Analysis of music-exposure interventions for impacting prosocial behaviour via behaviour change techniques and mechanisms of action: a rapid review

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Abstract

The aim of the study is to evaluate the interventions examining music exposure's effects on prosocial behaviour, to identify the behaviour change techniques (BCTs) through which they change it, and to examine the mechanisms of action (MoAs) that mediate the relationship between music exposure and prosocial behaviour. The review identified 15 research articles, comprising 19 relevant studies. The results revealed that, though many of the included studies did not provide enough information to code them adequately, the BCTs "Instruction on how to perform a behaviour", "Salience of consequences", "Reduce negative emotions" and "Identification of self as role model" were the most commonly utilized techniques. Additionally, "Emotion" was the most significant MoA in the intervention-behaviour relationship in this context, but too few BCTs were able to be coded to make conclusions about any BCT-MoA relationships.

Keywords Music-exposure interventions · Prosocial behaviour · Behaviour change techniques · Mechanisms of action

Background

Music has always played an important role in human life. It has been used in each culture throughout history to evoke strong emotional reactions, to entertain, and to motivate war and work (Levitin, 2006). It has accompanied major events, like religious rituals, weddings, funerals, initiations, and graduations. This connection to music is a result of humans' biological affinity for musical stimuli, demonstrated by the fact that infants show evidence of music-influenced behaviour before they start to be moulded by societal factors (Weinberger, 1998).

Despite its importance, listening to music used to be a relatively restricted activity, secluded to times and places where people could gather with others to experience it. But as technology has made recording, distributing, and playing music easier, it has become a presence in mostly every feature of our daily lives (Bergh & DeNora, 2009; Sipahi, 2018). During 2017, Americans spent about 4.5 h a day listening to music, mostly using their smartphones, computers, and TVs to do so (Nielson, 2017). While this is already a great deal of time, it doesn't account for the music that we are exposed to through television programs, movies, video games, and online videos, or in the background of stores, restaurants, and other public spaces.

An extensive body of research has shown music's myriad psychological and behavioural effects, including its influence on our emotions, mood states, attitudes, decision-making, and judgements. The psychological effects of music range from increased spatial recognition (Rauscher et al., 1993) to changing racial attitudes (Rudman & Lee, 2002) to improving short-term memory (Nguyen & Grahn, 2017). The behavioural impacts of music are also just as varied, like influencing the number and frequency of bets while gambling (Mentzoni et al., 2014), improving strength and endurance during aerobic and anaerobic exercises (Crust & Clough, 2006), or even increasing eye contact and reducing challenging behaviours in children on the autism spectrum (Schwartz et al., 2017; Whipple, 2004).

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Though it has a multitude of applications, music must be carefully selected and fit to the context and desired behaviour change. A number of production and compositional factors in music have been shown to drive music's influence. For instance, consumer researchers have studied objective factors of music like volume (Kellaris & Rice, 1993), tempo (Oakes, 2003), and texture (Kellaris & Kent, 1993), as well as subjective factors such as the perceived mood (Alpert et al., 2005), familiarity (Bailey & Areni, 2006), or liking of the music (Dubé et al., 1995). These characteristics have impacted behaviours i.e., purchases, shopping time, waiting time, dining time, and interactions between employees and customers (Garlin & Owen, 2006; Turley & Milliman, 2000). Even the genre and cultural style of the music can change what wine someone will select (North et al., 1999), or how much they will pay for utilitarian products (North et al., 2016).

There has been an increasing amount of interest in music interventions and their impact on prosocial behaviour. Defined as "voluntary behaviour intended to benefit another" (Eisenberg et al., 2010, p. 146), prosocial behaviour can range from donating to charity, to helping someone accomplish a task, to protecting the natural environment for no personal benefit. An increase in prosocial behaviour can also be formulated as a decrease in antisocial behaviours, such as physical or verbal aggression, or cheating (Anderson et al., 2010). The general learning model (GLM) suggests that depending on the content of the music exposed, either negative or positive effects of listening to music on social behaviour are to be expected. In particular, exposure to violent music should increase antisocial and decrease prosocial outcomes, while exposure to prosocial media is assumed to decrease antisocial and to increase prosocial outcomes (Greitemeyer, 2011). Existing literature has shown that listening to songs with prosocial lyrics increases the accessibility of prosocial cognitions, empathy, and helping behaviour (Greitemeyer, 2009a, b; Jacob et al., 2010), while decreases aggressive behaviour (Greitemeyer, 2011). Many of the music interventions studied so far examining pro- and anti-social behaviour have focused on the prosociality of the song. It is difficult to pin down exactly what makes a song prosocial, but famous examples like Michael Jackson's "Heal the World" can act as signposts (Ruth & Schramm, 2020).

Despite the growing interest in music's effects on prosocial behaviour, the research on the impact of music on prosociality has still focused largely on its psychological effects. For instance, exposure to music from a specific culture can make one feel more affiliated with that culture (Vuoskoski et al., 2017), music with prosocial lyrics can increase prosocial thoughts and interpersonal empathy (Greitemeyer, 2009b), and music with pro-equality lyrics can increase positive attitudes toward women (Greitemeyer et al., 2012). As prosocial lyrics were termed the lyrics about

helping and cooperation (Greitemeyer, 2011; Niven, 2015; Ruth & Schramm, 2020). These findings compliment the widely researched effects of music on the ability to regulate positive mood and emotion, which have also been shown to predict prosociality (Drouvelis & Grosskopf, 2016; Kou et al., 2019; Labbé et al., 2007).

Music and behaviour change

Music has great appeal as a potential component for behaviour change interventions. It can be played in the background almost anywhere, and therefore can easily be applied to a variety of real-world contexts (Halko et al., 2015). And there is a wealth and variety of potential musical stimuli that can be interchanged with very little effort and cost. These considerations make music an effective tool for behaviour change because, in most contexts, music-exposure interventions can be deployed effectively and tested quickly. Music-exposure interventions to increase prosocial behaviour could be applied to non-profit advertisements to increase donations (Bentley, 2020), in transportation infrastructure to reduce fare evasion and aggression (Dawson et al., 2017), or in cafeterias to increase recycling and composting (Sussman et al., 2013), among many other possibilities.

Tools like the Behaviour Change Technique Taxonomy (BCTTv1) can be used to classify the individual active components of behaviour change interventions (Michie et al., 2013). The BCTTv1 is a 93-item taxonomy of behaviour change techniques (BCTs) and is typically used for the development of new interventions. However, the BCTTv1 can also be applied to analysing and evaluating existing interventions. In the context of music-exposure interventions, the BCTTv1 can help to organize the many aspects of musical stimuli discussed above to distinguish which components are responsible for prosocial behaviour change and which are extraneous. The content of an intervention can be described through the use of behaviour change techniques (BCTs) which can be helpful when trying to examine to what extent the barriers and enablers to a behaviour are addressed in interventions. BCTs, barriers and/ or enablers may highlight potential missed opportunities for intervention design. In particular, BCTs, when applied, can improve the delivery of an intervention, as a wide range of BCTs can change the various theoretical determinants of behaviours. Some BCTs may be more effective at addressing specific types of determinants. For example, the technique "behavioural rehearsal/ practice" is likely to be effective when the barrier is a lack of skill to perform the behaviour. This represents high theoretical coherence between the intervention component and the theoretical determinant it targets. According to existing literature, interventions are more likely to be effective if they include components that specifically target the important

theoretical determinants of behaviour and behaviour change (Michie et al., 2008).

However, there is currently no evidence regarding the BCTs used in music-exposure interventions. The BCTTv1 has been used to analyse the effects of message content on smoking cessation (Michie et al., 2012), which is similar to the analysis of lyrical content in musical stimuli. However, it has never been used to categorize the components of musical genre and composition before. Therefore, this review seeks to classify these musical components using the BCTTv1, and also assess the BCTTv1's suitability for analysing musical stimuli.

While BCTs can help to classify intervention components, they cannot explain the underlying psychological drivers that elicit behaviour change. In order to get a more complete picture of the impact that music-exposure interventions have on prosocial behaviour, it is desirable to examine the variables that mediate the intervention-behaviour relationship. Therefore, this review will also extract the variables that have been tested as mediators in the included studies and map them to the nearest Mechanisms of Action (MoAs), as set out in Carey et al. (2019). This list of 26 MoAs is a combination of the 14 domains in the Theoretical Domains Framework (Atkins et al., 2020; Michie et al., 2013) and 12 of the most common and relevant constructs taken from a set of 83 behaviour change theories. Categorizing the BCTs and MoAs for the included studies will help to design better music-exposure interventions in the future by joining music-exposure interventions with the existing behaviour change literature (Moore & Evans, 2017).

Objectives

There is an intricate connection between the objective composition, psychological associations, and environmental context of music exposure and human behaviour. As a result, several reviews have compiled these effects (i.e., Schwartz et al., 2017). While Palazzi et al. (2019) included studies relating to music and helping behaviour in their review, none have explicitly sought to evaluate all of the available literature on music exposure's effects on prosocial behaviour. Additionally, despite the breadth of literature on the subject, no review has examined the effect of music exposure on behaviour using behaviour change methodologies. Therefore, the aim of the current study is to conduct a review to evaluate the interventions examining music exposure's effects on prosocial behaviour and to identify the available evidence.

Research questions:

1) Are music exposure interventions effective for influencing prosocial behaviour?

2) What are the BCTs within music-exposure that have been evaluated, and which of them are particularly effective in changing prosocial behaviour?

3) What MoAs mediate the relationship between music exposure and prosocial behaviour?

Method

Search strategy

The literature search followed the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) checklist for systematic reviews (Moher et al., 2015) and Cochrane's guidance to conduct rapid reviews (Garritty et al., 2020). An initial search was conducted in JSTOR to determine the appropriate search terms for the review. On August 9, 2020 a search of the research article databases JSTOR, PsycInfo, and Web of Science Core Collection was conducted with the following search terms: "(prosocial behavi* AND music) NOT therapy NOT training". The term "prosocial" also captured the studies which included the terms "altruistic" and "moral". Due to similarities in the search syntax, this search string was used for all 3 databases. The search terms "NOT therapy" and "NOT training" were used to avoid the inclusion of articles that had interventions with medically diagnosed individuals as the target population, and also to avoid interventions that included learning to play music, as "music therapy" and "music training" were common descriptors of those interventions. The search was not restricted by publication date, but was limited to published, peer-reviewed articles in research journals, due to time and resource constraints. All retrieved citations were gathered in Mendeley v1.19.4 reference management software.

Eligibility criteria

Articles were included in the final review if they contained at least one study that met all of the following criteria:

Published experimental studies (randomised controlled trials (RCTs) and non-randomised controlled studies (NRSs)) that examined the impact of music-exposure interventions on prosocial behaviour were included. A music-exposure intervention was defined as listening to music either in the background or foreground of an individual's attention (e.g. passive or active listening) (Dalton & Behm, 2007). Music-exposure interventions that involved a component of making or learning music were not examined due to their restricted applications to real-world contexts. These kinds of interventions would require a teacher, instruments, or a proper space to prac-

tice or play. Additionally, to differentiate music from other stimuli, like ambient sounds and white noise, music was defined as "organized sound that contains melody, harmony, and rhythm" (Dalton & Behm, 2007; Kühlmann et al., 2018; van der Zwaag et al., 2011).

For this review, the multidisciplinary consensus definition of behaviour was used:

> …anything a person does in response to internal or external events. Actions may be overt (motor or verbal) and directly measurable or covert (activities not view-able but involving voluntary muscles) and indirectly measurable; behaviours are physical events that occur in the body and are controlled by the brain. (Davis et al., 2015, p. 327).

Studies that relied on measures of behavioural intentions, rather than actual behaviour, were not included. The exception was studies that had an outcome measure that indicated a binding, but not necessarily performed, behavioural intention. One example is a participant indicating how much of a potential earnings pot (determined by lottery) they will donate to charity if they receive it. In addition to the outcome being behavioural, it was required that the behaviour be prosocial in nature, therefore, the following definition for prosocial behaviour was used to classify outcome variables: "voluntary behaviour intended to benefit another" (Eisenberg et al., 2007; Lay & Hoppmann, 2015; Martí-Vilar et al., 2019). Additionally, anti-social behavioural outcomes, such as cheating or aggression were also included; framed as a reduction in antisocial behaviour, it is equivalent to an increase in prosocial behaviour.

Studies that were in the English language and examined a human sample were included. Only studies sampling individuals from the general population who either examined adults (18+), or which did not have any age restriction for participants, were included. In addition, studies with sample populations that were selectively chosen due to a medical diagnosis were excluded. These limits were intended to increase the generalizability of the findings by excluding articles targeting infants as well as ill or otherwise medically affected individuals, which are both populations shown not to be representative of society as a whole in terms of engaging with musical stimuli (Cirelli et al., 2018; Hakvoort et al., 2015). No restrictions were placed on geographical region.

Selection of studies

The screening process of abstracts and titles of intervention studies was conducted by one reviewer. The reviewer determined the eligibility of studies on the basis of a review of the full texts, using the predefined inclusion criteria. A second reviewer screened all excluded full text articles, though.

After the selection process was finished, the PRISMA flow diagram was completed (Fig. 1).

Quality assessment

In order to evaluate the methodological quality of the studies included in the review, the Cochrane Collaboration Risk of Bias (CCRBT) (Higgins et al., 2011, 2019) was used. CCRBT is a two-part tool, addressing seven evidence-based domains, namely random sequence generation (selection bias), allocation concealment (selection bias), blinding of participants and personnel (performance bias), blinding of outcome assessment (detection bias), incomplete outcome data (attrition bias), selective outcome reporting (reporting bias), and other sources of bias (other bias). The first part of the tool gives sufficiently detailed support for judging the risk of bias, ensuring its transparency. The second part assigns a judgment relating to the risk of bias for each domain. This is achieved by assigning a judgment of "Low risk" of bias (+), "High risk" of bias (-), or "Unclear risk" of bias (?). In line with the Cochrane Collaboration's recommendations, those studies in which all the domains were rated positively were judged as having a low risk of bias, while the studies with one or more unclear domains were judged as having an unclear risk of bias. Furthermore, studies with one or more negatively rated domains were judged as having a high risk of bias (Higgins et al., 2011, 2019). In our review, the first two domains (random sequence generation and allocation concealment) were marked as not applicable for the quasi-experimental study designs. Although the tool was not developed with nonrandomized studies in mind, the general structure of the tool and the assessments seems useful to follow when creating risk of bias assessments for quasi-experimental studies (Higgins et al., 2011). Two review authors (AM, AG) independently evaluated the methodological quality of each study using both assessment tools. Discrepancies were resolved by means of a consensus procedure.

Data extraction

A data extraction form was created to extract the relevant information from the included studies. A single reviewer extracted the data, while a second reviewer checked for correctness and completeness of extracted data. Extracted data included article citations, and when the article contained multiple studies, the relevant study number was taken. The study designs, music-exposure interventions, and methods were all taken as to gather all the relevant information needed to code BCTs. The prosocial behaviour outcome measures, along with the results of the interventions, were extracted. The dependent variables labelled as having been tested as mediators in the intervention-outcome relationship

Fig. 1 Flow chart
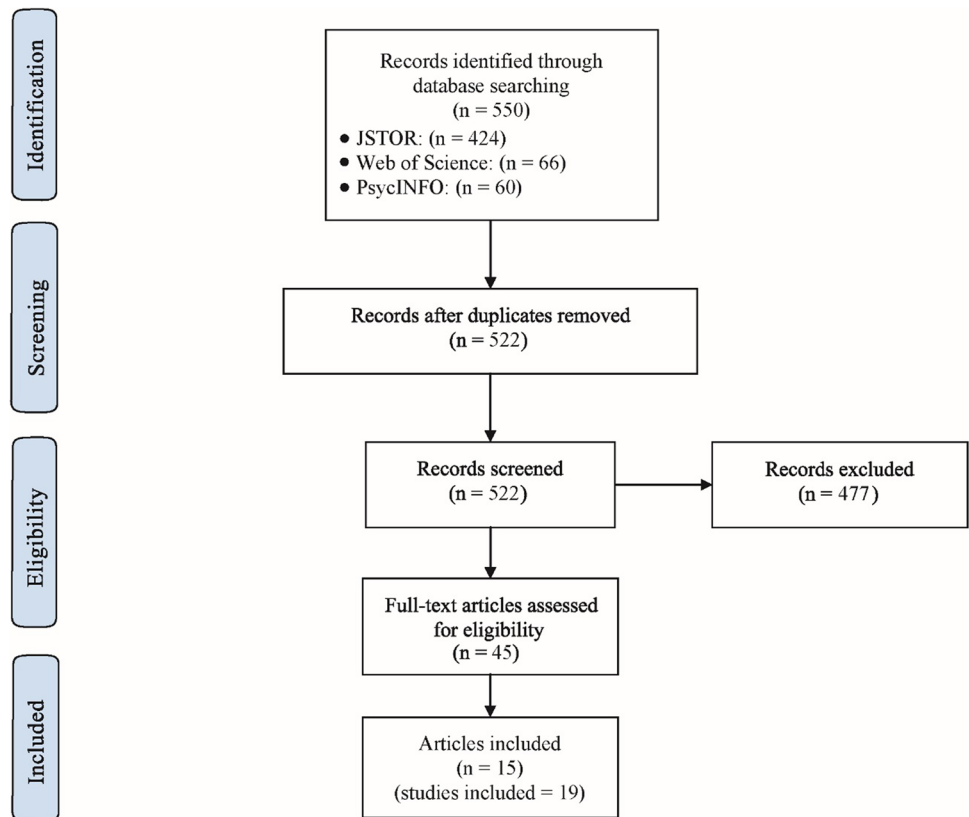
were also taken. Lastly, the musical stimuli used in each study were extracted when available (see Appendix Table 4).

Data synthesis

BCTs were double-coded by coders using the BCTTv1 (Michie et al., 2013). All coding was based on explicitly stated components in the intervention design of each study, and therefore if an intervention component was implied but not explicitly stated it was not coded. For studies with a multi-factorial design, each factor was considered separately, and those factors that did not qualify as part of a music-exposure intervention were deemed secondary in the BCT coding process. For example, Greitemeyer and Schwab (2014, Studies 2 and 3) manipulated both the lyrical content of the musical stimuli presented and the recipient of a dictator game. The dictator game recipient manipulation factor was deemed secondary due to the non-musical nature of the manipulation.

All dependent variables that were analysed as potential mediators between music-exposure interventions and prosocial behaviour outcomes in the included studies were categorized to their closest MoA, as laid out in Carey et al. (2019). The coding process for both the BCTs and MoAs was conducted by two independent reviewers and disagreements

were resolved through discussion, first with each other and then, when needed, a third party.

Results

The initial database search yielded 550 articles. After removing duplicate citations, 522 articles remained and were screened first by their titles, and then by their abstracts, leaving 45 articles for full text review. Any article that was not a published peer-reviewed article, or was not in English was excluded, as well as those articles which did not fall under the scope of a music-exposure intervention or did not use a prosocial behaviour as an outcome measure. After the texts were reviewed in their entirety, 15 articles were deemed appropriate for inclusion (Fig. 1). Some of the articles contained more than one study that fit the criteria of the review, therefore, from those 15 articles a total of 19 studies were included. Although there was no restriction of publication date for study inclusion, the earliest was published in 2004. Five studies were conducted between 2004 and 2009, five studies were conducted between 2010 and 2015, while nine studies were published between 2016 and 2020. The majority of studies were conducted in Germany ($n = 7$), whilst three were conducted in Austria and UK, two in USA, and one in each of the following countries: Japan, China, France,

and Mauritius with student population from Czech Republic and USA.

Participants

As specified in the search criteria, all studies have participants who were not diagnosed with any particular medical condition, and who were either not sampled for their age or who were adults (age 18+). Of the included studies, most used participants that were undergraduate or postgraduate students at universities (Fukui & Toyoshima, 2014; Greitemeyer, 2009a, Studies 1, 2, and 4; 2009b, Experiment 3; Greitemeyer & Schwab, 2014, Studies 2 and 3; Kniffin et al., 2017, Studies 1 and 2; North et al., 2004; Ruth & Schramm, 2020; Stupacher et al., 2017; Yu et al., 2019, Study 2). Three studies investigated restaurant patrons as participants (Beer & Greitemeyer, 2019; Jacob et al., 2010; Ruth, 2017). Another three studies used participants gathered from the general population (Greitemeyer, 2011, Study 5; Ruth, 2019), whilst one study used a combination of general population and student participants (Lang et al., 2016).

Most of the studies had no required eligibility criteria for participation, but Fukui and Toyoshima (2014) only accepted participants who reported themselves to have felt "chills" in response to hearing music, and who were not professional musicians. In addition, North et al. (2004) required participants to be a member of the gym where the study took place, which included having undergone an introductory gym session.

The sample sizes of the included studies varied considerably, from 22 to 786 (total = 3436, M = 181, median n = 100). Two studies had small sample sizes of 40 participants or below (Fukui & Toyoshima, 2014; Greitemeyer, 2009a, Study 1). Eight studies evaluated 41–100 participants (Greitemeyer, 2009a, Studies 2 and 4; 2009b, Experiment 3; 2011, Study 5; Greitemeyer & Schwab, 2014, Studies 2 and 3; Kniffin et al., 2017, Study 1; Yu et al., 2019, Study 2), whilst eight additional studies had more than 100 participants (Beer & Greitemeyer, 2019; Jacob et al., 2010; Kniffin et al., 2017, Study 2; Lang et al., 2016; North et al., 2004; Ruth, 2017, 2019; Ruth & Schramm, 2020).

Study designs

All included studies were RCTs and NRSs, as outlined in the review criteria above. Nearly all of the studies used a between-subjects design. Of those, seven studies employed a direct 2-condition between-subjects design (Greitemeyer, 2009a, Studies 1, 2 and 4; 2009b, Experiment 3; 2011, Study 5; Kniffin et al., 2017, Study 1; Ruth, 2017). Three studies employed a 3-condition between-subjects design (Jacob

et al., 2010; Kniffin et al., 2017, Study 2; Lang et al., 2016). Seven studies used a 2 × 2 between-subjects design (Greitemeyer & Schwab, 2014, Studies 2 and 3; North et al., 2004; Ruth, 2019; Ruth & Schramm, 2020; Stupacher et al., 2017; Yu et al., 2019, Study 2). And one study used a quasi-experimental 3-condition between-subjects design (Beer & Greitemeyer, 2019). Lastly, one study conducted an experiment with a 3 × 4 within-subjects, repeated measures design (Fukui & Toyoshima, 2014).

Quality assessment

The overview of risk of bias assessment is summarized in Table 1. Overall, the studies were judged as having an unclear risk of bias, as they had at least one domain judged as having unclear or low risk of bias (Higgins et al., 2011).

Music-exposure interventions

Each of the studies in this review included an experimental condition in which participants were exposed to music, as defined above, in some form, and an alternate condition that either exposed participants to a different musical/auditory stimulus or removed music altogether. The music stimuli manipulations studied fell into four categories: lyrical content, emotions/moods, production elements, and listener relationship to the music.

Of the 19 included studies, 11 manipulated the lyrical content of the music in the intervention. Nine of the lyrical content studies looked at the difference between music with prosocial lyrics and neutral lyrics (Greitemeyer, 2009a, Studies 1, 2, and 4; 2009b, Experiment 3; 2011, Study 5; Jacob et al., 2010; Ruth, 2017; Ruth & Schramm, 2020; Yu et al., 2019, Study 2). The lyrical content was determined as prosocial most often by pilot studies that exposed participants to many songs and had them rate each on how prosocial they thought it was. Two of the prosocial lyrics studies also examined the potential interaction effects of the lyrics with musical production elements, the first with unplugged/acoustic vs. electronic production (Ruth & Schramm, 2020), and the second tested the lyrics in combination with or completely without musical accompaniment (Yu et al., 2019, Study 2). The other two studies that examined lyrical content both had participants listen to songs that were rated as pro-integration by a pilot study in the same fashion as the prosocial songs and compared them to songs with neutral lyrics. Both of these pro-integration lyrics studies examined the interaction effects of these songs with the target of their prosocial behaviour tasks as either ingroup or outgroup members (Greitemeyer & Schwab, 2014, Studies 2 and 3).

Four studies tested the impact of music with different intended emotions or moods. North et al. (2004) had participants listen to music that was intended to generate a positive

Table 1 Risk of bias in included studies: low risk (+); unclear risk (?); high risk (-)

	Random sequence generation	Allocation concealment	Blinding of participants and personnel	Blinding of outcome assessment	Incomplete outcome data	Selective reporting	Other bias	Summary assessments
Beer and Greitemeyer (2019)	n/a	n/a	(+)	(+)	(+)	(?)	(?)	Unclear Risk of Bias
Fukui and Toyoshima (2014)	(+)	(+)	(+)	(+)	(+)	(?)	(?)	Unclear Risk of Bias
Greitemeyer (2009a), Studies 1, 2, 4	(?)	(?)	(+)	(+)	(+)	(?)	(?)	Unclear Risk of Bias
Greitemeyer (2009b), Experiment 3	(?)	(?)	(+)	(+)	(+)	(?)	(?)	Unclear Risk of Bias
Greitemeyer (2011), Study 5	(?)	(?)	(+)	(+)	(+)	(?)	(?)	Unclear Risk of Bias
Greitemeyer and Schwab (2014), Studies 2, 3	(?)	(?)	(+)	(+)	(+)	(?)	(?)	Unclear Risk of Bias
Jacob et al. (2010)	(?)	(?)	(+)	(+)	(+)	(?)	(?)	Unclear Risk of Bias
Kniffin et al. (2017), Studies 1, 2	(+)	(+)	(+)	(+)	(+)	(?)	(?)	Unclear Risk of Bias
Lang et al. (2016)	(?)	(?)	(+)	(+)	(+)	(?)	(?)	Unclear Risk of Bias
North et al. (2004)	(?)	(?)	(?)	(?)	(+)	(?)	(?)	Unclear Risk of Bias
Ruth and Schramm (2020)	(?)	(?)	(+)	(+)	(+)	(?)	(?)	Unclear Risk of Bias
Ruth (2017)	(?)	(?)	(+)	(+)	(+)	(?)	(?)	Unclear Risk of Bias
Ruth (2019)	(?)	(?)	(+)	(+)	(+)	(?)	(?)	Unclear Risk of Bias
Stupacher et al. (2017)	n/a (pseudo-rand-omized)	n/a	(+)	(+)	(+)	(?)	(?)	Unclear Risk of Bias
Yu et al. (2019), Study 2	(?)	(?)	(+)	(+)	(+)	(?)	(?)	Unclear Risk of Bias

mood or a negative mood. Kniffin et al. (2017, Study 1) tested happy vs. unhappy music, while Kniffin et al. (2017, Study 2) did the same but added a no music control condition. Beer and Greitemeyer (2019) tested uplifting music against melancholic or baseline music (music that had been playing previously in the restaurant).

Three studies examined forms of musical production elements. One of these compared music to no music at all (Yu et al., 2019, Study 2). Another, mentioned above, examined acoustic vs. electronic production elements (Ruth & Schramm, 2020). And the third compared listening to music to listening to a metronome (Stupacher et al., 2017). The first two of these studies looked at interaction effects with lyrical content, and the third examined interaction effects of synchronous behaviour with a confederate.

Three of the studies examined the listener's relationship to the music. Ruth (2019) had participants listen to music

they were either familiar with or unfamiliar with, and also manipulated whether the participants listened to the music attentively or inattentively. Fukui and Toyoshima (2014) asked participants to share music that gave them "chills" and music that they disliked and compared listening to those pieces of music with silence. Lang et al. (2016) tested music that was religious in nature against secular music as well as white noise. The study was categorized here because religious music does not relate to everyone in the same way. Religious individuals will have a different relationship with religious music than non-religious individuals, perhaps due to less exposure or different psychological associations.

Prosocial behaviours

Each of the studies included an outcome measure that evaluated prosocial behaviour, as defined above. These prosocial

outcome measures fall into 5 categories: aggressive behaviour, charitable donations, helping behaviour, game theory game, and cheating.

Two studies assessed aggressive behaviours. Greitemeyer and Schwab (2014, Study 2) measured the loudness and duration of white noise bursts that participants wanted to send to a fake opponent, and Greitemeyer (2011, Study 5) assessed the amount of hot chili sauce that participants put into a cup for a hot sauce-hating confederate to consume. Three studies assessed charitable donations and all three used a slight variation of the same measurement. Each one asked participants how much of the earnings that they would be getting from their participation in the experiment they would like to donate. Ruth (2019) and Ruth and Schramm (2020) entered each participant into a lottery, and asked participants how much of their potential earnings they would donate to charity. Greitemeyer (2009b, Experiment 3) gave participants their standard earnings at the end of the experiment and hinted that it would be nice for the participants to donate their earnings to a charity (whose donation box was in the room) and then assessed actual donations.

Nine of the included studies measured prosocial behaviour using some sort of helping outcome. Three studies (all three studies that took place in restaurants) assessed tips given to wait staff. Ruth (2017) and Beer and Greitemeyer (2019) measured tipping as a proportion of the total bill, while Jacob et al. (2010) looked at the proportion of patrons who left a tip, as well as the average tip per patron. Ruth (2017) used the number of patrons that ordered fair-trade coffee, as opposed to non-fair-trade coffee, as a second prosocial measure. Stupacher et al. (2017) as well as Greitemeyer (2009a, Study 1) had experimenters "accidentally" drop a cup with pencils in front of participants and measured the number of pencils that the participant helped pick up. Two studies measured prosocial behaviour by asking participants if they'd participate in an additional experiment for no extra payment for the benefit of another student (Greitemeyer, 2009a, Study 2; Yu et al., 2019, Study 2), while Greitemeyer and Schwab (2014, Study 3) asked participants how many leaflets they would distribute to help recruit participants for another study. North et al. (2004) asked participants how many leaflets they'd distribute to help a charity recruit members.

Four studies involved games to assess prosocial behaviour. Two of them used the dictator game (Fukui & Toyoshima, 2014; Greitemeyer, 2009a, Study 4), wherein a participant was given a sum of money and told that they could give as much of that money to another participant as they would like, and the recipient could not deny the receipt. The other two used the Voluntary Contribution Mechanism (Kniffin et al., 2017, Studies 1 and 2), which is a public goods game that incentivizes cooperation between participants by giving

a choice between keeping money for personal use or adding to a group pot that advantages everyone.

A single study assessed cheating behaviour (Lang et al., 2016). Participants were given a series of timed mathematical matrix tasks that became progressively harder and were paid according to the number of matrices that they reported having gotten correct. Whether the participants lied about the number of correct answers was assessed as the prosocial outcome behaviour.

Music-exposure effects on prosocial behaviour

Although most of the included studies reported that their music-exposure interventions significantly improved prosocial behaviour ($n = 12$), a few reported mixed results ($n = 5$), and some reported only non-significant results ($n = 2$).

Eight of the 11 interventions, that included manipulating the lyrical content of the musical stimulus, had a significant and positive effect on prosocial behaviour. Specifically, the two studies that manipulated pro-integration lyrics (Greitemeyer & Schwab, 2014, Studies 2 and 3), and six that manipulated prosocial lyrics (Greitemeyer, 2009a, Studies 1, 2 and 4; Greitemeyer, 2009b, Experiment 3; Greitemeyer, 2011, Study 5; Jacob et al., 2010), significantly improved prosocial behaviour. However, both Ruth (2017) and Yu et al. (2019, Study 2) reported mixed results. Ruth (2017) found that music with prosocial lyrics increased the sale of fair-trade coffee in a cafe but didn't increase the amount the patrons tipped their wait staff. While Yu et al. (2019, Study 2) found that prosocial lyrics caused greater agreement to help with an unpaid experiment, but only if those lyrics were accompanied by music rather than just being read as text. The last lyrical manipulation, Ruth and Schramm (2020), reported that music with prosocial lyrics did not significantly increase non-profit donations regardless if it was accompanied by acoustic or electronic music.

Two of the four studies whose interventions involved musical stimuli intended to elicit a particular mood or emotion had significant and positive impact on prosocial behaviour. Both of the included studies by Kniffin et al. (2017, Studies 2 and 3) observed that people exposed to happy music contributed more to a group pot in a voluntary contribution mechanism than those exposed to unhappy music. North et al. (2004) detected that music intended to create a positive mood caused people to be more likely to volunteer to help distribute fliers for a non-profit more than music intended to create a negative mood, but that both kinds of music caused the same number of people to sign a petition in support of the same non-profit. However, these results are due to a ceiling effect in the petition signing measure, making these mixed results more clearly positive. And lastly, Beer and Greitemeyer (2019) played uplifting, melancholic, and baseline music in a restaurant and found that none of

them differed in the amount that patrons tipped their wait staff.

Two of the three studies, that examined the effect of musical production elements on prosocial behaviour, found mixed results, and one found non-significant results. As mentioned above, Yu et al. (2019, Study 2) examined the effect of lyrics either accompanied by music or not and found that prosocial music only increased prosocial behaviour if it was accompanied by music. Stupacher et al. (2017) observed that, when listening to a metronome, people didn't help an experimenter pick up more pencils whether that experimenter had earlier tapped in rhythm with them or tapped out of rhythm with them, but that when they listened to music, people helped pick up more pencils with those that tapped in sync with them. Ruth and Schramm (2020) found that regardless of whether an individual listened to an acoustic or electronic version of a song, and whether that song had prosocial or neutral lyrics, did not change how much they donated to a non-profit organization.

Two of the three studies, that examined the listener's relationship with the musical stimuli, were significant, and one was mixed. Fukui et al. (2014) found that people gave more money to recipients in a dictator game after having listened to chill-inducing music and gave less after listening to music they disliked. While Ruth (2019) observed that both how familiar someone is with a prosocial song, and how much they are focusing their attention on it, influences the amount they donate to charity. However, Lang et al. (2016) found that religious music did not cause people to cheat less than secular music, or white noise, unless the listener happens to be religious.

A meta-analysis was considered to assess the overall effect of music-exposure interventions on prosocial behaviour. However, the broad range of study designs, along with the heterogeneity of intervention manipulations and prosocial outcome measures, made it both infeasible and likely not very informative. In addition, a meta-analysis evaluating the strength of the coded BCTs was also considered, but the lack of information necessary to code many BCTs in the included studies (expanded on below) left too little data for a meaningful analysis (see Table 2).

Behaviour change techniques

Overall, the included studies utilized only a few BCTs in their interventions. The kappa for interrater reliability in BCT coding was 0.787 (p < 0.001), 95% CI (0.503, 1.000) (substantial agreement). A total of ten BCTs were identified to comprise the music-exposure interventions; they were "3.3 Social support (emotional)" ($n = 6$), "4.1 Instruction on how to perform a behaviour" ($n = 10$), "5.2 Salience of consequences" ($n = 9$), "5.3 Information about social and environmental consequences" ($n = 3$), "5.6 Information

about emotional consequences" ($n = 1$), "7.1 Prompts/cues" ($n = 3$), "9.3 Comparative imagining of future outcomes" ($n = 1$), "11.2 Reduce negative emotions" ($n = 9$), "13.1 Identification of self as role model" ($n = 8$), and "12.4 Distraction" ($n = 1$). Of the 19 studies, four studies contained 4 BCTs, two studies had 6 BCTs and other two studies contained 5 BCTs, while one study had 8 BCTs, and 3 studies contained 3 BCTs, 2 BCTs and a single BCT in their interventions, respectively. Remarkably, 7 of the 19 studies lacked enough information in their study designs to code a single BCT to the intervention.

The most frequently included BCTs identified during the lyrical analysis of the prosocial songs were "4.1 Instruction on how to perform a behaviour", defined as to "advise or agree on how to perform the behaviour"; "5.2 Salience of consequences", defined as to "use methods specifically designed to emphasise the consequences of performing the behaviour with the aim of making them more memorable"; "11.2 Reduce negative emotions", defined as to "advise on ways of reducing negative emotions to facilitate performance of the behaviour"; "13.1 Identification of self as role model", defined as to "Inform that one's own behaviour may be an example to others". For example, prosocial songs that included the above BCTs were "Heal the world", "We are the world" and "Love Generation". Less frequently included BCTs identified during the lyrical analysis of the prosocial songs were "3.3 Social support (emotional)", defined as to "advise on, arrange, or provide emotional social support (e.g. from friends, relatives, colleagues, 'buddies' or staff) for performance of the behaviour"; "5.3 Information about social and environmental consequences", defined as to "provide information (e.g. written, verbal, visual) about social and environmental consequences of performing the behaviour"; "5.6 Information about emotional consequences", defined as to "provide information (e.g. written, verbal, visual) about emotional consequences of performing the behaviour"; "9.3 Comparative imagining of future outcomes", defined as to "prompt or advise the imagining and comparing of future outcomes of changed versus unchanged behaviour". For example, prosocial songs that included the above BCTs were "Help" and "Imagine".

Three studies contained the BCT "(7.1) Prompts/cues", defined as to "introduce or define environmental or social stimulus with the purpose of prompting or cueing the behaviour". Ruth and Schramm (2020) was coded to this BCT because the intervention manipulated lyrical content, specifically prosocial lyrics against neutral lyrics. Prosocial lyrics in Ruth and Schramm (2020) were defined as featuring "references to prosocial behaviour" - defined as behaviour "performed intentionally, without involving payment, and… is not an action that is done because of one's job" - while neutral lyrics dealt with "themes of love and partying". Of the 11 studies that manipulated lyrical content, Ruth and

Table 2 Study characteristics

Reference	Study design	Sample recruitment	Sample size	Intervention conditions	Prosocial behaviour	Prosocial behaviour outcome measure	Results
Beer and Greitemeyer (2019)	3 quasi-experimental conditions	Bill-paying patrons of a restaurant in Munich	277	*music feeling*: uplifting vs. melancholic vs. baseline	Tipping	The size of a tip left for wait staff as the percentage of the total bill	In no experimental condition did patrons offer a greater tip as a percentage of their total bill. However, older guests were more generous when exposed to uplifting and melancholic music compared to baseline music.
Fukui and Toyoshima 2014	3×4, within subjects	Mainly undergraduate and postgraduate students	22	*music feeling*: chill-inducing vs. disliked vs. no music *dictator game recipient*: ingroup female vs. ingroup male vs. outgroup female vs. outgroup male	Money allocation	Amount of Japanese Yen given in a dictator game	Participants gave more money in a dictator game after they had listened to their pre-ferred, chill-inducing music than before they listened to it. They gave less after listening to music they disliked than before they listened to it. And they gave the same amount in the dictator game before and after sitting in silence.
Greitemeyer and Schwab (2014), Study 2	2×2, between-subjects	Students at an Austrian university who received course credit for participation	100	*lyrics*: pro-integration vs. neutral *target group*: ingroup vs. outgroup	Aggressive white noise bursts against opponent	Loudness and duration of white noise bursts against opponent.	Participants who listened to songs with neutral lyrics played a white noise burst louder and longer against an outgroup member than an ingroup member, but participants who listened to pro-integration lyrics played the burst at the same loudness and duration whether the opponent was ingroup or outgroup.

Table 2 (continued)

Reference	Study design	Sample recruitment	Sample size	Intervention conditions	Prosocial behaviour	Prosocial behaviour outcome measure	Results
Greitemeyer and Schwab (2014), Study 3	2 × 2 between-subjects	Students at an Austrian university who received course credit for participation	100	*lyrics*: pro-integration vs. neutral *target group*: ingroup vs. outgroup	Helping recruit participants for another student's study	The number of leaflets the participant took to help another student recruit participants for their study	After listening to songs with neutral lyrics, participants took more leaflets on behalf on the ingroup member than the outgroup member. After listening to songs with pro-integration lyrics, participants did not differ on the number of leaflets taken for an ingroup vs. an outgroup member.
Greitemeyer (2009a), Study 1	2 conditions, between-subjects	Students at the Ludwig-Maximilians University in Munich	33	*lyrics*: prosocial vs. neutral	Picking up pencils	How many pencils the participant helped the experimenter pick up.	Participants who had listened to songs with prosocial lyrics helped the experimenter pick up more pencils than those who had listened to songs with neutral lyrics
Greitemeyer (2009a), Study 2	2 conditions, between-subjects	Students at the University of Sussex in Brighton	50	*lyrics*: prosocial vs. neutral	Participation in an unpaid study	Whether participants agreed to participate in extra experiments for no extra compensation, and the number of minutes they were willing to give to that experiment.	More participants who had listened to songs with prosocial lyrics were willing to help with further studies, and they were willing to devote more time to the studies than those who listened to songs with neutral lyrics
Greitemeyer (2009a), Study 4	2 conditions, between-subjects	Students at the University of Sussex in Brighton	50	*lyrics*: prosocial vs. neutral	Cooperative behaviour	How much money the participant gave the recipient in the dictator game.	People who listened to songs with prosocial lyrics gave more money in the dictator game than those who listened to songs with neutral lyrics

Table 2 (continued)

Reference	Study design	Sample recruitment	Sample size	Intervention conditions	Prosocial behaviour	Prosocial behaviour outcome measure	Results
Greitemeyer (2009b), Experiment 3	2 conditions, between-subjects	Students at LMU	90	*lyrics*: prosocial vs. neutral	Donation to charity	Whether the participant donated their earnings to the non-profit charity.	Participants who had listened to songs with prosocial lyrics were more likely to donate their experimental earnings than those who listened to songs with neutral lyrics.
Greitemeyer (2011), Study 5	2 conditions, between-subjects	Adults of a community sample in Brighton, UK	50	*lyrics*: prosocial vs. neutral	Hot chili sauce task	Grams of hot chili sauce put into a cup for a reluctant confederate to consume	Participants who had listened to songs with prosocial lyrics administered less hot chili sauce than those who listened to songs with neutral lyrics.
Jacob et al. (2010)	3 conditions, between-subjects	Restaurant patrons in a restaurant in Vannes, France	786	*lyrics*: prosocial vs. neutral vs. baseline	Tipping	Proportion of patrons who left a tip, and average tip per patron during a time slot	Time slots during which prosocial music was playing in the background had a higher proportion of patrons who tipped than those with neutral background music or baseline background music. And time slots in which prosocial music was playing in the background had a higher average tip per patron than those with neutral or baseline background music.
Kniffin et al. (2017), Study 1	2 condition between-subjects	Students in an undergraduate business course at a private North-eastern United States university	78	*music*: happy vs. unhappy	Voluntary Contribution Mechanism	Number of tokens (out of 10) placed in the common space during each round of the Voluntary Contribution Mechanism	Individuals who were exposed to happy music contributed more tokens than those who were exposed to unhappy music.

Table 2 (continued)

Reference	Study design	Sample recruitment	Sample size	Intervention conditions	Prosocial behaviour	Prosocial behaviour outcome measure	Results
Kniffin et al. (2017), Study 2	3 condition between-subjects	Students in a undergraduate business course at a private Northeastern United States university	188	*music feeling*: happy vs. unhappy vs. no music	Voluntary Contribution Mechanisms	Number of tokens (out of 10) placed in the common space during each round of the Voluntary Contribution Mechanism	Individuals who were exposed to happy music contributed more tokens than those who were exposed to unhappy music or no music.
Lang et al. (2016)	3 conditions, between-subjects	General population in Point aux Piments, Mauritius, a student population in as Masaryk University in the Czech Republic, and a student population at Duke University in the USA.	254	*music religiosity*: religious vs. secular vs. white noise	Cheating on math task	Whether a participant lied about the number of correctly completed mathematical matrices	In general, participants who listened to religious music cheated the same amount as those who listened to secular music or white noise. However, religious people cheated less when they had listened to religious music but did not cheat more or less than the general population after listening to secular music or white noise.
North et al. (2004)	2×2, between-subjects	Users of 2 gyms at a university in the East Midlands region of the UK	646	*music feeling*: positive vs. negative *task cost*: high vs. low	Helping a charity	Signing a non-profit petition, whether they indicated willingness to distribute leaflets for a non-profit, and the number of leaflets they were willing to distribute.	There was a ceiling effect for the signing of the non-profit petition, such that there was no significant difference between music conditions. But in the high-cost condition, gym-goers were willing to distribute more leaflets when uplifting music was played in the background than when annoying music was played in the background.

Table 2 (continued)

Reference	Study design	Sample recruitment	Sample size	Intervention conditions	Prosocial behaviour	Prosocial behaviour outcome measure	Results
Ruth and Schramm (2020)	2 × 2, between-subjects	Students at German University	136	*lyrics*: prosocial vs. neutral *music production*: unplugged vs. electronic	Donation to charity	Amount of potential experimental earnings they would be willing to donate to a non-profit organization	There was no interaction effect between music production elements and willingness to donate to a non-profit organization. Whether a person listened to a song with prosocial lyrics or neutral lyrics they donated the same amount, and they donated the same amount no matter if the song they listened to was electronic or unplugged.
Ruth (2017)	2 conditions, between-subjects	Patrons in a cafe	256	*lyrics*: prosocial vs. neutral	Ordering fair-trade coffee Tipping	Whether a customer ordered fair-trade coffee over regular coffee, and the amount of tip per bill as proportion of total bill.	When a customer had arrived while music with prosocial lyrics was playing the in background, they ordered more fair-trade coffee but did not leave more tips than customers who arrived while neutral lyrics were playing in the background.
Ruth (2019)	2 × 2, between-subjects	Convenience sample of German adults	220	*listening*: attentive vs. inattentive *song familiarity*: familiar vs. unfamiliar	Donation to charity	Percentage of potential earnings participants would donate to UNICEF	Participants who listened to familiar prosocial songs donated the same amount whether they were attentive to the music or not. While participants who listened to unfamiliar prosocial songs donated less when they were inattentive as opposed to when they were attentive.

Table 2 (continued)

Reference	Study design	Sample recruitment	Sample size	Intervention conditions	Prosocial behaviour	Prosocial behaviour outcome measure	Results
Stupacher et al. (2017)	2 × 2, between-subjects	Students at the University of Graz	40	*tapping*: synchronous vs. asynchronous *sound*: music vs. metronome	Picking up pencils	The number of pencils that the participant helped the experimenter pick up	Participants helped pick up more pencils if the experimenter had synchronously tapped than when they had asynchronously tapped. However, when listening to a metronome the number of pencils picked up did not differ between synchronous and asynchronous tappers, but it was significantly different between synchronous and asynchronous tappers when the participant had been listening to music.

Table 2 (continued)

Reference	Study design	Sample recruitment	Sample size	Intervention conditions	Prosocial behaviour	Prosocial behaviour outcome measure	Results
Yu et al. (2019), Study 2	2 × 2, between-subjects	Students of Beijing Normal University and Capital Normal University	60	*lyrics:* prosocial vs. neutral *musical accompaniment:* lyrics w/ music vs. lyrics w/o music	Participation in an unpaid study	Willingness to participate in an unpaid experiment	Prosocial lyrics, when accompanied by music, promoted a greater willingness to help with unpaid experiments than neutral lyrics accompanied by music. But when the lyrics were not accompanied my music, willingness to help with an unpaid experiment was not different between prosocial and neutral lyrics conditions. Additionally, prosocial lyrics promoted greater willingness to participate in an unpaid experiment more when accompanied by music than not. But there was no difference in willingness to help with neutral lyrics whether they were accompanied by music or not.

Schramm (2020) was the only one to explicitly define their parameters for a song's inclusion into a specific lyrical condition. The second study that contained "Prompts/cues" was Lang et al. (2016), which tested religious music against secular music and against white noise. This study determined which music fell under the "religious" or "secular" categories through consultation with local religious leaders and research assistants in the communities in which they conducted the experiment. Religious music often "played during collective rituals in the local temple" or during "Catholic mass", while secular music was matched to have a similar sound and tempo, but without the religious connections. Therefore the "religious" music in this study was deliberately chosen to "cue" a religious frame of mind. The last study to be coded to this BCT, Ruth (2019), tested only prosocial songs, but manipulated whether or not the participants were familiar with the music. Familiarity was deemed a cue in this context due to the author's theoretical backing that "when an inattentive listener notices a familiar [prosocial] song, he or she can rely on the pre-knowledge about the song" as the subconscious cue rather than needing to be consciously aware of it.

Ruth (2019) also was coded for the BCT "(12.4) Distraction" for testing whether a participant was listening attentively or inattentively. "Distraction" is defined as to "advise or arrange to use an alternative focus for attention to avoid triggers for unwanted behaviour". Inattentive listeners were given a mathematical task to complete while the musical stimulus was played in the background, thereby giving the participants an alternative focus for their attention. Although the musical stimulus itself had not been changed, this intervention was considered a music-exposure intervention due to the musical stimulus being manipulated to either the foreground or background of an individual's attention, as presented in the definition of music-exposure above.

Seven studies did not supply enough information in the description of the design of their interventions to code any BCTs, and of these, 2 studies manipulated lyrical content. The first study opted for a similar pilot testing method (Jacob et al., 2010), while the second study that did not contain enough information to code a BCT tested uplifting music against melancholic music and against baseline music (Beer & Greitemeyer, 2019). This study also opted to use a pilot testing method in which "six independent acquaintances of the first author… evaluated a variety of songs in terms of whether they were uplifting or melancholic." Also, five of the included studies had research designs that tested multiple factors related to the prosocial behaviour outcome measure. Fukui and Toyoshima (2014) changed the recipient in a game theory game, North et al. (2004) altered the personal cost of the prosocial behaviour, Kniffin et al. 2017 (Studies 1 and 2) manipulated rhythmicity, and Stupacher et al. (2017)

manipulated whether the participant tapped synchronously or asynchronously with a confederate.

Furthermore, eight studies included controls which contained BCTs. Three BCTs were identified during the lyrical analysis of the songs with neutral lyrics: "Social support (emotional)" ($n=3$) (Greitemeyer & Schwab, 2014; Ruth & Schramm, 2020), "Information about social and environmental consequences" ($n=8$) (Greitemeyer, 2009a, b, 2011; Greitemeyer & Schwab, 2014; Ruth & Schramm, 2020), and "Reduce negative emotions" ($n=8$) (Greitemeyer, 2009a, b, 2011; Greitemeyer & Schwab, 2014; Ruth & Schramm, 2020). The same BCTs have been also identified in the interventions (prosocial lyrics) of these studies. However, the prosocial lyrics that included in the interventions highlighted behaviours related to societal and communal benefits (e.g. care for others, helping other), rather than focusing on behaviours that only benefit the self. The content of the neutral lyrics dealt mostly with themes of love and partying (Table 3).

Effective interventions and behaviour change techniques

Eight interventions with identified BCTs significantly improved prosocial behaviour. A lyrical analysis of the songs in each study was conducted. Specifically, the two studies that manipulated pro-integration lyrics (Greitemeyer & Schwab, 2014, Studies 2 and 3), and five that manipulated prosocial lyrics (Greitemeyer, 2009a, Studies 1, 2 and 4; Greitemeyer, 2009b, Experiment 3; Greitemeyer, 2011, Study 5) contained six BCTs in the interventions (prosocial lyrics) and three BCTs in the controls (neutral lyrics). The BCTs which were identified in the prosocial songs were "Social support (emotional)", "Instruction on how to perform a behaviour", "Salience of consequences", "Information about social and environmental consequences", "Reduce negative emotions" and "Identification of self as role model". In addition, Ruth (2019) showed how important pre-knowledge and attention are for the processing of music with prosocial lyrics. Distraction and Prompts/ cues were identified as included BCTs, while no BCTs were identified during lyrical analysis of the songs. Four studies, although significantly improved prosocial behaviour, did not contain BCTs (Jacob et al., 2010; Kniffin et al., 2017, Studies 2 and 3; Fukui et al., 2014).

Three studies with identified BCTs reported mixed results. Ruth (2017) found that music with prosocial lyrics increased the sale of fair-trade coffee in a cafe but didn't increase the amount the patrons tipped their wait staff. Eight BCTs were identified in the prosocial lyrics of the intervention (Social support (emotional)", "Instruction on how to perform a behaviour", "Salience of consequences", "Information about social and environmental consequences",

Table 3 Behaviour change techniques and mechanisms of action

Reference	Music-exposure intervention	Behaviour change techniques	Mechanisms of action	Mediating variable tested	Significant MoA	Example quotes
Beer and Greitemeyer (2019)	music feeling: uplifting vs. melancholic vs. baseline	*NEI	-	-	-	-
Fukui and Toyoshima (2014)	music feeling: chill-inducing vs. disliked vs. no music	*NEI	Emotion	anxiety	-	-
				-	-	-
Greitemeyer (2009a), Study 1	lyrics: prosocial vs. neutral	3.3 Social support (emotional)	Emotion	mood	no	*"Help me get my feet back on the ground, Won't you please, please help me"* (song: Help)
		4.1 Instruction on how to perform a behaviour				*"We are the ones who'll make a brighter day so let's start giving (so let's start giving)"* (song: We Are the World)
		5.2 Salience of consequences				*"There are people dying, Oh, and it's time to lend a hand to life"* (song: We Are the World)
		11.2 Reduce negative emotions				*"I'm singing because I'm afraid of the dark, and hope that nothing's going to happen. A little bit of peace, a little bit of sun on this earth, we all live on"* (song: Ein bißchen Frieden).
		13.1 Identification of self as role model				*"If you care enough for the living, Make a better place for you and for me"* (song: Heal the World)

Table 3 (continued)

Reference	Music-exposure intervention	Behaviour change techniques	Mechanisms of action	Mediating variable tested	Sig-nificant MoA	Example quotes
Greitemeyer ([2009a](#)), Study 2	lyrics: prosocial vs. neutral	4.1 Instruction on how to perform a behaviour	Behavioural Cueing	prosocial thought accessibility	no	"Raise a glass for everyone, Spare a thought this yuletide for the deprived" (song: Feed the World)
		5.2 Salience of consequences				"Why most the children play in the street? Broken arms can fade the dreams" (song: Love Generation)
		11.2 Reduce negative emotions				"Just look to the rainbow you will see, The sun will shine 'till eternity" (song: Love generation)
		13.1 Identification of self as role model				"You ain't gotta feel guilt just selfless, Give a little help to the helpless, Do they know it's Christmas time at all? Feed the world, Let them know it's Christmas time again" (song: Feed the World)
Greitemeyer ([2009a](#)), Study 4	lyrics: prosocial vs. neutral	4.1 Instruction on how to perform a behaviour	Behavioural Cueing	prosocial thought accessibility	no	"Raise a glass for everyone, Spare a thought this yuletide for the deprived" (song: Feed the World)
		5.2 Salience of consequences	Emotion	empathy	yes	"Why most the children play in the street? Broken arms can fade the dreams" (song: Love Generation)
		11.2 Reduce negative emotions				"Just look to the rainbow you will see, The sun will shine 'till eternity" (song: Love generation)
		13.1 Identification of self as role model				"You ain't gotta feel guilt just selfless, Give a little help to the helpless, Do they know it's Christmas time at all? Feed the world, Let them know it's Christmas time again" (song: Feed the World)

Table 3 (continued)

Reference	Music-exposure intervention	Behaviour change techniques	Mechanisms of action	Mediating variable tested	Significant MoA	Example quotes
Greitemeyer (2009b), Experiment 3	lyrics: prosocial vs. neutral	3.3 Social support (emotional)	-	-	-	"Come together; Nobody can do this on his own, Feel together; What I mean" (Kommt zusammen)
		4.1 Instruction on how to perform a behaviour				"Feel the love generation" (song: Love Generation)
		5.2 Salience of consequences				"Why most the children play in the street? Broken arms can fade the dreams" (song: Love Generation)
		11.2 Reduce negative emotions				"Just look to the rainbow you will see, The sun will shine 'till eternity" (song: Love generation)
Greitemeyer (2011), Study 5	lyrics: prosocial vs. neutral	4.1 Instruction on how to perform a behaviour	Emotion	state hostility/ aggressive affect	yes	"Raise a glass for everyone, Spare a thought this yuletide for the deprived" (song: Feed the World)
		5.2 Salience of consequences				"Why most the children play in the street? Broken arms can fade the dreams" (song: Love Generation)
		11.2 Reduce negative emotions				"Just look to the rainbow you will see, The sun will shine 'till eternity" (song: Love generation)
		13.1 Identification of self as role model				"You ain't gotta feel guilt just selfless, Give a little help to the helpless, Do they know it's Christmas time at all? Feed the world, Let them know it's Christmas time again" (song: Feed the World)

Table 3 (continued)

Reference	Music-exposure intervention	Behaviour change techniques	Mechanisms of action	Mediating variable tested	Significant MoA	Example quotes
Greitemeyer and Schwab (2014), Study 2	lyrics: pro-integration vs. neutral	3.3 Social support (emotional)	Behavioural cueing	thoughts about integration	no	"Come together; Nobody can do this on his own, Feel together, What I mean" (Kommt zusammen)
		4.1 Instruction on how to perform a behaviour				"We have to bring the world together and learn to live as one." (song: United)
		5.2 Salience of consequences				"This is the answer for the people who lost their loved ones from hunger." (song: United)
		5.3 Information about social and environmental consequences				"This is the answer for the people who lost their loved ones from war." (song: United)
		11.2 Reduce negative emotions				"Live smiling until the end but happy days will come that nobody can believe" (song: United)
		13.1 Identification of self as role model				"It´s time to say; We are all one heart, This song is of all of us. So let´s sing it together in one big voice." (song: United)
Greitemeyer and Schwab (2014), Study 3	lyrics: pro-integration vs. neutral	3.3 Social support (emotional)	General Attitudes/Beliefs	blatant prejudice	no	"Whatever happens here - I´ll stop by you!" (song 5 vor 12)
		4.1 Instruction on how to perform a behaviour	General Attitudes/Beliefs	subtle prejudice	no	"We learn to live, when we learn to give" (song: Ebony and ivory)
		5.2 Salience of consequences				"All at once no longer on, Neighbors tell me, He is in the hospital, Erdal comes from the Black sea" (song 5 vor 12)

Table 3 (continued)

Reference	Music-exposure intervention	Behaviour change techniques	Mechanisms of action	Mediating variable tested	Significant MoA	Example quotes
		5.3 Information about social and environmental consequences				*"As he walked down our street, They sang some slogans, Didn't let Erdal go any further, He still tried to fight back, Five of you warn and he alone, Before it really started, Was it already over"* (song: song 5 vor 12)
		11.2 Reduce negative emotions				*"Ebony and ivory live together in perfect harmony, Side by side on my piano keyboard, oh Lord why don't we?"* (song: Ebony and ivory)
		13.1 Identification of self as role model				*"Erdal comes from Turkey And who here is against him Is my enemy too!"* (song: song 5 vor 12)
Jacob et al. (2010)	lyrics: prosocial vs. neutral vs. baseline	*NEI	-	-	-	-
Kniffin et al. (2017), Study 1	music: happy vs. unhappy	*NEI	-	-	-	-
Kniffin et al. (2017), Study 2	music feeling: happy vs. unhappy vs. no music	*NEI	Emotion	mood	-	-
Lang et al. (2016)	music religiosity: religious vs. secular vs. white noise	7.1 Prompts/cues	-	-	-	The condition specific musical stimulus played for 2 min, after which low-volume white noise was played for the rest of the experiment
North et al. (2004)	music feeling: positive vs. negative	*NEI	-	-	-	-

Table 3 (continued)

Reference	Music-exposure intervention	Behaviour change techniques	Mechanisms of action	Mediating variable tested	Significant MoA	Example quotes
Ruth (2017)	lyrics: prosocial vs. neutral	3.3 Social support (emotional)	-	-	-	"People help the people, And if your homesick, give me your hand and I'll hold it" (song: People help the people)
		4.1 Instruction on how to perform a behaviour				"Heal the world, Make it a better place" (song: Heal the world)
		5.2 Salience of consequences				"Did you ever stop to notice, All the children dead from war?" (song: Earth song)
		5.3 Information about social and environmental consequences				"Did you ever stop to notice, This crying Earth, these weeping shores?" (song: Earth song)
		5.6 Information about emotional consequences				"What have we done to the world? Look what we've done, What about all the peace, That you pledge your only son?" (song: Earth song)
		9.3 Comparative imagining of future outcomes				"Imagine there's no countries, It isn't hard to do, Nothing to kill or die for, And no religion, too. Imagine all the people, Livin' life in peace" (song: Imagine)
		11.2 Reduce negative emotions				"Cause we are beautiful no matter what they say, Yes, words won't bring us down, no, no, We are beautiful in every single way" (song: Beautiful)
		13.1 Identification of self as role model				"You may say I'm a dreamer, But I'm not the only one, I hope someday you'll join us, And the world will be as one" (song: Imagine)

Table 3 (continued)

Reference	Music-exposure intervention	Behaviour change techniques	Mechanisms of action	Mediating variable tested	Significant MoA	Example quotes
Ruth (2019)	Listening: attentive vs. inattentive song familiarity: familiar vs. unfamiliar	12.4 Distraction	Emotion + Knowledge	positive affect + activated pre-knowledge	yes	The recipients were distracted by a mathematical task taken from an intelligence structure test.
		7.1 Prompts/cues	Behavioural Cueing + Knowledge	prosocial thoughts + activated pre-knowledge	no	They listened to the music in an inattentive way.
			Emotion + Knowledge	negative affect + activated pre-knowledge	no	
			Emotion + Knowledge	empathy + activated pre-knowledge	no	
Ruth and Schramm (2020)	lyrics: prosocial vs. neutral music production: unplugged vs. electronic	4.1 Instruction on how to perform a behaviour	Emotion	positive affect	no	"It is time, and you already know, Come and change our future. Won't you start right now?" (song: we need to talk)
		5.2 Salience of Consequences	Emotion	negative affect	no	"Times are bad; there is too much war There are people dying, and they need your help" (song: we need to talk)
		7.1 Prompts/cues	Emotion	empathy	no	One of the authors composed a song that followed proto-typical hit songs in terms of arrangement, harmonies, melody and rhythm.
		13.1 Identification of self as role model	Behavioural Cueing	prosocial thoughts	no	"Take your time to think, and you will realize, You can change the world, so won't you take my advice?" (song: we need to talk)
Stupacher et al. (2017)	sound: music vs. metronome	*NEI	-		-	-
Yu et al. (2019), Study 1 and 2	lyrics: prosocial vs. neutral musical accompaniment: lyrics w/ music vs. lyrics w/o music	3.3 Social support (emotional)	-		-	"Hand in Hand we stand All across the land We can make this world A better place in which to live" (song: Hand in hand)

Table 3 (continued)

Reference	Music-exposure intervention	Behaviour change techniques	Mechanisms of action	Mediating variable tested	Significant MoA	Example quotes
		4.1 Instruction on how to perform a behaviour				*"Start to understand, Breaking down the walls, That come between us for all time"* (song: Hand in hand)
		11.2 Reduce negative emotions				*"Because of love, we are not easily saddened, That's why everything looks so happy, Because of love, we're simply grown up, It can still drive me crazy for you anytime"* (song: Because of love)

*NEI: Not enough information

"Information about emotional consequences", "Comparative imagining of future outcomes", "Reduce negative emotions", "Identification of self as role model"). Yu et al. (2019, Study 2) found that prosocial music only increased prosocial behaviour if it was accompanied by music. Three BCTs identified in the intervention only ("Social support (emotional)", "Instruction on how to perform a behaviour" and "Reduce negative emotions"). Lang et al. (2016) found that religious music did not cause people to cheat less than secular music, or white noise, unless the listener happens to be religious. However, only "Prompts/ cues" was identified and no BCTs were identified during lyrical analysis of the songs. Two studies with mixed results did not contain BCTs (North et al., 2004; Stupacher et al., 2017).

Two studies reported non-significant results (Beer & Greitemeyer, 2019; Ruth & Schramm, 2020), however only one included BCTs. Three BCTs were identified during the lyrical analysis of the prosocial songs ("Instruction on how to perform a behaviour", "Salience of consequences" and "Identification of self as role model") and three BCTs in the neutral songs ("Social support (emotional)", "Instruction on how to perform a behaviour" and "Reduce negative emotions"). "Prompts/ cues" was also identified. Ruth and Schramm (2020), reported that those listening to the unplugged version with prosocial lyrics showed the most empathetic emotions. Although prosocial lyrics had an effect on prosocial thoughts, they did not have any effect on behaviour.

Mechanisms of action

Seven of the 19 included studies analysed at least one potential mediator, all of which were lab-based experiments. The kappa for interrater reliability in MoA coding was 0.890 (p < 0.001), 95% CI (0.682, 1.000) (almost perfect agreement). Of the potential mediators, four were found to significantly mediate the intervention-outcome relationship, and two different MoAs were coded; "Emotion" (n = 3), and "Knowledge" (n = 1). Though it should be noted that while eight other dependent variables were tested and found not to significantly mediate the intervention-outcome relationship, they were coded as "Behavioural Cueing" (n = 4), "General Attitudes/Beliefs" (n = 2), and "Emotion" (n = 4).

The MoA "Emotion" was found to significantly mediate the effect of the music-exposure intervention and prosocial behaviour in four studies. The dependent variables coded to "Emotion" were "empathy" (Greitemeyer, 2009a, Study 4), "state hostility/aggressive affect" (Greitemeyer, 2011, Study 5), "mood" (Kniffin et al., 2017, Study 2), and "positive affect" (Ruth, 2019). Both of the studies in which "empathy" and "state hostility/aggressive affect" were analysed tested prosocial against neutral lyrics in their interventions, and both contained the BCTs "Instruction on how to perform a behaviour", "Salience of consequences", "Reduce negative

emotions" and "Identification of self as role model". Kniffin et al. (2017, Study 2) ("mood") manipulated exposure to happy, unhappy, or no music, but did not contain enough information to code BCTs. While Ruth (2019) ("positive affect") tested familiarity of and attentiveness to prosocial music and contained the BCTs "Distraction" and "Prompts/cues". Ruth (2019) was also the single study to find "Knowledge" as a significant MoA, indicating that a familiar song activates pre-knowledge, which affects the listener's positive emotions and eventually leads to more prosocial behaviour.

"Behavioural Cueing" was the most commonly tested non-significant MoA and included the dependent variables "prosocial thought accessibility" (Greitemeyer, 2009a, Studies 2 and 4; Ruth, 2019), and "integration-related thoughts" (Greitemeyer & Schwab, 2014, Study 2). The studies that tested "Behavioural Cueing" contained "Social support (emotional)", "Instruction on how to perform a behaviour", "Salience of consequences", "Information about social and environmental consequences", "Reduce negative emotions", "Identification of self as role model", "Distraction" and "Prompts/cues". Both variables coded as "General Attitudes/Beliefs", "blatant prejudice" and "subtle prejudice", were tested in Greitemeyer and Schwab (2014, Study 3), and contained "Social support (emotional)", "Instruction on how to perform a behaviour", "Salience of consequences", "Information about social and environmental consequences", "Reduce negative emotions", and "Identification of self as role model".

Discussion

Research question 1, evaluation of the included literature

The included interventions spanned a variety of intervention designs and outcome measures. The most common type of intervention tested was a lyrical manipulation, specifically comparing prosocial or pro-integration lyrics against neutral lyrics. Lyrical manipulations were also the most likely to significantly increase prosocial behaviours, ranging from helping someone who "accidentally" dropped some pencils (Greitemeyer, 2009a, Study 1), to donating to a non-profit (Greitemeyer, 2009b, Experiment 3), to having someone consume less unwanted hot chili sauce (Greitemeyer, 2011, Study 5). This seems to be a robust finding, rendered even more useful with the insight that prosocial lyrics are more effective when accompanied by music (Yu et al., 2019, Study 2), and when the songs are familiar (Ruth, 2019). However, the only study to explicitly define "prosocial lyrics" was also the only one that found that they didn't increase prosocial behaviour (Ruth & Schramm, 2020). Therefore, it is

imperative that future researchers examine the parameters of lyrical content to resolve this discrepancy.

The rest of the included intervention manipulations are understudied. The compositional elements of musical stimuli have been extensively studied in consumer behaviour, but there are only a few studies in the present review that manipulate composition. Only Ruth and Schramm (2020) truly manipulated composition, by recording the same original music with several different instruments. One explanation for the lack of composition-based experiments is that the majority of those who have studied the effects of music on prosocial behaviour are psychologists, not musicologists. It is far easier to manipulate lyrics than other musical parameters, and it is especially difficult to control every aspect of the musical stimulus without creating your own. However, more thought should be paid to compositional elements in future research.

Only a few studies examined the effects of musical stimuli intended to evoke a particular emotion, and generally compared a happy or uplifting music condition against an unhappy or annoying music condition. These studies had mixed results and could also be expanded upon. The emotional response to music can come from lyrics, or musical composition, and also from the combination of the two. So, the expansion of research into both of the previous two domains would enlighten this one as well.

Research question 2, behaviour change techniques

The current review identified ten BCTs that have been utilized in experimental music-exposure interventions designed to influence prosocial behaviour; "Social support (emotional)", "Instruction on how to perform a behaviour", "Salience of consequences", "Information about social and environmental consequences", "Information about emotional consequences", "Prompts/cues", "Comparative imagining of future outcomes", "Reduce negative emotions", "Identification of self as role model", and "Distraction". This is a remarkably small number considering the versatility of musical stimuli. Ultimately, the few BCTs identified are representative of the fact that many of the included studies did not adequately define their experimental conditions. For many of the studies that manipulated lyrical content, they did not specify objective conditions for classifying lyrics into their predetermined sets, rather, they relied on subjective, perceptual reactions from pilot study participants. It is therefore recommended that future researchers define specific parameters for the inclusion of musical stimuli into experimental conditions.

In addition to the difficulty presented by the lack of information, the BCTTv1 often could not quite fit to certain intervention components. Although the above ten BCTs were coded, there was significant debate amongst the coders about each

of them. "Prompts/cues" was agreed on to be the best fit for lyrical manipulations, and music intended to elicit a particular frame of mind. "Distraction", though only associated with one study in the current review, was chosen to reflect interventions that shifted attention to and from the musical stimulus.

Although there were too few BCTs coded to make any definitive statements about their effectiveness, there are a few interesting preliminary findings. "Instruction on how to perform a behaviour", "Salience of consequences", "Reduce negative emotions" and "Identification of self as role model" are associated with the most interventions that significantly increase prosocial behaviour. "Social support (emotional)", "Information about social and environmental consequences" as well as "Prompts/cues" seem to be promising BCTs for music-exposure interventions. Though many of the lyrical studies were not coded as "Prompts/cues" due to unclear designs, lyrical content is an effective avenue to utilize this BCT. It is left to future researchers to decide whether that kind of analysis is useful.

Research question 3, mechanisms of action

The current review indicated that the MoA "Emotion" may be a significant one in the relationship between music-exposure interventions and prosocial behaviour. However, it should be noted that only three of the studies that found "Emotion" was a significant MoA had coded BCTs. The current review suggests that the BCTs "Instruction on how to perform a behaviour", "Salience of consequences", "Reduce negative emotions" and "Identification of self as role model", "Prompts/cues", and "Distraction" may impact the MoA "Emotion", but evidence is lacking to support any strong or significant BCT-MoA relationships. "Behavioural Cueing", "General Attitudes/Beliefs", and "Knowledge" were also examined as mediators in the included studies, only "Emotion" and "Knowledge" were significant MoAs. "Knowledge" may also play an important role, as Lang et al. (2016) found that only religious people were impacted by religious music, hinting that the psychological associations built over time with musical stimuli influence our behaviour as much as the music itself.

Limitations

There are several limitations to the current research. The first is the lack of multiple reviewers to search the database results and to code studies for inclusion into the review. Also, during the initial database search, the search terms "NOT therapy and NOT training" were used to actively prevent a particular set of irrelevant articles from appearing. This was done due to time and resource constraints on the part of the reviewer and may have caused the search to inadvertently miss articles that would have fit the inclusion criteria. Studies in languages other than English and "grey" literature were not included, which also may have excluded relevant literature. Additionally, although three databases were searched for literature, more could have been searched for a greater chance of including all relevant research.

Also, musical stimuli manipulated by lyrics could have been analysed by each word or phrase, and musical composition elements could have been extracted in a systematized manner, instead of relying on the authors to convey the differences in their intervention conditions. However, this method was considered far too time-consuming to be worthwhile. And it is instead recommended that future researchers more precisely define their criteria for the inclusion of musical stimuli into experimental conditions. Another limitation here is publication bias. It is possible that a number of other potentially relevant studies were not published simply for lacking significant results, which could skew the current review's findings, and no analyses were conducted to evaluate publication bias.

Conclusion

This is the first review to examine music-based interventions using a behaviour change approach, specifically through BCTs and MoAs, by synthesizing the evidence from 19 studies. Although there is growing research interest, the influence of music-exposure interventions on prosocial behaviour has yet to be studied in much depth. However, the current review has found that lyrical and compositional changes to musical stimuli, related to the BCTs "Instruction on how to perform a behaviour", "Salience of consequences", "Reduce negative emotions" and "Identification of self as role model" can be effective in this context. Additionally, the current review has demonstrated that the MoA "Emotion" plays a role in the intervention-outcome relationship, though no significant BCT-MoA relationships could be determined.

These results have a number of implications for researchers and those responsible for selecting the music played in public spaces or non-profit advertisements. More research needs to be conducted in which experimental conditions and methods are clearly defined, as too few of the included studies contained enough information to code BCTs. Although the difficulties to code BCTs, the behaviour change interventions provided some significant insights regarding the identified MoA as important evidence, so future interventions can select BCTs that target those MoA. Additionally, those seeking to increase charitable donations, recycling, or general helping, as well as those seeking to reduce aggressive behaviours or cheating could utilize music that contains prosocial lyrics. Though "prosocial lyrics" are not clearly defined, music used in effective studies in this review, such as "Love Generation" by Bob Sinclair, or "Imagine" by John Lennon can be used as guides.

Appendix

Table 4 Musical stimuli used in each included study

Citation	Study #	Context	Music Stimulus Type	Song	Artist
Beer and Greitemeyer (2019)		Restaurant	Uplifting	Unspecified	Unspecified
			Melancholic	Unspecified	Unspecified
			Baseline (restaurant)	Unspecified	Unspecified
Fukui and Toyoshima (2014)		Lab	Self-Chosen Chill-Inducing	Unspecified	Unspecified
			Self-Chosen Disliked	Unspecified	Unspecified
Greitemeyer (2009a)	Study 1	Lab	Prosocial Lyrics	Heal the World	Michael Jackson
				Ein bißchen Frieden	Nicole
				We Are the World	Liveaid
				Help	Beatles
			Neutral Lyrics	On the Line	Michael Jackson
				Spiel um deine Seele	Peter Maffay
				An Englishman in New York	Sting
				Octopus's Garden	Beatles
	Studies 2 & 4	Lab	Prosocial Lyrics	Love Generation	Bob Sinclair
				Feed the World	U2 with Band Aid
			Neutral Lyrics	Rock this Party	Bob Sinclair
				Vertigo	U2 with Band Aid
Greitemeyer (2009b)	Experiment 3	Lab	Prosocial Lyrics	Love Generation	Bob Sinclair
				Kommt zusammen	2raumwohnung
			Neutral Lyrics	Rock this Party	Bob Sinclair
				Lachen und Weinen	2raumwohnung
Greitemeyer (2011)	Study 5	Lab	Prosocial Lyrics	Love Generation	Bob Sinclair
				Feed the World	U2 with Band Aid
			Neutral Lyrics	Rock this Party	Bob Sinclair
				Vertigo	U2 with Band Aid
Greitemeyer and Schwab (2014)	Study 2	Lab	Pro-integration	United	Playing for Change
				Kommt zusammen	2raumwohnung
			Neutral Lyrics	Stand by Me	Playing for Change
				36 Grad	2raumwohnung
	Study 3	Lab	Pro-integration	5 vor 12	Die Toten Hosen
				Ebony and Ivory	Paul McCartney
			Neutral Lyrics	Verschwende deine Zeit	Die Toten Hosen
				And I Love Her	Paul McCartney
Jacob et al. (2010)		Restaurant	Prosocial Lyrics	Unspecified	Unspecified
			Neutral Lyrics	Unspecified	Unspecified
Kniffin et al. (2017)	Studies 1 & 2	Lab	Happy	Yellow Submarine	The Beatles
				Walking on Sunshine	Katrina and the Waves
				Brown Eyed Girl	Van Morrison
				"Happy Days" Theme Song	N/A
			Unhappy	Smokahontas	Attack Attack!
				You Ain't No Family	Iwrestledabearonce
Lang et al. (2016)		Lab - Mauritius	Religious	Ritual Music for Thaipusam Kavadi	N/A
			Secular	Mera Mahi Bada Sohna Hai	Dhaai Akshar Prem Ke
		Lab - Czech Republic	Religious	Ave Maria	Charles Gounod
			Secular	Romance for piano in F Minor	Tchaikovsky
		Lab - USA	Religious	BWV 147 Jesu joy of man's desiring	J.S. Bach
			Secular	BWV 140 Sleepers Wake	J.S. Bach

Table 4 (continued)

Citation	Study #	Context	Music Stimulus Type	Song	Artist
North et al. (2004)		University Gym	Uplifting	Rockafellar Skank	Fatboy Slim
				Dreams	The Corrs
				Believe	Cher
				Music Sounds Better With You	Stardust
				Men in Black	Will Smith
				Livin' la Vida Loca	Ricky Martin
				One More Time	Daft Punk
				Music	Madonna
				Mambo No. 5	Lou Bega
				Hey Boy Hey Girl	Chemical Brothers
				Rock DJ	Robbie Williams
				Waiting for Tonight	Jennifer Lopez
				King of My Castle	Wamdue Project
				It Feels So Good	Sonique
				Sex Bomb	Tom Jones
				Sandstorm	Darude
				All the Small Things	Blink 182
				Around the World	Daft Punk
				S Club Party	S Club 7
				Ray of Light	Madonna
				Praise You	Fat Boy Slim
				Rise	Gabrielle
				The Time Is Now	Moloko
				The Thong Song	Sisqo
				Spice Up Your Life	Spice Girls
				Gettin' Jiggy Wit It	Will Smith
				Zombie Nation	Kernkraft 400
				Reach	S Club 7
				Toca's Miracle	Fragma
				Sky	Sonique
			Annoying	Clarinet Threads	Denis Smalley
				Idle Chatter	Paul Lansky
				Masque	Jon Hassell
				Nscor	Curtis Roads
				Ravinia/Vancouver	Jon Hassell
				Relationships for Melody Instruments	Clarence Barlow
				Sequence Symbols	James Dashow
				The Hands Movement 1	Michael Waisvisz
				The Hands Movement 2	Michael Waisvisz
				Transition No. 2	Stephen Kaske

Table 4 (continued)

Citation	Study #	Context	Music Stimulus Type	Song	Artist
Ruth (2017)		Restaurant	Prosocial Lyrics	The Earth Song	Michael Jackson
				Take Me to Church	Hozier
				Dear Mr. President	P!nk
				Same Love	Macklemore & Ryan Lewis
				Was wir alleine nicht schaffen	Xavier Naidoo
				Beautiful	Christina Aguilera
				Imagine	John Lennon
				Heal the World	Michael Jackson
				Ein Hoch auf uns	Andreas Bourani
				Freedom	George Michael
				Ein bisschen Frieden	Nicole
				Blowing in the Wind	Bob Dylan
				People Help the People	Birdy
				Wir beide	Juli
				Another Brick in the Wall	Pink Floyd
				Wind of Change	Scorpions
				Where is the Love	Black Eyed Peas
				See You Again	Wiz Khalifa
			Neutral Lyrics	Thriller	Michael Jackson
				Someone New	Hozier
				Raise Your Glass	P!nk
				Thrift Shop	Macklemore & Ryan Lewis
				Ich kenne nichts	Xavier Naidoo
				Genie in a Bottle	Christina Aguilera
				Stand By Me	John Lennon
				Dirty Diana	Michael Jackson
				Mein Herz schlagt schneller als deins	Andreas Bourani
				Faith	George Michael
				Alles nur fur dich	Nicole
				Rolling Stone	Bob Dylan
				Skinny Love	Birdy
				Perfekte Welle	Juli
				Wish You Were Here	Pink Floyd
				Still Loving You	Scorpions
				My Humps	Black Eyed Peas
				Black and Yellow	Wiz Khalifa
Ruth (2019)		Lab	Prosocial and Familiar	People Help the People	Birdy
				So Wie Du Bist	MoTrip
			Prosocial and Unfamiliar	Hands	24 various artists
				Schon so Wie Du Bist	Kenay
Ruth and Schramm (2020)		Lab	Unplugged/More Emotional	Original Song	N/A
			Electronic/Less Emotional	Original Song	N/A

Table 4 (continued)

Citation	Study #	Context	Music Stimulus Type	Song	Artist
Stupacher et al. (2017)		Lab	High in Groove	Flashlight	Parliament
				Look-Ka Py Py	The Meters
				Superstition	Stevie Wonder
Yu et al. (2019)	Study 2	Lab	Prosocial Lyrics	Hand in Hand	Unspecified
				Because of Love	Unspecified
			Neutral Lyrics	Blue Sky and White Cloud	Unspecified
				Beautiful Night on the Prairie	Unspecified

*Unspecified: specific stimulus was not reported in study

Data availability Data sharing not applicable to this article as no datasets were generated or analysed during the current study.

Declarations

Ethics approval and consent to participate Not applicable.

Consent for publication Not applicable.

Competing interests The authors declare that they have no competing interests.

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