

Ambient Sounds and Subliminal Layering in Low-Fidelity Music

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ABSTRACT

Ambient sounds can generate emotional affective responses in listeners and are often used as “distortions” in Low Fidelity (Lo-Fi) music. To further explore Lo-fi music’s relaxing characteristics and the uses of ambient sounds as methods of relaxation and mental health improvement, the emotional affective nature of ambient sounds when used as the “distortions” in Lo-Fi music was focused on in this study. To accomplish this goal, auditory subliminal perception was integrated into the experiment. This study is the first study that relates subliminal perception and sound perception, in correlation with ambient sounds and the psychological effects they can have. Utilizing a pre-experimental research method with a within-subjects design, establishing each subject as their own experimental control, the experimental research study was administered through a series of surveys. The results derived point to the possibility that the ambient stimulus loses its individual emotion-inducing nature as it transforms, when subliminally embedded into a larger composition of music, into something like background noise. Through this study, a new field of research has opened for the scientific community and further research will no doubt yield much more promising results, opening another door to understanding human sound perception and its effects on emotion.

Literature Review

Lo-Fi music is a genre of music characterized by a music production littered with purposeful “imperfections” that create an authentic and innovative sound. In fact, the genre is named after these “imperfections,” the technical term for which is low fidelity sound, referring to distortions created in sounds via electronic reproduction (Winston & Saywood, 2019). Lo-Fi music involves various genres of music depending on the associated music styles used by producers, but this paper will primarily focus on Lo-Fi as a subgenre of Hip-Hop music. Lo-fi music is built upon “unquantized” rhythms and “sidechaining.” “Unquantized” refers to rhythms that hold no pattern or beat, whereas “sidechaining” is a technique in which one instrument’s or sound’s frequency results in the temporary lowering of another sound’s volume (D’Errico, 2015). In some cases, the sounds involved in these techniques are ambient sounds, rather than electronically produced distortions- though they are still referred to as imperfections and are sometimes run through software to create a slightly different sound quality than when heard raw. “Unquantized” rhythms and “sidechaining” are used synergistically to create more of a sensation through “imperfections”, aiming to trigger nostalgic feelings via unconventional sounds that can be associated with “memories of popular media which may have been consumed during, or at least associated with, a listener’s childhood, and simultaneously, with a vague, abstract longing for a past which the listener is fully aware never existed” (Winston & Saywood, 2019, p. 41).

This is possible due to music’s expressive nature in its ability to impress emotions in a given audience. An explanation for this characteristic is the Associationism Theory, outlining the idea that music’s expressiveness is a matter of conventional association of certain musical elements, such as slow tempo, with certain emotional states, such as sadness. Music, unlike the misrepresentational characteristics of the phrase, music is the *language of emotions*, is more of a

“sad face” than a “sad sentence,” according to Susanne Langer’s theory of the symbolism of music (Kania, 2017). In accordance with this, both these theories, in the case of Hip-Hop Lo-Fi music, there may exist a chain of symbolic associations between the elements of the subgenre and the imperfections used in the music that invoke the “reflective nostalgia” analogous to the triggering of childhood memories, regardless of their existence (Fritzsche and Boym, 2001).

However, with Lo-Fi music, the associations are sparked between the “imperfections” and the era or target feelings. Since this study will examine Lo-fi music in terms of the ambient sounds sometimes used in Lo-Fi music, any associations created must originate from the ambient sounds themselves. Ambient sounds can generate emotional affective responses in listeners through the associationism theory. For instance, birdsong may be correlated to various associations: personal associations such as “blackbirds and long summer evenings, or a link between a particular bird and a time or place from childhood,” or cultural associations that are “shared between many people through folklore and stories, often about events that are constants in one’s life” (i.e. “the swallow and the coming of summer, or the kookaburra’s laugh and the rising sun...”) (Ntcomms, et al., 2013). In terms of evolutionary associations, birdsong is connected to how humans have evolved to relate birdsong with safety from storms and predators, and as an indication of dawn, which also is associated with safety. Though such evolutionary origins may not directly apply to modern times anymore, birdsong maintains its effects as indicated by patients who listen to birdsong being able to de-stress before surgeries and treatments, and birdsong’s apparent ability to make certain dirty settings seem “fresh” (Winterman, 2013). In fact, natural sounds -like birdsong- have been found to have significant impacts on psychological stress relief, as they are often found to be the most pleasant to listen to and the most familiar to listeners, as established in the results of a study conducted on stress recovery in correlation to exposure to nature sounds, in contrast with high noise, low noise, and white noise (Alvarsson et al., 2010). Overall, these studies point to the idea that stress-relieving associations can be established for ambient sounds in particular.

The goal of this study is to examine the emotional affective nature of only those ambient sounds when used as the “distortions” in Lo-Fi music, with the knowledge that, via the associationism theory, ambient sounds on their own can invoke emotional affective responses, in addition to the implication that the distortions in Lo-Fi music, specifically, can also impact listeners.

In order to examine the effect of only the ambient sounds when submerged in another composition of music- as in the case of Lo-Fi music- subliminal perception, was integrated into the study. Subliminal perception is defined as “a technique of projecting information below the viewing audience’s threshold of sensation or awareness” by the Federal Communications Commission (Tristani, 2001). In allowing for information to be conveyed without the conscious awareness of audience members, it is one way to test the effects of only the ambient sounds in Lo-Fi if the ambient sounds are used as the subliminal stimulus, especially in relation to the memory triggering aspects of the sounds and the theory of associationism. This is because emotions may be triggered by associations that may be made with the subliminal ambient sounds without the subject’s awareness, which may confirm whether or not the subliminal stimulus or the masking music (the larger piece of music the stimulus is embedded in) is the cause of any emotional responses evoked, and if conscious awareness of the sounds is necessary for such associations to be made, confirming or refuting the memory-association theory characterizing Lo-Fi music. In order to use the ambient sounds as a subliminal stimulus, though, the sounds must satisfy at least one of the conditions of the “modified categorization of subliminal stimuli” as outlined by accomplished American Psychologist Benjamin B. Wolman as follows:

“The stimulus is:

1. Below the level of registration
2. Above the level of registration, but below the level of detection
3. Above the level of detection and discrimination, but below the level of identification
4. Below the level of identification only because of a defensive action” (Smith, n.d.).

For this study, stipulation number two will be implemented as it best aligns with the research goal. The stimulus' effect on subjects can be examined only when it can be detected and differentiated from the masking sounds, but the subjects should not be able to outright identify the stimulus to ensure the stimulus' subliminal nature. However, it is important to recognize that the FCC definition and Wolman's Criteria Model- along with all other sources on subliminal perception used in this study- are primarily directed as visual subliminal communication, and very little literature exists on auditory subliminal perception. Therefore, this study is founded on the assumption that the principles of visual subliminal communication apply to auditory subliminal communication, rendering the Criteria Model applicable to the auditory subliminal stimulus used in this study. Similar assumptions have been drawn between other sources of visual subliminal testing techniques and this experiment throughout the study.

The actual experiments of this study themselves are based on methods for testing subliminal perception, which are heavily rooted in introspection- an unreliable source of data. To counter such unreliability, a review of previous studies was conducted, and a select variety of tests were implemented into this experiment into a section titled Bias Countering Measures. Some of these tests are based on the operationalization of conscious perception, which states that if the subject is unable to distinguish between stimuli, they most likely had not perceived, consciously or unconsciously, the stimulus- an integral principle of the Forced-Choice Recognition test (Singh & Cole, 2013, pp 54-56). Furthermore, in previous studies some subjects report a response to their awareness of the stimuli that does not fall into the categories of complete nor absent awareness, which is actually ignored by researchers studying SP, however this is taken into consideration in this experiment via the Contrastive Analysis Test's Degrees of Clearness aspect (Ramsøy & Overgaard, 2004, pp 3-5).

As for the possible larger impacts of this study, since ambient sound have been linked to stress-relieving associations, if ambient sounds are revealed to have a valid effect on the emotional states of listeners via subliminal testing, then this would serve as a new theoretical explanation for Lo-Fi music's relaxing characteristics- due to its inclusion of ambient sounds as distortions. Furthermore, the uses of ambient sounds in Lo-Fi music as methods to aid relaxation and mental health improvement might be diversified, which might expand Lo-Fi's exclusive relationship with the younger American generation to include the majority of the population on the basis that it is a psychological, rather than social, factor that accredits Lo-Fi's popularity, speculated to be due to Lo-Fi music being a coping mechanism for the younger generations who possess stronger links to depression and anxiety (Wang, n.d. pp 14-15). Also, if this experiment yields results that confirm the ambient sounds' emotional affective nature, our understanding of subliminal perception will increase, and a new area of research into auditory subliminal perception will be opened to the scientific community.

Methodology

This study utilized a pre-experimental research method with a within-subjects design, establishing each subject as their own experimental control. This topic is highly subjective, and testing methods for this study's focal points were limited, relying heavily on introspection, so many bias countering measures were integrated to counter such restraints and weaknesses. Additionally, subjects were debriefed at the end of the survey, which allowed for the subjects to take the examination without interfering thoughts or predetermined inclinations. This can be considered deception; however, it is acceptable to this extent in this research setting.

The experimental research study itself, which was administered to the subjects via a Google forms document, is a survey composed of five parts. There are two versions of the survey, Survey A and Survey B, that use two different masking music pieces- Szklarek, J [Problems] and Lepine, S [Confidence Allure]. Both pieces are apparent opposites in their emotional associations established by their bpm (beats per minute) rates and the pitch of their note; "across cultures...high pitch is associated with friendliness or deference, whereas low pitch is associated with seriousness or aggression" and, therefore, music "transposed lower in pitch... are perceived as less polite, less submissive and more threatening" (Huron, 2015, pp 2-4). These associations will be experimentally established in CT1 (discussed later)

and will make sure experimental results are due to the subliminal stimulus and not due to the masking sounds themselves. These two pieces were also chosen, as they mimic contemporary hip-hop Lo-Fi masking music qualities, but without any other electronic distortions, ensuring faithfulness to Lo-Fi music exploration in correlation to only the subliminal stimulus. The surveys are identical, apart from the different masking music used, and the survey outline is included in Appendix A. Section two required the subjects to report their genders, ages, and ethnicities to account for any other trends or confounding variables, but this information will not be used for identification purposes. In the main examinations, the subjects rated their responses as positive or negative, and exciting or calm, a scale derived from a Canadian-Pygmie cross-cultural study similarly focused on music perception judgment (Egermann and others, 2015). The scale ratings of low and high arousal were changed to exciting and calm to avoid ambiguity and increase comprehensibility, especially due to the subjects being adolescents.

The last section of the survey integrated two bias-countermeasures. The Contrastive Analysis (CA) test required subjects to a) report whether the subjects believe a subliminal stimulus was actually administered (Degrees of Certainty (DC)), and b) rate their experience of the subliminal stimuli (Degrees of Clearness (DCI)) if they previously believed a subliminal stimulus was administered. The CA is based on signal detection theory- the idea that in order to perceive something, the stimulus must be sensed, and the subject must decide that they sensed the signal. This test was inspired by a Danish review evaluating a compilation of research methods on subliminal studies called "Introspection and Subliminal Perception," although the signal-detection theory connection comes from a combination of other research and personal knowledge (Ramsøy & Overgaard, 2004). The Forced Choice Recognition test asked subjects to choose the one clip out of three options that they believe corresponds to the subliminal stimulus used in the main examination, and, in forcing them to choose the sound they believed they listened to, generates results on whether the subjects actually heard the subliminal sound (Singh & Cole, 1985). Lastly, the subliminal sounds were produced by myself with the help of an expert, and run through multiple noise reduction and normalizing software to ensure the sounds are clear, audible, and recognizable, which accounts for additional confounding variables.

Three control tests were run in this study. The Pre-Control Test (PCT), administered face to face, asked a separate set of five subjects to list what they could hear in a clip with the subliminal stimulus, and then asked to identify anything they could hear in the background, when told something was embedded. This is to ensure that the stimulus was subliminal and above the threshold for human discrimination. Control Test 1 (CT1) established any initial associations that the sounds used in the study present, expecting the ambient sounds to be associated with stress-relieving characteristics and the masking sounds to be associated with completely different affects. Control Test 2 (CT2) ensured the subliminal stimulus' adherence to the third stipulation of Wolman's Criteria Model by asking any changes that may or may not have occurred between the masking sounds in the presence and then absence of the subliminal stimulus. The questions of CT1 and CT2 were open response. Responses were screened for similar words and phrases to generate somewhat standardizable results. Subjects' identities and ages were kept anonymous. There were no leading questions asked, and all questions asked required them to simply report what they could identify or reflect on what they heard. CT1 and CT2 test samples were close in age to the main experiment's samples, somewhat representative of the school's ethnic diversity, isolated from a Southern Pennsylvania high school student population, and had no prior exposure to the survey, myself, nor any aspects of the study. The sample population for PCT was less representative, as subjects were of a larger age range and ethnic orientation, as some were members of a local neighborhood. However, a nonverbal communication cross-cultural study stating that certain nonverbal sounds have the same emotionally and intellectually affective responses regardless of cultural and language differences- implies cultural diversity should not affect the results drastically (Sauter and others, 2010, pp 2409-2411). The survey outlines for only CT1 and CT2 are included in Appendix A. There is no outline for the PCT as it was administered verbally, face to face.

Control Tests and Individual Analysis of Data

From the PCT, all 5 participants were able to identify the subliminal stimulus (rain sound) only after being informed that a sound was embedded in the clip, confirming the stimulus is subliminally embedded yet still above the threshold of human discrimination. In CT1- the test to determine if the ambient sounds could be identified and if they and the masking sounds had any emotional-affective correlation. Out of 12 participants who were administered the test, all 12 were able to identify the ambient sounds as rainfall and reported the same affective response to the sound when inquired about how the sound made them feel via repetitive words like “calm,” “relaxed,” and “soothing” in their replies. This likely implies that associations between rain and such “calming” emotions were commonly made by the subjects may be due to social associations, as all the subjects were of various ethnic origins, yet shared the same social context, so their reporting of similar responses means that personal and cultural associations did not greatly impact their responses, rather than the social factor they all share. Furthermore, the responses to the questions asking subjects to describe how the ambient sounds made them feel were heavily littered with sensory details, suggesting that associations were made to sensory experiences, and is in support of the idea that the distortions in Lo-Fi invoke target feelings in audiences via association “memories of associated with a listener’s childhood, and simultaneously, with a vague, abstract longing for a past which the listener is fully aware never existed” (Winston & Saywood, 2019, p. 41). This quote is in relation to music aiming to invoke feelings of nostalgia specifically, however the overall concept that is posed by the quote is applicable to this scenario if the words “childhood” and “past” are interpreted as previous experiences with rain sounds. Thus, in this case, the rain sounds are triggering associations to sensory memories, real or not, which invoke the target feelings of calmness and relaxation. If the sensory memories are not real, then the sensory details are provided based on a collective social impression of rain and the ideal experience with rain, which ties the memory and social associations together. This is just a possibility that may be an explanation for the data observed, making such claims is beyond the scope of this paper, and further research is required to confirm. However, CT1 demonstrated the expected result with the initial hypothesis and associationism theory in mind, as in CT1, subjects are consciously aware of the stimulus and can actively make associations with it. As for the masking sounds, Confidence Allure was unanimously associated with a positive response with common words like “exciting,” “upbeat,” “hyped,” “happy,” and “enthusiastic” reported the most frequently. Problems were associated with more negative responses with words like “scared,” “fear,” “sad,” “eerie,” “suspenseful,” and “dark.” This again brings into consideration that social associations are the major associations that have been made in this test for the same reasons as previously stated. Overall, CT1 demonstrated the expected results, confirming that the ambient sounds can be identified as rain, and social associations can be made that gives the sounds’ stress-relieving, soothing effect on listeners’ emotional states, and that the masking songs themselves have an emotional effect on the listeners. CT2, on the other hand, which sought to examine whether the rain sounds- once subliminally embedded into the masking songs- could be identified to verify the sounds new subliminal natures, resulted in a large majority of participants (9 out of 10 participants) reporting a quieter, more subdued response to the sounds once the subliminally embedded ambient sounds were removed from the clips. This indicates satisfactorily to the second condition of Wolman’s Criteria Model chosen for this study, that the participants, though unaware that any changes had been made from the clip with the subliminal stimulus present (SP Clip) to the clip with the subliminal stimulus absent (SA Clip), and unable to outright identify the subliminal sounds, were able to detect and discriminate between the SP and SA clips as they were able to hear the difference in the music without the sounds in them. However, the majority reporting a “quieter” effect for the SA clip was not expected. With Lo-Fi music, the presence of ambient distortions was what some associations made were assumed to be based on, and with the data from CT1 supporting that a “calming” social or memory-based association can be made with a rain ambience, if associations were made with the subliminal stimulus- as is the premise of what this study is exploring- then a more calming affect would be expected from the majority in response to the SP clip rather than the SA clip. If the “quiet” affect from CT2 data were to be assumed as similar to a “calm” affect, then the data from CT2 implies that social or memory-based associations between the subliminal stimuli were either not made, or that an opposing association (i.e. the opposite of calm like exciting) to the subliminal stimuli was made, which would then more align with the data gathered. However, further research would

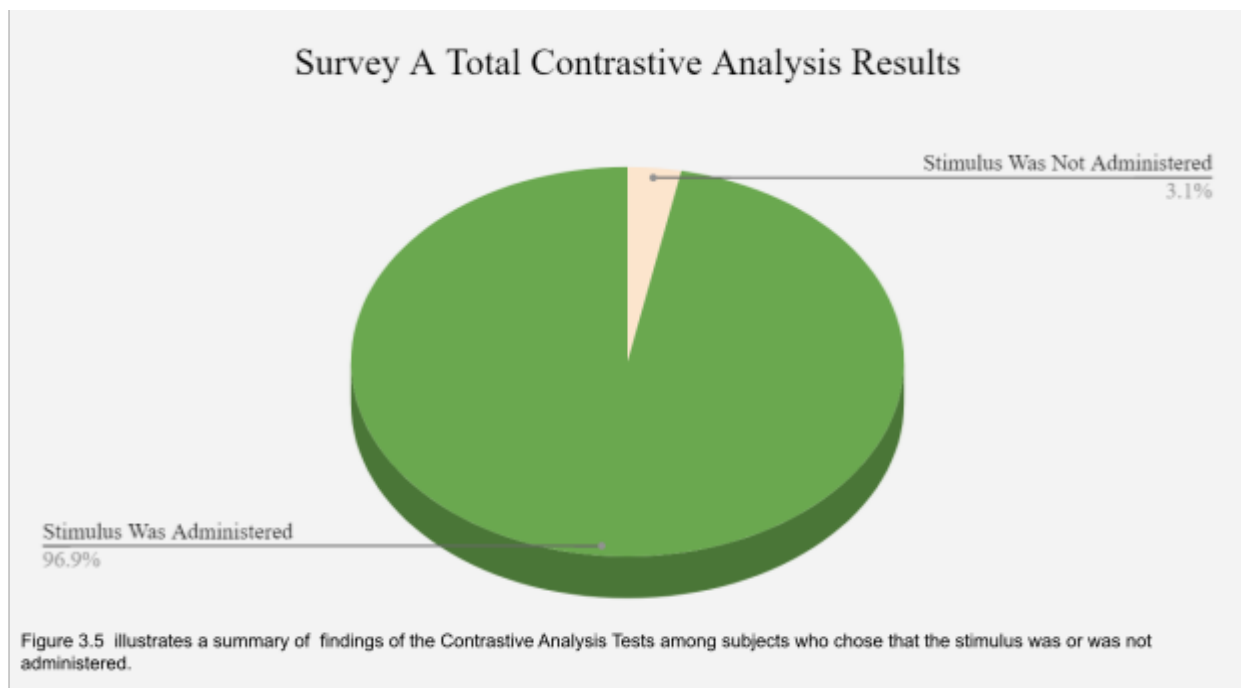
need to be conducted for such postulations to be confirmed or refuted and is beyond the scope of this study. The figures for both CT1 and CT2 can be found in Appendix B.

Main Examinations and Individual Analysis of Data

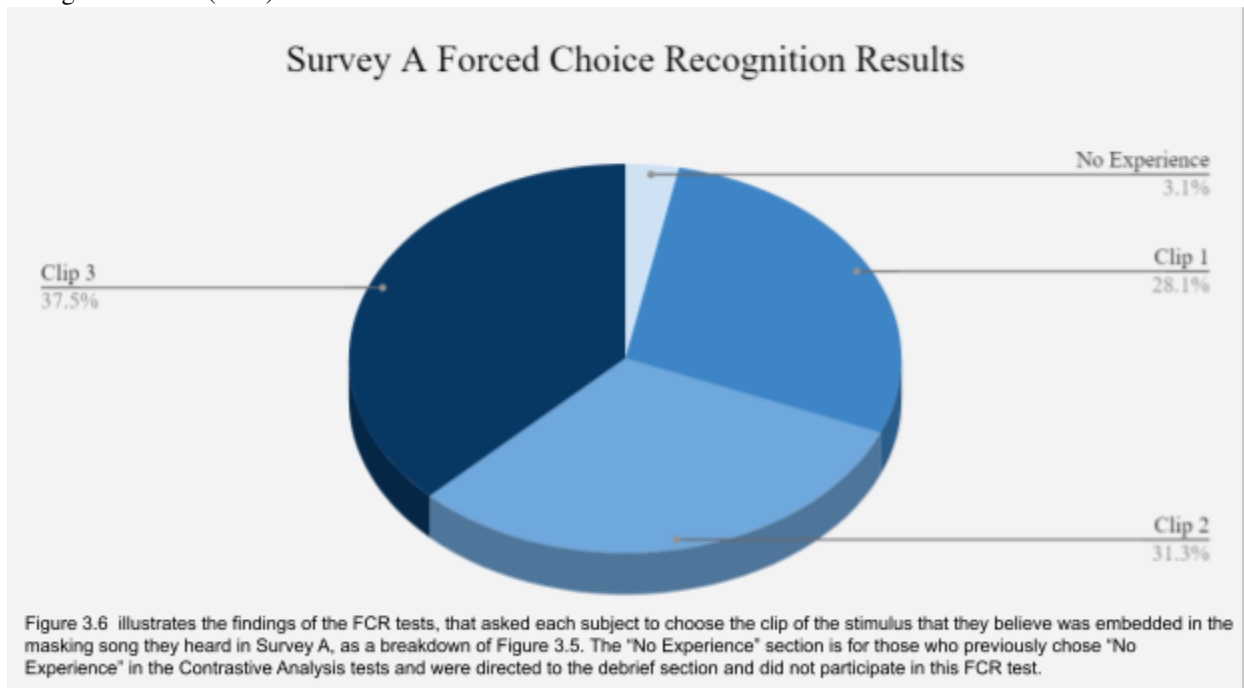
Interestingly, in both surveys A and B, there was a dramatic increase in the perceived calmness of the audio clips from examination 1 to examination 2 (SP clip to SA clip, respectively). In Survey A, there was a 250 percent increase from the initial 4 participants who initially claimed the audio clip sounded calm to a final 14 participants after the subliminal stimulus was removed. Similarly, in Survey B, there was a 186 percent increase. Both results imply that the subject perceived the SA Clip, as opposed to the SP clip, as more calming. At this point, in reference to the previous discussion of the CT2 results, the idea that associations that were made in CT1 are not being made in CT2 is further supported by the main examination data, contrary to the hypothesis that a calming association may still be able to be formed with relation to the same stimulus when embedded subliminally.

	CT2	E1- Calm	E2- Calm	Percent Change (Perception of Calm)
Survey A	90.00%	4	14	250% ▲
Survey B	90.00%	14	40	186% ▲

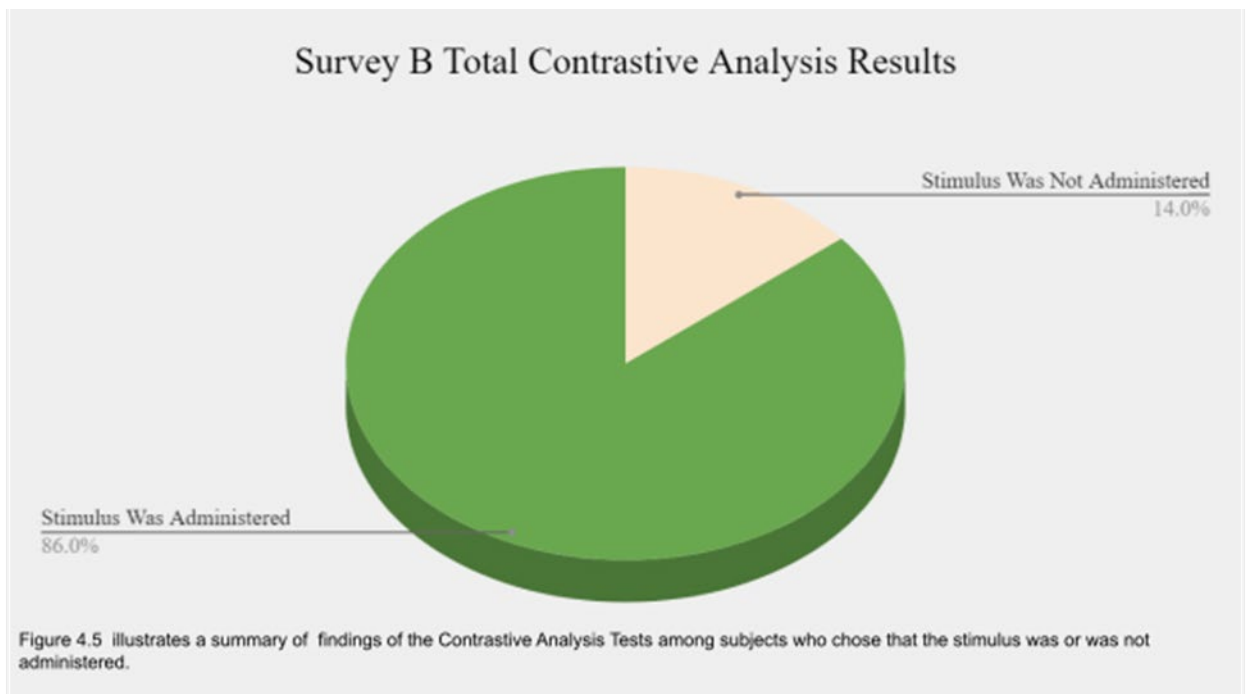
The Contrastive Analysis (CA) tests for Survey A resulted in 96.9 percent of subjects reporting that they believed a subliminal stimulus was administered, with 3.1 percent indicating that no subliminal stimulus was administered or that that had no experience of any stimulus had it been administered.

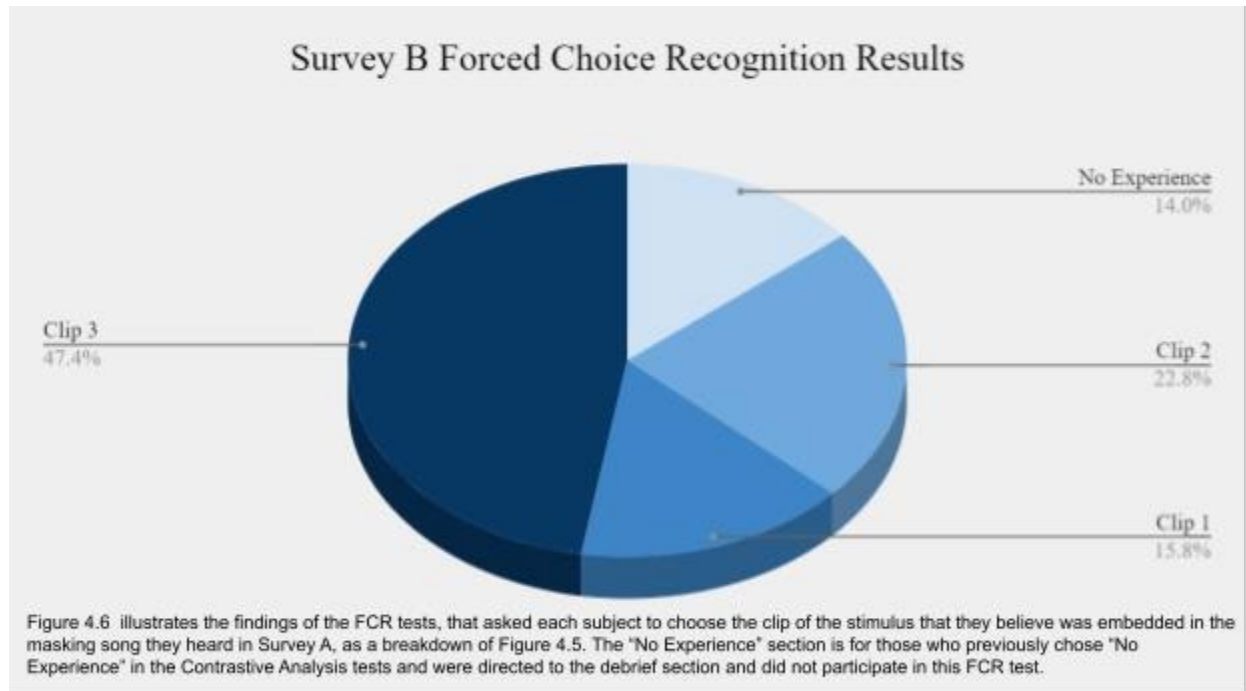


Of the 96.9 percent of subjects who believed a stimulus was administered, however, only 37.5 percent were able to identify clip 3 as the correct subliminal stimulus embedded in the song indicated by the Forced Choice Recognition Tests (FCR).



For Survey B, 86 percent of the subjects were able to notice that a subliminal stimulus was administered in the CA, and of that 86 percent, only 47.4 percent chose clip 3 in the FCR tests.





The percent of subjects identifying the correct subliminal stimulus is not significant, meaning there was no trend established that favored or disfavored the recognition of the subliminal stimulus used in the study. Subjects were almost equally likely to choose clips 1, 2, or 3 as the stimulus they believed was embedded in the masking songs. Should this data from the CA and FCR tests be taken into consideration alongside the developing idea that associations are not being established with the subliminal stimulus, then this data would appear to support the postulation that associations, both social and memory-based, can only be made when the stimulus they are supposed to be made regarding is presented to the subject above the conscious threshold and cannot be made with subliminal stimuli. This is because in CT1 when the stimulus was presented without subliminal embedment, "calming" associations were made, and the data from E1 and E2 of surveys A and B suggest that when embedded subliminally associations are not made or opposing associations are made. However, with the CA and FCR data it is clear that the subjects are not even able to identify the subliminal stimulus at all, which lends support in favor of the idea that associations are not made, given that should the case be that opposing associations are being made, then a trend would still be expected to be established with clip 3, the clip of the correct stimulus used in the FCR tests to suggest that they can identify and make an association, but the association made opposes the expected association.

Lastly, the collected data on ethnicities, gender, and age demonstrated no statistical significance when graphed, and were therefore excluded from this paper. This does not mean that there are no correlations that can be established with such variables and sound perception, rather it only indicates that no such relationship can be confirmed by this study. This is further addressed in the limitations section. Another, interpretation of the insignificance of data collected, is that the data attests to the idea that the perception of the music and stimuli used in the study is more dependent on social contexts and associations, rather than cultural or personal contexts- which would have demonstrated significant trends in correlation to age, ethnicity, and gender should this have not been the case.

Combined Analysis

As established in the individual analyses, the data collected in this study seems to point to the idea that no associations were established with the subliminal stimulus. However, this is contradictory to the fact that the stimulus can indeed be detected, as evidenced by CT2. At this point, to completely understand and analyze the data gathered, a question

arose: is it possible that associations are being established, but without the subliminal stimulus' identity playing a role in the associations? Researching this question led to the idea that the rain stimulus used may have somehow transformed when embedded subliminally, and the associations made by subjects to the transformed subliminal stimulus may have opposed the expected associations based on the hypothesis, which may have resulted in the different data trend observed in E1 and E2 of surveys A and B, with the CT1, CT2, and FCR tests taken into consideration.

The difference between music and noise, is that music is "experienced" because music is more than just the frequency or rhythm made by the sound, but also encompasses the emotion's it can invoke in those who listen to it (Reybrouck and others, 2019, pg.2). The ambient stimulus was confirmed to identify more as music than noise, as it evoked an emotionally

"calming" response from listeners on its own in CT1. However, in CT2, subjects reporting a more "quiet" and "subdued" response to the stimulus-absent clip not only indicates that they did indeed perceive the subliminal stimulus, but, in conjunction with the results of the main examination, might suggest that the subliminal stimulus lost its individual emotional-affective nature when embedded in the larger clip. When the songs chosen in this study were superimposed over the ambient stimulus, making it subliminal, its musical nature may have been transformed to identify as more like *background noise* that, when removed, made the song it was embedded in seem more "subdued" and "quiet." Subjects may have made associations to the stimulus, that may now be registered as background noise, that opposed the expected calm associations apparent in CT1. This is one possible explanation for the dramatic increase in calm ratings from the SP clips to the SA clips. The FCR data can also be interpreted to support this as it clearly suggests that the change in emotional response to the removal of the sound was not due to the identity of the subliminal stimulus as there is no significance demonstrated by the FCR data, which would align with the idea expressed previously if the changes in responses are actually due to a decrease in the opposing associations made with the background noise when background noise was reduced as a result of the removal of the transformed subliminal stimulus. What was discussed so far is just one plausible explanation for the data, however there is more supplementary information that supports such a conclusion.

Noise in general, has an affective response on people due to its correlation to mind-states. Quiet noise, that is a continuous sound without disturbances, allows people to enter tranquil mind-states and control them, whereas the opposite is true for "forceful" noise- louder, noncontinuous noise with disturbances- which will be termed the mind-state theory for ease of communication (Andringa & Lanser, 2013). If quiet is taken to be an "absence of disturbances," then the subliminal stimulus, when it was embedded, may have become a "disturbance" and lost its ability to allow listeners to enter a tranquil mind-state. So, the subjects may have demonstrated opposing associations to the transformed subliminal stimulus due to the disturbance the noise creates and its disruption of their ability to enter the tranquil mind-state. Therefore when removed, the perceived force of the masking song as a whole may have decreased to impress that "subdued" nature that the control subjects expresses- which aligns with the results of CT2- and reduced the opposing associations made by subjects as the transformed stimulus is removed, giving the SA clip the supposed ability to let the subject enter that tranquil mind-state when compared to the prior SP clip which would then seem louder and more forceful.

Conclusion

The initial goal of this study was to examine the effects of an ambient stimulus used in Lo-Fi music, to see if it could induce any emotional responses in people, especially in relation to the associationism theory and the memory-triggering characteristics of Lo-Fi music. The methodology that would allow for the testing of only the effect of one sound in the presence of another encompassing sound, like in the case of ambient sounds submerged in Lo-Fi music, seemed to be subliminal communication through a review of relevant literature. However, the results of this study have directly suggested that this is not the case. Further research has resulted in one possible explanation for the data gathered in this study, which postulates that the ambient stimulus loses its individual emotion-inducing nature as

it transforms, when subliminally embedded into a larger composition of music, into something like background noise. Should the tentative conclusion of this study be taken into consideration, then the initial inquiry of this study is not answered as the methodology was unexpectedly flawed. For the purposes of this study, with the tentative explanation in mind, a series of plausible conclusions that can be reached are that the subjects a) registered the subliminal stimuli, however as if it transformed into background noise, b) made opposing associations to the transformed subliminal stimulus, and c) when the subliminal stimulus was removed, the number of opposing associations were reduced, which via the mind-state theory, relates to the overall decrease of perceived force of the sounds experienced by the subjects, which is a plausible explanation for the increase in “calm” ratings from Examinations 1 to 2 in conjunction with the CT2 and FCR results. It is likely that in Lo-Fi music, because the ambient sounds used are not subliminal, listeners are able to be consciously aware of, clearly hear and identify, the ambient sounds without losing the overarching beat, allowing for associations, memory-based or social, to be made at all with the ambient sounds as referenced in Winston & Saywood. Again, due to the methodology of this study unexpectedly interfering with collection of significant data due to the unforeseen incompatibility of testing the associationism theory through subliminal stimuli, no definitive conclusions can be made. Though plausible analyses and conclusions were reached, they form only one possible explanation for the data derived from this study and require further research with slightly different methodologies and research goals to properly address the initial goal of this study, unveil other plausible explanations for data derived through the methodology of this study, or to confirm or refute the possible analyses and conclusions discussed. However, this study is the first study that relates subliminal perception and sound perception, in correlation with ambient sounds and the psychological effects they can have. As such, a new field of research has opened for the scientific community and further study will no doubt yield much more results, opening another door to understanding human sound perception and its effects on emotion.

Limitations

Subliminal perception used as the methodology, interfered with testing of the research goal. Another trial of this study could be run with the subliminal stimuli adhering to a different condition of Wolman’s Criteria Model. With the condition used in this study and if the possible explanation for the results is accounted for, then the subliminal stimulus’ transformation into background noise is a huge limitation as the initial research goal is completely disregarded. Future research with a different methodology might yield much better results with a better chance of yielding more significant results in response to the research goal. The Corona Pandemic also posed a huge limitation on this study as- due to electronic administration of tests- many responses failed to align with pre-written instructions, and very little responses overall were accounted for as few were able to, or interested in, participating in this study. Furthermore, standardized testing conditions could not be established. Sample wise, while many biascountering measures and other fail-safes were put in place to limit sources of bias, all cannot be accounted for and subjective experience of the content in the study varies by person, culture, race, etc. The Southern- Pennsylvania High School the subjects are sampled from do not display large cultural or ethnic diversity and are all of the same- or similar- social backgrounds. Therefore, trends that may have arisen if a larger, more representative sample were used, did not develop in this study. Though race, age, and gender were accounted for in this study to identify any potential trends or confounding variables, no significant data resulted, and no claims could be made regarding the effect of the aforementioned variables.

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References

- Alvarsson, J. J., Wiens, S., & Nilsson, M. E. (2010, March). Stress recovery during exposure to nature sound and environmental noise. Retrieved from <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2872309/>
- Andringa, T. C., & Lanser, J. J. (2013, April 08). How pleasant sounds promote and annoying sounds impede health: A cognitive approach. Retrieved from <http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3709327/>.
- D'Errico, M. (2015). Off the grid: Instrumental hip-hop and experimentalism after the golden age. In J. Williams (Ed.), *The Cambridge Companion to Hip-Hop* (Cambridge Companions to Music, pp. 280-291). Cambridge: Cambridge University Press. doi:10.1017/CCO9781139775298.026
- Egermann, H., Fernando, N., Chuen, L., & McAdams, S. (2015, January 07). Music induces universal emotion-related psychophysiological responses: Comparing Canadian listeners to Congolese Pygmies. Retrieved from <http://www.ncbi.nlm.nih.gov/pmc/articles/PMC4286616/>.
- Fritzsche, Peter & Boym, Svetlana. (2001). The Future of Nostalgia. *Slavic Review*. 61. 128. 10.2307/2696986.
- Huron, D. (2015). Affect induction through musical sounds: An ethological perspective. *Philosophical Transactions of the Royal Society B: Biological Sciences*, 370(1664), 20140098. doi:10.1098/rstb.2014.0098
- Kania, A. (2017, July 11). The Philosophy of Music. Retrieved from <https://plato.stanford.edu/entries/music/>
- Ntcomms, Says:, K., & Says:, N. (2013, January 09). What it says I don't know, but it sings a loud song: Reflections on birdsong, meaning, and place. Retrieved from <http://ntplanning.wordpress.com/2013/01/11/what-it-says-i-dont-know-but-it-sings-aloudsong-reflections-on-birdsong-meaning-and-place/>.
- Ramsøy, T. Z., & Overgaard, M. (2004). Introspection and subliminal perception. *Phenomenology and the Cognitive Sciences*, 3(1), 1-23. doi:10.1023/b:phen.0000041900.30172.e8
- Reybrouck, M., Podlipniak, P., & Welch, D. (2019). Music and Noise: Same or Different? What Our Body Tells Us. *Frontiers in Psychology*, 10. doi:10.3389/fpsyg.2019.01153
- Sauter, D. A., Eisner, F., Ekman, P., & Scott, S. K. (2010). Cross-cultural recognition of basic emotions through nonverbal emotional vocalizations. *Proceedings of the National Academy of Sciences*, 107(6), 2408-2412. doi:10.1073/pnas.0908239106
- Singh, S. N., & Cole, C. A. (1985). Forced-Choice Recognition Tests: A Critical Review. *Journal of Advertising*, 14(3), 52-58. doi:10.1080/00913367.1985.10672958
- Smith, L. (n.d.). Retrieved from <http://oregonstate.edu/instruct/soc499/cordray/media/sublmgs.html>
- Wang, J. (n.d.). Lofi hip-hop radio: Beats to relax/study to. Retrieved from <https://ojs.stanford.edu/ojs/index.php/theword/article/view/1705>
- Winston, Emma & Saywood, Lawrence. (2019). Beats to Relax/Study To: Contradiction and Paradox in Lo-Fi Hip Hop. *IASPM Journal*. 9. 40-54. 10.5429/2079-3871(2019)v9i2.4en. AP Research 17 Winterman, D. (2013, May 08). The surprising uses for birdsong. Retrieved from <http://www.bbc.com/news/magazine-22298779#>