

ChillsDB, A gold standard for aesthetic chills stimuli

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ABSTRACT

We introduce ChillsDB the first validated database of audiovisual stimuli eliciting aesthetic chills (goosebumps, psychogenic shivers) in a US population. To discover chills stimuli “in the wild”, we devised a bottom-up, ecologically-valid method consisting in searching for mentions of the emotion’s somatic markers in user comments throughout social media platforms (YouTube and Reddit). We successfully captured 204 chills-eliciting videos of three categories: music, film, and speech. We then tested the top 50 videos in the database on 600+ participants and validated a gold standard of 10 stimuli with a .9 probability of generating chills. All ChillsDB tools and data are fully available on GitHub and PhysioNet for researchers to be able to contribute and perform further analysis.

Background & Summary

Aesthetic chills are a universal marker of human peak experiences across the arts, sciences and world religions¹⁻³. Best characterized as the feeling of cold down the spine or goosebumps while engaging with music or film, chills are the sensation associated to shivers: short thermogenic tremors of skeletal muscles. Though ordinarily involved in the regulation of temperature (or as an immune response during fever), chills can also be triggered by information-related processes (e.g., music, stories, speeches), independently of changes in temperature (i.e., psychogenic shivers, thereafter “chills”).

As a conscious, measurable, and universal emotion, with clear delineated correlates and a wide range of behavioural consequences, chills are a promising field of study for affective and social neuroscience^{4,5}. However, no validated database of stimuli exists to elicit aesthetic chills. In psychology and neuroscience, using audiovisual stimuli is a standard procedure for generating and studying emotional reactions, both in humans and primates. Emotional stimulation includes images⁶, audio⁷, video⁸⁻¹³, or text¹⁴ and provides a reliable way to elicit emotion in controlled laboratory settings.

Chills seem to be a universal emotional phenomenon found across human culture and languages². As a predictor for the personality trait Openness to Experience², chills can be generated from a wide range of media: music, films, paintings, poetry, science, mathematics, religion, rituals¹. Studies report a number of behavioural effects such as increased altruism¹⁵, pleasure¹ and reward¹. More recently, chills have been related to learning and meaning-making¹, and demonstrated effects on cognitive functions such as attention and memory¹⁶. As an emotional peak, chills also have downstream effects on valence and arousal¹⁷, and physiologic factors such as heart rate¹⁸, pupil dilatation¹⁹, skin conductance¹⁹, and muscle contractions²⁰.

However, most research focuses solely on music as a stimulus^{15,21,22}, and researchers usually ask participants to bring their own chills-eliciting music to the laboratory¹⁵. Some databases exist for emotional labels that include chills as a signature (e.g., awe, being moved, kama muta), but none strictly focused on chills. To fill this gap, we introduce ChillsDB, a validated database of chill-eliciting stimuli for a US population. The database consists of 204 chill eliciting audiovisual stimuli collected from social media platforms (YouTube and Reddit) by counting mentions of keywords of somatic markers of aesthetic chills in the user comments. In a subsequent study, we validated 50 stimuli videos (t<10 minutes duration) in their propensity to elicit chills. The goal was to capture 10 videos with a probability to generate chills higher than .7 (i.e., 7 participants out of 10 should experience them when exposed to the stimulus).

Methods

Database Design

We used online social media platforms, YouTube and Reddit, as sources to gather stimulus which elicits chills. For data collection, we developed a Python-based tool to find stimuli distributed across social media platform using breadth-first search

40 algorithm²³. The tool uses a seed video as a starting point to search for related videos using the social media platforms's
41 recommendation system. For determining if the video qualifies as stimulus, the tool uses a predefined dictionary to find word
42 occurrences in the user comments of the video. The tool then traverses in the network of the seed video and checks if the video
43 qualifies as a stimulus. If the video qualifies, the tool traverses in the network of the qualified video to find more videos and
44 repeats the process. Else if the video does not qualify, the algorithm continues searching in the network of the seed video.

45 For the video to qualify as a chills eliciting stimulus, we use mentions of somatic markers of the shiver in user comments as
46 a way to determine the propensity of video to elicit chills. Based on the existing literature, we used a somatic marker dictionary
47 containing: 'frisson', 'chill', 'goosebump', 'gooseflesh' as the keywords for somatic reference to define aesthetic chills. Based
48 on the number of cumulative occurrences of the keyword in the user comment section, the stimulus was selected to be part of
49 the database. For the video to be selected as stimulus, we used the criterion of having at least 10 occurrences of the somatic
50 marker dictionary in the stimulus comments, with a total amount of comments greater than 100.

51 All the qualified videos were saved in a Comma Separated Values (.csv) file and videos with high mentions of somatic
52 markers were reused as seed videos to find newer videos. We collected the total comments, likes count, dislike count and
53 somatic marker occurrences from the qualified video. We used a similar process to gather stimulus from Reddit platforms.
54 We found stimulus in Reddit from forums 'r/Frisson', 'r/inspiring' and 'r/inspiration'. Since Reddit posts had significantly
55 lower comment counts than YouTube, we did not use minimum somatic marker occurrence criteria to select the stimulus. From
56 YouTube and Reddit we collected 204 stimulus samples (100 in YouTube and 104 in Reddit). From the 204 stimulus samples,
57 we selected the top 50 stimulus that mentioned the dictionary keywords with the highest frequency, to evaluate their propensity
58 in generating chills.

59 To validate the database stimulus, we used the Prolific online platform to recruit participants. We also set up an online
60 website to present the stimuli and collect user data. Participants from Prolific were redirected to the online platform and
61 completed the survey after watching the stimulus. Our online platform comprised two attention checks²⁴, one before and one
62 after the study so as to ensure high quality data.

63 Participants

64 660 subjects participated in our experiment (Mage=33.6, 50% males, 49.5% female and 0.5%=other). We removed 100
65 participants who reported an aberrant proportion of chills (N>10) and did not fulfil the two attention checks. Participants
66 were recruited on an online platform and were screened for psychiatric conditions or neurologic disorders. This sample was
67 representative of the US population. All the participants reside in the United States of America and practised English as their
68 first language. 75% White, 7.9% Multiracial, 8.4% Asian, 3.6% African American, 3.9% Hispanic, and 2% Middle Eastern.

69 Data Records

70 ChillsDB consists in 5 .csv sheets available under a CC0 1.0 license on the associated Harvard Dataverse²⁵.

- 71 1. YouTube: 100 videos captured during the YouTube breadth-first search. This file includes YouTube Video ID, Title of
72 the video, Total number of comments, Total number of Likes, Total Number of Dislikes, the results from the sentiment
73 analysis (Positive, Neutral, Stimulating), the count of each dictionary terms (Frisson, chill, gooseflesh, goosebumps) and
74 the comments from users.
- 75 2. Reddit: 104 videos captured during the Reddit search. This file includes YouTube Video ID, the SubReddit where it was
76 found, the title of the video, the number of upvotes and downvotes, the ID of the video, the URL, the total number of
77 comments and the comments from users.
- 78 3. Top 100: videos from the YouTube and Reddit batch with the most chills comments as a function of total number of
79 comments.
- 80 4. Top 50 and Top 10: Chills gold standard of validated videos with the highest chills ratio (i.e., the probability of chills as
81 calculated by the number of chills occurrence divided by number of participants).

82 Technical Validation

83 Out of the 50 selected videos, we found 4 types of videos: film, music, speech, and dance. Each video had on average 11.2
84 participants (min 8, max 24). Given the disparity in group sizes for each video, we calculated the ratio of chills report divided
85 by the number of participants for each video (Chills Ratio). The average Chills Ratio in our sample is 0.7 (Max=1, Min=.3).
86 Each video has on average 2.5 chills (max=4.2, min=.4). We then proceed to evaluate the top 10 videos of the batch (see
87 figure N). The top 10 videos have a probability greater than or equal to .9), which generate on average 2.3 chills. Hence, the

88 amount of chills remains the same even in top videos. These videos have on average 11 participants, 10 of whom reported
89 chills. Compared to the videos of the Zickfeld et al. study ($M=0.77$, $SD=0.12$, our chills ratio is significantly higher ($M=0.91$,
90 $SD=0.03$).

91 Usage Notes

92 We introduce ChillsDB, the first validated dataset for research on aesthetic chills. It includes a mix of films, music, and speeches,
93 which generate chills in a US population. We conclude that the technique employed here functions well and calls for further
94 research with other somatic markers (e.g., tears for sadness, gasping for awe, nausea for disgust). All our resources are fully
95 accessible on GitHub and PhysioNet. We hope that researchers will complement the data with their own findings and find
96 the stimuli useful for research. Future research should enrich the database with new content, further classify and analyse the
97 dataset, and test the gold standard with new populations (Middle-East, South America, Asia, Europe, and Africa).

98 Chills is a promising research field. Several hypotheses have been suggested to account for chills but they remain a
99 challenge to operationalize: Schoeller and Perlovsky have suggested that chills relate to learning rate and that they correspond
100 to a satiation of a vital need for information or knowledge^{1,26}. Sarasso and colleagues went further to suggest that they may
101 inhibit motor action for the purpose of knowledge-acquisition²⁷. With the exception of NEO PI-R and despite a promising
102 biomarker for peak experiences, chills are still largely exempt from psychometric questionnaires²⁸. We hope that this validated
103 gold standard will help advance this promising research area.

104 Code availability

105 The code for parsing YouTube and Reddit networks is available under an MIT license at

106 <https://github.com/ChillsTV/AffectiveStimuliScraper>.

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160 **Author contributions statement**

161 FS, AJ, and RS conceptualized the study and designed the experiments. GY and XH built the code under the supervision of AJ
162 and FS. FS and AJ analysed the results. All authors participated equally in writing the manuscript.

163 **Competing interests**

164 The authors declare no conflict of interest.

165 **Figures & Tables**

Chills Gold Standard (Top 10 videos)

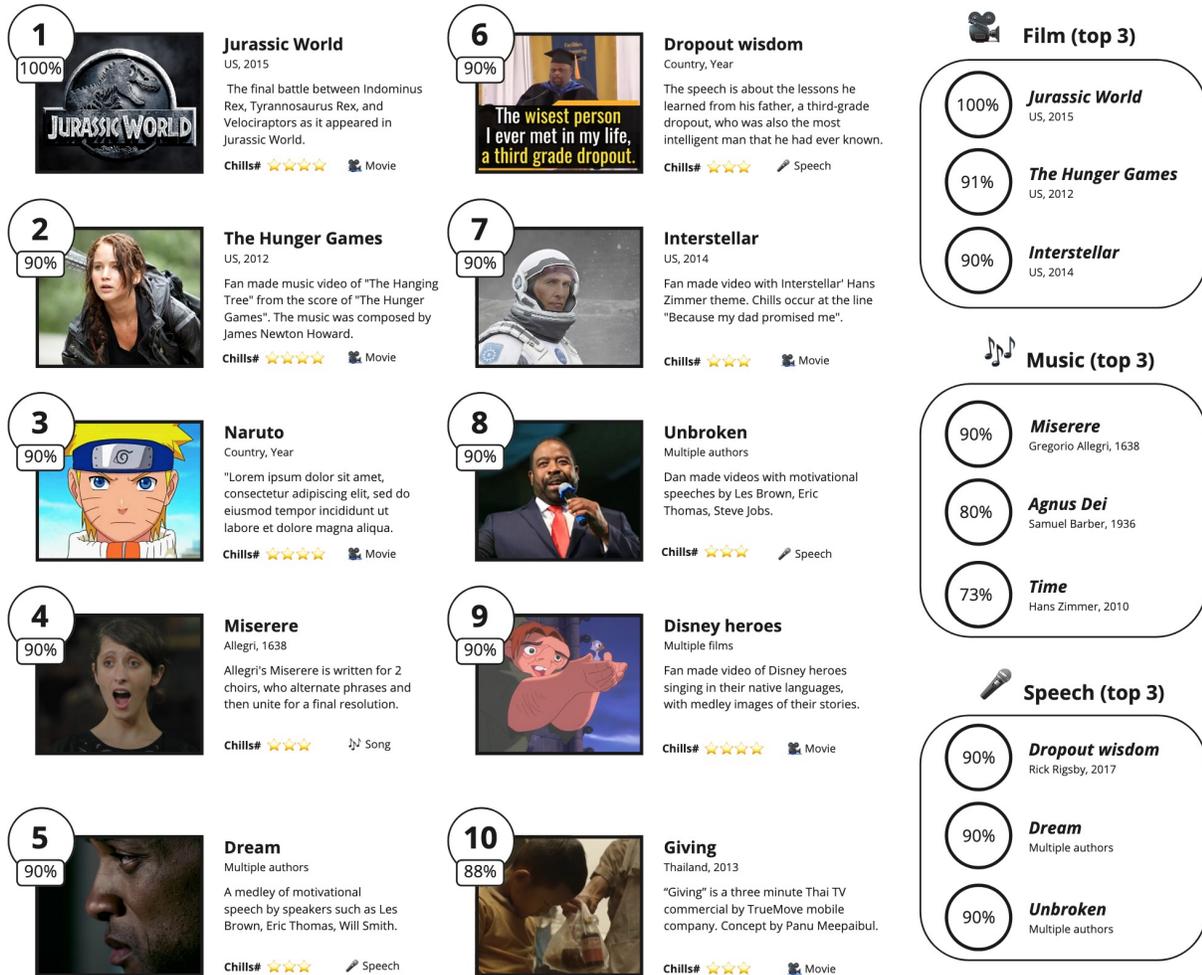


Figure 1. A gold standard for aesthetic chills: the top 10 validated videos from our study, including top 3 for each categories (film, music, and speech). All stimuli have a probability $\geq .9$ to elicit chills in a US population.