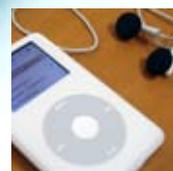


# BRSI

BELGIAN ROAD SAFETY  
OBSERVATORY

MP3 players and traffic safety  
"State of the Art"

2009

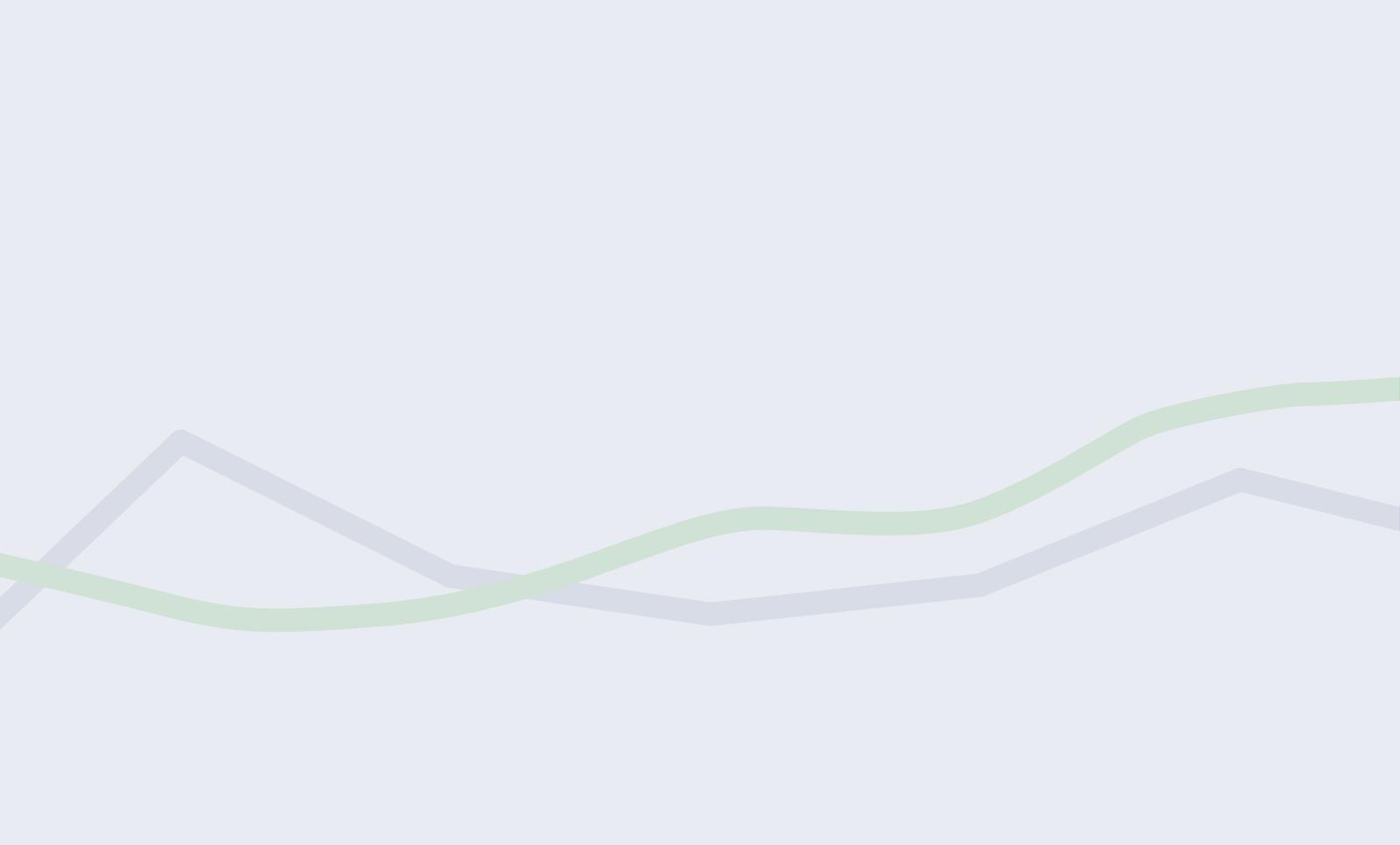


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Belgian Road Safety  
Institute



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## Executive summary

**Aim of the study.** The Belgian Government asked the Belgian Road Safety Institute's (IBSR/BIVV's) scientific advice regarding "MP3 players (portable sound carrier used via headphone/earphone) and traffic safety (pedestrians, cyclists and motor vehicle drivers)". The advice should focus on: (1) risk assessment of the use of MP3 players in traffic; (2) legal regulations around the use of MP3 players in traffic. In both cases the focus should lay on the target groups: pedestrians, cyclists and motor vehicle drivers<sup>1</sup>.

**Methodological considerations.** The authors of this report decided to investigate the topic via two channels: a systematic literature review in scientific databases and an experts' survey among the International Traffic Safety Data and Analysis Group (IRTAD).

(1) The literature review was carried out between the 7th of May and the 6th of June 2009 in the databases: ITRD, MEDLINE, Science direct, and TRIS. Variations of the following search strategy were used to identify articles on the topic: (traffic\* AND safety\* AND (music\* OR MP3\* OR iPod\* OR headphone\* OR earphone\* OR earplug\* OR headset\*)). No search limitations were taken into account in the first phase of the review.

(2) The experts' survey was carried out between the 13th of May and the 26th of June 2009. Experts of the International Traffic Safety Data and Analysis Group (IRTAD) were asked to provide information on their national legal situation regarding MP3 players and traffic safety and on any kind of scientific study on the topic which they are aware of.

The results of both parts are discussed in a common chapter (3) and the last chapter (4) presents the final recommendation to the Belgian Government.

**Results and discussion.** The analysis of the scientific literature on MP3 players and traffic safety can be summarized as follows: The effects of MP3 players on traffic safety is a very complex phenomenon, covering the (1) manual handling, (2) listening to music and (3) auditory limitations which all in themselves again contain several forms of distraction (e.g. visual-; auditory-; biomechanical (physical) - and cognitive distraction).

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1. This group includes two-wheeler motor vehicles as well as any other kind of motor vehicle.

(1) Adjustment of entertainment systems (in general) is one of the leading causes of in-vehicle distraction in crash data. Experimental studies on (car) simulators have proven the negative impact of the manual handling of an MP3 player on driving performance.

(2) Listening to music as such can have both, positive and negative impact on the driving performance. Several studies have shown that it can improve attention and alertness and can help to reduce stress and aggression (e.g. in traffic jams).

Studies focussing on the influence of music's intensity level, tempo, and style on driving performance generate heterogeneous results. Studies with a broader range of subjects and conditions are necessary to generalize conclusions regarding the effects of listening to music on driving performance.

Three identified studies have shown a negative impact of listening to music on pedestrians' crossing behaviour. No studies on the effects of listening to music on cyclists were identified by the search strategy of this review.

(3) To date, the Belgian law does not mention auditory limitations (such as complete or partial deafness, hearing loss or hearing aids) as medical criteria for the fitness to drive. Further, the 3rd EU Driving License Directive, Annex III does not mention hearing loss either as a contra-indication for fitness to drive. There is only the warning that in case of group 2 driving, the competent medical authority should pay attention to the scope of compensation. However, although hearing impairment is not mentioned as a contra-indication for fitness to drive, a study comparing the relative risks (RR) of the medical criteria showed that these people's relative risk (RR) of accident involvement is slightly increased.

All in all very little studies on pedestrians and cyclists have been identified by the search strategy of this report. Other databases (e.g. websites of cyclists' organisation) should be investigated in a more in-depth analysis of the effects of MP3 players on the safety of pedestrians and cyclists. Further, the search strategy on national legal regulations could be expanded to derive more complete, broader and specific information on legal regulations relevant for the use of MP3 players in traffic. Last but not least more elaborate research is needed which corresponds to the complexity of the topic (covering: manual handling, listening to music, auditory limitations and visual-, auditory-, biomechanical (physical)-, cognitive distraction, etc.), in order to assess the heterogeneous effect of MP3 players on traffic safety.

The analysis of the experts' survey gathered information on legal regulations of 14 countries (traffic acts) regarding the use of portable sound carriers via headphone/earphone in traffic. The information provided by IRTAD experts and literature review showed that the use of MP3 players in traffic is allowed in all countries as long as it does not interfere or endanger one's own or others' proper participation in traffic (BE, CH, DE, ES, FR, IL, SE, UK and USA). Certain countries (CH, DE, ES and IL) pointed out the potential risk of the manual handling of electronic devices and/or the use of headphones/earphones which is allowed as long as it does not impair the attention of the driver (CH, DE, ES and IL). The only ban identified within the literature review was on the use of headphones/earphones while driving a motor vehicle in the USA (US states Pennsylvania and Washington). All reported general regulations (10) cover the target group "motor vehicle drivers" and in most cases also cyclists (6). The Swiss expert was the only one who mentioned a (very) general regulation on "proper participation in traffic" which is also covering pedestrians and as such the use of MP3 players via headphones/earphones.

Regarding the outcomes of the experts' survey it has been mentioned though that, the prevalence of general regulations in this review is rather a conservative estimate, as the ITRAD experts were explicitly asked for regulations on MP3 players and traffic safety and might just simply not have

thought about mentioning (very) general regulations. Furthermore, the additional information from the literature review is based on an American publication from 1997 (NHTSA, 1997). No recent update of such an overview article was identified within the search strategy nor did the US expert from IRTAD provide any update or additional information. The search strategy on national regulations should be expanded to derive a more complete, broader and specific overview on general and specific regulations concerning the use of MP3 players in traffic. It may also be a good idea to recheck the obtained information with experts of the European Driving Licence Committee, as this is a network of national experts specialised in legal issues concerning fitness to drive.

**Conclusion (recommendation to the Belgian Government).** Articles 7.2 and 8.3 of the Belgian traffic legislation could serve as general regulations (“umbrella laws”) in the context of MP3 players and traffic safety. This would correspond to the practice in other countries (CH, DE, ES, FR, IL, SE, UK and USA). These general regulations stipulate general conditions for road users and drivers and could as such under certain circumstances (in theory) be used to sanctify the use of MP3 players in traffic.

If Belgium would opt for a more specific regulation on MP3 players in traffic, this should be formulated in an “open” manner (e.g. “No impairment through the use of infotainment systems). Such an “open” formulation could serve as an “umbrella” for any kind of impairment caused by MP3 players (e.g. manual handling, music, volume of sound, etc.) or by any other infotainment system (e.g. mobile phones, smart phones, navigation systems, etc.). The fast technical development in this sector requires “open” formulations in corresponding legal regulations.

Regarding these outcomes it seems advisable to focus on educative interventions rather than repressive regulations. The communicated message could contain several aspects: the risk of hearing damage and the according consequences, the possibility of cognitive impairment (distraction, reactions), the auditory senses which may be compromised, the responsibility of the road user regarding his/her one behaviour.

**Keywords.** MP3, traffic safety, music listening, distraction, driving, iPod, headphone, earphone, headset



# Introduction

**Aim of the study.** The Belgian government asked the Belgian Road Safety Institute's (IBSR/BIVV's) scientific advice regarding "MP3 players (portable sound carrier used via headphone/earphone) and traffic safety (pedestrians, cyclists and motor vehicle drivers)". The advice should focus on:

1. Risk assessment of the use of MP3 players in traffic;
2. Legal regulations around the use of MP3 players in traffic.

In both cases the focus should lay on the target groups: pedestrians, cyclists and motor vehicle drivers<sup>2</sup>. Thus, the aim of this study is to identify scientific literature on the risks of using an MP3 player in traffic and to give an overview of legal regulations in other countries on the topic.

**Methodological considerations.** The authors of this report decided to gather information on the topic via two ways. (1) Information regarding risk assessment of MP3 players in traffic, will be gathered by a systematic literature review in scientific databases; (2) information on the legal regulations of other countries concerning the use of MP3 players in traffic, will be gathered through of an experts' survey (International Traffic Safety Data and Analysis Group (IRTAD)). Information of both sources will be taken into account in the general results of both parts (literature review and experts' survey). (3) Final conclusions and discussion will summarize and discuss the results of both previous parts. The last chapter (4) presents the final recommendation to the Belgium government.

**What is an MP3 player?** An MP3 player is a commonly used term for a digital audio player (DAP) which is a consumer electronics device that has the primary function of storing, organizing and playing audio files. The term MP3 refers to "MPEG-1 Audio Layer 3", which is a standard for data compression for video and audio. The most sold brand (173,000,000 by September 2008) of MP3 player is iPod by Apple Inc. (Wikipedia, 2009abc). Currently gradually more MP4 players are on offer in the marketplace. Some DAP's (e.g. iPod) can read several compressed digital formats such as MP3 as well as MP4.

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2. This group includes two-wheeler motor vehicles as well as any other kind of motor vehicle.

**Fast technical development towards convergent devices.** Since the first mass-produced DAP (“MPMan”) in 1998. The innovation spread rapidly across the globe. In 2003 the first integrated MP3 player in mobile phone was introduced. Only two years later (2005) all five major handset makers (Nokia, Motorola, Samsung, LG and Sony Ericsson) had released music phones. Today more than half of all mobile phones in the world have an MP3 player (Wikipedia, 2009a). The latest development, the so called “smart phones” (e.g. BlackBerry) are examples of high convergent electronic devices which support e-mail, mobile telephone, text messaging, internet faxing, web browsing and other wireless information services as well as a multi-touch interface. Thus, the development in this sector is very fast, with a tendency in the direction of convergent devices which include MP3 players, mobile phones, photo/film cameras, digital agendas, USB sticks, etc. (Wikipedia, 2009 ad). In the literature one can also find the term “infotainment systems” to cover the broad area of devices enabling telephone calls, watching videos, managing e-mail, sending and reading instant messages, selecting and listening to music, etc. (Lee, 2007a).

**Terminology within this study (MP3 player).** The focus of this study is on portable sound carriers, which are used via headphone/earphone. Thus, the authors decided to use the term “MP3 players” within this study for any kind of portable sound carrier which is used via headphone/earphone. This definition includes listening to music by so called music phones, smart phones, MP4 players, walkmans, portable compact disc (CD) players etc.

**MP3 players use in traffic.** MP3 players, as part of portable sound devices can be used via headphones/earphones, but can also be connected to non-mobile DAPs (e.g. car stereo, computer, stereo, etc.) and then be used via the connected audio speakers. Schumacher et al. (2002) already stressed that entertainment in vehicles will change, based on the popularity of MP3 format of music storage and wireless radio. They conclude that especially younger buyers will be less interested in handling cassette tapes, compact discs (CDs), and digital video discs (DVDs), and will opt for downloading or streaming wirelessly. As of 2007, approximately 70% of all new cars will include the capability to connect to iPods for example (Lee, 2007a). Meanwhile “infotainment systems” include a broad array of devices that enable drivers to perform many tasks unrelated to driving (making telephone calls, watching videos, managing e-mail, sending and reading instant messages, selecting and listening to music). Lee (2007a) states that not only are “infotainment” devices becoming increasingly available, their use in cars is also increasing.

**What could be the possible risks of MP3 players in traffic?** Theoretically a participant in traffic, using an MP3 player, could be at higher risk as his/her attention is distracted by:

- Manual handling of MP3 player
  - Biomechanical (physical) distraction
  - Visual distraction
  - Cognitive distraction (attention bias or disturbed attention)
- Listening to music/ MP3 player via headphone/earphone
  - Cognitive distraction (attention bias or disturbed attention)
  - Emotional influence on driving performance (mood effects)
  - Auditory distraction



# 1. Literature review

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Aim of the literature review is to present a scientifically based overview regarding possible risks of the use of MP3 players in traffic.

First the methodology identifying scientific studies is described, followed by a presentation of the results regarding risks connected to (1) the manual handling and (2) the listening to music. (3) Final conclusions and discussion will summarize and discuss the results of both previous parts. The last chapter (4) presents the final recommendation to the Belgium government.

## 1.1 Method

In order to identify existing and current scientific studies on MP3 players and traffic safety, two main sources of literature were used within this review:

1. Existing literature databases in the field of transport, medicine and science.
2. Recommended articles by experts within road safety institutes (IRTAD network).

To cover a wide range of scientific literature, the following databases for the systematic literature review were investigated:

- International Transport Research Documentation (ITRD)
- MEDLINE (via PubMed)
- Science direct
- Transportation Research Information Services (TRIS) (via TRISonline)

The reviews were carried out between the 7th of May and the 6th of June 2009. No limitations, such as publication data or availability of abstracts, were used within the first step of the search. Used keywords were:

- traffic\*
- safety\*
- music\*
- MP3\*
- iPod\*
- headphone\*
- earphone\*
- earplug\*
- headset\*

The search strategy was adapted to the provided search headings of the databases (e.g. Medical subject headings (MeSH) terms within MEDLINE) and the amount of findings (e.g. within the search in Science direct the term "music\*" could not be used as a search including this term led to 1,738 articles). Based on the title, abstracts were selected for further information regarding the in- or exclusion of a study in this report. The search strategy was kept very wide in order to gain information also on relevant general topics such as, listening to music and traffic safety. Inclusion criteria on the manual handling of MP3 players was restricted to the use of MP3 players only (MP3 players as defined in this report as: portable sound carriers), as the handling of e.g. mobile phones led to an extensive amount of other studies investigating manual operations such as SMS, calling, etc. Mobile phone studies which compare the manual handling of a mobile phone with the handling of an MP3 player with regard to traffic safety were included in this report. Main exclusion criteria were:

- Studies on the use of mobile phones only;
- Studies on another topic or target groups (e.g. studies on pilots);
- Studies on the development of digital devices only;
- Unavailability of abstract.

Based on the information of title and abstract, studies were selected for this report. The following table summarizes the search strategies and main results per database.

Table 1: Methodology of literature review.

Database	Search term	Date of review	Reviewed titles	Reviewed abstracts	Included abstract/full texts
ITRD	MP3	07.05.09	8	8	3
	MP-3	07.05.09	1	1	1
	Ipod	07.05.09	7	7	3
	Music AND distraction	07.05.09	7	7	7
MEDLINE	("Automobiles"[Mesh] OR "Accidents, Traffic"[Mesh]) AND "Music"[Mesh]	25.05.09	5	2	1
	(traffic* AND safety* AND (music* OR MP3* OR iPod* OR headphone* OR earphone* OR earplug* OR headset*))	25.05.09	7	4	2
Science direct	(traffic* AND safety* AND (MP3* OR iPod* OR headphone* OR earphone* OR earplug* OR headset*))	02.06.09	400	26	8
TRIS	(traffic* AND safety* AND (music* OR MP3* OR iPod* OR headphone* OR earphone* OR earplug* OR headset*)) OR (MP3*)	27.05.09	50	24	10
Input experts	See: Experts' survey (Part II of this report)	13.05 – 26.06.09	10	10	4
Analysis of secondary literature	See: methodology literature review			24	24*
Total			524	118	
TOTAL after exclusion of doubles					51

\* => among which 13 articles providing information on the manual handling of entertainment system in general.

Aiming to identify more recent or unpublished studies in the investigated databases, the experts of the IRTAD network were asked to provide literature on the topic (see also Part II of this report). 10 texts were suggested by the experts. 4 of these articles were included in this report. Main exclusion criteria were studies dealing with mobile phones use only.

In the end the selected records of the databases ITRD, MEDLINE, Science direct, TRIS and the recommended articles by the IRTAD experts were compared to each other in order to exclude doubles. The analysis of the secondary literature led to additional findings.

## 1.2 Results

After exclusion of doubles and the analysis of the secondary literature 51 articles (27 from databases and experts' survey; 24 from analysis of the secondary literature) were identified to provide information on the use of MP3 players and traffic safety. Only a little part of these studies deal explicitly with MP3 players as the search strategy was kept very wide in order to also gain information on relevant general topics such as listening to music and traffic safety. An overview of the identified references regarding their content input for this review is attached in the annex.

Studies presenting information on the effects of mobile phones only, were not included in this report. Some recent references can be given though for the interested reader. A recent meta-analysis of the effects of mobile phones on driver performance by Caird et al. (2008) summarizes the main results on this topic. The study included a total of 33 studies with a total sample size of approximately 2000 participants. For more information see Caird et al. (2008). Ishigami & Klein (in review) are just about to publish their recent study on the risks of hands-free phones compared with those of handheld phones and de Waard et al. (in review) are about to publish their review on

mobile phone use while cycling: incidence and effects on behaviour and safety.

Furthermore, this expert's provided the following references on mobile phones and traffic safety: Dressel & Atchley (2008), Walsh et al. (2008), Walsh et al. (2007), AAA Foundation (Editor) (2008) and Dragutinovic & Twisk (2005)

**Distraction is a potential safety problem** (e.g. Stutts et al., 2001; Wang et al., 1996; Glaze & Ellis, 2003; Stevens & Minton, 2001; Lee, 2007a; Eby & Kostniuk, 2003; Salvucci et al., 2007; Crisler et al., 2008; Chisholm et al., 2008).

Dibben & Williamson (2007) use the categorization system of the National Highway Traffic Safety Administration (NHTSA) as an example to operationalise the phenomenon "distraction". NHTSA differentiates distraction into the following four categories:

- Visual;
- Auditory;
- Biomechanical (physical);
- Cognitive distraction.

**Visual distraction** associated with the use of MP3 players occurs when the person focuses on the (e.g. in-vehicle) MP3 player and takes his/her visual attention away from the road.

**Auditory distraction** occurs when the presence of music, along with road noises e.g. in vehicles, can mask the sound of auditory warning signals, such as sirens and horns or mask the auditory feedback from the e.g. vehicle, such as engine noise, which is useful for self-monitoring driving performance.

Biomechanical (physical) distraction is caused by physical manipulation (manual handling) of e.g. in-car audio devices, as the person uses his/her hands for example to change the sound volume or select another song. Very often this type of distraction is directly linked to visual distraction.

**Cognitive distraction** consists of absorbing thoughts which take up the attention of the person on the road. This is a difficult to assess contributory factor in real driving incidents. Listening to the MP3 player, like other dual tasks (e.g. conversation with another passenger or via mobile phone), may add to the persons' attention load (Dibben & Williamson, 2007).

In general a study on multitasking by the Johns Hopkins University (Editor) (2005) showed that while participants were attending to the visual tasks, the auditory parts of their brain showed decreased activity, and vice versa. The authors concluded, that the brain does not seem to be able to give full attention simultaneously to both the auditory task of listening and the visual task of driving; one of these tasks suffers when both are being performed at the same time (Johns Hopkins University (Editor), 2005)

Theoretically the above mentioned categorisation system of NHTSA may help to operationalise different types of distraction. Real sources of distraction (like for example music) involve some or all of the above mentioned forms of distraction at the same time (Dibben & Williamson, 2007). According to Dibben & Williamson (2007) music listening influences driving performance in two ways: distraction and mood effects. The identified studies within this (MP3) review measure in most cases outcome-variables like distracted driving performance or unsafe crossing behaviour in case of pedestrians, without differentiating into the four types of distraction offered by the NHTSA. Although, three major topics appeared to be distinguishable: (1) Manual handling of an MP3 player; (2) Listening to music (MP3 player) via

headphones/earphones and (3) general information on auditory limitations and traffic safety.

Based on the finding of the literature review the authors decided to distinguish the presentation of the literature review results accordingly to these three topics. The four types of distraction (visual-, auditory-, biomechanical (physical)- and cognitive distraction) of the NHTSA as well as the emotional influence on the driving performance (mood effect) of music in general (Dibben & Williamson, 2007) will be taken into account.

1. Manual handling of an MP3 player;
  - a. Biomechanical (physical) distraction
  - b. Visual distraction
  - c. Cognitive distraction (attention bias or disturbed attention)
2. Listening to music/MP3 player via headphone/earphone;
  - o Cognitive distraction (attention bias or disturbed attention)
  - o Emotional influence on driving performance (mood effects)
3. Auditory limitations and traffic safety.

### 1.2.1 Manual handling of MP3 player and its effect on traffic safety

17 articles on the manual handling of entertainment systems (Dingus et al., 1989; Green, 2007; Klauer et al., 2006; Chisholm et al. 2008; Eby & Kostniuk, 2003; Stutts et al., 2001; Wang et al., 1996; Glaze & Ellis, 2003; Stevens & Minton, 2001; Sussman et al., 1985; Lee, 2007a; Horrey & Wickens, 2006; Lee & Strayer, 2004; McCartt et al., 2006; Caird et al., 2008; Regan, et al. in preparation; McKnight & McKnight, 1993) and 6 articles on the manual handling of MP3 players were identified within this review (NZAA, 2008; Belhoula, 2006; experimental studies: Salvucci et al., 2007; Crisler et al., 2008; Chisholm et al., 2008; Chisholm et al, 2007<sup>3</sup>).

#### 1.2.1.1 Adjusting entertainment system while driving

Most motor vehicles are equipped with entertainment systems such as radios, cassette players, CD or MP3 players. Operating these systems involves manual manipulation of buttons, knobs, and media, which is cognitively and visually absorbing, as it requires attention to be directed away from the roadway and to the interface. Furthermore, when an event occurs, attention must be disengaged from the MP3 player back to the roadway. Several studies argue, that prolonged glances away from the road pose increase crash risk (Dingus et al., 1989, Green, 2007, Klauer et al., 2006 IN: Chisholm et al. 2008; Eby & Kostniuk, 2003).

Thus, the manual handling (adjustment) of entertainment systems (e.g. MP3 player) is a potential for physical, cognitive, and visual distraction and distraction is a potential safety problem (Eby & Kostniuk, 2003).

Analyses by several researchers have shown that adjusting an entertainment system is one of the leading in-vehicle triggering events for distraction-related tow-away crashes (Stutts et al., 2001; Wang et al., 1996); distraction-related police-reported crashes (Glaze & Ellis, 2003), and distraction-related fatal crashes (Stevens & Minton, 2001).

Between 13% and 50% of all crashes are attributed to driver distraction or inattention (Stutts et al., 2001; Sussman et al., 1985; Wang et al., 1996 IN: Lee, 2007a). An analysis of fatal accidents in England and Wales over the period 1985 – 1995 showed that in-vehicle distraction is reported as a contributory factor in about 2% of fatal accidents (this figure might be a conservative estimate) (Stevens & Minton, 2001). The effect of mobile phone conversation on driver distraction is well documented (Horrey & Wickens, 2006; Lee & Strayer, 2004; McCartt et al., 2006 IN: Lee, 2007a; Caird et al., 2008). Less is known about emerging infotainment technologies. Many pose

3. This publication refers to the same study as Chisholm et al. (2008).

a threat to driving safety that is at least as great as mobile phones (Regan, et al. in preparation IN: Lee, 2007a). The analysis of fatal accident in England and Wales showed that distraction by entertainment devices such as radio, cassette player or CDs is one of the leading cause of in-vehicle distraction (Interaction with passengers (26 fatal cases), others (20), Car radio/cassette player (19), followed by mobile telephones (8) and old technology driver information devices (e.g. maps) (Stevens & Minton, 2001).

An experimental study by McKnight and McKnight (1993) used radio tuning as a baseline for comparing mobile phone activities and its effects on simulated driving performance. They observed similar decrements in driving performance caused by radio tuning and intense cellular phone conversation. The authors concluded that the two activities produce similar levels of driver distraction (McKnight and McKnight, 1993 IN: Eby & Kostniuk, 2003).

### 1.2.1.2 Manual handling of an MP3 player while driving

Compared to the manual handling of cassette or CD players, operating an MP3 player requires less manual actions, as more songs can be comprised on these devices, but the selection of this rising media content becomes more and more complex (NZAA, 2008; Belhoula, 2006).

The 2008 AA Insurance Drivers Index, which surveyed 2573 New Zealand drivers aged 18-75, reports that MP3 players are a very popular way to play music and that drivers report them as less distracting than CDs or radios. Only 8% of those surveyed stated that they have become distracted from driving by their MP3 player. However, 17.7% of drivers aged 18-24 report being distracted from driving by their MP3 player (NZAA, 2008). Belhoula (2006) states that at the moment approximately 5000 music MP3 coded titles can fit on an infotainment system which includes a 20 GB HDD, a DVD -player and a CD -changer. The volume of the media content increases rapidly. Technical concepts have been developed, which aim to assist the driver. Additional assistance features seem to be necessary in order to retain safety in the interaction with such entertainment systems and the corresponding huge content. Belhoula (2006) presents in his article an according concept which may help to solve these difficulties.

Several experimental (car) simulator studies (Salvucci et al., 2007; Crisler et al., 2008; Chisholm et al., 2008) showed negative effects of operating an MP3 player while driving on the driving performance.

An American (car) driving simulator study (Salvucci et al., 2007) assessed the effects of the manual handling of an iPod on the driving performance. The iPods in the study had audio and video functions. The test persons had to search for a specific song, a podcast fragment and a video fragment at a defined moment. The results show, that the selection of the correct media had a significant effect on the lateral position of the vehicle. According to the authors this effect was comparable to the effect of dialing a number on a mobile telephone while driving. Furthermore, an effect on the driving speed could be identified. The test person drove slower and this might (according to the authors) compensate the negative effect on the lateral position of the vehicle (Salvucci et al., 2007).

Crisler et al. (2008) analysed the effect of wireless telephone communications (text and voice) and using an iPod on lane keeping, speed, speed variability, lateral speed, and lane position variability using a driving simulator. In the study young adult licensed drivers had to drive along a very curvy simulated driving environment while using a mobile phone and an iPod (communicating using wireless devices, controlling an iPod, and participating in conversations and word games). The results show that lane keeping performance remained robust for voice communication tasks but significantly decremented for text messaging and iPod tasks which needed manual manipulation. All tasks

resulted in significant increases in speed variability. Lateral speed increases were observed for the iPod task as well as for all wireless communication tasks other than the mobile phone.

The Canadian (car) simulator study of Chisholm et al. (2008) assessed 19 young drivers who had to fulfil easy and difficult iPod tasks. While driving along a residential area, urban area and on a motor highway they encountered a number of critical events including a pedestrian entering the roadway, a vehicle pullout, and a lead vehicle braking. In all cases they had to brake and/or adjust the position of the vehicle. Drivers' hazard response, frequency of collisions and eye movement measures were examined to determine the effect of the iPod tasks on the driving performance. In comparison to the reaction on these events without any iPod tasks the test persons seemed to need more time for braking. Comparisons of the results of the baseline (no iPod task) with the easy and difficult iPod task showed increases in collisions (28; 34; 53) and in perception response time (PRT) (1.12s; 1.17s; 1.30s). The authors concluded that iPod interactions impaired drivers' ability to respond to hazards on the roadway and maintain safe vehicle control. The difficult iPod interaction led to decrements in PRT. Over the duration of the six experimental sessions, driving performance improved in all conditions. The difficult iPod tasks significantly increased the amount of visual attention directed into the vehicle above that of the baseline condition. With practice, the responses to driving hazards while interacting with the iPod tasks improved somewhat, but the relative difference compared to the baseline condition remained. The authors concluded that access to difficult iPod tasks while vehicles are in motion should be curtailed (Chisholm et al. 2008).

Regarding these findings it can be concluded that the manual handling of an MP3 player while driving in a car has a negative influence on the driving performance and thus, is a potential threat to traffic safety.

No studies on the manual handling of MP3 players by cyclists or pedestrians were found within this review. Further, among the studies on motor vehicle drivers no study focused on the tow-wheeled motor vehicles.

### 1.2.2 Listening to music/MP3 player and its effect on traffic safety

Eby & Kostniuk (2003) describe music as a complex stimulus that includes an intensity level, tempo, and style that collectively elicit a psychological response. It is for instance very difficult to operationalise different types of music. For example the tempo alone does not determine whether music may be experienced as stressful or not. A "four on the floor" bass drum pattern at 120 beats per minute for example in which every quarter note is punctuated with a bass drum beat as in techno music will create more stress than for example a "one drop reggae rhythm" (bass drum punctuation on third quarter note) on the same tempo. One's own character mainly determines the personal response towards certain music (Eby & Kostniuk, 2003).

According to Dibben & Williamson (2007) music listening influences driving performance in two ways: distraction and mood effects. In other words music is a complex stimulus which might affect driving performance via:

- Cognitive distraction (attention bias or disturbed attention)
- Emotional influence on driving performance (mood effects)
- Auditory distraction

The literature review identified 6 references addressing the prevalence of listening to music while travelling and driving (Dibben & Williamson, 2007; Stutts et al., 2001; Slobada et al., 2001; Eby & Kostniuk, 2003; Oron-Gilad et al., 2008; Vogel et al., 2008)

The majority of identified studies (18 references) dealt with the effects of listening to music while driving a car:

- Matthews et al. (1998), Hasegawa & Oguri (2006), Wiesenthal et al. (2000), Wiesenthal et al. (2003), Stidger (2003) and Oron-Gilad et al. (2008) assess positive effects of listening to music against stress, aggression and fatigue while driving.
- Vaca (2007); Children's Hospital of Philadelphia (2007) and Rhodes et al. (2005) analysed the risk perception of teenagers (among which listening to music).
- Music intensity and tempo and driving performance is analysed by Turner et al. (1996), Beh & Hirst (1999), Eby & Kostnjuk (2003), Consiglio et al. (2003) McKenzie (2004), Brodsky (2002) and Campbell & Stradling (2003)
- Music's emotional valence and driving performance is focused on in the study of Pêcher et al. (2009).
- A general study regarding the potential distraction of listening to the radio was carried out by Bruyas et al. (2006)

No study was identified which focused on two-wheeled motor vehicles.

Only three identified studies examine pedestrians' behaviour at crosswalks while being distracted (among others by listening to music) (Heller et al. 2008, Bungum et al., 2005; Nasar et al. 2008).

No studies on cyclists and distraction via listening to music were identified. Listening to music while travelling and in particular while driving a car is a very widespread phenomenon (Dibben & Williamson, 2007; Stutts et al, 2001; Slobada et al, 2001; Eby & Kostniuk, 2003). Dibben & Williamson (2007) concluded in their survey of 1,780 British drivers, that listening to music while driving is the preferred activity of the majority of drivers, particularly of those under 50 years of age. Respondents reported that music improves their concentration and relaxation and minimizes boredom (Dibben & Williamson, 2007). In the study of Oron-Gilad et al. (2008) all involved truck drivers (12) state that they listen to music while driving and that they think music has a positive effect on their driving. An American observation study showed that audio (in most cases radio) was playing in vehicles 72% of the times, with only 4 of the 70 participants not listening to audio at all (Stutts et al., 2001 In: Dibben & Williamson, 2007). Slobada et al. (2001) carried out a small-scale diary study, including all modes of transport rather than driving alone. They revealed 91% of the people listening to music while travelling compared to only 46% listening to music while at home. According to Slobada et al. (2001) driving alone in a motor vehicle is the most common circumstance to listen to music (Slobada et al. 2001 IN: Eby & Kostniuk, 2003). A recent study of Vogel et al. (2008) found out that almost all adolescents participating in their study have an MP3 player and often play their MP3 player at maximum volume.

#### 1.2.2.1 Studies on the effect of music on driving

According to Dibben & Williamson (2007) music, as source of in-vehicle distraction, can have both positive and negative effects on driving performance. The results of the identified studies in this review (MP3) support this statement. Furthermore, effects of certain types of music on driving performance remain unclear. More elaborate research with a broader range of subject and conditions seems necessary.

**Positive effects of listening to music against stress, aggression and fatigue while driving.** Matthews et al. (1998) and Hasegawa & Oguri (2006) showed that music can increase attention and might help in long traffic jams to reduce stress and aggression (Wiesenthal et al. 2000; Wiesenthal et al. 2003). The study of Stidger (2003) on "5 traffic safety hazards in your town" points out the example of a radio station playing calming music during rush hour and issued a CD of the most popular tunes as an effort to reduce

road rage. Oron-Gilad et al. (2008) investigated alertness maintaining tasks (AMTs) while driving. They assessed “listening to music while driving” and “driving only” as control to “driving with one of the three AMTs”. According to the authors “listening to music while driving” was more beneficial than they expected. Within this study music was a good method for maintaining alertness, or at least definitely better than driving without music. Music was also acknowledged and approved by all drivers, which might be because they just simply enjoyed driving with their favourite music.

**The research on teenagers’ perception of listening to music as potential risk for driving safety generates mixed results.** In a recent report of Vaca (2007) teenagers state in discussions about motor vehicle safety risks that distraction while driving is a serious problem for teen drivers; distraction included mobile telephones, playing music and risks caused by passengers (see also: Children’s Hospital of Philadelphia, 2007). On the other hand the study of Rhodes et al. (2005), which analysed all crashes reported by law enforcement officers in the state of Alabama during five years (1999-20003), showed that students (aged 16-20) do not see certain behaviour while driving, such as driving with multiple friends, listening to loud music, or eating while driving, as particularly risky.

**Music intensity and driving performance.** Turner et al. (1996) found out that listening to soft music (about 55-77 dBA) while driving improves reaction times to unexpected braking events and that high intensity music (80 dBA) did not lead to a similar effect. On the other hand Beh & Hirst (1999) showed that under high-demand driving conditions, both soft and loud (heavy metal) music decreased (shorter) reaction times to unexpected centrally-located events, but significantly increased (longer) reaction times to peripherally-located events (Beh & Hirst, 1999 IN: Eby & Kostnjuk, 2003). In their study, Consiglio et al. (2003) compared the effects of mobile telephone conversations and other potential interferences on braking responses. They found out that the reaction time for braking increased for all kinds of communication variables but not for listening to the radio.

**Music tempo and driving performance.** Studies dealing with the impact of tempo on cognition (Dalla Bella et al., 2001; Khalfa et al., 2008 IN: Pêcher et al. 2009) demonstrated that cognitive performance improves with a fast musical tempo in the background. Other studies have examined the impact of music tempo (and intensity) in more complex and dynamic situations, such as driving (Beh & Hirst, 1999; McKenzie, 2004; Brodsky, 2002; IN: Pêcher et al. 2009). Brodsky (2002) observed that the faster the tempo, the higher the impairment on driving performance. Participants driving on a simulated roadway were presented three different tempos (from 60-130 beats-per-minute: slow, moderate and fast tempo) while the music intensity was held constant. The study showed that the speed, speed estimation and the number of traffic violations (e.g. collisions, running red lights and straying onto another lane) increased with a fast music tempo. Eby & Kostniuk (2003) criticise on Brodsky’s study, that he only used music students in his first experiment and undergraduates in the second experiment. They think it might be premature to draw conclusions about driver distraction and music until further research is conducted with a broader range of subjects and conditions (Eby & Kostniuk, 2003). In their interview study Campbell & Stradling (2003) observed that especially young drivers (17-24 years) and men involved in accidents stated that they drive faster while listening to music.

**Music’s emotional valence and driving performance.** A recent study of Pêcher et al. (2009) assessed the effect of music’s emotional valence on the attention behaviour while driving. While driving in a simulator happy, sad and neutral music excerpts were alternated with no-music phases. Pêcher et

al. found that happy music distracted drivers the most. While listening to sad music the drivers drove slowly and kept their vehicle in its lane. Happy music was associated with an important decrease of mean speed whereas it slightly decreased for sad music. Furthermore, the lateral control deteriorated for happy music and improved for sad and neutral music. The driving situation in this simulator study was rather simple (driving on a straight 2x2 lane highway (except for some slight curves), without traffic and road signs). A more complex situation, as in slow traffic conditions on an urban road for instance, might lead to different results (Pêcher et al. 2009).

The study of Bruyas et al. (2006) on the impact of vocal communication on the driving concluded that listening to the radio, which is non-personalized and non-interactive, does not interfere with the driving task. The level of the deterioration depends on the type of conversation, in particular how interactive it is for the driver and its complexity (Bruyas et al., 2006).

A broader range of subject and conditions might be necessary to generalize conclusions. Further investigation is needed to determine the relationship between music (intensity, tempo and emotional valence) and driving distraction (Eby & Kostniuk, 2003; Pêcher et al., 2009).

No studies focusing on tow-wheeled motor vehicles were identified in this review.

#### 1.2.2.2 Studies on the effect of music on cyclists and pedestrians

Only three identified studies examined pedestrians' behaviour at crosswalks while being distracted (among others by listening to music) (Heller et al. 2008, Bungum et al., 2005). Hatfield & Murphy (2006) carried out a study on the effects of mobile phone use on pedestrian crossing behaviour at signalised and un-signalised intersections.

Heller et al. (2008) state that several recent studies have suggested that engaging in an auditory distractive activity can cause pedestrians to miss salient objects in their environment. Their study describes safety efforts that are focused on helping to make pedestrians more aware of their surroundings (e.g. new technologies which warn drivers about likely violations of traffic control devices or the existence of pedestrians within an intersection).

Bungum et al. (2005) observed the behaviour of 866 pedestrians. "Distracted pedestrians" were defined as those wearing headphones, talking on a mobile phone, eating, drinking, smoking or talking as they crossed the street. The study showed that only 13.5% of pedestrians looked left and right and entered the crosswalk while the white light was flashing (which is the definition of "cautious crossing" in the study). Approximately 20% of pedestrians were distracted as they crossed the street. Regression analysis indicated that distraction was negatively, but weakly, associated with displaying cautious pedestrian behaviours (Bungum et al., 2005).

The study of Nasar et al. (2008), which also observed pedestrian crossing behaviour, compared mobile phones users, iPod users and those pedestrians using neither one of these devices. They concluded that mobile phone users crossed unsafely into oncoming traffic significantly more than did either of the other groups and that the "neither group" exhibited the safest behaviour (Nasar et al. 2008). Thus, pedestrians using an MP3 players seem to show more risky crossing behaviour than those without (MP3 and mobile phone), but pedestrians using a mobile telephone show significantly higher risk behaviour than the two other groups.

No study on cyclists and distraction through listening to music was identified.

### 1.2.3 Auditory limitations and traffic safety

This literature review identified three studies which provide general information on auditory limitations and traffic safety (Vogel et al., 2008; Nelson & Nilsson, 1990; Vaa et al. 2001).

Again this literature review did not identify any references providing information on auditory limitations of pedestrians and cyclists. The authors assume that this is due to the search strategy of this report focussing in particular on MP3 players and the effect of music on road safety.

Loud music or in extreme cases the use of special headphones which completely eliminate environmental noise, lead to auditory limitations while performing in traffic. A recent study of Vogel et al. (2008) explored adolescents' behaviour and opinions about exposure to loud music from MP3 players. The authors carried out a qualitative analysis of focus-group discussions with teenagers aged 12 to 18 years of two large secondary schools (rural and urban). Almost all adolescences in the study have an MP3 player and (especially male students and students from pre-vocational schools) often play their MP3 player at maximum volume. In general they appeared to be aware of the risks of exposure to loud music, but they expressed low personal vulnerability to music induced hearing loss.

Nelson & Nilsson (1990) compared headphones and speaker effects on simulated driving. The authors compared two sessions of twelve persons driving three hours in a car simulator while listening to sound level 63dB over (1) stereo headphones and (2) from a dashboard speaker. The results show that for the most complex task presented (shifting gears) the headphone-wearing driver's average reaction time was about one third second longer than with the speaker.

A meta-analysis of Vaa et al. (2001) which examined deafness, hearing loss and the use of hearing aids, showed that these people's relative risk (RR) of accident involvement is slightly increased.

At date, the Belgian law does not mention auditory limitations as medical criteria for the fitness to drive. This means that drivers with auditory limitations (such as complete or partial deafness, hearing loss or hearing aids) are fit to drive and that (in principle) no limitation, restriction or adaptation is mandatory, unless the treating or deciding physician decides otherwise (Royal Decree 23 March 1998 on the Driving Licence, Annex 6). In practice very few cases are known in which a physician decided to limit or restrict the use of the DL or indicated that the use of a hearing aid was mandatory (Tant, 2009). Further, the 3rd EU DL directive, Annex III does not mention hearing loss either as a contra-indication of fitness to drive. There is only the warning that in case of group 2 driving, the competent medical authority should pay attention to the scope of compensation.

If there is a clear link between the use of headphones or earphones and an impairment to drive, the "umbrella" law<sup>4</sup> (mentioned in part II of this report; Experts survey - Belgium legislation) could be used to sanction the driver. However, the final judgement at a police court would be highly dependent on the exact description of the situation by a police officer and the appreciation of a judge (Akkermans, 2009).

The authors of this report have not found any specific literature on pedestrians and cyclists and auditory limitations through the use of MP3 players.

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4. "umbrella" law = a general regulation that is used to cover or replace several possible more detailed regulations in order to avoid making regular changes or additions to the detailed regulations.



## 2 Experts' survey

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As the first rough screening of the literature showed that probably not many scientific studies regarding MP3 and traffic exist, the authors decided to investigate the topic besides the systematic literature review in existing databases also by means of an experts' survey.

Primary aim of this survey was to identify existing studies on MP3 players and traffic safety (see also Part I. of this report). Secondary aim was to collect information on the according legal situation in other countries. Thus, the authors decided to address this survey to traffic safety experts (IRTAD) and not to legal experts on road safety (a forum for legal experts on road safety could have been for example the Driving Licence Committee (European Union, 2009)).

IRTAD is an international database that gathers data on traffic and road accidents from 27 out of the 30 Organisation for economic co-operation and development (OECD) Member countries. At the moment, more than 50 institutes worldwide, representing an extensive range of public and private organisations with a direct interest in road safety, are members of the IRTAD Group (IRTAD, 2009b; see also: List of IRTAD members in the annex). The following countries are participating in the IRTAD network:

Australia, Austria, Belgium, Canada, Czech Republic, Denmark, Finland, France, Germany, Hungary, Iceland, Ireland, Israel, Japan, Jordan, Korea, Malaysia, Netherlands, New Zealand, Norway, Poland, Slovenia, Spain, Sweden, Switzerland, United Kingdom and United States.

Furthermore, the following international organisation are IRTAD members: European Commission (DG TREN), European Automobile Manufacturers Association (ACEA), FIA Foundation, The Motorcycle Industry in Europe (ACEM) and the World Bank (for more information see: IRTAD, 2009 and OECD, 2009).

The following chapters describe the methodology of the experts' survey and summarize the main results on country level. The identified literature on MP3 players and traffic safety were taken into account in Part I of this report (see: Chapter 1.1 (method) and 1.2 (results)). The results regarding the legal situation on MP3 players and traffic safety are presented in chapter 2.2

## 2.1 Method

Based on the first rough screening of the literature regarding MP3 players and traffic safety the authors developed a short questionnaire, focussing on the following issues:

1. Identification of scientific studies on MP3 players and traffic safety;
2. Information on the legal situation regarding MP3 players and traffic safety.

The idea was to identify existing literature on the topic by asking the experts first about the legal situation on MP3 players and traffic safety in their country and then, in a second step to ask them about the base of this legal regulation. In a third step, the experts were asked to provide any information on scientific studies on the topic which they know (see letter to the experts in the annex). The following questions were used:

*1. Are there any national or regional legal regulations (road traffic act) on using portable sound carriers used via headphone/earphone (e.g. MP3 players) in your country?*

Yes  No

Please, name country/region: \_\_\_\_\_

If yes,

- Do the regulations concern (Multiple answers are possible):
  - the manual handling of portable sound carriers
  - the use of headphone/earphone
  - others, please specify: \_\_\_\_\_
- Do the regulations concern (Multiple answers are possible):
  - pedestrians
  - cyclists
  - motor vehicle drivers
- Could you please give a short (English) description of the legal regulation?
- Could you please provide us with the reference of the legal regulation?
- Is the legal regulation based on:
  - scientific study
  - expert advice
  - other, please specify: \_\_\_\_\_
  - o Could you please provide us with the respective references (or the original documents)?

2. Do you know any (other) scientific study (published or unpublished) on this topic?

Yes  No

If yes,

- Could you please provide us with the respective references (or the original documents, if possible)?

The questionnaire together with a short introduction on the purpose of the study was sent to the forum of experts on the 13th of May 2009 (see letter to the experts in the annex). The IRTAD network allowed contact with 50 institutions worldwide (27 countries), representing an extensive range of public and private organisations with a direct interest in road safety (IRTAD, 2009b; see also list of IRTAD members in the annex).

The experts were asked to provide their input until the 27th of May 2009. After comparing the obtained information with the results of the literature review, selected experts were asked to confirm the additional literature results regarding legal regulations on the use of MP3 players in traffic of their country.

Obtained information until the 26th of June 2009 was included in this report. Input from the literature review which was not confirmed by the according national expert was included and indicated as such, in this report.

## 2.2 Results

Information on 14 out of 28 countries, participating in the IRTAD network, was gathered in this report.

IRTAD experts provided information on 11 countries: Australia (AUS), Belgium (BE), Germany (DE), Denmark (DK), France (FR), Iceland (IS), the Netherlands (NL), Norway (NO), Spain (ES), Sweden (SE) and United Kingdom (UK). Additionally, the literature review (Part I of this report) provided information on the following four countries: Israel (IL) and the United States of America

(USA). This information is based on an overview article gathering among others legal regulations concerning the use of mobile phones among which regulations which might be relevant for the use of portable sound carriers via headphone/earphone (NHTSA, 1997). This report is rather old but no recent update of such an overview report was identified.

The experts provided 10 references on scientific studies. 4 of these articles were included in this report. Main exclusion criteria were studies dealing with mobile phones use only. The information of the reported scientific studies was taken into account in Part I of this report (see chapter 1.1 (method) and 1.2 (results)).

The reported information on the legal situation regarding MP3 players and traffic safety can be summarized as follows:

- Most countries (9 countries) have some kind of general regulation which may also cover the use of portable sound carriers via headphone/earphone (BE, CH, DE, ES, FR, IL, SE, UK and USA)
  - BE, Fr, SE and UK have very general regulations stipulating general conditions for drivers to control the vehicle.
  - CH, DE, ES, IL and USA have more specific regulations mentioning the manual handling of electronic devices (all 5 countries) or the use of headphones/earphones (all except IL).
  - The IRTAD expert of DE furthermore reported specific legal regulations concerning the volume of sound.

Table 2:  
Main results on national regulations  
(experts' survey).

Country	Legal regulations on portable sound carriers via headphone/earphone		
	Yes, general regulation	No	Manual handling
AUS		No*	
BE	Yes		x
CH	Yes		x
DE	Yes		x
DK		No*	
ES	Yes		x
FR	Yes		x
IL	Yes		x
IS		No*	
NL		No*	
NO		No*	
SE	Yes		
UK	Yes		
US Pennsylvania	Yes		
US Washington	Yes		

No\* = general regulations which might also concern the use of portable sound carriers via headphone/earphone were asked for.

- o The only ban which was identified within the literature review was one on the use of headphones/earphones while driving a motor vehicle in the USA (US states Pennsylvania and Washington).
- All reported general regulations concern motor vehicle drivers. The situation for cyclists is legally regulated in 6 countries (BE, CH, DE, ES, UK and USA). In FR the coverage of the national regulation for cyclists remains unclear.
- Only CH reported general regulations concerning pedestrians and the use of portable sound carriers via headphone/earphone.
- Experts from 5 countries (AUS, DK, IS, NL and NO) stated that they do not have any regulations concerning the use of portable sound carriers via headphone/earphone.

It has to be mentioned though that the report of general regulations which might also have relevance for the use of portable sound carriers via headphone/earphone for all target groups (pedestrians, cyclists, motor vehicle drivers) might be underrepresented, as the experts' survey asked for specific regulations on the topic.

Table 2 summarizes the main results of the experts' survey on country level. The following chapters describe the reported legal regulation on MP3 players and traffic safety by country.

Source of distraction		Targeted group addressed in regulation		
Use of headphone/earphone	Other	Pedestrians	Cyclists	Motor vehicle drivers
?	Stipulating general conditions for driver to control vehicle		x	x
x		x	x	x
x	Sound volume		x	x
x			x	x
x	Stipulating general conditions for driver to control vehicle		?	x
				x
	Stipulating general conditions for driver to control vehicle			x
	Stipulating general conditions for driver to control vehicle		x	x
x			x	x
x				x

headphone/earphone might be underrepresented, as specific regulations on the use of portable sound carriers via headphone/

### 2.2.1 Belgium (BE)

In the Belgian traffic legislation, no specific articles can be found that prohibit the manual handling of portable sound carriers or the use of headphone/earphone. A general article ("umbrella law") exists that stipulates general conditions for a driver to control his/her vehicle.

The regulation concerns cyclists and motor vehicle drivers.

Article 8.3 of the Belgian traffic law (Koninklijk besluit van 1 december 1975 houdende algemeen reglement op de politie van het wegverkeer en van het gebruik van de openbare weg; B.S. 09.12.1975 – Royal decree of December 1st, 1975, concerning the general rules related to the policing of road traffic and the use of the public road; published on 09.12.1975) states the following:

"Any driver must be capable to drive, be in a proper physical condition and have sufficient knowledge and driver skills. He must, at all times, be capable of performing all the necessary driving actions and, at all times, have the vehicle he drives, or the animals he guides, under control."

In practice, this article provides a general "umbrella" for cases where the police, prosecutor or court determines that something impeded the driver of a vehicle to properly drive a car. Holding objects in your hands that impede a driver from driving in a proper way, such as hand-holding a portable sound carrier, could therefore be punishable. Although this could in theory also be the case for the use of earphones, the Belgian expert is not aware of any court decisions on this subject.

### 2.2.2 Switzerland (CH)

In Switzerland a general regulations exist which concerns the manual handling of portable sound carriers and the use of headphones/earphones.

This regulation concerns all participants in traffic (pedestrians, cyclists and motor vehicle drivers).

**Drivers of motor vehicles and bicycles.** Article 31, part 1 of the SVG (Strassenverkehrsgesetz) and Article 3, part 1 VRV (Verkehrsregelverordnung) state that the driver must concentrate on the road and the traffic while driving. He or she may not carry out activities while driving which negatively impact the operation of the vehicle. Additionally, the driver must take care not to reduce his or her attention to driving by auditory devices ("Tonwiedergabegeräte"; e.g. radio, CD player, MP3 player), communication- or information systems (see also: Admin CH, 2009ab; NHTSA, 1997). This regulation concerns any kind of drivers, cyclists as well as motor vehicle drivers.

In other words, listening to music while driving (including cycling), is allowed as long as the attention of the driver is not impaired. Judgement of the attention impairment has to be done based on the specific circumstances of the individual case. Cases of attention impairment (e.g. auditory impairment) can be fined.

**Pedestrians.** The articles mentioned above do not concern pedestrians. Pedestrians are covered by the general regulation of Article 26, part 1 SVG which states that:

Everybody participating in traffic has to behave in a way, that he or she does not interfere or endangers the proper participation in traffic of others (see also: Admin CH, 2009c).

An interference or endangerment of other participants in traffic might, under certain circumstances also be caused by the use of an MP3 player as part of auditory impairment of the participant.

### 2.2.3 Germany (DE)

In Germany general regulations concerning the manual handling of portable sound carriers, the use of headphones/earphones and the sound volume do exist.

The regulation concerns cyclists and motor vehicle drivers.

§23 of the Road Traffic Regulations ("Straßenverkehrsordnung" StVO) state that it is the vehicle driver's responsibility that visibility (range of vision) and hearing are not impaired by equipment.

This general regulation involves the use of MP3 players. That is to say the use of an MP3 player is allowed if it does not affect the driver's visibility (range of vision) and hearing.

### 2.2.4 Spain (ES)

In Spain general regulations concerning the manual handling of portable sound carriers and the use of headphones/earphones exist.

These regulations concern cyclists and motor vehicle drivers.

The legal regulation regarding the prohibition of using headphones or mobile phones correspond to the Royal Legislative Decree 339/1990, of the 2nd of March, that passes the Articled Text of Law on Traffic, traffic of motor vehicles and road safety. More concretely, the sections (e) and (f) of the article 65 of Title V specify that what follows is considered as being a serious offence:

- e. Driving and using devices incompatible with the compulsory permanent attention to driving in the terms that are fixed in the regulation.
- f. Driving using headphones or earphones connected with receivers or sound carriers, driving while using mobile phone devices, as well as any other communication system that implies a manual handling, in the terms that are fixed in the regulation, with the exceptions for specific reasons linked with safety, hygiene or work prevention.

With regard to the bicycles, as a general rule, persons that drive a bicycle or hold it have to comply with the General Rules of Traffic (R.D. 1428/2003). Consequently, the previously mentioned law also applies to them.

The sanctions for this type of offence are:

- Fine from 91 to 300 EUR.
- The suspension of the driving licence for a period of minimum one month up to three months could be applied. (not applicable to cyclists).
- Since the penalty point system came into force on the 1st of July 2006, three points can be withdrawn. (not applicable to cyclists).

For this reason in 2007 as well as last year, the national Ministry of Transport (Dirección General de Tráfico (DGT) has carried out information and control campaigns in order to avoid traffic accidents related to the lack of attention or distraction.

### 2.2.5 France (FR)

France has general regulations ("umbrella law") stipulating general conditions for a driver to control his/her vehicle.

These regulations concern motor vehicle drivers. It remained unclear if this regulation also concerns cyclists.

The French ITRAD expert provided the following information:

"The French traffic law does not mention any specific law on portable sound carriers. With regard to vigilance and attention of the driver, the law states that:

- All drivers have to remain in a constant state and position of executing the manoeuvres that are imposed in a suitable way and without delay. His or her movement possibilities and visual field may not be reduced due to the number or position of passengers, transported objects, or due to non transparent objects on the windows
- The use of a hand held mobile phone is forbidden (but hands-free kit is tolerated).
- The placement of an apparatus which is equipped by a monitor and not providing aid in driving or navigation, in the visual field of a driver while driving the vehicle, is forbidden" (Sibi, 2009).

### 2.2.6 Israel (IL)

The following information on Israel is based on the findings of the literature only.

Israel has a general regulation concerning motor vehicle drivers and the manual handling of portable sound carriers.

The Israeli Transportation Regulations (5721-1961/1970) Regulation 28, Section 1 28A states that:

"Anyone who drives a motor vehicle must hold two hands on the wheel or handlebars as long as that vehicle is in motion. He or she may remove one hand if he or she needs to do anything to guarantee the proper operation of the vehicle corresponding to the rules of transportation" (NHTSA, 1997).

### 2.2.7 Sweden (SE)

The Swedish traffic law does not mention any specific law on portable sound carriers. Sweden has a general regulation ("umbrella law") stipulating general conditions for a driver to control his/her vehicle.

This regulation concerns motor vehicle drivers.

The Swedish Decree on Road Traffic ("Svensk Författningssamling" 1972: 603, as amended) states that:

"Motor vehicle drivers must take the necessary caution, care and prudence while on the road to avoid traffic accidents" (NHTSA, 1997).

### 2.2.8 United Kingdom (UK)

United Kingdom has a general regulation ("umbrella law") stipulating general conditions for a driver to control his/her vehicle.

These regulations concern cyclists and motor vehicle drivers.

The UK Highway Code – Rule 148 states that:

"Cyclists, motorcyclist and drivers should avoid anything that would distract them from the requirement to ride/drive safely and this can include listening to an MP3 player" (UK Government, 2009).

In terms of regulations, the requirement to avoid distractions is set out in national regulations, which are The Road Vehicles (Construction & Use) Regulations 1986 – Statutory Instruments 1986 No. 1078, which say:

"Regulation 104 Drivers Control: No person shall drive or cause or permit any other person to drive, a motor vehicle on a road if he is in such a position that he cannot have proper control of the vehicle or have full view of the road and traffic ahead".

### 2.2.9 United States of America (USA)

The following information on two states of the United States of America is based on the findings of the literature only.

#### **Pennsylvania**

"The General Assembly of the Commonwealth of Pennsylvania hereby enacts as follows: Section 1. Section 3314 of Title 75 of the Pennsylvania Consolidated Statutes is amended to read:

Section 3314. Prohibiting Use of Hearing Impairment Devices.

(a) General rule. - No driver shall operate a vehicle while wearing or using one or more headphones, earphones or any similar device which the department by regulation determines would impair the ability of the driver to hear traffic sounds.

(b) Exception. - This section does not prohibit the use of:

(1) hearing aids or other devices for improving the hearing of the driver nor does it prohibit the use of :

(2) a headset in conjunction with a cellular telephone that only provides sound through one ear and allows surrounding sounds to be heard with the other ear; or

(3) communication equipment by the driver of a fire vehicle or by motorcycle operators complying with section 3525 (relating to protective equipment for motorcycle riders).

Section 2. This act shall take effect in 60 days" (NHTSA, 1997).

#### **Washington**

Washington has legal regulations concerning the use of headphones/earphones.

These regulations concern any motor vehicle driver on a public highway.

"Annotated revised code of Washington title 46. Motor vehicles chapter 46.37. Vehicle lighting and other equipment Rev. Code Wash. (ARCW) § 46.37.480 (1996) §46.37.480. Television viewers – Earphones states that:

(1) No person shall drive any motor vehicle equipped with any television viewer, screen, or other means of visually receiving a television broadcast which is located in the motor vehicle at any point forward of the back of the driver's seat, or which is visible to the driver while operating the motor vehicle. This subsection does not apply to law enforcement vehicles communicating with mobile computer networks.

(2) No person shall operate any motor vehicle on a public highway while wearing any headset or earphones connected to any electronic device capable of receiving a radio broadcast or playing a sound recording for the purpose of transmitting a sound to the human auditory senses and which headset or earphones muffle or exclude other sounds. This subsection does not apply to students and instructors participating in a Washington State Motorcycle Safety Program.

(3) This section does not apply to authorized emergency vehicles, motorcyclists wearing a helmet with built-in headsets or earphones as approved by the Washington State Patrol, or motorists using hands-free, wireless communications systems, as approved by the equipment section of the Washington State Patrol" (NHTSA, 1997).



## 3 Final conclusions and discussion

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Aim of this report is to conclude a scientific advice for the Belgian Government regarding the use of "MP3 players (portable sound carrier used via headphone/earphone) and traffic safety (pedestrians, cyclists and motor vehicle drivers)". The advice should focus on: (1) risk assessment of the use of MP3 players in traffic; (2) legal regulations around the use of MP3 players in traffic.

### 3.1 Literature review

The analysis of the scientific literature on MP3 players and traffic safety can be summarized as follows. Listening to music while travelling and in particular while driving a car is a very widespread phenomenon (Dibeen & Williamson, 2007; Stutts et al, 2003; Slobada et al, 2001; Eby & Kostniuk, 2003). The effects of MP3 players on traffic safety is a very diverse/heterogeneous/varied phenomenon, covering the (1) manual handling, (2) listening to music and (3) auditory limitations which all in themselves again contain several forms of distraction (e.g. visual-; auditory-; biomechanical (physical)- and cognitive distraction).

**Manual handling of an MP3 player and traffic safety.** Analyses of **crash data** have shown that adjustment of entertainment systems (in general) is one of the leading causes of in-vehicle distraction, at least as much as mobile phone manipulation, but less than distraction by passengers (Stutts et al., 2001; Wang et al., 1996; Glaze & Ellis, 2003; Stevens & Minton, 2001; Lee, 2007). The selection of the rising media content (fast technical development) becomes increasingly complex. According supporting systems are being developed and evaluated in the last years (Belhoula, 2006).

Experimental studies on (car) simulators have shown that the manual handling of an MP3 player has a negative impact on driving performance and thus, is a potential threat to traffic safety (Salvucci et al., 2007; Crisler et al., 2008; Chisholm et al., 2008). These measured impacts on the driving performance are probably conservative estimates, as MP3 players in real life are most of the time not fixed to the driver's dashboard like in the simulator but lay on the passenger seat or in the lap of the driver. Especially difficult adjustment tasks should be avoided while driving a vehicle.

No studies on the manual handling of MP3 players in cyclists or pedestrians were identified by the search strategy of this review.

**Listening to music and traffic safety.** Several studies have shown that listening to music while travelling or driving is a very widespread phenomenon (Dibeen & Williamson, 2007; Stutts et al, 2003; Slobada et al, 2001; Eby & Kostniuk, 2003).

Music is a very complex stimulus that includes an intensity level, tempo, and style that collectively elicit a psychological response (Eby & Kostniuk, 2003). Listening to music influences driving performance in two ways: distraction (in-vehicle distraction) and mood effects; and can have both, positive and negative impact on the driving performance (Dibben & Williamson, 2007).

Several studies have shown that listening to music while driving can improve attention and help to reduce stress and aggression (e.g. in traffic jams) (Matthews et al., 1998; Hasegawa & Oguri, 2006; Wiesenthal et al., 2000; Wiesenthal et al. 2003; Stidger, 2003). A study of Oran-Gilad et al. (2008) among truck drivers found that music was a good method for maintaining alertness, or at least definitely better than driving without.

Studies on teenagers' perception of listening to music as potential risk for driving safety generate mixed results. Vaca (2007) and Children's Hospital of Philadelphia, (2007) found that teenagers experience distracted driving (among which "playing music") as a risk. Rhodes et al. (2005) who analysed

crash data observed that students (aged 16-20) do not perceive listening to loud music as particularly risky.

Studies focussing on the influence of music's intensity level, tempo, and style on driving performance generate heterogeneous results. Turner et al. (1996) found that soft music had a positive effect on the reaction time. On the other hand Beh & Hirst (1999) showed that under high-demand driving conditions, both soft and loud (heavy metal) music decreased (shorter) reaction times to unexpected centrally-located events, but significantly increased (longer) reaction times to peripherally-located events (Beh & Hirst, 1999 in Eby & Kostnjuk, 2003). Consiglio et al. (2003) found in their study on the effects of communication on braking response that the reaction time for braking increased for all kinds of communication (e.g. handheld-, hand free mobile phones, passenger) variables but not for listening to the radio. Brodsky (2002) concluded in his study that the higher the tempo of music, the higher the impairment of driving performance. Especially young drivers (17-24 years) and men involved in accidents stated that they drive faster while listening to music (Campbell & Stradling, 2003). Pêcher et al. (2009) found that happy music seems to distract drivers more than sad or neutral music. A more general study of Buyas et al. (2006) on the impact of vocal communication on the driving concluded that listening to the radio, which is non-personalized and non-interactive, does not interfere with the driving task. The level of the deterioration depends on the type of conversation, in particular how interactive it is for the driver and its complexity (Bruyas et al., 2006).

Three studies have shown a negative impact of listening to music on pedestrians' crossing behaviour (Heller et al., 2008, Bungum et al., 2005; Nasar et al., 2008). No studies on the effects of listening to music in cyclists were identified by the search strategy of this review.

More studies, including a broader range of subjects and conditions might be necessary to generalize the conclusions regarding the effects of listening to music on traffic safety.

**Auditory limitations.** To date, the Belgian law does not mention auditory limitations (such as complete or partial deafness, hearing loss or hearing aids) as medical criteria for the fitness to drive. Further, the 3rd EU DL directive, Annex III, does not mention hearing loss either as a contra-indication for fitness to drive. There is only the warning that in case of group 2 driving, the competent medical authority should pay attention to the scope of compensation. However, although hearing impairment is not mentioned as contra-indication for fitness to drive, a study comparing the relative risks (RR) of the medical criteria showed that "hearing" resulted in a slightly increased RR.

### 3.2 Experts' survey

This report gathered information on the legal situation regarding portable sound carriers via headphone/earphone of 14 countries (national traffic acts). The information provided by IRTAD experts and literature review showed that the use of MP3 players in traffic is allowed in all countries as long as it does not interfere or endanger one's own or others' proper participation in traffic (BE, CH, DE, ES, FR, IL, SE, UK and USA). Certain countries (CH, DE, ES and IL) pointed out the potential risk of the manual handling of electronic devices and/or the use of headphones/earphones which is allowed as long as it does not impair the attention of the driver (CH, DE, ES and IL). The only ban which was identified within the literature review was one on the use of headphones/earphones while driving a motor vehicle in the USA (US states Pennsylvania and Washington). All reported general regulations (10) cover the target group "motor vehicle drivers" and in most cases also cyclists (6). The

Swiss expert was the only one who mentioned a (very) general regulation on “proper participation in traffic” which is also covering pedestrians and as such the use of MP3 players via headphones/earphones.

It has to be mentioned though that, the prevalence of general regulations in this review is rather a conservative estimate, as the ITRAD experts were explicitly asked for regulations on MP3 players and traffic safety and might just simply not have thought about mentioning (very) general regulations. Furthermore, the additional information from the literature review is based on an American publication from 1997 (NHTSA, 1997). No recent update of such an overview article was identified within the search strategy nor did the US expert from IRTAD provide any update or additional information. The search strategy on national regulations should be expanded to derive a more complete, broader and specific overview on general and specific regulations concerning the use of MP3 players in traffic. It may also be a good idea to recheck the obtained information with experts of the European Driving Licence Committee, as this is a network of national experts specialised in legal issues concerning fitness to drive.

### 3.3 Legal regulations in Belgium

Belgium has two (very) general regulations which might be of relevance for the discussion around MP3 and traffic safety.

Article 7.2 of the Belgian traffic law states that “all users of public roads have to behave in a way, that he/she does not interfere nor endangers other road users”.

This article covers all target groups (pedestrians, cyclists, motor vehicle drivers and others). An interference or endangerment of other participants in traffic might, under certain circumstances, also be caused by the use of an MP3 player.

Furthermore, Article 8.3 of the Belgian traffic law stipulates general conditions for a driver to control his/her vehicle: “Any driver must be capable to drive, be in a proper physical condition and have sufficient knowledge and driver skills. He/she must, at all times, be capable of performing all the necessary driving actions and, at all times, have the vehicle he/she drives or the animals he/she guides under control”.

In practice, these articles can provide a general “umbrella” for cases where the police, prosecutor or court judge the driver of a vehicle to have done something that impedes him from properly driving a car (Article 8.3) or in the case of road users to have behaved in a way which interfered or endangered others (Article 7.2). Thus, the use of MP3 players in traffic could (in theory) under certain circumstances be punishable. Judging the impairment of a driver or the inadequate behaviour of the road user would have to be done based on investigation of the specific individual circumstances.

If BE would opt for a more specific regulation on MP3 players in traffic, this should be formulated in an “open” manner (e.g. “No impairment through the use of infotainment systems”). Such an “open” formulation could serve as an “umbrella” for any kind of impairment caused by MP3 players (e.g. manual handling, music, volume, etc. ) or any other infotainment system (e.g. mobile phones, smart phones, navigation systems, etc.). The fast technical development in this sector requires “open” formulations in corresponding legal regulations.

(Legal regulations on auditory limitations have been described already before)

### 3.4 Future research

All in all very little studies on pedestrians and cyclists have been identified by the search strategy of this report. Other databases (e.g. websites of "cyclists' safety boards") should be investigated in a more in-depth analysis on the effects of MP3 players on the safety of pedestrians and cyclists. Further, the search strategy on national legal regulations could be expanded to derive more complete, broader and specific information on legal regulations relevant for the use of MP3 players in traffic. Last but not least more elaborate research is needed which corresponds to the complexity of the topic (covering: manual handling, listening to music, auditory limitations and visual-, auditory-, biomechanical (physical)-, cognitive distraction, etc.), in order to assess the effect of MP3 players on traffic safety.



# 4 Recommendation to the Belgian Government

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The following recommendation has been sent to the Belgian government on the 1st of July 2009:

#### 4.1 English Version

##### **Recommendation “MP3 player in traffic”**

This recommendation is based on an internal BIVV/IBSR-report: MP3 players and traffic safety: State of the Art (Meesmann, Boets and Tant).

**Purpose.** The IBSR/BIVV was asked to prepare a recommendation regarding the possibilities of a ban, and/or the development of specific regulations, on the use of MP3 players in traffic

**Method.** The IBSR/BIVV investigated the topic via two channels: (1) a systematic literature review in scientific databases (ITRD, MEDLINE, Science direct, and TRIS) and (2) an experts' survey among the International Traffic Safety Data and Analysis Group (IRTAD).

**Results and Conclusions.** The literature review let us to the conclusion that it is far from evident to prohibit the use of all sound carriers in traffic. There are indications that using sound carriers (e.g. MP3 players) has an undeniable negative effect on the safety of road users. These effects differ though depending on the situation, the person, the type of road user and sometimes also on the type of sound carrier and the characteristics of the music (volume, genre, etc.). Furthermore, the interpretation (and therefore also the practical translation into legal texts) of the scientific literature is hampered by so-called “interaction effects” (e.g. a specific element may disturb one person but not necessarily another person).

However, the effects (especially of music itself) are not always negative: researchers noticed in certain situations better driving performances (e.g. traffic jams) and found induced emotional moods, that are even supportive to the traffic participation.

The complexity of the effects of sound carriers on traffic safety can theoretically be explained by pointing, on the one hand, at the variable effects related to the use of a sound carrier, and on the other hand, at the various aspects of behaviour in traffic (as driver, road user, regarding strategic or practical aspects of the behaviours, etc.).

First of all, there is the manual handling of the sound carrier. There are obvious (and always) negative effects on traffic-related behaviour during, just before and just after the manipulation of any device. Although no international scientific literature was found with regard to these distracting effects for pedestrians or cyclists, it may be reasonable to assume that these count for all types of road users.

Articles 7.2 and 8.3 of the Highway Code provide a legal framework for the aspect of manual handling. Article 7.2 obliges road users to behave in such manner that they do not hamper nor endanger other road users. Article 8.3 states that each driver should be able to steer and should possess the required physical fitness, knowledge and skills. Moreover, drivers should always be capable of performing all driving movements. Manipulation of any kind of device while participating in traffic could thus be interpreted as a violation against one or both of these articles<sup>5</sup>.

Besides the “manual handling”, also the “music itself” can be a distinct factor influencing the traffic behaviour of the road user. Due to the intrinsic complexity of music (e.g. intensity, tempo, genre and interaction with the individual emotional state) the literature does not provide uniform conclusions about its effects on traffic behaviour. Some studies reveal (in certain cases)

5. For more details on these legal regulations see chapter 2.2.1 and 3.3

that there are clear cognitive, attention and sometimes also emotional distractions, while other studies argue that also supporting or positive effects in these domains can be shown. The psychological character of these effects makes it difficult to set up a legal framework or to develop concrete and practical directives.

Apart from the attention and cognitive aspect of music, also its intensity (sound volume) counts. Music intensity and related effects are (at least partly) easier to objectivise. Apart from the road safety aspect, a European recommendation limiting the number of decibels produced by sound carriers was recently published. This was based on the fact that these carriers can cause considerable hearing damage. Although this damage is not always immediately noticed or noticeable, it will manifest itself at a later age and will then be experienced as a hindrance. At present, neither on the Belgian, nor on the European level do the medical criteria which determine fitness to drive, include absence or reductions of the auditory function. There are no elements to conclude that hearing-impaired road users would account for an increased traffic danger. This is obviously related to these persons' insight, auto-limitation and the relatively large redundancy of important signals in traffic (both auditory AND visual). This is of course just the case when only the auditory function is considered. If the balance function (anatomically close to the auditory system) is implied though, problems do possibly arise in terms of the fitness to drive and the required physical abilities of the driver. If the sound carrier only puts the road user on the same functional level of a hearing-impaired person, there are no medico-legal reasons to restrict him/her in traffic, as long as the Articles 7.2 and 8.3 of the Highway Code are respected.

The international expert survey gives us an idea of the considered regulation and "philosophy" in several European countries and the USA. In general, the regulations are quite similar as in the Belgian situation: a clear regulation on the "manual-handling aspect" and a general regulation about the "additional effects" stating that a road user may not endanger his/her own and other road users' traffic participation (for whatever reason). Most of the foreign regulations only consider motor vehicle drivers, while in some cases "all road users" are intended. In the Belgian Highway Code, Article 8.3 applies to all drivers and Article 7.2 applies to all road users.

**Recommendation.** The absence of clear and concrete evidence about a consistent negative effect of the use of sound carriers (MP3 players) on road safety leads us to the conclusion that their use in traffic should not specifically be prohibited. It is however clear that the use of any kind of "infotainment" device induces an additional load on traffic participation and that each road user is (already) legally responsible for his/her own psycho-medical-social condition. The latter should allow safe traffic participation (Articles 7.2 and 8.3 of the Highway Code). In case a new regulation would be developed, the diversity and ever-increasing offer of sound carriers and infotainment systems should be taken into consideration. The term "MP3 player" might soon be out-dated. The use of too specific terminology (such as: "mobile phone" in the current Article 8.4) might limit the applicability of relevant legal regulations. In an adapted form, Article 8.4 could also become applicable to all infotainment systems and not merely to mobile phones. This could explicitly regulate the "manual-handling aspect".

Regarding these outcomes it seems advisable to focus on educative interventions rather than repressive regulations. The communicated message could contain several aspects: the risk of hearing damage and the according consequences, the possibility of cognitive impairment (distraction, reactions), the auditory senses which may be compromised, the responsibility of the road user regarding his/her one behaviour.

## 4.2 Dutch Version

### Aanbeveling “MP3 spelers en verkeer”

Deze aanbeveling is gebaseerd op een intern BIVV rapport: MP3 players and traffic safety: State of the Art (Meesmann, Boets en Tant).

**Doelstelling.** Het BIVV werd gevraagd een aanbeveling voor te bereiden betreffende het mogelijk verbod op of een specifieke reglementering betreffende het gebruik van MP3 spelers in het verkeer.

**Methode.** Na herformulering van de vraag werd zowel een internationale literatuurstudie uitgevoerd als een bevraging van internationale experts. De literatuurstudie werd uitgevoerd gebruik makende van de grote bestaande wetenschappelijke databestanden en zoekmachines, met vooraf bepaalde zoektermen. De expertenbevraging verliep via een internationaal netwerk dat voor deze discussie relevante experts groepeerde.

**Resultaten en Conclusies.** De literatuurstudie laat besluiten dat het zeker geen evidentie is om alle gebruik van geluidsdragers te verbieden in het verkeer. Er worden elementen aangedragen die aangeven dat het gebruik van geluidsdragers onmiskenbaar een negatieve invloed kan uitoefenen op de veiligheid van de weggebruiker. Deze effecten zijn echter niet eenduidig omdat ze afhankelijk zijn van de situatie, de persoon, het type van weggebruik en soms ook van de soort geluidsdrager en de kenmerken van de muziek (volume, genre, ...). Verder is het zo dat de interpretatie (en dus ook de praktische vertaling in wetteksten) van de gevonden wetenschappelijke teksten bemoeilijkt wordt door het optreden van zogenaamde ‘interactie-effecten’: wat voor de ene persoon wel een storend element is, is dat niet noodzakelijk voor een ander persoon.

Echter, de effecten (vooral dan van de muziek zelf) zijn niet altijd negatief: in sommige situaties noteerden de onderzoekers enerzijds ook een verbetering van prestaties gerelateerd aan het rijden en/of het verkeer, en anderzijds werden gemoedstoestanden vastgesteld die eerder faciliterend waren.

De complexiteit van de geresulteerde effecten van geluidsdragers is theoretisch te verduidelijken door te wijzen enerzijds op de verschillende elementen van de geïntroduceerde storende factor (namelijk de effecten van het gebruik van een geluidsdrager) als anderzijds op de verschillende aspecten van de verkeersgedragingen (als bestuurder, als weggebruiker, betreffende strategische of praktische elementen van de gedragingen, ...).

Er is ten eerste de manuele handeling die gesteld wordt om het apparaat te bedienen. Er zijn duidelijke (en altijd) negatieve effecten op verkeersrelevante aspecten van het gedrag tijdens, net voor en net na het ‘manueel bedienen’ van eender welk apparaat. Hoewel er geen wetenschappelijke internationale literatuur gevonden werd die dit staft voor voetgangers of fietsers, kan redelijkerwijs worden aangenomen dat deze effecten dezelfde zijn voor alle soorten weggebruik.

Een wetgeving die dit manueel aspect reglementeert is voorhanden krachtens het Verkeersreglement<sup>6</sup>, met name de artikels 7.2<sup>7</sup> en 8.3<sup>8</sup>. Artikel 7.2 verplicht de weggebruiker zich zo te gedragen op de openbare weg dat ze geen hinder of gevaar veroorzaken voor de andere weggebruikers.

6. Koninklijk besluit van 1 december 1975 houdende algemeen reglement op de politie van het wegverkeer en van het gebruik van de openbare weg. (B.S. 09.12.1975)

7. Artikel 7.2 De weggebruikers moeten zich zo gedragen op de openbare weg dat ze geen hinder of gevaar veroorzaken voor de andere weggebruikers, hierin begrepen het personeel dat aan het werk is voor het onderhoud van de wegen en de uitrusting langs de weg, de diensten voor toezicht en de prioritaire voertuigen.

8. Artikel 8.3 Elke bestuurder moet in staat zijn te sturen, en de vereiste lichaamsgeschiktheid en de nodige kennis en rijvaardigheid bezitten. Hij moet steeds in staat zijn alle nodige rijbewegingen uit te voeren en voortdurend zijn voertuig of zijn dieren goed in de hand hebben.

Artikel 8.3 stelt dat bestuurders in staat moeten zijn te sturen, en de nodige lichaamsgeschiktheid, kennis en vaardigheid moet bezitten. De bestuurder moet tevens ook steeds in staat zijn alle rijbewegingen uit te voeren. Het manueel bedienen van eender welk apparaat tijdens de verkeersdeelname kan geïnterpreteerd worden als een inbreuk tegen één of beide artikels.

Naast de 'manuele handeling' kan de 'muziek zelf' een bepalende factor zijn in de verkeersgedragingen van de weggebruiker. Door zijn intrinsieke complexiteit (intensiteit, tempo, genre, interactie met de gemoedstoestand van het individu, ...) kan de literatuur geen eenduidige conclusies bieden betreffende de effecten op het verkeersgedrag. Er zijn studies die aantonen dat er zeker (in sommige gevallen) een cognitieve, aandachts en soms ook emotionele last geïntroduceerd wordt. Andere studies argumenteren dat er in het cognitieve, aandachts en emotionele domein ook 'winsten' kunnen aangetoond worden. De psychologische aard van deze effecten heeft als gevolg dat deze zich ook niet gemakkelijk laat reglementeren of zelfs omzetten in concrete en praktische richtlijnen.

Naast het 'aandachts' en 'cognitieve aspect' van de muziek, is er uiteraard ook het intensiteitsaspect. Dit intensiteitsaspect, en de effecten ervan, zijn (ten minste deels) wel duidelijker objectiveerbaar. Los van het verkeersveiligheidsaspect bestaat er sinds kort een Europese aanbeveling om het aantal decibels dat een geluidsdrager maximaal mag produceren te limiteren. De achtergrond van de aanbeveling is dat er veel gehoorschade veroorzaakt kan worden. Hoewel deze schade niet altijd onmiddellijk opgemerkt wordt of opvallend is, is ze wel degelijk aanwezig, komt zeker op later leeftijd tot uiting, en wordt ze (dan) wel degelijk als beperkend ervaren. Een afwezigheid of vermindering van gehoorsfunctie is op dit moment niet opgenomen in de medische criteria van de rijgeschiktheid, noch op Belgisch, noch op Europees niveau. Niets wijst er op gehoorsgestoorde weggebruikers een groter gevaar zouden opleveren. De redenen hiervoor zijn ongetwijfeld zelfkennis en –beperking en de relatief grote redundantie in de aangeboden (belangrijke) signalen (auditief EN visueel). Dit is uiteraard wanneer het louter gaat over de auditieve functie. Wanneer er een implicatie is van de evenwichtsfunctie (die anatomisch nauw vervonden is met de auditieve) dan is er uiteraard wel een aandachtspunt betreffende de rijgeschiktheid en de vereiste lichamelijke functies waarover een weggebruiker moet kunnen beschikken. Voor zover de geluidsdrager de weggebruiker functioneel gelijkstelt met een iemand met een auditieve beperking, zijn er dus geen medico-legale redenen om dit te verbaliseren zolang men voldoet aan de voornoemde artikels 7.2 en 8.3 van het Verkeersreglement.

De internationale experts bevraging levert ons een beeld op van de reglementering en gehanteerde filosofie van een aantal Europese landen en de USA. Deze komt in grote lijnen overeen met de situatie in België: een duidelijke reglementering betreffende het 'manueel aspect' en een algemene reglementering betreffende de 'bijkomende effecten' waarbij men stelt dat de eigen verkeersdeelname en die van de andere weggebruikers niet in gevaar mag komen (om welke reden dan ook). De meeste buitenlandse wetgevingen gaan het over het gemotoriseerd verkeer, in sommige gevallen worden 'alle bestuurders' beoogd. In de Belgische wetgeving slaat het voornoemde artikel 8.3 op alle bestuurders en het voornoemde artikel 7.2 op alle weggebruikers.

**Aanbeveling.** De afwezigheid van duidelijke en concrete evidentie van een consequente sterke negatieve invloed van het dragen van geluidsdragers op de verkeersveiligheid moet ons doen besluiten dat het gebruik ervan in het verkeer niet specifiek verboden dient te worden. Wat wel vaststaat is dat het gebruik van eender welke vorm van infotainment een extra 'last' kan opleveren tijdens de verkeersdeelname en dat elke weggebruiker

wettelijk (reeds) verantwoordelijk is voor zijn eigen psycho-medico-sociale toestand. Deze laatste moet een veilige verkeersdeelname toelaten (artikels 7.2 en 8.3 van het Verkeersreglement. Bij het formuleren van een eventuele nieuwe regelgeving dient rekening gehouden te worden met de diversiteit en groeiend aanbod van geluidsdragers en infotainment systemen. Een formulering als 'MP3 speler' zal snel achterhaald zijn. Door het gebruik van een te specifieke of concrete terminologie (zoals bijvoorbeeld in het huidige artikel 8.4<sup>9</sup>) kan in sommige gevallen een relevante reglementering toch niet toepasbaar zijn omwille van de formulering. In een aangepaste vorm zou artikel 8.4d ook van toepassing kunnen gemaakt worden op alle infotainment systemen en dus niet enkel de draagbare telefoon. Dit zou expliciet het 'manuele aspect' kunnen regelen.

Gezien het voorgaande lijkt het aangewezen om in plaats van repressieve maatregelen te nemen, ons eerder te richten op maatregelen en acties met een educatieve waarde. De over te brengen boodschap kan uit meerdere aangehaalde aspecten bestaan: het gevaar van gehoorschade en de gevolgen daarvan, de mogelijke invloed van een veranderde cognitieve toestand (afleidbaarheid, reactiemogelijkheid), het wegvallen van het auditieve informatiekanaal, de verantwoordelijkheid van de weggebruiker betreffende zijn eigen toestand.

### 4.3 French Version

#### **Recommandation «baladeurs MP3 dans la circulation»**

Cette recommandation s'appuie sur un rapport interne de l'IBSR intitulé « MP3 players and traffic safety : State of the Art » (Meesmann, Boets et Tant).

**Objectif.** Il a été demandé à l'IBSR d'élaborer une recommandation portant sur une éventuelle interdiction d'utiliser les baladeurs MP3 dans la circulation ou une réglementation spécifique en la matière.

**Méthode.** Après reformulation de la demande, il a été procédé, d'une part, à une étude de littérature internationale et, d'autre part, au questionnement d'experts internationaux. L'étude de littérature s'est basée sur la recherche de termes prédéfinis dans les vastes bases de données et outils de recherche scientifiques existants. L'enquête auprès des experts a été réalisée via un réseau international regroupant des spécialistes en la matière.

**Résultats et Conclusions.** Il ressort de l'étude de littérature qu'il n'est pas évident d'interdire l'utilisation de baladeurs musicaux dans le trafic. Divers éléments montrent que l'usage de ces baladeurs risque indéniablement d'avoir un impact négatif sur la sécurité des usagers. Les effets ne peuvent toutefois être établis de manière univoque étant donné qu'ils sont fonction de la situation, de la personne, de la nature de l'utilisateur et parfois également du type de baladeur musical et des caractéristiques liées à la musique (volume, genre...). A noter que certains « effets d'interaction » perturbent l'interprétation (et donc la transposition sous forme de textes de loi) des textes scientifiques : ce qui est considéré comme gênant par un individu ne l'est pas nécessairement pour d'autres.

Cela dit, les effets (et principalement ceux générés par la musique proprement dite) ne sont pas toujours négatifs : dans certains cas, les chercheurs ont noté une amélioration des prestations au niveau de la conduite et/ou du trafic ainsi que l'apparition d'un état d'esprit favorable à la conduite.

Théoriquement, la complexité des effets générés par les baladeurs musicaux peut s'expliquer, d'une part, par la diversité des éléments liés au facteur perturbant (à savoir les effets de l'utilisation d'un baladeur musical) et, d'autre

9. Artikel 8.4 Behalve wanneer zijn voertuig stilstaat of geparkeerd is, mag de bestuurder geen gebruik maken van een draagbare telefoon die hij in de hand houdt.

part, par les différents aspects liés aux comportements dans le trafic (en tant que conducteur, usager de la route, concernant les aspects stratégiques ou pratiques des comportements...).

Il y a tout d'abord le geste manuel accompli pour actionner l'appareil. L'« actionnement manuel » d'un appareil, quel qu'il soit, a manifestement (toujours) un impact négatif sur les aspects comportementaux importants dans le trafic, et ce, pendant, juste avant et juste après cet actionnement. Malgré l'absence de littérature scientifique internationale qui corrobore cette thèse pour les piétons ou les cyclistes, on peut logiquement supposer que ces effets sont les mêmes pour tous les types d'usagers.

La législation qui régit cet aspect manuel est reprise dans le Code de la Route<sup>10</sup>, aux articles 7.2<sup>11</sup> et 8.3<sup>12</sup>. L'article 7.2 oblige les usagers à se comporter sur la voie publique de manière telle qu'ils ne causent aucune gêne ou danger pour les autres usagers. L'article 8.3 stipule que tout conducteur doit être en état de conduire, présenter les qualités physiques requises et posséder les connaissances et l'habileté nécessaires. Il doit également être constamment en mesure d'effectuer toutes les manœuvres qui lui incombent. L'actionnement manuel d'un appareil quelconque lors de la participation au trafic peut être interprété comme une infraction à l'un de ces articles, voire aux deux.

Outre le « geste manuel », la « musique proprement dite » peut également être un facteur déterminant au niveau du comportement de l'usager dans la circulation. Vu la complexité intrinsèque de cette problématique (intensité, rythme, genre, interaction avec l'état d'esprit de l'individu...), la littérature ne permet pas de tirer des conclusions univoques quant aux effets sur le comportement routier. Diverses études révèlent la présence indéniable (dans certains cas) d'une gêne cognitive, attentionnelle ou même parfois émotionnelle. Cela dit, d'autres études parlent également de certains « gains » dans ces trois domaines. La nature psychologique de ces effets est telle qu'ils ne se laissent pas facilement couler sous forme de réglementation ni de directives concrètes et pratiques.

Outre l'« aspect attentionnel et cognitif » de la musique, il y a bien entendu son niveau d'intensité. L'intensité sonore et ses effets peuvent (du moins, en partie) être plus clairement objectivés. Une recommandation européenne visant à fixer un seuil maximal de décibels pour les baladeurs musicaux existe depuis peu. Rédigée sans aucun égard pour l'aspect sécuritaire des routes, cette recommandation est née des nombreuses lésions auditives que peuvent causer ces baladeurs. Bien que cette lésion ne soit pas toujours immédiatement identifiable ou visible, elle est bel et bien présente. Elle se manifesterait inéluctablement à un âge plus avancé et sera alors vécue comme restrictive. Actuellement, l'absence ou la diminution de la fonction auditive ne constitue pas un critère médical d'aptitude à la conduite. Ni en Belgique, ni au niveau européen. Rien n'indique que les usagers malentendants représenteraient un plus grand danger sur les routes. La connaissance de soi et l'autolimitation ainsi que la redondance, relativement grande, des signaux (auditifs ET visuels importants) proposés en sont indubitablement les raisons. Ceci n'est vrai que lorsque la fonction auditive est la seule affectée. Quand la fonction d'équilibre (qui, au niveau anatomique, est étroitement liée à

10. Arrêté royal du 1er décembre 1975 portant règlement général sur la police de la circulation routière et de l'usage de la voie publique. (M.B. 09.12.1975)

11. Article 7.2. Les usagers doivent se comporter sur la voie publique de manière telle qu'ils ne causent aucune gêne ou danger pour les autres usagers, en ce compris le personnel œuvrant pour l'entretien de la voirie et des équipements la bordant, les services de surveillance et les véhicules prioritaires.

12. Article 8.3. Tout conducteur doit être en état de conduire, présenter les qualités physiques requises et posséder les connaissances et l'habileté nécessaires. Il doit être constamment en mesure d'effectuer toutes les manœuvres qui lui incombent et doit avoir constamment le contrôle du véhicule ou des animaux qu'il conduit.

la fonction auditive) est également touchée, il convient de vérifier l'impact sur l'aptitude à la conduite et les fonctions physiques dont doit pouvoir disposer un usager de la route. Dans la mesure où un usager qui utilise un baladeur musical est assimilé, d'un point de vue fonctionnel, à une personne atteinte d'une déficience auditive, il n'y a aucune raison médico-légale de procéder à une verbalisation, pour autant qu'il satisfasse aux articles 7.2 et 8.3 susmentionnés du Code de la Route.

Le sondage international effectué auprès d'experts nous donne un aperçu de la réglementation et de la philosophie appliquée dans une série de pays européens et aux Etats-Unis. On constate que la situation y est grosso modo similaire à celle de la Belgique: une réglementation claire concernant l'« aspect manuel » et une réglementation générale pour les « effets connexes », qui précise que, lors de la participation au trafic, on ne peut mettre en danger sa vie ni celle des autres usagers de la route (pour quelle que raison que ce soit). La plupart des législations étrangères ont trait au trafic motorisé et visent, dans certains cas, tous les conducteurs. Dans le Code de la Route belge, les articles 8.3 et 7.2 susmentionnés se rapportent respectivement à tous les conducteurs et à tous les usagers de la route.

**Recommandation.** L'absence d'évidence claire et concrète que le port de baladeurs musicaux exerce systématiquement une influence très négative sur la sécurité routière doit nous amener à ne pas interdire leur usage dans la circulation. Il ne fait aucun doute que l'utilisation d'une quelconque forme d'« infotainment » peut constituer une « gêne » supplémentaire pour la participation au trafic et que tout usager de la route est (déjà) légalement responsable de sa propre situation psycho-médico-sociale. Cette dernière disposition doit permettre une participation sûre au trafic (articles 7.2 et 8.3 du Code de la Route). Lors de la rédaction d'une éventuelle nouvelle législation, il faudra tenir compte de la diversité et de l'offre croissante des baladeurs musicaux, et des systèmes d'« infotainment ». Une dénomination comme « baladeurs MP3 » deviendra rapidement obsolète. Bien que pertinente, une réglementation, dont la terminologie est trop spécifique ou concrète (comme à l'article 8.4<sup>13</sup>, par exemple), risque, dans certains cas, de ne pouvoir être appliquée en raison de sa formulation. S'il était remanié, l'article 8.4 pourrait également s'appliquer à tous les systèmes « infotainment », et non plus uniquement au téléphone portable. Ceci pourrait régler l'« aspect manuel » de manière explicite.

Au regard de ce qui précède, il semble recommandé de privilégier les mesures et actions à valeur éducative aux mesures répressives. Le message à véhiculer peut faire référence aux divers aspects cités : le danger des lésions auditives et leurs conséquences, l'éventuelle influence d'une situation cognitive modifiée (distraction, possibilité de réaction), la disparition du canal d'informations auditif et la responsabilité de l'usager de la route concernant sa propre situation.

<sup>13</sup> Article 8.4. Sauf si son véhicule est à l'arrêt ou en stationnement, le conducteur ne peut faire usage d'un téléphone portable en le tenant en main.



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## 6. Annex

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Annex 1:  
Overview of identified  
articles and their  
content input in this  
report

REFERENCE	Legal regulations	Manual handling	
		Entertainment systems	MP3 players
Beh & Hirst, 1999			
Belhoula, 2006			X
Brodsky, 2002			
Bruyas et al., 2006			
Bungum et al., 2005			
Caird et al., 2007		X	
Campbell & Stradling, 2003			
Children's Hospital of Philadelphia (Editor), 2007			
Chisholm et al., 2008		X	X
Consiglio et al., 2003			
Crisler et al., 2008			X
Dibeen & Williamson, 2007			
Dingus et al., 1989		X	
Eby & Kostniuk, 2003		X	
Glaze & Ellis, 2003		X	
Green, 2007		X	
Hasegawa & Oguri, 2006			
Hatfield & Murphy, 2007			
Heller et al. 2008			
Horrey & Wickens, 2006		X	
Johns Hopkins University (Editor), 2005			
Klauer et al., 2006		X	
Lee & Strayer, 2004		X	
Lee, 2007a		X	
Lee, 2007b		X	
Matthews et al., 1998			
McCartt et al., 2006		X	
McKenzie, 2004			
McKnight & McKnight, 1993		X	
Nasar et al. 2008			
Nelson & Nilsson, 1990			
NHTSA, 1997	X		
NZAA, 2008			X
Oron-Gilad et al., 2008			
Pêcher et al., 2009			
Regan, et al. in preparation		X	
Rhodes et al., 2005			
Salvucci et al., 2007			X
Schumacher et al., 2002			
Slobada et al., 2001			
Stevens & Minton, 2001		X	
Stidger (2003)			
Stutts et al., 2001		X	
Sussman et al., 1985		X	
Turner et al., 1996			
Vaa et al. 2001			
Vaca, 2007			
Vogel et al., 2008			
Wang et al., 1996		X	
Wiesenthal et al., 2000			
Wiesenthal et al., 2003			

INFORMATION ON				
Listening to music		Auditory limitations		Others
Prevalence	Effects on motor vehicle drivers	Effects on pedestrians		
	X			
	X			
	X			
		X		
	X			
	X			
	X			
X				
X	X			
	X			
		X	X	
				X
	X			
	X			
		X	X	
X	X			
	X			
X				X
	X			
	X		X	
X	X		X	
	X			
	X			

## Annex 2: IRTAD members

The IRTAD is a worldwide network of public and private organisations with an interest in road safety. Currently, the following 50 institutions are members of the ITRAD network (ITRAD, 2009b):

### Australia

- Australian Transport Safety Bureau
- University of Queensland (CONROD)

### Austria

- Kuratorium für Verkehrssicherheit (KFV)

### Belgium

- Belgian Road Safety Institute (IBSR/BIVV)
- Nissan Motor Manufacturing (UK) Ltd. Belgium Branch

### Canada

- Transport Canada

### Czech Republic

- Transport Research Centre (CDV)

### Denmark

- Road Directorate
- Danish Transport Research Institute (DTF)
- Aalborg University

### Finland

- Finnish Road Administration (FinnRA)

### France

- Service d'études techniques des routes et autoroutes (SETRA)
- Institut national de recherche sur les transports et leur sécurité (INRETS)
- PSA Peugeot Citroën
- Observatoire national interministériel de sécurité routière

### Germany

- Bundesanstalt für Strassenwesen (BASt)
- Allgemeiner Deutscher Automobil-Club e.V. (ADAC)
- Bosch
- DaimlerChrysler
- DEKRA
- Deutscher Verkehrssicherheitsrat e.V. (DVR)
- Unfallforschung der Versicherer GDV
- Volkswagen

### Hungary

- Institute for Transport Sciences (KTI)

### Iceland

- Public Road Administration

### Ireland

- Road Safety Authority (RSA)

### Israel

- National Road Safety Authority
- Or Yarok Association

### Japan

- National Police Agency
- Institute for Traffic Research and Data Analysis (ITARDA)
- National Research Institute for Police Science (NRIPS)

### Jordan

- Jordan Traffic Institute

### Korea

- Road Traffic Safety Authority (ROTA)
- Korean Transportation Safety Authority (KOTSA)

### Malaysia

- Malaysian Institute of Road Safety Research (MIROS)

### Netherlands

- Ministerie van Verkeer en Waterstaat
- Institute for Road Safety Research (SWOV)

## New Zealand

- Ministry of Transport

## Norway

- Norwegian Public Road Administration

## Poland

- Motor Transport Institute (ITS)

## Slovenia

- Directorate for Roads (DRSC)

## Spain

- Direccion General de Trafico (DGT)
- RACC Automovil Club
- University of Valencia

## Sweden

- National Road Administration
- Swedish Road & Transport Research Institute (VTI)

## Switzerland

- Swiss Council for Accident Prevention (BfU)

## United Kingdom

- Department for Transport
- Ford

## United States

- National Highway Traffic Safety Administration (NHTSA)
- University of Michigan

## International Organisations

- European Commission (DG TREN)
- European Automobile Manufacturers Association (ACEA)
- FIA Foundation
- The Motorcycle Industry in Europe (ACEM)
- World Bank

Annex 3:  
Mail sent to IRTAD experts  
(13.05.09)

Dear Madam/Sir

I contact you with the greetings from my colleague Yvan Casteels (IRTAD-Belgium) from the Belgian Road Safety Institute (BIVV). Yvan Casteels suggested you may be able to help with some information we have been searching for.

Our national Government asked our scientific advice regarding "**MP3 players** (portable sound carrier used via headphone/earphone) **and traffic safety** (pedestrians, cyclists and motor vehicle drivers)".

As the first screen of the literature showed that little scientific information on the subject is available I would like to ask you, as an expert on road safety in your country, to answer a few questions on the subject. Please feel free, to forward this email to other experts.

1. Are there any national or regional legal regulations (road traffic act) on using portable sound carriers used via headphone/earphone (e.g. MP3 players) in your country?

Yes  No

Please, name country/region: \_\_\_\_\_

If yes,

- Do the regulations concern (Multiple answers are possible):
  - the manual handling of portable sound carriers
  - the use of headphone/earphone
  - others, please specify: \_\_\_\_\_
- Do the regulations concern (Multiple answers are possible):
  - pedestrians
  - cyclists
  - motor vehicle drivers
- Could you please give a short (English) description of the legal regulation?
- Could you please provide us with the reference of the legal regulation?
- Is the legal regulation based on:
  - scientific study
  - expert advice
  - other, please specify: \_\_\_\_\_
  - o Could you please provide us with the respective references (or the original documents)?

2. Do you know any (other) scientific study (published or unpublished) on this topic?

Yes  No

If yes,

- Could you please provide us with the respective references (or the original documents, if possible)?

Since the submission of the report is scheduled on the 1st of July, I am looking forward to receiving your reaction as soon as possible (latest until the 27th of May).

Any information would be greatly appreciated.

Kind Regards  
Uta Meesmann

## LIST OF ABBREVIATIONS - TABLES - ANNEX

### LIST OF ABBREVIATIONS

AUS	Australia
BE	Belgium
CB	Citizens' band radio (funk/radio)
CD	Compact disc
CH	Switzerland
DAP	Digital audio player
dBA	A-weighted decibels
DE	Germany
DGT	Spain's national Ministry of Transport (Dirección General de Tráfico)
DK	Denmark
DVD	Digital video disc
ES	Spain
FR	France
IBSR/BIVV	Belgian Road Safety Institute (IBSR/BIVV, 2009)
IL	Israel
IRTAD	International Traffic Safety Data and Analysis Group
IS	Iceland
ITRD	International Transport Research Documentation (ITRD, 2009)
MEDLINE	Database of medical literature maintained by the United States National Library of Medicine (NCBI) (NCBI, 2009)
MeSH	Medical Subject Heading is the U.S. National Library of Medicine's controlled vocabulary used for indexing articles for MEDLINE/PubMed. MeSH terminology provides a consistent way to retrieve information that may use different terminology for the same concepts.
MP3	MPEG-1 Audio Layer 3 (standard for data compression for video and audio)
NCBI	National Library of Medicine (USA)
NHTSA	National Highway Traffic Safety Administration (USA)
NL	Netherlands
NO	Norway
OECD	Organisation for economic co-operation and development (OECD, 2009)
PRT	Perception response time
PubMed	Online access to MEDLINE (NCBI, 2009)
RR	Relative risk
SE	Sweden
TRIS	Transport Research Information Services (TRIS, 2009)
TRISonline	Online access to TRIS (TRIS, 2009)
TRL	The UK's Transport Research Laboratory (TRL, 2009)
UK	United Kingdom
US	United States of America

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