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RESEARCH ARTICLE

AGGRESSIVE BEHAVIOR WILEY

Violent and prosocial music: Evidence for the impact of lyrics and musical tone on aggressive thoughts, feelings, and behaviors

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Abstract

Although there is a large research base on the psychological impacts of violent and prosocial visual media, there is little research addressing the impacts of violent and prosocial music, and which facets of the music have the greatest impact. Four experiments tested the impact of lyrics and/or musical tone on aggressive and prosocial behavior, and on underlying psychological processes, using purpose-built songs to avoid the effect of music-related confounds. In study one, where mildly aggressive, overtly aggressive and violent lyrics were compared to neutral lyrics, any level of lyrical aggression caused an increase in behavioral aggression, which plateaued for all three aggression conditions. Violent lyrics were better recalled than other lyrics one week later. In studies two-three no significant effects of lyrics, or of aggressive versus nonaggressive musical tone, were found on aggressive or prosocial behavior. In terms of internal states, violent lyrics increased hostility/hostile cognitions in all studies, and negatively impacted affective state in three studies. Prosocial lyrics decreased hostility/hostile cognitions in three studies, but always in tandem with another factor. Aggressive musical tone increased physiological arousal in two studies and increased negative affect in one. In study four those who listened to violent lyrics drove more aggressively on a simulated drive that included triggers for aggression. Overall, violent lyrics consistently elicited hostility/hostile cognitions and negative affect, but these did not always translate to aggressive behavior. Violent music seems more likely to elicit behavioral aggression when there are aggression triggers and a clear way to aggress. Implications are discussed.

KEYWORDS

aggression, hostility, lyrics, musical tone, prosocial music, violent music

1 | INTRODUCTION

In recent decades music featuring violent lyrics and/or which has an aggressive musical tone has become more accessible, more popular, and, in some cases, more mainstream (Christenson et al., 2019; Warburton et al., 2014; Warburton, 2012, 2014; Whelan, 2010). Such music may have lyrics that describe or endorse violent acts, or have musical characteristics that "feel aggressive," such as a driving beat, distorted electric sound or angry/energizing/aggressive undertone. Understanding the effects of such music, and its converse (e.g., music with prosocial lyrics and/or a clean, acoustic sound with a calm undertone), is important. For many people such music is like wallpaper, constantly in the background of their lives, and potentially influencing their behavior, whether they are aware of it or not. However, despite a considerable literature on the impacts of violent visual media, there is comparatively little research into the psychological effects of listening to either violent or prosocial music, or the internal processes that underlie these effects. To address this gap, the current studies examine the effects of music with violent and prosocial lyrics on aggressive and prosocial behavior, and compares the relative impacts of musical lyrics and tone.

1.1 | Violent music and music videos, and aggressive thoughts and feelings

Early research has provided some indicative findings, although as noted by Anderson et al. (2003) and Warburton et al. (2014), there have also been problems around methodology such as poor lyrical clarity, confounding issues around accompanying videos, and poor stimulus matching for characteristics such as arousal. Nonetheless, some of these early findings are suggestive of lyrics effects. For example, Peterson and Pfost (1989) showed male participants music videos that were either erotic-violent, erotic-nonviolent, nonerotic-violent, or nonerotic-nonviolent. Findings were mixed, however participants who watched nonerotic-violent rock music reported significantly higher scores for adversarial sexual beliefs. St Lawrence and Joyner (1991) found that sexually violent and Christian rock music, compared with classical music, increased sex-role stereotyping and negative attitudes toward women in males. This finding suggested that musical characteristics other than lyrics, such as "tone," caused the effect, although questions have been raised around lyrical clarity and the prior attitudes of religious participants (e.g., Wright et al., 2018). In 1995 Johnson, Jackson and Gatto presented 11–16 year old African American males with rap music videos that were either violent or nonviolent. Controls saw/heard no music video. Responding to vignettes, those in the violent music condition reported greater acceptance of violence (including toward women) and a greater likelihood they would engage in the depicted violent behaviors in the 'real world'. Johnson, Adams et al. (1995) had African American adolescents' either watch a nonviolent rap music video where women were sexually subordinated or see/hear no video. Participants then responded to a vignette, with those who watched the rap video giving the highest endorsement of teen dating violence. Wester et al. (1997) looked at the effect of listening to sexually violent music on males' negative attitudes toward women, but found three null effects and one small effect.

A later series of five experimental studies by Anderson et al. (2003) corrected for some past methodological problems by ensuring lyrical clarity and matching stimuli for arousal. They found consistently that listening to violent music increased aggressive thoughts and hostile feelings. Similarly, Humphrey (2007) found that songs with violent compared to nonviolent lyrics primed aggressive cognitions, most strongly when a video accompanied the song. Pieschl and Fegers (2015) contrasted violent and prosocial lyrics and fast versus slow tempo. Although there were no effects for tempo, those who listened to violent lyrics had significantly higher subsequent scores on the Word Completion Task for Aggressive Cognitions and significantly higher levels of anger. It should be noted that affective responses to violent music may differ for devotees of violent music (Olsen et al., 2022, 2023). For example, fans of violent death metal report feelings of empowerment and joy after listening, whilst nonfans report feelings of tension, fear and anger (Thompson et al., 2019).

1.2 | Violent music and aggressive behavior

In a study by Barongan and Hall (1995) male college students listened to either misogynistic or neutral rap music, with participants who heard misogynistic music being more likely to select a violent and sexually assaultive video to show to female confederates despite reporting they knew it would be found distressing by them. In 2006, Fischer and Greitemeyer presented three experimental studies investigating aggressive behavior. In study one participants heard either misogynous or neutral song lyrics and then had the opportunity to aggress against either a male or female confederate using the hot sauce paradigm. The most aggressive group were those who heard the misogynous song lyrics and were instructed to allocate their hot sauce to a female (rather than male) confederate. In study three participants heard either misogynistic, men-hating or neutral songs and aggression was measured as how long participants would make another participant submerge their hand in icy water. The most aggressive groups were males who had listened to misogynous music and could aggress against a female, and females who had listened to men-hating songs and could aggress against a male. Mast and McAndrew (2011) also used the hot sauce measure of aggression and found that heavy metal with violent lyrics elicited significantly greater aggression than heavy metal with neutral lyrics or a no music control. In 2012, Krahé and Bieneck used lyric-free music with either an aversive or a pleasant musical tone as stimuli, and included a no music control group. They found that whereas aversive music increased negative affect and aggression (as measured using an essay evaluation paradigm), pleasant music increased positive affect and reduced aggression. A 2006 study by Tropeano (2006) in which participants listened to a violent music video, a nonviolent music

video or no video, found that those who listened to the violent music video endorsed more aggressive or violent responses to a series of vignettes than participants in other groups.

With regard to longer-term impacts, Warburton et al. (2008) found that long-term exposure to violent music was significantly positively correlated with both trait aggression and self-reported recent aggression. However, facet-level analysis suggested the strongest links were with indirect aggression, relational aggression and hostility. They concluded that exposure to violent music increased hostile thoughts and feelings and aggressive impulses, but that, in the absence of visual scripts for behavior, these impulses were less likely to translate to direct, physical aggression. A study by Waite et al. (1992) in a locked treatment facility recorded acts of aggression for 33 weeks to get a baseline measure, and then for 22 weeks following the removal of MTV (a music video medium where aggressive content was common; Sherman & Dominick, 1986). They recorded a 48% reduction in aggressive behavior. In a more recent 1-year longitudinal study of mid-adolescents, Coyne and Padilla-Walker (2015) found that listening to music with aggressive content was linked with greater aggression and decreased prosocial behavior over time, even when controlling for initial levels of aggressive and prosocial behavior.

1.3 | Prosocial music and prosocial and aggressive behavior

In terms of the effects of prosocial music, research is fairly sparse. Similar to Krahé and Bieneck (2012), Fried and Berkowitz (1979) found that those who listened to soothing compared to aversive music were more helpful afterward. Corresponding changes to affective state were reported (soothed/contented vs. irritated/annoyed/angry), and as there were no lyrics to the music, this suggests that the musical tone was a key driver of both affective changes and the presumably resultant helping behavior. Greitemeyer (2009) found across three experimental studies that listening to songs with prosocial (relative to neutral) lyrics increased prosocial thoughts, empathy and pro-social behavior. Similarly, Ruth (2017) found that listening to pro-social compared to neutral lyrics in a naturalistic setting (a café) increased prosocial behavior. In the Pieschl and Fegers (2015) study noted earlier, no effect of prosocial lyrics on prosocial cognitions was found. However, a more recent study by Yu et al. (2019) found that prosocial compared to neutral lyrics increased prosocial cognitions and emotions. In a second study, lyrics with music led to greater prosocial behavior than written lyrics alone, although the main effect of prosocial versus neutral lyrics did not reach significance, perhaps weakened by the small effect of written lyrics.

Across five experimental studies, Greitemeyer (2011) found that listening to prosocial compared to neutral lyrics led to decreases in aggressive cognitions, affects and behaviors, with mediational analyses suggesting the behavioral effects were due to changes in affective state. In 2016, Böhm et al. found that listening to prosocial versus neutral lyrics decreased aggressive thoughts but not aggressive feelings.

1.4 | Violent music and aggressive driving behavior

A 2018 driving simulator study by Brodsky et al. (2018) concluded that "drivers who were exposed to hostile music with violent content … demonstrated increased cruising speeds and a higher percentage of time exceeding speed limits" and categorized this as "music genre induced driver aggression" (p. 1). Although a number of peer-reviewed studies have used such speeding behaviors as an indicator of aggressive driving (e.g., Deffenbacher, Deffenbacher, et al., 2003), it should be noted that current definitions of aggression (e.g., Anderson & Bushman, 2002; Warburton & Anderson, 2015, 2018) would preclude this from being aggression, which involves the specific motivation to harm another. Thus, this speeding behavior may be more indicative of driver recklessness. An unpublished study by Hancock et al. (2013) used speeding, tailgating and high-speed tailgating as measures of aggressive driving. They found no effect of violent music in conditions where there was no provocation, but a clear effect of music type on aggression when a provocation was present, suggesting that listening to violent music whilst driving may prime the driver to be aggressive, but that a trigger may be required for the person to act on activated aggressive tendencies. Again, speeding would seem more indicative of driver recklessness than aggression in this study. However, tailgating and high-speed tailgating may be considered more aggressive, as these behaviors target the driver in front and are threatening behaviors.

1.5 | The effect of musical tone versus lyrics

Taken together, studies have found effects for both musical tone and lyrical content on aggressive thoughts, feelings and behaviors. Some researchers have suggested that because a key psychological impact of listening to music is one's emotional response (e.g., Egermann et al., 2011), it is probable that musical tone, a characteristic likely to elicit an emotional response, would have the greatest eventual impact on behavior, including aggressive behavior (e.g., Roberts et al., 2003). However, others have suggested that violent lyrics may have a stronger effect on aggressive behavior because they may activate a range of aggression-related concepts in the associative neural network of the listener, increasing the likelihood of aggressive behavior (Warburton et al., 2014).

Although no studies to date have directly tested the comparative effects of lyrics and tone in violent and prosocial music, a study by Brummert Lennings and Warburton (2011) provides some indication. Holding musical tone constant (using three stimuli songs from different genres, all of which had an aggressive tone and violent lyrics), they tested the effect of violent lyrics on aggressive behavior using the hot sauce paradigm, in a 2 (violent lyrics present vs. no lyrics) * 2 (video present vs. video absent) plus no music control group

design. Although all groups who heard any music were significantly more aggressive than the control group, there was a robust effect of lyrics, with both groups who heard lyrics being significantly more aggressive than those who heard the music with the lyrics digitally removed. This suggests some effect of tone (as the groups who heard no lyrics were more aggressive than controls), but a significantly stronger effect of lyrics. In this study, adding the visual element of a video clip did not significantly increase aggression.

1.6 | Theoretical approaches

The General Aggression Model (GAM: Anderson & Bushman, 2002) and the related General Learning Model (GLM: Gentile & Gentile, 2021) provide a clear account of the internal processes that may explain the impact of violent and prosocial music on behavior. In simple terms, both models suggest that when a person experiences a trigger, such as a provocation or a cue for aggression, various cognitions and affects are activated in the person's associative neural network. These may predispose the person to respond with aggression (GAM and GLM) or prosocially (GLM), and this predisposition will be affected by levels of physiological arousal (people are more likely to act on an impulse if aroused) and by the degree to which the person thinks through/appraises their response options and makes a thoughtful versus impulsive/automatic response. The operation of aggressive schema are central to both models, and to Script Theory (Huesmann, 1998), which posits that people who internalize aggressive scripts for behavior that they encounter in both the real and virtual worlds, will enact them in life given relevant cues. With these theories in mind, it is important that studies of violent and prosocial music examine the internal processes that may underlie aggressive or prosocial behaviors, notably the active cognitions and emotions/affects, and the level of physiological arousal.

1.7 | The current studies

Violent and prosocial music are still understudied, and to date no research has examined what level of aggressive content impacts aggressive behavior, or has directly examined the comparative effects of lyrics versus musical tone. Only one study has used purpose recorded songs (Pieschl & Fegers, 2015) and none have used purpose-recorded songs, written from scratch, that hold constant key musical characteristics that could be confounds. The current studies address these gaps—study one by systematically increasing levels of aggressive lyrical content in purpose-written and recorded songs and then testing for aggression and changes to internal states (hostility/hostile cognitions, affective state, physiological arousal), and studies two-four by manipulating lyrics (violent, neutral, prosocial) and tone (aggressive, nonaggressive/pleasant) using another set of purpose-written and recorded songs and testing for changed internal states, prosocial behavior (studies two-three) and aggression (studies two-four).

2 | STUDY 1: LEVEL OF AGGRESSION IN LYRICS

The first study examined whether increasing the level of aggression in song lyrics increased aggressive behavior concordantly. It was expected there would be a linear increase as song lyrics become more violent. It was also expected that internal processes—aggressive cognition, negative affect and physiological arousal—would be influenced in a linear fashion. Finally, long-term memory acquisition of key concepts was tested by asking participants to recall lyrics one week after hearing song stimuli.

2.1 | Method

2.1.1 | Ethical approval

This project was run in accordance with the Declaration of Helsinki and had approval from the university Human Research Ethics Committee (HREC: approval number 5201400118).

2.1.2 | Participants

As previous literature in the field has consistently found significant main effects with group sizes of 12–20 (e.g., Anderson et al., 2003; Greitemeyer, 2009, 2011; Johnson, Adams et al., 1995; Johnson, Jackson, et al., 1995; Mast & McAndrew, 2011), groups of 20–25 were considered sufficient to find main effects in this study. Of the 100 undergraduate psychology students who participated, 11 were excluded for completion failure, suspicion or producing outlying data (±4SDs from the mean), leaving 88 participants (75 females, 13 males; M_{age} = 19.88, SD = 2.29). As gender is a likely confound in aggression experiments, in this experiment and all others, participants were randomly allocated within gender. There were four conditions: listening to music with nonaggressive lyrics, subtly aggressive lyrics, overtly aggressive lyrics, or violent lyrics.

2.1.3 | Song stimuli

The songs were constructed around a single musical template and a lyrical template in which key words could be changed (see Coyne et al., 2021). For example, the nonaggressive song line "Things are *cool*. I *sway* and *bend*" [key words italicized] became "Things are *odd*. I *prod* and *squeeze*" in the subtle aggression condition, "Things are *raw*. I *hit* and *punch*" in the overt aggression condition, and "Things are *gore*. I *cut* and *slash*" in the violent condition. The musical style was mainstream pop with a pleasant tone. Four song versions by the same male musical artist were recorded, using the same musical backing track for each to hold all musical characteristics of the songs constant. Lyrics were given clear enunciation, and all songs were 5 min and 35 s long. Pilot testing revealed that the songs did not

differ significantly on arousal and lyrical clarity, but did differ on the level of aggression conveyed in the manner predicted (see Supporting Information Material A2 for more details).

2.1.4 | Measures

Aggression: Hot sauce paradigm

The hot chili sauce paradigm, using identical methodology and materials to Warburton et al. (2006), provided the measure of aggressive behavior, which was operationalised as the amount of grams of hot chili sauce that participants would allocate to an unseen participant knowing that (a) the chili sauce was very hot, (b) the person disliked hot foods, and (c) that they would have to eat the entire allocation given.

Internal states—aggressive cognition, hostility, affect, and physiological arousal

The Feelings Checklist (Warburton et al., 2006) uses a 7-point bipolar scale to test the three key routes of the GAM—hostile cognition, affect and arousal. It has 12 items measuring affective state (e.g., happy-sad), five items measuring self-reported physiological arousal (e.g., inactive-active) and nine items measuring hostility/hostile cognition (e.g., trusting-untrusting). Higher scores indicate positive affect, greater physiological arousal and hostile cognition respectively. Activated aggressive cognitions were measured using the 98 item Word Completion Task (WCT: Anderson et al., 2003, 2004). Each state was measured before and after hearing the song, with Cronbach's alphas across administrations ranging from .76 to .95.

Covariates

Four variables that are demonstrated to be relevant to aggressive behavior were measured. They were trait pro-socialness (the 16-item Prosocialness Scale for Adults; Caprara et al., 2005), trait empathy (the 15-item Short Empathy Quotient; Muncer & Ling, 2006), trait anger (the 6-item Trait Anger Scale of Warburton et al., 2008) and trait aggression (the 29-item Aggression Questionnaire, Buss & Perry, 1992). Internal consistency was adequate to very good for all four scales (α's = .91, .79, .72, .91 respectively).

2.1.5 | Procedure

For Part One of the study, participants attended the laboratory, ostensibly for an experiment examining links between taste perception, hearing, cognition and emotion. Song stimuli had been pre-tested to a comfortable ~80 dB peak volume via headphones. The method used by Warburton et al. (2006) was employed to set up the hot sauce paradigm backstory and prepare participants for hot sauce allocation. Participants then listened to their allotted song, after which they allocated their hot sauce sample, using the method of Warburton et al. (2006). The Feelings Checklist and covariate measures were completed at baseline and after hearing the music. For Part two, participants returned to the laboratory and were asked to recall any lyrics they could remember from the song they had heard the week before. Responses were written down verbatim.

2.2 | Results

For all studies reported here, when dependent variables were significantly or marginally skewed, analyses were bootstrapped with 2000 replications. No bootstrapping was performed for analyses where the dependent variables were not skewed. As expected following random allocation, groups did not differ on average scores for covariates across the majority of studies (cf. Study 2 below). Correlations between all covariates and dependent variables were checked, and covariates with significant correlations with dependent variables were included in the main analyses.

2.2.1 | Aggressive behavior

No covariates correlated significantly with aggressive behavior, and covariates were therefore excluded from analyses. There was a significant overall effect of group, $\chi^2(3) = 9.53$, $p = .023$, $\eta_p^2 = 0.05$. Inspection of the plot (see Figure 1) revealed a pattern whereby predicted means for all three groups who experienced some level of aggressive lyrical content were very similar, and these seemed to be substantially higher than the control group mean. Thus, a single contrast was tested comparing the three groups combined vs the control group. Compared to the control group, the combined group with aggressive lyrics had a significantly higher level of aggression (hot sauce allocation), $\chi^2(1) = 9.17$, $p = .003$, $\eta_p^2 = 0.04$.

2.2.2 | Changes to internal states

Change scores were calculated for internal states by subtracting time 1 scores from time 2 scores. Positive scores thus reflected an increase (e.g., increased hostility) and negative scores a decrease (e.g., decreased hostility). For affect, a positive score reflected an increase in positive affect and a negative score an increase in negative affect. The same single contrast of the three groups who received aggressive lyrics vs the control group were examined in all analyses. Trait anger and trait aggression correlated with hostility and were included as covariates. There was a significant effect of lyrics on hostility, $\chi^2(3) = 16.15$, $p = .001$, $\eta_p^2 = 0.10$, whereby all groups who heard lyrics with any aggressive content had increases in hostility, while the control group had a decrease (see Figure 2). The contrast comparing the three groups who received aggressive lyrics vs the control group was significant, $\chi^2(1) = 14.07$, $p < .001$, $\eta_p^2 = 0.09$. Trait aggression correlated with affective state and was included as a covariate. There was a

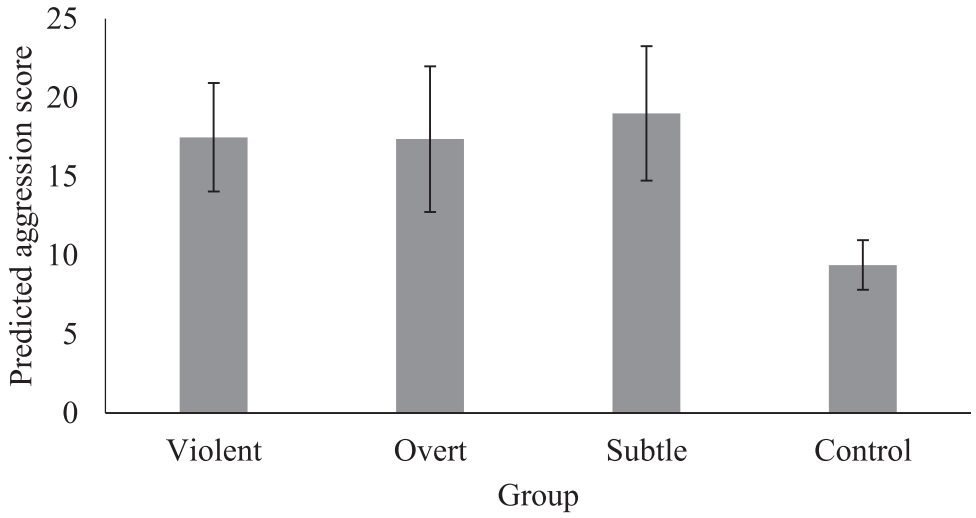

FIGURE 1 Hot sauce allocation by lyrics group.

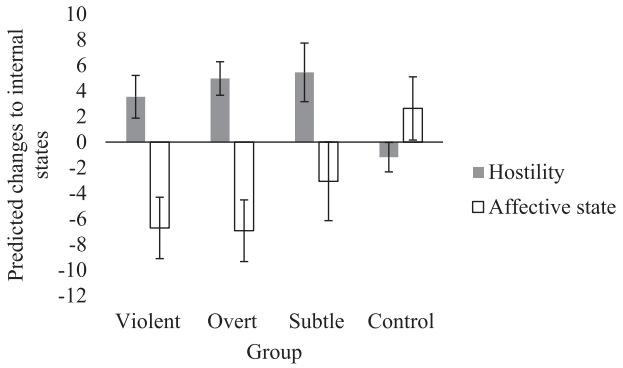

FIGURE 2 Changes to hostility and affective state after listening to music by lyrics group.

significant effect of lyrics on affective state, $\chi^2(3) = 9.96$, $p = .019$, $\eta_p^2 = 0.09$, whereby all groups who heard lyrics with any aggressive content had increased negative affect while the control group had increased positive affect (see Figure 2). The contrast was again significant, $\chi^2(1) = 8.22$, $p = .004$, $\eta_p^2 = 0.08$. No covariates correlated with physiological arousal or aggressive cognition and there was no significant effect of lyrics group on either measure. Post hoc power analyses found a coefficient of 0.47 for medium-sized main effects in this study, suggesting that the effects for aggression, hostility and affect were significant despite analyses being under-powered.

2.2.3 | Recall of lyrics

Supporting Information: Table A1 in the Supporting Information Material shows analyses for recall of key words, synonyms and related words by lyrics type group. Across analyses, participants recalled violent lyrics better than other types of lyrics.

2.3 | Study one discussion

Although aggressive lyrics elicited greater aggression than nonaggressive lyrics, the predicted linear increase was not found. Rather, any form of aggressive content seemed to elicit roughly the same level of aggression. This may have been due to priming, with all levels of aggressive content activating enough aggression-related concepts in semantic memory to cause the effect (Roskos-Ewoldsen et al., 2007).

Whilst aggression did not follow the predicted linear increases, two internal variables did. There was an increase in hostile cognitions for all three groups who heard music with aggressive lyrics, with this increase being fairly linear as lyrics grew more aggressive. Those who heard the nonaggressive lyrics had a decrease. Similarly, the strongest decrease in affective state was amongst those who heard the most aggressive lyrics, with the nonaggressive lyrics group reporting an improvement. This suggests that as music becomes increasingly aggressive, it has a greater impact on internal levels of hostility and affect. This increase though, does not seem to translate into a systematic increase in responding aggressively to those impulses.

In terms of long-term effects, it was noteworthy that those who heard the violent lyrics clearly recalled more key words, synonyms and keyword-related words than any other group, suggesting that perhaps a high level of violence in the lyrics was something that captured attention and had an emotional or cognitive impact, thus facilitating a stronger transfer into long-term memory.

3 | STUDY 2: COMPARATIVE EFFECTS OF LYRICS AND MUSICAL TONE

Having ascertained that aggressive and violent lyrics impacted aggressive behavior, hostile cognition and affective state in study one, study two extended the finding by examining the extent to which musical tone may also impact these factors and comparing the

size of lyrics versus tone effects. It was anticipated, in line with Brummert Lennings and Warburton (2011), that both tone and lyrics would have some effect, with lyrics having the strongest effect.

3.1 | METHOD

3.1.1 | Ethics

This project was HREC approved in the same protocol as Study one.

3.1.2 | Participants and design

Participants were 100 undergraduate psychology students who completed the experiment for course credit and 16 recruits from the social circles of the experimenters who went into a draw for a $100 gift voucher. Eleven participants were excluded from the study because of having participated in similar research previously or because of suspicion about the cover story, leaving a final sample of $N = 105$ (68 Females, 37 males; $M_{age} = 21.93$, SD = 6.64). Participants were randomly assigned to one of seven groups in a 2 (aggressive or nonaggressive musical tone) * 3 (violent, neutral or prosocial lyrics) plus 1 (no music control group) between subjects design.

3.1.3 | Song stimuli

As in study one, the songs were purpose written and recorded for this study to eliminate the influence of confounds related to musical characteristics. First, a lyrical template was created for a song entitled "Every time I see you." Key words and phrases were changed to reflect violent or prosocial feelings and actions. Because it was important for the neutral song to have no emotional valence, its lyrics were slightly more altered to allow for neutrality, whilst maintaining the same structure.

> Violent/Prosocial: Every time I see you/I want to **hurt/help** you/I **want to kill/will support** you/I **want to crush/be there for** you/Do you hear me?/I want to **smash/lift** you, I **want to stab/will assist** you, I want to **hurt, hurt, hurt/help, help help** you, I want to **spill your blood/see you smile**.
>
> Neutral: Every time I see you/I **think of breakfast**/I **want my jumper**/**Get my umbrella**/Do you hear me?/I **think of car wax**/I **want some ajax**/I want to **check, check, check** it/I want to **read my mail**. [Key words/phrases in bold].

An aggressive and nonaggressive musical template for the song was then written and recorded. Chord structure, percussion, vocal melody, and tempo were kept constant across the versions and a repeated 8-bar verse, 8-bar chorus structure was used. Aggressive tone was captured by using distorted guitar riffs and drum patterns commonly used in heavy metal music with a dark synthesizer effect being overlaid to create an ominous, aggressive undertone. For the nonaggressive tone, distorted guitars were replaced with soft piano and the drums were replaced with a softer percussion sound (played with brushes). An accordion effect was overlaid to create a happy, pleasant undertone. When lyrics were added vocally, lyrical clarity was kept high and the melody remained the same. In the aggressive tone songs, lyrics were sung with an elevated growl timbre, whereas the nonaggressive tone songs were sung in a soft, gentle tone. All songs were recorded in a professional studio (Lowder productions), were sung by the same male vocalist, and were 6 min in length. All final song stimuli were independently reviewed by Professor Doug Gentile, who found them fit for purpose.

3.1.4 | Measures

Aggression and prosocial behavior

There were two measures of aggression. The first was the hot sauce task, as used in study one. The second was the tangram task (Saleem et al., 2015) which measures aggression as the proportion of hard tangrams a participant would allocate to another participant knowing that (a) the hard tangrams are very hard [unsolvable] and (b) the other person would not receive their $10.00 payment unless they completed 10 of the 11 allocated tangrams correctly. Prosocial behavior was measured as the proportion of easy tangrams allocated.

Covariates and internal state

As in study one, participants completed the Feelings Checklist (α's from .75 to .94) and the Aggression Questionnaire ($\alpha = .89$). In addition they completed the Violent Music Exposure Index (VMI: Warburton et al., 2008) where standardized scores are summed for three open-ended questions about levels of exposure to violent musical content ("On average, how many hours per week would you spend listening to music in which people are hurt or killed or which has aggressive or antisocial undertones and themes"), five questions about preferences for angry/aggressive music ("I like to attend live music venues where there is an angry vibe" where 1 = does not describe me at all and 6 = describes me perfectly) and a single question "Have you ever obtained the lyrics of songs with violent themes" Yes/No). In this study the Cronbachs α was .77.

Attention check

Four questions were used to ascertain that participants were paying attention to the song stimuli ("What do you think the singer was singing about, mainly?", "What instruments were being played?"). All participants demonstrated attention to the song.

3.1.5 | Procedure

The procedure was identical to that for study one, with the exception that (a) the cover story was amended slightly to include that puzzles would test cognition, (b) time one questionnaires reflected the measures from the current study, (c) participants were given tangram puzzle practice

immediately after completing the time one questionnaires, (d) participants completed the tangram task after allocating the hot sauce, (e) participants were asked the attention questions at the end of the session, and (f) there was no 2nd session for lyrics recall. The behavioral measures were not counterbalanced, as doing so would have changed the carefully constructed and complex sequence of events that made the experiment believable and thus able to elicit naturalistic responses.

3.2 | Results

As noted above, there were no group differences in the covariates trait aggression or previous exposure to violent music, with the exception of a significant interaction between lyrics and musical tone on previous exposure to violent music. Analyses were therefore run twice, both with and without previous exposure to violent music as a covariate. Results did not change with or without inclusion of the covariate, and therefore to maintain consistency with the other studies in this paper, covariates were only included when they significantly correlated with the dependent variable.

3.2.1 | Aggressive and prosocial behavior

In terms of the hot sauce measure of aggression, hard tangrams (aggression) and easy tangrams (prosocial behavior) there were no significant main effects or interactions. The covariates trait aggression and previous exposure to violent music were only associated with the hot sauce measure of aggression and were entered as covariates to that analysis only. No covariate produced a significant main effect although greater previous exposure to violent music had a significant correlation with trait aggression ($r(75) = 0.25$, $p = .03$). Post hoc power analyses found coefficients of 0.61 (lyrics) and 0.72 (tone) for medium-sized main effects in this study, suggesting that these analyses were a little under-powered.

3.2.2 | Changes to internal states

The covariates did not significantly correlate with any change to internal states measures. For hostility/hostile cognition, there was a significant main effect of lyrics, $\chi^2(2) = 11.68$, $p = .003$, $\eta_p^2 = 0.12$, but no main effect for musical tone or interaction between tone and lyrics groups (see Figure 3). It is noteworthy that only the nonaggressive tone/prosocial lyrics group recorded a decrease in hostility. Contrasts revealed one significant group difference using an adjusted p value of .05/3 = .017, with prosocial lyrics producing less hostile cognition than violent lyrics, $M_{Diff} = -4.54$, $z = -3.28$, $p = .001$, $\eta_p^2 = 0.12$. There was a main effect of musical tone on physiological arousal, so that a more aggressive musical tone increased arousal and a nonaggressive musical tone led to either a small increase (violent lyrics group) or a decrease (other groups) in physiological arousal, $F(2, 83) = 7.38$, $p = .008$, $\eta_p^2 = 0.08$ (see Figure 3). There were no significant main effects or interactions for changes to affective state.

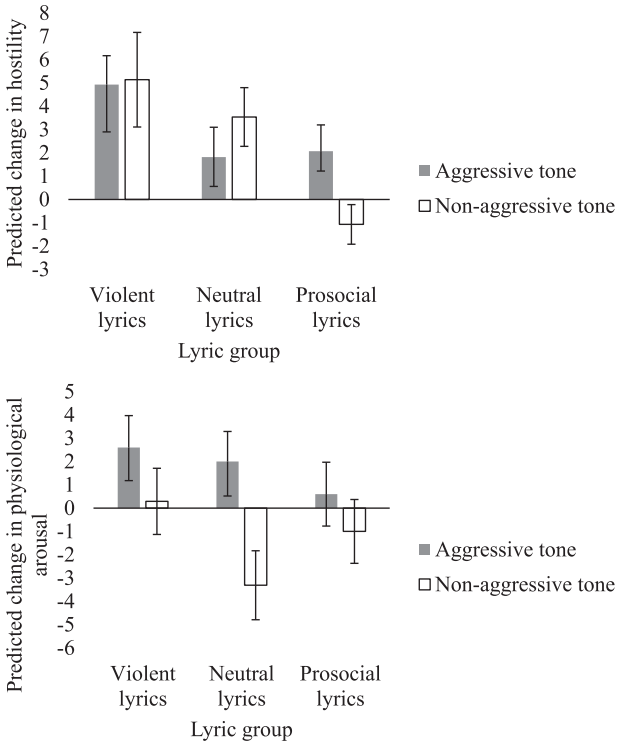

FIGURE 3 Changes to hostility (top) and physiological arousal (bottom) after listening to music, by lyrics group and musical tone group.

3.3 | Study two discussion

Contrary to hypotheses, this study failed to find an effect of tone or lyrics on aggressive or prosocial behavior. This is contrary to the study one findings, which found a weak but significant effect, and with previous studies which have found an effect of violent lyrics on aggression (Brummert Lennings & Warburton, 2011; Fischer & Greitemeyer, 2006; Mast & McAndrew, 2011) and of prosocial lyrics on prosocial behavior (Greitemeyer, 2009). It is possible that the strength of the tangram task effects may have been weakened by the inability to counterbalance presentation of these variables. For example, Lindsay and Anderson (2000) found that where dependant variables are measured 2nd or 3rd, experimental manipulation effects may be weakened or disappear altogether.

In line with hypotheses, participants who heard violent lyrics robustly demonstrated increased hostility/hostile cognition, as well as increased physiological arousal, internal states that are known to be precursors to aggression. It seems possible that exposure to violent or prosocial music causes an impulse congruent with the lyrics, but that, as suggested by Warburton et al. (2008), the lack of specific scripts for aggression in the music may inhibit the translation into behavior, causing effects to be weaker. The finding that greater exposure to violent music was linked with greater trait aggression aligned with the findings of Warburton et al. (2008).

4 | STUDY 3: COMPARATIVE EFFECTS OF LYRICS, TONE AND VIDEO

In study three a different measure of aggression was used, and a video condition was added to ascertain whether the valence of an accompanying video (violent vs prosocial) would influence the impact of the song lyrics and tone on key outcomes. Also, given the potential issues around self-report of physiological arousal, a physiological indicator of arousal was used.

4.1 | Method

4.1.1 | Ethics approval

This project was run in accordance with the Declaration of Helsinki and had approval from the university HREC (approval number 5201200098).

4.1.2 | Participants and design

Participants were 109 undergraduate students who participated for course credit and a further five participants recruited from friends and family of the researcher. One participant did not complete the study and their results were not included in analyses. The final sample N = 113 consisted of 26 males and 87 females with a mean age of 20.37 (SD = 5.01). Participants were randomly allocated to one of 8 groups in a 2 (aggressive vs. Nonaggressive musical tone) x 2 (violent vs. prosocial lyrics) x 2 (violent vs. prosocial video) between-subject factorial design.

4.1.3 | Manipulations

Musical tone and lyrics were manipulated using the same stimuli as study two, using just the violent and pro-social songs. A further manipulation involved producing a violent and a pro-social 4-min video clip to accompany each song. Created in imovie, the clips combined a collage of snipped 3 second YouTube clips containing images such as kicking, punching, fighting, bullying and blood, or hugging, helping, volunteer work, smiling and foreign aid. All video clips were rated as either violent or prosocial in a 4-person pilot test.

4.1.4 | Materials and measures

Aggression and prosocial behavior

Aggression was measured using the well-validated Bushman/Saults Competitive Reaction Time Task (see Warburton & Bushman, 2019). Aggression was operationalised as the summed, standardized mean scores for the duration and intensity of the noise blast delivered by participants across 25 trials. Win/lose ratios were pre-programmed with participants always losing the first trial and losing 13/25 trials in total. Aggression and prosocial behavior were also measured using the tangram task used in study two.

Internal processes, covariates and manipulation and attention checks

The Feelings Checklist was used to measure affective state and hostility/hostile cognition pre- and post-manipulation. The WCT measured aggressive cognition. Physiological arousal was measured as blood pressure and pulse using an Omron HEM-7211 monitor. Trait aggression was measured with the AQ (used in studies one and two).

Participants were also asked to describe the nature of the lyrics (Violent, Neutral, Prosocial, Other–specify) and to recall any lyrics remembered; how they would describe the overall tone of the music they heard (Violent, non-Violent, Other-specify); and how they would describe the nature of the video (Violent, Neutral, Prosocial, Other–specify) and to describe some of the actions they saw portrayed in the video. These items checked both whether participants were attending and whether the manipulations of lyric, tone and video were effective.

4.1.5 | Procedure

After being given a cover story, participants remained inactive whilst baseline blood pressure and pulse readings were taken. They then completed the AQ and the Feelings Checklist scales, and undertook the tangram preparations of Saleem et al. (2015) and CRTT practice. Participants then listened to the song with or without the video, after which blood pressure and pulse were taken, the Feelings Checklist and WCT were completed, and participants undertook the competitive reaction time task, allocated tangrams and completed the attention check questionnaire before being debriefed and thanked for their time. As there had been some variance in time taken to complete the tangram task in previous studies, the CRTT, which is generally completed within a similar time frame by participants, always preceded the tangram task to ensure the second dependant variable was completed within a consistent time frame from the first.

4.2 | Results

4.2.1 | Manipulation and attention checks

In a brief pilot, four participants heard and saw all stimuli, and identified the correct category for lyrics, tone and video in all cases. In the manipulation and attention check for the main study, categories chosen and free text answers were examined in tandem. In some data sheets the recalled lyrics or video content were clearly pro-social or violent in nature (e.g., 'people being kind to one another', 'I will support you, I will be there for you'), but the chosen category may not have matched (i.e., may have been neutral, other or misidentified). In these instances we gave precedence to the recalled content, assuming that the participant had attended to the stimuli properly and did comprehend the content as intended. 96.4% of

participants identified the lyrics category correctly. 87.9% identified the musical tone category correctly, and 99.1% identified the video category correctly. This suggests that the lyrics and video manipulations were quite successful. The tone manipulation was successful for a substantial majority of participants, but some participants were unsure how to categorize musical tone, choosing 'Other' and categorizing the music by genre or misidentifying the category.

4.2.2 | Lyrics, tone, video and aggression and prosocial behavior

The covariate trait aggression was significantly correlated with the competitive reaction time task measure of aggression, but not with either tangram task. It was therefore included as a covariate in the competitive reaction time task analysis only. There were no significant main effects of group and no interactions between groups in terms of aggressive or prosocial behavior. Post hoc power analyses found a coefficient of 0.75 for medium-sized main effects in this study, suggesting close to sufficient power.

4.2.3 | Changes to internal states

Trait aggression was not associated with any of the changes to internal states measures. There were significant main effects of lyric type, $\chi^2(1) = 9.58$, $p = .002$, $\eta_p^2 = 0.08$ and video type, $\chi^2(1) = 4.01$, $p = .045$, $\eta_p^2 = 0.03$ on hostility/hostile cognition. These are not interpreted further, as there was also a significant interaction between lyric type and video type, $\chi^2(1) = 11.54$, $p < .001$, $\eta_p^2 = 0.10$, whereby participants who experienced any level of violence in the video or the lyrics had increased hostility, but the group with neither had a small decrease (see Figure 4). There were also significant main effects of lyrics type, $\chi^2(1) = 9.61$, $p = .002$, $\eta_p^2 = 0.08$ and video type, $\chi^2(1) = 10.81$, $p = .001$, $\eta_p^2 = 0.09$, on affective state, as well as a significant interaction whereby participants who experienced any level of violence in the video or the lyrics had a substantially larger increase in negative affect than the group who experienced neither, $\chi^2(1) = 6.35$, $p = .012$, $\eta_p^2 = 0.06$ (see Figure 4). In terms of aggressive cognition, there was a main effect of video group on percentage of aggressive word completions post-manipulation, whereby those who watched the violent video had a greater percentage of aggressive cognitions (predicted $M = 0.41$, $SE = 0.02$ vs $M = 0.36$, $SD = 0.02$, $\chi^2(1) = 3.90$, $p = .048$, $\eta_p^2 = 0.03$). There were no group effects on any of the physiological arousal measures.

4.3 | Discussion study 3

In this study there were again no significant effects of either tone or lyrics on behavioral outcomes. Given the length of time between experiencing the stimuli and collecting the behavioral outcome data in this study, it is possible that the null findings may have been impacted by fading priming effects, especially for the tangram task

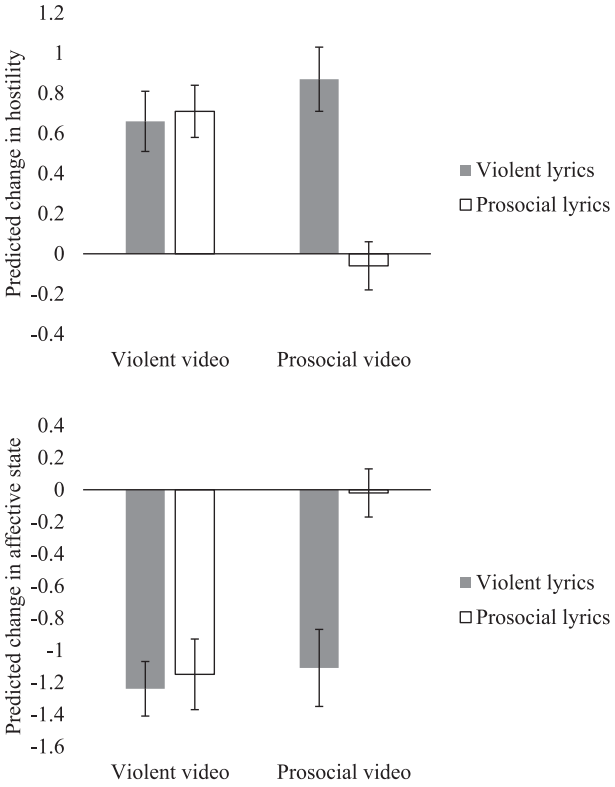

FIGURE 4 Changes to hostility (top) and affective state (bottom) after listening to music, by lyrics group and video group.

which was administered last (see Lindsay & Anderson, 2000). For example, Arendt (2013) found a significant effect at 3 min had faded to nonsignificance by 16 min, with modeling suggesting a faster fade again. In retrospect, testing a single behavioral outcome directly after song exposure may be a more robust approach.

As in earlier studies, lyrics had a clear effect on internal states, with violent lyrics increasing hostility and negative affect across both video conditions. In addition, adding the visual cues of a video also had an impact. Those who heard prosocial lyrics but saw a violent video had an increase in hostility and negative affect similar in magnitude to the increase seen in both groups who heard violent lyrics. In contrast, those who heard prosocial lyrics and saw a prosocial video had a small decrease in hostility/hostile cognition and affect scores that stayed near baseline. This suggests that the impacts of lyrical content on internal states can be moderated by the valence of visual media that accompanies it.

5 | STUDY 4: EFFECTS ON AGGRESSIVE DRIVING BEHAVIORS

Taken together, the earlier studies suggest that violent music may increase the impulse to aggress by increasing hostility, hostile cognitions and negative affect, but that these impulses do not always translate to aggressive behavior. It is possible that a trigger may be needed for these impulses to consistently translate to aggressive behavior, as was found by Hancock et al. (2013). Given the lack of

specific scripts for aggression in the song lyrics, it is also possible that a clear course of aggressive action might also facilitate those impulses translating into aggressive behavior. Thus, for the final study, participants listened to the same song stimuli in a practical situation (driving on a simulator) which included frustrating events to trigger aggression and a clear context where the person could be aggressive.

5.1 | Method

5.1.1 | Ethics approval

This project was run in accordance with the Declaration of Helsinki and had approval from the university HREC (approval number 5201200098).

5.1.2 | Participants

Participants were 100 undergraduate students who received course credit for their participation and 22 respondents to advertisements and invitations to participate who went in a draw to win a $50 shopping voucher. Two participants who guessed the true nature of the study were removed from the data set leaving a total sample of N = 120, consisting of 40 males and 78 females with a mean age of 23.78 (SD = 8.58). All participants possessed a provisional driver's licence or higher and were not hearing or visually impaired. Participants were randomly allocated within gender to one of six groups in a 3 (violent, neutral, prosocial lyrics) * 2 (aggressive vs. nonaggressive musical tone) between subjects design.

5.1.3 | Music stimuli

The songs developed for study two were looped so that participants could hear the song for the full duration of their drive.

5.1.4 | Aggressive driving

The virtual drive was undertaken on a STISIM Driver simulator (version 400, developed by Systems Technology Inc). The driver set up was in the style of an automatic vehicle featuring an adjustable driving seat with seatbelt, standard driver controls for operation, steering wheel and horn, indicator, foot brake and accelerator pedals. The simulator includes three networked side-by-side computer monitors providing a 135° view of the roadway which allows for front, side and rear viewpoints. Car and road sounds are part of the simulation. A purpose-built high beam flashlight was attached to the driving simulator for this experiment so that when a high beam button was pressed a visible light flashed behind the simulator screen.

All participants completed the same 3.5 km drive in the context of a suburban setting. At the correct speed limit, the drive took 8 min on average. To trigger driver aggression, the driving task was programmed with potentially frustrating events, such as pedestrians suddenly jaywalking onto the middle of the road blocking the driver's progress. Song music files were uploaded onto an Apple i-pod and a Behringer audio mixer (model: XENYX1204FX) was installed to enable simultaneous sound delivery for both music and simulator driving sounds to be received by participants. A set of Sennheiser headphones (model: HD 202) was utilized for the delivery of sound to minimize noise pollution, a method of sound delivery (for both driving and music) that has been used successfully in previous driver behavior research (see Nelson & Nilsson, 1990). The volume of the music and simulator driving sounds were kept constant for all six conditions (peaking at a comfortable ~80 dB). A Canon digital video camera (model: MV 400i) was positioned approximately one meter behind and, to the left of the driving simulator seat, levelled at the height of the simulation screens to capture participant's behavior during the driving task.

A number of earlier studies of aggressive driving have classified behaviors such as speeding as aggressive, but as noted earlier, such behaviors do not meet current definitions of aggression. For this study three clearly aggressive driving behaviors were measured: aggressive horning, aggressive high beaming of other drivers and rude verbal commentary directed at other road users. These were selected because: (a) they are intentional and threatening antisocial acts directed towards other road users; (b) they are indicators of aggressive driving behavior that have been well documented by aggressive driving researchers such as Dula and Ballard (2003), and (c) they are considered to be purposeful behaviors that cannot be deemed to result from driver distraction or cognitive load effects. Aggressive horning was operationalised as horning directed at another road user (e.g., driver or pedestrian) over and above a single use to warn of their vehicle positioning or approach. Aggressive high beaming was operationalised as any incidence of high beaming directed at another road user positioned ahead of the driver. Rude verbal commentary was operationalised as any incidence where a rude, insulting or intimidating comment was directed toward anther road user. This could include name-calling, swearing at other drivers, or harassing drivers to "hurry up." For all three the measure was a simple count of occurrences. Data were obtained through scrutiny of the STISIM logs and coding of the video. For the latter, standardized behavior categories were created from the operationalisations already noted, and video footage was scrutinized by two independent raters blind to the musical conditions. As the coded behaviors were very straightforward to interpret, a high inter-rater reliability was expected and obtained (see Supporting Information: Table B1 in the Supporting Information Material). As there was little discrepancy in scores from the two raters, they were averaged to give the final score for each measure.

5.1.5 | Materials and measures

Internal states

As in earlier studies, affective state and hostility were measured using the Feelings Checklist and aggressive cognition was measured using

the WCT. In this study physiological arousal was measured as heart rate using a Nordic Track heart rate monitor, with the baseline reading being the average of three readings across 10 min where participants sat quietly. A further 6-item measure of other-driver-directed hostility was created from items in the Judgmental and Disbelieving Thinking subscale of the Driver's Angry Thoughts Questionnaire (Deffenbacher, Petrilli, et al., 2003). Items (e.g., "They think they are above the rules," "I can't believe they're so inconsiderate") use a 5-point rating scale "1 = not at all" to "5 = all of the time" with a higher score indicating greater hostility toward other drivers. In this study this scale had very good internal consistency ($\alpha = .88$).

5.1.6 | Procedure

After being welcomed to the study and being given a cover story, participants were seated in the simulator, the heart rate wrist monitor was attached, and baseline readings taken. Participants then completed the Feelings checklist, were shown the simulator controls, and completed a test drive. Participants were instructed to treat the drive seriously and drive as they would normally. The video camera was then switched to record, the music/car sounds turned on, and the experimental driving task initiated. Immediately after the drive, heart rate was recorded and the WCT, Feelings Checklist and other questionnaires were administered. Participants were then debriefed and thanked.

5.2 | Results

5.2.1 | Lyrics, tone, and aggressive driving

There was no main effect of musical tone on aggressive driving and no interaction between musical tone and lyric type. However, there was a large-sized main effect of lyrics on aggressive driving, $\chi^2(2) = 27.17$, $p < .001$, $\eta_p^2 = 0.23$ (see Table 1). Bonferroni adjusted contrasts (p Value adjusted to .05/3) revealed that aggressive driving was significantly greater for those who listened to violent (predicted $M = 16.45$, SE = 2.24) compared to neutral (predicted $M = 6.09$, SE = 1.62) music, $M_{Diff} = 10.37$, $z = 3.70$, $p < .001$, $\eta_p^2 = 0.15$ and violent compared to prosocial (predicted $M = 4.38$, SE = 0.70) music, $M_{Diff} = 12.07$, $z = 5.19$, $p < .001$, $\eta_p^2 = 0.20$. Post hoc power analyses found coefficients of 0.68 (lyrics) and 0.78 (tone) for medium-sized main effects in this study, underscoring the size of the lyrics effect.

5.2.2 | Lyrics, tone, and internal states

There was a large-sized main effect of lyric type $\chi^2(2) = 32.30$, $p < .001$, $\eta_p^2 = 0.28$, and a moderate-sized main effect of musical tone, $\chi^2(1) = 13.28$, $p < .001$, $\eta_p^2 = 0.11$, on changes to hostility/hostile cognition, but there was no significant interaction (see Figure 5 for all internal states analyses; contrast tests for all internal states are reported in the Supporting Information Material, B2). There was also a large-sized main effect of lyric type, $F(2, 112) = 17.17$, $p < .001$, $\eta_p^2 = 0.23$) and a moderate-sized main effect of musical tone, $F(1, 112) = 9.88$, $p = .002$, $\eta_p^2 = 0.08$) on changes to affective state, but there was no significant interaction. It is noteworthy that every group reported an increase in negative affect, presumably due to the frustrating events built into the drive, so group differences reflected the degree of increase in negative affect. There were moderate-sized main effects of both lyric type, $\chi^2(2) = 10.43$, $p = .005$, $\eta_p^2 = 0.09$, and musical tone, $\chi^2(1) = 8.68$, $p = .003$, $\eta_p^2 = 0.07$, on changes to heart rate, but there was no significant interaction. There was a large sized effect of lyrics on aggressive cognition, $F(2, 112) = 12.14$, $p < .001$, $\eta_p^2 = 0.18$, but no main effect for tone and no tone-lyrics interaction. The same pattern was replicated for hostility toward other drivers (lyrics main effect: $F(2, 112) = 33.45$, $p < .001$, $\eta_p^2 = 0.37$).

5.3 | Discussion study 4

In this study, the same pattern of violent lyrics impacting hostile cognitions and affective state was found, with smaller but significant effects for musical tone also found. However, unlike studies two and three, increases in aggressive feelings and cognitions also translated into aggressive behavior. This is presumably because there was a trigger for aggressive behavior in conjunction with a clear opportunity to be aggressive. This suggests that aggressive thoughts and feelings elicited by violent music may be more likely to translate to aggressive behavior in situations that are triggering for aggression and where the

TABLE 1 Aggressive driving by behavior type and group.

Tone	Aggressive tone						Nonaggressive tone					
	Violent		Neutral		Prosocial		Violent		Neutral		Prosocial	
Lyrics	*M*	SD	*M*	SD	*M*	SD	*M*	SD	*M*	SD	*M*	SD
Aggressive horning	12.13	10.95	7.37	12.70	4.73	4.42	12.89	10.09	4.08	5.48	3.18	4.10
Aggressive high beaming	3.63	4.76	0.32	1.16	0.10	0.31	2.92	6.70	0.18	0.49	0	0
Aggressive commentary	1.10	1.80	0.24	0.71	0.20	0.52	0.24	0.48	0	0	0.55	1.23
Driver aggression total	16.85	13.18	7.92	12.90	5.03	4.59	16.05	14.75	4.25	5.52	3.73	4.20

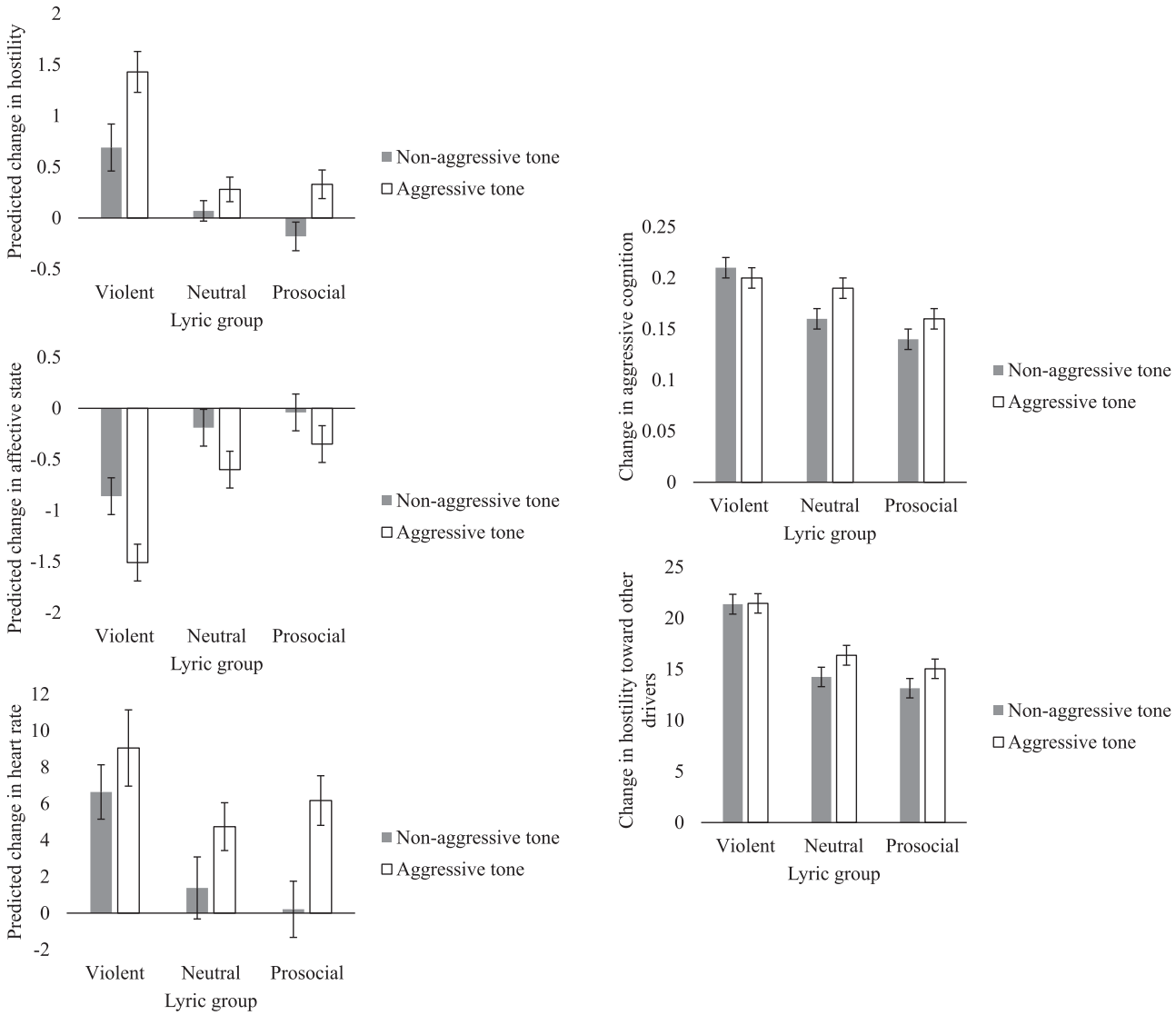

FIGURE 5 Changes to hostility, affective state, heart rate, aggressive cognition, and hostility toward other drivers after listening to music, by lyrics group and musical tone group.

situation provides some guidance as to the nature of an aggressive response.

6 | GENERAL DISCUSSION

Across all four studies, it was clear that violent music compared to prosocial music, reliably increased hostility/hostile cognitions, and that this effect was primarily driven by violent music lyrics rather than an aggressive musical tone. This aligns with past research (Anderson et al., 2003; Humphrey, 2007; Pieschl & Fegers, 2015), and cannot be explained by variations in musical features that are potential confounds (e.g., tempo and melody) because the purpose-built musical stimuli held these constant. In addition, prosocial lyrics decreased hostility/hostile cognitions in all studies which used prosocial lyrics (studies two-four), but always in conjunction with another factor: an upbeat musical tone in studies two and four, and a prosocial video in study three. The decrease in hostile cognition aligns with the findings of Greitemeyer (2011) and Böhm et al. (2016), and the importance of a pleasant musical tone in reducing hostile cognitions is concordant with the findings of Krahé, and Bieneck (2012) and Fried and Berkowitz (1979), who found similar links between pleasant musical tone and prosocial behavior. Overall, the effect of violent lyrics on increasing hostility/hostile cognitions was stronger and more consistent than the effect of prosocial lyrics on reducing them.

The effects of aggressive versus nonaggressive/pleasant musical tone were less consistent and were smaller in magnitude. In study two an aggressive musical tone was associated with increased arousal across lyrics conditions, whereas a nonaggressive/pleasant musical tone either had no change or was associated with reduced arousal across lyrics conditions. In study four a more aggressive tone was

associated with higher heart rate. Thus, there is some evidence that an aggressive musical tone increases physiological arousal. In study four an aggressive compared to nonaggressive/pleasant musical tone was also associated with greater increases to both hostility and negative affect, although for both outcomes the effects of lyrics were larger in magnitude.

Together, the findings related to internal states are not consistent with the notion that music effects are primarily driven by emotional responses and musical tone (e.g., Roberts et al., 2003, St Lawrence & Joyner, 1991) and align more closely with theories which posit that violent lyrics should activate/prime aggressive thoughts and feelings in a person's associative neural network (e.g., the GAM: Anderson & Bushman, 2002), and that prosocial lyrics should similarly impact prosocial thoughts and feelings (e.g., the GLM: Gentile & Gentile, 2020).

Although the findings for the effect of violent versus prosocial music on internal states was fairly consistent across studies, the effects on actual aggressive behavior were less consistent. In the first study there was a small effect on aggressive behavior, where lyrics with any amount of aggression seemed to prime aggressive behavior, but the effect was not strong. In studies two and three the effects did not reach significance, although in retrospect the Study two main effects analyses were found to be a little underpowered and in Study three, there may have been too great a gap between experiencing the music stimulus and completing the behavioral measures to capture a priming effect for either aggressive or prosocial behavior. In Study four, where a trigger for aggression and a driving simulator were used, there was clear evidence of violent lyrics increasing aggressive thoughts and feelings, and these translating into aggressive driving. It should also be noted that the replicated finding of violent music exposure being positively correlated with trait aggression does suggest a link between degree of violent music exposure and levels of aggressive behavior. Overall, it seems that aggressive impulses related to hearing violent music increase the likelihood of aggressive behavior, but that aggression is far more likely to eventuate when there is a trigger and where there is a clear pathway to aggressive action.

Such a pattern aligns with the notion that visual media provide specific scripts for behavior (see Huesmann, 1998), but that such scripts may be missing in music. Thus, where a movie or video game may elicit aggressive or prosocial behavior that aligns with the content watched, the same may not be true with heard media such as music (Warburton et al., 2008). However, where the situation provides the script (such as when driving a car), and where a trigger activates further aggressive thoughts and action tendencies (Anderson & Bushman, 2002; Warburton & Anderson, 2015, 2018), then aggression may be much more likely.

6.1 | Limitations and future research

Although research with similar or smaller sample sizes has found effects in the past (e.g., Anderson et al., 2003; Greitemeyer, 2009, 2011; Johnson, Adams, et al., 1995; Johnson, Jackson, et al., 1995; Mast & McAndrew, 2011), it is clear from post hoc analyses that the per-group sample sizes used provided insufficient power for some analyses. Whilst robust effects were found for some outcomes such as hostility/hostile cognition and triggered aggression, it is possible some smaller or less robust effects were missed. Thus, future research looking to replicate and extend these findings should use larger group sizes to ascertain all effects. It is also possible that the song stimuli created and used in this study may be less effective in different cultures, where it would be advisable to pilot test and, if needed, revise the song stimuli.

6.2 | Implications

The obvious implication of Study four is that listening to violent lyrics when driving may increase the likelihood of aggressive driving when that person is triggered, whereas listening to prosocial or pleasant-sounding music while driving may result in less aggression, hostility, arousal and negative affect. This is potentially important given the prevalence and safety implications of road rage (Love et al., 2022). It is also possible that such a pattern may follow in other settings, or where music is accompanied by scripts for aggressive or prosocial behavior such as in a video clip. For example, it has already been shown by Waite et al. (1992) that simply removing MTV from screens in a locked facility led to reduced aggression. It seems likely that background music that has neutral or prosocial lyrics or is pleasant in tone may be protective for aggression in many situations where music is played. Conversely, music with violent lyrics or an aggressive tone, played in situations where there may be triggers for aggression and where there are opportunities for aggression (e.g., some drinking venues) may increase the likelihood of aggressive behavior. Further research may benefit from looking at such links in terms of the effect of intoxication.

6.3 | Conclusions

In the media violence and prosocial media research domains, the medium of music is still under-researched. These studies suggest that auditory media may have qualitatively different impacts to visual media, and so further research is clearly needed to gauge this difference, particularly in terms of how internal states translate to real world behavior. Nevertheless, these studies provide evidence that violent and prosocial music reliably change a listener's internal psychological state, and that in the right conditions these changes can impact behavior.

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CONFLICT OF INTEREST STATEMENT

The authors declare no conflict of interest.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available on request from the corresponding author. The data are not publicly available due to privacy or ethical restrictions.

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