

# Video and Film Rating Algorithm using EEG Response Measurement to Content: Focus on Sexuality

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## ABSTRACT

This study attempted to analyze human brain responses toward visual content through EEG signals and intended to measure brain wave reactions of different age groups to determine the sexuality level of the media. The experimental stimuli consist of three different video footage (rated ages 12, 15, and 18) to analyze how subjects react in situations where they actually watch sexual content. For measuring and analyzing brain wave reactions, EEG equipment records alpha, beta, and gamma wave responses of the subjects' left and right frontal lobes, temporal lobes, and occipital lobes. The subjects of this study were 28 total and they are divided into two groups. The experiment configures a sexual content classification scale with age or gender as a discriminating variable and brain region-specific response frequencies (left/right, frontal/temporal/occipital, alpha/beta/gamma waves) as independent variables. The experimental results showed the possibility of distinguishing gender and age differences. The apparent differences in brain wave response areas and bands among high school girls, high school boys, and college students are found. Using these brain wave response data, this study explored the potential of developing algorithm for measurement of age-specific responses to sexual content and apply it as a film rating.

**Key words:** EEG, Film Classification, Neuro-science, Movie Rating

## 1. INTRODUCTION

Until the late 1990s, the Korean Committee for Performance Ethics was in charge of judging on movies, records and games in Korea. But after the constitutional ruling that censorship of these materials is unconstitutional, the Korea Media Rating Board(KMRB) was established to advocate self-regulation of the private sector. Since then, the Game Rating Board was launched independently of the KMRB in 2006 because of the need for regulation on gambling games[1].

Currently, the rating of video clips (films and video materials) organized by the KMRB is divided into five categories: Film suitable for all ages, Film intended for audiences 12 years old and over, Film

intended for audiences 15 and over, No one under 18 is allowed, and Restriction in screening. The rating criteria are divided into seven categories: Theme, Violence, Sexuality, Horror, Drugs, Language, and Imitable behavior[2].

Video rating organizations exist worldwide on a private or government level and the main purpose of the rating is protecting youth from harmful content exposure. As adolescents are in a stage of both physical and psychological development, extremely sexual or violent content could have a negative influence on them. So the rating system provides suitable content for each age group. However, the goal of youth protection is bound to conflict with the ideology of "freedom of expression," which has led to constant disputes over the violation between

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freedom of expression and objectivity of judgment on rating or classification. The main reason for this is the classification process determined by subjective judgment of the rating board members. In other words, certain scenes may seem overly suggestive or not by members. Rating results are determined by subjective judgment of the reviewers not only for this reason but also because objective review criteria do not exist [3]. In case of sexuality for example, criteria of physical exposure by age or sexual contact are presented, but the criteria can't be accurately differentiated between ages. Furthermore the criteria are abstractly defined it is hard to consent among reviewers.

Thus, the outcome of the review is bound to change according to the values of the reviewers. The way in which an agreement or majority decision determines the rating of a video or a game is bound to have limitations of complaints about the result of the judgment. There are some advantages of using subjective evaluating method, such as identifying the context of images. But there is a need to supplement scientific methods that can compensate for these problems. It is possible to measure and classify the violence, sexuality, and harmfulness of video content scientifically as the development of information technology and medical engineering.

This study attempted to measure human emotions or minds to visual content through measuring EEG signals. Using user's brain response to images, this research tried whether these brain response data can be applied to classifying sexual images.

## 2. RELATED WORKS

### 2.1 Media Rating and Sexuality

There are four subcommittees in the KMRB (film rating classification, video rating classification, performance recommendation, advertisement) and film and video rating classification sub-

committee have eight or 10 professional members, respectively.(as of February 2020) The problem with the classification of video materials by such committee agreements has been continuously controversial. This controversy, in particular, stems mainly from the ambiguity of factors related to the level of sexuality and violence.

Typical case is the controversy over the film rating result that was raised in the summer of 2013 when film director Kim Ki-duk's "Moebius" was rated 'Restriction in screening' category by the KMRB. In some cases, the same movie is rated at different ages in different countries. While a foreign film "Revolutionary Road" was rated as not available for youth viewing in Korea, it was declared 7 years old or older in Sweden and 17 years old or younger in the United States. With such a lack of clear regulations and common understanding on the factors that determine the ratings result, similar social controversies have been repeated in Korea.

In the United States, Motion Picture Association of America(MPAA) is in charge of rating classifications. Frequently it is pointed out that MPAA's rating system ignores the context in which sex or violence is presented and focuses only on quantitative aspects of how much sex or violence is included[4]. Therefore many films received PG-13 (Parental Guide 13 years old) rating, which contain heavily sexual content.

Studies have shown that over the past two years since January 1, 2000, when PG-13 was introduced, the percentage of content suitable for adults as a whole has increased. What is characteristic is that the increase in the sex factor has not been so large while the violent factor has increased[5]. This can be interpreted as meaning that MPAA has a very conservative standard in terms of sexuality, although it has a large tolerance for violence.

An analysis of how effectively MPAA's rating system worked to filter violent or sexual scenes in popular movies in the United States from 1950

to 2006 reveals that MPAA's rating system is rather efficient in filtering explicit sexual elements, but not in violent factors. Paradoxically, these studies suggest that children and teens are more likely to be exposed to harmful content [6]. That is, countries in cultures with strong gender-motivated uncertainty and feminine characteristics are most lenient in their ratings, and that generosity in these classes tends to increase film makers' revenues[7].

In other words, because the more favorable a video is rated, the more profit will increase, the film companies use loopholes in rating systems through rating agencies to get as generous ratings as possible. Even when the classification system should be content based on sexuality, it poses a problem because it based on age. Studies on the existing rating system show that the gap between the content and rating is wide and the rating system is not working properly.

## 2.2 Response Measure of Sexual Content

Studies have been under way to scientifically measure the emotional or psychological changes of people who exposed to violent or sexual content, and some have measured physiological responses of exposure to sexual media stimulus. Sexuality study of media was launched extensively in the 1970s, when media scholars referred to it as the "aggressive queue theory" that contact with sexual content leads to another sexual content craving and emotionally aggressive behavior[8,9].

The excitation transfer theory, then presented, suggests that sexual expression of media enhance aggressive behavior, such as sexual assault, and that participants who watch sexually explicit movies consistently overestimate the frequency of the average person's aural sex, anal sex, sadistic metamorphosis, and hydration rather than the control group that watched movies that did not contain sexual content.[10,11]. In addition, response studies on media sexuality are conducted in a variety of

approaches, including individual differences, gender differences and attitudes toward sex. In the field of automatic video recognition study, gender classification is possible using visual pattern recognition. [12]

However, the studies that have been conducted do not provide a clear scientific evidence for sexuality as they are only based on behavioral analysis of those observed and participants in the experiment. For this reason, attempts have been made to converge engineering and physiological approaches in addition to socio-scientific behavioral analysis to provide clear criteria and grounds for media sexuality measurement.

The study[13], which applied fusion methodologies to automatically analyze violent scenes and sounds in movies, said it performed automated processing and analysis about 10 movies to distinguish violent images at 83 percent hit rates. Another study also developed an algorithm to detect and automatically block violent images. The algorithm resulting in efficient operation of image data bases, management of image data on the Internet, and pre-blocking harmful images toward teenagers[14]. Studies are also being conducted using a variety of physiological and psychological measurement methods, such as measuring genital reactions to sensational images, to measure the sexual response of subjects[15].

## 3. METHOD

This study was intended to measure and analyze the brain wave reactions of different age groups to determine the sexuality level of the media. Using these brain wave response data, this experiment tried to verify the validity of rating for sexual content. The subjects of this study were 28 subjects. The subjects are divided into two groups. High school group has 14 subjects aged 18, half male and half female. College group has also 14 subjects aged over 19. Experiments were conducted in a closed laboratory equipped with 32

channel wireless EEG (Electroencephalogram) model (LXE323-RF) of Laxtha company.

International standard attachment of 10–20 electrode caps were used. (FP1, F2, F7, FZ, F4, F8, C3, CZ4, TZ3, CZ3, CZ4, P52, P52, P2, P2) as a method of detecting brain wave signals.

The experimental stimuli consist of three different video footage (rated ages 12 or older, rated 15 or older and rated 18 or older) to analyze how subjects react in situations where they actually watch movies. Following Table 1 provides details.

Each stimulus was edited and used in 1 minute and 30 seconds to fit the purpose of the study, focusing on the areas where sexuality was a problem in each movie.(Table 2, Fig. 1, 2, 3)

#### 4. RESULTS AND DISCUSSION

For measuring and analyzing brain wave reactions, EEG equipment records alpha, beta, and gamma wave responses of the subjects’ left and right frontal lobes, temporal lobes, and occipital lobes. The analysis produced four groups of female high school students, male high school students, female college students, and male college students. The analysis set each brain wave reaction as dependent variables and conducted a one-way analysis of variance (ANOVA). The results were pre-

sented significance of statistics at the 95% level, and the values presented represent the dominance of each waveform.

As for the sexual stimuli with rating of 12 years of age or older, statistically significant differences between the beta waves of the frontal left brain and the right temporal right brain were found (95% of the significance level). And the alpha wave of the frontal left brain and beta waves of the frontal right brain were found to have failed to meet the



Fig. 1. Experiment Clip: Be my pet(12+).



Fig. 2. Experiment Clip: S-Diary(15+).



Fig. 3. Experiment Clip: Sex is zero 2(18+).

Table 1. Experiment Stimuli

Title	Release Date	Running Time	Rating
Be my pet	2011. 11. 10	110 min	12+
S-Diary	2004. 10. 22	104 min	15+
Sex is zero2	2007. 12. 12	115 min	18+

Table 2. Experiment Clip Content

Title	Content
Be my pet	Man takes off his pants in front of girl while takes shampoo
S-Diary	Man and woman take bath together in bathtub
Sex is zero2	Side view of naked woman and man while they have sex

significant levels by an approximate difference of 0.6. As shown in Table 3, significant differences were found in the beta-wave reactions of subjects' frontal lobes ( $F=2.96, p<.05$ ). Female high school students ( $M=18.3, SD=15.51$ ) had the strongest beta-wave response in their frontal lobes, followed by male college students, female college students and male high school students.

The beta-wave reactions of right temporal lobes were also found to be significant ( $F=3.93, p<.02$ ). Female high school students ( $M=24.84$  and  $SD=9.5$ ) showed the strongest beta-wave response, followed by male college students, female college students and male high school students (Table 4).

It seems reasonable that the beta wave response of high school girls is the highest in the audience rating of 12 years and older compared to other groups. This is because the stimulus is the least level of sexuality, which can be a high response from a group of female high school students who are younger and pure than other group. This could be a trivial stimulus for a group of college students or high school boys.

As for the sexual stimuli with rating of 15 years of age or older, significant differences between groups were found in the occipital right hemispheres and the occipital left hemispheres. As shown in Table 5, the subjects' gamma reactions

in the occipital right brain were strongest among male high school students ( $M=11.83, SD=3.09$ ), followed by female college students, male college students, and female high school students. (Table 5)

A significant difference was also found in gamma responses in the occipital left hemisphere, with the strongest response from male high school students, followed by female, female, and male college students. (Table 6)

The highest gamma-wave response among high school students compared to other groups in the rating of 15 or older is analyzed also reasonable. Because its sexuality level is somewhat high, so one can expect the strongest response from the group of male and female high school students who have high sexual curiosity. And the response was also from gamma waves, which mean a very strong concentration than beta waves, which are normally concentrated, and alpha waves, which mean concentration and stability.

Meanwhile, group differences were found at the level of statistical significance level .06 in the frontal left alpha wave, frontal left beta wave, and occipital left gamma wave, as for the sexuality level of 18+ stimulus. In the case of alpha-wave responses in the frontal left alpha wave of the subjects, female high school group were the strongest, followed by female college students, male college

Table 3. Beta-wave of Frontal Left Lobe(12+ Stimuli)

Group	Mean	SD	F	P
Female College	7.37	11.38	2.96	.05
Female High School	18.3	15.51		
Male College	3.69	10.18		
Male High School	1.17	0.81		

Table 5. Gamma-wave of Occipital Right Lobe(15+ Stimuli)

Group	Mean	SD	F	P
Female College	10.54	3.60	4.07	.02
Female High School	6.0	3.98		
Male College	7.61	3.25		
Male High School	11.83	3.09		

Table 4. Beta-wave of Temporal Right Lobe(12+ Stimuli)

Group	Mean	SD	F	P
Female College	15.6	8.29	3.93	.02
Female High School	24.84	9.5		
Male College	20.31	10.6		
Male High School	9.74	4.19		

Table 6. Gamma-wave of Occipital Left Lobe(15+ Stimuli)

Group	Mean	SD	F	P
Female College	8.46	1.12	4.94	.01
Female High School	7.0	4.30		
Male College	6.96	5.27		
Male High School	14.23	4.46		

students and male high school students. In the case of beta waves in the left frontal lobe, male high school students showed the strongest response in reverse order to alpha waves.

## 5. CONCLUSION AND SUGGESTION

As with the arguments presented in previous brain wave studies, the EEG response analysis for sexual stimuli has not yet shown fully consistent results with the response results by regions of the left and right brain, frontal and occipital lobes, and temporal lobes. Also, the dominant wave types, such as alpha and beta waves and gamma waves, did not fully match the existing results. But this is very similar to previous studies that show brain waves has individual differences and have characteristics that are difficult to standardize. In other words, it can be assumed that using brain waves as a measure of movie rating requires a larger number of subjects' samples and that greater amounts of brain wave response DB construction and long-term research should precede.

Nevertheless, the results of this experiment found a partially consistent significant difference in the sexual content. For example, the lower the sexual openness or sexual tendency previously held by the subjects, the higher the brain wave response to the low-age viewing rating, and the higher the sexual openness held by the subjects, the stronger the response of the higher frequency band.

The highest beta-wave response among young female students compared to other age groups, even with such low ratings (rated aged 12 or older), could be a reason why the existing video rating system should be supplemented. This is because research shows that teenagers do not get excited or react to sexual sensitivities unconditionally.

Also it is time for video content produced and distributed through various channels such as the Internet, SNS and YouTube. Now the whole con-

tent can't be rated and restricted by people. The system of rating film by several rating members cannot isolate young people from harmful images anymore.

As the results of this study show, the brain wave response to the sexual content showed the possibility of distinguishing gender and age differences. The apparent differences in brain wave response areas and bands among high school girls, high school boys, and college students are found. And the table below summarizes the validity of differences between right and left hemispheric and brain wave frequency areas. Reflecting these differences, it is expected that further experiments in the future will enable the design of video classification algorithms if more subjects are established with age-specific, gender-based brain wave response data.

In other words, we could configure a sexual content classification scale with age or gender as a discriminating variable and brain region-specific response frequencies (left/right, frontal/temporal/occipital, alpha/beta/gamma waves) as independent variables. Based on the results of the above EEG response analysis, the scale components can be summarized as follows. (○=valid, △=moderate, X=invalid)

As shown in the Table 7, beta waves of the frontal lobe show a difference in response to stimuli, and the left hemisphere dominance shows more activity. For temporal lobe, the remaining data except right brain beta waves were excluded. For the occipital lobe, only gamma waves were statistically significant, which could be interpreted as induced by a strong stimulus because the brain region that produces image recognition is the occipital region. The gamma waves of the frontal lobes and alpha waves of the temporal and occipital lobes were analyzed to be weak in relation to the sexuality classification.

This study explored the potential of neuro-scientific measurement of age-specific responses to

Table 7. Sexuality Classification scale summarize based on EEG

Brain Area	Brain Wave	Validity
Left Frontal Lobe	Alpha	△
	Beta	○
	Gamma	X
Right Frontal Lobe	Alpha	X
	Beta	△
	Gamma	X
Left Temporal Lobe	Alpha	X
	Beta	X
	Gamma	X
Right Temporal Lobe	Alpha	X
	Beta	○
	Gamma	X
Occipital Lobe	Alpha	X
	Beta	X
	Gamma	○

sexual content and apply it as a film rating scale. Further research in the future will provide more scientific standards for classifying sexual content. And if scientific understanding tools are developed for various conflicts surrounding film classification, which is a major social and national problem, it will help prevent controversy over video rating judging.

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