Title
In and Out of Flow: Lo-Fi Study Beats and Their “Impactive” Qualities

Author
Tsai, Skylar

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Lo-Fi Study Beats and Their “Impactive” Qualities

Skylar Tsai

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Abstract

Investigating the linkage between Lo-Fi hip hop's audio qualities and listening behavior, the project seeks to understand study beats both in terms of their intrinsic, musical qualities and their position in Spotify listeners' everyday lives. Using digital and ethnographic methods, an analysis of three user-generated Lo-Fi study playlists was performed, complemented by a user questionnaire, to conjecture listening patterns and trends in musical engagement. Additionally interpreting listening as a parallel process to and intertwining exercise with non-musical activities, the project asks through what processes of appropriation on the individual level is Lo-Fi music made sufficiently capable of inducing flow.

Introduction

Lo-Fi hip hop, routinely crowned "best music to study to", is a musical genre named after its embrace of "low-fidelity" sonic features.[1] On top of the fuzzy audio and some misplayed notes, Lo-Fi music's steady tempo, trance-inducing loops, and gentle tunes have helped build its reputation as a sedative and concentration-aiding genre. Its popularity is evidenced by its omnipresence in hour-long study playlists across countless streaming platforms, amassing thousands of student and office worker followings. Studies in various psychology disciplines have been replicated to assess the threshold between music-as-blocking-out-noise and music-as-distractor, particularly when manipulating rhythmic complexity, mode, tempo, harmony, and the presence of vocals, and many have detected greater distraction effects for musics of greater sonic complexity.[2] More broadly though, experiments on the influence of music, including Lo-Fi hip hop, on individuals' cognitive performance has consistently produced mixed results, putting Lo-Fi's acclaimed efficacy to doubt.[3] This paradox–where Lo-Fi study beats can not only propel users into their flow state but also emerge as a disruptive entity–raises questions about how and why Lo-Fi possesses this duality, warranting a more nuanced

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[1] Emma Winston and Lawrence Saywood, "Beats to Relax/Study to: Contradiction and Paradox in Lo-Fi Hip Hop," *IASPM Journal* 9, no. 2 (2019): pp. 40-54, https://doi.org/10.5429/2079-3871(2019)v9i2.4en, 40.

[2] Adrian Furnham and Anna Bradley, "Music While You Work: The Differential Distraction of Background Music on the Cognitive Test Performance of Introverts and Extraverts," *Applied Cognitive Psychology* 11, no. 5 (1997): 445–55, https://doi.org/10.1002/(sici)1099-0720(199710)11:5<445::aid-acp472>3.0.co;2-r, 453.

[3] Arielle S Dolegui, "The Impact of Listening to Music on Cognitive Performance," Inquiries Journal (Inquiries Journal, September 1, 2013), http://www.inquiriesjournal.com/articles/1657/the-impact-of-listening-to-music-on-cognitive-performance; Franziska Goltz and Makiko Sadakata, "Do You Listen to Music While Studying? A Portrait of How People Use Music to Optimize Their Cognitive Performance," *Acta Psychologica* 220 (2021): p. 103417, https://doi.org/10.1016/j.actpsy.2021.103417; Roger Johansson et al., "Eye Movements and Reading Comprehension While Listening to Preferred and Non-Preferred Study Music," *Psychology of Music* 40, no. 3 (October 2011): pp. 339-356, https://doi.org/10.1177/0305735610387777.

explanation about intermediaries shaping the studying-listening experience.[4] In this case, listeners' musical experience may lie not only in the Lo-Fi tracks' formal elements but also in ways through which listeners selectively *appropriate* them, which in turn affect listeners' "styles of consciousness" and "modes of embodiment."[5]

The mutualistic relationship between Lo-Fi study beats and their listeners is unique in that, in branding Lo-Fi hip hop as study music, Lo-Fi study beats, more so than other "background music", are meant to be subjugate to the listeners' main, usually nonmusical, matter of concern (e.g., homework assignment). Though empirical observations showed otherwise, by this logic, musical engagement in the form of *impactive listening*–where music suddenly intrigues the listener, emerging from the subconscious, and prompts a listener to "[identify] and [source] it"[6] –should be resisted, because doing so implicates distraction from work. Research revealed that "stimulative music" –music with faster tempos, louder volumes, and more unsettling rhythms–is a more effective distractor than "sedative music", but these general findings' pertinence to Lo-Fi beats has not yet been ascertained.[7] Given this gap, the present study sought to address the question: To what degree are stimulative audio qualities associated with *impactive listening* among Lo-Fi study beats listeners? Considering there is no unanimity in deciding whether music is beneficial to concentration, an additional question was posed: How

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[4] Georgina Born, "Listening, Mediation, Event: Anthropological and Sociological Perspectives," *Journal of the Royal Musical Association* 135, no. S1 (2010): pp. 79-89, https://doi.org/10.1080/02690400903414855, 12.

[5] Tia DeNora, "After Adorno: Rethinking Music Sociology," *Cambridge University Press*, September 6, 2003, https://doi.org/10.1017/cbo9780511489426, 46-7.

[6] Matthew Flynn, "Accounting for Listening: How Music Streaming Has Changed What It Means to Listen" (Kinephanos, 2016), 12. https://livrepository.liverpool.ac.uk/3017665/1/Accounting%20for%20Listening%20Final%20Elementals.pdf.

[7] Carol A. Smith and Larry W. Morris, "Differential Effects of Stimulative and Sedative Music on Anxiety, Concentration, and Performance," *Psychological Reports* 41, no. 3_suppl (1977): pp. 1047-1053, https://doi.org/10.2466/pr0.1977.41.3f.1047, 1049.

can existing theories on musical *appropriation* provide an explanation for students' differential experiences with study music? In acknowledgement of past research on stimulative and sedative musics, it was hypothesized that, when acting as "study music", Lo-Fi tracks with which listeners interacted would be more acoustically stimulative than those that lacked listener engagement. Probing whether stimulativeness is associated with impactive listening can contribute to discourse on the fundamentals of music listening–what it means to listen and how much of the musical experience is dictated by *the musical agent*. Further, this paper presents a relevant case of how ubiquitous music may shape day-to-day listening, as an analysis of Lo-Fi's relational significance could speak back to current theories surrounding ubiquity and increased mindless listening.[8] Whether results concur or refute the hypothesis, a better understanding of Lo-Fi's study beats may help close the lacuna in the musicological discussion about study music, which remains scarcely written.

The Case Study

Study Overview

Three Lo-fi Spotify playlists were scrutinized to examine whether impactive listening can be attributed to how intrinsically stimulative a Lo-Fi track is. Rather than testing the hypothesis in a controlled experimental setting, the study employed digital methods to retrospectively analyze trends in user behavior. Spotify was selected as the target platform because the Spotify for Developers Application Programming Interface (API) grants users track-by-track breakdowns of audio features, which allowed the quantification and comparison of

[8] Anahid Kassabian, *Ubiquitous Listening: Affect, Attention, and Distributed Subjectivity* (Berkeley: Univ of California Press, 2013), xi.

stimulativeness in several categories: danceability, energy, speechiness, loudness, valence, tempo, acousticness, instrumentalness, liveness, mode, and more.

TABLE 1. *Spotify's Audio Features*

Audio Feature	Definition
Acousticness	A measure of how acoustic, or how little electronic manipulations there are in the music.
Danceability	A measure of how easy it is to dance to the music, based on "tempo, rhythm stability, beat strength, and overall regularity."
Energy	A measure of "intensity and activity" based on features like "dynamic range, perceived loudness, timbre, onset rate, and general entropy."
Instrumentalness	How little vocal content there is in the music. A track with high instrumentalness is likely to have no vocals at all.
Liveness	Level of audience presence. Higher score indicates "an increased probability that the track was performed live."
Loudness	The "primary psychological correlate of physical strength (amplitude)." Measured in decibels.
Speechiness	How saturated with spoken words a track is. A track with high speechiness will have mostly spoken words (e.g., rap), while one with low speechiness may be entirely free of speech (e.g., instrumental music).
Tempo	The speed of music, measured in beats per minute (BPM).
Valence	The degree of "musical positiveness", with high valence sounding more positive (happy, empowering, etc.) and lower valence sounding more negative (sad, angry, etc.).

Note: The Spotify API's "Get Tracks' Audio Features" endpoint returns more values than provided by the table. Included are features that were of primary interest to the current study.
Source: Definitions from Spotify for Developers, "Get Tracks' Audio Features," Accessed May 24, 2023, https://developer.spotify.com/documentation/web-api/reference/get-several-audio-features.

To better grasp how student Spotify users usually engage with study beats, an anonymous survey was also distributed to undergraduate students at the University of California, Los

Angeles (UCLA). The survey inquired students about their listening habits, whether they create and stream their own study playlists, and from where they typically acquire Lo-Fi tracks for these purposes. Following the audio and survey analyses, a discussion of Lo-Fi study beats in relation to theories about music listening was presented.

Operationalization of Variables

Impactive listening

Impactive listening, unlike mere active listening, warrants listeners to act on the music to enable future retrieval.[9] Some possible forms of impactive listening include saving tracks and learning the title of a track, the album name, or its artist. In this study, impactive listening was operationalized as the act of saving a Lo-Fi track to a study playlist. This decision was made with consideration of the data available for API request: Of particular interest was the timestamp when each track is saved to a playlist. The API does not grant access to hit rates or any other calculations of reaches, so track-saving was the primary and most observable indication of impactive listening. The *Track Selection* selection details how timestamps were used to discriminate non-impactive tracks from impactive tracks.

Stimulative Audio Features

As the project seeks to place different Lo-Fi study beats on the spectrum of stimulativeness, it was crucial to determine musical features that could dictate the tracks' position relative to one another. The quantification of stimulative qualities was made possible by referencing "Every Noise at Once", a platform that displays all musical genres recorded by The

[9] Flynn, "Accounting for Listening," 12.

Echo Nest, which is a music intelligence company now owned by Spotify. On "Every Noise at Once," an method of sorting genres is by "engagement" (see Figure 1), which uses audio features to rank genres according to how "acoustically distracting" their tracks are.

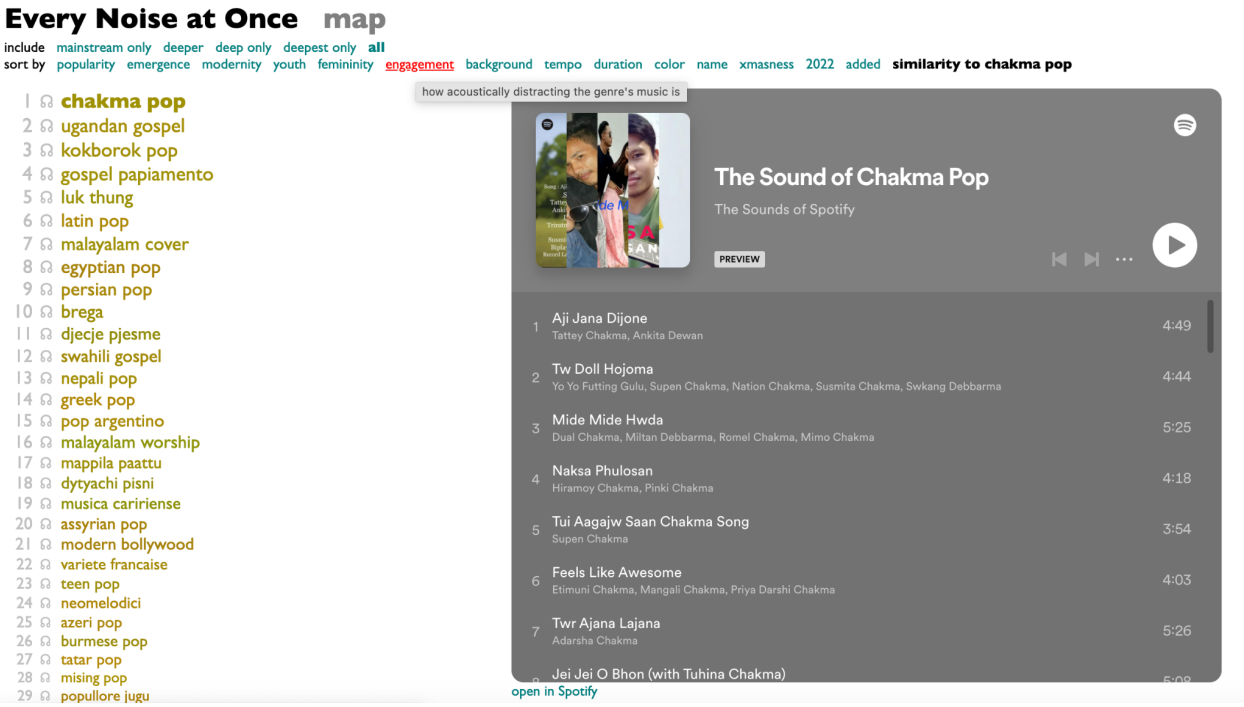

Figure 1. Every Noise at Once's "engagement" ranking ranks musical genres according to how acoustically distracting their tracks are. Clicking on a genre name shows a sample playlist and other similar genres.

For the ease of comparison, stimulativeness was defined as the quality of being "acoustically distracting."[10] A preliminary analysis of Chakma pop–the most acoustically distracting musical genre based on the ranking–was performed to quantify stimulativeness in terms of Spotify's audio ratings. Each listed genre on the website has a sample playlist. Hence, the sample playlist for Chakma pop, shown above, underwent analysis via the API endpoint "Get Tracks' Audio Features." When compared with tracks in the most-liked Lo-Fi study playlist

[10] Glenn McDonald, "Engagement Level Ranking," Every noise at once, accessed March 29, 2023, https://everynoise.com/everynoise1d.cgi?vector=engagement&scope=all.

(Lofi Girl's "Study Lofi"), tracks of Chakma pop were found to have significantly higher scores in danceability, energy, loudness, speechiness, valence, and tempo and lower scores in instrumentalness and acousticness. Under the hypothesis, Lo-Fi beats associated with track-saving behavior would have higher scores in the aforementioned six categories but lower scores in the remaining two.

Playlist Selection

In hopes of better gauging an ordinary user's listening habits, the objective was to acquire low discoverability, user-generated, non-editorial playlists. The process of playlist selection was as follows: Spotify's search page displays sixty-six genre categories (see Figure 2), each of which contains lists of playlists. A random study playlist subsumed under the "Student" category was identified.

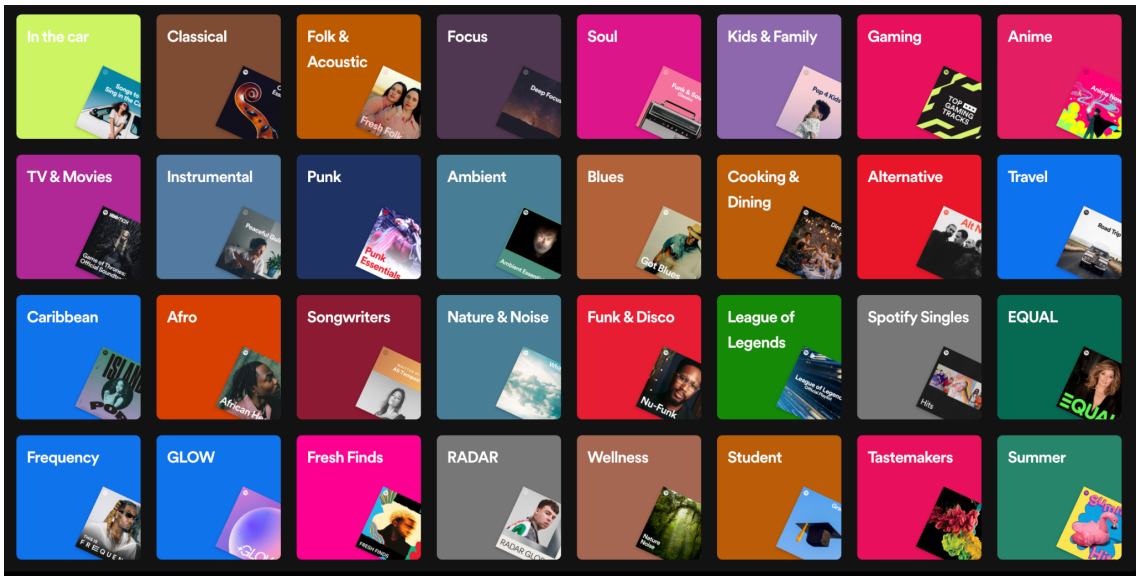

Figure 2. A snapshot of Spotify's list of genres. (Image by Author).

Then in said playlist, three tracks from three different artists were randomly selected. For each of these tracks, the corresponding artist's "Discovered On" section, which shows all playlists contributing to said artist's streams, was perused. The bottom ten playlists, having the least contribution to the artist's streams, were extracted, because those were assumed to have a lesser reach, and thus diminished discoverability, compared to extensively streamed, mass-consumed playlists. Then, playlists with like counts of more than thirty were excluded, leaving three user playlists, two with zero likes and one with one like. For the purposes of preserving user anonymity and for easy identification, said playlists were arbitrarily designated English alphabets and will be referred to as "Playlist A", "Playlist B", and "Playlist C" in the paper.

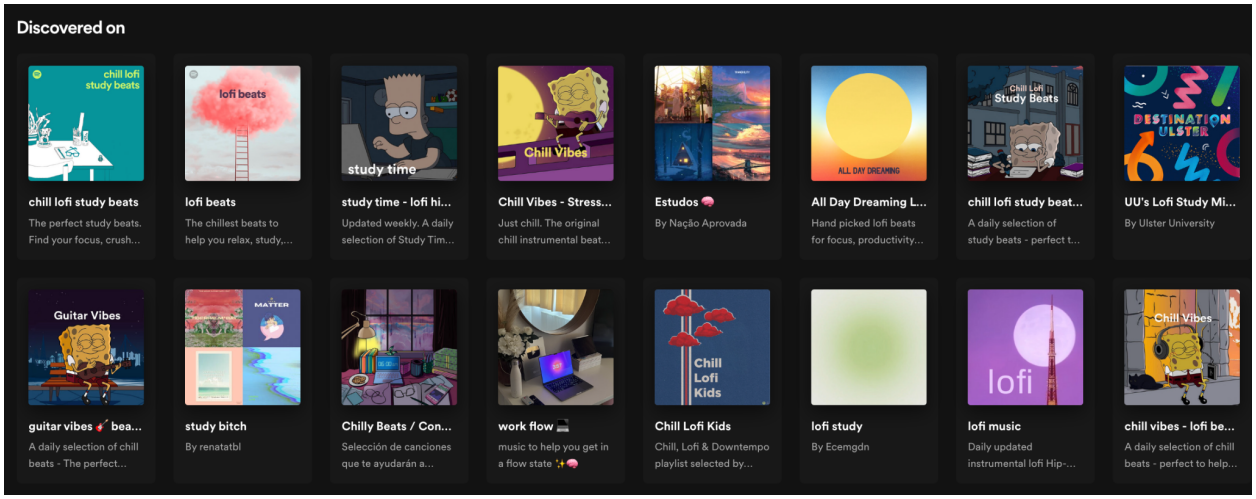

Figure 3. An artist's *Discovered On* section ranks all playlists in which said artist's tracks are featured. Playlists that contribute the most to the artist's streams are higher on the list. (Image by Author).

Track information for each playlist was obtained through the API endpoint "Get Playlist Items", which returns the track IDs and the timestamps when tracks were saved. Figures 4 and 5

are the JSON output of each API request. Finally, JSON data were converted into CSV files for analysis.

```
{
  "added_at": "2015-01-15T12:39:22Z",
  "added_by": {
    "external_urls": {
      "spotify": "https://open.spotify.com/user/jmperezperez"
    },
    "href": "https://api.spotify.com/v1/users/jmperezperez",
    "id": "jmperezperez",
    "type": "user",
    "uri": "spotify:user:jmperezperez"
  },
  "is_local": false,
  "track": {
    "album": {
      "album_type": "album",
      "total_tracks": 20,
      "external_urls": {
        "spotify": "https://open.spotify.com/album/2pANdqPvxInB0YvcDiw4ko"
      },
      "href": "https://api.spotify.com/v1/albums/2pANdqPvxInB0YvcDiw4ko",
      "id": "2pANdqPvxInB0YvcDiw4ko",
      "images": [
        {
          "url":
"https://i.scdn.co/image/ab67616d0000b273ce6d0eef0c1ce77e5f95bbbc",
          "height": 640,
          "width": 640
        },
        {
          "url":
"https://i.scdn.co/image/ab67616d00001e02ce6d0eef0c1ce77e5f95bbbc",
          "height": 300,
          "width": 300
        },
        {
          "url":
"https://i.scdn.co/image/ab67616d00004851ce6d0eef0c1ce77e5f95bbbc",
          "height": 64,
          "width": 64
        }
      ],
      "name": "Progressive Psy Trance Picks Vol.8",
      "release_date": "2012-04-02",
      "release_date_precision": "day",
      "type": "album",
      "uri": "spotify:album:2pANdqPvxInB0YvcDiw4ko",
      "artists": [
        {
          "external_urls": {
```


Figure 4. Requesting playlist information through "Get Playlist items." (Image by Author).

RESPONSE SAMPLE

```
{
  "audio_features": [
    {
      "acousticness": 0.943,
      "analysis_url": "https://api.spotify.com/v1/audio-
analysis/10hweQwWcUhBcpipYEvCYD",
      "danceability": 0.532,
      "duration_ms": 96005,
      "energy": 0.137,
      "id": "10hweQwWcUhBcpipYEvCYD",
      "instrumentalness": 0.824,
      "key": 3,
      "liveness": 0.0852,
      "loudness": -19.672,
      "mode": 1,
      "speechiness": 0.0648,
      "tempo": 89.346,
      "time_signature": 3,
      "track_href": "https://api.spotify.com/v1/tracks/10hweQwWcUhBcpipYEvCYD",
      "type": "audio_features",
      "uri": "spotify:track:10hweQwWcUhBcpipYEvCYD",
      "valence": 0.0732
    },
    {
      "acousticness": 0.861,
      "analysis_url": "https://api.spotify.com/v1/audio-
analysis/4o7SUrpCFLp5hlqPbDXfOO",
      "danceability": 0.526,
      "duration_ms": 122361,
      "energy": 0.535,
      "id": "4o7SUrpCFLp5hlqPbDXfOO",
      "instrumentalness": 0.86,
      "key": 4,
      "liveness": 0.413,
      "loudness": -8.515,
      "mode": 0,
      "speechiness": 0.319,
      "tempo": 150.357,
      "time_signature": 4,
      "track_href": "https://api.spotify.com/v1/tracks/4o7SUrpCFLp5hlqPbDXfOO",
      "type": "audio_features",
      "uri": "spotify:track:4o7SUrpCFLp5hlqPbDXfOO",
      "valence": 0.952
    },
```


Figure 5. Requesting track information through "Get Tracks' Audio Features." (Image by Author).

Track Selection

Since "impactive listening" involves listeners' sudden engagement with music while they are preoccupied by a non-musical task, the assumption was that tracks will mainly be saved independently and sparsely through time. Thus, by tracing the time each track was saved to the playlist, tracks that were saved in bulk were eliminated. Using these criteria, two raters identified the "impactive tracks" in Playlists A, B, and C. Table 2 is a summary table of the three playlists. With the endpoint "Get Tracks' Audio Features", impactive tracks underwent audio analysis for their danceability, energy, loudness, speechiness, valence, tempo, instrumentalness, and acousticness.

TABLE 2. *Playlist Information*

Playlist Name	Total Number of Tracks	Average Duration (s)	Number of Impactive Tracks
Playlist A	96	148.658	14
Playlist B	57	143.374	19
Playlist C	66	140.188	14

Method of Analysis

For each playlist, average values of the audio features were computed, yielding eight averages for non-impactive tracks and eight averages for impactive tracks. Since the sample sizes were small, distributions of each audio feature were evaluated to determine the appropriate statistical test. Based on an examination of the histograms and relevant statistical assumptions, the non-parametric Mann-Whitney U-test was used to test the average differences.

Results and Discussion

Audio Analysis of Spotify Playlists

Playlist A

Fourteen impactive tracks were identified and compared with fourteen randomly selected non-impactive tracks in Playlist A. Mann-Whitney U-test suggests that impactive tracks are not

statistically higher or lower in any of the hypothesized categories when compared to non-impactive tracks.

Table 3. *Descriptive Statistics Table for Playlist A*

	Group	N	Mean	Median	SD	SE
acousticness	NI_A	14	0.5693	0.6250	0.2885	0.0771
	I_A	14	0.641	0.6200	0.2704	0.0723
danceability	NI_A	14	0.6829	0.6600	0.1134	0.0303
	I_A	14	0.681	0.6750	0.1250	0.0334
speechiness	NI_A	14	0.0771	0.0750	0.0478	0.0128
	I_A	14	0.104	0.0600	0.1040	0.0278
energy	NI_A	14	0.4407	0.4000	0.1502	0.0401
	I_A	14	0.400	0.4100	0.1621	0.0433
instrumentalness	NI_A	14	0.7414	0.8350	0.2632	0.0703
	I_A	14	0.859	0.8800	0.0866	0.0231
loudness	NI_A	14	−10.5493	−10.9300	3.5368	0.9452
	I_A	14	−10.464	−10.4800	2.5498	0.6815
valence	NI_A	14	0.4050	0.3550	0.2152	0.0575
	I_A	14	0.382	0.2950	0.2500	0.0668
tempo	NI_A	14	107.4886	86.9700	36.5729	9.7745
	I_A	14	129.084	131.2700	42.8338	11.4478

Table 4. *Results of Mann-Whitney U-Test for Playlist A*

		Statistic	p
danceability	Mann-Whitney U	98.0	0.509
speechiness	Mann-Whitney U	97.5	0.500
energy	Mann-Whitney U	88.5	0.339
loudness	Mann-Whitney U	89.0	0.666
valence	Mann-Whitney U	83.5	0.260
tempo	Mann-Whitney U	64.0	0.943

Note. $H_a\ \mu_{NI\_A} < \mu_{I\_A}$

		Statistic	p
acousticness	Mann-Whitney U	87.0	0.315
instrumentalness	Mann-Whitney U	76.0	0.161

Note. $H_a\ \mu_{NI\_A} > \mu_{I\_A}$

Playlist B

Nineteen impactive tracks were identified and compared with nineteen randomly selected non-impactive tracks in Playlist B. Mann-Whitney U-test suggests that impactive tracks are not

significantly higher or lower in any of the hypothesized categories when compared to non-impactive tracks.

Table 5. *Descriptive Statistics Table for Playlist B*

	Group	N	Mean	Median	SD	SE
acousticness	NI_B	19	0.752	0.8100	0.1911	0.0438
	I_B	19	0.636	0.7100	0.307	0.0704
danceability	NI_B	19	0.683	0.6700	0.1189	0.0273
	I_B	19	0.631	0.6500	0.140	0.0322
energy	NI_B	19	0.329	0.3400	0.1449	0.0332
	I_B	19	0.344	0.3500	0.220	0.0504
instrumentalness	NI_B	19	0.662	0.8700	0.3793	0.0870
	I_B	19	0.690	0.8400	0.327	0.0750
loudness	NI_B	19	−12.887	−11.9400	4.1342	0.9485
	I_B	19	−13.597	−13.8800	3.876	0.8892
speechiness	NI_B	19	0.109	0.0600	0.0984	0.0226
	I_B	19	0.108	0.0500	0.134	0.0306
tempo	NI_B	19	92.881	84.0300	23.1350	5.3075
	I_B	19	106.479	103.9400	30.065	6.8973
valence	NI_B	19	0.486	0.5200	0.2419	0.0555
	I_B	19	0.284	0.2100	0.188	0.0431

Table 6. *Results of Mann-Whitney U-Test for Playlist B*

		Statistic	p
danceability	Mann-Whitney U	135.5	0.908
energy	Mann-Whitney U	177.0	0.547
loudness	Mann-Whitney U	135.0	0.910
speechiness	Mann-Whitney U	134.5	0.916
tempo	Mann-Whitney U	130.0	0.072
valence	Mann-Whitney U	86.5	0.997

Note. $H_a\ \mu_{NI\_B} < \mu_{I\_B}$

		Statistic	p
acousticness	Mann-Whitney U	145	0.153
instrumentalness	Mann-Whitney U	178	0.477

Note. $H_a\ \mu_{NI\_B} > \mu_{I\_B}$

Playlist C

Fourteen impactive tracks were identified and compared with fourteen randomly selected non-impactive tracks in Playlist C. Mann-Whitney U-test suggests that impactive tracks are significantly higher in danceability (p=0.005), speechiness (p<.001), and valence (p=.003) than

non-impactive tracks. However, there are no statistically notable differences between them in other categories.

Table 7. *Descriptive Statistics Table for Playlist C*

	Group	N	Mean	Median	SD	SE
acousticness	NI_C	14	0.7636	0.8750	0.2721	0.0727
	I_C	14	0.704	0.790	0.2738	0.0732
instrumentalness	NI_C	14	0.7964	0.8950	0.2388	0.0638
	I_C	14	0.837	0.890	0.1603	0.0428
danceability	NI_C	14	0.6300	0.6250	0.0861	0.0230
	I_C	14	0.733	0.730	0.1055	0.0282
energy	NI_C	14	0.2993	0.2650	0.1577	0.0421
	I_C	14	0.334	0.320	0.1751	0.0468
speechiness	NI_C	14	0.0757	0.0400	0.0879	0.0235
	I_C	14	0.154	0.115	0.0956	0.0255
tempo	NI_C	14	113.0186	127.0000	30.0775	8.0386
	I_C	14	110.014	91.070	36.2871	9.6981
valence	NI_C	14	0.2500	0.1500	0.2059	0.0550
	I_C	14	0.444	0.415	0.1907	0.0510
loudness	NI_C	14	−15.7093	−16.7150	5.5062	1.4716
	I_C	14	−12.351	−11.640	4.0960	1.0947

Table 8. *Results of Mann-Whitney U-test for Playlist C*

		Statistic	p
danceability	Mann-Whitney U	41.0	0.005
energy	Mann-Whitney U	90.0	0.365
speechiness	Mann-Whitney U	30.0	<.001
tempo	Mann-Whitney U	93.0	0.598
valence	Mann-Whitney U	38.5	0.003
loudness	Mann-Whitney U	64.0	0.063

Note. $H_a\ \mu_{NI\_C} < \mu_{I\_C}$

		Statistic	p
acousticness	Mann-Whitney U	76.5	0.167
instrumentalness	Mann-Whitney U	95.5	0.555

Note. $H_a\ \mu_{NI\_C} > \mu_{I\_C}$

Summary and Interpretation of the Audio Analysis

Taken together, the hypothesis was not supported by results of Playlists A and B, both of which demonstrated the lack of statistically significant differences in the impactive and non-impactive tracks' audio features. Playlist C partially substantiates the original hypothesis,

suggesting that danceability, speechiness, and valence are higher among the impactive tracks; nonetheless, results of other audio features are still largely in line with those of Playlists A and B. The predominant negative results point to several possibilities: It may indicate that The Echo Nest's determination of "acoustically distracting" is inaccurate for Lo-Fi music, or that stimulative audio qualities are no more action-inducing than sedative. More importantly though, it may reveal other extramusical factors–be them contextual or intrapersonal–which influence the degree of musical engagement. Discussion of the survey results, as well as the section on the theoretical considerations of music listening, speak more in detail about this matter.

Spotify User Survey

The user survey had 31 respondents, nearly half of whom claimed to be avid study beat listeners on Spotify (n=14). Among those individuals, two of them do not have their own study playlists but stream and save tracks from Spotify-recommended study playlists. Although some survey respondents (n=8) reported that study beats do not interfere with concentration–and that there is a lack of direct behavioral engagement with the music, such as checking the title of a track– the fact that some of them (n=6) reported behavioral engagement with study beats show their capability to interrupt flow, which is consistent with previous studies. From the survey results, it was also clear that musical engagement can manifest in many forms; some pause studying to check a track's title (n=3), some save a track (n=3), but more do both (n=8). Considering the API does not provide information like click or save rates, it was only possible to analyze saves-to-playlist as an indication of impactive listening. Therefore, there may be even higher levels of impactive listening beyond what could be deduced by current methodology. Excluding Lo-Fi music, there is a great diversity in the musical genres participants use as study

music, including Western classical or instrumental, electronic, and popular music. Among them, too, have similar proportions of individuals who do and do not habitually engage with their study music in aforementioned ways. The convergence of results across genres and across levels of stimulativeness is perhaps suggestive that music's intrinsically stimulative or sedative nature does not provide a holistic rationale for listening behavior. Not only does this observation align with empirical research, but it also sheds light on the dependency of musical experience on the individual listener.

Application of Theoretical Principles

Study beats listeners' capacity for impactive listening warrants a better understanding of the interacting forces–musical and extramusical–which shape the listening experience. When asked about why they prefer study beats over other kinds of music, participants from past research explained that its sedative effect aids concentration, though empirical studies have repeatedly produced mixed results.[11] It was unknown how owners of the select playlists perceive study beats, but the large proportion of survey respondents (n=14) who intentionally play Lo-Fi while working signifies that there exists a sociopsychological mediation to music listening:[12] In this case, as Ruth Herbert proposes, the belief that certain types of music are capable of minimizing distraction and the consequent "accumulated habitual use in contexts requiring concentration" jointly enhance the musical experience.[13] In other words, individuals may construe Lo-Fi as affording concentration and through this internalization suppress music's

[11] Goltz and Sadakata, "Do You Listen to Music While Studying?", 4.

[12] Eric F. Clarke, "Ways of Listening," *Oxford Academic*, August 18, 2005, https://doi.org/10.1093/acprof:oso/9780195151947.001.0001.

[13] Ruth Herbert, *Everyday Music Listening: Absorption, Dissociation and Trancing* (London: Routledge Taylor & Francis Group, 2016), 67.

stimulative ability. This follows Tia DeNora's discussion of music as a "prosthetic technology", which "[profiles] the physical manner in which tasks are executed" and permits "the worker…to constitute herself as an embodied, productive agent and to engage in the skilled production of her work in and through reference to the music and the way in which it affords these things."[14] Rather than the music promoting concentration, listeners' construals and deliberate way of interacting with Lo-Fi lend it governing power over their productivity and reinforce the association of Lo-Fi with enhanced intellectual performance.

In the wider discussion of listening, the permeation of music in our day-to-day activities inspired scholars to explicate the transformation of human-music interactions. Literature on ubiquitous music and passive listening is dense, and this paper does not attempt to expound on its application to Lo-Fi study music. Despite this, it may be worth pointing out that ubiquity, or rather the active use of music to accompany daily activities, could have rendered an investigation of *appropriation* more critical, as it concerns the boundary between *hearing* and *listening*.[15] In light of music's potential for impactive engagement, Lo-Fi listeners' fluctuating attentional focus is an indication of two things: firstly, that there are limits to music's prosthetic power. As there is on average a greater exposure to music daily, what renders a piece of music sufficiently *stimulative*, in either the physiological, emotional sense or both, remains an open question. Secondly, it is debatable whether the movement of music from the subconscious to the conscious parallels a switch from *hearing* to *listening*, and whether it is music's stimulativeness that enables such a transition or if it is other unaccounted, possibly extramusical, factors. Perhaps, the fact that, for different individuals, Lo-Fi music can freely move between different levels of

[14] DeNora, *Music in Everyday Life*, 104.

[15] Kassabian, *Ubiquitous Listening*, xxi.

consciousness speaks more broadly about the criticality of *appropriation* even prior to the first listen.[16] Depending on how users establish the role of study beats–as mere ambient music or as a tool to aid attention–users are proactively shaping their musical experiences; just as some respondents reported little to no track-saving behavior, other respondents reported uninhibited interaction with music. The differential musical experiences are themselves emblematic of the intimate and specific two-way interaction between the musical agent and the experiencer.[17] In so far as Lo-Fi music and a nonmusical stimulus (e.g., intellectual task) are simultaneously received, Lo-Fi music shapes the activity of studying.

Limitations and Future Directions

Another limitation, though, lies in the lack of melodic analysis. Behavioral studies that controlled for musical familiarity showed that familiar music increased emotional arousal more so than unfamiliar music.[18] When subjects were to complete cognitive tasks against the backdrop of familiar Lo-Fi music, they had shorter reaction times than those who were given unfamiliar music, a difference which the researchers theorized as a function of elevated uncertainty and attentional demand for unfamiliar stimuli.[19] Given that a sizable population of Lo-Fi artists sample existing tunes,[20] a dimension that future research can examine is whether musical familiarity in Lo-Fi beats can influence impactive listening in focused states. Undoubtedly, the

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[16] DeNora, *Music in Everyday Life*, 31.

[17] DeNora, *Music in Everyday Life*, 41.

[18] Iris van den Bosch, Valorie N. Salimpoor, and Robert J. Zatorre, "Familiarity Mediates the Relationship between Emotional Arousal and Pleasure during Music Listening," *Frontiers in Human Neuroscience* 7 (September 2013), https://doi.org/10.3389/fnhum.2013.00534.

[19] Ulrich Kirk et al., "Effects of Three Genres of Focus Music on Heart Rate Variability and Sustained Attention," *Journal of Cognitive Enhancement* 6, no. 2 (2021): pp. 143-158, https://doi.org/10.1007/s41465-021-00226-3.

[20] Winston and Saywood, "Beats to Relax/Study to", 43.

digital methodology that the present study adopted restricted what could be said about familiarity, not to mention other extramusical associations Lo-Fi listeners may have made with each of their playlisted tracks. As such, an in-depth case study that analyzes playlists of identified users and complements the digital analysis with person-centered ethnography could provide more insight into how impactive listening occurs.

Another limitation in terms of the results' generalizability stems from the playlist-selection process. This process was ideated with the intent of systematically reaching user playlists. While it promised the identification of playlists with on average a low discoverability, it still excluded private playlists which, hidden from public view, could have also been, or even more so, reflective of the private sphere of music listening. Further, it is imperative to acknowledge that the designation of "impactive" and "non-impactive" was dependent on a multitude of assumptions. First, it was assumed that impactive listening occurs only momentarily, which presumably would translate into tracks being saved sparsely over time. Said assumption could be easily countered by situations where impactive listening occurs for one track, but the listener happens to not resume their nonmusical activity (i.e., studying) in time that the next track begins playing and in a similar manner intrigues them. Despite the first track being saved due to impactive listening, saving the second track disqualified both tracks for analysis. Secondly, though all three playlists indicated in their names that they are "study playlists" –that is, curated for the purpose of studying–it is conceivable that they may be played at other occasions as well. Thus, it becomes difficult to speculate using numerical data whether the type of impactive listening is of interest to the study or not. More broadly, there is the question of the extent to which said phenomenon on Spotify is applicable to YouTube, which is potentially the

greatest hub of Lo-Fi music.[21] Future research can explore impactive listening in the YouTube Lo-Fi community, using not only the YouTube API but also a text analysis of the comment sections to trace possible intersections between "the music" and its extramusical counterparts.

Conclusion

By analyzing audio characteristics of Lo-Fi study beats, the present study suggests that, assuming users' simultaneous engagement in other nonmusical tasks, track-saving behavior is not purely motivated by the stimulative nature of music. Additionally, survey responses point at a more intricate and ineffable two-way interaction between music and its listener; despite the apparent disruptive effect music in general may bear, such an effect does not equally manifest on everyone. Existing theories about musical appropriation and consciousness, particularly works of Tia DeNora and Ruth Herbert, seem to offer a probable explanation for users' differential experiences. To achieve a more holistic account of the studying-listening experience, an ethnographic extension of the current study is needed. Though it remains arguable whether Lo-Fi hip hop is conducive to cognitive performance, its irreplaceable position in the realm of study music makes it difficult to ignore how it shapes, and is shaped by, the activity of studying.

[21] Julia Alexander, "Lo-Fi Beats to Quarantine to Are Booming on YouTube," The Verge, April 20, 2020, https://www.theverge.com/2020/4/20/21222294/lofi-chillhop-youtube-productivity-community-views-subscribers.

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