

Trajectories of metal music engagement during adolescence and substance use in adulthood

Catherine McConnell^{*}, François Poulin, Olivier Vivier

Department of Psychology, Université du Québec à Montréal, Montréal, Québec, Canada

ARTICLE INFO

Keywords:

Marginal music preferences
Metal music
Substance use
Adolescence
Alcohol use

ABSTRACT

Non-mainstream rock music preferences, such as metal, have been linked to substance use in adolescence and emerging adulthood. This study examined whether these links persist into adulthood, with particular attention to gender differences. From ages 15 to 22, 364 participants (59% female) annually reported their interest in metal music. Problematic alcohol and cannabis use were assessed at age 35. Control variables, including early use and known risk factors were measured during early adolescence, along with as metal music interest at age 35. Latent trajectory analysis revealed two groups: low interest (non-fans; 67%) and high interest (fans; 33%). Gender moderation analysis showed that women in the high-interest trajectory were more likely to report problematic alcohol use at age 35. These findings suggest that sustained engagement with metal during adolescence and emerging adulthood may function as a developmental and sociocultural marker of elevated risk for problematic drinking among some women. This association likely reflects a combination of selection and contextual processes, including gendered experiences within music scenes, rather than a direct causal effect of musical preference.

Music plays a particularly meaningful role in the lives of many adolescents and young adults (Bonneville-Roussy et al., 2013). Beyond entertainment, it serves as a powerful medium through which they make sense of themselves and the world around them, shaping their socialization, supporting identity formation, and helping them navigate emotional and behavioral challenges (Franken, Keijsers, & Bogt, 2017; Franken, Keijsers, Dijkstra, & Ter Bogt, 2017). Through repeated engagement with the sounds, lyrics and meanings of the genres they cherish, youth often internalize the norms, values, and behavioral expectations embedded within these musical cultures (Rentfrow & Gosling, 2006; Selfhout et al., 2008). For some, a strong identification with marginal music cultures such as metal can carry particular significance. These cultures often provide a broader worldview and set of values from which young people can draw to shape who they are and who they aspire to become (Arnett, 1996; Becht & Ter Bogt, 2026; MacDonald & Saarikallio, 2022). Music can foster a sense of belonging and serve as a form of resistance. At the same time, it may also promote attitudes and behaviors that place youth at risk at the identity, psychosocial, and behavioral levels (Ter Bogt et al., 2021). Metal culture, especially, encourages its followers to challenge social conventions perceived as restrictive or stigmatizing (Lozon & Bensimon, 2014). In

this context, certain risky behaviors, such as alcohol and cannabis use, may become symbolic acts, allowing young fans to embody and perform their affiliation with a culture built around ideals of excess, provocation, and marginality (Spracklen, 2018). For many, these practices are more than simple habits; they become part of a meaningful narrative of who they are and how they choose to stand apart. Given that substance use patterns established during adolescence and young adulthood tend to persist and sometimes escalate into more problematic forms later in adulthood (Kairouz et al., 2008), a sustained preference for metal during these formative years may represent a long-term vulnerability. The present study explores this possibility by examining how trajectories of metal preference from adolescence into early adulthood relate to alcohol and cannabis use in the mid-thirties. Gender is also examined as a potential moderator, as men and women often navigate and experience metal culture in distinct ways.

Mainstream versus non-mainstream rock music

Mainstream music (e.g., pop) and non-mainstream music (e.g., metal, goth rock and punk) differ on several dimensions, including their popularity, the nature of their themes, their sonic and aesthetic

^{*} Corresponding author at: Department of Psychology, Université du Québec à Montréal, 100 Sherbrooke Street West, Montréal, QC H2X3P2, Canada.

E-mail addresses: Mcconnell.catherine@courrier.uqam.ca (C. McConnell), poulin.francois@uqam.ca (F. Poulin), vivier.olivier@courrier.uqam.ca (O. Vivier).

qualities, and the characteristics of their audiences (Gardikiotis & Baltzis, 2011). Popular music tends to reach broad and diverse audiences through accessible themes and a sound designed for widespread appeal. Non-mainstream genres, in contrast, generally cultivate more specialized communities of listeners who are drawn to distinctive artistic styles, expressive intensity, or alternative cultural identities. These genres often explore more complex or emotionally charged topics and convey atmospheres that can be darker or more introspective (Ter Bogt et al., 2012).

Non-mainstream rock, including metal, goth rock, and punk, is distinguished from mainstream rock, which is typically more melodic and oriented toward mass radio audiences (Dowd, 2013). The sound and atmosphere of non-mainstream rock subgenres are often described as intense, raw, and deliberately unconventional. This aesthetic emerges from both their thematic content, sometimes provocative or somber, and their sonic qualities: heavily distorted guitars, fast and forceful drumming, and abrasive textures that together create a powerful and immersive musical experience. Listeners are often drawn to these genres because they resonate with themes of existential questioning, marginality, or emotional struggle.

At the same time, metal is not a monolithic genre, but an umbrella encompassing a wide range of subgenres, such as extreme metal, thrash metal, symphonic metal, progressive metal, and doom metal, each organized around distinct constellations of musical aesthetics, thematic concerns, and stylistic conventions. Despite these important differences, many elements are broadly recognizable across metal (e.g., heavy distortion, amplified intensity, emphasis on intensity and emotional expression, etc.), though they often manifest differently depending on subgenre and scene.

Metal culture frequently addresses personal and social challenges, including experiences of injustice and alienation (Lacourse et al., 2001). It is grounded in a stance of questioning or resisting societal norms perceived as exclusionary or oppressive (Arnett, 1996; Ter Bogt et al., 2021). As such, the metal scene provides both a voice and a sense of belonging for individuals who feel misunderstood or marginalized, offering a cultural space in which darker or more complex life experiences can be expressed. At the same time, this culture values authenticity and resistance to conformity and the pressure associated with social conformity (Ter Bogt et al., 2011). Yet, despite this emphasis on freedom and self-expression, implicit behavioral norms continue to reflect broader gender inequalities: women in the metal scene often face pressures to demonstrate their legitimacy by adhering to masculine-coded standards (Krenske & McKay, 2000). Metal thus represents not only a musical genre but also a social world with a strong collective identity, shaped and reinforced through its visual, symbolic, and cultural expressions of defiance and emotional release (Weinstein, 2000).

Pioneering bands such as Black Sabbath and Judas Priest helped lay the foundations, as early as the 1970s, for a musical and cultural movement that is rich, evolving, and multifaceted (Hein, 2004). Metallica's *Master of Puppets* (1986) further exemplifies the genre's longstanding orientation toward questioning social pressures and resisting superficiality. Over time, metal has developed into a culture, sometimes even a counterculture, centered on the pursuit of an authentic sense of self, expressed with intensity and conviction (Weinstein, 2000). Many fans describe themselves as "proud outsiders" embracing forms of emotional release and transgression as ways of asserting a distinct identity and finding solidarity within a community of like-minded individuals (Hein, 2004). Visual elements inherited from biker culture, including black leather, long hair, piercings, studs, and metal accessories, symbolize a deliberate distancing from dominant stylistic norms and a celebration of alternative modes of expression. Within this context, behaviors such as heavy alcohol or drug use have sometimes been understood as expressions of resistance to social expectations, serving both as markers of group belonging and as means of coping with psychological and social pressures (Arnett, 1993; Lozon & Bensimon, 2014). Iconic figures such as Ozzy Osbourne came to symbolize these

extreme, boundary-pushing dimensions of metal culture. These practices can be viewed as intense forms of defiance in response to experiences of stigma, constraint, or mismatch between personal desires and social prohibitions. Importantly, many of these behaviors have historically aligned with broader masculine norms within the metal scene.

Evolution of metal preference from adolescence to young adulthood

Several longitudinal studies have examined how preferences for non-mainstream rock evolve as youth move from adolescence into young adulthood. The longitudinal study by Delsing et al. (2008), conducted with 2344 participants (Mage = 14.4 at T1; 75.2% girls), found that most adolescents lose interest in non-mainstream rock around ages 17–18, while a smaller group maintain and, in some cases, deepen their interest into their early twenties. This developmental period is one in which musical preferences tend to stabilize, becoming more stable and more confidently claimed as part of one's identity (Delsing et al., 2008). In this sense, the trajectories of non-mainstream rock preference emerging in adolescence are not linear but reflect diverse and evolving paths.

In a similar vein, Ter Bogt et al. (2021) assessed musical preferences on six occasions between ages 12 and 21 using the Music Preference Questionnaire (MPQ-R; Sikkema, 1999) among 900 Dutch adolescents (51.1% girls). Multivariate latent growth curve analyses identified three distinct trajectories of preference for metal: a high trajectory declining after age 18 (7% of the sample), a moderate and stable trajectory (15%), and a low and stable trajectory (78%). Overall, the appeal of metal typically rises between ages 13 and 17 before tapering off around age 18. After this point, those who maintain a strong preference for metal often begin to stand out more clearly from mainstream youth culture. These findings point to a subgroup of young metal fans whose commitment to the genre remains steady from adolescence into the early twenties, a group whose musical attachment can be seen as a meaningful thread running through their developmental journey.

Developmental and cultural affiliations perspective on links between non-mainstream rock music preference and substance use

Music can be a lifeline during adolescence and emerging adulthood, helping youth express and regulate difficult experiences (Miranda et al., 2012). Through the genres they embrace, adolescents explore who they are becoming, find emotional resonance, and locate communities where shared taste becomes a form of mutual recognition. It is therefore understandable that youth facing psychosocial difficulties gravitate toward musical worlds that mirror, validate, or give voice to their inner experiences (Ter Bogt et al., 2021). In this context, associations have been observed between culturally marginal music genres and higher alcohol or cannabis use (Ter Bogt et al., 2021). Importantly, these links should not be interpreted as evidence that non-mainstream rock causes maladjustment. Rather, they likely reflect a mix of selection and social influence processes embedded in broader psychosocial, sociocognitive, identity-related, and motivational contexts.

Developmental contextualism

To integrate these processes within a single framework, we rely on developmental contextualism (Lerner, 1989) which conceptualizes development as emerging from bidirectional interactions between individuals and their contexts. Within this perspective, individuals actively select environments that may, over time, reinforce their behavior patterns. In this framework, mechanisms often discussed in relation to metal music engagement, such as peer affiliation and socialization, norms and learning processes, and identity and coping functions, are better understood as interconnected aspects of

person–context interactions rather than as separate explanations. Accordingly, musical preferences are conceptualized as developmental markers embedded within a broader sociocultural context. Metal preference, in this view, reflects that context rather than constituting a direct source of risk.

Psychosocial and sociocognitive mechanisms

One pathway involves peer selection and socialization processes. Music Marker Theory (Ter Bogt et al., 2013) builds on the idea that “similarity fosters affiliation”: youth tend to form friendships with peers who share similar musical tastes and align with the attitudes and behavioral norms associated with a given musical culture (Liu et al., 2018). Within these groups, young metal fans may experience implicit or explicit pressures tied to metal identity (Slater & Henry, 2013). In addition, peer contexts centered around metal music may normalize and sometimes encourage alcohol and cannabis use (Franken, Keijsers, & Bogt, 2017; Franken, Keijsers, Dijkstra, & Ter Bogt, 2017). In this sense, marginal musical preferences may function as markers of exposure to specific peer environments, which can place some youth on trajectories characterized by heightened substance-use risk.

Cognitive mechanisms

The General Learning Model (Buckley & Anderson, 2006) suggests that repeated engagement with media content, including music, can shape cognition and behavior in both the short and long term. According to this model, listening to music activates mental schemas, physiological responses, and emotions that, once triggered, guide the listener toward behaviors consistent with the activated cognitive script. For example, attentive and emotionally engaged listening to Black Sabbath's *Sweet Leaf* (1971), an explicit ode to cannabis and its euphoric, liberating effects, may activate cognitive, emotional, and physiological scripts associated with cannabis use. Such activation can influence thoughts about consumption, evoke positive emotions such as relief or exhilaration, and stimulate the listener in ways that may reinforce the appeal of cannabis use (Coyne & Padilla-Walker, 2015). Over time, repeated exposure to musical content that valorizes alcohol or cannabis use may contribute to the gradual consolidation of more permissive substance-related schemas and norms, potentially increasing normalization of these practices.

Identity and motivational mechanisms

Adolescence is a pivotal period for the development of individual and social identity (Tajfel & Turner, 1979). Because identities are still forming, youth may be especially receptive to groups and cultural environments that offer a coherent system of meanings, values and a sense of belonging. Belonging to a group defined by a marginal musical preference, such as metal, actively contributes to identity formation by shaping the self according to group norms (Selfhout et al., 2008; Ter Bogt et al., 2013). When a young metal fan engages in this identity quest, they may do so with great intensity, potentially becoming deeply invested in the group's norms and values. Motivated by inclusion, young members may internalize identity expectations, sometimes with limited critical distance, particularly when belonging provides a strong sense of meaning and social recognition (Akerlof & Kranton, 2002). Metal culture is often described as distinctive, unconventional, and anti-authoritarian identity, and may nonetheless require strong conformity (Larsson, 2013). For many, metal is not merely a musical taste but a way of life, implying adherence to transgressive values and practices (Hines & McFerran, 2014; Przybylski et al., 2010). Metal fans often describe themselves as outsiders, embracing their musical identity as a symbol of independence from authority. This sense of belonging provides a shared cultural framework that they perceive as essential to their psychological balance, even as it carries identity-related risks (Ter Bogt et al., 2021).

Within this context, alcohol and cannabis use can be interpreted as expressions of personal freedom, resistance to authority, or rejection of dominant social norms. Thus, belonging to metal-oriented peer groups functions as a double-edged sword: it can provide refuge, belonging, and protection against alienation, yet also reinforce behaviors, such as excessive substance use, that intensify marginalization and contribute to stigma (Frandsen, 2010).

Empirical studies on metal music and alcohol and drug use

Since the 1990s, most studies have shown that young metal fans are more likely to consume alcohol and cannabis compared to their peers who prefer mainstream or “quintessential” styles, such as jazz or classical music (Chen et al., 2006; Lacourse et al., 2001; Miranda & Claes, 2004; Mulder et al., 2010). In addition, a cross-sectional study found that adolescents drawn to intense, rebellious, and energetic musical styles, such as metal, report higher levels of alcohol and cannabis use than those who do not engage with these genres (Tanner et al., 2008). The longitudinal study by Ter Bogt et al. (2021), described above, further indicates that sustained metal fans (7% of their sample) showed higher levels of cannabis and illicit drug use between ages 18 and 21. Alcohol consumption, however, was not assessed in this study. Importantly, none of these studies examined whether the association between metal preference and substance use might contribute to the development of problematic substance-use patterns later in adulthood.

Substance use in adolescent metalheads: long-term trends

Adolescence and early adulthood are key periods of identity development, during which young people seek to assert their autonomy and differentiate themselves from others. It is also during this period that many young people first initiate alcohol and cannabis use sometimes serving as a means of self-expression or rebellion (Feldstein & Miller, 2006). These developmental processes contribute to the emergence of problematic substance use (Schulenberg et al., 2019). Youth aged 15 to 24 show the highest rates of binge drinking, alcohol dependence, and cannabis use (Kairouz et al., 2008). The habits formed during these years tend to persist and increase the risk of substance-related disorders in adulthood (McCabe et al., 2022). In this context, the link between a sustained preference for metal music throughout these developmental stages and long-term problematic alcohol and cannabis use should be examined.

Moderating role of gender

Research has consistently documented the predominance of men within the metal fanbase (Arnett, 1991, 1996). While metal culture primarily attracts males, women comprise roughly one-third of its fans (Laakasuo et al., 2025). Norms and behaviors associated with participation in metal culture are often socially coded as masculine and may therefore be experienced differently, or judged more harshly, when adopted by women (Hill, 2016).

Metal culture is experienced differently by men and women. Studies indicate that female metal fans often encounter multiple forms of marginalization: drawn to metal as a space for self-expression and escape from restrictive social expectations, they may enter an environment that is already marginal and male-dominated, where they may feel objectified or excluded (Messick et al., 2024; Rogers & Deflem, 2021). To establish legitimacy within this subgroup, some women may engage more intensively in behaviors such as alcohol or cannabis use, which are socially associated with masculinity (Hill, 2016). Yet these behaviors, by conflicting with broader societal expectations for women, may amplify their social stigmatization. These dynamics suggest that young female metal fans may face unique challenges: the very engagement that supports their identity and belonging within the metal community may also expose them to heightened social scrutiny and potentially increase the

risk of problematic patterns of substance use.

Current study

This present study builds on previous work by examining trajectories of metal music engagement and their long-term associations with alcohol and cannabis use, with attention to gender as a moderating variable.

The first aim is to identify metal music engagement trajectories using data collected annually from age 15 to 22. Based on [Ter Bogt et al. \(2021\)](#), it is anticipated that three trajectories will emerge: one characterized by consistently high engagement with metal music, another marked by high interest during adolescence that diminishes in emerging adulthood, and a third indicating a stable lack of interest throughout the period (Hypothesis 1). The second aim is to examine how these metal engagement trajectories relate to substance use outcomes measured at age 35. Specifically, the study focuses on three indicators of problematic alcohol use (alcohol-related consequences, binge drinking, and alcohol dependence) and one indicator of cannabis use (frequency). These associations are examined while controlling for baseline levels of key variables, which have been identified as early predictors of later problematic substance use ([Arteaga et al., 2010](#); [Chassin et al., 2002](#); [Hayatbakhsh et al., 2008](#); [Van Ryzin et al., 2012](#)). These variables were assessed at ages 13–14, prior to the trajectory period and include antisocial behavior, depressive symptoms, parental monitoring, alcohol use and cannabis use. Additionally, metal music engagement at age 35 was included as a control to account for any potential influence on the association between metal trajectories and substance use. It is hypothesized that individuals with a sustained preference for metal music will report higher levels of problematic substance use at age 35 compared to those in the other two groups (H2). The third aim is to examine whether sex moderates the association between metal engagement trajectories and substance use in adulthood. This exploratory aim examines whether sustained metal preference from ages 15 to 22 is differentially associated with adult substance use among men and women.

Methods

Participants

The data used in this study were derived from a longitudinal project initiated in 2001 with 390 students ($M_{age} = 12.38$, $SD = 0.42$, 58% female) from 6th grade classes within a school board located in the greater Montreal area. Most of the participants (90%) identified as Caucasian, originating from families where both parents (mother/father) had equivalent levels of education, with an average of 13.08 years ($SD = 2.68$) for mothers and 13.20 years ($SD = 3.20$) for fathers. Most of the participants came from intact families (69%). These families' average annual income at the beginning of the study was \$CA 48,750 ($SD = 12,500$). Participants underwent repeated assessments until age 35, with 76% ($n = 297$) of the original sample participating in the final data collection. The subsample selected for the first aim of the study includes participants who reported their music preferences on at least one occasion between the ages of 15 and 22 ($n = 364$; 59% female). The subsample selected for the second and third aim includes participants who reported their substance use at age 35 ($n = 297$, 63% female).

Procedures

At ages 13 and 14, participants completed questionnaires in class under the supervision of research assistants. Between the ages of 15 and 22, they took part annually in structured telephone interviews conducted by trained research assistants. At age 35, data were collected through an online self-report survey. Parental consent was obtained up to age 18, after which participants provided their own consent. Participants were financially compensated for their involvement. Ethical

approval was granted by the Human Research Ethics Committee at the authors' university.

Instruments

Metal music engagement from ages 15 to 22

Metal music engagement was assessed using an item adapted from the Music Preference Questionnaire ([Nater et al., 2005](#)). The interviewer asked the participants if they liked metal, using Metallica and Slayer as examples. The participants responded on a 3-point Likert scale (1 = not at all, to 3 = very much).

Substance use at age 35

Alcohol-related consequences

Alcohol-related consequences over the past year were assessed using 16 items from the "Screening/Assessment of Help Needs-Alcohol" ([Tremblay & Blanchette-Martin, 2009](#)) rated on a 5-point Likert scale (0 = Never or almost never, to 4 = Always or almost always). Examples of items are "Have you missed work or school days because of your drinking?" and "Has your drinking negatively affected one of your friendships or one of your close relationships?" A mean score was computed, with higher scores indicating greater alcohol-related consequences ($\alpha = 0.84$).

Binge drinking

Past-year binge drinking was assessed with a single item: "In the past 12 months, how many times have you consumed five or more drinks on a single occasion?". Participants could select any whole number from 0 to 20, as well as 25, 30, 35, 40, 45, 50, 55, 60, 65, 70, and 75 or more. The reference period of the past year is commonly used to link alcohol consumption to alcohol-related problems ([Cranford et al., 2006](#)), and this categorization aligns with the National Institute on Alcohol Abuse and Alcoholism's past-year binge drinking measure ([Internet., 2007](#)).

Alcohol dependence

Alcohol dependence was assessed using 11 items from the Severity of Alcohol Dependence Data Questionnaire ([Raistrick et al., 1983](#)), translated in French by [Tremblay and Blanchette-Martin \(2009\)](#). Each item is rated on a 5-point Likert scale (0 = Never or almost never, 4 = Always or almost always). Example items include: "Do you find it hard to stop thinking about drinking?" and "Do you drink all day long, from morning till night?". A mean score was computed, with higher scores indicating greater levels of alcohol dependence ($\alpha = 0.87$).

Frequency of cannabis use at age 35

Cannabis use over the past 12 months was assessed using a: "During the past 12 months, how frequently have you used cannabis (e.g., hash, pot, etc.)?". Participants responded by indicating the number of times they had used cannabis during the past year, using a scale from 0 to 5 (0 = Never; 1 = Less than once per month; 2 = 1–3 times per month; 3 = Once or twice per week; 4 = 3–6 times per week; 5 = Every day).

Control variables at ages 13 and 14

Average alcohol use per month

Participants reported their alcohol consumption frequency using the item: "How many alcoholic beverages (e.g., beer, wine, shots, etc.) have you consumed in the past month?". Responses were recorded on a 13-point frequency scale, ranging from 0 to 13 (41 drinks/times or more).

Average cannabis use per month

Participants responded to an item assessing cannabis use: "How many times have you used cannabis or hashish in the past month?". Responses were recorded on a 13-point frequency scale, ranging from 0 to 13 (41 times or more).

Antisocial behavior

Participants were asked to respond to a 16-item questionnaire that combined items from the antisocial behavior scale by (Metzler et al., 1998,) along with items from the questionnaire developed by Janosz et al. (2007), providing a more comprehensive evaluation. Items included “skipped school without permission”, “stole or attempted to steal items valued at \$5 or more” and “intentionally damaged or tried to damage property.” Responses were recorded on a 6-point frequency scale ranging from 1 (never) to 6 (more than 10 times). A mean score was calculated across items ($\alpha = 0.82$ at both times).

Depressive symptoms

Participants completed the validated French version of the Children's Depression Inventory (CDI; Boivin et al., 1994; Kovacs, 1985), which consists of 26 items. Each item offered three statements reflecting varying levels of symptom severity over the preceding two weeks (e.g., “I feel tired sometimes,” “I am often tired,” or “I am always tired”), and respondents selected the one that represented their experience the most. Total symptom scores were obtained by summing responses across items, with higher scores denoting more pronounced depressive symptoms. The measure demonstrated good internal consistency ($\alpha = 0.82$ and 0.86).

Parental monitoring

Parental monitoring was measured using the parental knowledge scale from Stattin and Kerr (2000) Parental Supervision Questionnaire. Adolescents provided responses to nine items assessing the extent of their parents' awareness regarding their activities. Items were rated on a 5-point Likert scale, ranging from 0 (never) to 4 (always or almost always). Sample items include: “Do your parents know what you do in your free time?” and “Do your parents know the friends you meet in your free time?” Higher scores reflected greater parental knowledge. The scale demonstrated great internal consistency ($\alpha = 0.84$ and 0.85).

Given that the control variables were measured at ages 13 and 14, mean scores were computed to obtain more reliable indicators of the early adolescence period. Pearson's product-moment correlations between data collection points were in the high range ($r = 0.61$ to 0.69) which allowed the use of mean scores.

Metal music engagement at age 35

Metal music engagement was assessed using one item from the Musical Questionnaire (Heisbourg, 2021). The item was: “Do you like metal? (extreme metal, trash metal, symphonic metal, progressive metal, doom metal, etc.)”. Participants responded on a 5-point Likert scale, ranging from 0 (I hate) to 5 (I adore).

Statistical analyses

Analyses were conducted using Mplus v.8.8 (Muthén & Muthén, 1998). Missing data were estimated with the Full Information Maximum Likelihood (FIML) method which estimates, from the entire data base, model parameters that maximize the probability of identifying the observed data (Baraldi & Enders, 2010). Thus, participants who did not complete all measurement points were still included in the latent class trajectory analyses if they reported their music preference at least once between the ages of 15 and 22 ($N = 364$). The regression model and invariance analyses on the CFA were conducted with information from all participants who had alcohol and cannabis data available at age 35 ($N = 297$). Models were estimated with the robust Maximum Likelihood Estimator (MLR), which adjusts for non-normality in some variables (e.g., alcohol use and depressive symptoms) and provides robust standard errors and fit indices.

The analyses were conducted to address three core objectives. First, we identified distinct trajectories of metal music engagement from ages 15 to 22. Second, we examined the associations between these trajectories and problematic alcohol, and cannabis use at age 35. Prior to

addressing this second aim, two preparatory analyses were performed: (1) a confirmatory factor analysis (CFA) to validate the latent structure of problematic alcohol use, and (2) a gender invariance analysis of this latent variable. Third, we assessed whether sex moderated the longitudinal associations between music trajectories and substance use outcomes. These objectives were addressed within a Structural Equation Modeling (SEM) framework.

First, a single-trajectory Latent Growth Model (LGM; Walls et al., 2006) was estimated to examine changes in metal music engagement from ages 15 to 22. This model assessed: 1) the overall shape of the growth curve, 2) the intercept, slope, and quadratic term, and 3) the heterogeneity in intra-class variance. Time was treated as a fixed equidistant parameter, with mean engagement scores spanning from age 15 (fixed at 0, representing the first time point of the metal music engagement trajectories) to age 22 (fixed at 7). Model fit was evaluated using χ^2 (non-significant values indicate good fit), the Root Mean Squares Error of Approximation (RMSEA; ≤ 0.05 indicates a good fit; Browne & Cudeck, 1993), and the Standardized Root Mean Squared Residual (SRMR; ≤ 0.08 for acceptable fit; Marsh et al., 2004), as well as the Comparative Fit Index and the Tucker–Lewis Index (CFI/TLI; ≥ 0.95 represent an excellent fit; Hu & Bentler, 1999).

Second, a Latent Class Growth Analysis (LCGA; Muthén & Muthén, 2000) was conducted to identify distinct trajectories of metal music engagement, grouping individuals with similar developmental trajectories across a repeated measure. In this approach, variation within subgroups is assumed homogeneous, so the variance of latent slopes and intercepts was fixed to zero within each class but allowed to vary between classes. Time points were fixed incrementally. Several fit indices were used to identify the optimal number of latent trajectories: Akaike Information Criterion (AIC; Akaike, 1987), Bayesian Information Criterion (BIC; Schwarz, 1978), and Sample Size Adjusted Bayesian Information Criterion (SSABIC), where lower values reveal better fit; entropy (Celeux & Soromenho, 1996), where values over 0.8 reveal good classification and values close to 1 reveal high classification precision; posterior probabilities of latent class membership (Muthén & Muthén, 2000), where values under 0.8 reveal classification uncertainty; Vuong-Lo-Mendel-Rubin (VLMR), Lo-Mendell-Rubin Likelihood Ratio Test (LMR-LRT; Lo et al., 2001) and Bootstrap Likelihood Ratio Test (BLRT; McLachlan & Peel, 2000) where non-significant p -values ($p > .05$) suggest that adding a class does not significantly improve model fit, and significant p -values ($p < .05$) indicate a better fit with the additional class.

Third, a confirmatory factor analysis was performed to examine the factorial structure of the problematic alcohol use latent variable (alcohol-related consequences, past-year binge drinking, and alcohol dependence), subsequently incorporated into the model as a dependent variable using goodness-of-fit indices such as the χ^2 test, CFI, TLI, RMSEA and SRMR. The validity of the latent variable was evaluated from these indices to determine how well the indicators explain the latent component.

Fourth, gender invariance of the latent problematic alcohol use construct was evaluated by first testing for configural invariance, then metric (weak), and finally scalar invariance (strong) in accordance with the invariance measurement steps suggested by Brown (2006). Configural invariance assesses the equivalence of the factor structure across sexes, metric (weak) serves to confirm that the items of each factor hold equivalent meaning and scalar invariance (strong) ensures mean-level comparisons across groups (Bonneville-Roussy et al., 2013). Following the guidelines outlined by Marsh et al. (2009), model fit is considered acceptable when CFI and TLI exceed 0.90, and excellent when values surpass 0.95. For RMSEA and SRMR, values below 0.08 indicate acceptable fit, while values below 0.05 reflect excellent fit. In testing for measurement invariance, it is standard practice to compare chi-square values ($\Delta\chi^2$) to evaluate whether a more constrained model fits the data adequately (Brown, 2006). However, because the chi-square statistic is highly sensitive to sample size, it may unfairly penalize larger

samples. To address this, [Chen \(2007\)](#) recommends evaluating changes in fit indices. Specifically, a change of less than 0.010 in CFI or TLI, combined with a change of less than 0.015 in RMSEA or 0.030 in SRMR, provides evidence for invariance and supports the more restrictive model. In the present study, the configural model was just identified ($df = 0$) and therefore had perfect fit (by definition). As such, metric invariance was based on absolute fit indices and a chi-square difference test.

Finally, the latent variable for problematic alcohol use and the cannabis use variable were incorporated into the model along with the metal music engagement trajectories. [Fig. 1](#) presents the tested model. To account for potential sex differences, we tested the equivalence of the regression associations by sex. Baseline levels at ages 13–14 (depression, antisocial behavior, parental monitoring, alcohol use, cannabis use) as well as metal music engagement at age 35 are included as control variables.

Results

Descriptive statistics

Descriptive statistics and correlations (Spearman) between the study variables are reported in [Table 1](#). Examination of this table indicates that average metal music engagement remains relatively stable over time, with scores consistently closer to those of non-fans. Test-retest correlations across adjacent time points indicate good temporal stability. Over time, metal music engagement shows increasing correlations with problematic substance use at age 35 (alcohol and cannabis). Indicators of problematic alcohol use and frequency of cannabis are also positively correlated with each other. Sex was positively associated with both problematic alcohol use and the frequency of cannabis use, suggesting that men are more likely to encounter these issues. Additionally, sex showed positive correlations with metal music engagement across all time points, indicating a stronger engagement with this musical genre among men. All control variables were positively correlated with alcohol and cannabis related outcomes, although the strength of these associations varied. The strongest correlations are with early substance use, followed by parental knowledge and depressive symptoms (of comparable strength), with antisocial behavior showing the smallest positive associations.

Identification of trajectories

Step 1: unconditional latent growth model (LGM)

To confirm the relevance of considering multi-trajectory models, a one-trajectory Latent Growth Model was used to determine (1) the heterogeneity in the intra-class variance and (2) the shape of the trajectory a priori.

Analysis of the single-class trajectory revealed that a quadratic model best describes the evolution of metal music engagement in this sample ($N = 364$). The linear model was specified and parameters estimated ($\chi^2(23) = 67.92, p < .001$; CFI = 0.94; TLI = 0.95; RMSEA = 0.073 [90% CI = 0.054, 0.094]; SRMR = 0.052), but it did not fit the data as well as the quadratic model that showed an excellent fit ($\chi^2(19) = 50.84, p < .001$; CFI = 0.96; TLI = 0.96; RMSEA = 0.068 [90% CI = 0.046, 0.091]; SRMR = 0.040). Although the χ^2 is reported, this fit index tends to favor small samples and is often significant with complex models and large samples, as in the present study ([Wang & Wang, 2019](#)). The cubic term was also tested but did not converge.

The intra-class variance for all growth factors (intercept, linear, and quadratic) was significant ($p \leq .001$), supporting the use of multi-class models. Consequently, multi-trajectory models were evaluated using the LCGA procedure to verify the presence of distinct developmental trajectories in metal music engagement.

Step 2: conditional latent class growth analyses (LCGA)

To determine the optimal number of homogenous latent classes, the model fit information was used (see [Table 2](#) for statistical indices for one-, two- and three-class models). Models with two, and three classes were compared to assess the best fit.

The fit indices of the model with two growth trajectories were excellent: entropy was 0.89, both the values of the LMR-LRT and VLMR-LRT were significant ($p = .000$), with posterior probabilities of class membership greater than 0.90, indicating accurate class assignments. The inclusion of a third class did not improve the model. Although the three-class model showed lower (i.e., improved) AIC, BIC and SSABIC values, it was not retained due to non-significant results on the VLMR, LMR-LRT and BLRT tests as well as reduced entropy. Therefore, the two-class model was considered the optimal solution.

The two metal music engagement trajectories are shown in [Fig. 2](#). As predicted, most participants (67.31%; $N = 245$; 72.45% female)

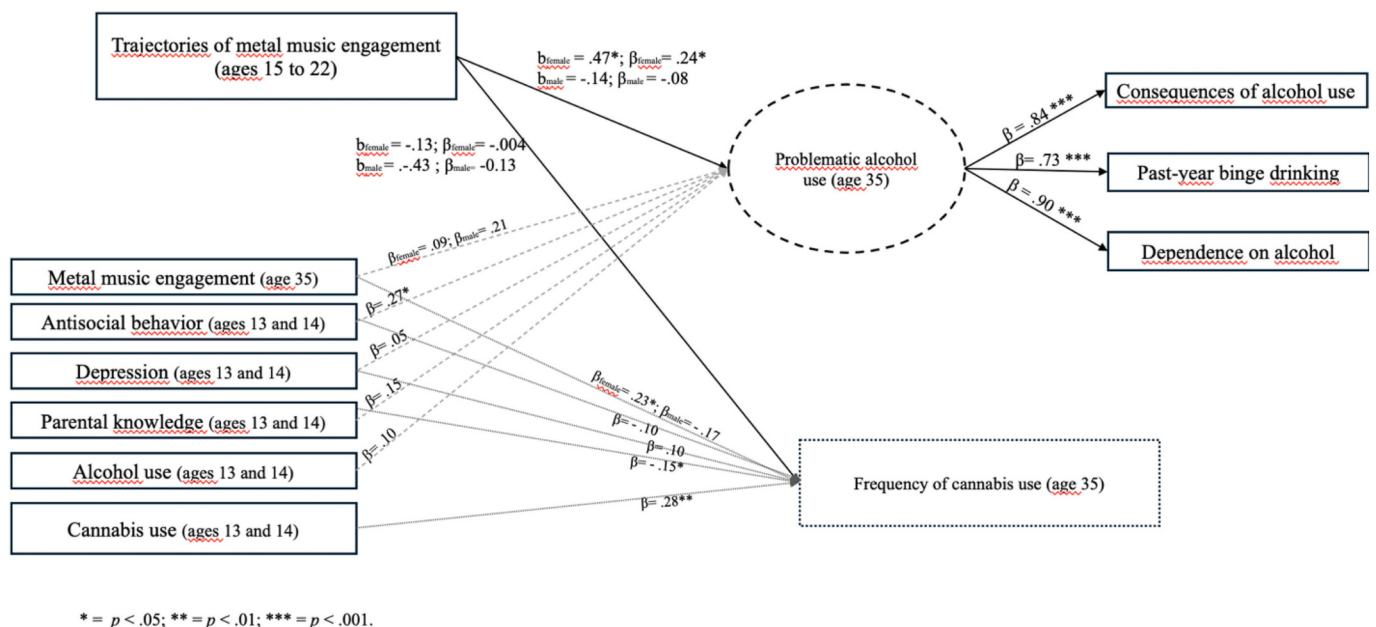


Fig. 1. Model of metal music trajectories and substance use.

Table 1
Descriptive statistics and correlations between study variables.

Study variables	M (SD)	Correlations																		
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
<i>Metal music engagement</i>																				
1. Age 15	1.64 (0.81)		0.69**	0.52**	0.41**	0.45**	0.37**	0.36**	0.42**	0.32**	0.21**	0.18**	0.23**	0.23**	0.10*	0.17**	0.20**	0.25**	0.18**	0.23**
2. Age 16	1.70 (0.82)			0.62**	0.48**	0.48**	0.38**	0.37**	0.38**	0.34**	0.23**	0.22**	0.24**	0.25**	0.12*	0.17**	0.17**	0.18**	0.14**	0.27**
3. Age 17	1.72 (0.81)				0.59**	0.51**	0.43**	0.42**	0.44**	0.32**	0.18**	0.16**	0.17**	0.21**	0.10**	0.16**	0.17**	0.15**	0.07	0.29**
4. Age 18	1.62 (0.78)					0.70**	0.60**	0.59**	0.57**	0.43**	0.24**	0.22**	0.20**	0.25**	0.07	0.12*	0.11*	0.10*	0.07	0.28**
5. Age 19	1.58 (0.75)						0.68**	0.68**	0.64**	0.48**	0.28**	0.25**	0.25**	0.30**	0.05	0.09	0.10*	0.10*	0.05	0.28**
6. Age 20	1.69 (0.79)							0.71**	0.74**	0.53**	0.34**	0.34**	0.33**	0.37**	0.06	0.12*	0.15**	0.10*	0.05	0.29**
7. Age 21	1.72 (0.80)								0.80**	0.53**	0.35**	0.34**	0.34**	0.42**	0.12*	0.18	0.18**	0.09	0.05	0.28**
8. Age 22	1.66 (0.77)									0.50**	0.34**	0.31*	0.32**	0.36**	0.07	0.13*	0.16**	0.10*	0.06	0.25**
<i>Problematic alcohol-use at age 35</i>																				
9. Alcohol-Related Consequences												0.89**	0.90**	0.75**	0.20**	0.20**	0.29**	0.29**	0.15**	0.22**
10. Past-Year Binge Drinking													0.89**	0.75**	0.23**	0.22**	0.30**	0.29**	0.12*	0.25**
11. Alcohol Dependence														0.75**	0.22**	0.20**	0.25**	0.30**	0.15**	0.22**
<i>Cannabis use at age 35</i>																				
12. Frequency of Cannabis Use															0.15**	0.21**	0.26**	0.25**	0.05	0.25**
<i>Control variables at ages 13–14</i>																				
13. Average alcohol-use per month																0.71**	0.66**	0.45**	−0.02	0.08
14. Average cannabis use per month																	0.69**	0.45**	0.12*	0.1
15. Antisocial behavior																		0.52**	−0.12*	0.15**
16. Depression																			0.52**	−0.53
17. Parental Knowledge																				0.03
<i>Control variable at age 35</i>																				
18. Metal music engagement	1.61 (1.78)										0.67**	0.65**	0.65**	0.72**	0.75**	0.15**	0.20**	0.22**	0.07	0.37**
<i>Moderator</i>																				
19. Gender																				

Note. N = 364 1 = Women, 2 = Men. * = $p < .05$. ** = $p < .01$.

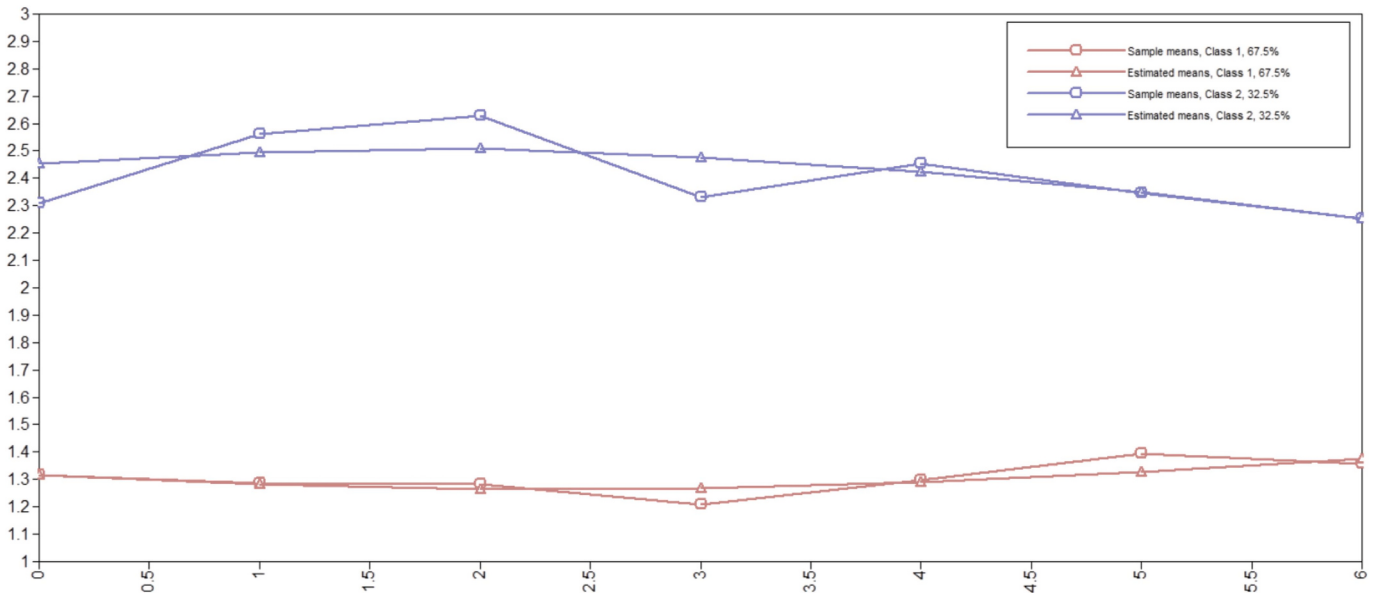
Table 2

Fit indices for one-, two- and three-class models for metal music engagement.

Solution	AIC	BIC	SSABIC	Average Latent Class Probabilities	Entropy	Class Counts and Proportions	MLR- LRT (<i>p</i>)	VMLR- LRT (<i>p</i>)	BLRT (<i>p</i>)
1-class	4026.08	4088.34	4037.58	—	—	—	—	—	—
2-class	3993.26	4051.64	4004.047	97.6% 95.5%	0.89	32.32% (117) 67.68% (245)	***	***	***
3-class	3898.69	3972.63	3912.35	86.6% 93.7% 95.7%	0.844	23.48% (85) 19.34% (70) 57.18% (207)	n.s	n.s	***

Note: AIC = Akaike information criterion, BIC = Bayesian information criterion, SSABIC = sample size adjusted BIC, LMR-LRT = Lo-Mendell-Rubin adjusted likelihood ratio test, VLMR-LRT = Vuong-Lo-Mendell-Rubin Likelihood Ratio Test, BLRT = Bootstrapped Likelihood Ratio Test. Optimal model is in bold.

* $p < .05$; ** $p < .01$; *** $p < .001$.

**Fig. 2.** Model with two metal music trajectories (LCGA).

Note: The MPQ-R (Nater et al., 2005) scale ranges from 1 (I do not like metal) to 3 (I adore metal), with 2 representing (I am indifferent to metal).

followed a “Lower metal music engagement” trajectory (Class 1), characterized by low initial interest in metal music at age 15, with a slight increase over time. The intercept for this group was $M = 1.34$ ($p < .001$), the slope was $M = -0.07$ ($p < .05$), and the quadratic slope was $M = 0.02$ ($p < .001$). This group maintained a consistently low engagement throughout the period, with scores remaining close to 1.34 throughout the period. A smaller group (32.69%; $N = 119$; 27,55% female) followed a “Higher metal music engagement” trajectory (Class 2), which demonstrated higher initial engagement at age 15 that slightly declined over time, though it remained relatively high throughout the period. The intercept for this group was $M = 2.39$ ($p < .001$), the slope was $M = 0.07$ ($p > .05$), and the quadratic slope was $M = -0.01$ ($p < .05$). Contrary to expectations, the “Declining metal music engagement” trajectory characterized by a high initial engagement at age 15 followed by a significant decline in emerging adulthood did not emerge from the analysis.

Links between metal music trajectories and problematic substance use

Confirmatory factor analysis model

A confirmatory factor analysis was conducted to assess the statistical validity of the latent construct of problematic alcohol use on a subsample of 297 participants who completed assessments at age 35. In the initial model (including only alcohol-related items), only standardized factor loadings are reported; model fit indices are not available as the model was saturated. All indicators significantly contributed to their

respective latent constructs. The standardized loadings for alcohol-related consequences, past-year binge drinking, and alcohol dependence in relation to problematic alcohol use were 0.84, 0.73, and 0.90, respectively, all significant at $p < .001$. This indicates adequate measurement of the latent construct.

Gender invariance of the latent construct

Using the same subsample and following standard procedures for longitudinal invariance measurement, we estimated a series of increasingly constrained models: configural, metric (weak) and scalar (strong; Little, 2024). At each level, the more restrictive model was compared to the preceding one using both absolute fit indices and chi-square difference testing (Bonneville-Roussy et al., 2013). The results provide evidence of scalar invariance of the problematic alcohol use latent construct across sexes. Model fits and comparative results for gender invariance analyses are presented in Table 3.

Regression model

A regression model was then conducted based on the scalar invariance model on a sample of 297 participants, each assigned to a metal music trajectory. The predictors included metal music trajectories and baseline measures of antisocial behavior, depression, parental monitoring, alcohol use, and cannabis use (assessed at ages 13 and 14), as well as metal music engagement at age 35. The latent construct of problematic alcohol use and cannabis use at age 35 served as dependent

Table 3

Gender Invariance Model Fits and Comparisons.

Model		CFI	TLI	RMSEA	SRMR	Δ CFI	Δ TLI	Δ RMSEA	Δ SRMR	$\Delta\chi^2$	df	p
Invariance	M1	1	1	0	0						0	
	M2	0.999	0.996	0.043	0.028	0.999	0.996	0.043	0.028	0.81	2	0.67
	M3	1	1	0	0.029	0.001	-0.004	-0.043	0.001	0.66	4	0.72

Note. M1 = configural model; M2 = weak (metric) invariance; M3 = strong (intercept) invariance. Delta coefficients are the absolute differences between the models. M2 is compared with M1; M3 is compared with M2. CFI = comparative fit index; TLI = Tucker-Lewis index; RMSEA = root-mean-square error of approximation; SRMR = standardized root-mean-square residual.

variables. To examine sex differences in the associations between trajectories and substance use outcomes, regression coefficients were estimated separately for males and females using a multigroup approach. The remaining paths in the model (i.e., between baseline levels and DV) were constrained to be equal across sexes, separately for each dependent variable, except for metal engagement at age 35 which was freely estimated due to its conceptual association with the main predictor.

The model fit was good (CFI = 0.97; TLI = 0.96; RMSEA = 0.04 [90% CI = 0.00, 0.07]; SRMR = 0.04). Additionally, results showed that for females, being on the high metal trajectory predicted greater problematic alcohol use ($b = 0.47$; $\beta = 0.24$; $SE = 0.21$; $p = .023$), but not cannabis use ($b = -0.01$; $\beta = -0.004$; $SE = 0.28$; $p > .05$). In other words, females following the high trajectory showed more alcohol-related problems than those on the low trajectory. For males, trajectories predicted neither alcohol use problems ($b = -0.14$; $\beta = -0.08$; $SE = 0.27$; $p > .05$), or cannabis use ($b = -0.43$; $\beta = -0.13$; $SE = 0.38$; $p > .05$).

For covariates, antisocial behavior at ages 13 and 14 predicted later problematic alcohol use ($\beta = 0.26$; $SE = 0.18$; $p < .05$), but less cannabis use at age 35 ($\beta = -0.18$; $SE = 0.27$; $p < .05$). Cannabis use at ages 13 and 14 predicted cannabis use at age 35 ($\beta = 0.28$; $SE = 0.07$; $p < .01$). Parental monitoring at ages 13 and 14 predicted less cannabis use at age 35 ($\beta = -0.15$; $SE = 0.16$; $p < .05$). Finally, metal music engagement at age 35 predicted cannabis use at age 35 among women ($\beta = 0.23$; $SE = 0.09$; $p < .05$) but not for men ($\beta = 0.17$; $SE = 0.11$; $p > .05$).

Discussion

Previous research has documented associations between metal music preferences and substance use during adolescence and emerging adulthood. However, most of these studies were cross-sectional and did not measure substance use beyond early emerging adulthood. Given that higher substance use at that age is likely to result in problematic use later in adulthood, a sustained preference for metal music from adolescence into emerging adulthood may have long-term problematic consequences for use. This study addressed this question using a 22-year longitudinal design that include repeated assessments of metal music preference from adolescence into emerging adulthood and problematic alcohol and cannabis use in established adulthood. The results of this study (1) identify two trajectories of metal music engagement across adolescence and emerging adulthood, including a lower one and a higher one, and (2) demonstrate that membership in the higher-engagement trajectory is associated with problematic alcohol use among women at age 35.

Trajectories of metal music engagement

Two distinct trajectories of metal music engagement emerged. The first, labeled the lower trajectory, included 67.31% of participants (72.45% female) who consistently reported disliking metal music between the ages of 15 and 22. The second, the higher trajectory, included 32.69% of participants (27.55% female) who maintained a sustained interest in metal music throughout this period. The fact that only a small number of women show a high level of interest in metal suggests that

female metal fans face overlapping forms of marginalization, including being a minority even within the very community they identify with. Our findings differ from those of [Ter Bogt et al., 2021](#)), who identified a third trajectory characterized by a temporary infatuation with metal music during mid-adolescence (ages 13–17), which declined sharply by late adolescence (age 18). While such an intermediate trajectory was expected, its absence may be due to the exclusion of early/mid-adolescence (ages 13–14) from the longitudinal design. It is possible that a middle trajectory is discernible in early adolescence. It might have merged with the higher trajectory, as evidenced by the decline in interest around ages 17–18.

Metal engagement trajectories and problematic alcohol use at age 35

The results suggest women who like metal music during adolescence and emerging adulthood are more vulnerable to later problematic alcohol use at age 35 compared to women who did not, even after controlling for early adolescent alcohol use and several established risk factors for later substance-related problems. In contrast, men who preferred metal from 15 to 22 years of age did not differ from male non-fans on any substance-use indicators assessed.

These findings raise the question of why sustained metal engagement is associated with later problematic drinking among women but not men, and whether metal preference itself provides the most informative explanation. Given the study's limited ability to account for pre-existing adversity and for mediating or moderating processes linking trajectories to later substance use, the discussion is organized around two complementary sets of hypotheses.

The first set focuses on processes embedded in participation in metal-related cultural contexts that may shape development in gendered ways, including identity-related dynamics, psychosocial and sociocognitive pressures, and coping functions. The second set considers the possibility that unmeasured underlying vulnerabilities or contextual factors account for both metal engagement and later substance use (i.e., a third-variable or selection hypothesis). Importantly, these hypotheses are presented as plausible interpretations rather than directly tested mechanisms.

Metal culture as a developmental context

Adolescence and emerging adulthood are key periods for identity formation ([Bosma, 2001](#)). During this time, musical preferences often function as symbolic social badges that signal belonging and become woven into individuals' emerging life narratives ([North & Hargreaves, 2012](#)). From this perspective, sustained engagement with metal may indicate that metal music related meanings, values, and peer contexts became developmentally salient for some women, potentially shaping socialization and coping over time.

One possible pathway is that metal may serve as a valued space for emotional expression, autonomy, and resistance to restrictive gender expectations. Qualitative research suggests that some women experience metal as an outlet for emotional release and self-expression, particularly when other environments feel constraining ([Krenske & McKay, 2000](#)). In this context, alcohol use may sometimes serve a parallel function by providing short-term relief or emotional discharge that

aligns with a rebellious ethos.

A second, non-exclusive pathway concerns the social dynamics of legitimacy and belonging within some metal scenes. Although women's experiences likely vary across subgenres and local contexts, authenticity and legitimacy are often shaped by masculine norms (Krenske & McKay, 2000). This perspective is consistent with ethnographic work conducted in Montreal, a major North American hub for metal music, which shows that women may feel pressure to establish credibility as legitimate scene members in male-dominated environments (Beauchamp, 2021). Under such conditions, heavy drinking may function not only as a coping strategy but also as a social practice that facilitates bonding, signals authenticity, or helps conform to masculine-coded expectations. Importantly, this interpretation does not suggest that these dynamics characterize all women who engage with metal; rather, they may apply to some women in specific scenes or at specific developmental periods.

These culture-linked dynamics may also intersect with broader gender norms surrounding alcohol use. Because heavy drinking tends to be more socially sanctioned for women than for men, behaviors accepted, or even valued, within some metal contexts may place women at odds with mainstream gender expectations (Chassin et al., 2002; Krenske & McKay, 2000; Nolen-Hoeksema & Hilt, 2009; Weinstein, 2000; Young et al., 2005). At the same time, acceptance within male-dominated scenes may remain conditional on repeatedly demonstrating authenticity. For some women, this combination of pressures could contribute to the maintenance of risky drinking patterns. By contrast, men generally do not face the same tension between establishing legitimacy within the scene and navigating broader societal expectations regarding alcohol use. This framework may help explain why the long-term association emerged for alcohol but not cannabis. Alcohol often carries a distinct symbolic and relational role in social settings, including functions tied to bonding and adult participation, and may therefore be more likely than cannabis to function as a marker of belonging or legitimacy within certain peer contexts. This interpretation remains provisional and would require direct measurement of peer norms, identity-related pressures, and substance-use motives within metal-related environments.

Third-variable and selection explanations

An alternative interpretation is that the observed association reflects selection effects and unmeasured third variables rather than culture-specific socialization processes. In this account, earlier vulnerabilities, such as psychosocial adversity and sustained experiences of social difficulties, may increase the likelihood of both gravitating toward non-mainstream music cultures and using alcohol as a coping tool. From this perspective, metal preference and later substance use may co-occur because they are both embedded in a broader constellation of developmental experiences, not because metal engagement itself is the primary driver of later drinking problems.

Several contextual processes invoked to explain the findings (e.g., perceived marginalization and social influences) were not directly assessed. Although the analyses controlled for early adolescent alcohol use and other established predictors (prior mental health, antisocial behavior), residual confounding remains plausible, especially for constructs not measured in the dataset (e.g., social affiliations, peer-group norms, coping motives, emotional regulation difficulties, victimization). Accordingly, metal engagement may function as a developmental marker of broader vulnerability and coping contexts that also predict later substance use, rather than as a primary causal driver.

Female metal fans represent a small and largely understudied subgroup that has not previously been examined longitudinally with respect to their substance use. The interpretations offered here should be considered tentative. The proposed mechanisms are best viewed as theoretically informed hypotheses rather than established explanations.

Strengths, limitations and future studies

This study has several methodological strengths and makes a meaningful contribution to the literature on marginal musical preferences and developmental outcomes. The longitudinal design spans nearly 22 years and benefits from a high retention rate, allowing for robust developmental analyses across adolescence, emerging adulthood, and established adulthood. Metal music preference was assessed repeatedly between ages 15 and 22, which enabled the identification of distinct trajectories of engagement using latent trajectory modeling rather than relying on single time-point measures. To our knowledge, this is the first longitudinal study to examine how sustained involvement in a marginal music culture during adolescence and emerging adulthood relates to problematic alcohol and cannabis use in mid-adulthood. Importantly, the study extends prior work by demonstrating that these associations are different across genders, thereby bringing attention to a subgroup of women who has remained largely invisible in longitudinal empirical research on music preferences and substance use. By identifying long-term associations that differ for women and men, the study moves beyond short-term risk correlations (confirmed by prior studies) and highlights how cultural preferences may be embedded within longer developmental trajectories. Furthermore, potential confounding factors were carefully addressed by controlling for early adolescent alcohol use as well as established risk factors for later substance-related problems. Although the study does not directly test mechanisms of risk amplification or amelioration, it provides a critical developmental foundation for future research to examine how identity-related, psychosocial, and contextual processes may shape long-term outcomes associated with marginal culture affiliations.

Nonetheless, several limitations should be noted. First, the sample was relatively socio-demographically homogeneous, which may limit the generalizability of the findings; replication in more diverse populations is needed to clarify how cultural engagement relates to developmental outcomes. Second, the study relied on self-report data, raising the possibility of shared method variance and social desirability bias. This issue is particularly relevant for single-item indicators, especially the measure of metal music preference, which may show lower reliability and validity than multi-item or multi-method assessments. Accordingly, interpretations of musical trajectories should be made with caution, and future research using more robust measurement strategies is warranted, as we cannot assume that the observed long-term associations are solely attributable to metal preference. An additional limitation concerns potential unmeasured confounding and selection effects. Because the design is correlational, causal inferences are not warranted. It is possible that earlier vulnerabilities, such as childhood or adolescent adversity, a persistent sense of social marginalization, or broader psychosocial difficulties predispose some individuals both to gravitate toward non-mainstream music cultures and to engage in substance use as a coping strategy. As such, the observed associations should not be interpreted as evidence that metal music or metal culture causally produces later substance-related outcomes. Rather, consistent with our developmental and sociocultural framing, metal preference is best viewed as a marker of a broader constellation of experiences and contexts that may co-occur with long-term risk. Potential protective dimensions of involvement in non-mainstream music cultures (e.g., social support, identity affirmation) were not assessed, even though such factors may help explain when cultural involvement is beneficial versus when it co-occurs with elevated risk.

Future research should examine the social and psychological processes that may underlie the long-term association between sustained metal preference among women and problematic alcohol use at age 35. Metal-focused studies could investigate gendered dynamics within relevant peer and cultural contexts (e.g., marginalization, identity formation, authenticity pressures, conformity to masculine-coded norms), alongside the emotion-regulation and coping functions that metal communities may serve. Research should also test whether early

adversity is a stronger predictor of later substance use than metal preference, or vice versa, and whether metal preference adds incremental predictive value once adversity is considered. Because adolescence and emerging adulthood are periods when alcohol experimentation is common, longitudinal studies could examine whether exposure to heavier-drinking norms in metal-oriented peer groups contributes to the consolidation of drinking motives and routines over time, while explicitly considering alternative explanations such as selection into specific peer contexts. They should also model early covariates not only as controls but as potentially protective or risk-enhancing influences (e. g., early substance use, parental knowledge, depressive symptoms, antisocial behavior), examining how these factors shape trajectories of music engagement and substance-use outcomes. Beginning the assessment of musical preferences in pre- and early adolescence would further improve our understanding of developmental processes of risk amplification and moderation. Finally, comparative research across multiple non-mainstream genres is needed to determine whether the observed patterns are specific to metal or reflect broader dynamics of subcultural involvement. Such analyses were beyond the scope of the present study because they require sufficiently large samples to estimate reliable trajectories across relatively uncommon and often gender-skewed music preferences, particularly for gender-stratified analyses. Future research should model trajectories for multiple genres within the same dataset, directly compare long-term outcomes, and examine gender differences within a unified analytic framework using sufficiently large samples to ensure adequate representation of women within each non-mainstream music preference group.

Conclusion

Prior studies have documented associations between preferences for certain non-mainstream music genres and short-term risks of problematic substance use during adolescence and emerging adulthood. However, little is known about their long-term implications for alcohol and cannabis use in established adulthood, particularly among women involved in these music cultures. Extending this work, the present study suggests that sustained engagement with metal music between ages 15 and 22 represents a developmental and sociocultural marker of increased risk for problematic alcohol use at age 35 among women, rather than a discrete causal factor.

The present study contributes to the literature by showing that female fans who maintained strong involvement in the metal scene during adolescence and emerging adulthood were more likely to report problematic drinking in adulthood, even after accounting for early alcohol use and early vulnerabilities to adult problematic alcohol use (i.e., depression, antisocial behavior, etc.). In contrast, male fans did not differ from male non-fans on any substance use indicators.

Adolescence and the early stage of emerging adulthood is marked by experimentation with alcohol and other substances. Because drinking habits often take shape during this period, the cultural emphasis on heavy drinking within the metal scene can reinforce risky behaviors at a critical time of identity formation. It is possible that these dynamics and cultural norms increase the likelihood that early experimentation evolves into persistent and problematic use later in life.

These findings support the interpretation of musical preferences as developmental markers, rather than as causal determinants of later problematic outcomes. Music often plays a positive role during adolescence and emerging adulthood by supporting identity formation, belonging, and emotional expression. However, for a subgroup of women, sustained engagement with metal music may coincide with broader psychosocial contexts that increase vulnerability to problematic alcohol use later in life.

Applied implications

Conceptualizing metal preference as a developmental marker

embedded in a broader sociocultural context supports a reflective, non-alarmist interpretation of musical tastes. Rather than treating metal as a discrete risk factor, parents, educators, and clinicians can view sustained engagement with metal as a broader constellation of sociocultural and developmental influences and use it as starting point for open, non-judgmental conversations about what the music and the scene provide, identity support, belonging, emotion regulation, and peer norms.

In some cultural environments, these elements may converge in ways that shape women's social experiences and coping strategies, including how and why alcohol is used, in ways that may be different from those of men. More broadly, gendered socialization, norm enforcement, and the symbolic role of alcohol may help explain why similar patterns of musical engagement are associated with long-term drinking outcomes among women but not men.

When substance use is present, this perspective can help practitioners explore whether alcohol or cannabis functions as coping, social functions, or identity signaling within specific peer contexts, and to support alternative coping strategies and healthier sources of belonging when needed. In short, metal preference is not a risk indicator but may help identify contexts that warrant clinical exploration and future research.

CRedit authorship contribution statement

Catherine McConnell: Writing – original draft, Formal analysis, Conceptualization. **François Poulin:** Writing – review & editing, Supervision, Funding acquisition, Data curation. **Olivier Vivier:** Methodology, Formal analysis.

Data availability

The data that has been used is confidential.

References

- Akaike, H. (1987). Factor analysis and AIC. *Psychometrika*, 52, 317–332. <https://doi.org/10.1007/BF02294359>
- Akerlof, G.-A., & Kranton, R.-E. (2002). Identity and schooling: Some lessons for the economics of education. *Journal of Economic Literature*, 40(4), 1167–1201. <https://doi.org/10.1257/002205102762203585>
- Arnett, J. (1991). Adolescents and heavy metal music: From the mouths of metalheads. *Youth & Society*, 23(1), 76–98. <https://doi.org/10.1177/0044118X91023001004>
- Arnett, J. (1993). Three profiles of heavy metal fans: A taste for sensation and a subculture of alienation. *Qualitative Sociology*, 16(4), 423–443. <https://doi.org/10.1007/BF00989973>
- Arnett, J. (1996). *Metalheads: Heavy Metal Music and Adolescent Alienation*. Westview Press. <https://doi.org/10.4324/9780429498985>
- Arteaga, I., Chen, C. C., & Reynolds, A. J. (2010). Childhood predictors of adult substance abuse. *Children and Youth Services Review*, 32(8), 1108–1120. <https://doi.org/10.1016/j.childyouth.2010.04.025>
- Baraldi, A. N., & Enders, C. K. (2010). An introduction to modern missing data analyses. *Journal of School Psychology*, 48(1), 5–37. <https://doi.org/10.1016/j.jsp.2009.10.001>
- Beauchamp, C. (2021). *Gender and extreme metal: Understanding gender relations in the Montreal extreme metal scene with Schippers' gender framework [Master's thesis, Concordia University]*. Spectrum Research Repository. <https://spectrum.library.concordia.ca/id/eprint/988125/>.
- Becht, A., & Ter Bogt, T. (2026). "I Can See Clearly Now": On the time-varying associations between self-concept clarity and music preferences across adolescence into young adulthood. *Psychology of Music*, 0(0). <https://doi.org/10.1177/0305735625141439>
- Bogt, T. F. T., Gabhainn, S. N., Simons-Morton, B. G., Ferreira, M., Hublet, A., Godeau, E., & the HBSC Risk Behavior and the HBSC Peer Culture Focus Groups. (2012). Dance is the new metal: Adolescent music preferences and substance use across Europe. *Substance Use & Misuse*, 47(2), 130–142. <https://doi.org/10.3109/10826084.2012.637438>
- Boivin, M., Poulin, F., & Vitaro, F. (1994). Depressed mood and peer rejection in childhood. *Development and Psychopathology*, 6(3), 483–498. <https://doi.org/10.1017/S0954579400006064>
- Bonneville-Roussy, A., Rentfrow, P. J., Xu, M. K., & Potter, J. (2013). Music through the ages: Trends in musical engagement and preferences from adolescence through middle adulthood. *Journal of Personality and Social Psychology*, 105(4), 703–717. <https://doi.org/10.1037/a0033770>
- Bosma, H. A. (2001). Identity development: Adolescence through adulthood. *Identity*, 1(1), 95–96. <https://doi.org/10.1207/S1532706X>

- Brown, T. A. (2006). *Confirmatory factor analysis for applied research*. New York, NY: Guilford Press.
- Browne, M. W., & Cudeck, R. (1993). Alternative ways of assessing model fit. In K. A. Bollen, & J. S. Long (Eds.), *Testing structural equation models* (pp. 136–162). Sage Publications.
- Buckley, K., & Anderson, C. (2006). *A theoretical model of the effects and consequences of playing video games*. Chapter. Lawrence Erlbaum Associates.
- Celex, G., & Soromenho, G. (1996). An entropy criterion for assessing the number of clusters in a mixture model. *Journal of Classification*, 13, 195–212. <https://doi.org/10.1007/BF01246098>
- Chassin, L., Pitts, S. C., & Prost, J. (2002). Binge drinking trajectories from adolescence to emerging adulthood in a high-risk sample: Predictors and substance abuse outcomes. *Journal of Consulting and Clinical Psychology*, 70(1), 67.
- Chen, F. F. (2007). Sensitivity of goodness of fit indices to lack of measurement invariance. *Structural Equation Modeling*, 14, 464–504.
- Chen, M. J., Miller, B. A., Grube, J. W., & Waiters, E. D. (2006). Music, substance use, and aggression. *Journal of Studies on Alcohol*, 67(3), 373–381. <https://doi.org/10.15288/jsa.2006.67.373>
- Coyne, S. M., & Padilla-Walker, L. M. (2015). Sex, violence, & rock n' roll: Longitudinal effects of music on aggression, sex, and prosocial behavior during adolescence. *Journal of Adolescence*, 41, 96–104. <https://doi.org/10.1016/j.adolescence.2015.03.002>
- Cranford, J. A., McCabe, S. E., & Boyd, C. J. (2006). A new measure of binge drinking: Prevalence and correlates in a probability sample of undergraduates. *Alcoholism: Clinical and Experimental Research*, 30, 1896–1905. <https://doi.org/10.1111/j.1530-0277.2006.00234.x>
- Delsing, M. J. M. H., ter Bogt, T. F. M., Engels, R. C. M. E., & Meeus, W. H. J. (2008). Adolescents' music preferences and personality characteristics. *Eur. J. Pers.*, 22, 109–130. <https://doi.org/10.1002/per.665>
- Dowd, T. J. (2013). Music from abroad: The internationalization of the US mainstream music market, 1940–90. In *Redefining mainstream popular music* (1st ed., pp. 1–12). Routledge.
- Feldstein, S. W., & Miller, W. R. (2006). Substance use and risk-taking among adolescents. *Journal of Mental Health*, 15(6), 633–643. <https://doi.org/10.1080/09638230600998896>
- Frandsen, D. (2010). Living for music, dying for life: The self-destructive lifestyle in the heavy metal culture. In *Heavy Fundamentals: Music, Metal and Politics* (pp. 9–17). Brill. https://doi.org/10.1163/9781848880177_003
- Young, A. M., Morales, M., McCabe, S. E., Boyd, C. J., & D'arcy, H. (2005). Drinking like a guy: Frequent binge drinking among undergraduate women. *Substance Use & Misuse*, 40(2), 241–267. <https://doi.org/10.1081/JA-200048464>
- Franken, A., Keijsers, L., Dijkstra, J. K., Ter Bogt, T. (2017). Music preferences, friendship, and externalizing behavior in early adolescence: A SIENA examination of the music marker theory using the SNARE study. *Journal of Youth and Adolescence*, 46(8), 1839–1850. <https://doi.org/10.1007/s10964-017-0633-4>
- Gardikiotis, A., & Baltzis, A. (2011). "Rock music for myself and justice to the world": Musical identity, values, and music preferences. *Psychology of Music*, 40(2), 143–163. <https://doi.org/10.1177/0305735610386836> (Original work published 2012)
- Hayatbaksh, M. R., Mamun, A. A., Najman, J. M., O'Callaghan, M. J., Bor, W., & Alati, R. (2008). Early childhood predictors of early substance use and substance use disorders: Prospective study. *Australian & New Zealand Journal of Psychiatry*, 42(8), 720–731. <https://doi.org/10.1080/0004867080220634>
- Hein, F. (2004). Chapitre 6. Les amateurs de metal. In *Hard rock, Heavy Metal, Metal*. Guichen: Éditions Mélanie Seteun. <https://doi.org/10.4000/books.ms.771>
- Heisbourg, E. (2021). Le lien entre préférences musicales et attitudes politiques au Québec. *Politique et Sociétés*, 40(3), 197–236. <https://doi.org/10.7202/1083029ar>
- Hill, R. L. (2016). Listening to hard rock and metal music. In *Gender, Metal and the Media: Women Fans and the Gendered Experience of Music* (pp. 105–132). London: Palgrave Macmillan UK. https://doi.org/10.1057/978-1-137-55441-3_5
- Hines, M., & McFerran, K. S. (2014). Metal made me who I am: Seven adult men reflect on their engagement with metal music during adolescence. *International Journal of Community Music*, 7(2), 205–222. <https://doi.org/10.1386/ijcm.7.2.205.1>
- Hu, L., & Bentler, P. M. (1999). Cutoff criteria for fit indexes in covariance structure analysis: Conventional criteria versus new alternatives. *Structural Equation Modeling: A Multidisciplinary Journal*, 6(1), 1–55. <https://doi.org/10.1080/10705519909540118>
- Janosz, M., Bouthillier, M., Bowen, F., Chouinard, R., & Desbiens, N. (2007). *Développement et validation du questionnaire sur l'environnement socioéducatif des écoles primaires (QES-primaire) (Rapport n3550-U3)*. Université de Montréal. <https://docplayer.fr/46563053-Rapport-de-validation-de-questionnaire-sur-l-environnement-socioeducatif-des-ecoles-primaires-qes-primaire.html>
- Kairouz, S., Boyer, R., Nadeau, L., Perreault, M., & Fiset-Laniel, J. (2008). *Troubles Mentaux, Toxicomanie et Autres Problèmes Liés à la Santé Mentale Chez les Adultes Québécois. Enquête sur la Santé Dans les Collectivités Canadiennes (cycle 1.2)* (p. 67). Québec: Institut de la Statistique du Québec.
- Kovacs, M. (1985). The children's depression inventory (CDI). *Psychopharmacology Bulletin*, 21(4), 995–998.
- Krenke, L., & McKay, J. (2000). "Hard and heavy": Gender and power in a heavy metal music subculture. *Gender, Place and Culture*, 7(3), 287–304. <https://doi.org/10.1080/713668874>
- Laakasuo, Michael, Leshner, Connor, & Pereira, Maya (2025). *Made of metal: Reviewing the psychology and personality of subgroups of the metal music fandom*. https://doi.org/10.31234/osf.io/x7hcb_v1
- Lacourse, E., Claes, M., & Villeneuve, M. (2001). Heavy metal music and adolescent suicidal risk. *Journal of Youth and Adolescence*, 30(3), 321–332. <https://doi.org/10.1023/A:1010492128537>
- Larsson, S. (2013). I bang my head, therefore I am': Constructing individual and social authenticity in the heavy metal subculture. *Young*, 21(1), 95–110. <https://doi.org/10.1177/1103308812467673> (Original work published 2013)
- Lerner, R. M. (1989). Developmental contextualism and the life-span view of person-context interaction. In M. H. Bornstein, & J. S. Bruner (Eds.), *Interaction in human development* (pp. 217–239). Lawrence Erlbaum Associates, Inc.
- Little, T. D. (2024). *Longitudinal structural equation modeling*. Guilford Publications.
- Liu, M., Hu, X., & Sched, M. (2018). The relation of culture, socio-economics, and friendship to music preferences: A large-scale, cross-country study. *PLoS One*, 13 (12), Article e0208186. <https://doi.org/10.1371/journal.pone.0208186>
- Lo, Y., Mendell, N. R., & Rubin, D. B. (2001). Testing the number of Components in a normal mixture. *Biometrika*, 88(3), 767–778. <https://doi.org/10.1093/biomet/88.3.767>
- Lozon, J., & Bensimon, M. (2014). Music misuse: A review of the personal and collective roles of "problem music. *Aggression and Violent Behavior*, 19(3), 207–218. <https://doi.org/10.1016/j.avb.2014.04.003>
- MacDonald, R., & Saarikallio, S. (2022). Musical identities in action: Embodied, situated, and dynamic. *Musicae Scientiae*, 26(4), 729–745. <https://doi.org/10.1177/10298649221108305>
- Marsh, H. W., Muthén, B., Asparouhov, T., Lüdtke, O., Robitzsch, A., Morin, A. J. S., & Trautwein, U. (2009). Exploratory structural equation modeling, integrating CFA and EFA: Applications to students' evaluations of university teaching. *Structural Equation Modeling*, 16, 439–476.
- Marsh, H. W., Hau, K.-T., & Wen, Z. (2004). In search of golden rules: Comment on hypothesis-testing approaches to setting cutoff values for fit indexes and dangers in overgeneralizing Hu and Bentler's (1999) findings. *Structural Equation Modeling: A Multidisciplinary Journal*, 11(3), 320–341. https://doi.org/10.1207/s15328007sem1103_2
- McCabe, S. E., Schulenberg, J. E., Schepis, T. S., McCabe, V. V., & Veliz, P. T. (2022). Longitudinal analysis of substance use disorder symptom severity at age 18 years and substance use disorder in adulthood. *JAMA Network Open*, 5(4), Article e225324. <https://doi.org/10.1001/jamanetworkopen.2022.5324>
- McLachlan, G. J., & Peel, D. (2000). *Finite mixture models*. New York: Wiley. <https://doi.org/10.1002/0471721182>
- Messick, K. J., Agcaolli, D., Drane, H., & Taylor, H. (2024). Are heavy metal fans sexist? The relationship between metal music depicting misogynistic violence and sexism. *Metal Music Studies*, 10(1), 41–60. https://doi.org/10.1386/mms_00126_1
- Metzler, C. W., Biglan, A., Ary, D. V., & Li, F. (1998). The stability and validity of early adolescents' reports of parenting constructs. *Journal of Family Psychology*, 12(4), 600–619. <https://doi.org/10.1037/0893-3200.12.4.600>
- Miranda, D., & Claes, M. (2004). Rap music genres and deviant behaviors in French-Canadian adolescents. *Journal of Youth and Adolescence*, 33(2), 113–122. <https://doi.org/10.1023/B:JOYO.0000013423.34021.45>
- Miranda, D., Gaudreau, P., Debrosse, R., Morizot, J., & Kirmayer, L. J. (2012). Music listening and mental health: Variations on internalizing psychopathology. In *Music, Health, and Wellbeing* (pp. 514–530). <https://doi.org/10.1093/acprof:oso/978019586974.003.0004>
- Mulder, J., Ter Bogt, T. F., Raaijmakers, Q. A., Nic Gabhainn, S., Monshouwer, K., & Vollebergh, W. A. (2010). Is it the music? Peer substance use as a mediator of the link between music preferences and adolescent substance use. *Journal of Adolescence*, 33(3), 387–394. <https://doi.org/10.1016/j.adolescence.2009.09.001>
- Muthén, B. O., & Muthén, L. K. (2000). Integrating person-centered and variable-centered analyses: Growth mixture modeling with latent trajectory classes. *Alcoholism, Clinical and Experimental Research*, 24(6), 882–891.
- Muthén, B., & Muthén, L. K. (2000). Integrating person-centered and variable-centered analyses: Growth mixture modeling with latent trajectory classes. *Alcoholism: Clinical and Experimental Research*, 24(6), 882–891. <https://doi.org/10.1111/j.1530-0277.2000.tb02070.x> [pubmed.ncbi.nlm.nih.gov]. [scirp.org].
- Muthén, L. K., & Muthén, B. O. (1998–2015). *Mplus user's guide* (Seventh Edition). Los Angeles, CA: Muthén & Muthén.
- Nater, U. M., Krebs, M., & Ehlert, U. (2005). Sensation seeking, music preference, and psychophysiological reactivity to music. *Musicae Scientiae*, 9(2), 239–254. <https://doi.org/10.1177/102986490500900205>
- NIAAA. [Internet.]. (2007). *Defining binge drinking. What colleges need to know now. Bethesda (MD)*. National Institutes of Health [cited 2023 Feb 20]. Available from: https://www.collegedrinkingprevention.gov/sites/cdp/files/documents/1CollegeBulletin-508_361C4E.pdf
- Nolen-Hoeksema, S., & Hilt, L. M. (2009). Gender differences in depression. In I. H. Gotlib, & C. L. Hammen (Eds.), *Handbook of depression* (2nd ed., pp. 386–404). The Guilford Press.
- North, A. C., & Hargreaves, D. J. (2012). Pop music subcultures and wellbeing. In R. MacDonald, G. Kreutz, & L. Mitchell (Eds.), *Music, health, and wellbeing* (pp. 263–276). Oxford Academic. <https://doi.org/10.1093/acprof:oso/978019586974.003.0033>
- Przybylski, A. K., Rigby, C. S., & Ryan, R. M. (2010). A motivational model of video game engagement. *Review of General Psychology*, 14(2), 154–166. <https://doi.org/10.1037/a0019440>
- Raistrick, D., Dunbar, G., & Davidson, R. (1983). Development of a questionnaire to measure alcohol dependence. *British Journal of Addiction*, 78(1), 89–95. <https://doi.org/10.1111/j.1360-0443.1983.tb02484.x>
- Rentfrow, P. J., & Gosling, S. D. (2006). Message in a ballad: The role of music preferences in interpersonal perception: The role of music preferences in

- interpersonal perception. *Psychological Science*, 17(3), 236–242. <https://doi.org/10.1111/j.1467-9280.2006.01691.x>
- Rogers, A. S., & Deflem, M. (2021). Metalhead: Music as identity. In *Doing Gender in Heavy Metal: Perceptions on Women in a Hypermasculine Subculture* (pp. 41–46). Chapter, Anthem Press.
- Schulenberg, J., Maslowsky, J., Patrick, M. E., & Martz, M. (2019). Substance use in the context of adolescent development. In *The Oxford Handbook of Adolescent Substance Abuse* (pp. 19–35).
- Schwarz, G. (1978). Estimating the dimension of a model. *Annals of Statistics*, 6, 461–464. <https://doi.org/10.1214/aos/1176344136>
- Selfhout, M. H., Delsing, M. J., Ter Bogt, T. F., & Meeus, W. H. (2008). Heavy metal and hip-hop style preferences and externalizing problem behavior: A two-wave longitudinal study. *Youth & Society*, 39(4), 435–452. <https://doi.org/10.1177/004118X0730806>
- Sikkema, P. (1999). *Jongeren'99: Een Generatie Waar om Gevochten Wordt [Youth'99: A Generation That Is Being Fought For]*. Interview-NSS/Qrius Research.
- Slater, M. D., & Henry, K. L. (2013). Prospective in urgency of music-related media exposure on adolescent substance-use initiation: A peer group mediation model. *Journal of Health Communication*, 18(3), 291–305. <https://doi.org/10.1080/10810730.2012.727959>
- Spracklen, K. (2018). Sex, drugs, Satan and rock and roll: Re-thinking dark leisure, from theoretical framework to an exploration of pop-rock-metal music norms. *Annals of Leisure Research*, 21(4), 407–423. <https://doi.org/10.1080/11745398.2017.1326156>
- Stattin, H., & Kerr, M. (2000). Parental monitoring: A reinterpretation. *Child Development*, 71(4), 1072–1085. <https://doi.org/10.1111/1467-8624.00210>
- Tajfel, H., & Turner, J. C. (1979). An integrative theory of intergroup conflict. In W. G. Austin, & S. Worchel (Eds.), *The social psychology of intergroup relations* (pp. 33–47). Monterey: Brooks/Cole.
- Tanner, J., Asbridge, M., & Wortley, S. (2008). Our favourite melodies: Musical consumption and teenage lifestyles 1. *The British Journal of Sociology*, 59(1), 117–144. <https://doi.org/10.1111/j.1468-4446.2007.00185.x>
- Ter Bogt, T., Soitos, S., & Delsing, M. (2011). Music listening in adolescence. In B. B. B.rown, & M. J. Prinstein (Eds.), *1. Encyclopedia of Adolescence* (pp. 240–250). Academic Press. <https://doi.org/10.1016/B978-0-12-373951-3.00029-6>.
- Ter Bogt, T. F., Keijsers, L., & Meeus, W. H. (2013). Early adolescent music preferences and minor delinquency. *Pediatrics*, 131(2), 380–389. <https://doi.org/10.1542/peds.2012-0708>
- Ter Bogt, T. T., Hale, W. W., III, & Becht, A. (2021). Wild years": Rock music, problem behaviors and mental well-being in adolescence and young adulthood. *Journal of Youth and Adolescence*, 50(12), 2487–2500. <https://doi.org/10.1007/s10964-021-01505-0>
- Tremblay, J., & Blanchette-Martin, N. (2009). *Manuel D'utilisation du Déba-Alcool/ Drogues/Jeu*. Québec: Trois-Rivières.
- Van Ryzin, M. J., Fosco, G. M., & Dishion, T. J. (2012). Family and peer predictors of substance use from early adolescence to early adulthood: An 11-year prospective analysis. *Addictive Behaviors*, 37(12), 1314–1324. <https://doi.org/10.1016/j.addbeh.2012.06.020>
- Walls, T. A., Wielt, D. B., Bollen, K. A., & Curran, P. J. (2006). *Latent curve models: A structural equation approach* (pp. 643–646). Hoboken, NJ: Wiley. *Psychometrika* 72, (2007) <https://doi.org/10.1007/s11336-007-9011-6>.
- Wang, J., & Wang, X. (2019). *Structural equation modeling: Applications using Mplus* (2nd ed.). John Wiley & Sons.
- Weinstein, D. (2000). *Heavy Metal: The Music and Its Culture*. Da Capo Press.