A Meta-Analysis of Multimedia Program Effectiveness Research on Listening Comprehension

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Abstract

Research Purpose: While investigating the different characteristics of educational technology enhancing language learning, multimedia features were found beneficial. Compared to the traditional classroom, it is shown that using multimedia in classroom is consistently superior to all-lecture approaches and allows learners to expose in authentic material, saving learning time and performing better than traditional lectures. Movies or Computer and Language Learning (CALL) become the teaching resources commonly used in language classrooms. Most of the time, language learners of non-proficiency level found it difficult to understand oral speech shown in movies or films. Therefore, in the previous studies, most of the results suggested that the findings of captioning films, CALL and instructing listening strategies to expand learners' capability on listening comprehension were widely agreeable to one another. The article presents a meta-analysis of multimedia program effectiveness research on listening comprehension.

Research Method: This article summarizes a comprehensive synthesis of experimental intervention studies on multimedia and language learning on listening comprehension that have included students ranging from high school to college. The modalities of interventions on instructional components included types and order of captioning languages, listening strategy instructions, Computers and Language Learning (CALL). Effect sizes for a corpus of 31 intervention studies were analyzed across instructional domains, subgroup sample characteristics, intervention parameters, and methodological procedures.

Research Result: The overall mean effect size of multimedia instruction intervention was positive (g= 0.457, Z=12.074, p<0.05). The meta-analysis of studies controlling for captioning status indicates a positive effect of high magnitude for captioning native-language of .739 standard deviations, with outcome measures in the target-language captions showing a positive effect of .538 standard deviations. Effect sizes were more positive for a combined model that included components of using multimedia with subtitles and instructing listening strategies before class than for competing models simply conducted in lectures. Interventions that included instructional components related to controlling listening comprehension with the modalities of approaches on captioning languages, the captioning order, listening strategy instructions, Computers and Language Learning (CALL) were significant predictors of effect size, and interventions that varied from control conditions in terms of teaching material, strategies, and arrangements of instructional interventions yielded larger effect sizes than studies that failed to control for such variations.

Conclusion：The results are supportive of the all-pervasive influence of captioning multimedia teaching material, listening strategy instructions and CALL instruction models for promoting the

language performance on listening comprehension.

Keywords: multimedia; meta-analysis; listening comprehension; listening strategy; subtitle

1.   Introduction

1.1. The argumentation on the applications of multimedia on language learning and instruction

Multimedia is widely used in classroom for enhancing students' comprehension. The theorists, who believe in Single-Channel Limited Capacity Mode, indicated that television viewing can overload the processing system of television viewers. Lang (1995) argued that the attention of television viewers were guided to certain parts of the messages, which help viewers comprehend a complex message without fully processing the myriad of detail contained within it. Contrast to the Single-Channel Limited Capacity Mode, attention is a process of resource allocation (Kahneman, 1973). Further, unattended information is sometimes remembered and than appears to be admitted into the processing system (Triesman & Riley, 1969). Instead of causing overload on cognition (Basil, 1992), nonverbal information provided by multimedia is not for giving details to expand verbal information, but for attractions to attention and comprehension. Some scholars suggested that limitations in processing simultaneous are determined by limited resources (Kahneman, 1973; Navon & Gopher, 1979). Hsia (1971) also argued that more redundant the audio and video channels, the less information would be lost. And she further indicated that audio and video redundancy might actually increase the capacity of the information processing system.

1.2. Dual-coding theory and its applications on multimedia language learning material

According to Paivio (1986), there are two classes of phenomena handled cognitively by separate subsystems, verbal system (language) and nonverbal system (image). Television is considered a dual-sensory medium. Mokhtar (1997) explained that the interaction between the verbal system and nonverbal system through the relevant researches on television viewing. Findhal (1971) indicated that viewers switched visual channels and auditory channel to decode visual symbols and spoken symbols utilize visual symbols. Therefore, subtitling or captioning is commonly used along with multimedia to improve students' listening comprehension in foreign language teaching.

1.3. The effects of Bi-modal Input on multimedia language learning

Peters (1974) suggested that subtitled TV programs helped viewers little in language learning because viewers paid more attention on the mother-tongue subtitles and ignored the target language speech. Vanderplank (1990) have verified that bi-modal input of script and sound enhanced the comprehension of the verbal message. According to the Input Hypothesis (Krashen, 1985), both the meaningful and contextual language are acquired. Because of adopting someone else's language does not mean the language is taken in as one's linguistic competence (Vanderplank, 1990). And Verderplank futher defined the attention stage in his Extensive

Subtitled Television Watching and Language Learning Model to account for what learners do with extensive comprehensible input.

1.4. Goals of the current meta-analysis

A numerous of empirical studies have been conducted and provided useful suggestions for improving students' listening comprehension by the help of multimedia programs. To ensure that multimedia programs best meet the constantly changing social needs and what intervention best meet the needs of students for enhancing the listening ability, a comprehensive synthesis of experimental intervention studies must be carried out to ascertain the real needs of students and the directions for curriculum design conducted by instructors. It is therefore the intent of the present study to examine the results of empirical studies intervened with a modality of approaches (i.e. subtitles, captioning order, CALL, listening strategies, and song), followed by a comparison with the findings of previous studies.

It is difficult to evaluate the actual effectiveness of integrating different approaches in multimedia material on listening comprehension overall and how specific moderator variables influence effects through qualitative approaches. Thus a meta-analysis was conducted to organize quantify studies on the effectiveness of listening comprehension in foreign language learning (i.e. subtitles, CALL, captioning order, song, listening strategies) to answer the following questions:

1. In terms of quantitative analysis, what is the status quo of approaches used for listening comprehension? Specifically, what intervention settings were involved?

2. What is the overall effectiveness of employing various intervention setting in multimedia material on listening comprehension by students?

3. What kinds of moderator variables influence the effects of listening comprehension on foreign language learning?

2. **Method**

2.1. Data sources and search strategy

After the screening stage in National Digital Library of Theses and Dissertations in Taiwan, the literature searches yielded 31 journal article abstracts and master thesis remained related to experimental studies on listening comprehension, including those using designs with using subtitle, CALL, captioning order and listening strategies as a treatment, and randomized matched subjects were included. Because the limitation of the number of empirical studies on listening comprehension via multimedia, only few material written in English were used. The five following sets of keywords were used to search the databases (i.e. CEPS, ERIC): (1) subtitle;(2) CALL (Computer and Language Learning); (3) captioning order; (4) listening strategies; and (5) song.

The studies presented sufficient information to calculate effect sizes, such as means, standard deviations, and the number of people in each group with the sample sizes of each group were provided.

2.2. Data analysis: calculating effect sizes and calculating publication bias

The following meta-analysis steps recommended by Borenstein, Hedges, Higgins, and Rothstein (2009) were employed: (a) create the effect sizes of each article, (b) calculate the weighted mean effect size across articles, (c) calculate the confidence interval for the average effect size, and (d) determine whether the effect size of any particular group was influenced by a moderator variable based on a heterogeneity analysis (using the test statistic QB).

The fail-safe N of Rosenthal (1979) (i.e., classic fail-safe N) was used to estimate how many insignificant effect sizes (unpublished data) would be necessary to reduce the overall effect size to an insignificant level. Moreover, we also adopted the fail-safe N of Orwin (1983) to estimate the number of missing null studies that would be required to bring the mean effect size to a trivial level.

3. Results and Discussions

3.1. Descriptive Analysis

The searched studies were divided into five groups (i.e. CALL, listening strategies, song, subtitle, and captioning order). The distribution of the effect sizes of the 31 articles is shown in Table 1. The largest effect size (g=0.835) was found on the moderator of subtitles. The effect sizes of intervention settings, such as CALL(g=0.549), listening strategies(g=0.527) and song (g=0.519), were larger than the average effect size (g=0.457) of the 31 articles. Using the procedure of Lipsey and Wilson (2001) within a random-effect model to integrate the effect sizes of the 31 included articles, the overall mean effect size of the 31 articles was a moderate one of 0.457, with a 95% confidence interval of 0.383-0.531. Q statistics revealed that the effect sizes in the meta-analysis were heterogeneous (Q_{total} = 257.311, z =12.074, p < 0.001), which indicates that there were differences among the effect sizes that were attributable to sources other than subject-level sampling error. According to Cohen (1988), effect sizes ≥0.80 and ≤0.20 are considered large and small, respectively, with intermediate values considered moderate. Thus, the present findings suggest that the above intervention settings have a moderate effect size for listening comprehension; in other words, multimedia material supported with CALL, listening strategies and song performed significantly superior to multimedia supported with subtitles (g=0.449) and multimedia supported with combined subtitles appearing in order during the process of language learning, whose effect size was the smallest of the 31 articles (g= 0.191, with a 95% confidence interval of -0.089-0.470).

Table 1. The effect size of fixed effect analysis

Group	k	g	z	95% CI	Q_{Bdf}	df[Q]
CALL	3	0.549	4.177	0.291-0.807	4.713	2
Listening strategies	4	0.527	6.334	0.364-0.691	1.191	3
Song	1	0.519	1.984	0.006-1.031	0.000	0
subtitle	15	0.449	9.341	0.355-0.544	239.123	14
subtitle order	8	0.191	1.337	-0.089-0.470	7.516	7
Overall	31	0.457	12.074	0.383-0.531	257.311	30

*p < 0.05; **p < 0.01; ***p < 0.001.

In order to avoid the coding assessment of Publication Bias, we conducted Orwin's fail-safe N and Classic fial-safe N for the subgroup comaparison on captioning language (Table 2).

Table 2.   Results of Orwin's fail-safe N for the group comparison

Hedge's g in observed studies	0.45701
Criterion for a 'trivial' hedge's g	0.00000
Mean hedge's g in missing studies	0.00000

3.2. Orwin fail-safe N

As shown in Table 3 Results of the classic fail-safe N, the Orwin fail-safe N addresses the possibility that studies are missing from the analysis and that these studies, if included in the analysis, would shift the effect size toward the null.   Orwin's fail-safe N differs from the classic fail-safe N in two ways.

First, the mean hedges's g in the new (missing) studies can be a value other than the nil value (currently, it is set to 0). Second, the criterion value is an effect size rather than a p-value. That is, the Orwin fail-safe N is the number of (missing) studies that, when added to the analysis, will move the combined hedges's g past a specified threshold (currently, 0).
The criterion value must be set between the other two values for the Orwin fail-safe N to be computed.

Table 3.   Results of Classic fail-safe N for the subgroup comparison on captioning language.

Z-value for observed studies	13.09072
P-value for observed studies	0.00000
Alpha	0.05000
Tails	2.00000
Z for alpha	1.95996
Number of observed studies	31.00000
Number of missing studies that would bring p-value to > alpha	1352.00000

3.3. Classic fail-safe N and evaluation for publication bias

This meta analysis incorporates data from 31 studies, which yield a z-value of 13.09072 and corresponding 2-tailed p-value of 0.00000. Put another way, there would be need to be 1352 missing studies for every observed study for the effect to be nullified.

3.4. Intervention setting
3.4.1. L1/ L2

The effect size was largest for video texts supported with target language (g = 2.036, SE=0.442, 95% CI= [1.17, 2.902], p=0.000, followed by video texts supported with native language) (g = 1.691, SE=0.575, 95% CI= [0.565, 2.818], p=0.003). In other words, the effect size of video texts supported with subtitles in target language performed significantly superior to video texts supported with native language.

3.4.2. Captioning order

The captioning order (second language used before first language) (g = -0.035, SE=0.492, 95% CI= [-1.000, 0.929], p=0.943) did not yield significant effect sizes. The results revealed that the subtitles of target and native languages had a positive effect on the effectiveness of listening comprehension, whereas the effect was not significant for listening comprehension on the captioning order appeared in the video.

3.4.3. CALL

As shown in Table 1, CALL (g = 0.549, $p < 0.001$) achieved a moderate-to-high effect size, while there was no significant effect size for video texts supported with subtitles in order (combined with target language and native language) (g = 0.191, p =0.224). CALL (Computer and Language Learning) appear to be more effective than the other groups. They provide the opportunity to access target languages, interact with others, both give and receive feedback, and are able to increase learner interest in language learning compared to Videos. CALL have been used to organize specific learning topics, clarify learning goals, and develop innovative teaching methods (Golonka et al., 2012). The present findings reveal that CALL, the applications of listening strategies on listening comprehension and song produced significant moderate-to-high effects in language learning, in contrast to video text supported with combined subtitles in order. The context-sensitivity, and easy interaction offered by CALL appears to provide more opportunities for interaction, which benefits for language learning, and ultimately produces a positive learning outcome.

3.4.4. Listening Strategies

Of the 4 articles on the effects of listening strategies instruction on listening comprehension, subjects in the experimental group were instructed eight English listening strategies in total, which were consisted in the metacognitive strategies, and cognitive strategies. They included selective attention, listening for main ideas, questioning for clarification, self-monitoring, prediction, linguistic inference, note-taking, and repetition. The results revealed that the effective learners on listening comprehension employed the above strategies significantly more frequently than the less effective learners (Lin, 2006). Lu (2015) has verified that there was a significant difference in students' English listening performance in short dialogue test before and after the Direct Listening Strategy Instruction (DLSI) . And further Lu suggested a significant difference of the strategy use among learners at different proficiency levels, which supported the findings found by O'Malley et al. (1989) . That is, the difference between proficient and less proficient listeners is not the number of strategies that they use but the frequency and type of strategies they choose to use.

4. Conclusion

Finally, the contribution of this study note that the current meta-analysis reveals not only that video texts supported with subtitles is superior to video texts supported without subtitle but also that the language selection on subtitles (ie. native or target language) in programs designed to develop listening comprehension are superior to programs that aim to use all-English videos without subtitles and use video texts supported without subtitles. The results revealed that video texts supported with target language will be of greater value for improving listening

comprehension than video texts supported with native language. And as the results of the previous studies, the study verified multimedia had a significant positive effect as compared to more traditional presentation through the verification of meta analysis. This finding also aligns with the multimedia learning theory, which proposes that the stronger match between verbal and nonverbal information optimally attuned to the narration is beneficial for learning (Mayer, 2003; Takacs et al., 2015).

By investigating the empirical research that has been conducted into listening comprehension in foreign language learning in published journal articles and unpublished dissertations and conference papers, our research provides concrete evidence regarding the overall effects of using mobile devices in language education and how those effects vary between moderator variables. Even though Golonka, et al. (2012) mentioned that the limitations of CALL, such as distraction, lack of effective software, shallow interaction, and increased workload, in previous research, this meta-analysis outcome found that learning with CALL, Listening strategies, video texts supported with subtitles and song produced a moderate mean effect size of 0.549, 0.527, 0.449 and 0.519, for the effects on listening comprehension, respectively. These mean that students in the experimental groups who were learning multimedia material with the aid of CALL, listening strategies, song, and video texts supported with subtitles could outperform their counterparts who learned languages without such aids.

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