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A Study on the Human Response of Pencil Writing Sound in ASMR

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Abstract: Means autonomous sensory meridian response which makes the mind calm by the five senses. Among them, ASMR using sound refers to healing sound which makes the mind comfortable as sound. In particular, the ASMR sound presents pleasure as well as comfort to those who are psychologically disturbed or want to be comforted in any way. The sound of ASMR has been variously excavated as a quieter sound like a squat or whispering sound. In this study, we study about pencil writing sound among ASMR sound. The writing of a pencil is one of the typical sounds of ASMR sound. As a result of the study, the sound of writing with a pencil shows a sound component in which the low frequency band and the high frequency band are balanced with each other around 1.500 Hz. The EEG test results showed that the delta wave and theta wave were activated inducing the psychiatric body to rest state. The results of the MOS test and the interview showed that many people think that the sound of writing with a pencil seems to cleanse the mind and relax the mind. Through this study, it has been proven that the fricatives of charcoal and study repeatedly calmly and repeatedly have a relaxing effect on people and a calming effect on their minds.

Key words: ASMR, healing sound, mind comfortable, pencil writing sound, relaxing effect, calming effect

INTRODUCTION

Modern people are exposed to various tasks and are always exposed to fatigue and stress. The reason for this was the competition based on the flood of information obtained through the multimedia environment based on digital and various communication exchanges. Especially, in the course of the industrialization and modernization of society, the intensified competition between countries, societies and individuals is making people feel nervous and impatient at all times. This impatience leads to irritability and eventually increases the drinking and smoking population. Drinking and smoking can make the body sick but stress also makes the mind sick. So, from now on, modern people are interested in physical and psychological health. Modern people like healing and comfort as if they miss their warm and soft words and touches. The reason why many people are having a drink or club activities or hobbies after work with their colleagues is also a way to comfort themselves and reward themselves. In the process, ASMR has emerged and ASMR ultimately aims to heal through the satisfaction of the five senses. Among them, ASMR which focuses on sound can be said to be a method of self-hearing. While it is not exactly what ASMR originated by when and by whom, the time when the world began to gain popularity is quite old. The evidence suggests that related videos are floating around on YouTube. In this study, we will try to demonstrate the effect of ASMR sound by studying the human body's response to the writing with a pencil among the ASMR acoustics which is becoming more and more popular now a days. To record the sound for research, we recorded a pencil writing sound in a quiet studio booth using a digital condenser microphone that can guarantee fine recording quality. The recorded sound was analyzed by acoustic analysis tool. To investigate the effect of pencil writing on the human body directly, EEG was measured and MOS test was performed on about 50 subjects (Andersen, 2015; Smith *et al*., 2017).

What is ASMR? ASMR is an acronym for Autonomous Sensory Meridian Response and is recorded in the glossary as a term referring to sensory experience of psychological stability or pleasure in response to visual, auditory, tactile, olfactory or cognitive stimuli have. Among them, auditory ASMR sound has been used all over the world for decades as part of psychotherapy using sound. Since, 2010, the term has come to be known as ASMR in the United States or Australia and is sometimes referred to as "whisper therapy". Various ASMRs are introduced in Korea through podcasts and YouTube. In Korea as well as well-being and well-dying as well as new words such as healing and work and life

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balance are emerging economically and psychologically, there is much room for life. ASMR enthusiasts also express the stimulus that makes ASMR feel the term ASMR trigger. The MOS common trigger of ASMR, sound can be judged to be a kind of small, repetitive, fresh stimuli. For example, a whispering voice, a scratching sound or a "fussy" sound can be said to trigger the ASMR sound. Some people feel a small tapping of something or a paper-triggering sound, some feel the trigger of natural sounds like rains, winds and waves. Among them, those with a passion that is very unique to ASMR sound create a sound similar to the ear-picking sound, develop a new ASMR sound and record such sounds in various angles from a variety of microphones, making it a 3D sound and uploading it to YouTube. ASMR Sound Trigger YouTube videos set up various situations and made role-plays, so that, they evolve like images for psychotherapy using music or sound. However, the effect on ASMR has not been scientifically proven and there are some controversies due to differences in auditory responses depending on the individual (Campo and Kehle, 2016; Young and Blansert, 2015).

MATERIALS AND METHODS

ASMR sounds are endless. There are various sounds such as strong sound, soft sound and whisper. However, sound that is classified as noise in the sense of common sense can not belong to ASMR sound. It should sound as comfortable as possible. The MOS common feature of ASMR sound can be judged to be small, repetitive, freshly stimulating sounds. From this point of view, in this study, we decided to study the sound of pencil writing which is a typical sound among ASMR sounds. In this study, we analyzed the acoustic characteristics of the ASMR sound which is the sound of the pencil writing and examined how the human body reacts to the sound of writing the pencil. The components of the pencil writing sound were analyzed through the acoustic analysis and the human response was analyzed through brain wave analysis, MOS test and interview (Fredborg *et al*., 2017; Gallagher, 2016).

Acoustic analysis of pencil writing sound: Acoustic analysis is based on three elements of sound. Acoustic analysis includes time domain analysis, spectrogram analysis and spectrum analysis. The time domain analysis analyzes the size and continuity of the sound, the spectrogram analyzes the energy by the pitch of the sound and the spectrum analyzes the characteristics of the tone by frequency band. A tool for acoustical analysis of pencil writing used Adobe's audition program. The size and continuity of sound are analyzed by time domain waveform, sound component and energy by spectrogram, distribution of sound band by band and overall frequency characteristic by spectrum. The analysis of these frequency components uses the FFT concept to obtain the results.

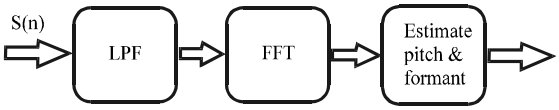

Fig. 1: FFT diagram for obtaining sound information

Figure 1 is a diagram of the process of digitizing an analog sound signal by Fast Fourier Transform (FFT). As a first step in digitizing an analog signal, a Low-Pass Filter (LPF) is performed to pass a low-frequency signal while filtering out a large amount of noise at a high frequency. Next, the sound signal is transformed, so as to be easy to analyze by using fast fourier transform. Through such a process, we provide a basis for analyzing pitch and formants of acoustic frequencies (Ahn *et al*., 2017, 2018a, b; Bae *et al*., 2017).

Time domain analysis: For the acoustic analysis of pencil writing, we analyze the size and continuity of pencil writing sound analyzed by time domain analysis. We have derived a time domain graph of pencil writing among ASMR sounds. In the time domain graph, the energy of the pencil writing sound components was analyzed and the continuity and continuity were analyzed:

$$\text{Time}_{\text{energy}} = \frac{1}{N}\left[\sum_{n=1}^{N}\left(E_1(n) - E_2(n)\right)^2\right] \quad (1)$$

Equation 1 is the energy obtained in the time domain. Figure 2 is a time-domain graph of pencil writing. In the time domain graph of pencil writing, we can see that the thin solid line is continuous. The thin solid line indicates that the size of the sound is small and continuous. In other words, the sound of pencil writing is a continuous, whispering sound. In this way, the writing of pencil writing is analyzed as being able to relax the mind with the sound of concentration without being irritating (Bae and Bae, 2017; Barratt and Davis, 2015).

Spectrogram analysis of pencil writing sound: We analyzed spectrogram graphs to analyze sound energy for pencil writing sound. In the spectrogram analysis method, the pencil writing sound is digitally converted data El(n)

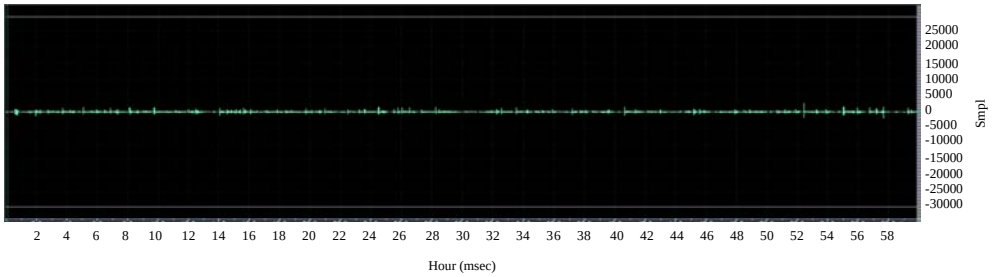

Fig. 2: Time domain graph of pencil writing sound

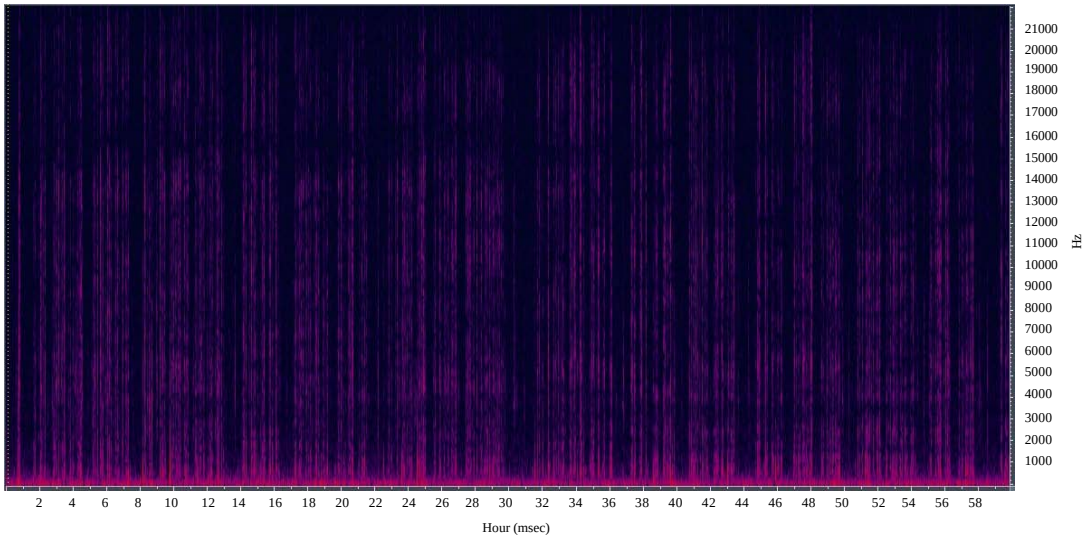

Fig. 3: Spectrogram graph of pencil writing sound

and the energy value of sound information is called E2(n). The energy of each frequency component was measured by the following Eq. 2:

$$\text{Time}_{\text{energy}} = \frac{1}{N}\left[\sum_{n=1}^{N}\left(FE_1(n) - FE_2(n)\right)^2\right] \quad (2)$$

The difference of each frequency component was analyzed by the above equation and the sound energy was measured. Equation 2 is a formula for converting the sound information into data.

Let, FE1(n) be the data after frequency conversion of the input sound and FE2(n) be the FFT conversion value of the sound. The information of each sound was measured by the following formula.

Figure 3 shows the spectrogram graph of pencil writing sound. The thin and long graphs are arranged closely like a rainy figure. The reason why pencil writing is represented by thin, dense vertical line graphs is that pencil writing has a quiet and fine sound characteristic. The pencil writing sound component has a strong frequency energy below 1.500 Hz and evenly distributed energy in the frequency range above 1.500 Hz. The sound of low frequency area of pencil writing comforts the mind of the person and the sound of the high frequency region delicately stimulates the mind of the person and makes the whole body feel the sound.

Spectrum analysis of pencil writing sound: Through the spectrum analysis of pencil writing sound, we investigated the distribution of frequency and the characteristics of sound components. Spectrum analysis shows how the pencil writing sounds are displayed in the audible frequency band and in what type of frequency band:

$$D_{LS} = \sqrt{\frac{1}{2\pi}\int_{-\pi}^{\pi}\left[10\log_{10}\frac{p(\omega)^2}{\hat{p}(\omega)}\right]^2 d\omega} \quad (3)$$

Where:

$P(\bullet)$ = Original signal

$\hat{P}(\bullet)$ = Created signal

Equation 3 is a formula for measuring the spectral distinction using log-spectral distance. Figure 4 is a

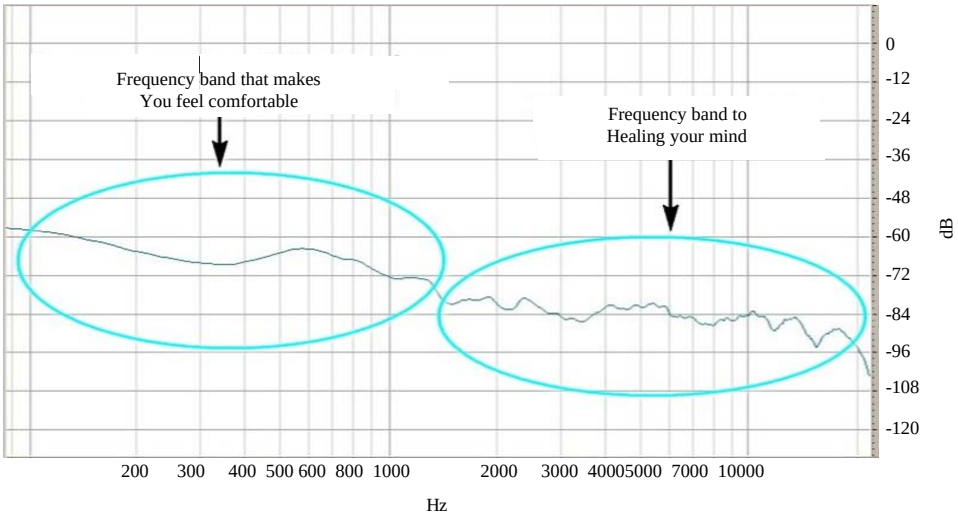

Fig. 4: Spectral graph of pencil writing sound

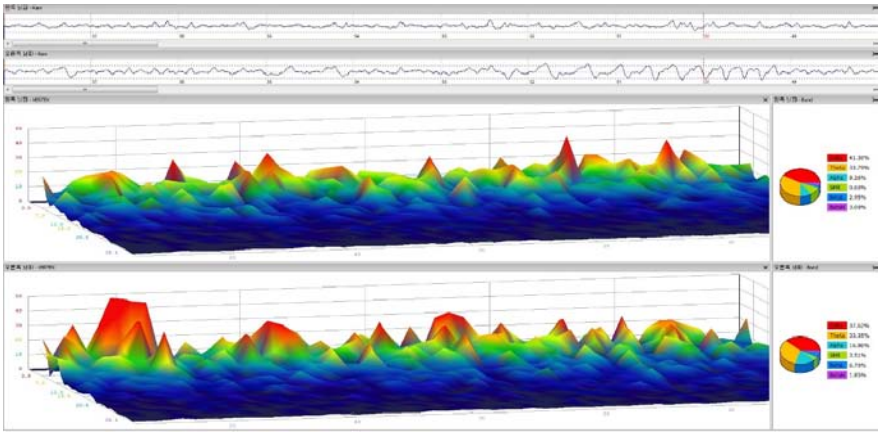

Fig. 5: EEG of after listening to pencil writing sound

spectral graph of pencil writing sound. In Fig. 4, it is divided into two areas starting from about 1.500 Hz. Generally, the sound of low frequency band covers the entire skin of the human body and propagates deeply inside the human body to transmit sound feeling to the internal organs. The sound of the high frequency band is transmitted to the brain and delivers rapid response to the mind. The frequency characteristics of pencil writing sound are as follows. Since, the sound in the low frequency band of 1.500 Hz or less forms a stronger frequency than the sound in the high frequency band of 1.500 Hz or more, it transmits comfort to the whole human body more strongly with the sound of the low frequency band and the high frequency band is comforted.

EEG analysis of pencil writing sound: We analyzed the psychological response through the analysis of EEG as part of the study on the human response characteristics of the sound of pencil writing. The left brain and right brain changes were measured by attaching an EEG reader to the frontal lobe and temporal lobe which were particularly sensitive to the sound response and the sound of pencil writing. Electroencephalogram (EEG) was performed by listening to a pencil writing to the recipient in a quiet space (Campo and Kehle, 2016; Grewe *et al*., 2007).

Figure 5 is an electroencephalogram graph measuring the brain waves of a recipient listening to pencil writing. Electroencephalogram (EEG) measurements of pencil writing indicate that both left and right brain delta and theta wave are higher than alpha beta waves. Delta waves and theta waves are stronger when they are at rest or when they sleep and alpha or beta waves are when they focus on work or when they are busy. The fact that

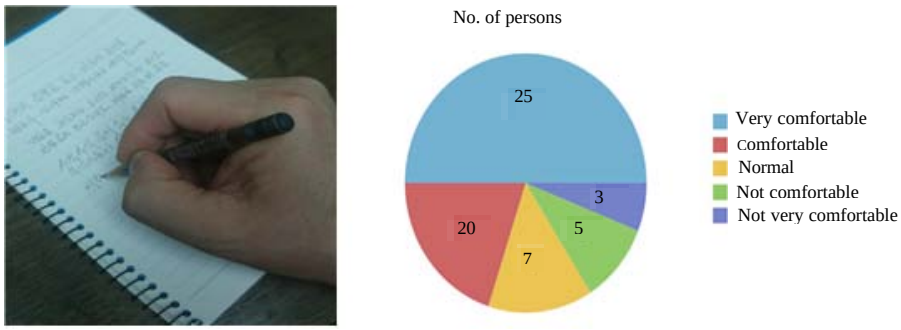

Fig. 6: The MOS test for the sound of pencil writing

Table 1: Interview summary of pencil writing sound

Feeling contents	Personnel	Evaluations
Whispering feeling	25	It feels comfortably comforting
Feeling small	17	It feels like writing a letter to someone
Rough scratching	8	Uncomfortable and uncomfortable feeling

delta wave and theta wave appear high in the EEG of the writing of the pencil writing sound seems to be the condition that the human body is healing comfortably both psychologically and physically Table 1.

MOS test of pencil writing sound: MOS test (Means Opinion Score Test) is a test that is used as an informal questionnaire mainly used for call quality test. MOS test is an opinion verification test that has been proven to be reliable by making it possible to present objective and sincere opinions even, if a small number of people are receiving the experiment. In recent year, it has been used to investigate the opinions of people in various fields (Raichle, 2015; Smith *et al*., 2017; Bae *et al.,* 2013).

In this study, we also used MOS test in the study of human response to the sound of pencil writing. The MOS test for the writing of pencil writing among the ASMR sounds was performed in a form that gathered the opinions of the listeners who responded to the sound of the pencil writing. For the MOS test, we surveyed 50 students about how the sound of pencil writing affects the human body. We also interviewed what they thought of when they heard the pencil writing sound. The MOS test of pencil writing as described in Fig. 6, said that 25 people received very comfortable response and 10 people felt comfortable. If you add 7 people to the fact that it was just normal, 42 people (80%) responded positively.

We interviewed to listen to the sound of pencil writing among ASMR sound. Interviews were conducted in a way that freely asked opinions from 50 people who conducted the MOS test. The answer is also that the pencil writing sound is a small, regular and constant sound, so, quietly the response of comfort to the heart prevails. The results did not deviate much from what was expected. MOS test of the answers showed the feeling of whispering, subconscious, epileptic, squashed, scratchy, calm and positive emotional state which made me feel relaxed and calm.

RESULTS AND DISCUSSION

To analyze more closely the reason why ASMR sound is attracted to modern people, we are studying various characteristics of ASMR sound by extracting one by one and analyzing it. In the first study, we studied pencil writing which is the most popular sound among ASMR sounds. The research was carried out through acoustic analysis, brain wave analysis, MOS test and interview. The pencil writing sound confirmed by the acoustic analysis was confirmed to be a small and continuous sound component. In other words, the sound of pencil writing is a continuous, whispering sound. In this way, the sound of pencil writing was analyzed as a result of being able to relax the mind with concentrated sound without stimulation. When viewed in the frequency domain, the characteristic of the frequency of pencil writing sound is that the sound in the low frequency band below 1.500 Hz forms a stronger frequency than the sound in the high frequency band above 1.500 Hz, so that, the sound in the low frequency band transmits comfort to the whole body more strongly and the high-frequency band is slightly subdued and comforting. Delta wave and theta wave were high in EEG of pencil writing sound. It shows that the human body is healing comfortably both psychologically and physically. In the results of the MOS test and in the interviews, there were many opinions that the sound of pencil writing was whispering and a feeling of being small and there were many positive evaluations. On the other hand, there were opinions that when a pencil

lead is rubbed against a paper with a small number of opinions, a rough scratching and repetitive sound is irritating to the ear. However, as previous studies have shown that most people are better at concentrating in white noise, the sound of pencil writing among ASMR sounds has received positive reviews for most people, except for those with sensitive personality.

CONCLUSION

The Autonomous Sensory Meridian Response (ASMR) or Whisper Community can be seen as the content that has begun to be created via. YouTube to heal people who have been hurt, lonely, depressed or angry by video or sound. In the meantime, a variety of YouTube has been created and tens of thousands of ASMR videos and sounds are being introduced and influenced by people online. Among them are ASMR content that is plausible and sympathetic but there are also a few outrageous and crude ASMR content. Therefore, we the audience of the audience, should select well, accept, appreciate and evaluate. In this study, we analyzed and verified various methods of pencil writing sound which is the most popular among ASMR sounds. Acoustic study, EEG test, MOS test and Interview were the research methods. The conclusion obtained through this research is that among the ASMR sounds, pencil writing sound is a small, constantly repeated sound that gives familiarity and comfort to those who listen. In addition, we can confirm that the pencil writing sound has the most popular sound component and the sensitive characteristic as ASMR sound. The fact that ASMR sound has attracted a great deal of attention from modern people shows that it is stressful for people to take social life. It would be most effective to use the appropriate ASMR to comfort your mind to your own psychological state. Although, ASMR sound is a sound, it does not directly affect the body like a drug or caffeine but I am afraid that if people rely too much on ASMR sound, they will become addicted. As ASMR sound has been proven to affect the body and mind of the human body, it is necessary to research, verify, secure and systematically manage various ASMR sounds by commissioning to medical institutions and sound research institutes in national, government. In addition, how to use ASMR users more effectively should be studied as well.

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