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The Effect of Language Proficiency on Concentration Levels When Exposed to Media

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ABSTRACT

In a world that is becoming increasingly globalized, the understanding of different languages and cultures has become essential for a connected and harmonious global society. Considering the importance of this issue, we investigated to what extent language has an impact on experiencing social media in the form of short videos. To this end, we conducted an experiment with three experimental groups of different levels of English proficiency, measuring brain activity by analyzing alpha, beta, delta, theta, and gamma brainwaves using electroencephalogram (EEG). Through our research, we were able to conclude that the understanding of language does not have a significant impact on levels of focus, especially when people experience visual media with short length. This surprising and unexpected result leads to many implications on societal occurrences including the development of an effective social media platform.

Introduction

As the world is becoming more connected internationally, people now have access to media around the world in a variety of different cultures. In this societal occurrence, we found the need to investigate how language psychologically and neurologically affects the individual experience of various forms of media such as short videos. Various studies in the past have shown how linguistic abilities affected certain occurrences or factors.

According to Nawal A. F. (2018), writing in a second language (L2) is a complex task that demands a solid framework and precise execution to ensure linguistic accuracy. This process requires significant cognitive effort from L2 learners, necessitating their full attention and concentration.

Evidence indicates that L2 learners rarely consider their thought processes while writing because their cognitive resources are overwhelmed by the task. One reason for this cognitive overload could be the translation of their original thoughts from their native language (L1) into the target language.

Numerous studies have shown that students often rely on their L1 to produce texts in their L2. Veerappan et al. (2013) (as cited in Nawal A. F., 2018) observed that English as a foreign language writers frequently switch to their L1 when reviewing their text. They reassess and evaluate the quality of their text in L1, indicating that while the final product is in L2, the creation process heavily involves L1. During the writing process, L2 learners seem to concentrate on translating words, which can compromise the form and lead to poor writing quality.

As Kalyuga et al. (1999, p. 351) (as cited in Nawal A. F., 2018) noted, "only a few elements of information can be processed in working memory at any time. Too many elements may overburden working memory, decreasing the effectiveness of processing."

Contrary to the significant effects observed in academic contexts, there are areas where language proficiency does not exert a substantial influence. Research on perceptual and motor tasks, for example, indicates that these activities can be performed independently of linguistic abilities. Goodale and Milner (1992) explored the distinct neural pathways involved in visual perception and motor action, demonstrating that individuals with

impaired language comprehension, such as aphasia patients, can still effectively engage in visual recognition and motor tasks.

Furthermore, emotional responses to stimuli are often found to be largely independent of language proficiency. Studies by Ekman (1992) on basic emotions revealed that individuals can recognize and respond to emotional expressions similarly regardless of their linguistic abilities. This suggests that the processing of emotional cues operates through mechanisms that do not rely heavily on language.

Additionally, the execution of procedural and motor skills, such as playing a musical instrument or riding a bicycle, appears to be unaffected by language proficiency. Willingham's (1998) research on motor skill learning highlights that these skills depend primarily on procedural memory and practice, rather than linguistic knowledge.

Through this literature review, it can be seen that language proficiency has a significant effect on how an individual concentrates on a certain task, whereas it does not have a noticeable effect on perception or emotional responses. However, no studies have been conducted so far on how language proficiency affects concentration levels while individuals watch short videos. Therefore, we designed a study to explore the impact of language on levels of focus in this case.

To explore this topic, we conducted research to determine whether the understanding of language, out of many other factors such as visual and auditory effects, has a profound impact on individuals' experience of media in the form of short videos. For this purpose, we designed a study, conducted an experiment, and recorded and analyzed the results. Through our research, we were able to elucidate how language affects media experience such as the ability of concentration, further suggesting a strategy to develop a social media platform that can be more effective throughout the world.

Method

Study Design

To effectively conduct our research, we decided to measure the brain activity of a person while watching movie trailers. Our method of measurement was electroencephalography (EEG). An EEG is a test that measures electrical activity in the brain using small electrodes attached to the scalp. It shows the communication of brain cells via electrical impulses as wavy lines on a recording.

We selected EEG for our method of measurement due to its ability to identify one's concentration power. Rahma and Nurhadi (2017) stated that such concentration power can be determined through the conditions of the oscillations of brainwaves. The aforementioned brainwaves include delta, alpha, beta, theta, and gamma waves. Out of these brainwaves, it is known that the ideal concentration condition is associated with brainwaves at the range of 13-40 Hz and especially so at the frequencies of 15-18 Hz. While brainwaves which are in the range of 22-40 Hz are also related to concentration, they are often associated with anxiety. Because brainwaves can be used to assess concentration, we decided to use EEG to measure levels of concentration while the participants watch videos.

To test the effect of language on concentration on a video, we found it necessary to gather participants with varying levels of proficiency in a certain language. Based on this notion, we collected participants who were all of Korean ethnicity with different abilities in understanding the English language. Therefore, by comparing the brainwaves of participants with different levels of understanding English while watching videos in that language, we could interpret the effect of language on the ability to focus.

We divided participants into three separate groups. The first group consisted of native English speakers who are able to understand English. The second group contained non-native English speakers who are also able to understand English. The third group was made of non-native English speakers who are unable to understand English. We defined 'native' as those who have lived in an English-speaking country for at least four years

between the ages of five and ten, and 'non-native' as those who have not. This standard was based on the period when children gradually start to think in increasingly complex ways and understand nuances of language. There were 4 participants in the group with native English speakers and 5 participants each in the groups with non-native English speakers who understand and do not understand English, with a total of 14 people taking part in the experiment.

We showed two short videos to participants. The two videos shown to the participants were the trailers for the movies *When You Finish Saving The World* (2022) which is 2 minutes and 25 seconds long, and *The Black Phone* (2021), which is 2 minutes and 56 seconds long. We selected videos with large amounts of dialogue to effectively determine the effect of language on concentration. In addition, two trailers of movies with different genres were shown in order to observe whether language affects concentration differently according to the genre of the video. The genre of *When You Finish Saving The World* is comedy/drama whereas the genre of *The Black Phone* is horror/mystery.

We used a brainwave monitor to measure the brainwaves of the participants watching the videos. In particular, we recorded the rhythms of alpha, beta, gamma, theta and delta waves and used the values of average percentages for each wave to compare brain activity between experimental groups. In this case, high beta and gamma waves are associated with concentration while high alpha, theta, and delta waves are related to relaxation. We compared the results by calculating the mean values for each brainwave in each group and comparing the values between groups. We then used analysis of variance (ANOVA) to determine whether there is a significant difference between groups.

In addition, after each trailer, participants were asked to take a short survey to see how well they understood the content. We created five questions for each survey using Google Forms and recorded the results of how many questions the participants answered correctly (Supplemental Data 1). The surveys were meant to confirm the participants' abilities of understanding English. A participant having one or less questions wrong per survey was considered having sufficient English abilities while a participant having two or more questions wrong per survey was considered having insufficient English abilities.

Experimental Procedure

The procedure begins with the participant donning a brainwave monitor on their head to ensure accurate data collection. We initiate the recording of the participant's brainwaves, capturing their neural activity as they watch the trailer for *When You Finish Saving The World*. After the trailer concludes, we stop the recording and have the participant complete a survey related to the trailer to assess their comprehension and engagement (Supplemental Data 1). Following this, we resume brainwave recording as the participant views the trailer for *The Black Phone*. Once the second trailer viewing is complete, we stop the recording and the participant takes another survey, this time focusing on *The Black Phone* trailer. The collected data from both trailers, including brainwave recordings and survey results, are documented in an Excel file and further organized into a comprehensive document. This entire sequence is systematically repeated for each participant.

Results

Delta waves are the slowest brainwave type with frequencies between 1-3 Hz, closely associated with deep states of relaxation and control over unconscious bodily functions. They predominantly manifest during periods of deep sleep or coma, emanating from the thalamus, a small part of the brain. These waves induce a profound calming effect on the mind, facilitating a loss of bodily awareness. In addition, it has been observed that delta waves decrease in peak performers when high focus is necessary.

Theta waves are slightly faster with frequencies ranging from 4-7 Hz, signifying a very relaxed brain state characterized by creativity, intuition, and daydreaming. Theta waves are involved in sleep and daydreaming, and indicate creativity and intuition. (Koudelková and Strmiska, 2018) They are most often measured during deep sleep, as well as during REM cycles or dreaming periods.

Moreover, alpha waves have frequencies between approximately 8-12 Hz. Alpha waves are often associated with a relaxed yet conscious state or a condition in which the brain is changing to a more relaxed state while still able to shift into a quicker brainwave state when it is required. Therefore, when alpha waves are prevalent in an individual's brain, it is likely that the individual is in a physically and mentally relaxed state without being semi-conscious or distracted.

Beta waves have frequencies between approximately 13-38 Hz. Beta waves are related to a condition of intellectual activity or concentration focused externally. Beta brainwave activity is often shown when individuals are alert and awake, and especially when they are concentrating on a problem or topic. Abhag et al. (2016) explains that beta waves can be divided into three different frequency ranges, which are low beta waves, mid-range beta waves, and high beta waves. Low beta waves have frequencies between 12-15 Hz, and are associated mostly with quiet, focused, introverted concentration. Mid-range beta waves have frequencies between 15-20 Hz, and are associated with increases in energy, anxiety, and performance. High beta waves have frequencies between 18-40 Hz, and are associated with significant stress, anxiety, paranoia, high energy, and high arousal. Like this, it can be seen that the measurement of beta waves is important in assessing rates of concentration in an experiment participant.

Gamma brainwaves have frequencies between 39-42 Hz and are the shortest and fastest type. Gamma brainwave activity is associated with heightened perception and is often prominent during stressful situations or in circumstances when individuals need to focus. Moreover, it can be seen that gamma waves are related to a state in which an individual is learning or solving a problem. Gamma brainwaves are analogous to beta waves in that both are prominent when an individual is concentrating or engaging in rigorous intellectual activities. Therefore, the measurement of gamma waves, along with beta waves, is crucial in evaluating the level of focus in a participant.

Through this knowledge, we could analyze the measurements of brainwaves to determine whether language has an effect on concentration levels in participants. The brainwaves of 14 participants were recorded while they watched two movie trailers. The group with 4 native English speakers was recorded as group A, the group with 5 non-native English speakers who can understand English was recorded as group B, and the group with 5 non-native English speakers who cannot understand English was recorded as group C. The average percentages of gamma, beta, alpha, theta, and delta waves for each group while watching the trailer for *When You Finish Saving The World* was organized in a table (Table 1). The average percentages of the waves for each group while watching the trailer for *The Black Phone* was also organized (Table 2).

Table 1. Average percentages of brainwaves for the *When You Finish Saving The World* trailer

	Gamma			Beta			Alpha			Theta			Delta		
	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C
Participant 1	13	13	16	33	37	39	25	22	23	22	22	18	7	6	4
Participant 2	9	16	12	32	42	29	27	21	27	23	16	23	9	5	9
Participant 3	10	17	19	32	34	47	25	23	17	24	20	14	9	6	3

Participant 4	16	12	14	36	46	39	20	23	22	21	15	19	7	4	6
Participant 5		18	12		49	34		17	24		12	22		4	8
Mean	12	15.2	14.6	33.3	41.6	37.6	24.3	21.2	22.6	22.5	17	19.2	8	5	6

Table 2. Average percentages of brainwaves for *The Black Phone* trailer

	Gamma			Beta			Alpha			Theta			Delta		
	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C
Participant 1	16	18	15	36	41	45	22	20	22	20	17	14	6	4	4
Participant 2	18	13	11	46	39	31	16	24	28	16	18	22	4	6	8
Participant 3	17	21	22	39	38	48	20	18	15	18	18	12	6	5	3
Participant 4	18	12	19	42	46	46	19	24	18	15	14	14	6	4	3
Participant 5		20	14		53	31		15	24		10	22		2	9
Mean	17.3	16.8	16.2	40.8	43.4	40.2	19.3	20.2	21.4	17.3	15.4	16.8	5.5	4.2	5.4

After watching each trailer, participants answered the survey about its content in order to assess English proficiency (Supplemental Data 1). As can be seen in the tables below, all participants of group A and B had one or less questions incorrectly answered per survey (Table 3). However, all participants in group C had two or more questions incorrectly answered per survey (Table 4).

Table 3. Number of problems wrong for the *When You Finish Saving The World* trailer

	Number of Problems Wrong		
	A	B	C
Participant 1	0	0	2
Participant 2	0	1	2
Participant 3	1	1	3
Participant 4	0	0	4
Participant 5		0	5

Table 4. Number of problems wrong for the *The Black Phone* trailer

	Number of Problems Wrong		
	A	B	C
Participant 1	0	0	3
Participant 2	0	1	3
Participant 3	0	0	3
Participant 4	1	1	2
Participant 5		0	2

We compared the waves of the data sets for each experimental group to see whether language had a significant effect on brain activity and concentration. To do so, we used the single factor ANOVA test with the null hypothesis being that the specific brainwave tested has the same average percentage for all three groups.

Comparing the gamma waves measured while participants watched the trailer for *When You Finish Saving The World*, F=1.490295, F crit=3.982298 and thus, F<F crit and there is no significant difference between groups. Comparing the beta waves measured, F=2.4876564, F crit=3.982298 and because F<F crit, there is no significant difference between groups. Comparing the alpha waves measured, F=1.0857484, F crit=3.982298 and thus, F<F crit and there is no significant difference between groups. Comparing the theta waves measured, F=3.0949797, F crit=3.982298 and F<F crit, and therefore there is no significant difference between groups. Comparing the delta waves measured, F=3.2930672, F crit=3.982298 and thus, F<F crit and there is no significant difference between groups.

Comparing the gamma waves measured while participants watched the trailer for *The Black Phone*, F=0.0955267, F crit=3.982298 and therefore, F<F crit and there is no significant difference between groups. Comparing the beta waves measured, F=0.3196059, F crit=3.982298 and because F<F crit, there is no significant difference between groups. Comparing the alpha waves measured, F=0.3149306, F crit=3.982298 and thus, F<F crit and there is no significant difference between groups. Comparing the theta waves measured, F=0.3084468, F crit=3.982298 and F<F crit, and therefore, there is no significant difference between groups. Comparing the delta waves measured, F=0.6111111, F crit=3.982298 and thus, F<F crit and there is no significant difference between groups.

Based on the ANOVA test, we could see that none of the waves of each group had a significant difference from one another, regardless of the film trailer. Because neither beta and gamma waves, which are related to concentration, nor alpha, delta, and theta waves, which are associated with relaxation, had any statistical difference, it can be seen that language does not have a significant effect on concentration. This conclusion can also be inferred through the bar graphs, from which it can be seen that the average percentages of the brainwaves for each group vary only slightly from each other (Figure 1, Figure 2). The bar graphs were created using the average values of the average percentages of each wave in each group while watching a specific movie trailer.

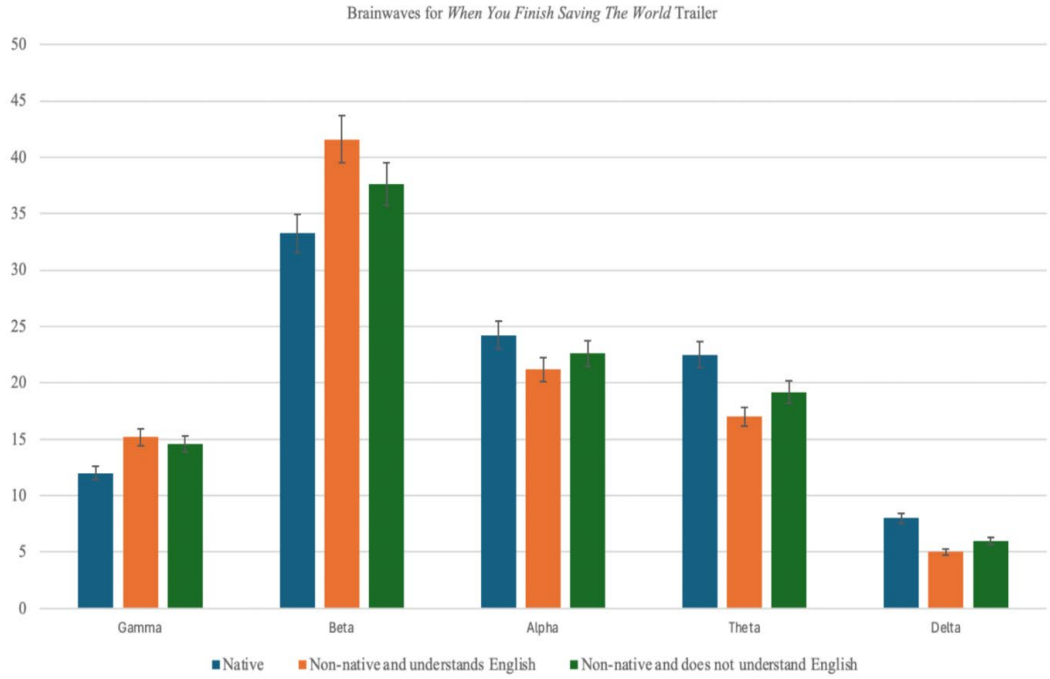

Figure 1. Bar graph showing each brainwave for participants of each group while watching the *When You Finish Savings the World* trailer.

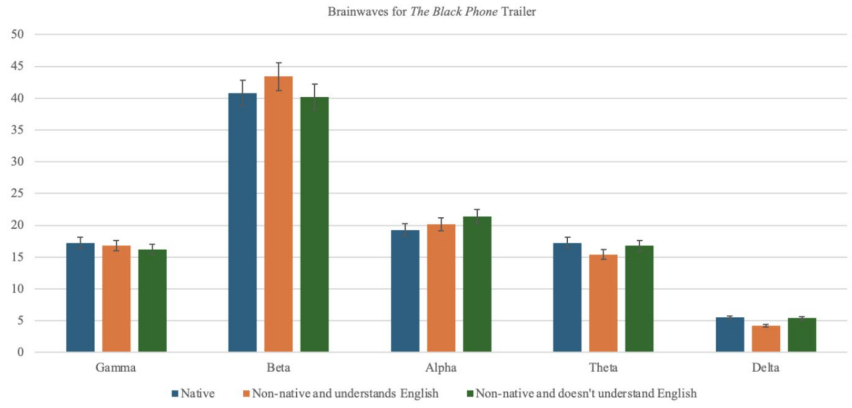

Figure 2. Bar graph showing each brainwave for participants of each group while watching the *The Black Phone* trailer.

Moreover, because there was no significant difference for the brainwaves measured while watching either the trailer for *When You Finish Saving The World* and *The Black Phone*, it can be seen that the genre of the video does not have an effect on how language impacts concentration while watching the video.

Conclusion

In our research, the three groups (a group with native English speakers, a group with non-native English speakers who understand English, and a group with non-native English speakers who do not understand English) that participated in our experiment did not have a significant difference in brainwaves despite varying levels of proficiency in the language of the videos shown. From this result, it can be concluded that language does not have a significant role in concentration levels while an individual is watching short videos. This conclusion can further lead to the assumption that people can have interest in videos of relatively short length regardless of whether they understand the words used in the videos. Moreover, it can be speculated that the minor influence that language has on the level of focus is correlated with the global popularity of short videos on social media.

Discussion

Through our experiment, we were able to make a surprising and unexpected discovery that language does not significantly affect the concentration of individuals when they experience videos of relatively short length. Because of this, we speculated that various other factors of the video such as visual and auditory effects could have more prominent influences on concentration than language, particularly when the videos are short.

Further, we could attribute the recent international prevalence of short videos such as “reels” from Instagram and “shorts” on YouTube to our results. Reels or shorts depend greatly on their visual effects and attention-grabbing sounds. Also, because they are usually less than 90 seconds long and considered “short” videos, it can be seen through our results that language does not significantly impact one’s interest or concentration on them. This could be a valid reason for why short videos created in certain countries using specific languages can gain popularity internationally. Thus, this aspect could be considered in making an effective social media platform.

We understand the fact that alternate conclusions could be made in experiments using other types of methodology such as fMRI. For example, because fMRI brain activity shows which regions of the brain become active while EEG shows only brainwaves, it could be implied that there may be different results.

Moreover, regarding the fact that our experiment was based on relatively short videos, it could be predicted that there may be alternate results if an experiment is conducted based on videos of longer length. Because of this, we attributed our discovery specifically to short videos. Thus, further experiments could be conducted exploring whether the length of the video has an influence on the extent to which language affects one’s concentration on the visual stimulus.

It should also be recognized that our experiment was conducted for videos in the English language. Different results may arise for videos in other languages. Therefore, it could be discussed on how a variety of languages impact the influence of language on concentration levels.

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