Discotheques and the risk of hearing loss among youth: risky listening behavior and its psychosocial correlates

Ineke Vogel1*, Johannes Brug1,2, Catharina P. B. Van der Ploeg3 and Hein Raat1

1Department of Public Health, Erasmus MC University Medical Center, PO Box 2040, 3000 CA Rotterdam, The Netherlands, 2EMGO Institute, VU University Medical Center, 1081 BT Amsterdam, The Netherlands and 3Department of Prevention and Healthcare, TNO Quality of Life, 2301 CE Leiden, The Netherlands

*Correspondence to: I. Vogel. E-mail: i.vogel@erasmusmc.nl

Received on September 15, 2009; accepted on February 27, 2010

Abstract

There is an increasing population at risk of hearing loss and tinnitus due to increasing high-volume music listening. To inform prevention strategies and interventions, this study aimed to identify important protection motivation theory-based constructs as well as the constructs ‘consideration of future consequences’ and ‘habit strength’ as correlates of adolescents’ unsafe discotheque-visiting behavior. We invited 1687 adolescents (12–19 years old) at Dutch secondary schools to complete questionnaires about music-listening behaviors, sociodemographic characteristics and psychosocial determinants of behavior. Over 70% of participants reported to have visited discotheques; 24.6% of them were categorized as visitors at risk for hearing loss due to estimated exposure of 100 dBA for 1.25 hours per week or more without the use of hearing protection. Compared with visitors not at risk for hearing loss, those at risk were more likely not to live with both parents and less likely to consider future consequences and for them visiting high-volume music discotheques was more habitual. Risky exposure to high-volume music in discotheques is associated with several sociodemographic and psychosocial factors, with habit strength being the strongest correlate. Voluntary behavior change among adolescents might be difficult to achieve, because visiting discotheques seems to be strongly linked to current adolescent lifestyle.

Introduction

There is an increasing population at risk of suffering from hearing symptoms such as hearing loss and tinnitus due to increasing high-volume music listening [1]. Attendance of discotheques is one of the most popular leisure activities of young people in Western countries such as the Netherlands and Germany [2]; prolonged exposure to high-volume music in discotheques poses an even greater risk of hearing loss compared with excessive exposure to MP3-player music [1]. Repeated exposures over extended periods of time and combined exposure to other sources of high-volume music such as music in cars, in headphones or at pop concerts increase the risk.

To develop effective intervention strategies for hearing loss prevention, more insight into psychosocial determinants of unsafe listening behavior is needed [3]. To gain such insight, a theory is needed that explains perceptions of health threats, and how these perceptions result in diverse adaptive or maladaptive coping styles. On the basis of the literature, we selected the protection motivation theory (PMT) as the most appropriate theoretical framework to study psychosocial correlates, because it...
explains the cognitive processes that are used when people receive health information and has been proven reliable in predicting health-related intentions and behaviors in a variety of contexts [4–6].

Furthermore, a structured literature overview summarized published findings on sociodemographic, psychosocial and other correlates of risk and protective behaviors for hearing loss caused by loud music in young people aged 12–25 years [7]. This overview also used the PMT as a theoretical framework for categorizing the psychosocial correlates.

In the present study, we used the PMT as a whole to assess the combined influence of underlying psychosocial mechanisms on adolescents’ discotheque-visiting behavior.

According to the PMT, health protective, safe, behavior (or the ‘adaptive response’ a person engages in) is directly influenced by protection motivation, which is the result of an evaluation of environmental and personal factors. PMT posits that the probability of an adaptive response—in this case hearing conservation behavior—is increased by four beliefs: the threat is perceived as severe (severity), and as of high personal relevance (vulnerability); the adaptive response is perceived as effective for warding off the threat (response efficacy), and the personal abilities and self-confidence to engage in the adaptive response is perceived as high (self-efficacy). However, the probability of an adaptive response is decreased by the perceived rewards of a maladaptive response, i.e., enjoying high-volume music in discotheques and the perceived costs or barriers of the adaptive response [6].

We explored the relevance of two new constructs that might be important to consider when developing interventions. The first is ‘consideration of future consequences (CFC)’ [8]. This construct was included because it influences PMT constructs such as vulnerability and self-efficacy. People tend to minimize probability of future risks [9]. Because hearing loss develops gradually and most people with mild high-frequency hearing loss are unaware of their impairment, the risk of hearing loss is easily underestimated [10] and not perceived to be of high personal relevance [11]. A factor that might influence beliefs about personal vulnerability is the extent to which an individual can imagine negative occurrences in the distant future. A general tendency to disregard future consequences may prevent an individual from feeling particularly vulnerable [8].

The second additional concept of which the relevance was explored is ‘habit strength’ [12]. This construct was included because we hypothesized that adolescents’ discotheque visiting may be a kind of habitual behavior, for which no intentional thinking is required.

This study aimed to identify important PMT-based constructs as well as CFC and habit strength as correlates of frequent discotheque-visiting behavior without using hearing protection among adolescents.

## Methods

### Participants

In 2007, a convenience sample of 1687 adolescents aged 12–19 years in 68 classes at 15 Dutch secondary schools (well spread over the country in both urban and rural areas) were invited to complete questionnaires on the sociodemographic factors, discotheque-visiting behavior, PMT constructs and habit strength; these questionnaires were completed under supervision of a researcher (IV) at school and took ~45 min to complete. The surveys were completed anonymously and without collaboration, and could not be linked back to the participants. Adolescents and parents received written information about the study. Participation by adolescents was voluntary, and parents could refuse their child’s participation. The study was approved by the Medical Ethics Committee at Erasmus MC, University Medical Center Rotterdam.

The response rate was 89.9% (n = 1516). Four questionnaires were excluded due to incomplete data. Of the 1512 participants, 71.8% (n = 1086) reported to have visited a discotheque at least one time in the past year. Therefore, 1086 questionnaires could be used in the analyses. We tested
whether there were geographical differences. This was not the case. In the total sample \((n = 1086)\), 48.3% of participants were living in a rural area and 51.7% in an urban area. Within the subgroup of adolescents who were ‘at risk’ for developing hearing damage given the self-reported exposure to loud music in discotheques \((n = 267)\), 49.8% were living in a rural area and 50.2% were living in an urban area; in the subgroup adolescents who were ‘not at risk’ for developing hearing damage \((n = 819)\), 47.7% were living in a rural area and 52.3% in an urban area. The distribution of this geographical characteristic (rural/urban area) among adolescents ‘at risk’ respectively ‘not at risk’ was not statistically significant \((P = 0.56)\); therefore, this geographical characteristic was not included in the analyses.

Survey

The appendix to this paper presents the survey items on the sociodemographic factors, discotheque-visiting behavior, PMT constructs and habit strength. Ethnicity (Dutch or Western migrant, non-Western migrant) was determined by country of birth of the mother and father according to the definitions of Statistics Netherlands [13]. The adolescent was of non-Western ethnic origin if at least one of the parents was born in a non-Western country. If both parents were born in a non-Western country, the country of birth of the mother determined the ethnicity.

Habit strength was measured by asking the adolescents whether they agreed with statements on two of the three primary features of habitual behavior [12]: (i) automaticity and (ii) the sense of identity the behavior reflects. The third feature, the repeated character of the behavior (‘visiting discotheques is something I do very often’), was excluded to avoid too high correlations between habit strength and the outcome measure, since the frequency of use is also included in the calculation of the behavior outcome measure. Protection motivation was measured with behavioral intentions, since these are the best measures for someone’s ‘protection motivation’ [6].

Adolescents’ appreciation of their future was assessed using the Dutch version of the 12-item ‘CFC scale ’ [8, 14]. This scale refers to the extent to which individuals consider potential distant outcomes. Statements have to be rated such as: ‘Often I engage in a particular behavior in order to achieve outcomes that may not result for many years’ and ‘I think that sacrificing now is usually unnecessary since future outcomes can be dealt with at a later time’.

All items related to the PMT constructs, CFC and habit strength were measured by asking the adolescents to rate their agreement with each item on a bipolar five-point scale \((-2 = \text{not at all}; +2 = \text{completely})\). For constructs that were assessed with multiple items, the mean score was calculated after sufficient internal consistency was established, with positive scores indicating high levels of the construct. Internal consistency was assessed with Cronbach’s alpha. For a short scale, Cronbach’s alpha should be >0.70 [15]. Table I gives information on the number of scale items, range and internal consistency for each construct.

Estimation of risky discotheque-visiting behavior

On the basis of current occupational safety standards or guidelines [16, 17], music volume levels equal to or exceeding the equivalent of 85 dBA for 40 hours per week were assumed to be potentially damaging. By applying the principle that a doubling in level (+3 dBA, as decibels have a logarithmic scale) can be offset by halving the permissible exposure duration, a permissible exposure limit (PEL) can be calculated for each individual sound level expressed in decibels [18, 19]. Exposure to a level of 88 dBA for 20 hours per week is thus assumed to be equivalent to the exposure to 85 dBA for 40 hours per week. Based on previous research, the average decibel level in discotheques was assumed to be 100 dBA [20]. Using the equation: 
\[
\text{PEL}_{(\text{week})} = 40/2^{(L - 85)/3},
\]
where \(L\) stands for the estimated dBA level [18, 19], it can be calculated that adolescents that reported to have spent on average 1.25 hours per week or more in a discotheque
are assumed to be exposed to potentially hazardous music levels and were categorized as frequent visitors or ‘visitors at risk for hearing loss’. Adolescents that initially were categorized as ‘visitors at risk for hearing loss’ but reported to have used hearing protection devices always or nearly always were categorized as ‘visitors not at risk for hearing loss’ \( (n = 5) \).

**Statistical analysis**

Statistical analyses were performed using the SPSS program (version 15; SPSS Inc, Chicago, IL, USA). Frequency tables were used to explore the sociodemographic characteristics of the total study population \( (n = 1086) \) and those categorized as at risk \( (n = 267) \) or not at risk \( (n = 819) \) for hearing loss. Mean and frequency differences of the total study population characteristics were examined through univariate analysis of variance and chi-square statistics, respectively. Zero-order correlations were calculated for all psychosocial variables to assess for multicollinearity and to explore associations between these variables. To take into account the interrelations between the psychosocial constructs, a conceptual hierarchical framework (Table II) was used.

Hierarchical logistic regression analyses have been designed to test theoretical assumptions and to examine the influence of hierarchical levels of a conceptual framework in a sequential way [21]. Starting with Level 1, factors from the next hierarchical levels were stepwise added. It was assumed that the sociodemographic factors would be the factors likely to directly or indirectly determine all proposed psychosocial factors. Therefore, in Step 1 the sociodemographic characteristics were entered. In Step 2, CFC was added to the analyses, of which the influence on visiting behavior is mediated by PMT constructs such as vulnerability and self-efficacy. Therefore, in Step 3 the PMT constructs were included in the model. In Step 4, protection motivation was added to the model, because it is expected to mediate between the other PMT constructs and behavior. Because it has been found that the utility of the construct ‘protection motivation’—i.e., the intention to change behavior—as a predictor of behavior declines as habit strength increases [22], we added habit strength in the final step to the model. Omnibus tests of model coefficients indicated whether adding a block resulted in a significant increase of the explained variance. Any \( P \) values of <0.05 were considered to be statistically significant. When subsequent levels are added to the model,

### Table I. Number of scale items, internal consistency and interpretation of high scores for the PMT and additional constructs

<table>
<thead>
<tr>
<th>Psychosocial constructs</th>
<th>Number of items(^a)</th>
<th>Cronbach’s alpha</th>
<th>Association with unsafe behavior(^b)</th>
</tr>
</thead>
<tbody>
<tr>
<td>CFC</td>
<td>12</td>
<td>0.79</td>
<td>–</td>
</tr>
<tr>
<td>PMT</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rewards</td>
<td>4</td>
<td>0.83</td>
<td>+</td>
</tr>
<tr>
<td>maladaptive</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>response</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Severity</td>
<td>6</td>
<td>0.74</td>
<td>–</td>
</tr>
<tr>
<td>Vulnerability</td>
<td>1</td>
<td>NA(^c)</td>
<td>–</td>
</tr>
<tr>
<td>Response efficacy</td>
<td>3</td>
<td>0.72</td>
<td>–</td>
</tr>
<tr>
<td>Self-efficacy</td>
<td>1</td>
<td>NA(^c)</td>
<td>–</td>
</tr>
<tr>
<td>Protection motivation</td>
<td>2</td>
<td>0.78</td>
<td>–</td>
</tr>
<tr>
<td>Habit strength</td>
<td>2</td>
<td>0.87</td>
<td>+</td>
</tr>
</tbody>
</table>

\(^a\)These constructs were assessed with one or more items on five-point scales. The most negative answers were coded with –2, the most positive answers with +2. A mean score over all items was calculated ranging from –2 to +2.

\(^b\)Association between the correlate and unsafe behavior (visiting discotheques during 1.25 hours per week or more); +: a higher risk for unsafe behavior is expected to follow a higher score on the correlate; –: a lower risk for unsafe behavior is expected to follow a higher score on the correlate.

\(^c\)Single-item scale; NA = not applicable.

### Table II. Conceptual hierarchical framework

Hierarchical levels to assess correlates of unsafe discotheque-visiting behavior

<table>
<thead>
<tr>
<th>Level</th>
<th>Construct</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Sociodemographic characteristics</td>
</tr>
<tr>
<td>2</td>
<td>CFC</td>
</tr>
<tr>
<td>3</td>
<td>PMT constructs</td>
</tr>
<tr>
<td>4</td>
<td>Protection motivation</td>
</tr>
<tr>
<td>5</td>
<td>Habit strength</td>
</tr>
</tbody>
</table>

I. Vogel *et al.*
some significant upstream constructs (from a previous hierarchical level) may no longer have a significant direct effect on the behavior because of mediation; i.e., it was expected that in the final model, CFC and the PMT constructs (added in Steps 2 and 3) may no longer be significant.

Results

Study population
Of the visitors, 24.6% \( (n = 267) \) were categorized as being at risk for hearing loss due to \( \geq 1.25 \) hours of discotheque music exposure per week.

Table IIIA gives an overview of the sociodemographic characteristics of the total study population, which were similar to those of adolescents in the general Dutch population [13].

Briefly, it shows that 44.3% of the visitors categorized to be not at risk for hearing loss were attending pre-vocational schools, and 15.4% were not living with both parents. Of the visitors categorized to be at risk for hearing loss, 61.4% were attending pre-vocational schools and 28.2% were not living with both parents \( (\text{all } P < 0.01) \).

Table IIIB shows that the means of the psychosocial constructs between the groups of visitors, except for severity, differed in the expected direction \( \text{(all } P < 0.05) \).

Correlates of unsafe discotheque-visiting behavior
The results of the hierarchical multiple regression analyses are shown in Table IV. Adding each block, except for Block 4 protection motivation, resulted in a significant increase in percentages of explained variance.

In the first step age, educational level and home situation were significant predictors and this step explained 14.8% (Nagelkerke \( R^2 \)) of the variance of the unsafe behavior. For example, adolescents attending practical pre-vocational education were 2.5 times more likely to be categorized as visitors at risk for hearing loss than their pre-university counterparts \( \text{(odds ratio (OR) 2.45; 95\% confidence interval (CI): 1.53–3.92).} \) When in the subsequent steps CFC (Step 2), the PMT constructs intrinsic rewards, extrinsic rewards, severity, vulnerability, response efficacy and self-efficacy (Step 3) and protection motivation (Step 4) were added, the explained variance increased to 17.1, 25.5 and 25.7%, respectively. Visitors categorized to be at risk for hearing loss reported significantly less CFC and were more likely to experience rewards from the unsafe behavior than those not at risk. However, visitors at risk significantly more often reported higher levels of severity.

In the fifth and final step, when habit strength was included, the explained variance increased to 41.4%. From the sociodemographic factors, older age and home situation were significantly correlated with the unsafe behavior at all levels of the hierarchical model: adolescents not living with both parents were more likely to be at risk for hearing loss than those living with both parents \( \text{(OR 1.83; 95\% CI: 1.20–2.81).} \) Visitors categorized to be at risk for hearing loss were less likely to consider future consequences, and for them visiting high-volume music discotheques was more often a habit than for those not at risk \( \text{(OR 3.36; 95\% CI: 2.67–4.23).} \)

Discussion

Both visitors at risk and visitors not at risk had no intention to protect their hearing in the future. In this study, the PMT in combination with the psychological constructs CFC and habit strength was found to be a useful hierarchical framework for examining adolescents’ discotheque-visiting behavior. However, as previously shown, the utility of the PMT constructs for explaining risky discotheque visiting behavior declined as habit strength increased [22]. In the final model, the demographic factors age and not living with both parents, and the concepts CFC, severity and habit strength were significant predictors of unsafe discotheque visiting behavior. In preceding models, other significant predictors were: ‘rewards of the maladaptive response’ \( \text{(Models 3 and 4)} \) and ‘self-efficacy’ \( \text{(Model 3).} \)

Older age and not living with both parents were significant predictors of unsafe discotheque-visiting behavior.
behavior at all levels of the hierarchical model. This might reflect the fact that older adolescents and those not living with both parents have more opportunities to attend discotheques because they are less supervised by their parents, especially if it is assumed that a single parent might find it more difficult than two parents to monitor a child’s behavior.

In general, all visitors recognized a certain vulnerability of listening to high-volume music in discotheques.Remarkably,although visitors at risk considered the consequences of hearing symptoms as more severe than visitors not at risk for hearing loss,they did not consider hearing protection in discotheques to be useful,had no confidence in their ability to change their behavior and did not intend to change their behavior. When developing interventions, it could be useful to stress the severity of hearing loss and other problems, for example, by providing real examples of people who had lost hearing through listening to loud music.

Previously, it was found that visiting discotheques correlated with other general risk behaviors,such as smoking,underage drinking, staying out late and getting drunk [23]. Visiting discotheques seems to be a common part of many adolescents’ lives for which no intentional thinking is required. This would explain why habit strength was the strongest psychosocial predictor of unsafe visiting behavior. However, as suggested by Florentine et al. [24] it is also possible that a person has a dependency-like disorder underlying excessive listening to loud music.

### Table III. Characteristics of study population (n = 1086)

<table>
<thead>
<tr>
<th>Frequency in study population (unless otherwise specified)</th>
<th>P values&lt;sup&gt;c&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Total (n = 1086)</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Visitors not at risk&lt;sup&gt;a&lt;/sup&gt; (n = 819)</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Visitors at risk&lt;sup&gt;b&lt;/sup&gt; (n = 267)</strong></td>
<td></td>
</tr>
</tbody>
</table>

#### A. Sociodemographic

<table>
<thead>
<tr>
<th>Gender</th>
<th>Total (n = 1086)</th>
<th>Visitors not at risk&lt;sup&gt;a&lt;/sup&gt; (n = 819)</th>
<th>Visitors at risk&lt;sup&gt;b&lt;/sup&gt; (n = 267)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>47.0%</td>
<td>45.8%</td>
<td>50.6%</td>
</tr>
</tbody>
</table>

#### Secondary education

<table>
<thead>
<tr>
<th>Type</th>
<th>Total (n = 1086)</th>
<th>Visitors not at risk&lt;sup&gt;a&lt;/sup&gt; (n = 819)</th>
<th>Visitors at risk&lt;sup&gt;b&lt;/sup&gt; (n = 267)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Practical prevocational</td>
<td>16.9%</td>
<td>14.2%</td>
<td>25.1%</td>
</tr>
<tr>
<td>Theoretical prevocational</td>
<td>31.7%</td>
<td>30.1%</td>
<td>36.3%</td>
</tr>
<tr>
<td>Senior general secondary</td>
<td>25.5%</td>
<td>27.0%</td>
<td>21.0%</td>
</tr>
<tr>
<td>Pre-university</td>
<td>26.0%</td>
<td>28.7%</td>
<td>17.6%</td>
</tr>
</tbody>
</table>

#### Ethnicity

<table>
<thead>
<tr>
<th>Type</th>
<th>Total (n = 1086)</th>
<th>Visitors not at risk&lt;sup&gt;a&lt;/sup&gt; (n = 819)</th>
<th>Visitors at risk&lt;sup&gt;b&lt;/sup&gt; (n = 267)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Non-Western migrant</td>
<td>11.4%</td>
<td>11.1%</td>
<td>12.4%</td>
</tr>
</tbody>
</table>

#### Home situation

<table>
<thead>
<tr>
<th>Total (n = 1086)</th>
<th>Visitors not at risk&lt;sup&gt;a&lt;/sup&gt; (n = 819)</th>
<th>Visitors at risk&lt;sup&gt;b&lt;/sup&gt; (n = 267)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Not with both parents</td>
<td>18.6%</td>
<td>15.4%</td>
</tr>
</tbody>
</table>

#### Means (standard deviations)

<table>
<thead>
<tr>
<th>Total (n = 1086)</th>
<th>Visitors not at risk&lt;sup&gt;a&lt;/sup&gt; (n = 819)</th>
<th>Visitors at risk&lt;sup&gt;b&lt;/sup&gt; (n = 267)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age in years</td>
<td>14.8 (1.21)</td>
<td>14.6 (1.17)</td>
</tr>
</tbody>
</table>

#### B. Psychosocial

<table>
<thead>
<tr>
<th>Total (n = 1086)</th>
<th>Visitors not at risk&lt;sup&gt;a&lt;/sup&gt; (n = 819)</th>
<th>Visitors at risk&lt;sup&gt;b&lt;/sup&gt; (n = 267)</th>
</tr>
</thead>
<tbody>
<tr>
<td>CFC</td>
<td>–0.02 (0.58)</td>
<td>0.02 (0.57)</td>
</tr>
<tr>
<td>PMT</td>
<td>–0.25 (0.85)</td>
<td>–0.37 (0.83)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Total (n = 1086)</th>
<th>Visitors not at risk&lt;sup&gt;a&lt;/sup&gt; (n = 819)</th>
<th>Visitors at risk&lt;sup&gt;b&lt;/sup&gt; (n = 267)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rewards maladaptive response</td>
<td>1.16 (0.58)</td>
<td>1.14 (0.60)</td>
</tr>
<tr>
<td>Severity</td>
<td>0.69 (0.99)</td>
<td>0.73 (0.96)</td>
</tr>
<tr>
<td>Vulnerability</td>
<td>0.01 (0.87)</td>
<td>0.09 (0.85)</td>
</tr>
<tr>
<td>Response efficacy</td>
<td>–0.34 (1.19)</td>
<td>–0.23 (1.16)</td>
</tr>
<tr>
<td>Protection motivation</td>
<td>–1.15 (0.89)</td>
<td>–1.09 (0.90)</td>
</tr>
<tr>
<td>Habit strength</td>
<td>–0.40 (1.17)</td>
<td>–0.72 (1.05)</td>
</tr>
</tbody>
</table>

<sup>a</sup>Visitors not at risk for hearing loss are visitors that are estimated to have visited discotheques during <1.25 hours per week.

<sup>b</sup>Visitors at risk for hearing loss are visitors that are estimated to have visited discotheques during 1.25 hours per week or more.

<sup>c</sup>Visitors not at risk compared with visitors at risk

*P < 0.05, ***P < 0.001.
Visitors at risk for hearing loss reported to be significantly less interested in considering future consequences than visitors not at risk, at all levels of the hierarchical framework. Frequent visitors that do not wear hearing protection are probably more concerned with maximizing immediate benefits and may be more strongly influenced by the relatively more concrete and certain immediate consequences than by uncertain, probabilistic future outcomes [8]. Indeed these visitors also reported to experience rewards of the maladaptive response such as bodily pleasure and the opportunity to congregate without having to communicate, while visitors not at risk did not report to experience such rewards. According to Hetu and Fortin [25], feeling music through one’s body parts is a type of sensation that is sought as an integral part of the ‘listening’ experience; discotheque music is thus not listened to, but it is supposed to ‘possess’ those who are exposed. Furthermore, loud music provides adolescents with an opportunity to congregate without having to communicate; this is referred to as the ‘social noise phenomenon’ [26]. Because loud music prevents communication at distances of <1 m, it enables adolescents to move inside the personal space of members of the opposite sex in order to communicate with them, however, limited the mode of communication may be [26].

However, it is also suggested that at least some adolescents are willing to take the risk of suffering from hearing symptoms to feel the sensation of loud music [27]. This willingness to accept long-term

### Table IV. Multivariate ORs, 95% CIs and explained variance (Nagelkerke $R^2$) from hierarchical multilevel multiple logistic regression analyses with unsafe-visiting behavior$^a$ as dependent variable and demographic factors (Step 1), considering future consequences (Step 2), PMT constructs (Steps 3 and 4) and habit strength (Step 5) as independent variables

<table>
<thead>
<tr>
<th></th>
<th>Model 1 OR$^b$ (95% CI)</th>
<th>Model 2 OR$^b$ (95% CI)</th>
<th>Model 3 OR$^b$ (95% CI)</th>
<th>Model 4 OR$^b$ (95% CI)</th>
<th>Model 5 OR$^b$ (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Demographic factors</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age in years</td>
<td>1.67 (1.47–1.90)</td>
<td>1.70 (1.49–1.94)</td>
<td>1.76 (1.53–2.03)</td>
<td>1.76 (1.52–2.02)</td>
<td>1.61 (1.38–1.87)</td>
</tr>
<tr>
<td>Male</td>
<td>1.05 (0.78–1.42)</td>
<td>1.01 (0.74–1.37)</td>
<td>1.03 (0.75–1.42)</td>
<td>1.04 (0.75–1.43)</td>
<td>1.08 (0.76–1.53)</td>
</tr>
<tr>
<td>Educational level</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Practical pre-vocational</td>
<td>2.45 (1.53–3.92)</td>
<td>2.21 (1.37–3.56)</td>
<td>1.69 (1.02–2.81)</td>
<td>1.77 (1.06–2.96)</td>
<td>1.50 (0.86–2.61)</td>
</tr>
<tr>
<td>Theoretical pre-vocational</td>
<td>1.81 (1.19–2.74)</td>
<td>1.68 (1.10–2.56)</td>
<td>1.36 (0.88–2.11)</td>
<td>1.38 (0.89–2.15)</td>
<td>1.31 (0.81–2.12)</td>
</tr>
<tr>
<td>Senior general</td>
<td>1.30 (0.83–2.05)</td>
<td>1.26 (0.80–1.99)</td>
<td>1.19 (0.74–1.91)</td>
<td>1.20 (0.75–1.93)</td>
<td>1.11 (0.66–1.87)</td>
</tr>
<tr>
<td>Pre-university</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
</tr>
<tr>
<td>Non-Western migrant</td>
<td>0.80 (0.49–1.30)</td>
<td>0.89 (0.54–1.45)</td>
<td>0.86 (0.52–1.44)</td>
<td>0.88 (0.53–1.47)</td>
<td>0.67 (0.38–1.18)</td>
</tr>
<tr>
<td>Not living with both parents</td>
<td>2.09 (1.45–3.02)</td>
<td>2.11 (1.46–3.06)</td>
<td>1.95 (1.32–2.88)</td>
<td>1.95 (1.32–2.87)</td>
<td>1.83 (1.20–2.81)</td>
</tr>
<tr>
<td>CFC</td>
<td>0.56 (0.42–0.74)</td>
<td>0.64 (0.47–0.88)</td>
<td>0.65 (0.48–0.89)</td>
<td>0.68 (0.48–0.97)</td>
<td></td>
</tr>
<tr>
<td>PMT constructs</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rewards maladaptive response</td>
<td></td>
<td>1.94 (1.55–2.41)</td>
<td>1.90 (1.52–2.37)</td>
<td>0.78 (0.58–1.05)</td>
<td></td>
</tr>
<tr>
<td>Severity</td>
<td>1.64 (1.22–2.19)</td>
<td>1.63 (1.22–2.19)</td>
<td>1.48 (1.08–2.04)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vulnerability</td>
<td>1.11 (0.93–1.32)</td>
<td>1.10 (0.92–1.31)</td>
<td>1.20 (0.99–1.45)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Response efficacy</td>
<td>0.85 (0.68–1.07)</td>
<td>0.87 (0.69–1.09)</td>
<td>0.84 (0.66–1.08)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Self-efficacy</td>
<td>0.84 (0.72–0.98)</td>
<td>0.86 (0.73–1.00)</td>
<td>0.89 (0.75–1.05)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Protection motivation</td>
<td>0.90 (0.73–1.10)</td>
<td>1.09 (0.87–1.37)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Habit strength</td>
<td></td>
<td>3.36 (2.67–4.23)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Nagelkerke $R^2$  

<table>
<thead>
<tr>
<th>Model 1</th>
<th>Model 2</th>
<th>Model 3</th>
<th>Model 4</th>
<th>Model 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.148</td>
<td>0.171</td>
<td>0.255</td>
<td>0.257</td>
<td>0.414</td>
</tr>
</tbody>
</table>

$^a$Unsafe visiting means visiting discotheques during 1.25 hours per week or more.

$^b$The OR represents a one-unit change in the scale score.
risks for short-term perceived benefits is well documented in relation to other risk behaviors [28].

Prevention or risk reduction may be induced through promotion of protective behaviors among the adolescents themselves, or through health protection measures, i.e., aimed at rules, regulations and facilities that protect adolescents from potentially damaging high-volume music levels. To increase adolescents’ safe-listening behavior, insight into potentially important and modifiable mediators is needed to be able to develop effective intervention strategies. Findings from this study contribute to such insight. Future, specific evidence-based and theory-based studies—preferably longitudinal studies—should assess useful correlates in greater depth, including the roles of parental monitoring, because in the final level of the hierarchical framework, there was still a significant difference between adolescents living with both parents and those not.

Methodological considerations
The participation rate in this study was high, and the characteristics of the study group were representative of those in the general population of Dutch adolescents [13]. However, some limitations of the present study need to be addressed. We relied on adolescents’ self-reports. As no studies are available on the reliability and validity of adolescents’ self-reports on discotheque-visiting behavior, there is a risk for both over-reporting and under-reporting of such behaviors [29]. We did not measure the actual volume levels that the adolescents were exposed to, but applied conservative sound levels that were reported previously. In the absence of guidelines or requirements on exposure during leisure time, we applied occupational safety standards. However, given the fact that occupational safety standards rely on the combination of exposure level and duration, the World Health Organization and the Scientific Committee on Emerging and Newly Identified Health Risks have proposed that such a general model should equally be applied to other situations where sound has a detrimental effect such as that from music under leisure situations [1, 30]. Isolated visits to a discotheque do not in and of themselves cause healing loss, but rather repeated exposures over extended periods of time may. The cross-sectional nature implies that no causal relationships can be inferred [31].

We did not consider multiple comparisons within the analyses for the variable ‘educational level’, because it will lead to fewer errors of interpretation when the data under evaluation are actual observations on nature [32]. Identification of important psychosocial determinants on the basis of significance only might lead to overappraisal of variables with negligible effects in studies with large sample sizes. Therefore, we also took the size of the OR into account when discussing the results.

Conclusion
Specific target groups for hearing loss prevention due to discotheque attendance are older adolescents and those not living with both parents. Effective interventions should include the constructs ‘CFC’, ‘rewards of the maladaptive response’, ‘self-efficacy’, ‘severity’ and ‘habit strength’, because they have the potential to—directly or indirectly—influence discotheque visiting behavior. Operationalizations of these constructs may be found in previously published research [7]. However, because habit strength was the strongest predictor of unsafe visiting behavior, the results of the present study indicate that behavior change among adolescents might be difficult to achieve. As suggested by Weichbold and Zorowka [33], visiting discotheques may be part of current adolescent lifestyle and associated with peer-group standards. Also, incentives to attend a discotheque may be much stronger than the perceived threat of future hearing damage resulting from the loud music [33]. Furthermore, the possibility for an individual visitor to influence the level of music is very limited. To protect their hearing, theoretically they can apply hearing protection devices or opt to avoid such events, but such changes in behavior cannot reasonably be expected. In our study, only eight adolescents reported to always or nearly always wear hearing protection during discotheque visits, which is comparable to some previous findings [33], but
much lower than others [34]. Therefore, to reduce
the risk of music-induced hearing loss or tinnitus
among adolescents who attend music venues, envi-
ronmental interventions may be more effective,
such as keeping a certain distance clear around the
loudspeakers and to make easily available ‘ear rest
areas’ (areas with low-volume music) for regular
breaks, as well as hearing protection devices [35].
In addition, even volume-level limitations may be
warranted.

Funding

The Netherlands’ Organization for Health Research
and Development (ZonMw) Prevention Research
Program (#2100.0107).

Acknowledgements

We are grateful to the students who participated in
the study and to the staff of the Municipal Health
Services Fryslân and Nieuwe Waterweg Noord
who helped to recruit and motivate secondary
schools to participate in this project. Approval was
obtained from the Medical Ethics Committee of
the Erasmus MC, University Medical Center,
Rotterdam. The work was done entirely independ-
ently from the funder.

Conflict of interest statement

None declared.

References

1. Scientific Committee on Emerging and Newly Identified
Health Risks (SCENIHR). Potential health risks of exposure
to noise from personal music players and mobile phones in-
cluding a music playing function. 2008. Available at: http://
ec.europa.eu/health/ph_risk/committees/04_scenihr/docs/
2. Leitmann T. Lautstärke in Diskotheken. Eine Abschätzung
des Gehörschadenrisikos bei jungen Erwachsenen. Z Lärmb-
3. Green LW, Kreuter MW. Health Promotion Planning: An
Educational and Environmental Approach, 3rd edn. Mountain
4. Floyd DL, Prentice-Dunn S, Rogers RW. A meta-analysis of
research on protection motivation theory. J Appl Soc Psych-
5. Rogers RW. Cognitive and physiological processes in fear
appeals and attitude change: a revised theory of protection
motivation. In: Cacioppo J, Petty R (eds). Social Psycho-
physiology: A Sourcebook. New York: Guilford Press, 1983,
153–76.
In: Gochman DS, (ed.). Handbook of Health Behavior Re-
search 1: Personal and Social Determinants. New York:
7. Vogel I, Brug J, Van der Ploeg CPB et al. Young people’s
exposure to loud music: a summary of the literature. Am J
8. Strathman A, Gleicher F, Boninger DS et al. The consider-
ation of future consequences: weighing immediate and dis-
742–52.
9. Weinstein ND. Unrealistic optimism about susceptibility to
health problems: conclusions from a community-wide sam-
11. Vogel I, Brug J, Hosli El et al. MP3 players and hearing
loss: adolescents’ perceptions of loud music and hearing
12. Verplanken B, Orbell S. Reflections on past behavior: a self-
report index of habit strength. J Appl Soc Psychol 2003; 33:
1313–30.
14. Van Exel NJA, Koolman X, De Graaf G. Overweight and
Obesity in Dutch Adolescents: Associations with Health Life-
style, Personality, Social Context and Future Consequences:
Methods & Tables. 2005. Rotterdam, The Netherlands: Insti-
tute for Medical Technology Assessment (iMTA), 93.
15. Streiner DL. A checklist for evaluating the usefulness of
J Europ Union 2003; L42: 38-44. Available at: http://eue-
lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2003:042:
18. American Academy of Audiology. Position Statement:
Preventing Noise-Induced Occupational Hearing Loss.
2003. Available at: http://www.audiology.org/resources/
documentlibrary/Documents/niohlprevention.pdf. Accessed:
31 December 2007.
Acoustics—Determination of Occupational Noise Exposure
and Estimation of Noise-Induced Hearing Impairment. ISO
and hearing loss: opportunities for and barriers to
improving environmental conditions. Int J Audiol 2009;
48: 531–6.
Appendix

Appendix: Survey items

1 Sociodemographic characteristics
   - Are you a boy or a girl?
   - What is your date of birth?
   - What kind of education do you attend?
   - With whom do you share a household?
   - What is your country of birth?
   - What is your father’s country of birth?
   - What is your mother’s country of birth?

2 Music-listening behavior
   - Have you been to a discotheque in the last year?
   - On average over the last year, how many times per month did you go to a discotheque?
   - When you go to a discotheque, how long do you normally stay?
   - When you visit a discotheque do you normally use hearing protection?

3 Psychosocial constructs

A PMT

1 Rewards maladaptive response
   - Music in discotheques has to be played at high volumes because you can get totally lost in it
   - Music in discotheques has to be played at high volumes because you can dance better
   - Music in discotheques has to be played at high volumes because it makes the atmosphere better
   - Music in discotheques has to be played at high volumes because otherwise you have to talk too much

2 Severity
   - I think it is important to be able to hear well
   - I think it is a very serious matter not to be able to hear well
   - I find it very serious when I experience temporary hearing problems (tinnitus, muffled sounds or temporary hearing loss)
   - I think I would have a lot of trouble if I were not able to hear well
Appendix: Continued

- I would find it a very serious matter to have loss of hearing now
- I would find it a very serious matter to have loss of hearing in the future

3 Vulnerability
- I think it is possible for people of my age to suffer hearing loss because of listening to very high-volume music in discotheques

4 Response efficacy
- I think that hearing loss due to listening to high-volume music can be prevented by playing the music in discotheques not too loud
- I think it is useful to wear earplugs in a discotheque
- I think it is useful to take regular breaks of listening to high-volume music in discotheques, for example, by going outside for a while

5 Self-efficacy
- I am able to wear earplugs in a discotheque to protect my hearing when everybody does that

6 Protection motivation (intention)
- I intend to protect my hearing during discotheque visits from now on
- I am certain I am going to protect my hearing during discotheque visits from now on

B Habit strength
- Visiting discotheques with high-volume music is something I do automatically (without thinking)
- Visiting discotheques with high-volume music is something that is typically ‘me’