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Research Article

SEX DRUGS AND ROCK AND ROLL: EVIDENCE SUPPORTING THE STORIED TRILOGY

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ABSTRACT

Sex, drugs, and rock and roll (SDRR) is a storied trilogy in popular culture. However, in scientific literature, there is little empirical evidence to determine if there is a positive relationship between these three phenomena, despite biological, psychological, and social reasons that would suggest they are connected. Via questionnaire, we asked participants to self-report alcohol and drug use, sexual behaviors and attitudes, and musical ability and preference. Although evidence was limited, there was some support for an SDRR connection, particularly among male performers and female listeners of rock and "harder" music. Interestingly, this mimics patterns of several bird species where males are the producers and females are the consumers of song. Ethological considerations and future directions are discussed.

Keywords: *Rockmusic, birdsong, sex and drugs, substance use.*

INTRODUCTION

A 1977 song by Ian Dury boasted the title "Sex & Drugs & Rock & Roll," and this phrase can be noted throughout popular culture (Bogosian, 1990; Brake, 2013). Are these three phenomena indeed inherently connected? The positive association between sexuality (i.e., being sexually active, engaging in risky sexual behavior) and substance use is documented extensively in scientific literature (Rees, Argys, & Averett, 2001; Sen, 2002; Tapert, Aarons, Sedlar, & Brown, 2001). Schulte and Hser (2014) stated that "substance use and risky sexual behavior represent part of a constellation of reckless behaviors" (p.

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8). Is music also part of this constellation? Via survey, we attempted to gauge whether there is a positive relationship between sex, drugs, and rock and roll (SDRR)

Evidence does indirectly support connections between the components of this triumvirate. People with increased sensation seeking (a personality trait marked by a preference for risky, intense experiences) prefer rock music (Little & Zuckerman, 1986), and sensation seeking is strongly connected to substance use (Wagner, 2001). Some studies (Chen et al., 2006; Forsyth, Barnard, & McKegany, 1997; Miller & Quigley, 2012) have demonstrated that listeners of particular musical genres (e.g., rap, rock) were more likely than others to have engaged in substance use. Greenburg and colleagues (2015) showed that substance use was weakly related to musical expertise. A study by Arnett (1991) showed that adolescents who liked heavy metal music were more likely to illegal drug use and driving while drunk. However, this study did not consider other music potentially considered to be rock and roll. To our knowledge, there are no studies to date that have empirically examined the sex, drugs, and rock and roll (SDRR) association per se.

Possible Biological Mechanisms of SDRR

Although our study consists of behavioral self-report, there are physiological reasons why there may be a positive SDRR relationship. If there are biological underpinnings of SDRR, evolutionarily adaptive functioning may be elucidated.

Testosterone

Dabbs and Morris (1990) highlighted that high testosterone (T), an androgenic steroid hormone, presents a picture of "excessive behavior" (p. 209). Dabbs (2000) noted that people with high T are "competitive, bold, energetic, attractive…and frequently outrageous" (p. 5). It may be the case that T underpins the SDRR relationship.

Human sexual behavior, though complex and a product of numerous variables, is influenced by T levels. T moderates interest and motivation in sexual activity (Dabbs, 2000; Hirschenhauser & Oliveira, 2006). In men and women men, higher T levels are associated with increased sexual interest, desire, excitement, and activity (Bogaert & Fisher, 1995; Halpern et al., 1997, 1998; van Anders & Dunn, 2009). T is also related to sexual risk, as it is a predictor of number of sexual partners (Pollet, van der Meij, Cobey, & Buunk, 2011; van Anders, Hamilton, & Watson, 2007) and the desire for sex outside of one's committed relationships (Edelstein, Chopik, & Kean, 2011).

There is evidence that T is connected to substance use. Higher T is related to increased hard drug use, marijuana, alcohol use, and substance abuse issues (Dabbs, 2000; Dabbs & Morris, 1990; King, Errico, & Parsons, 1995). Substance use itself is related to other risk-taking behaviors, particularly sexual risk (Santelli, Robin, Brener, & Lowry, 2001), sensation-seeking (Wagner, 2001), and disinhibition (Colfax et al., 2004; Iacono et al., 1999). T has been well documented as a factor in risk-taking, sensation-seeking, and disinhibition in human and non-human animal models (Cooper et al., 2014; Daitzman & Zuckerman, 1980; Ronay & von Hipple, 2010; Wood et al., 2013) and has long been theorized to underlie impulsivity as a stable trait (Eysenck, 1967; Zuckerman, Buchsbaum, & Murphy, 1980). Impulsiveness positively predicts daily cocaine use (Moeller et al., 2001). There are likely common genetic mediators of

impulsivity, drug abuse and addiction, and risk taking (Kreek et al., 2005); indeed, Allen and colleagues (1998) showed that people with a history of drug dependence had higher levels of impulsivity.

Testosterone can also be linked to music. Musicians show higher spatial abilities than non-musicians (Hassler, 1991). Because musical ability is linked to spatial ability, and T is linked to increased spatial abilities (Hassler, Gupta, & Wollmann, 1992), it may be that T facilitates musical ability by influencing spatial abilities (Borniger, Chaudhry, & Muehlenbein, 2013; Hassler et al., 1992). Hassler (2000) noted that musicians are more likely to be non-right-handed, which is associated with increased T levels. Borniger et al. (2013) found that women (but not men) with lower second-to-fourth digit (2D:4D) finger ratios had a higher rank in a musical orchestra than those with higher ratios. Since lower 2D:4D is associated with higher prenatal androgen levels (Manning, 2002), this indicates a positive relationship between prenatal T and musical orchestra rank. Similarly, Hassler (1991) showed that musical creativity was related to higher salivary T in women but lower T in men. This follows the results of Hassler and Nieschlag (1989), who found that female composers had higher T levels and male composers had lower T levels.

Fukui (2001) showed that when women listen to music, their T levels increased over baseline, with a notable increase when they listened to their favorite music; however, for men T decreased when listening to music. Fink and colleagues (2004) found inverse relationships between 2D:4D and androgenized behaviors in women but not in men, theorizing that this connection may be more evident in women because men have a decreased within-sex variation in prenatal and circulating T than women, rendering comparisons ineffective. Moreover, Bancroft (2002) suggested that women may have a greater sensitivity to T. As such, we may see sex differences in the embodiment of SDRR.

Nonetheless, T cannot be the lone determinant of musical ability. If this were true, since men, on average, have higher T levels, they would typically possess better musical ability than women do, but repeated studies have shown that this is not the case (see Ellis et al., 2008).

Dopamine

It is possible that an SDRR connection may be a product of dopaminergic reward, at least in part. Blum and colleagues (2012) commented upon the association between sex, drugs, and rock and roll and posited that there may be gene polymorphisms associated with aberrant, excessive behaviors related to sexual behavior, drug addiction, and music, commonly mediated by dopaminergic activity. The appetitive properties of sexual behavior are mediated by the mesolimbic dopamine system (Balfour, Yu, & Coolen, 2004). Dopamine (DA) levels in this neural pathway are elevated during sexual activity (Mermelstein & Becker, 1995; Wenkstern, Pfaus, & Fibiger, 1993), and the introduction of DA into this pathway also facilitates sexual behavior (Everitt, Cador, & Robbins, 1989).

Drug use increases DA transmission in the mesolimbic pathway. The use of opiates, ethanol, cannabinoids, nicotine, and other psychostimulants increases DA in limbic nuclei, particularly in the nucleus accumbens (Boileau et al., 2003; Pierce & Kumaresan, 2006). Drugs that activate this system are potentially addicting, and they facilitate emotional arousal, compulsion, and an ability to discount the negative consequences of

use (Childress et al.,1999). Furthermore, testosterone appears to be reinforcing and works on the mesolimbic DA pathway, which is highly involved in drug abuse (Wood, 2004).

Music activates reward-related dopamine pathways and is therefore reinforcing (Salimpoor et al., 2013). Researchers have found that listening to music is tied to DA release in brain areas related to reward and motivation, such as the striatum, amygdala, orbitofrontal cortex, and ventral medial prefrontal cortex (Blood & Zatorre, 2001; Menon & Levitin, 2005; Salimpoor et al., 2011; Salimpoor & Zatorre, 2013; Trainor, McDonald, & Alain, 2002), integral neural circuitry underlying reward and motivation (Balfour, Yu, & Coolen, 2004). However, DA receptors are not exclusive to the brain. Musicians have an increased number of peripheral blood lymphocytes (PBL), which contain DA receptors (Emanuele et al., 2009) and have DA transporter on their plasma membrane (Pellicano, Pontieri, Fanciulli, &, Buttarelli 2011). Changes in the expression of DA transport or receptors in PBL are associated with drug abuse and alcohol abuse (see Pellicano et al, 2011, for review). As DA is thought to be a reinforcement and reward mediator (Alcaro, Huber, & Pankseep, 2007), there may be a genetic predisposition to excess in SDRR.

Possible Psychological Mechanisms of SDRR

Although we approached the present research theorizing biological mechanisms that underpin the SDRR connection, there are several psychological and social reasons why sexuality, drug use, and rock music may be positively related. Wicke (1990) stressed that people can be attracted to rock music as a complex social experience and cultural tradition. This can include specific styles of communication, hair, dress, dance, and artwork that influence the cognitive and learning patterns of listeners (Wicke, 1990). This sociocultural tradition can arguably include substance abuse and heightened sexuality. Miller and Quigley (2012) underscored that socialization into "rebellious" musical subcultures can influence behavioral choices - even those that have deleterious health consequences, such as problematic substance use.

It is well known that "sex sells," such that media containing sexuality is appealing to consumers (Streitmatter, 2004). Sex is prominently featured within the "selling" of the rock genre. Hobbs and Gallup (2011) showed that 9 out of ten country, pop, and R&B songs in the 2009 Billboard Top 10 (an index of popular songs in the United States) contained sexual/reproductive lyrics, about such topics as genitalia, uncommitted sex, and promiscuity. Similarly, Primack and colleagues (2008) documented that more than a third of Billboard's top songs in 2005, assessed across genres, featured lyrics about oral sex, penile-anal sex, or penile-vaginal sex, with most pertaining to degrading sex; songs containing degrading sex also frequently contained messages of substance use (e.g., alcohol, marijuana, cocaine).

Along these lines, lyrics in popular music contain references to drug and alcohol use. Hall, West, and Neeley (2013) estimated that one out of nine songs from the Billboard Hot 100 year-end songs from 1959 to 2009 featured content about alcohol and other drugs. Evidence suggests that substance use may be positively related to listening to music containing messages of such (Chen et al., 2006; Forsyth et al., 1997).

Personality may also come into play in the SDRR connection. Sensation seekers are more prone to like "harder" rock music due to the forceful sensory stimulation the music conjures (Arnett, 1992; Rawlings et al., 1998). Modeling also may come into play. Observational learning has long been known to affects others to use substances (Ellickson & Hays, 1992). Furthermore, throughout history people have long learned about sexuality through observation (Lawrence, 2015). Brown and colleagues (2006) showed that exposure to sexuality in music is positively associated with emerging adults' sexual behavior. If those prominent in the rock music scene are involved in sex and drugs, others may follow.

Thus, in addition to the biological influences, there is likely a host of social, learning, and cognitive mechanisms involved in the SDRR connection. It is important to point out, however, that musical choice likely does not cause problematic behavior; rather, certain musical preferences, such as for genres that some have deemed "problem music" (e.g., hard rock, punk), may be indicative of those who are emotionally vulnerable (Baker & Bor, 2008; North & Hargreaves, 2006).

The Present Study

It is important to stress that we present the above evidence as to reasons why sex, drugs, and rock and roll may be connected. However, the aim of the present study is simply to provide empirical evidence for the association. We sought to document if there is indeed a positive relationship between sex, drugs, and rock music in terms of both performance and exposure. We predicted that rock musicians would have an increased sex/drugs lifestyle (i.e., increased sexual desire, sexual activity, substance use), as would musicians in general. We further predicted that people who prefer rock music, and have a heightened preference and exposure to music in general, would have an increased sex/drugs lifestyle.

METHOD

All procedures were approved by the local ethics board. We recruited participants through the subject pool of a mid-sized college in the northeastern United States and through social media sites. Students took part in the study in exchange for course credit, and other participants were not remunerated. There were 467 respondents (181 men, 286 women) who completed an anonymous online survey, with a mean age of 21.19 (*SD*= 5.09, range: 18-57 years), and 89.7% were college students. They reported their ethnic background as: 62.1% White; 16.3% Asian; 10.1% Black/African American; 6.4% Multiethnic; 4.3% Hispanic/Latino-a/Spanish origin, .4% American Indian; and .4% Middle Eastern. In addition to demographics, we asked about sexuality, drug and alcohol use, music ability, and music preferences, described below.

Sexual Activity

We used a modified version of the Adapted Adolescent Sexual Activity Index (ASAI) to assess sexual behavior (Hansen, Paskett, & Carter, 1999). The face validity of these items indicated that they could be extended to adult sexual practices. Because we were interested in examining sexual activity specifically, we omitted some items (e.g., hugging,

cuddling), and we added an item pertaining to oral sex. We asked participants six questions: "In the last year how often have you… kissed someone?" "…had someone put his or her hands under your clothing?" "…put your hands under someone else's clothing?" "…undressed with genitals/breasts showing in front of someone in a sexual situation?" "…engaged in oral sex?" and "…engaged in sexual intercourse (vaginal or anal penetration)?" Participants responded on a 9-point scale, ranging from 1 = *Never* to 9 = *Several times a day*. Internal consistency for our responses was excellent (α= .97; 95% *CI*= .96, .97). We calculated the sum of responses to yield a *sexual activities score*, with a possible range from 6 to 54.

Additional sexuality questions.
As in previous studies of sexuality (e.g., Hughes, Dispenza, & Gallup, 2004; Thornhill & Gangestad, 1994), we asked participants to report how old they were the first time they had masturbated and the first time they had sexual intercourse, and we asked how many sexual partners they had in the previous year. Participants provided a numerical response and skipped items that were not applicable. Further, because the connection between sexuality and drugs use is associated with risk, we asked participants to report whether they had ever had unprotected (no condom) sexual intercourse with a regular partner, and in a separate question, with a one-night stand ("hook-up"). This approach was similar to other studies of sexual risk (e.g., Sullivan et al., 2009).

Sexual Desire

Because we understood our sample would consist mostly of emerging adults, we wanted specifically to address a potential partner access issue. We asked, "If you could, how frequently would you have sex?" "How often do you think about having sex?" and "How often do you want sex when it is unavailable to you (a receptive partner is not around)?" Participants responded on a 9-point scale, ranging from 1 = *Never* to 9 = *Several times* a day. Internal consistency for responses to these three items was very good (α= .87; 95% *CI*= .84, .89). We summed responses to form a *sexual desire score*, ranging from 3 to 27.

Alcohol Use

We used items from the Alcohol Use Disorders Identification Test (AUDIT) (Babor & Grant, 1989), which was developed by the World Health Organization to elucidate alcohol use that is hazardous and that demonstrates a risk of dependence (Allen, Litten, Fertig, & Barbor, 1997; World Health Organization, 2001). We asked, "How often did you have a drink containing alcohol in the past year? Consider a 'drink' to be a can or bottle of beer, a glass of wine, a wine cooler, or one cocktail or shot of hard liquor (like scotch, gin, vodka, tequila, rum, whiskey, etc.)?" Answer options ranged from 0 = *Never* to 6 = *6 or more times a week*. We also asked, "How many drinks did you have on a typical day when you were drinking in the past year?" Answer options ranged from 1 = *1 to 2 drinks* to 5 = *10 or more drinks*. We further asked, "How often did you have 4 or more drinks on one occasion in the past year?" Answer options ranged from 0 = *Never* to 6 = *Almost daily*. Participants who reported not drinking in the past year were coded with 0 for the latter two questions. Although the original AUDIT asks frequency of having "6 or more drinks on one occasion," we changed the number to 4 to be in line with other

studies of binge drinking, particularly in emerging adults (Viner & Taylor, 2007). Evidence shows wording changes do not impact AUDIT scores (Ivis, Adlaf, & Rehm, 2000). We also expanded the range of possible responses. Internal consistency for our participants' responses to these three questions was very good (α= .85; 95% *CI*= .82, . 87). We summed responses to these three items to form an *alcohol use score* with a possible range of 0 to 17.

Drug Use

We asked participants, "Have you EVER used any of these drugs? (Please check all that apply.)" The research team generated the list of illegal drug choices after consulting the National Institutes of Health's (2012) chart of commonly abused drugs. The only written-in response was *Hydrocodone/Oxy.* Answers indicated that 42.6% of our sample had used a drug at some point. We counted the number of different types of drugs a participant has ever used, a procedure similar to previous studies of drug abuse (Gross, Barrett, Shestowsky, & Pihl, 2002; Lenton, Boys, & Norcross, 1997). We reviewed responses and noted if the participant had ever used a drug in each of four psychoactive drug classes, coding each participant with "yes" or "no" to each.

Sex/drugs Milieu

Noting the "meta-experience of rock musicianship" (Miller & Quigley, 2012, p. 390). using each construct measured above, we aimed to ascribe an overall "sex/drugs milieu" for participants using each construct measured as reported above. This single score also allows us to avoid increased risk of Type I error when making many comparisons, e.g., t-tests. We conducted a factor analysis and used principle components factoring with Varimax rotation to determine dimensional factors for alcohol score, number of drugs used, sexual activity score, and sexual desire score. A KMO value of .704 and Bartlett's Test of Sphericity ($p < .001$) showed that factor analysis was appropriate. Analysis yielded a simple structure of one factor, as shown in Table 1, with all factors loading at . 66 and over. We used regression factor scores for additional analyses and labeled this *sex/drugs milieu score*.

Measure	Loading
Sexual activity	.689
Sexual desire	.737
Alcohol use score	.749
Number of drugs tried	.669

Table 1. Sexuality and Drug-use Measure Scores with Factor Loading

Musicianship

Similarly to Greenburg et al. (2015), we asked participants if they considered themselves to be either a skilled player of a musical instrument or a skilled singer. If a participant

answered "yes" to either of these questions, we considered them to be a musician, which was the case for 33.2% of our sample (71 men and 84 women).

Rock music specialty

We asked only of those who declared themselves to be musicians, "What genre of music is your specialty (for example, hard rock, heavy metal, pop rock, classical)?" This was an open-ended question that allowed a single response. Noting an absence in the literature of agreed-upon genres that constitute "rock," in consultation with a veteran musician, we considered participants to have a rock specialty if they answered "rock," "heavy metal," "alternative," "hard rock," and "indie rock." We coded responses to indicate whether the person's musical specialty was rock or not. Among all musicians, 31.4% of men (n= 16) and 19% of women (*n*= 11) said they were rock musicians.

Musical ability

Similarly to Borniger et al. (2013), we generated items to measure self-reports of musical ability. Through skip logic, only those who reported that they musicians were presented with these questions. Two veteran musicians (i.e., several decades of cumulative musical experience) assisted the research team in creating questions gauged at assessing musical skills and experience. We asked participants to report their skill level of: "Improvisation/ jamming," "Playing songs 'by ear' (i.e., listen to a song and replicate the melody, rhythm, bass, etc., of that song without looking at sheet music, guitar tabs, or other musical notation)," "Composing your own music," "Technical performance," and "Expressive performance." Response options ranged from 1 = *Not at all skilled* to 5 = *Extremely skilled*. We summed responses to these five items to form a *musical ability score*. Scores had a possible range of 5 to 25.

Performance experience

We asked respondents who indicated they were musicians, "Which best describes your music performance experience (instrumental or singing)? (Check all that apply.)" We assigned participants 1 point each for the following eight musical activities: "I played in…an elementary or middle school band or orchestra," "…a high school band or orchestra," "…a college band or orchestra," "…a band or orchestra for which I had to audition," "…a professional (paid) band or orchestra," "I started my own band or orchestra," "I was a musical soloist in one or more of the above," and "I still participate in one or more of the above." We assigned participants 0 points for "I have none." We summed points to form a *music experience score* that ranged from 0 to 8.

Music Exposure and Preference

All participants answered questions about listening to music. Similarly to the protocol of Borniger et al.'s (2013) study of musical exposure, we asked the open-ended questions, "About how many hours per week do you listen to music?" "About how many songs are on your iPod, other mp3 player, phone, laptop/computer, etc.?" and "About how many musical CDs or records do you own?" Due to the probability of general estimates, we recorded participants' answers to these three items as ranked scores (1 through 4) based on quartiles of our sample distribution.

From a list of 36 musical genres generated by the researchers, participants selected all genres to which they listened. We summed the number of different genres participants reported liking. From the same list of music, participants selected their single favorite genre. Although within-genre music varies widely, for research purposes, we consulted previous literature and with a veteran musician (i.e., an academic degree in musical recording) for classification help. Similarly to Rawlings et al.'s (1998) preferences analyses, we considered participants to listen to or favor "rock" if they selected *alternative, hard rock, heavy metal or punk*. We coded participants who listened to rock as 1 = *yes* and all others who answered the genre question with 0 = *no*. Likewise, we coded participants who selected rock as their favorite genre as 1 = *yes* and all others who answered the question with 0 = *no*.

Analysis by Sex

In our planned analyses, we considered men and women separately where possible. Research consistently indicates that men abuse drugs and alcohol at an earlier age, more frequently, and in greater amounts than women do (U.S. Department of Health and Human Services, 2014). Further, it has been well established that men think about sex more frequently, want sex more often, want more sexual partners, masturbate more, and like a wider variety of sexual practices (Baumeister, Catanese, & Vohs, 2001). The evidence reviewed above also suggests that men and women may differ with respect to the physiological underpinnings of musicality (Hassler 1991, 2000).

RESULTS

Rock Musicians versus All Others

Binary logistic regression showed that overall sex/drugs milieu score was not able to predict successfully who was a rock musician among men, $\chi 2 = 1.09$, $p = .297$, or women, $\chi 2 = .040$, $p = .842$.

Chi-square tests of independence showed that male rock musicians (23.5%) were more likely than others (5.7%) to have taken a stimulant, $\chi 2\ 1, N = 174) = 7.03$, $p = .008$, Phi = .201, and male rock musicians (29.4%) were also more likely than others (12.1%) to have taken a hallucinogen, $\chi 2(1, N = 174) = 3.87$, $p = .049$, *Phi* = .149. This was not true for female rock musicians. There was no association for depressants or opiates for either gender. Chi-square tests of independence showed that for men there was no association between ever having no-condom sex with a main partner and being a rock musician (64.7%) or not a rock musician (48.4%). The results were the same for female rock musicians (90%) and all others (61.2%). Although these percentages reflected the predicted outcome, the results were not statistically significant. Chi-square tests of independence further showed that for men there was no statistical association between ever having no-condom sex with a short-term partner and being a rock musician (13.3%) or not a rock musician (14.6%). However, female rock musicians (50%) were more likely than other women (10%) to have ever had no-condom sex with a short-term partner, $\chi 2(1, N = 271) = 15.24$, $p < .001$, *Phi* = .237. There were no differences in age at first masturbation, age at first intercourse, and number of sex partners in the previous year for rock musicians versus everyone else. This was true for both men and women.

Rock Musicians versus Other Musicians

We collapsed across gender for additional analyses due to small sample sizes; not all participants answered all questions. Regression analysis showed that sex/drugs milieu score predicted self-reported musical *ability*, $F(1, 34) = 2.12$, $p = .041$, explaining 9.1% of the variance ($\beta = .342$; 95% *CI* = .036, 1.71; adjusted $R^2 = .091$). However, another regression analysis showed that sex/drugs milieu score did not predict musical performance *experience*, $F(1, 119) = .992$, $p = .321$. Chi-square tests of independence exact tests showed that more rock musicians (73.1%) than other musicians (47.4%) had no-condom sex with a main partner, $\chi2(1, N = 104) = 5.16$, $p = .023$, *Phi* = .223. Similarly, more rock musicians (29.2%) than other musicians (7.8%) had no-condom sex with a short-term partner, $\chi2(1, N = 101) = 7.45$, $p = .006$, *Phi* = .272. One-tailed independent *t*-tests showed there were no differences between rock musicians and other musicians in age at first masturbation, age at first sexual intercourse, and number of sex partners last year.

All Musicians versus Non-musicians

Binary logistic regression analysis showed that overall sex/drugs milieu score was not able to predict successfully who was a musician among men, $\chi2 = .044$, $p = .834$, or women, $\chi2 = 3.67$, p = .056. The model predicted 0 musicians. Chi-square tests of independence showed that female musicians were *less* likely than female non-musicians to have taken a stimulant, $\chi2(1, N = 249) = 6.72$, $p = .010$, *Phi* = .156, with a small effect size. This was not true for men. There were no differences in having taken a depressant, hallucinogen, or opiate between musicians and non-musicians for either gender. Chi-square tests of independence also showed that there was no association between being a musician or a non-musician and ever having no-condom sex with a long-term or short-term partner. This was true for men and women. There were no differences in age at first masturbation, age at first intercourse, and number of sex partners in the previous year for musicians versus non-musicians. This was true for both men and women.

Musical Preference and Exposure

One-tailed Spearman's rho analyses showed that for women, sex/drugs score was positively related to hours of music listened to the number of songs reported on one's electronic music-playing devices, $r_s(206) = .28$, $p < .001$, and positively related to the number of CDs or records the participant reported owning, $r_s(207) = .12$, $p = .039$. Neither of these relationships were significant for men. For men, however, sex/drugs score was related to the number of hours participants reported listening to music per week, $r_s(131) = .22$, $p = .006$. This relationship was not significant for women. For women, there was a positive correlation between sex/drugs score and reported number of different genres liked, $r(212) = .20$, $p = .002$ (one-tailed). This was not true for men. Moreover, one-tailed independent samples *t*-tests showed that women who listen to rock music had a higher sex/drugs score ($M = .120$, $SD = .992$) than women who do not listen to rock music ($M = -.200$, $SD = .919$), $t(209) = 2.41$, $p = .009$, $d = .33$. Although the means fell in the predicted directions, this was not significant for men. There was no significant difference in sex/drugs score between those who favored rock music versus those who favored another genre. This was true for both men and women.

We then compared sex/drug milieu score of individuals who favorited each musical genre. We collapsed across gender, because cell counts were too low for meaningful statistical analyses. Genres with very low favored count were excluded from analyses (Big band: *n*= 2; Disco: *n* = 2; Funk: *n* = 1; Folk: *n*= 3; Jazz: *n* = 1; Latin *n* = 3; Reggae: *n* = 3; Ska: *n* = 2; Show tunes: *n* = 3). We also excluded Oldies (*n* = 5) because of the indeterminate nature of the label (i.e., this could refer to music from the 1940s, 1980s, etc.). A one-way ANOVA showed that sex/drugs score varied by genre, $F(11, 300) = 2.36$, $p = .008$. Results are presented in Table 2.

Table 2. Mean Sex/drugs Milieu Score, by Favorite Musical Genre

Favorite Genre	*N*	*Mean sex/drugs score*	*SD*	*Rated as "typically hard-driving, fast tempo"*
Hip Hop or Rap	58	.397	1.05	Yes
Hard Rock	18	.291	.946	Yes
Techno	18	.210	.907	Yes
R & B	35	.166	1.11	No
Punk	5	.159	.907	Yes
Alternative	29	.156	1.13	Yes
Heavy Metal	4	.127	.784	Yes
Country	45	.089	.850	No
Pop Rock	73	-.239	.963	No
Religious	8	-.374	.734	No
Soft Rock	9	-.565	.810	No
Classical	10	-.660	.839	No
Total	312	.050	1.01	

Post-hoc LSD tests showed that those who favored hip hop or rap had a higher sex/drugs Score than those who favored pop rock ($p < .001$), religious ($p = .039$), soft rock ($p = .007$), or classical music ($p = .002$); those who favored hard rock had a higher sex/drugs score than those who favored pop rock ($p = .043$), soft rock ($p = .035$), and classical ($p = .018$); those who favored techno had a higher sex/drug score than those who favored classical ($p = .015$); those who favored R & B had a higher sex/drugs score than those who favored pop rock ($p = .047$), soft rock ($p = .049$), and classical ($p = .020$); and those who favored country or alternative had a higher sex/drugs score than those who favored classical ($p = .031$, $p = .025$, respectively).

Preference for "Harder" Musical Genres

Although not planned initially, upon viewing the ostensible pattern of how sex/drug score varied by genre, we wished to determine if there was a greater sex/drug experience among those who favor all music typically characterized by a harder, faster tempo, and not just rock music.

Researchers of musical classification have commented on "the fuzzy nature of genre boundaries" (Tzanetakis & Cook, 2002, p. 301), and our research team could not find a valid scientific source of what genres typically constitute faster or "harder" music or a typical tempo for a given genre. We thus presented independent raters (N = 4) with a list of our participants' 12 favorite musical genres. Raters were experienced musicians, each with at least 25 years of musical recording and performing experience. We asked raters to

describe whether each genre "typically has a hard-driving beat/tempo." Although raters anecdotally commented that it was difficult to pinpoint the typical beat of a genre, interrater agreement was excellent (α = .95; 95% *CI* =.88, .98). Rating results are presented in Table 2.

One-tailed independent samples *t*-tests showed that male participants who preferred genres with a hard-driving tempo had a higher sex/drugs score (M = .352, SD = 1.02) than men who did not (M = -.021, SD = 1.03), $t(121) = 2.00$, p= .024, d = .36. Likewise, female participants who preferred genres with a hard driving a hard-driving tempo had a higher sex/drugs score (M = .213, SD = 1.05) than women who did not (M = -.166, SD= .940), $t(187)$= 2.49, p = .007, d = .38.

We examined the association of drug class use (i.e., having ever used) and hard music preference. Low cell size prevented viable statistical analysis by sex. Fisher's exact tests showed there was no association for stimulant, depressant, or opiate use. However, there was an association for hallucinogen use (p = .015), whereby those who favor a harder-tempo music genre (18.3%) were more likely than those who favor other music (9.5%) to have taken a hallucinogen. Chi-square tests of independence showed that there was no association between no-condom sex with a main partner and hard music preference, and there was no association between no-condom sex with a short-term partner and hard music preference. However, a one-tailed t-test of independence showed that those who favored hard music reported more sex partners in the past year (M= 2.05, SD= 3.13) than those who favored other music (M = 1.34, SD = 1.75), $t(201) = 2.39$, p = .009, d = .28. There was no difference in age of first masturbation or age of first intercourse between the two groups.

DISCUSSION

Sex, drugs, and rock and roll (SDRR) is what one writer called "a trinity held as gospel" in the life of musicians (Roy, 2014). Is there scientific basis for this oft noted association? Based on our data, there is some evidence, but finding a SDRR connection depends on and whom and what you are considering. Rock musicians did not have an increased overall sex/drugs lifestyle compared to others. However, rock musicianship does seem to relate to a part of SDRR for each sex. Female rock musicians were five times more likely than others to have unsafe sex with a short-term partner. Male rock musicians were more than four times as likely as others to have tried stimulants and more than twice as likely as others to have tried hallucinogens; such drugs arguably enhance, rather than depress, psychomotor activity and increase awareness experience (e.g., Vollenweideret al., 1998) and may reflect the increased sensation seeking noted in those who have increased testosterone.

Other results emerged when considering musicians only. Among all musicians, those with a greater musical ability had higher sex/drugs milieu scores. This supports a model of testosterone as a common underpinning. Rock musicians compared to other musicians were more likely to have had unsafe sex with main (long-term) and non-main (short-term) partners. Since other analyses yielded nonsignificant results, the idea of rock musicians having an amplified sex/drugs lifestyle is only partially supported. We

stress that we had a small sample (n = 27) of rock musicians. A larger sample would increase confidence in findings and allow for viable gender comparisons.

There is ample evidence to substantiate that music has emotional and physiological effects on the listener (Witvliet & Vrana, 2007), as people report strongly engaged, meaningful experiences when listening to music (Lamont, 2011). In terms of musical preference and exposure, an SDRR connection was supported, particularly for women. The higher the sex/drugs milieu, the more songs a woman had in her music collection, and women with higher sex/drugs score liked a greater variety of musical genres. Also, women who reported listening to rock music had higher sex/drugs scores than women who did not. The only finding for men was that those with higher SDRR scores listened to music more hours per week. Fukui (2006) documented that women experience increased T when listening to their favorite type of music, but Fukui (1998) also documented that exposure to music lowers T in men. This may explain why we observed more results with our female hard music listeners. Women may have a lower threshold of response to T (Bancroft, 2002). As explained by Fink and colleagues (2004), because men generally have more T, there is increased within-sex variation in androgens in women.

Women may be more vulnerable to mesolimbic effects, and this is one reason why they may be more susceptible to substance abuse (Becker, 2009). If women are more sensitive to mesolimbic reinforcement, and music triggers mesolimbic activity, this may help explain women's enhanced embodiment of SDRR in terms of musical consumption. Actual endocrine profiles may shed more light on this. With further respect to music consumerism, it would be interesting to consider the sexuality and substance use habits of avid listeners known as "groupies," who are typically female, ardent fans of musicians who may attend performances.

Other findings suggest that a positive sex/drugs/rock and roll connection is predicated on what constitutes "rock" music. Men and women who preferred "harder" music had an overall greater sex/drugs experience and more sex partners in the previous year. Hallucinogen use was particularly amplified in those who prefer hard music. These individuals may be sensation seekers. Studies have shown that sensation seekers tend to enjoy more "hard" music than "soft" music (Arnett, 1992; Rawlings et al., 1998). Preferences for hard rock are associated with not only sensation seeking, but also with reckless behaviors such as having unprotected sex, presumably because of the high intensity of these experiences (Arnett, 1992). Thus, when evaluating the validity of the SDRR mantra, one must take into consideration that conceptions of what constitutes "rock and roll" should be reevaluated, as it appears to hold true only for harder music. To wit, Spotify (2015), a subscription service for digital music streaming, conducted a study in which they found that metal listeners are the most "loyal fans," defined as those who continually return to listen to music from a preferred "core artist." It would be interesting to investigate what is driving increased positive reinforcement for these fans of hardcore music.

Although neurochemical processes may be the proximate mediators of the SDRR connection, there is an evolutionary angle to be considered given the present study's results. The SDRR relationship speaks more to men's music ability (i.e., producers of music) and to women's music preference (i.e., consumers of the music). Ethologically speaking, this mirrors nonhuman animal trends. For example, in many species of birds, it

is the males who produce songs to attract mates and to mark/hold their territories, and it is the females who assess and respond to these vocalizations (Reid et al., 2005). Interestingly, evidence suggests that female birds respond more positively to songs that are difficult for the male to produce, such as those that require rapid, coordinated vocal tract movement. Female birds will solicit males for mating who are proficient in this skill (Ballentine, Hyman, & Nowicki, 2004). It can be argued, then, that women's attraction to men who perform rapid, complex music, such as heavy metal, mimics behaviors observed in other species.

Moreover, birds and other non-human animals communicate alarm through sophisticated vocalizations (Templeton, Greene, & Davis, 2005). It may be the case that male hard-core musicians are "communicating" alarm, anger, and outrage through their musical performances, and female consumers are responding, with "harder" music making a more salient statement. Over three decades ago, Grossberg (1983) commented that rock music exercises "cultural politics" in that can be used by its fans as a basis for social, cultural, and institutional understanding and change, and that among its messages are those of anger and frustration.

We did observe some arguably weak relationships between sex, drugs, and both musical production and musical preferences. One reason for a weak relationship may be that the SDRR connection is attenuating over time, although documenting change was not the aim of the present study. Our sample, largely consisting of college students, may represent a generational cohort with declining drug use and promiscuity. The National Institute on Drug Abuse (2015) did recently report a long-term decrease in the use of alcohol and illicit substance among teens. Young people today are consistently presented with safe sex and anti-drug education, and such programs that occur of many years do tend to be effective (Stigler, Neusel, & Perry, 2011).

Along these lines, researchers have long noted age effects and cohort effects in sexual behavior (Adams & Turner, 1985; Sprecher, Treger, & Sakaluk, 2013). Further, risk-taking decreases over the lifespan (Rutledge et al., 2016). Moreover, testosterone does decline with age in both men (Harman, Metter, Tobin, Pearson, & Blackman, 2001) and women (Zumoff, Strain, Miller, & Rosner, 1995). Our sample was relatively homogenous with nine out of 10 participants age 18 to 25. We did not have a large enough sample of older individuals to make viable comparisons. In addition, post-hoc tests show that in our study age was only weakly related to sex/drug score r (416)= .17, p = .001. As such, we did not enter it into prediction models. Nonetheless, future studies examining SDRR may wish to focus on recruiting a more diverse sample to allow for viable cross-sectional age analysis.

With further respect to demographic considerations, substance use and abuse vary with ethnicity (McCabe et al., 2007), as does sexual experience (Meston & Ahrold, 2010). The n of most of our ethnic groups was too low for meaningful statistical analyses. Future studies may aim to recruit a larger sample size of people of various ethnicities to ascertain the effects of ethnicity on SDRR. Furthermore, Dabbs and Morris (1990) showed that socioeconomic status moderated the relationship between T and risky behaviors and posited that higher education can control of the risky tendencies related to T. Our sample was relatively homogenous education-wise, and our predominantly college student sample limits generalizability, particularly because those

who value academic achievement are less likely to engage in problematic drug and alcohol use (Bradley & Greene, 2013).

There may be a social desirability bias in our participants' responses. This can come in the form of underreporting or omission. To wit, not all participants answered all questions pertaining to drug and alcohol use and sexuality. There can be issues with self-reports, including difficulties with estimates, memory issues, and intentional lying (Hyde & DeLamater, 2011) that should be kept in mind when interpreting these results. As an example, those who have higher T tend to "show off" more and demonstrate more roguery (Dabbs, 2000). It may be the case that musicians do have elevated T and are exaggerating reports of their sexual prowess and drug use as part of a desired image.

We asked participants to self-report their musical ability. This is in line with some previous research (e.g., Borniger et al., 2013). It may be the case more detailed, objective measures would yield clearer results. Likewise, future investigations could have experts analyze the perceptual and behavioral correlates and consequences of varying musical timber, amplitude, tempo, etc., in relation to SDRR. This was outside of the resources of our research team.

An examination of attitude and behavioral differences per musical genre preference is difficult. Genres are broad in terms of tempo, i.e., beats per minute (BPM). As an example, a search of the punk genre reveals songs like artists like Patti Smith's rendition of "Hey Joe" at 58 BPM versus The Misfits' "Night of the Living Dead" at 213 BPM (BPMdatabase.com, 2016). Thus, future studies of SDRR could also solicit ratings for particular songs to determine exact preferences for tempo, instruments, vocals, etc. Along these lines, as noted by Greasley and Lamont (2006), people may be drawn to music for its use versus for its genre. For example, people may prefer music for the mood it creates at a given moment, or for its time period, such music from a given decade (Greasley & Lamont, 2006). Genre may not be the best general determinant of musical preference. In addition, music preferences can change rapidly, and long-term favorite music can differ from short-term favorite (Lamont & Webb, 2010). Detecting an SDRR connection may therefore be challenging.

Biological mechanisms that may contribute to the SRDD relationship, but we did not take biological measures in our study. It would be interesting to measure precise androgen profile in regard to SDRR. Additionally, the bidirectional relationship between T the environment should be considered (Fukui, 998). Future research may attempt to gauge drug and sexual attitudes in the context of music exposure in controlled laboratory studies and in the field.

Future studies may also wish to consider intelligence as a common factor influencing sex, substance use, and music production and preferences. Evidence suggests that those with higher general intelligence may be more likely to seek evolutionary novel stimuli, such as potent, modern drugs (Kanazawa & Hellberg, 2010; White & Batty, 2012); and those with lower intelligence may be more likely to seek evolutionary familiar stimuli, such as sex (Hopcroft, 2006; Kanazawa, 2004) and certain types of music (Kanazawa, 2004, 2010a, 2010b, 2012; Kanazawa & Perina, 2012). We did not account for intelligence in the present study, although it is a possible countervailing factor in the SDRR association.

The results of the present study offer directions for future analyses. It would be noteworthy for future studies to investigate the relationship between 2D:4D and SDRR,

as research has previously linked low 2D:4D to increased drug and alcohol abuse (Verster & de Haan, 2011) and musical ability (Borniger et al.,2013; Sluming & Manning, 2000).

In sum, this study documents a positive relationship between sex and drugs and rock and roll only under certain circumstances. In general, among musicians only, SDRR appears to be more salient phenomenon among male performers and female consumers of "hard" music. This study provided an initial, exploratory investigation on the SDRR relationship, but it would be very interesting to explore further the psychological correlates and consequences of this phenomenon.

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