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The Effect of Input Modality and Sensory Mode on L2 Listening Fatigue: A Case of Iranian Intermediate EFL Learners

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Abstract

The present research was conducted to examine the effect of different input modality interaction in L2 on listening fatigue. Eighty-six intermediate Iranian EFL learners selected through random sampling, after administering a paper-based TOEFL among an initial sample of 120 BA learners majoring in English language translation, took part in the study and were randomly assigned into three experimental groups. Three types of input modality treatments were given in the first phase. Group one received audio treatment (A), group two received video treatment (V) and group three was taught listening through audio-video-caption (AVC) treatment. A TOEFL listening test and a researcher-made validated listening fatigue questionnaire were utilized as pretest and posttest. Afterwards, during the qualitative phase, oral interviews were employed to elect 30 % of the participant's' attitudes about the effect of the received treatment on their listening fatigue. Using Two-way ANCOVA revealed that input modality had a very strong significant effect on listening fatigue reduction. Audio group had the best performance and AVC group had the least significant performance. These findings were also supported by a small qualitative phase and learners gave their positive support and attitude to audio input modality as the best. These findings have some pedagogical implications for teaching and learning an L2, the most important of which is finding the best match between input modality intervention and its sensory mode match to assist EFL learners both enhance their L2 listening comprehension and at the same time reduce their debilitative listening fatigue.

Keywords: Audios, Caption, Listening Fatigue, Input Modality, Sensory Mode, Videos

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1. Introduction

Among language skills, listening has been referred to by many researchers as the most important skill (Guo & Wills, 2006; Hamouda, 2013; Swain, 1995) given the key role it plays in the presentation of language input to the learners. Furthermore, many scholars have consensus on the complexity of the listening skill and consider it the most arduous language component to acquire (Chen, 2013; Graham, 2006; Walker, 2014). These researchers argued that listening is a complex process which puts a lot of burden on the learners' mind and in order to teach it successfully, one must consider its extralinguistic and psychological features as well.

Therefore, one of the important factors, according to Sydorenko (2010), which can effect on the listener's' performance is input modality. Modality refers to the method of presenting input and in the area of listening instruction it has undergone significant evolution following the emergence of multimedia learning. Brinton (2001) has listed the positive effects of using multimedia among which considering the learners' different learning styles or their perceptual modalities is of great vitality.

Cherry (1981) maintains that within the cognitive domain, the process most intimately associated with learning is perception and defines it as the manner in which the senses receive and extract information from the environment. One of the very significant issues related to research in the field of listening has been investigating whether there is a correspondence between the input modality in teaching listening and the learners' perceptual modality. This correlation, technically known as meshing hypothesis, emphasized that "instruction should be provided in the mode that matches the learner's style" (Pashler, McDaniel, Rohrer, & Bjork, 2008, p. 108).

In this respect, an important research area drawing the attention of many listening scholars was to explore the effectiveness of using unimodal vs. multimodal input presentation methods in teaching listening comprehension (e.g., Grimes, 1990; Levie & Lentz, 1982; Reese, 1984). These studies merely focused on the linguistic outcomes and did not consider the match or mismatch between the learners' perceptual modality and the input presentation modality and its possible psychological outcomes. In fact, there was a big gap in previous studies and it was the ignorance of the cognitive or processing capacity of each perceptual modality which created contradictory results in various researches. Learners with different perceptual modalities have different cognitive capacity and exploit a different working (WM) memory with regard to its power in processing and storage functions. As emphasized by many scholars (e.g., Baddeley, 1986; Hitch & Baddeley, 1976; Just & Carpenter, 1992) WM has been shown to have a key role both in L1 and L2 comprehension. Several researchers have shown that the ignorance of the processing capacity of each perceptual modality and also the

mismatch between input modality and learners' perceptual modality can increase the load on the WM, interferes with its processing and storage capacity, and thus overloads the individuals' cognitive processing capacity. During listening comprehension, these conditions can finally produce mental fatigue as a destructive cognitive and psychological variable which can negatively affect the listening performance of different learners.

2. Literature Review

Input is the most important element in language learning and without it one cannot acquire a second language. A crucial aspect of input which has drawn considerable attention among language researchers refers to the issue of "input modality". The way or mode in which input is presented to learners has a great influence on the learning outcome and it is itself affected by several factors including technology, learners' learning styles or perceptual modalities, as well as processing capacity of different learners.

This interest in modality of input went on and, as Plass and Jones (2005) express, it has gotten increasing significance in language learning in recent years following the increased use of multimedia materials. Multimedia, that is, a combination of print, audio, and imagery, has been argued to enhance input by making it more comprehensible (Plass & Jones, 2005). Brinton (2001) counted on the positive effects of using multimedia including: (a) it allows for the provision of authentic input and thus exposure to target culture, (b) it motivates learners, and (c) it accounts for students' different learning styles (Brinton, 2001).

Students' learning styles, as a crucial factor in multimedia instruction, came to be noticed as a major source of individual differences (IDs) following the advent of learner-centred approaches in the mid-1960s. Sternberg, Grigorenko and Zhang (2008) argued that teachers need to take into consideration differences in how students learn and think and design instruction accordingly to obtain optimal instructional outcomes. An important aspect of learning styles which is not adequately investigated is perceptual modality also referred to as sensory modality or sensory mode. Gange (1977) maintains that through the learner's perceptual channels broadly classified as visual, auditory, tactile and kinaesthetic, information is taken in, encoded and stored. The way in which the second language learner perceives and organizes stimuli occurring in the learning environment determines his or her facility in acquiring the language (Rossi-Le, 1989, p. 12).

The important point concerning the relationship between perceptual learning styles and second language learning is reflected in the hypothesis known as "meshing or matching hypothesis". According to Pashler et al.

(2008), "different modes of instruction might be optimal for different people because different modes of presentation exploit the specific perceptual and cognitive strengths of different individuals" (pp. 109- 110). In this regard, Dekker, Lee, Howard-Jones, and Jolles. (2012) reported that 94% of educators believed that students perform better when they receive information in their preferred learning style (as cited in Rogowsky, Calhoun, & Tallal, 2015).

Another aspect of learners' perceptual learning styles in relation to the input modality presented by multimedia systems refers to the processing capacity of each perceptual modality. Hovy and Arens (1990) hypothesize that modalities can be unimodal or multimodal. Concerning their efficiency, Dwyer (1978) states that the efficacy of multimedia instruction is based on the assumption that adding an additional channel of media to transmit a message will effectively increase the amount of communication (as cited in Daniels, 1996, p. 15). This notion, as Daniels (1996) maintains, is primarily based on two theories that support multiple-channel communication: the 'cue-summation theory' and the 'dual-code theory'. For instance, Dual-code theory (Paivio, 1991, 2007) states that a combination of imagery and verbal information improves information processing. Similarly, according to Daniels (1996, p. 15) cue-summation theory contends that learning increases as the number of available cues or stimuli are increased. On the other hand, there are other researchers who oppose multimedia use and advocate single-input modality, pointing out to a number of difficulties involved in its use specifically those related to the capacity of different perceptual modalities of the learners. In fact, while well-designed multichannel presentations appear to improve recall and transfer of information, evidence suggests that all learners do not benefit from multiple channels of information delivery in the same way (Hsia, 1971; Lee, Hunt, & Pellegrino, 1991; Park & Hannafin, 1993, as cited in Daniels, 1996, pp.14-15). Several researchers, including Grimes (1991) and Hsia (1971) suggest that individuals' cognitive processing capacity can be "overloaded" by excessive stimuli contained in multiple channel messages resulting in jamming of the system, reduction of communication, equivocation and loss of information (as cited in Daniels, 1996). This phenomenon known as "the redundancy principle" of the cognitive load theory (Sweller, 2005) assumes that redundant material slows down information processing and learning.

As the result of increasing cognitive load on working memory and the consequent problems mentioned above, mental fatigue might emerge which can have a negative influence on the performance of learners with different perceptual modality. Ackerman, Kanfer, Shapiro, and Newton (2010) announced that mental or cognitive fatigue is experienced when there are sustained demands on cognitive effort and other cognitive activities such as

thinking, concentration, problem-solving, and frequent responding. Moreover, Boksem, Meijman and Lorist (2005) maintain that fatigued people often experience difficulties in concentration and appear more easily distractible.

Furthermore, it deserves mentioning that variability in listening comprehension may, in some cases, be related to differences in student's cognitive and memory processing abilities. As comprehension involves the interaction of a wide range of cognitive skills and processes, there are many occasions where difficulties arise that may lead to listening fatigue and thus comprehension failure (Cain & Oakhill, 2007). Bloomfield et al. (2010) mentioned that the mental state of listeners is also of high significance and can easily influence the learners' ability to comprehend the message. More accurately, if a listener is anxious, distracted, or unable to concentrate, it will be much more difficult to process what is being said.

Concerning listening research, previous studies have been mostly devoted to factors influential in the listening process (e.g., Bloomfield et al., 2010; Buck, 2001; Chang & Read, 2008; Chen, 2005; Goh, 1999). On the whole, these studies have identified a wide list of potential variables under the main five categories of *text*, *speaker*, *task*, *environment* and *listener*. As the result, a plethora of linguistic, cognitive, and affective characteristics were demonstrated to affect learners' performance in listening. In the same vain, a few scholars have theoretically referred to fatigue as a significant listener's psychological characteristic which can impact on listening performance. However, no practical study exists either in EFL or ESL context to focus on the effect of fatigue during listening performance. Of course, fatigue, as a destructive factor, as well as its consequences have been investigated by many researchers in hard occupational conditions (e.g., Ackerman et al., 2010; Boksem, Meijman, & Lorist, 2006; Kaneko & Sakamoto, 2001; Kramer, Kapteyn, & Houtgast, 2006; Nachtegaal, Kuik, & Anema, 2009). Most recently, Hornsby and his colleagues have investigated the effect of listening fatigue on the academic performance and life quality in children with hearing impairment and concluded that listening fatigue can negatively lower their performance (Hornsby, Werfel, Camarata, & Bess 2014; Hornsby, Naylor, & Bess, 2016). However, to the surprise of the researcher, there is no practical study in the area of L2 listening. More specifically, there is a severe paucity of research delving into the interaction between input modality and learners' perceptual modality and the producing effect on fatigue during listening performance.

In general, this exploration is going to scrutinize the relationship between different types of multimedia presentation methods and listening fatigue among Iranian EFL learners with different sensory modes during listening performance. More specifically, it is an attempt to find out the effect

of unimodal presentation of audio or video vs. the multimodal presentation of audio/video/caption on the listening fatigue of learners with auditory vs. visual perceptual learning styles. This, in turn, will help in recognizing learners with the highest capacity to resist fatigue during learning practices. Also, this research study is an endeavor to compare and validate the existing theories in the area of multimedia instruction. As was previously mentioned, some theories including dual-code theory and cue-summation theory are in favor of multiple channel instruction while others like the redundancy principle or the split-attention effect advocate single-input modality. Consequently, an important aim here will be looking for the truthfulness and validity of the above theories in either advocating or contradicting the occurrence of fatigue during listening comprehension.

For the purpose of the current research, the following questions were proposed:

1. Does input modality (A, V, AVC) have any significant effect on Iranian EFL learners' listening fatigue with different sensory modes (auditory, visual, and haptic)?
2. What are the Iranian auditory vs. visual EFL learners' attitudes toward the effects of A, V, and AVC treatments on Iranian EFL learners' listening and listening fatigue? Do the findings obtained through the quantitative and qualitative results converge or diverge?

3. Method

3.1 Participants

The participants of this study were selected through convenience sampling from among four different classes, a total of 120 students, at the B.A. level majoring in English translation and literature at Islamic Azad University of Hamedan. To obtain a more homogeneous sample, just B.A. students were invited to make the initial sample. Then, after administering a version of TOEFL test, 90 participants possessing the necessary requirements including proficiency level were selected to comprise the final sample. They were both male and female with the age range of 19 to 35. These 90 students, from different socio-economic backgrounds, were randomly divided and assigned to three experimental groups each involving 30 students. However, 4 of the learners did not attend the whole semester and were absent for the posttest. Accordingly, the number reduced to 86 learners. The audio group had 27 learners, the video group included 30 learners without any dropouts, and the AVC group involved 29 participants.

The three experimental groups were different from one another in the input modality, that is, the method used to instruct listening comprehension differed across the experimental groups. Therefore, group one was named the audio (A) group in which the input modality was through audio materials,

group two was referred to as video group (V) in which the modality used to represent input was by video materials, and finally the third group which was known as the audio/video/caption (AVC) group received the input through simultaneous using of audio materials and video or films which had captions as well.

3.2. Instruments

The materails used in this study and the tasks that participants engaged have been fully explained in the following sections.

3.2.1. O'Brien's (1990) Learning Channel Preference Checklist

The Learning Style Preference Checklist developed by O'Brien's (1990) is the first learning style questionnaire widely known in the ESL/EFL field which is developed to help foreign language learners identify the ways they learn best. This questionnaire consists of 30 statements and is divided into three learning styles or perceptual modalities on a three-point scale including auditory, visual, and haptic styles which learners are asked to choose based on their learning preferences. The total score was calculated for each section by assigning 1 score to 'Never applies to me', 2 scores for 'Sometimes applies to me' and 3 scores for 'Often applies to me' on the basis of rubrics given by the questionnaire itself. Accordingly, the highest possible total score for each section would be 30 and the lowest will be 10. Then, the highest score for a section indicates the dominant sensory mode or learning perceptual tendency for the learners.

3.2.2. Listening Fatigue Questionnaire

There are several questionnaires developed by different scholars and some educational organizations to measure both mental and physical fatigue during various studies which have been conducted either in demanding job conditions or medical circumstances. Since the fatigue concept embraces a number of components including motivation, effort, interest, concentration, planning, thinking, performance, frustration and so on, there is not a single instrument covering all these elements concurrently. Consequently, choosing the appropriate and related items as well as doing several modifications, the researcher developed and validated a 21-item questionnaire based on the different available questionnaires and the Iranian experts' opinions to make a suitable scale for the current study. All the necessary measures were taken by the researcher in order to develop a reliable and valid instrument suited and applicable to Iranian EFL context. This instrument was a five-point Likert scale questionnaire and students were asked to choose one of the options: never, rarely, sometimes, often, and always based on how they felt before and after their listening performance.

3.2.3. Test of TOEFL

In order to achieve homogeneity among the subjects regarding their general English proficiency, a paper-based TOEFL test was administered at the beginning of the study. Because of the difficulty of administering a complete TOEFL test and the lack of enough audio facilities the listening comprehension section was not included. Also, the TWE essay section was excluded because of the difficulty of scoring and due to the lack of adept and certified TOEFL scorers. Accordingly, the administered TOEFL test included only structure and written expression section and the reading comprehension section. This TOEFL consisiting of 90 items was given to the initial participants in order to have homogenized participants. The reliability of the test was calcuted using KR-21 formula and it came out to be 0.80.

3.2.4. Test of Listening

A TOEFL listening comprehension test consisiting of 50 items was used to measure the learners' listening comprehension ability. This test was once given to the participants as the pretest and again as the posttest at the end of the treatment. The reliability of the test was calcuted using Cronbach alpha and It turned out to be 0.81.

3.2.5. Semi-structured Oral Interview

At the end of the study and after the treatment and the posttest, semi-structured oral interviews were conducted with 30 percent (10 participants) in each of the experimental groups to elicit their attitudes toward the usefulness, suitability and educational value of different types of input modality (A, V, AVC) and the effect it exerted upon the listening fatigue and L2 listening comprehension. The content of these oral interviews was based on the latest conceptualizations and theories regarding input modality. These oral interviews were audio-taped by the researcher himself and were meticuously listened and transcribed for further analysis. In order to gauranttee the content validity or the inter-coder reliability, two raters rated these oral interviews and the needed content analysis using the appropriate procedures was carried out. Transcribing, coding, and sorting the data gathered in these oral interviews were conducted by using MAXQDA. MAXQDA is a software program that aids researchers in carrying out computer-assisted qualitative and mixed methods data, text and multimedia analyses in all humanities and social sciences and in applied linguistics studies.

3.3. Procedure

from among 4 different classes at the B.A. level from Islamic Azad University of Hamedan. After administering the test of TOEFL, those learners who scored in the range of ±1.5 standard deviations from the mean

were selected as the intermediate learners for the purpose of the present study. The justification for using ±1.5 SD and not ±1 SD is that more participants were needed to comprise the three experimental groups. In other words, learners who greatly outperform other learners or had low extreme scores were excluded from the study. Also, the assignment of three experimental groups to A, V, and AVC was done randomly to add to the internal validity of the research.

All the groups had the pretest of listening and pre-administration of the listening fatigue questionnaire, 8 sessions of treatment, and the posttest of listening and post-administration of the listening fatigue questionnaire. In the first session, before the treatment starts, the researcher explained the aim of the study to the participants. The first experimental group, the audio group (A) was taught the listening skill through the audio materials such as podcasts, radio programs, and listening from Voice of America. The second group, the video group (V), was taught using the video materials such as the video lessons from the Four Corners series, TED Talks, and movies. The third group, the audio/video/caption (AVC), received podcasts and VOA English, videos from CNN, and movies which had caption. They were given to the participants one after the other in each session. All the groups worked on the listening each session equally but with different modes of input. The researcher asked the participants of each group some comprehension questions about what they heard in the listening in each group once the listening was broadcasted. The aim of these questions was to get the learners engaged in the comprehension as much as possible.

3.4. Data Analysis

For analyzing the obtained data, the SPSS software version 21 was used. This software was also used to calculate the reliability of the developed questionnaires and other descriptive statistics which were needed to describe the features of the sample including minimum and maximum scores, mean, standard deviation, and SEM. Also, normality test of Kolmogrove and Shapiro were used to check the assumptions for using parametric tests. The related normality distribution figures and P-P Plots were also provided using SPSS to help gain a better view of the descriptive statistics. The researcher used the parametric factorial or two-way ANCOVA to answer the first and second research questions. The reason for using two-way ANCOVA was the existence of two independent variables: input modality with three levels (A, V, AVC) and sensory mode with three levels (auditory, visual, and haptic) and listening fatigue scores used as both pretest and posttest. The listening fatigue pretest scores were the covariate in running two-way factorial ANCOVA in answering question 1. Qualitative interpretations using descriptive statistics and percentages were also utilized to find regularities in Iranian EFL learners' attitudes toward the input modality effect on listening

fatigue. Hence, qualitative interpretations and descriptions were the main devices used for answering questions 2. The results of the quantitative and qualitative phases were compared to see if they diverged or converged.

4. Results and Discussion

4.1. Results

4.1.1. Research Question One

To answer this question, a factor analysis was first run to establish the construct of listening fatigue for foreign language learners. The factor analysis was done, using a principal component analysis with oblique rotation (*N*=86). To determine the number of factors to be extracted in the listening fatigue for foreign language learners' questionnaire, some standards were followed to guarantee that the minimum eigenvalue was 1.0, and that each factor accounted for at least 2.5% of the total variance.

Table 1

Cronbach Alpha, Questionnaire Items, and Factor Loadings of the Items for each Subscale of Listening Fatigue Questionnaire

Factor (saubscale	A	Questionnaire items	Loadings
1.Anxiety/Stress/Depression	.82	2. I get worried when I have to listen to a text quickly.	.78
		5. I get nervous during listening tasks when I do not understand every word.	.79
		6. When I am listening to a text, it is difficult for me to differentiate the words from one another.	.75
		7. When I am listening to a text, I often get so stressed that I cannot remember what I have heard.	.80
		8. Listening to new information makes me uneasy.	.74
		9. I feel nervous when I fall behind during listening to a text.	.82
		10. I get upset when I am not sure whether I understand what I am listening to.	.80
		11. I sweat noticeably while trying to understand a listening text.	.73
		16. I experience negative thoughts while listening to a very difficult text	.78
		21. Learning to understand spoken English is the hardest part of learning English for me.	.82
2.Attention/Distractibility/ Concentration	.79	3. It is hard for me to concentrate on what an English speaking person is saying unless I know that person.	.69
		4. I become confused when listening to important information.	.73
		12. It is difficult for me to listen to a text when there is even a little bit of background noise.	.65

Table 1 Continued.			
		13. I am intolerant of anything that keeps me away from getting on with a listening task.	.69
		14. I have difficulty paying attention to a listening task for long periods of time.	.78
3. Emotional Exhaustion/ Tiredness	.76	1. I feel stressed prior to doing a listening task.	.59
		18. I feel emotionally drained after doing a listening task.	.66
		20. In general, it takes me some time to feel relaxed after listening to a text.	.67
4. Cognitive Effort	.74	15. It takes a lot of effort for me to concentrate on listening texts.	.70
		17. At the end of a listening task, I feel worn-out.	.69
		19. After completing a listening task, I am unable to think clearly.	.67

4.1.2 Descriptive Statistics and Assumptions

Descriptive statistics for the performances of different subgroups on both pre- and posttest listening fatigue questionnaire are arranged in Table 2.

Table 2

Descriptive Statistics for Participants' Performances on Listening Fatigue Questionnaire

	N	Min	Max	Mean	Std. Deviation	Skewness	Kurtosis
Pretest (LF1)	30	30	60	45.47	6.728	.144	-.451
Posttest (LF2)	34	33	66	49.92	7.856	-.332	-.389

As it can be seen from the Table 2, the mean for the Iranian EFL learners' listening fatigue scores on the pretest was 45.47 with a standard deviation of 6.72. The minimum and maximum scores were 30 and 60, respectively. The mean score was slightly higher for the posttest administration of the listening fatigue questionnaire (M=49.92) and the standard deviation was larger (SD=7.85). The scores ranged from 33 to 66. The skewness and kurtosis values were also with the acceptable range ±1.96 for the two administrations, indicating the normality of the distribution of scores. The related figures and the application of Kolmogrove-Smirnov and Shapiro-Wilk's tests ($p>.05$) of normality showed that learners' scores on two administrations of listening fatigue questionnaire were normally distributed. Table 3 below presents the descriptive statistics for learners' listening fatigue scores across all the study groups.

Unlike listening comprehension, learners' listening fatigue has changed unevenly for different modality groups. The mean score and the standard deviation showed a considerable decrease from the pretest to the posttest for the audio group. Mean score has descended from 45.44 to 44.59 and the standard deviation has lowered from 5.86 to 8.56. However, listening

fatigue mean scores have witnessed an augment from the pretest and posttest for other two study groups. The mean score rose from 45.83 to 52.50 in the video group and it grew from 45.10 to 52.21 in the audio/video/caption mode as the group.

As far as the second independent variable, i.e. sensory mode, is concerned it can be observed that auditory learners have shown less listening fatigue compared with visual or haptic learners across the three modality groups on both pretest and posttest administrations of the listening fatigue questionnaire. In order to check the significance of these differences, inferential statistics should be employed. Like question one, the presence of two independent variables with more than two levels and one continuous dependent variable (posttest listening fatigue scores) and a continuous covariate (pretest listening fatigue scores) necessitates the application of a two-way analysis of covariance (ANCOVA).

The factorial or two-way (factorial) ANCOVA has many assumptions and necessary requirements that all were checked. First, the covariate should be measured before the treatments. In this study the listening fatigue questionnaire was filled out as the pretest before the input modality interventions. Therefore, the scores on the covariate were not influenced by the treatment. Second, the internal reliability listening fatigue questionnaire was confirmed three times in the study. Third, the covariate should be linearly related to all levels of the two independent variables which was confirmed by the two following figures.

Table 3

Descriptive Statistics for Participants' Performances on Pre- and Posttest Listening Fatigue Scores Across Various Study Group

Groups		Pretest (LF1)			Posttest (LF2)	
Input Modality	Sensory Mode	N	Mean	Std. Deviation	Mean	Std. Deviation
Audio	Auditory	14	44.43	6.824	37.86	4.881
	Visual	10	47.30	5.078	50.00	3.801
	Haptic	3	44.00	1.000	58.00	1.000
	Total	27	45.44	5.866	44.59	8.568
Video	Auditory	14	49.79	6.435	51.29	4.065
	Visual	12	42.08	7.845	53.42	7.229
	Haptic	4	43.25	2.754	54.00	8.981
	Total	30	45.83	7.548	52.50	6.079
Audio/Video/Caption	Auditory	13	41.77	5.585	49.31	6.330
	Visual	12	46.92	6.374	54.25	6.468
	Haptic	4	50.50	7.550	55.50	1.291
	Total	29	45.10	6.795	52.21	6.405
Total	Auditory	41	45.41	7.021	46.07	7.853
	Visual	34	45.32	6.857	52.71	6.211
	Haptic	11	46.09	5.647	55.64	5.259
	Total	86	45.47	6.728	49.92	7.856

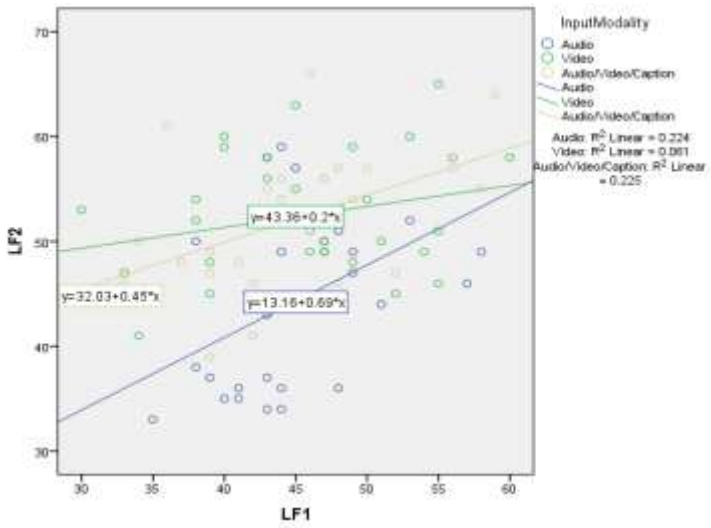

Figure 1. The Fit Line at Input Modality Subgroups' Performances on LF1 and LF2

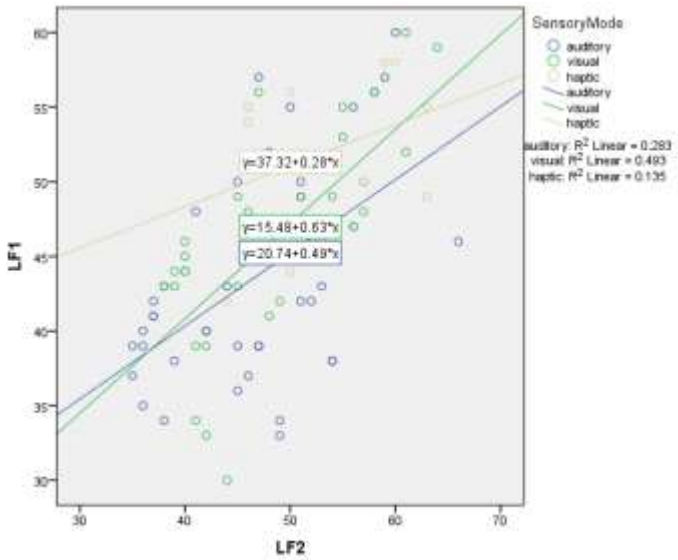

Figure 2. The Fit Line at Sensory Mode Subgroups' Performances on LF1 and LF2

Figures 1 and 2 reveal a linear (straight-line) relationship for each group's scores on the listening fatigue pretest and posttest scores. No indication of a curvilinear relationship between the different subgroups' scores on LF1 and LF2 can be spotted. The fourth assumption requires the homogeneity of regression slopes, i.e. there should not be any interaction

between the covariate and the various levels of the independent variables. Test of between-subjects effects can check the presence or violation of this important assumption, See Table 4 below.

Table 4

Test of Between-subjects Effects for Study Groups' Pretest and Posttest Listening Fatigue Scores

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.
Corrected Model	3547.806[a]	17	208.694	8.355	.000
Intercept	130.890	1	130.890	5.240	.025
Input Modality * LF1	2.448	2	1.224	.049	.952
Sensory Mode * LF1	45.580	2	22.790	.912	.406
Input Modality * Sensory Mode	274.049	8	34.256	1.371	.225
Input Modality * Sensory Mode * LF1	70.334	4	17.584	.704	.592
Error	1698.624	68	24.980		
Total	219547.000	86			
Corrected Total	5246.430	85			

a. R Squared = .676 (Adjusted R Squared = .595)

The obtained Sig. values for the interaction of the various study groups and listening fatigue scores on the pretest are less than .05, showing that the interactions between pretest listening scores (the covariate) and the two independent variables (input modality and sensory mode) were not statistically significant and, therefore, the homogeneity of regression slopes assumption was preserved.

4.1.3. Results of the Two-Way ANCOVA

The first statistics in the factorial two-way ANCOVA is Levene's test of equality of error variances that scrutinizes the credibility of the null hypothesis that the error variance of the dependent variable is the same across the various groups created by the interplay of the two independent variables. Table 5 has displayed the results.

Table 5

Levene's Test of Equality of Error Variances for Question Two

F	df1	df2	Sig.
1.442	8	77	.130

Design: Intercept + LF1 + Input Modality + Sensory Mode + Input Modality * Sensory Mode

As seen in this table, the Sig. value for the Levene's test of equality of error variances equals .130 which is larger than the .05, representing that the assumption of the equality of variances was preserved. The following table displays the results of the employed ANCOVA.

Table 6

Tests of Between-subjects Effects for the Study Groups' Scores on the Listening Fatigue Posttest

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.	Partial Eta Squared	Noncent. Parameter	Observed Power[b]
Corrected Model	3353.553[a]	9	372.6	14.96	.000	.639	134.64	1.000
Intercept	1538.818	1	1538.8	61.78	.000	.448	61.78	1.000
LF1	526.630	1	526.63	21.14	.000	.218	21.14	.995
Input Modality	220.399	2	110.20	4.42	.015	.104	8.84	.745
Sensory Mode	1154.763	2	577.38	23.18	.000	.379	46.36	1.000
Input Modality *Sensory Mode	552.006	4	138.00	5.541	.001	.226	22.16	.970
Error	1892.877	76	24.90					
Total	219547.000	86						
Corrected Total	5246.430	85						

a. R Squared = .639 (Adjusted R Squared = .596)
b. Computed using alpha = .05

The application of the ANCOVA revealed that there was a significant interaction effect between input modality and sensory mode: F (4, 76) = 5.541, p < .05 with a very small effect size (partial eta squared = .226). Input modality showed a statistically significant effect on Iranian EFL learners' listening fatigue on the posttest: F (2, 76) = 4.425, p = .015, partial eta squared=.104. This effect size signifies that 10.4 percent of the variance in the posttest listening fatigue scores are explained based on the study groups and the received input modality interventions. However, sensory mode had a larger significant effect on learners' listening fatigue scores on the posttest: F (2, 76) = 23.182, p =. 000, partial eta squared =.379.

The partial Eta value for the impact of the listening fatigue scores on the pretest (covariate) was .218. This rather large index is statistically significant at p<.05, signifying a robust and substantial connection between listening fatigue scores obtained through the pre- and posttest administrations. Therefore, the covariate could explain about 21.8 percent of the variance in the posttest listening fatigue scores. Table 7. provides us with the adjusted means on the posttest listening scores for the different input modality groups (the significant effect of the study). The adjusted means which were computed after the effect of the pretest scores (covariate) were statistically detached are shown here:

Table 7

Estimated Marginal Means for the Input Modality Groups' Scores on the Listening Fatigue Posttest Scores (LF2)

			95% Confidence Interval	
Input Modality	Mean	Std. Error	Lower Bound	Upper Bound
Audio	48.711[a]	1.182	46.357	51.065
Video	53.077[a]	1.059	50.968	55.186
Audio/Video/Caption	52.634[a]	1.069	50.505	54.763

a. Covariates appearing in the model are evaluated at the following values: LF1 = 45.47.

The adjusted means for the Audio, Video, and Audio/Video/Caption groups were 48.71, 53.07, and 52.63, correspondingly. The means for A, V, and AVC groups' scores on the posttest have increased sequentially. Post hoc pairwise comparisons were utilized to locate the exact place of the differences among input modality groups. See Table 8.

Table 8

Estimated Marginal Means for the Input Modality Groups' Listening Fatigue Scores on the Posttest (LF2)

					95% Confidence Interval for Difference[a]	
(I) Input Modality	(J) Input Modality	Mean Difference (I-J)	Std. Error	Sig.[a]	Lower Bound	Upper Bound
Audio	Video	-4.366*	1.587	.022	-8.250	-.482
	Audio/Video/Caption	-3.923*	1.595	.048	-7.827	-.019
Video	Audio	4.366*	1.587	.022	.482	8.250
	Audio/Video/Caption	.443	1.507	1.000	-3.246	4.132
Audio/Video/Caption	Audio	3.923*	1.595	.048	.019	7.827
	Video	-.443	1.507	1.000	-4.132	3.246

Based on estimated marginal means

*. The mean difference is significant at the .05 level.

a. Adjustment for multiple comparisons: Bonferroni.

Statistics in this table coupled with the previous table results about adjusted means discloses that audio/video/caption group showed more anxiety on the posttest than video and audio groups ($p<.05$). Also video learner's listening fatigue grew significantly larger than the audio group participants ($p<.05$). These findings indicate that adding to the input modality number can increase listening comprehension; however, it leads to more listening fatigue. The sensory mode had a significant impact on listening fatigue scores as shown in the following table.

Table 9

Estimated Marginal Means for the Interaction Effect of Input Modality and Sensory Mode on Listening Fatigue Posttest

				95% Confidence Interval	
Input Modality	Sensory Mode	Mean	Std. Error	Lower Bound	Upper Bound
Audio	Auditory	38.286[a]	1.337	35.623	40.949
	Visual	49.240[a]	1.587	46.080	52.400
	Haptic	58.607[a]	2.884	52.862	64.352
Video	Auditory	49.496[a]	1.389	46.729	52.263
	Visual	54.817[a]	1.473	51.885	57.750
	Haptic	54.917[a]	2.503	49.932	59.903
Audio/Video/Caption	Auditory	50.838[a]	1.424	48.003	53.674
	Visual	53.649[a]	1.447	50.768	56.530
	Haptic	53.415[a]	2.536	48.363	58.466

a. Covariates appearing in the model are evaluated at the following values: LF1 = 45.47.

As displayed in Table 9, some differences exist among posttest listening fatigue scores among students with different sensory mode tendencies (auditory, visual, and haptic) in the three different input modality groups. In audio input modality group, auditory students have the minimum mean scores (M=38.28), visual and haptic students gained higher mean scores (49.24 and 58.60, respectively). In the video modality group, the lowest mean score was for auditory students with mean score of 49.49 and the visual and haptic students' means for listening fatigue scores equaled 54.81 and 54.91, in sequence. In the AVC input modality group, students possessing different sensory mode propensities exhibited least differences ($M_{auditory}$=50.83, M_{visual}=53.64, and M_{haptic}=53.41). These score changes are displayed in Figure 3.

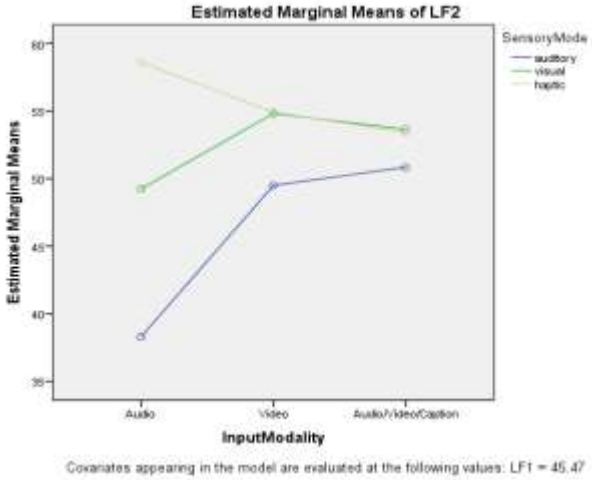

Figure 3. The Fit Line at Subgroups' Performances on LF2 for The Interaction of Input Modality and Sensory Mode

There are various methods and post hoc analyses to examine where the exact differences are in a 3 by 3 factorial two-way ANCOVA according to statisticians; nevertheless, one of the best and facile ones is to employ three separate one-way ANOVAs to explore the differences among different sensory modes in each modality group.

Table 10

One-Way ANOVAs for the Impact of Different Sensory Modes on the LF Posttest Scores in Three Input Modality Groups

		Sum of Squares	df	Mean Square	F	Sig.
Audio Group	Between Groups	1453.368	2	726.684	40.285	.000
	Within Groups	432.929	24	18.039		
	Total	1886.296	26			
Video Group	Between Groups	39.726	2	19.863	.520	.600
	Within Groups	1031.774	27	38.214		
	Total	1071.500	29			
AVC Group	Between Groups	202.739	2	101.370	2.786	.080
	Within Groups	946.019	26	36.385		
	Total	1148.759	28			

As summarized in Table 10, there are significant differences among learners with different sensory modes only in audio but not in the other two groups. The results of the employed Scheffe test for the audio group concerning the effect of different auditory, visual, and haptic modes on learners' posttest LF scores are displayed in Table 11.

Table 11

Multiple Comparisons for the Impact of Different Sensory Mode Styles on the LF Posttest Scores in Audio Modality Group

					95% Confidence Interval	
(I) Sensory Mode	(J) Sensory Mode	Mean Difference (I-J)	Std. Error	Sig.	Lower Bound	Upper Bound
Auditory	Visual	-12.071*	1.759	.000	-16.66	-7.48
	Haptic	-20.071*	2.702	.000	-27.12	-13.02
Visual	Auditory	12.071*	1.759	.000	7.48	16.66
	Haptic	-8.000*	2.796	.030	-15.29	-.71
Haptic	Auditory	20.071*	2.702	.000	13.02	27.12
	Visual	8.000*	2.796	.030	.71	15.29

*. The mean difference is significant at the 0.05 level.

As inferred from Table 11, in the audio input modality group, auditory learners showed significantly lower listening fatigue compared with the visual and haptic learners, demonstrating the direct relationship between audio input modality and auditory perceptual style in reducing the listening fatigue among Iranian EFL learners.

4.1.4 Research Question Two

By analyzing and several reviewing of the provided answers and by getting assistance from MAXGDA qualitative data analysis software, these general findings were located. First, nearly all participants said that taking a listening test is inevitably accompanied by fatigue and boredom. They also expressed the idea that they felt fatigue at the end of each class session. Therefore, the fatigue is always felt by learners either during classroom sessions or exam sessions.

Second, learners in audio group mentioned less feeling of fatigue and anxiety feelings after they attended audio input modality treatments. One learner in the audio group reported that *".....I always felt fatigue and tiredness whenever I took a listening test; however, after attending this course, I developed a more secure and positive attitude towards L2 listening comprehension*". This feeling was reported by six more learners in the audio group. Another student said "*I was afflicted by fatigue when I took the pretest; however, I felt more relaxed on the posttest and after passing the course treatment*".

Participants in the video class express more feeling of fatigue in comparison to the audio class. They said they sometimes couldn't concentrate on the instructional materials that they needed to analyze both through eyes and ears. A learner cited that "*I think I could generally foster my listening during the course sessions; but, on the posttest I felt very tired and sometimes embarrassed*".

The most severe cases of fatigue, tiredness, and anxiety on the pretest, course sessions, and posttest were reported by those learners who received listening instruction in the form of audio/video/caption materials. Nearly half of the participants in AVC group claimed that this type of treatment can cause fatigue and stress among the learners in the short term. Samira, a participant, argue that "*I enjoyed the course sessions a lot but on the posttest I felt totally confused and bored,...I didn't know why, but I think captions were not present and therefore, I couldn't comprehend and answer the items*". Other learners also express their hesitation that AVC materials can reduce fatigue on the listening exam sessions or short period courses.

Putting all interviewees' replies in the three input modality groups, it can be concluded that generally with adding an input channel for L2 listening lead to more fatigue and thus confusion among learners. The only group that claimed the treatment it had received reduced their fatigue was audio group or the unimodal input receiver participants. Accordingly, the findings of the qualitative phase are in line with the findings of the quantitative phase, i.e., the results of the qualitative and quantitative phases

converge about the effect of the type of input modality and the amount of felt listening fatigue.

4.2. Discussion

The first and the most important finding of the current research disclosed that input modality intervention had a statistically significant effect on lowering and intensifying listening fatigue among Iranian EFL learners. The listening fatigue among audio group learners significantly was reduced compared with the other two input modality groups. Video group (who received input through two sensory channels) also showed significantly more fatigue than the audio group and less than the AVC group. In other words, by adding more channels to the received input, the listening fatigue significantly increases.

The second finding of the study revealed that sensory mode (auditory, visual, and haptic perceptual learning styles) had only significant influence on Iranian EFL learners' listening fatigue in the audio group but not in the video and AVC groups. In the audio group, auditory learners showed significantly lower listening fatigue compared with visual and haptic learners, indicating a direct relationship between audio-input modality and auditory perceptual style in lowering L2 listening fatigue when the intervention is done only through one channel, in this case, the audio input.

The third finding of the study showed that Iranian EFL learners' attitudes toward the role, effectiveness, and advantages of different input modality interventions for lowering listening fatigue was in line with the finding of the quantitative phase. Learners asserted that adding any new type of input modality did not decrease the L2 listening fatigue, rather it had adverse effect and it intensified the amount of listening fatigue. Regarding the findings of the study, no former study has ever elicited EFL or ESL learners' attitudes about the effect of using different input modalities on L2 listening fatigue.

One of the most important contributions of the current research is the approval of the construct reality of "listening fatigue". The construct of listening fatigue was shown to have psychological reality and it is defined as "extreme tiredness resulting from such factors as mental/cognitive effort, stress, anxiety, depression, distraction, and emotional exhaustion which may negatively affect the listening comprehension process". The componential construct analysis using SPSS program revealed that listening fatigue encompassed some subcomponents including stress or anxiety, distraction and concentration, mental/cognitive effort, and tiredness or emotional exhaustion. Accordingly, the concept of listening fatigue is introduced to SLA literature by the findings of this study and both its theoretical and psychological existence have been affirmed.

An adequate body of research in the literature, in the same line with the present finding would seem to support the single channel theory. Analyzing the results of almost 50 studies on visual-verbal presentations, Dwyer (1972) stated that the addition of cues in a second channel can be distracting and detrimental to learning. Mayer and Moreno (2003) note that a potential problem during multimedia learning pertains to the fact that the processing demands induced by the learning task may go beyond the processing capacity of the cognitive system and thus leads to cognitive overload. Even the high amount of cognitive load can deteriorate the psychophysiological status of the learner and at last results in mental fatigue during any task, in this case, listening comprehension. Another study advocating the use of single-channel instruction has been done by Muraida and Spector (1992). They investigated the use of audio-visual vs. audio materials on text comprehension and found no significant advantage for visually and aurally presented text (Muraida & Spector, 1992).

One of the main shortcomings of previous researches which has provided the rationale for the current study is that the processing and storage capacity of different modalities has not been considered. In fact, the presence of some studies with contradictory findings would be due to this ignorance which was given priority in this research. In this respect, one of the main studies in support of audio input presentation with regard to reducing listening fatigue has been undertaken by Hsia (1971). He carried out a comprehensive review of the existing literature on the processing capacity of modalities and discovered that beside the complexity and difficulty of the information, the increasing number of cues can also tax on each modality capacity. Hsia (1971) concluded that while well designed multiple-channel presentations seem to be more effective, in comparison to unimodal presentations they can go beyond the processing capacity of the central nervous system faster. He maintained that the central nervous system act as a multi-channel mechanism until processing capacity is exceeded. At this point due to the resulted "jamming", the system may be shrinked into a single-channel system and then the result will be equivocation and loss of information (Hsia, 1971). Flemming (1970) concluded that overloading the senses through multiple channels of information could result in less efficient learning and communication.

Furthermore, it was discussed that attention plays a significant role in listening comprehension process and has a direct relationship with the number of modalities in presenting input. In fact, the more the number of modalities the more difficult it will be to maintain attention. Baddeley (2003) mentioned that multiple concurrent activities require frequent shifting in attention resources which puts too much burden on the central executive of working memory over and above that imposed by the activities themselves.

Therefore, listening through multimodal input channels of audio-visual or AVC which entails repeated switching in attention and puts too much demand on executive control may result in listening fatigue, while unimodal input presentation through audio files prove to be more fruitful in lowering fatigue during the listening task.

5. Conclusion and Implications

The main conclusion of the present research is that receiving multimedia through one input modality channel can decrease L2 listening fatigue; however, receiving input from more than one channel can lead to more fatigue due to the more involvement of mind with receiving, decoding, analyzing, and reconstructing the information. Of course, the three-channel input modality intervention causes more fatigue and confusion than two-channel input intervention. The second crucial conclusion is that sensory mode directly influences the fatigue. Auditory learners show less listening fatigue in one-channel input modality classes. However, being visual doesn't decrease fatigue in the video class.

The findings of current study have some important pedagogical implications for those who are involved in learning and teaching English as a foreign or second language including EFL learners, teachers, and syllabus designers. The community of EFL learners can employ the findings of the current study to improve the L2 listening comprehension and reduce their listening fatigue. Learners should be familiar with their sensory modes for L2 learning or their perceptual learning styles. Knowing their auditory, visual or other styles can help them to choose the most effective multimedia for their own listening comprehension improvement. If they possess auditory perceptual (sensory mode) styles, they should choose more audio-oriented material and if they have a dominant visual style in their learning perception, they are recommended to follow more video materials. By choosing the most appropriate type of input modality based on their perceptual learning style (sensory mode) they can lower their fatigue and let their mental abilities to listen better.

Teachers can use the findings of this study in their EFL listening classes and their teaching practices. Teachers should be aware that listening comprehension and fatigue negatively influence each other. They should try to lower their learners' listening fatigue by determining their best learning sensory modes. Then, they should tailor their teaching materials and tasks based on these learning perceptual inclinations and choose the best type of input modality and listening materials. They should recognize that auditory learners can learn better from audio input and visual learners can improve their listening by watching video materials. Assigning the input materials for improving listening that do not match learners' perceptual style not only

lower their learning but also exhaust their mind and increases their fatigue during and after listening tasks. Teachers should also try to assign listening materials without captions because based on the findings of this study, receiving input from many channels can only bring about fatigue, negative attitude and exhaustion. Using captions should be very limited because they distract learners' attention from the audio and video stream of input.

Syllabus designers and those who are involved in curriculum planning and material development should also arrange and write their listening materials on the basis of effectiveness of different types of input modality according to learners' sensory modes. They should provide some surveys or checklists that aid EFL learners discern their dominant perceptual styles by the help of their instructors and then choose those instructional materials and related multimedia. Definitely, syllabus designers should provide rich audiovisual files to give learners the option to choose these files based on their best channel of listening comprehension development. Designing instructional materials can help learners enhance their EFL listening and gradually reduce and finally overcome their listening fatigue.

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