

Aesthetic chills foster self-acceptance and emotional breakthrough in depression

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Abstract

Aesthetic chills, a strong emotional reaction characterized by a specific bodily response of thermoregulatory mechanisms such as shivers and goosebumps, may hold scientific and clinical potential for reward-related or dopaminergic illnesses. In this first exploratory study, we examined the effects of chills stimulation on subjects clinically diagnosed with depression. Our results suggest that chill-inducing stimuli may have the potential to affect the core schema of depressed patients, specifically in terms of shame and self-acceptance. These results suggest that the mechanism of action during the chills response may resemble the form of problem resolution induced by the psychedelic and psychotherapeutic experience, leading to similar positive outcomes for the subject. Further research is needed to fully understand the effects of chills on mental health and to determine the feasibility and safety of using aesthetic chills as a therapeutic intervention.

Keywords

Chills; Depression; Self-acceptance; Shame, Emotional Breakthrough; Emotion; Numbing; Anhedonia; Music; Film; Motivation

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1. Introduction

Aesthetic chills are a peak emotional response induced by powerful, sometimes life-changing stimuli and characterized by a specific bodily response of thermoregulatory mechanisms such as shivers and goosebumps (Blood & Zatorre, 2001; Chabin et al., 2020; McCrae, 2007; Schoeller, 2015b). Stimuli known to induce chills include music (Mori & Iwanaga, 2014), film (Schoeller & Perlovsky, 2016), speech (Wassiliwizky et al., 2017), science (Schoeller, 2015a), as well as secular, and religious rituals (Schoeller, 2015a). As a strong hedonic response to emotional stimuli engaging the brain reward system (Blood & Zatorre, 2001; Salimpoor et al., 2011), we suspect that chills may hold scientific and clinical potential for reward-related or dopaminergic illnesses. However, virtually nothing is known about chills and psychopathology (Schoeller & Krishnakumar, 2019). The goal of this first exploratory study is to examine the effects of chills stimulation on subjects clinically diagnosed with depression. We investigated whether 1) chill-inducing content may affect the so-called core schema of depressed patients (specifically shame and self-acceptance) and 2) the mechanism at play during the chills response may resemble the form of problem resolution induced by the psychedelic and psychotherapeutic experience (Roseman et al., 2019), leading to similar positive outcomes for affective disorders patients.

Depression is a debilitating mental illness characterized by emotional numbness and a generalized lack of motivation or pleasure in life (i.e., anhedonia). Depressed patients often exhibit patterns of constant negative rumination about themselves and others, as well as patterns of social isolation (Malhi & Mann, 2018; Martin, 2014). Psychotherapy for depressed patients typically attempts to stop the self-reinforcing cycle of negative emotions by addressing the patient's core maladaptive beliefs (Bishop et al., 2022; Chodkiewicz et al., 2022; Tariq et al., 2021). Specifically, evidence shows that schema related to the self and shame plays an essential role in depression and should be the main focus of intervention (Bishop et al., 2022; Wei et al., 2005). Core maladaptive beliefs can be traced back to adverse childhood experiences (e.g., rape, neglect, abuse) and are often met with considerable resistance by the patient due to the installment of a deep sense of shame and self-deprecation, where the patient perceives himself as inherently defective (Cormier et al., 2011; Talarowska et al., 2022).

The main challenge of psychotherapy is to address these dysfunctional patterns of thoughts and feelings learned early in childhood during states of heightened brain plasticity (Lockwood and Perris 2012). In recent years, there has been considerable interest in the psychedelic experience and its extraordinary phenomenology as a means to induce flexibility in core beliefs (Carhart-Harris & Friston, 2019; Raison et al., 2022). Evidence indicates that psychedelics can help alleviate the symptoms of depression, including in long-term treatment resistance patients (Iacobucci, 2022; Mans et al., 2021; Shukuroglou et al., 2022). The subjective experience of emotional breakthroughs and psychological insights have been found to be major predictors of long-term therapeutic outcomes and patient well-being (Davis et al., 2021; Roseman et al., 2019). However, these peak experiences are difficult to reproduce in the absence of psychotomimetic drugs or require years of psychotherapeutic support.

Here, we investigated whether aesthetic chills could mimic some of these effects and thereby induce changes in deep-seated models of the self to mitigate shame (i.e., foster self-acceptance). Chills often occur at the pinnacle of the stimulus, where some form of resolution takes place (e.g., when the story comes to an end). Hence, chills are often described by subjects as deeply meaningful events and may mark a turning point in the individual's life trajectory following a profound realization induced by some extraordinary event (Schoeller & Perlovsky, 2016). In religious settings, chills can be described as "evidence for the presence and existence of God". Chills have been reported in relation to a variety of religious rituals and mystical experiences such as Cuban Espiritismo (Espírito Santo 2015) American pentecostals (Inbody 2015) or rituals in rural Kerala (Neff and Husaini 1987), for further review on chills and mystical experiences see (Gay et al. 1980; Schoeller 2015). Interestingly, chills are also reported by scientists when grasping the reach of ideas of deep significance in their fields of research (Cronin, 1982; Chandrasekhar, 1987; Lamé in O'Connor and Robertson, 2015). In scientific settings, they are associated with a deep realization of the explanatory power of some physical theories (Schoeller, 2015).

To test the effects of chill videos on depression and self-schema, we used two stimuli from ChillsDB, a recently constituted chills stimuli database (Schoeller et al., 2022): one motivational video targeting specifically self-schema through emotional invectives to the listener and a viral commercial video targeting pro-social feelings and known to elicit chills and tears. Both have been shown in past studies to elicit chills in 80% of subjects as well as powerful emotional reactions (Jain et al., 2022). To estimate the subjective effects of chills and assess to what extent they may resemble the psychedelic or psychotherapeutic experiences, we

used the recently constituted Emotional Breakthrough Inventory (EBI). While a complicated construct, EBI is closely related to the notion of catharsis in poetics (Lehne & Koelsch, 2015) or abreaction in psychotherapy (Jackson, 1994), describing the release of accumulated tension due to the difficulty for the patient to assimilate some traumatic experience (cf. also decompensation). This fits well with computational models of chills and storytelling proposed in (Schoeller & Perlovsky, 2016), where chills occur at the pinnacle of the story and narrative tension reaches a global minimum after a significant buildup.

2. Methods

2.1. Participants

100 participants took part in the experiment (Mean age=37, 55 females). We removed 4 participants that were not clinically diagnosed with depression. All participants reported being clinically diagnosed with depression and had to pass rigorous checks and unbiased screening within the online platform used for this study (Prolific). Participants were further screened for their command of English as a native language.

2.2. Procedure

After being informed about the experiment and signing the consent form, the participant is randomly assigned to one of the two experimental conditions (Giving video and Dream video). Participants were first asked to answer questions about demographics (age, gender, nationality, ethnicity), and questions from 6 EAS of the YSQ-S3 (Self-acceptance, Trust, Social Belonging, Self-reliance/competence, Emotional Fulfillment). Following the circumplex model of emotion (Russell, 1980), participants were asked to report their current mood in feeling “Extremely Unpleasant” to “Extremely Pleasant” for the valence rating, “Extremely Calm” to “Extremely Excited” for the arousal rating before exposure to the stimulus on a 10 point likert scale. Immediately after watching the entirety of the stimulus, the participants were asked about their emotional valence and arousal, and some phenomenological questions about the experience (see supplementary materials). Participants were asked whether they experienced chills and whether the video reminded them of any personal experience. Participants then answer the Emotional Breakthrough Inventory and take the same 6 EAS from the YSQ-S3 in a randomized

order. Participants were provided with a contact for any further information. The experiment lasted about 15 minutes.

2.3. Materials

2.3.1. Stimuli

To identify the stimuli, we used ChillsDB, an open-source database of validated audiovisual stimuli that are known to elicit aesthetic chills (goosebumps, psychogenic shivers) in a US population (Schoeller et al., 2022). The database consists of 204 chills-eliciting videos in three categories: music, film, and speech (see Figure 1). ChillsDB was built using an ecologically-valid method for harnessing chills stimuli “in the wild” by searching for mentions of somatic markers in user comments using algorithms to parse social media platforms (YouTube and Reddit). The stimuli were extracted from the Gold Standard of the top 6 validated videos. Both stimuli have a probability $\geq .8$ of eliciting chills in a US population. “Giving” (Thailand, 2013) is a three-minute Thai TV commercial by the TrueMove mobile company. It was created by Panu Meepaiul. The Dream stimulus was selected specifically for its ability to affect the self-image of subjects. It is a medley of motivational speeches by speakers such as Les Brown, Eric Thomas, and Will Smith, accompanied by emotional music.

2.3.2. Measures

a. Emotional Breakthrough Inventory

The EBI was developed using an Internet survey of those who reported using a psychedelic. It is a reliable and validated scale that is positively associated with increases in well-being after a psychedelic experience (Roseman et al., 2019). The EBI consists of eight statements such as “I felt able to explore challenging emotions and memories” and asks about “emotional release”, “closure”, “emotional breakthrough” and “resolution of conflict”. Participants rated the extent to which they agreed with each statement on a 0–10 scale (with 0 being “No, not more than usually” and 10 being “Yes, entirely or completely”).

b. YSQ4

YSQ is a 56 item self-report measure of 14 EAS. Items (e.g. “I know I can depend on the people closest to me to always be there for me” (Emotional Fulfillment) or “I respect other’s wishes even when they are different from mine” (Empathic Consideration) are rated on a 6-point scale ranging from “Completely untrue of me” to “Describes me perfectly”. The original YPSQ has demonstrated satisfactory internal reliability, factorial, construct, and incremental validity in its introductory article by (Louis et al., 2018). For this study, we measured the schema most often associated with depression (Bishop et al., 2022; Wei et al., 2005; Tariq et al., 2021). These are Self-acceptance/lovability schema (equivalent to the Shame/effectiveness schema in the original early maladaptive schema), the Trust schema (equivalent to Mistrust/abuse in EMS), Social Belonging (Social Isolation and Belonging), Self-reliance/competence (Dependence / Incompetence), Emotional Fulfillment (Emotional Deprivation).

2.4. Ethics

The experiment is in compliance with the Helsinki Declaration. The study was approved by the Committee on the Use of Humans as Experimental Subjects at MIT. All participants gave their voluntary informed consent and we followed the Ethics Code of the American Psychological Association. All participants were informed about the purpose of the research, their right to decline to participate and to withdraw from the experiment, and the limits of confidentiality. We also provided them with a contact for any questions concerning the research and with the opportunity to ask any questions regarding the phenomenon under study (aesthetic chills) and receive appropriate answers. All participants reacted positively to the experiment and were thankful for the opportunity to learn about the phenomenon.

2.5. Reviewer disclosure

Following the standard reviewer disclosure request endorsed by the Center for Open Science (Nosek et al., 2018), we confirm to have reported all measures, conditions, data exclusions, and how we determined our sample sizes.

3. Results

In total, 57 participants experienced chills (33 in the Giving stimulus, 24 in the Dream stimulus). We found that these participants reported a more important emotional breakthrough ($m = 5.18$, $sd = 1.56$) than those who did not report chills ($m = 3.64$, $sd = 1.31$) (see Figure 1). A Mann Whitney U revealed that this difference is statistically significant ($Statistic = 510$, $p < 0.001$) (see Table 1). The reported intensity of the chills significantly correlated positively with the emotional breakthrough ($r(94) = 0.546$, $p < 0.001$). The item most significantly associated with the chills episodes were Emotionally Difficult Feelings, Challenging Emotions, and Emotional Release (see Table 2).

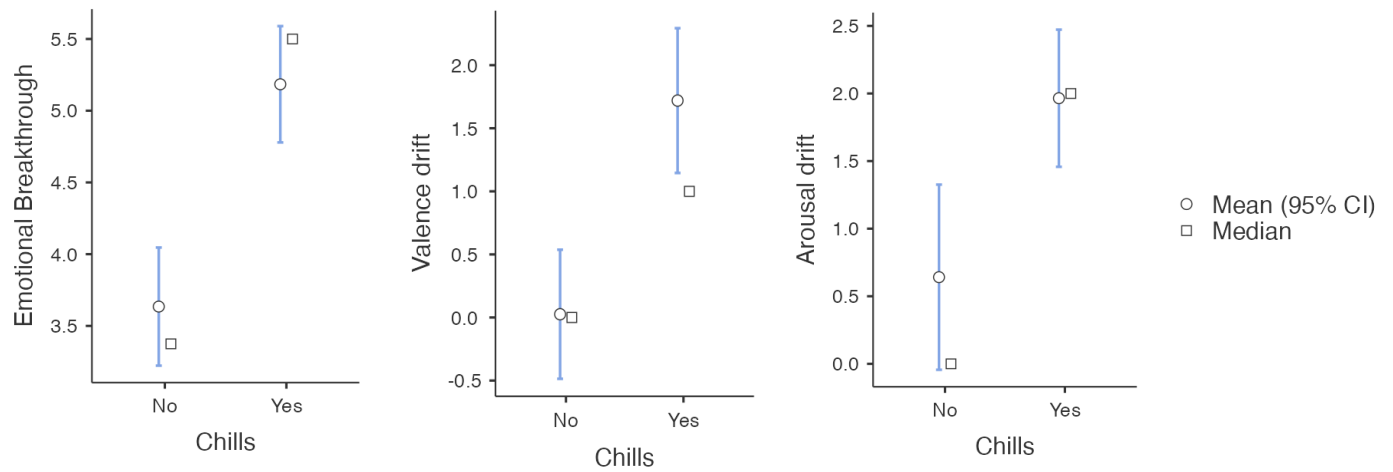


Figure 1: Differences in emotional breakthrough, valence drift and arousal drift across the chills and non chills conditions.

We then proceeded to test for differences in valence and arousal in subjects who experienced chills compared to those who did not. We did not find any significant difference ($Statistic = 994$, $p = 0.376$) between pre-exposure arousal ratings between no chills ($m = 3.49$, $sd = 1.71$) and chills exposure ($m = 3.91$, $sd = 1.98$). Similarly, we did not find any significant difference ($Statistic = 1094$, $p = 0.898$) between pre-exposure -valence ratings between no chills ($m = 5.67$, $sd = 1.66$) and chills exposure ($m = 5.74$, $sd = 1.96$) indicating independence between pre exposure emotional state on propensity of getting chills.

Table 1. Mean and Standard Deviations for Emotional Breakthrough, Arousal drift and Valence drifts

	No-Chills Exposure	Chills Exposure	Test	Statistic	p
Emotional Breakthrough	3.64 ± 1.31	5.18 ± 1.56	Mann-Whitney U	510	< .001
Pre-Arousal Rating	3.49 ± 1.71	3.91 ± 1.98	Mann-Whitney U	994	0.376
Pre-Valence Rating	5.67 ± 1.66	5.74 ± 1.96	Mann-Whitney U	1094	0.898
Post-Arousal Rating	4.12 ± 2.19	5.88 ± 2.195	Mann-Whitney U	640	< .001
Post-Valence Rating	5.69 ± 1.85	7.46 ± 2.11	Mann-Whitney U	561	< .001
Arousal Drift	0.64 ± 2.18	1.96 ± 1.95	Mann-Whitney U	694	0.002
Valence Drift	0.03 ± 1.63	1.72 ± 2.21	Mann-Whitney U	592	< .001

Chills participants reported greater valence ($m = 7.46$, $sd=2.11$) and arousal ($m = 5.88$; $sd = 2.19$) ratings after the stimulus than those who did not report chills ($M_{valence} = 5.69$, $sd=1.85$; $M_{arousal} = 4.13$; $sd = 2.19$) (see Table 1). A Mann Whitney U Test indicated both differences to be significant across chills exposure conditions for both valence ($Statistic = 561$, $p < .001$) and arousal ratings ($Statistic = 640$, $p < .001$). We also found significant differences for drift in both valence ($Statistic = 592$, $p < .001$) and arousal ($Statistic = 694$, $p = .002$). We have represented the drift in valence and arousal as a vector in Figure 2. We found that an increase in chills intensity correlates with an increase in valence ($r(94)=0.44$, <0.001) and arousal ($r(94)=0.421$, <0.001).

We then examined the difference in adaptive schema change depending on whether subjects experienced chills or not. There was a statistically significant difference in improvement in self-acceptance ($Statistic = 698$, $p=0.002$). We further found a marginal increase in all adaptive schema which warrants further exploration to better understand the mechanisms behind this effect and to determine whether it can be expanded upon in future studies. (see Figure 3).

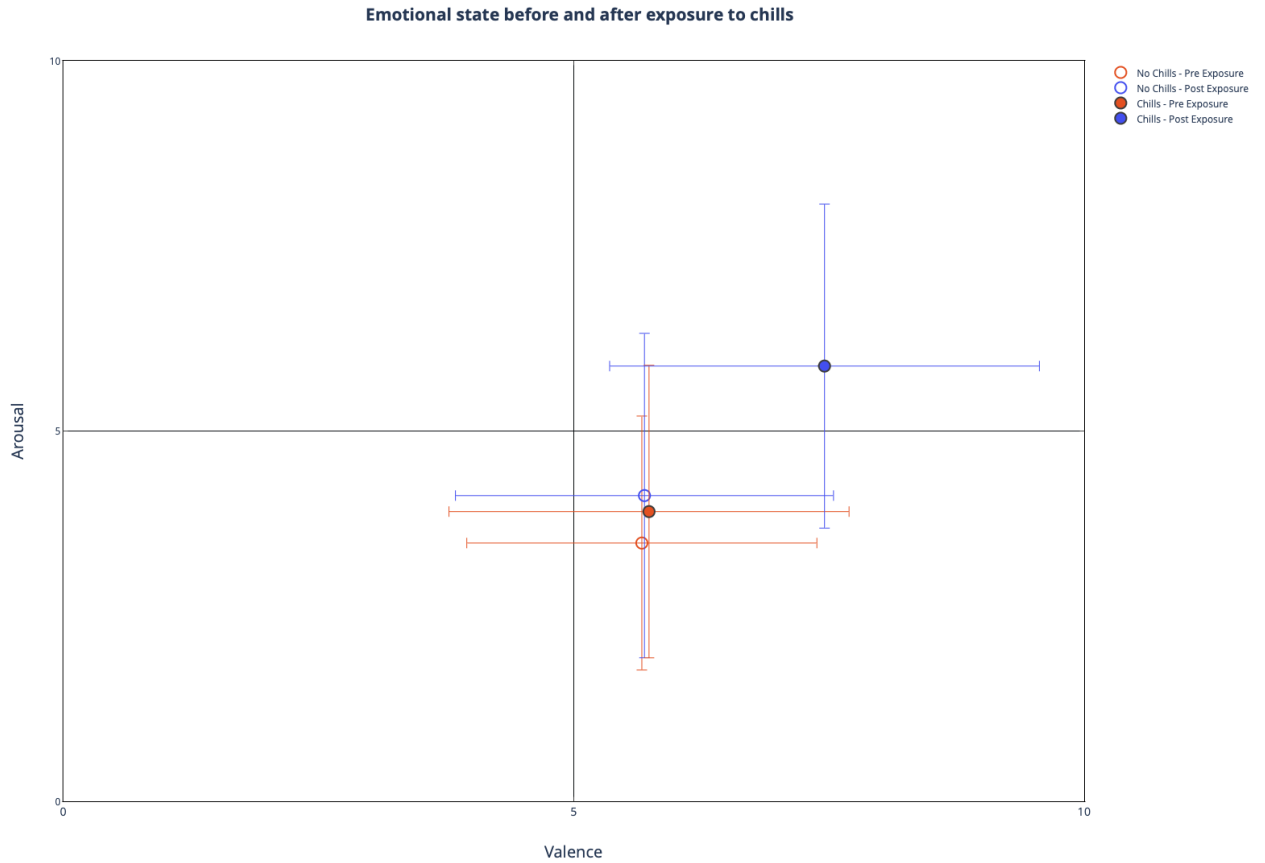


Figure 2: Emotional drift in valence and arousal in chills and no chills conditions. The chills participants reported a greater drift in emotional valence and arousal, and a change from a bottom quadrant to a top quadrant, whereas the participants who did not experience chills remained in the same emotional space.

Table 2: Nonparametric test of each individual item of the Emotional Breakthrough Inventory. Chills are most significantly correlated with Difficult Feelings, Emotional Release, and Emotional Breakthrough.

		Statistic	p
I faced emotionally difficult feelings that I usually push aside.	Mann-Whitney U	662	<.001
I experienced a resolution of a personal conflict/trauma.	Mann-Whitney U	771	0.009
I achieved an emotional release followed by a sense of relief.	Mann-Whitney U	414	<.001
I felt emotionally stuck throughout, without breakthrough.	Mann-Whitney U	1049	0.636
I felt able to explore challenging emotions and memories.	Mann-Whitney U	679	0.001
I was able to get a sense of closure on an emotional problem.	Mann-Whitney U	727	0.003
I was resisting and avoiding challenging feelings throughout, without breakthrough.	Mann-Whitney U	961	0.252
I had an emotional breakthrough.	Mann-Whitney U	675	<.001

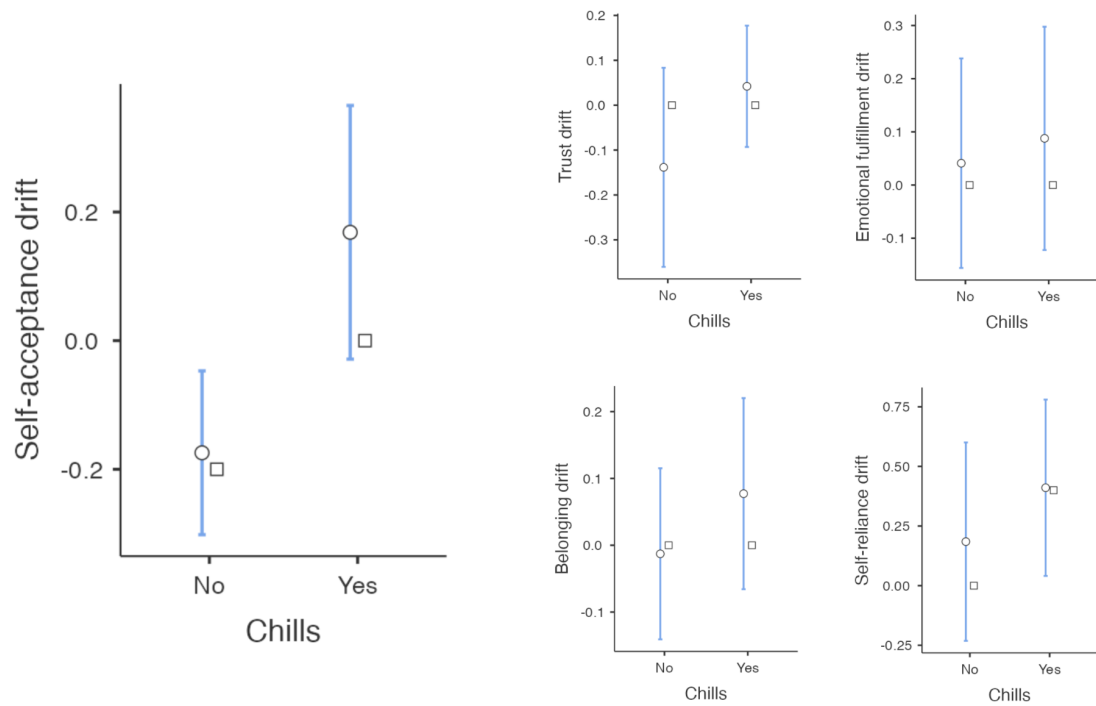


Figure 3: Participants experiencing chills show a significant increase in self-acceptance and a marginal increase in all Adaptive Schema measured.

4. Discussion

In this exploratory study, we tested the effect of two chills stimulations on depressed subjects. We found that the subjects who experienced chills displayed significantly greater self-acceptance (i.e., less shame), as measured by the self-acceptance adaptive schema of Young and colleagues. Furthermore, we found that participants who experienced chills reported a greater emotional breakthrough, a measure commonly used in psychedelic research to assess the patient's propensity to experience difficult emotions during the session. Similar to prior studies (Jain et al., 2022), we also found that chills were significantly correlated with a change in valence and arousal, a positive outcome for depressed patients who ordinarily struggle with anhedonia and lower reward sensitivity (Pizzagalli, 2014, 2022).

The results of our study suggest that chill-inducing stimuli may have the potential to affect the core schema of depressed patients, specifically in terms of shame and self-acceptance. By inducing a strong emotional response, aesthetic chills may provide a means to challenge and overcome these negative schema, potentially leading to improved mental

health and overall well-being. The mechanism of action during the chills response is not well understood, but our results suggest that it may resemble the form of problem resolution induced by the psychedelic and psychotherapeutic experience (Carhart-Harris & Friston, 2019). This finding is intriguing, as it suggests that aesthetic chills may be able to mimic some of the therapeutic effects of psychedelics without the use of psychoactive drugs. This may be particularly useful for individuals who are unable or unwilling to use psychedelics for various reasons, such as legal restrictions, safety concerns, or personal preferences.

However, our study is only exploratory and has several limitations. First, our sample size is small and may not be representative of the general population. Second, we used a self-report measure to assess the effects of chills on shame and self-acceptance, which may be subject to bias and error. Third, we did not control for other potential confounding factors, such as the type of chill-inducing stimulus, the individual's history, and context, or the presence of other mental health conditions. Future research should aim to address these limitations and provide more robust evidence for the effects of chills on depression and other mental health conditions. This could be done through larger, more diverse samples, more objective measures of emotional response, and more controlled experimental designs. Additionally, research should explore the underlying mechanisms of the chills response and its potential therapeutic applications, as well as the potential risks and drawbacks of using aesthetic chills as a therapeutic intervention.

5. Conclusion

In conclusion, our study suggests that chill-inducing stimuli may have the potential to affect the core schema of depressed patients, specifically in terms of shame and self-acceptance. The mechanism of action during the chills response may resemble the form of problem resolution induced by the psychedelic and psychotherapeutic experience, leading to similar positive outcomes for the subject. Further research is needed to fully understand the effects of chills stimulation on depression and other reward-related or dopaminergic illnesses. However, our findings suggest that aesthetic chills may be a promising avenue for future therapeutic interventions, as they offer a non-pharmacological and easily accessible means to induce emotional breakthroughs and psychological insights.

6. Acknowledgment

All authors contributed equally.

7. Conflict of interest

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