing L2 learners' extraneous cognitive load by providing more modalities for learners to process than text-picture.

According to Plass and Johns (2005), there are three stages for SLA: (a) comprehensible input, (b) interaction, and (c) comprehensible output. In the first stage of the cognitive approach for second language acquisition, comprehensible input, the underlying assumption is that the learner needs help identifying the critical features in "the wealth of the linguistic and nonlinguistic information they receive" (Plass & Jones, 2005). Text-Video material provides rich, meaningful, and contextual comprehensible input for learners to comprehend. The second stage of the cognitive approach includes "information links that provide simplification, elaboration, clarification, definitional support, or redundancy" (Plass & Jones, 2005). Text-Video provides an overview of a new topic and visually represent links between the concepts to be learned. The third stage, comprehensible output, as "the need for use of language in meaningful contexts to develop the learners' communicative competency" . Text-Video material provides rich and meaningful contexts for learners to produce comprehensible output.

In summary, text-video materials can provide learners with a more rich, meaningful, contextual dual multimedia presentation, helping to reduce their cognition working load and improving the success of L2 learning.

CHAPTER 6
CONCLUSION

Previous studies have examined the effects of multimedia on various aspects of L2 learning — listening, speaking, reading and writing comprehension. These studies supported the effectiveness of multimedia material in facilitating L2 learning. However, no study in SLA has examined multimedia material, specifically video in combination with text, as a dual multimedia material in grammar comprehension. This study focused on this issue by comparing text-only, text-picture, and text-video over time. It adds to the growing body of literature relating to the benefits of multimedia material for SLA.

This study investigated the effectiveness of three types of grammar teaching materials: text-only, text-picture, and text-video over time by means of immediate and delayed post-tests. Pairwise comparisons revealed that text-video material performed the best. The results are generally consistent with previous studies (Chun & Plass 1993, 1996). The relative ineffectiveness of text-picture for grammar comprehension may be explored with further researches.

At least four important implications can be derived from results of this study. First, it has been shown that text-video has a significant impact on grammar comprehension generally. Second, although text-picture is a type of multimedia material, and has an immediate performance improvement over text-only material, in the long term it has no significant benefit over text-only material for grammar comprehension. Third, when the target grammar form has lower complexity (i.e. the learner's working load is not as heavy), text-picture is as effective as text-video for short-term grammar comprehension, both better than text-only. However, when the target form is more complex (the leaner's working load is heavy), only text-video has a significant performance improvement. It seems that while text-picture multimedia provides contextual support, it is limited in its ability to reduce learners' working load and improve comprehension when the target form became more complex.

6.1 Significance of the study

This study contributes to the field of research into the effectiveness of multimedia on grammar comprehension — particularly Chinese directional complement — which hasn't been extensively explored within SLA disciplines. It also provides additional support to Mayer's cognitive theory (1997, 2001, 2002) that multimedia material — especially video — is a particularly useful tool in building meaningful connections between the verbal and visual mental representations needed for L2 grammar learning comprehension. The goal of this study was to highlight the effectiveness of multimedia material in L2 grammar teaching and learning. It is my hope that it will draw L2 instructors' attention to the effectiveness of different types of multimedia material — picture or video — in different complexity levels of L2 grammar teaching, and will encourage L2 instructors to design their grammar teaching material in ways that will best reduce learners' extraneous cognitive load.

6.2 Theoretical implications

As far as theoretical implications are concerned, the study's results support the generative theory of multimedia learning (Mayer, 1997). The basic theme of this theory is that the design of multimedia instruction affects the degree to which learners engage in the cognitive processes required for meaningful learning within the visual and verbal information processing system (Mayer, 1997). This theory suggests that presenting the explanation in words and corresponding illustrations is effective because it helps guide learners' cognitive processes. Storing information in memory is not supposed to be a difficult task, but retrieving it is expected to be difficult. In order to make the task easy for learners, we can provide multiple retrieval cues by integrating two different forms of mental representations. Mayer's cognitive theory of multimedia learning provides an ideal theoretical framework to investigate multimedia learning and the cognitive processes involved in L2 learning. Future studies should be designed to assess its different components.

L2 grammar with high degree of complexity can be very challenging for both instructors and learners. This study's findings have shown that text-video material can be a great tool for teaching complex grammar structure. Video material should be designed to provide L2 learners multiple cues for retrieving the information by integrating tow different forms of mental representations — verbal and visual.

6.3 Pedagogical implications

This study represents a preliminary effort to empirically examine the efficacy of the use of multimedia material on L2 grammar instruction by comparing three different scenarios: video clips combined with text, still pictures combined with text, and text alone. Further research is needed for a thorough understanding of this issue and for confirmation of the findings. This is especially true when considering that there may be additional variables that would add different interpersonal effects based on learning style preferences which were necessarily excluded from this study. It is recommended that this study be replicated with a larger number of participants from the same background. It would be interesting to compare results across levels of proficiency and varieties of L2 grammars. These suggested avenues of research might shed more light on L2 grammar acquisition using multimedia materials, and should enlighten us as to which combinations of media will enhance L2 grammar learning the most. Finally, it is hoped that the outcome of this study will be of some use to future research studies.

The aforementioned findings and discussion have pedagogical and theoretical implications for language learning and for learning with multimedia in general. Furthermore, they direct our attention to some important design principles that need to be taken into consideration when developing instructional multimedia materials. As far as pedagogical implications are concerned, what has been mentioned above constitutes evidence addressing the design of multimedia instruction for second-language learning. Stated more specifically, what has been presented demonstrates that exposing learners to multiple modalities of presentation (i.e., printed text, sound, pic-

ture, or video) produces a language-learning environment which can have a real impact on learning.

In order to create effective multimedia instructional materials, two principles need to be considered. The first principle is that instructional materials designed to accommodate individual differences should combine the use of integrated media. Students may have personal modes or combinations of modes that work best for them as individuals; thus, we must never assume that specific media will be put to the same use or have the same effect on all students. The second principle that needs to be taken into consideration is that the selection of the mode of presentation should be based on how it best supports a particular cognitive process. Cognitive processes are said to be supported by the characteristics of the particular mode. Therefore, an instructional designer should make a sound judgment regarding which mode of presentation is suitable to a given learning situation.

6.4 Methodological implications for research

There were some limitations to this study. First, the small size of the sample population (N=54) limits the conclusions that can be drawn from the observed behavior. A similar study with a greater number of subjects is needed in order to obtain reliable and generalizable results. Second, assessment of the learning outcome was measured only with filling in blanks with provided choices, one translation question and one sentence-construction exercise. The challenge lies with the need to devise alternative assessment techniques that tap various aspects of grammar knowledge. Third, the study does not consider analyzing the individual performance data such as the user's study path and reaction time when interacting with a given item. Such an examination would provide qualitative information about the cognitive process underlying the participant's learning activity.

APPENDIX A

IMMEDIATE-TEST ON DIRECTIONAL COMPLEMENTS

1 Fill in the blanks with 上、下、进、出、回、来、去.

1）我晚上八点到你家楼下接你，请你到了八点就下楼_____。

2）喂！妈妈，我在家。请你回来的时候，买_____些水果_____。

3）我们要考生词，请你拿_____一张纸和一张笔_____。

4）我们上课已经十五分钟了，白英爱才走_____教室_____。

5）我的生日舞会的时候，我的朋友们带____了很多礼物。

6）弟弟今天很累，才七点钟就跳____床睡觉了。

7）他穿好衣服，走____门，开车去朋友家了。

2 Please translate into Chinese: "She walked into the book store."

3 Please make one sentence with directional complement structure you just learned according to the picture.

APPENDIX B

DELAYED-TEST ON DIRECTIONAL COMPLEMENTS

1 Fill in the blanks with 上、下、进、出、来、去.

1）我们今天晚上一起去白英爱的生日晚会吧！我来找你，你到了七点就下楼_____。

2）白英爱的生日晚会，我们带什么东西_____呢？

3）我们要考试，请你拿_____一张纸和一张笔_____。

4）白英爱今天有事儿，一下课就走_____教室_____了。

5）我的生日聚会，大家带____了很多礼物。

6）我在楼下，你赶快___楼____！

7）他吃了早饭，走____门，坐车去学校了。

8）我们上课已经十五分钟了，他才慢慢地走____教室_____。

2 Please translate into Chinese: "He walked out the library."

3 Please make one sentence with directional complement structure you just learned according to the picture.

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