An exploratory survey of in-vehicle music listening

Nicola Dibben and Victoria J. Williamson

Psychology of Music 2007 35: 571 originally published online 16 August 2007
DOI: 10.1177/0305735607079725

An exploratory survey of in-vehicle music listening

Psychology of Music

Psychology of Music

vol 35(4): 571–589 [0305-7356
(200710) 35:4; 571–589
10.1177/0305735607079725
http://pom.sagepub.com

NICOLA DIBBEN
UNIVERSITY OF SHEFFIELD, UK
VICTORIA J. WILLIAMSON
UNIVERSITY OF YORK, UK

ABSTRACT Listening to music whilst driving is a common activity, with a number of potentially positive and negative influences on driving performance and safety: previous research suggests that music is a source of distraction and can influence driver mood, with subsequent effects on driving behaviour. However, little systematic evidence exists about the extent or type of in-vehicle listening practices in real-world contexts, and their effect on driving performance. A survey was carried out to discover the extent to which people listen to music while driving, what they are listening to and why, and whether there is any association with driving safety, measured by possession of four or more years' no-claims on motor insurance. The survey of 1780 British drivers reveals that approximately two-thirds listen to recorded music and music radio while driving, with music reported to be less distracting than conversation. The most commonly cited reasons for listening to music while driving were its benefits for relaxation and concentration. The survey indicates associations between possession of 'no claims' on motor insurance and a preference for silence. However, the genre of music playing also appears to influence driving performance: there is an association between possession of no-claims, genre of music, and a difference in the frequency with which certain genres were playing at the time of the last accident, relative to the expected norm for that genre. These findings support evidence for music as a source of in-vehicle distraction, which can have both positive and negative effects on driving performance.

KEYWORDS: *attention, distraction, driving, music listening preferences*

Many drivers turn down the volume of music in their car when attempting to carry out a complex manoeuvre, such as reverse parallel parking. Conversely, drivers often turn music on, or up, when stuck in slow-moving traffic or on long motorway journeys. From this anecdotal evidence, it is clear that people regulate their exposure to music while driving, and that music affects people's

ability to drive. But why do people choose to listen to music while driving, and what evidence is there that music affects driving performance? This article reports the findings of a survey which investigated in-vehicle listening practices and driving performance. The aim is to discover what people are listening to and why, and to further understanding of music's influence on driving performance.

The experience of in-vehicle music listening

Since the 1970s, when radios became fitted as standard in many cars, people have been able to listen to recorded music while driving. Today, with the inclusion of radios, compact disc, tape and mp3 players in vehicle entertainment systems, the opportunity for self-selected music listening while driving has increased. A recent observational study of American drivers showed that audio (most often the radio) was playing in vehicles 72 percent of the time, with only four of the 70 participants not listening to audio at all (Stutts et al., 2003). A small-scale diary study, carried out in England and including all modes of transport rather than driving only, revealed that music was present during 91 percent of transport experiences (Sloboda et al., 2001). So why are people listening to music while they drive?

Anecdotal evidence suggests that people listen to music while driving because it provides an enjoyable experience: it entertains and prevents boredom, provides stimulation and relaxes drivers. Listening to music is commonly mentioned as a counter-measure to driver fatigue: for example, turning up the volume of the radio was the most common technique reported by male college students to avoid drowsiness (Nguyen et al., 1998). The observational study by Stutts et al. (2003) revealed that audio was more likely to be on when there was less light, traffic conditions were moderate or heavy, and when no passengers were present in the vehicle, suggesting that music is used to entertain and relax. Using interviews, Bull (2001) has identified a number of recurrent themes in drivers' descriptions of their music-accompanied driving experiences: use of media in vehicles masks random environmental sounds, creating an 'accompanied' form of aural privacy, in which music provides an experience of 'connection' with others. This 'private space' makes possible a range of other experiences: drivers report that they listen to whatever they like, as loudly as they like, and can even sing along because they feel less observed than at home; they report finding potential frustrations of driving transformed by listening. Furthermore, Bull notes the re-appropriation of 'empty' or 'stolen' time which listening to music while travelling allows.

One way in which this kind of use of music has been conceptualized is as 'self-therapy' (cf. DeNora, 2000). From this perspective, listening to music while driving can be seen as a means for individuals to alter their environment in a way that is appropriate to their needs. Studies of music in daily life

(DeNora, 2000) and music in workplace settings (Lesiuk, 2005) have shown that individuals learn over time how to use music in this way, rather than it simply being an outcome of hearing music.

This qualitative research on music listening in vehicles has suggested a number of phenomenological consequences of listening to music while driving, but what evidence is there that music influences driving performance?

Associations between music listening and driving performance

A review of previous research reveals that music listening influences driving performance via two main routes: distraction and mood effects. Each of these is dealt with below.

Distraction is caused by an event, object or person that induces the driver to shift his or her attention away from the driving task. Driving is a complex action that requires cognitive, sensory and motor skills; drivers must be able to plan their actions, maintain a high level of attention, process and interpret information, and control the mechanical operations necessary to operate their vehicle. Any competing stimulus that occupies cognitive resources could interfere with any of these processes and have detrimental effects on road position, speed maintenance and control, reaction times and negotiation of gaps in traffic.

Using fatal accident reports from police forces, Stevens and Minton (2001) showed that in-vehicle distraction was a contributory factor in 2 percent of fatal accidents in England and Wales over the 10-year period from 1985; and the National Highway Traffic Safety Administration (NHTSA) estimates that around a quarter of traffic accidents in the United States of America are caused by distraction, which annually accounts for 1.2 million incidents (Shelton, 2001). The NHTSA identifies four types of driver distraction: visual, auditory, biomechanical and cognitive. These provide a useful way of categorizing types of distraction potentially associated with music listening, although real sources of in-vehicle distraction, including music, may involve some or all of these forms of distraction at the same time.

Visual distraction associated with music listening occurs when drivers focus on the in-vehicle entertainment system and take their visual attention from the road. Research indicates that radios and in-vehicle information systems have greater potential for distraction than conventional vehicle instrumentation: a study by Reeves and Stevens (1996), for example, showed that drivers spent more time looking at a radio, tape player and traffic information system relative to looking at the road, than they spent looking at the speedometer. Biomechanical distraction is caused by physical manipulation of in-car audio equipment since drivers use their hands to tune the radio, or change a tape, for example, which can interfere with the ability to steer or change gear. An analysis of observational data gathered from 70 drivers in the United States of America revealed that 91 percent of drivers

manipulated audio system controls while driving, taking up 1 percent of the total driving time (Stutts et al., 2003). Drivers who used their audio system adjusted their audio controls at an average of eight times each per hour of driving; each manipulation averaged 5.5 seconds and involved a shift of focus of the driver's gaze to the inside of the car, and removal of his or her hands from the steering wheel (Stutts et al., 2003).

Evidence of a link between visual/biomechanical distraction due to in-vehicle entertainment systems and road accidents is provided by analysis of police accident reports. Studies of accident reports in the United States of America (Stutts et al., 2001), and England and Wales (Stevens and Minton, 2001), show that in-vehicle entertainment systems were the first and second most frequent source of in-vehicle distraction, respectively. This evidence of distraction due to in-vehicle entertainment systems is supported by driving simulation and field studies which indicate that operation of entertainment systems results in decrements in driving performance: an on-road study showed that tuning a radio takes up more visual attention than changing a cassette or using a mobile phone, resulting in longer periods in which the driver's gaze is directed away from the road, and larger deviations in road position, especially for inexperienced drivers (Wikman et al., 1998). A simulator study revealed that operating an entertainment system was associated with lower speeds and greater deviations from the posted speed limit than either a mobile-phone task or no distraction (Horberry et al., 2006). However, the introduction of voice-operated control systems may minimize biomechanical and visual distractions in the future.

Auditory distraction in the form of masking is rarely commented on in the literature. The presence of music, along with road noise in vehicles, can mask the sound of auditory warning signals, such as sirens and horns, thereby potentially increasing accident risk, especially for older drivers (Slawinski and McNeil, 2002). The presence of music can also mask auditory feedback from the vehicle, such as engine noise, which is useful for self-monitoring driving performance.

Cognitive distraction consists of absorbing thoughts which take up the driver's attention, but is difficult to assess as a contributory factor in real driving incidents. Listening to music while driving, like other dual tasks (such as holding a conversation with a passenger, or via a mobile phone), may add to a driver's attentional load: listening to music, at a bare minimum, requires us to process sounds and often words, and drivers may find themselves using additional resources to tap along to the rhythm, sing, or recall memories triggered by the music. A number of studies have shown that driver distraction involving mobile phones can be due to holding a conversation on a mobile phone, and not merely due to the physical manipulation of the handset (Strayer and Johnston, 2001). Can listening to music therefore incur cognitive distraction from driving, in addition to that due to manipulation of an in-vehicle entertainment system?

There is some evidence that, under more demanding conditions and complex tasks, auditory stimuli can distract attention away from driving. In a simulated driving task, Strayer and Johnston (2001) found no significant impairment of braking response to a simulated traffic signal in the presence of a radio broadcast, or a book played from tape, while participants displayed more lane-drifting when listening to radio programmes except in the easiest of tasks conducted in the morning. The enhanced performance in the morning is congruent with previous research which indicates that performance is usually at its peak at this time due to circadian patterns of alertness (Jancke et al., 1994). The presence of music improved response time to centrally located visual cues in a driving tracking and vigilance task, but increased response time to peripheral signals under the most demanding conditions (Beh and Hirst, 1999). Evidence from driving game simulations shows similar results: lap-times were reduced in conditions of high demand (a backward counting task, and music with higher tempo and sound level) relative to low demand (a shadowing counting task, and music with slower tempo and lower sound level) (North and Hargreaves, 1999). The authors suggest that the more complex task required more attention, and is therefore more affected by music, as both tasks compete for limited attentional resources. The results regarding the effects of attentional deficits on driving performance are supported by an on-road study of speed maintenance: this showed that under conditions of high attentional demand, speedometer inspection decreased and the speed of participants driving under imposed speed restrictions inadvertently increased to a preferred level (Recarte and Nunes, 2002). Further evidence of competition for attentional resources is provided by evidence that liking for music is influenced by the driving task (North and Hargreaves, 1999): in the simulated driving study, music was liked less in the high demand task, particularly in the case of the high activity music.

Alongside distraction, the second, related key means by which in-vehicle music listening influences driving performance is via its effects on driver mood and arousal. Music listening can alter arousal levels, which has potentially positive and negative consequences, depending on particular circumstances. One commonly cited positive benefit of music listening while driving is its ability to combat drowsiness. But to what extent is the effectiveness of this practice upheld by research findings? A study of crash-risk, based on drivers on major rural highways in America, found that drivers with a sound system playing were at a lower risk of crashing than drivers without a sound system playing (Cummings et al., 2001). The findings of the small number of laboratory studies which have investigated the use of music as a counter-measure to drowsiness suggest that music may be of short-term usefulness: sleep-restricted participants who drove for 2.5 hours in a car simulator tended to exhibit less lane-drifting while listening to the radio than when cold air was blown onto the face, or when there was no

countermeasure (Reyner and Horne, 1998). However, this result was not statistically significant and the trend was most marked for the first 30 minutes. The authors conclude that listening to a radio is at best a temporary countermeasure which drivers can use to reduce their drowsiness in the short-term while they find a place to stop and avail themselves of more effective countermeasures, such as sleeping. Interestingly, drivers' self-ratings of their sleepiness were significantly lower when listening to the radio, even though an EEG showed no significant effect on sleepiness, and their performance did not improve significantly. The implication of this is that listening to the radio may inadvertently reduce drivers' self-perception of drowsiness, potentially contributing to the dangers of continuing to drive while sleepy. This is particularly pertinent given that young adults report using in-car entertainment as a countermeasure more than older drivers, and are also most at risk of sleep-related crashes.

In general terms, 'arousal', as previously discussed, refers to the state of alertness, from being asleep to being in a highly energized state, and can be thought of as one aspect of mood (where valence is the other). Research into driver stress and mild aggression, such as using the horn, gesturing and swearing, suggests that aggressive driving behaviour contributes to accidents, and is associated with greater traffic congestion, stress, arousal and time pressures. This is partly because, in conditions of high traffic congestion, other road users are viewed as obstacles that prevent drivers from reaching their destination in the desired time (Shinar, 1998). Music is often used to reduce stress and improve mood in therapeutic contexts, and it has been shown that individuals in a more positive mood are more likely to be altruistic and display less aggression (Konecni et al., 1976; North et al., 2003). Thus, use of music while driving may reduce driver stress and improve mood, with a subsequent reduction in roadway aggression. Wiesenthal et al. (2000) demonstrated that music can reduce negative effects while driving, but that the presence of driver-chosen music only reduces mild driver aggression in conditions of low time urgency (Wiesenthal et al., 2003). The authors suggest that this may be due either to a distraction effect, whereby attention is drawn from the driving environment under low-demand conditions, or to a mood enhancing effect of the music, outweighed under conditions of higher stress, when drivers' arousal levels are already likely to be high. An additional reason may be that music improves mood because it enhances perceived control – a factor which qualitative studies have highlighted as an important issue (Bull, 2001), and one which can reduce driver stress (Connell and Joint, 1997).

Most of the studies discussed above are concerned with the influence of either the presence or absence of a radio playing in the vehicle, yet few specify whether music was playing (as opposed to a spoken broadcast), nor what kinds of music were used. The next section considers evidence for the influence of specific musical attributes on driving performance.

Which aspects of musical material influence driving performance?

There is a stereotyped association between dangerous driving and loud, fast music, but is there any evidence that the intensity and tempo of music can influence driving behaviour?

Belojevic et al. (2001) investigated the role of background noise amplitude upon task performance. They found that, for a number of the participants, the noisier conditions led to increased concentration problems and fatigue. Another study by Ayres and Hughes (1986) compared visual acuity, visual search and pursuit tracking tasks during music presented at 70 or 107 dB. They found that visual acuity was significantly impaired by the presence of the louder music, and interestingly, the effect was not significant with noise at the same volume. Together with Beh and Hirst's finding that response time to peripheral signals was reduced by loud music (85 dBA), these studies suggest that loud music can be detrimental to driving performance. Low intensity music, on the other hand, may improve response times under some conditions (Beh and Hirst, 1999; Turner et al., 1996).

The other attribute of musical material which has been investigated is tempo. In the only published study of its kind to focus on the effects of tempo, 28 students were played music, with tempos that ranged from 60–120 beats per minute, as they drove a virtual car through the streets of Chicago (Brodsky, 2002). The results showed that drivers were twice as likely to make bad judgements, or even have an accident, when they listened to fast music, compared to slow or medium tempos, and that the speed of their driving and estimate of their speed rose as the tempo of the music increased. Brodsky concludes that music tempo can account for distraction effects, whereas intensity can account for arousal effects, and suggests that the temporal character of music may influence the experience of time, and therefore of speed.

These experiments suggest that extremes of loud noise and tempo can significantly affect driving performance, with the potential to compromise safety on the roads. However, the situation is further complicated because musical complexity (Furnham and Allass, 1999) may also be implicated: theoretically, the greater the complexity of the music we listen to, the larger the effect on our attentional resources, level of arousal and emotional/mood state. Furthermore, any effects of music are likely to be mediated by the individual characteristics of the driver, such as their musical preferences and familiarity with the music (Hilliard and Tolin, 1979; Wiesenthal et al., 2003), their personality and level of sensation-seeking (Barnett, 2004), their gender (Turner et al., 1996), and the amount of concentration required to carry out the task of driving at any specific moment in time.

Research questions and methodology

Despite the preponderance of in-vehicle music-listening, the review of previous studies reveals a surprisingly small amount of research conducted into the effects of music on driving. Previous studies use two main investigative methods. With the first, laboratory and field experiments manipulate specified aspects of the driving environment to provide systematic evidence regarding the influence of auditory stimuli and specific structural attributes of music on aspects of driving performance. The second type of study uses data gathered from accident reports (and, more rarely, observational data) to investigate the involvement of music in accidents, although this focuses on the manipulation of in-vehicle sound systems rather than on the effects of listening to music per se. These studies shed light on how music influences driving performance, but there is presently little contextual information about how or why drivers use music, or on what kinds of music they are listening to. Furthermore, there is an absence of datasets linking real-world in-vehicle listening practices, the specific music listened to, and driving performance. Thus, an alternative approach is to consider the relationship between music listening and driving performance from a broader perspective, using a survey-style instrument. The survey reported here uses such data to shed light on in-vehicle listening practices and their relationships with driving performance.

In order to check for any association between listening practices and driving performance, drivers in this study were categorized according to possession of four or more years' no-claims discount on their motor insurance. The analysis therefore treats no-claims insurance status as an approximate indication of driving performance. However, this measure is not an accurate measure of driver 'safety': possession of no-claims discount assumes four or more years' accident free motoring, even though drivers may have had accidents which they fail to report; it mitigates against the youngest drivers, since time is needed to build up a no-claims bonus; drivers can lose their claims-free status even though the accident may not be their fault; and in some cases drivers can keep their no-claims status even when they have an accident, by buying a protection clause as an addition to their motor insurance. However, the only other available 'real world' measures of driver safety, such as police accident reports, suffer many limitations when viewed as data for analysis of the relationship between driving performance and activities such as music listening (Stevens and Minton, 2001; Young et al., 2003). Furthermore, they do not allow for data to be gathered from the same individual about their driving performance and listening practices. Thus, while recognizing the limitations of possession of no-claims on motor insurance as a measure of driving performance, and its status as an approximate indication of driver safety, it is currently the only available measure of real-world individual driving performance and listening practices

that allows a large-scale study. Its use here for the first time provides an opportunity to assess the usefulness and limitations of this method, in relation to existing evidence.

METHOD

Participants

Respondents to the survey were members of a proprietary online panel (YouGov). Anyone can volunteer to become a member of the panel, but in order to reach a broader population, respondents are also actively recruited through advertising on a range of non-political websites. The active panel consists of approximately 100,000, of whom 6000 were invited to participate in the survey and 2473 responded. Only the responses from drivers are dealt with in this analysis (N = 1780). All information provided by respondents was recorded anonymously. The sample is representative of the adult population of Great Britain, based on age, gender, social grade and region. The sample constituted 971 males and 809 females, aged 18 and above: 18–29 (N = 396), 30–50 (N = 760) and over 50 (N = 624). A total of 1050 participants had four or more years' no-claims discount on their motor insurance, and 306 were without no-claims discount.

Survey Instrument

The survey gathered demographic data, information about preferred forms of in-vehicle entertainment while driving, information about preferred and most listened-to musical genres and radio stations while driving, possession of four or more years' no-claims discount on their vehicle insurance, whether they had ever had an accident while music was playing, and, if so, the genre of the music. The survey was administered online between 29 April and 3 May 2005.

Results

WHAT LISTENING ACTIVITIES DO DRIVERS ENGAGE IN?

A large proportion of drivers in this survey reported listening to playback of recorded music (e.g. CDs and tapes) and music radio while driving, while silence was least common (Table 1). The preference for some form of auditory stimulation while driving is supported by previous studies of drivers outside Britain (e.g. Stutts et al., 2003).

Age- and gender-related listening behaviours were revealed by comparing observed frequencies with expected frequencies based on each age and gender group. There were significant age differences for the frequency of listening to recorded music (chi-square = 49.22, d.f. = 2, $p < .001$), music radio (chi-square = 17.54, d.f. = 2, $p < .001$), engaging in conversation while driving (chi-square = 47.67, d.f. = 2, $p < .001$), and silence (chi-square = 45.05, d.f. = 2, $p < .001$): drivers in the two youngest age groups reported

TABLE 1 *Frequency of in-vehicle listening as a percentage of each age group. Respondents could select more than one option*

	Age		
Listening activity (%)	18–29 ($N = 396$)	30–50 ($N = 760$)	over 50 ($N = 624$)
CD/tapes	74	67	43
Music radio	76	73	57
Talk radio	27	34	39
Conversation	49	49	31
Silence	7	8	19

listening to recorded music, music radio, and conversing more frequently than drivers over 50, while these older drivers reported preferring to drive in silence more than the two younger age groups (Table 1). Listening to talk-radio increases across the three age groups (chi-square = 10.1, d.f. = 2, $p = .006$). Interestingly the risk of masking auditory signals is greater for older drivers (Slawinski and McNeil, 2002); therefore the preference for driving in silence may represent recognition of this limitation by some drivers.

When asked about the experience of listening activities while driving, 62 percent of drivers agreed that music soothed them while driving, making them calmer and more relaxed, while just under a quarter of drivers said that music aided their concentration. Conversation and spoken word were reported as being equally distracting by all age groups (Table 2). However, there were significant differences between age groups in the frequency with which drivers sang along to music (chi-square = 7.93, d.f. = 2, $p = .02$), whether music helped their concentration (chi-square = 7.95, d.f. = 2, $p = .02$), whether they found music to be a distraction (chi-square = 10.58, d.f. = 2, $p = .005$), and whether music was calming (chi-square = 9.8, d.f. = 2, $p = .007$). Music was reported to be calming more often by drivers aged over 50 than by younger age groups. Drivers in the two youngest age groups reported singing along to music while driving more often than drivers aged over 50 and were more likely to report finding music a distraction.

There were some differences in the relationship of in-vehicle listening to listening in other locations. A small proportion of drivers (13%) said that they listened to different music at home than when driving, and this was significantly affected by age (chi-square = 10.71, d.f. = 2, $p = .005$): respondents in the two older age groups were more likely to listen to different music at home from that while driving, than drivers aged 18–29. Aging may result in a widening of music preferences (Russell, 1997), or a learning effect: for example, there is some evidence from studies of music listening at work that people learn how to use music for self-therapeutic ends (Lesiuk, 2005). For some respondents, driving represented the only time they were able to

TABLE 2 *Frequency of musical functions in vehicles as a percentage of each age group. Respondents could select more than one option*

Musical function (%)	Age 18–29 ($N = 396$)	30–50 ($N = 760$)	over 50 ($N = 624$)
Music aids my concentration	23	21	27
Music makes me calmer and more relaxed	61	58	67
Music can be a distraction	9	7	3
I often sing along to music	60	54	41
I find conversation or spoken word distracting	8	6	8

listen to the music they wanted: this was true of 17 percent of drivers aged 18–29 and 30–50, compared with 11 percent of drivers aged over 50. One implication of this may be that younger drivers are less discriminating about whether the music they listen to is appropriate to their driving needs.

When asked which genres of music and radio stations they preferred to listen to while driving, and which they listened to the most, chart pop was the most frequently cited, perhaps due to its greater overall radio airtime in the UK than other genres. Genre and station preferences differed with age: drivers aged 18–29 tended to listen to dance/house, r'n'b, indie/rock, and BBC Radio 1 (a chart/pop station); drivers aged 30–50 listened to easy listening and indie/rock and BBC Radio 2 (an easy-listening and rock station); and drivers aged over 50 tended to listen to classical and easy listening genres and Classic FM (a classical music station) and BBC Radio 2 (easy-listening and rock). With the exception of a male preference for talk-radio (chi-square = 32.02, d.f. = 1, $p < .001$), and a greater frequency of women reporting that they sang along to music while driving (chi-square = 39.32, d.f. = 1, $p < .001$), there were no gender differences.

IS THERE AN ASSOCIATION BETWEEN DRIVING PERFORMANCE AND LISTENING BEHAVIOUR?

In order to check for any relationship between driving performance and music listening while driving, respondents were categorized according to their possession of four or more years' no-claims discount on their motor insurance. As expected, older drivers were more likely to possess no-claims discount than younger drivers. There was no difference according to gender (Table 3).

Twenty-three percent of drivers who had had an accident reported that music was playing at the time. This was not significantly affected by gender, age or whether or not the individual was claims free. In itself, the finding that music was present in nearly a quarter of the last accidents to have occurred, rather than the majority of them, suggests that there is no direct link between the presence of music while driving and involvement in an accident.

TABLE 3 *Percentage of respondents in possession of four or more years' no-claims discount on motor insurance as a function of age and gender*

4 or more years of no claims		Male	Female	18–29	30–50	Over 50
	$N = 1780$	$N = 971$	$N = 809$	$N = 396$	$N = 760$	$N = 624$
Yes %	78	79	77	37	82	91
No %	18	17	18	52	15	6
Don't know %	4	4	5	10	3	3

In comparison with other drivers, those with no claims on their insurance report significantly less conversation with passengers while driving (chi-square = 15.53, d.f. = 1, $p < .001$), listen to less music on tape and CD (chi-square = 8.672, d.f. = 1, $p = .003$), and prefer silence while driving (chi-square = 4.161, d.f. = 1, $p = .04$).[1] These findings are congruent with laboratory and police report studies which have shown that conversations and word generation tasks can be highly distracting (Strayer and Johnston, 2001), and that interaction with passengers is the most frequent source of in-vehicle distraction in accidents (Stevens and Minton, 2001).

However, the finding that claims-free drivers are less likely to listen to music while driving is confounded with age; the tendency for older drivers to possess no-claims discount, combined with the presence of age-related behavioural differences as highlighted above, means that age is confounded with possession of no-claims discount on motor insurance. In order to tease out effects of listening behaviours, chi-square analyses of listening behaviours and functions for drivers, with and without no-claims, were carried out within age groups. The analysis revealed one significant difference: drivers with no-claims discount aged between 18 and 29 are more likely to prefer silence while driving than drivers without no-claims discount (chi-square = 4.56, d.f. = 1, $p = .03$). This finding supports evidence from other studies that show that in-vehicle auditory activities are potential distractions (Young et al., 2003). Claims-free drivers aged 18–29 were also significantly more likely to report that their vehicle was the only location where they could listen to the music they wanted (chi-square = 7.97, d.f. = 1, $p = .005$). This goes against the idea that drivers who are restricted regarding the music they can listen to elsewhere may choose less appropriate music for driving, with detrimental effects on driving performance; if anything, it supports Bull's (2001) argument that the car presents a location for perceived control and choice, which may in turn have benefits for mood and behaviour.

These results show that many drivers believe that music is an important influence on their levels of relaxation and concentration while driving, and there is some indication of an association between presence of music and driving performance for particular age groups. If detrimental effects of music on driving are partly to do with visual and biomechanical distraction due to

in-vehicle audio systems, then the type of music listened to should make little difference to driving performance. To check whether there is any association between type of music and driving safety, the genre of music drivers listen to was analysed in relation to possession of no-claims discount. Given the age-related differences in genre preferences revealed earlier, all analyses are carried out within age groups; gender is excluded from the analysis due to a lack of significant differences.

There is a significant association between no-claims discount and the most listened-to genres of music for the over-50s (chi-square = 15.74, d.f. = 3, $p = .001$): drivers aged over 50, with no claims discount, listen to more easy listening and less chart-pop music.[2] Significant associations were found between possession of no-claims discount and radio stations most listened to for the 18–29 age group (chi-square = 15.85, d.f. = 5, $p = .007$), but not for the older age groups: drivers with no-claims discount aged 18–29 tend to listen to BBC Radio 1 less, and BBC Radio 2 more, compared to drivers without no-claims discount.[3] The music content of these radio stations reflects the genre preferences reported by these age groups, so although many other aspects of the programme content may also be significant, the coincidence of both radio and genre preferences provides converging evidence for the musical preferences of this group of drivers. These results suggest that there is an association between the genre of music listened to the most and driving performance, with one major caveat: the associations between genre preferences and possession of no-claims discount may be confounded with age within the age groupings used here. For this reason, further analysis was carried out into the genre of music playing at the time of the last accident, in relation to the norms for each age group.

Chi-square comparisons were carried out between the observed frequencies of drivers who were listening to each genre at the time of the accident, and expected frequencies based on responses to 'most listened-to genres', for each age group. The analysis reveals a significant difference between the genre of music playing at the time of the last accident, compared to the norm for the age group. For drivers aged 18–29, dance/house was playing significantly more often at the time of the last accident than would be expected according to the frequency of dance/house played most often while driving (chi-square = 4.44, d.f. = 1, $p = .04$), whereas indie/rock/punk was playing significantly less often (chi-square = 6.68, d.f. = 1, $p = .01$). For drivers aged 30–50, three genres were playing significantly less often at the time of the accident than expected: classical music (chi-square = 6.34, d.f. = 1, $p = .01$), chart-pop (chi-square = 5.59, d.f. = 1, $p = .02$), and indie/rock/punk (chi-square = 4.83, d.f. = 1, $p = .03$). For drivers aged over 50 who had had an accident, classical music was playing at the time of the accident less frequently than expected (chi-square = 6.05, d.f. = 1, $p = .01$). These results suggest that there may be an association between the genre of music playing and driving performance. Dance/house is usually fast tempo and

played at a loud volume, and it may be that under some circumstances this is distracting for drivers aged 18–29, who tend to listen to this genre more than any other age group in the survey. Conversely, drivers in the older age groups who had had an accident appear to have listened to the most prevalent genre for their age group less often than would be expected from the norm for their age group. Possible explanations of this finding are either that the presence of the usual choice of music for these age groups is beneficial, or that drivers in these age groups are more likely to have an accident when they are interacting with passengers (which previous research has shown is the time when music is most often absent altogether).

Discussion of findings

This survey of British drivers indicates that listening to music while driving, whether from radio or from recorded format, is the preferred in-vehicle activity of the majority of drivers, particularly those under 50 years of age. Respondents reported that music benefited their driving experience and performance through improvements to their concentration and relaxation. Few drivers in the survey drove in silence, and the high incidence of singing along to music while driving suggests that drivers are actively engaging with the music, and therefore minimizing boredom. These activities offer arousal and positive mood effects, which previous studies have shown can be helpful to driving performance at moderate levels.

The survey highlights the potential importance of in-vehicle music listening as a source of perceived control and arousal, which has self-reported benefits for mood. A large proportion of drivers in this survey (particularly older drivers) reported that music soothes them while they drive. These drivers tend to listen to Classic FM, a British radio station specializing in Western classical music, whose programming is explicitly marketed in terms of its utility for relaxation at work and while travelling. Music's ability to reduce stress is well documented (e.g. Holland, 1995), and music which induces listeners into a positive and relaxed mood has the potential to elicit more considerate driving, since people in positive moods tend to behave more altruistically (North et al., 2003; Wiesenthal et al., 2000).

The survey also provides evidence of the extent to which music may be a source of distraction relative to other in-vehicle auditory stimulation. The discovery that the majority of drivers report finding conversation more distracting than music supports experimental and accident report evidence that conversation is distracting to drivers. Singing along to music was reported equally often by drivers with and without no-claims bonus, indicating that it is not a significant form of distraction. This finding is congruent with the results of experimental studies, which have shown that conversation is detrimental to attention while driving, whereas word-shadowing (similar to singing along to recorded music) is not (Strayer and Johnston, 2001).

Singing may also be less distracting than conversation because is it more flexible: one can start and stop singing at will with no ill consequences, whereas a conversation demands some level of sustained attention throughout in order to maintain its logic and preserve social etiquette.

Despite these perceived benefits reported by drivers, the survey suggests that music is a potential source of distraction which can be detrimental to driving performance: drivers with four or more years' no-claims on their insurance are less likely to listen to music while driving. This may be because these drivers are less subject to visual, bio-mechanical or auditory distractions. However, there is some evidence that drivers with four or more years' no-claims have different listening preferences to other drivers in their age group, and some genres also tend to occur more frequently at accidents than would be expected (after taking into account the prevalence of particular genres in the normal listening preferences for that age group). This suggests that it is not only the activity of listening to music while driving which influences driving performance, but the kind of music listened to. The question this raises is why different listening preferences should be associated with driving performance. We suggest three possible explanations.

First, the associations between listening preferences and driving performance may be a result of co-variation with age-related listening preferences. Analyses were conducted within age groups in order to take age-related effects into account. However, these age groups are still relatively broad and the associations that comparisons within these age groups reveal may be the result of age-related trends in the data. This may mean that the associations between listening practices and driving performance are correlated rather than causal, and that the influential factor on driving performance is the age and lifestyle or personality characteristics of the driver. For example, it may be that older drivers who listen to classical music more are less likely to be involved in a road accident because they are simply 'safer drivers' (perhaps due to lower levels of sensation-seeking or risk-taking, drink-driving, and so on). There is currently contradictory evidence as to whether preference for certain genres of music is associated with certain personality characteristics, and further research into this is needed before the influence of personality can be confirmed.

A second possible explanation for the associations between listening practices and driving performance is that different genres are associated with different functions for drivers, and it is the activities these functions are associated with which influence driving safety. For example, in this survey house and dance music were associated with a higher incidence of accidents for the youngest age group. This music may be associated with occasions when groups of friends are going out, travelling together and driving at night. This could introduce other potential distractions and driving difficulties which may contribute to decrements in driving performance, such as poorer visibility, greater driver drowsiness, more distraction due to

interaction with passengers, or the influence of drugs or alcohol. Thus, particular genres or radio stations may be associated with different kinds of activities and functions which differentially affect driving performance.

A third possible explanation for the associations between listening preferences and driving performance, is that different genres affect driving safety to different extents and in different ways, due to their musical characteristics. This is the argument presented by experimental studies of music-listening while driving. For example, in this survey, dance and house are both associated with drivers aged 18–29 with less than four years' accident free motoring: both tend to be fast tempo music, designed to be played at high volume, and sometimes incorporating complex rhythmic patterns and layered textures. These features of music have been found to be highly arousing for listeners, one effect of which can be to increase alertness. However, at high levels, fast and loud music has been shown to divert attention away from driving (Brodsky, 2002; Recarte and Nunes, 2002), and result in greater aggression in some circumstances (Wiesenthal et al., 2003). Thus, although this survey cannot provide causal evidence for the influence of particular musical characteristics on driving performance, its findings are congruent with the attentional hypothesis of driving performance and the evidence of previous experimental studies.

The main methodological implication of these findings is that possession of no claims discount on motor insurance can be used as a rough approximation of driver performance, despite the lack of a direct link between 'unsafe' driving and loss of claims status: analysis of the survey data reveals a correspondence between these findings and those from other sources of evidence. However, the confounding of possession of no-claims discount with age makes it impossible to determine the causal character of the associations between driving performance and musical preferences. Future studies of driver performance and real-world music listening behaviour could overcome this by using observational data, gathered from inside and outside vehicles, to provide more precise evidence.

In sum, the survey has provided an overview of in-vehicle listening practices in Great Britain: it shows that listening to music while driving is an extremely common practice which the majority of drivers believe to be beneficial to their driving, even though 'safer' drivers in the survey tended to listen to music less than other drivers. The survey found associations between in-vehicle music listening and driving performance, the causal character of which needs to be explored in future research. Most importantly, this study suggests that further research is needed into the effects of specific musical attributes on cognitive distraction, extending the findings of studies which have begun to explore effects of tempo and loudness (e.g. Brodsky, 2002). Gathering data on preference for radio stations and genres is necessarily a broad-brush approach and is no substitute for controlled experimental research which manipulates musical parameters, or case studies of driver

behaviour and music. It also suggests the need to explore the extent of, and interaction between, the different factors of driver personality, life style, the social function of the music, and musical attributes, as they relate to driving performance. In addition, there is scope to analyse the musical output of radio stations, like Classic FM, and drivers' own musical choices, to determine those aspects of music which people find most beneficial in relation to particular driving needs. Lastly, the dominant use of music to relax while driving suggests that future research could explore the psychological processes which enable this to happen. This research, therefore, provides a context for more in-depth studies of the particular functions of music listening that are identified here, and of the benefits, as well as the dangers, of listening to music while driving.

ACKNOWLEDGEMENTS

This research was commissioned by Band and Brown, for Privilege Insurance, May 2005. The omnibus survey was conducted by YouGov Plc. The data is used with the permission of Band and Brown.

NOTES

1. All chi-square calculations use specified expected values, rather than assuming that all categories are equal.
2. Genre data were aggregated into six categories: 'classical'; 'chart/pop'; 'indie/rock'; 'dance/house'; 'easy listening'; and 'other' (containing blues/jazz, chill out, folk, hiphop/rap, latin, salsa, soul, r'n'b, world and other). 'Don't know' responses were excluded from the analysis.
3. Data were aggregated into six categories: BBC Radio 1; BBC Radio 2; Radio 3 and Classic FM; Radio 4, 5 and Talksport; BBC local and other local stations; national commercial stations and Virgin Radio. 'Don't know/other' responses were excluded from the analysis.

REFERENCES

Ayres, T.J. and Hughes, P. (1986) 'Visual Acuity with Noise and Music at 107dbA', *Journal of Auditory Research* 26(1): 65–74.

Barnett, V.J. (2004) 'The Performance and Experience of Extraverts and Introverts Playing a Computer Racing Simulation: Mediating Effects of Increasing Complexity in Musical Distraction', unpublished undergraduate thesis, University of York, Department of Psychology.

Beh, H.C. and Hirst, R. (1999) 'Performance on Driving-Related Tasks during Music', *Ergonomics* 42(8): 1087–98.

Belojevic, G., Slepcevic, V. and Jakoljevici, B. (2001) 'Mental Performance in Noise: The Role of Introversion', *Journal of Environmental Psychology* 21: 209–13.

Brodsky, W. (2002) 'The Effects of Music Tempo on Simulated Driving Performance and Vehicular Control', *Transportation Research Part F, 4*: 219–41.

Bull, M. (2001) 'Soundscapes of the Car: A Critical Study of Automobile Habitation', in D. Miller (ed.) *Car Cultures*, pp.185–202. Oxford: Berg.

Connell, D. and Joint, M. (1997) 'Driver Aggression', in *Aggressive Driving: Three Studies.* AAA Foundation for Traffic Safety. URL (consulted April 2006): http://aaafoundation.org

Cummings, P., Koepsell, T.D., Moffat, J.M. and Rivara, F.P. (2001) 'Drowsiness, Counter-measures to Drowsiness, and the Risk of a Motor Vehicle Crash', *Injury Prevention* 7: 194–9.

DeNora, T. (2000) *Music in Everyday Life.* Cambridge: Cambridge University Press.

Furnham, A. and Allass, K. (1999) 'The Influence of Musical Distraction of Varying Complexity on the Cognitive Performance of Extraverts and Introverts', *European Journal of Personality* 13: 27–38.

Hilliard, O.M. and Tolin, P. (1979) 'Effects of Familiarity with Background Music on Performance of Simple and Difficult Reading Comprehension Tasks', *Perceptual and Motor Skills* 49: 713–4.

Holland, P. (1995) 'The Role of Music in the Effective Relief of Stress', in T. Wigram, B. Saperston and R. West (eds) *The Art and Science of Music Therapy: A Handbook,* pp. 406–32. Chur, Switzerland: Harwood Academic Press.

Horberry, T., Anderson, J., Regan, M.A., Triggs, T.J. and Brown, J. (2006) 'Driver Distraction: The Effects of Concurrent In-Vehicle Tasks, Road Environment Complexity and Age on Driving Performance', *Accident Analysis and Prevention* 38: 185–91.

Jancke, L., Musial, F., Vogt, J. and Kalveram, K.T. (1994) 'Monitoring Radio Programmes and Time of Day Affect Simulated Car-Driving Performance', *Perceptual and Motor Skills* 79(1): 484–6.

Konecni, V.J., Crozier, J.B. and Doob, A.N. (1976) 'Anger and Expression of Aggression: Effects on Aesthetic Performance', *Scientific Aesthetics* 1: 47–55.

Lesiuk, T. (2005) 'The Effect of Music Listening on Work Performance', *Psychology of Music* 33(2): 173–91.

Nguyen, L.T., Jauregui, B. and Dinges, D.F. (1998). *Changing Behaviors to Prevent Drowsy Driving and Promote Traffic Safety: Review of Proven, Promising, and Unproven Techniques.* AAA Foundation for Traffic Safety. URL (consulted April 2006): http://www.aaafoundation.org/pdf/drowsydriving.pdf

North, A.C. and Hargreaves, D.J. (1999) 'Music and Driving Game Performance', *Scandinavian Journal of Psychology* 40: 285–92.

North, A.C., Tarrant, M. and Hargreaves, D.J (2003) 'The Effects of Music on Helping Behaviour: A Field Study', *Environment and Behaviour* 36(2): 266–75.

Recarte, M.A. and Nunes, L. M. (2002) 'Mental Load and Loss of Control over Speed in Real Driving: Towards a Theory of Attentional Speed Control', *Transportation Research Part F* 5(2): 111–22.

Reyner, L.A. and Horne, J.A. (1998) 'Evaluation "In-car" Countermeasures to Sleepiness: Cold Air and Radio', *Sleep* 21(1): 46–50.

Reeves and Stevens ([1993] 1996) 'A Practical Method for Comparing Driving Distraction Associated with In-Vehicle Equipment', in A.G. Gale (ed.) *Vision in Vehicles* 5, Conference in Glasgow, September 9-11, Amsterdam, Elsevier.

Russell, P.A. (1997) 'Musical Tastes and Society', in D.J. Hargreaves and A.C. North (eds.), 'The Social Psychology of Music' Oxford University Press.

Shelton, L.R. (2001) *Statement before the Subcommittee on Highways and Transit, Committee on Transportation and Infrastructure, U.S. House of Representatives*, May 9, 2001. URL: http://www.nhtsa.dot.gov/nhtsa/announce/testimony/distractiontestimony.html

Shinar, D. (1998) 'Aggressive Driving: The Contribution of the Drivers and the Situation', *Transportation Research Part F* 1: 137–60.
Slawinski, E.B. and McNeil, J.F. (2002) 'Age, Music, and Driving Performance: Detection of External Warning Sounds in Vehicles', *Psychomusicology* 18: 123–31.
Sloboda, J.A., O'Neill, S.A. and Ivaldi, A. (2001) 'Functions of Music in Everyday Life: An Exploratory Study Using the Experience Sampling Method', *Musicae Scientiae* 5: 9–32.
Stevens, A. and Minton, R. (2001) 'In-Vehicle Distraction and Fatal Accidents in England and Wales', *Accident Analysis and Prevention* 33: 539–45.
Strayer, D.L. and Johnston, W.A. (2001) 'Driven to Distraction: Dual-Task Studies of Simulated Driving and Conversing on a Cellular Phone', *Psychological Science* 12: 462–6.
Stutts, J.C., Reinfurt, D.W., Staplin, L. and Rodgman, E.A. (2001) *The Role of Driver Distraction in Traffic Crashes*. Report prepared for AAA Foundation for Traffic Safety, Washington, DC. URL (consulted April 2006): http://www.aaafoundation.org/projects/ index.cfm?button=distraction
Stutts, J. et al. (2003) *Distractions in Everyday Driving.* Report prepared for AAA Foundation for Traffic Safety, Washington, DC. URL (consulted April 2006): http://www.aaafoundation.org/pdf/DistractionsInEverydayDriving.pdf
Turner, M.L., Fernandez, J.E. and Nelson, K. (1996) 'The Effects of Music Amplitude on the Reaction to Unexpected Visual Events', *The Journal of General Psychology* 123(1): 51–62.
Wiesenthal, D.L., Hennessy, D.A. and Totten, B. (2000) 'The Influence of Music on Driver Stress', *Journal of Applied Social Psychology* 30: 1709–19.
Wiesenthal, D.L., Hennessy, D.A. and Totten, B. (2003) 'The Influence of Music on Mild Driver Aggression', *Transportation Research Part F* 6(2): 125–34.
Wikman, A-S., Nieminen, T. and Summala, H. (1998) 'Driving Experience and Time Sharing During In-Car Tasks on Roads of Different Width', *Ergonomics* 41: 358–72.
Young, K., Regan, M. and Hammer, M. (2003) *Driver Distraction: A Review of the Literature.* Monash University Accident Research Centre, Report no. 206. URL (consulted April 2006): http://www.monash.edu.au/muarc/reports/ muarc206.html

NICOLA DIBBEN is a Senior Lecturer and Director of the Masters Degree in Psychology of Music at the Department of Music, University of Sheffield. Her interdisciplinary research into music, mind and culture has explored music perception, gender and identity, and analysis of popular music, and has addressed a diverse range of questions, from underlying pitch structure in early 20th-century Viennese music, to physiological arousal in emotional experience of music. She is co-ordinating editor of the journal *Popular Music,* and consulting editor to *Musicae Scientiae*.
Address: Dept of Music, University of Sheffield, 38 Taptonville Road, Sheffield, S10 5BR. [email: n.j.dibben@shef.ac.uk]

VICTORIA J. WILLIAMSON is a doctoral student at the University of York, UK, researching musical memory. Her previous research includes a study of how personality mediates the effects of background music on driving performance.
Address: Victoria Williamson, Department of Psychology, University of York, Heslington, York YO10 5DD. [email: v.williamson@psych.york.ac.uk]