How Effective Are Pictograms in Communicating Risk: bout Driving-Impairing Medicines?

SUSANA P. MONTEIRO[1,2], REN´E HUISKES[1], LISET VAN DIJK[3], JULIA C.M. VAN WEERT[4], AND JOHAN J. DE GIER[1,2]

[1]Department of Pharmacotherapy and Pharmaceutical Care, University of Groningen, Groningen, The Netherlands
[2]Driving Under the Influence of Drugs, Alcohol and Medicines (DRUID) Project
[3]Netherlands Institute for Health Services Research (NIVEL), Utrecht, The Netherlands
[4]Amsterdam School of Communication Research/ASCoR, Department of Communication Sciences, University of Amsterdam, Amsterdam, The Netherlands

Objectives: To evaluate and compare the effectiveness of 2 pictograms in communicating risk in terms of respondents' level of
understanding, estimated level of driving risk, and intention to change driving behavior. The added value of a side-text was also investigated.

Methods: Two experiments were conducted among 270 drivers visiting a pharmacy. Experiment one used a 2 (rating model vs. triangle model pictogram, same side-text) × 3 (minor vs. moderate vs. severe driving risk) between-subjects design. Respondents (n = 30 per condition) were exposed to one of the 6 conditions. To verify the added value of the side-text, a 2 (rating model with side-text vs. rating model without side-text) × 3 (same categories as before) between-subjects design was used.

Results: Although the majority of the respondents understood that the pictograms were related to driving behavior, less than 10 percent and about 36 percent of the respondents looking at the triangle model and at the rating model, respectively, understood it fully. For all categories of risk, respondents who saw the rating model pictogram associated the pictogram significantly more often with risk of medication intake for driving than those who saw the triangle model pictograms. Those exposed to the triangle model overestimated the driving risk of the lowest category and underestimated the risk of the highest category; 78.8 percent of the respondents stated they were (very) likely to change their driving behavior if they were confronted with the pictogram. The added value of the side-text was not confirmed.

Conclusions: Despite not being fully self-explanatory in conveying warnings and safety-related information, the pictograms evaluated in this research

provided good insight into the different levels of driving risks, especially the rating model pictogram, because respondents' intentions to change their driving behaviors increased with higher categories of risk. The added value of the side-text in the rating model pictogram was not confirmed in this research. Pictograms can be seen as a valuable means to reinforce both written and spoken information given to patients by health care providers at the time of consultation.

INTRODUCTION

It has been known for many years that the consumption of psychoactive substances, such as sedatives, anxiolytics, or an- tidepressants, has risks and a potentially negative effect on the ability to drive (Davis et al. 2003), yet not much has been done to evaluate risk communication with regard to driving under the influence of driving-impairing medicines; for example, by using pictograms.

Risk communication is central to effective decision making in modern health care (Davis et al. 2003; Edwards and Elwyn 1999; Edwards et al. 2003; Paling 2003; Thomson et al. 2005) and constitutes the basis for informed patient consent (Gordon-Lubitz 2003; Paling 2003; Thomson et al. 2005).

Risk communication can be defined as an interactive process of exchange of information about risk (Lofstedt 2002, 2007, 2008a, 2008b; Lofstedt and Perri 2008), leading to a better understanding and better decisions about clinical management (Edwards et al. 2002, 2003; Thomson et al. 2005). It stimulates patients to weigh the risks and benefits of a treatment choice or behavioral (risk-reducing) change (Edwards and Elwyn 1999; Edwards et al. 2000). Visual displays of risk information, such as pictograms, are known to increase patient understanding of risk (Gordon-Lubitz 2003; Lofstedt 2008b; Paling 2003).

Pictograms are increasingly being recommended and used to convey warnings and other safety-related information (Katz et al. 2006; Mansoor and Dowse 2004) and are useful to communicate information to patients with low literacy (Dowse and Ehleres 2001, 2005; Hill and Roslan 2004; Houts et al. 2006; Mansoor and Dowse 2004; Morrell et al. 1990; Ngoh and Shepherd 1997).

Pictograms are known to enhance comprehension (Dowse and Ehlers 2001, 2005; Houts et al. 2001, 2006; Katz et al. 2006; Mansoor and Dowse 2004; Sorfleet et al. 2009), recall of information (Dowse and Ehlers 2001, 2005; Hill and Roslan 2004; Houts et al. 1998, 2006; Katz et al. 2006; Mansoor and Dowse 2004; Sorfleet et al. 2009), adherence (Houts et al. 2006; Katz et al. 2006), and communication across language barriers (Lemmon and Hyman 2006). To be effective, pictograms should make use of familiar objects and symbols (Dowse and Ehlers 2001; Hill and Roslan 2004; Ngoh and Shepherd 1997). The design should be simple, realistic, and with limited content (Hill and Roslan 2004) and the pictogram should, at all times, be self-explanatory (Houts et al. 2006). If these requirements are not considered during the development of pictograms, there is a higher chance that the message and/or concepts will be beyond patients' understanding.

PICTOGRAMS IN TRAFFIC SAFETY

In 2005, the European Union suggested the introduction of a compulsory and harmonized pictogram on medicines' packaging for driving-impairing medicines. Such pictograms should be based on the European classification of drugs ac- cording to their effects in the European Road Safety Action Programme as part of the "efforts to combat the scourge of drink-driving and find solutions to the issue of the use of drugs and medicines" (European Road Safety Action Program). Some European countries have already developed pictograms showing the potential risk of driving-impairing medicines (Gomez-Talegon et al. 2011) but only in France (French Ministry of Health and Solidarity 2005) and Spain (Spanish Ministry of Health, Social Services and Equality 2007) is the use of pictograms on the package of such medicines legally binding. France is the only country where a 3-tier labeling system was developed and printed on the box of all medicines de- pending on their level of risk (categories 1 to 3, Figure 1; Agence française de sécurité sanitaire des produits de santé

2009; Orriols et al. 2010), which can be seen as an advantage when compared to other pictograms that make no distinction between different levels of risk. However, the pictogram sys- tem existing in France (referred to as triangle model pictogram from this point forward) had the disadvantage of not show- ing all levels of risk in one picture. The triangle pictogram in isolation reflects which level of risk medicines represent (risk category) but has no frame of reference related to other levels of risk. Considering the latter, a new pictogram system was developed within the European DRUID (DRiving Under the Influence of Drugs, medicines and alcohol) project (DRUID project 2006; from this point forward, this pictogram will be referred as rating model pictogram) as a proposal to communicate the risk of driving under the influence of medicines to patients (Meesmann et al. 2011).

[FIGURE 1]

In the rating model pictogram (Figure 2), the various risks of impairing driving ability are displayed horizontally in a bar. From left to right, categories range from 0 (*no impairment*, which means no driving risk) to 3 (*severe impairment*, associated with a severe driving risk), which clearly places each level of risk within a range from 0 to 3, making it clear to the subject that the different levels of risk are relevant. A traffic-light color was given to each category because people tend to associate the color red with danger, the yellow with caution, and the green with safety (Veldhuijzen et al. 2006). Therefore, green (category 0), yellow (category 1), orange (category 2), and red (category 3) colors were chosen to represent each category.

[FIGURE 2]

Finally, the category attributed to a medicine is indicated by a triangle with a black car inside, because triangles are commonly associated with a warning message and the car is related to driving. A small text on the top of the pictogram saying "your risk in traffic" was added to avoid misunderstandings, allowing patients to associate the risk of taking this medicine and driving. The pictogram can also be

supplemented with side-texts. The side-text selected for each category is the same as the one present in the triangle model (Figure 1).

OBJECTIVES OF THE STUDY

The aim of the this study was to evaluate and compare the effectiveness of the rating and triangle model pictograms in communicating risk associated with driving-impairing medicines in terms of understanding, estimated level of driving risk, and intention to change driving behavior. The added value of a side-text in the rating model pictogram was assessed as well. The triangle model pictogram was selected for comparison because it was the only existing pictogram with a distinction between 3 different categories or levels of impairment and, as such, the only alternative yet for comparison.

Methods

Design

Two experiments were conducted among patients with a driver's license visiting a pharmacy. The first experiment involved a 2 (rating model pictogram vs. triangle model pictogram) ✕ 3 (categories of impairment: minor driving risk vs. moderate driving risk vs. severe driving risk) between- subjects design. The participating patients ($n = 30$ per condition) were exposed to one of 6 conditions in which the pictogram (rating model or triangle model pictogram) and the risk category (category 1, 2, or 3) were manipulated.

For the triangle model, the original pictogram was used, exactly as it is printed on the box of medicines known to impair driving fitness in France. As for the rating model, it was used as developed within DRUID. Both pictograms had the same side-text. In the second experiment, the added value of the side-text was examined by using a 2 (rating model with side- text vs. rating model without side-text) ✕ 3 (minor vs. moderate vs. severe driving risk) between-subjects design. Here, the respondents were exposed to the rating model pictogram with or without side-text and one of the 3 risk categories.

With the main aim of determining whether the questions asked during the interview were clear and to measure the average length of the interview, a pretest was conducted among 20 patients from a community pharmacy in Groningen, not part of the actual study.

A structured interview was carried out involving participants ($N = 270$) visiting 1 out of 4 selected Dutch community pharmacies located in Groningen and actively participating in traffic with motorized vehicles was carried out. Participants younger than 18 years old and those who could not speak or read Dutch were considered not eligible for the interview and were excluded.

The pictograms were affixed on a medicine box created for the present study. In total, 9 groups of 30 participants each were created: 3 rating pictograms with side-text (categories 1, 2, and 3), 3 triangle pictograms with side-text (categories 1, 2, and 3), and 3 rating pictograms without side-text (categories 1, 2, and 3). Participants were randomly exposed to a medicine box with 1 of these 9 pictograms. Because the rating pictograms with side-text could be used for both

experiment 1 and experiment 2, one group served both experiments. Table 1 shows how participants were distributed in each group.

[TABLE 1]

In The Netherlands, no approval from the medical ethics committee is needed for studies like this, because the study only included an interview about interpretation of pictograms in a general context (not related to received medication) after explicitly asking for patients' consent. Moreover, all health care professionals and respondents involved were adequately informed about the nature of the study and participated voluntarily and anonymously. Participants were interviewed in the waiting area of the pharmacy by a research associate.

Measurements

Due to the specificities of the questions related to risk perception, no validated examples of questionnaires were available. As such, the questionnaires were developed within the re- search group. Questions related to intention to change driving behavior were based on extensive work by Ajzen (n.d.). For the evaluation of the pictograms, the same measurements were used as in the study conducted by van Weert et al. (2011).

Understanding of the Pictogram

First, respondents were asked to give their free interpretation of the pictogram they were exposed to. The answers to these questions were discussed and judged by 2 of the researchers (S.P.M. and R.H.). An answer given by a respondent was considered to be fully correct when a reference to traffic and to driving risk in traffic (minor, moderate, and severe), expressed by the category of the pictogram (category 1, category 2, and category 3, respectively), was made. This was considered to be a key element in the interpretation of the meaning of the pictogram because the category is what differentiates different levels of risk of driving under the influence. The remaining answers, not necessarily wrong but incomplete, were interpreted and coded depending on the type of answer. Respondents' answers were categorized as (1) not correct (low level of under-standing of the meaning of the pictogram) if answers were not traffic related or related to the category; (2) traffic-related answers but describing a different category than the one shown; (3) traffic-related answers without a reference to the risk mentioned by the risk category; and (4) fully correct (high level of understanding) whenever participants' answers were traffic related with a correct reference to the risk depicted by the pictogram category.

Evaluation of the Pictograms

Respondents were asked to rate the pictogram on 5 items with a 7-point semantic differential scale that has been used in a previous study (van Weert et al. 2011). Items related to perceived ease (1 = *difficult*, 7 = *easy*), clarity (1 = *not clear*, 7

= *clear*), complexity (1 = *complex*, 7 = *not complex*), ease of understanding of the pictogram (1 = *difficult to understand*,

7 = *easy to understand*), and level of ambiguity (1 = *ambiguous*,

7 = *not ambiguous*) were used to estimate respondents' overall evaluations of the pictograms. Cronbach's alpha of the overall scale was 0.90.

Estimated Level of Driving Risk

Respondents could select one of the options given by a 5-point Likert scale ranging from *harmless* (1) to *very dangerous* (5). The options were thereafter coupled with the categories of impairment as follows: category 0: Likert scale options 1 and 2 = *very safe* and *safe*; category 1: Likert scale option 3 = *little danger*; category 2: Likert scale option 4 = *dangerous*; and category 3: Likert option 5 = *very dangerous*. The questions on risk perception were developed specifically for this study.

Intention to Change Driving Behavior

To answer the question, "How likely would you change your driving behavior if this pictogram was affixed to your medicine box?" a 5-point Likert scale, adapted from the theory of planned behavior questionnaire developed by Azjen (n.d.), was used (1 = *very unlikely* to 5 = *very likely*). Participants were also asked how they would change their driving behavior if a pictogram was shown on the medicine box. Answers to this question were driving equally, slightly less often, less often, much less often, not anymore.

Sociodemographic Characteristics

Sociodemographic items included in the questionnaire were gender, age, and educational level.

Analysis

Descriptive analysis was conducted to analyze respondents' characteristics, such as gender, age, and education level. A chi-square test of independence was used to investigate differences in gender, education level, and understanding of the pictograms between conditions (pictogram system) and an analysis of variance (ANOVA) was used to test whether there were differences in age between conditions.

To test the effects of the pictograms in experiment 1, two separate ANOVAs were conducted with the estimated level of driving risk and the intention to change driving behavior as dependent variables and the pictogram systems (rating model vs. triangle model) and risk categories (category 1, category 2, and category 3) as factors. The same analyses were conducted in experiment 2 but with the pictograms with and without side-text (rating model with side-text vs. rating model without side-text) and risk categories (category 1, category 2, and category 3) as factors. *t*-Test analyses were carried out to investigate differences in the categories (category 1, category 2, and category 3) within the pictogram systems included in experiment 1 (rating model vs. triangle model) and in experiment 2 (rating model with side-text vs. rating model without side-text) for the same dependent variables.

RESULTS

A total of 360 persons were approached. Of those 360 persons, 32 (75% females) did not possess a driver's license and were excluded. Of the remaining 328 persons, 58 (62.1% females) did not want to take part of the study for several reasons: no time (44.8%), no interest (29.3%), not feeling fit due to illness (12.1%), and other reasons (13.8%). The net response of the study was 82.3 percent: 270 out of 328 persons participated.

[TABLE 2]

Table 2 summarizes the relevant characteristics of the participants. The total study population was equally distributed in terms of gender ($N = 137$; 50.7% males). The mean age of the participants was 48.4 years old and almost half of the respondents had a university degree ($N = 123$; 45.6%). A chi- square test for independence showed no significant differences between gender and pictogram model (rating model with and without side-text and triangle model), $\chi^2(2, N = 270) = 1.452, P = .484$. The same analysis was conducted to investigate the association between education level and pictogram model. No significant association was found between these 2 variables, $\chi^2(4, N = 270) = 1.278, P = .865$. A one-way ANOVA test between age and pictogram model showed no significant differences, $F(2, N = 270) = 0.242, P = .785, \eta^2 = 0.001$.

Understanding of the Pictograms

Respondents were asked to interpret the pictogram they were shown. Answers were judged from right to wrong (see Methods section). As illustrated in Figure 3, 72.2 percent of the participants who were shown 1 of the triangle model pictograms ($N = 90$) did not make any reference to any category of impairment, compared to 46.7 and 36.0 percent of the respondents who looked at the rating model with and without side-text, respectively. The percentage of fully correct answers (traffic related with correct reference to categories of risk) was significantly higher with the rating model pictograms when compared to the triangle one (experiment 1), $\chi^2(3, N = 180) = 23.939, P < .001$. No statistically significant differences were found between the rating model pictogram with and without side-text (experiment 2), $\chi^2(3, N = 180) = 2.836, P = .418$. Looking at respondents' ages and education levels in the understanding of the pictograms, 9 out of 74 (12.2%) respondents between 20 and 39 years of age and 6 out of 70 (8.6%) respondents between 60 and 89 years of age gave incorrect answers and 21 out of 74 (28.4%) respondents between 20 and 39 years and 20 out of 70 (28.6%) respondents between 60 and 89 years old gave fully correct answers. Regarding education level, 5 out of 54 (9.3%) respondents with a low level of education and 11 out of 123 (8.9%) highly educated respondents gave an incorrect answer and 12 out of 54 (22.2%) respondents with a low education level and 41 out of 123 (33.3%) highly educated respondents gave fully correct answers. Age and education level did not statistically influence the interpretation of the pictograms (age: $\chi^2(6, N = 270) = 6.025, P = .420$; and education level; $\chi^2(6, N = 270) = 9.250, P = .160$). For all categories of risk, respondents who saw the rating model pictogram associated the pictogram

significantly more often with risk of medication intake for driving than those who saw the triangle model pictograms ($p_{(category1)} = 0.013; p_{(category2)} = 0.003; p_{(category3)} = 0.015$ calculated using the chi-square test).

Evaluation of the Pictograms

[FIGURE 3, 4 AND 5]

Respondents were asked to rate the pictograms on items related to perceived ease, clarity, complexity, ease of under- standing of the pictogram, and level of ambiguity. The mean evaluation scores for each pictogram system (rating model with side-text, triangle model, and rating model without side- text) were, respectively, 5.80 (SD = 1.12), 5.55 (SD = 1.12), and 5.76 (SD = 1.25). Overall, the pictograms were evaluated in the same manner by respondents (see Figure 4), without statistically significant differences between the 3 pictogram systems, $F(2,267) = 1.23$; $P = .294$, $\eta^2 = 0.009$. The results showed no significant interaction effects between risk category and pictograms (in both experiments 1 and 2) on the evaluation of the pictograms.

Estimated Level of Driving Risk

A comparison between estimated level of driving risk in all 3 pictogram models as well as a comparison between each category within a pictogram model were made. The overall estimated level of driving risk (1 = *harmless*; 5 = *very dangerous*) was not significantly different among the pictogram systems, $F(2,267) = 0.029$; $P = .972$, $\eta^2 < 0.001$. However, the results showed a significant interaction effect between risk category (categories 1 and 3) and pictograms (triangle model and rating model, experiment 1), $F(1,116) = 6.062$, $P = .015$, $\eta^2 = 0.05$. There was no difference in estimated driving risk between categories 1 and 3 of the triangle model. However, respondents exposed to category 1 of the rating model estimated a lower level of driving risk than those exposed to category 1 of the triangle model, whereas respondents exposed to category 3 of the rating model estimated a higher level of driving risk than those exposed to category 3 of the triangle model. Simple effect analysis revealed that respondents exposed to the rating model also reported a significantly higher driving risk for category 3 compared to category 2 and for category 2 compared to category 1. Within the triangle pictogram groups, these differences were not found. When analyzing differences per category in experiment 1, results of the estimated level of driving risk showed a significant difference, $t(58) = -2.263$; $P = .027$, between category 1 of the rating model ($M = 3.27$; SD = 0.69) and the triangle model ($M = 3.63$; SD = 0.55). Respondents exposed to one of the triangle model pictograms attached a similar level of danger to categories 1 ($M = 3.63$; SD = 0.55), 2 ($M = 3.80$; SD = 0.61), and 3 ($M = 4.03$; SD = 0.81), whereas respondents exposed to the rating model pictogram associated the category 2 ($M = 3.87$; SD = 0.57) and 3 ($M = 4.27$; SD = 0.58) pictograms of the rating model with more dangerous situations (experiment 1, Figure 5a). Perception of danger was not influenced by the presence of side-text in the rating model pictogram

(experiment 2) for any of the categories (see Figure 5b for statistical results). As displayed

in Figure 5b, the estimated levels of danger were, to a high
extent, comparable between respondents exposed to the rating model pictogram with or without side-text, indicating that the level of danger was well estimated from the rating model pictogram itself (without side-text). In this specific case, the side-text showed no added value for any of the categories.

Intention to Change Driving Behavior

Considering the intention to change driving behavior, 78.8 percent (213 out of 270) of the respondents stated that they were likely or very likely to change their behavior, regardless of the pictogram or the category presented. The intention to change driving behavior (considering all categories of risk) did not significantly differ among pictorial systems, $F(2,267) = 1.443; P = .238, \eta^2 = 0.01$. The results showed a significant interaction effect between risk category (categories 1 and 3) and pictograms (triangle model and rating model), $F(1,116) = 9.288, P = .003, \eta^2 = 0.07$. This indicates that, similar to the estimation of levels of driving risk, respondents exposed to the lower category of the rating model were less willing to change their driving behaviors compared to respondents ex- posed to the same category of the triangle model. However, respondents exposed to category 3 of the rating model were more willing to change their driving behaviors compared to respondents exposed to category 3 of the triangle model. Thus, when comparing the rating model with side-text and the tri- angle model (experiment 1) per category, it was found that the higher the category (or risk level), the greater the intention to change driving behavior for the rating model (Figure 6a) but not for the triangle model.
For experiment 2 (rating model with side-text and rating model without side-text), a significant interaction effect between risk category (categories 2 and 3) and pictograms, $F(1,116) = 4.448, P = .037, \eta^2 = 0.04$, was found as well. This indicates that respondents who were exposed to a category 1 rating model with side-text were less willing to change their driving behaviors than respondents exposed to a category 1 rating model without side-text, whereas respondents exposed to a category 3 rating model with side-text were more willing to change their driving behaviors than respondents exposed to a category 3 rating model without side-text.
As illustrated in Figure 6b, if respondents were exposed to the rating model with side-text, the willingness to change their behaviors increased with the category. If the respondents were exposed to the rating model without side-text, their intentions to change their driving behaviors were greater in categories 2 and 3 compared to category 1 yet still comparable in categories 2 and 3.

DISCUSSION
Approximately one third of the respondents fully understood the meaning of the rating model pictogram, with and without side-text, and these pictograms were significantly more related to the level of risk than the triangle model ones. The intention to change driving behavior increased with higher risk categories. The

added value of the side-text in the rating model pictogram was not confirmed in this research.

[FIGURE 6]

When used as the only source of information, the messages indicated by the pictogram models in this study were not fully self-explanatory in communicating the risk message. This percentage is low compared to recommendations from the American National Standard Institute (ANSI Z535.3) and the Organization for International Standardization's (ISO 3864), which state that, in a comprehension test, symbols must reach at least

85 percent (ANSI) or 67 percent (ISO) of correct answers to be considered acceptable (Dowse and Ehlers 2001; Mansoor and Dowse 2004).

Despite the performance of the pictograms, the results showed that the rating model pictogram with and without side-text was associated with more correct answers than the triangle model (35.6% vs. 7.8%, respectively). However, if one considers that the correct answer does not need to make reference to the category of the pictogram, the percentage of correct answers would be essentially the same in both pictogram systems (80% for the triangle model vs. 82.3% for the rating model). In this case, both pictograms could be considered as comprehensible according to the ISO 3864 norm. This indicates that the definition of correct answers used may have

been too strict. Because the results of experiment 2 showed that the side-text had no added value, differences in the interpretation could be explained by the layout and design of the rating model pictogram. It seems that the design of the rating model pictograms was better than the triangle model in conveying the information about the different levels of risk of driving under the influence of certain medicines. This is in line with previous research where the importance of an appropriate design of the pictograms was reported to influence the correct interpretation of the message (Houts et al. 2001; Mansoor and Dowse 2004; Ngoh and Shepherd 1997; Sorfleet et al. 2009; Veldhuijzen et al. 2006; Wolf et al. 2006). Nevertheless, it should be stressed that these pictograms alone are unlikely to provide the complete message. This relates to the fact that respondents linked the pictogram to a traffic-related message but the majority failed to successfully associate it with the ex- act risk message. This supports the idea that pictograms are relevant when used in combination with oral and/or written information given by health care providers to avoid misinterpretations of any kind (Dowse and Ehlers 2005; Katz et al. 2006) and to improve recall (Dowse and Ehlers 2001, 2005; Hill and Roslan 2004; Houts et al. 1998, 2006; Katz et al. 2006; Mansoor and Dowse 2004; Sorfleet et al. 2009).

Regardless of the type of pictogram, respondents associated higher categories with higher levels of driving risk (experiments 1 and 2), which led to higher estimations of danger. This outcome shows that, despite the lower percentage of fully correct answers regarding understanding of the pictogram, respondents were able to link the different levels of driving risks to a pictogram category. Category 1 pictograms of the rating model were associated significantly less with danger than the homologue from the triangle model (experiment 1), indicating that respondents tend to overestimate the lower categories of the triangle model

pictogram and underestimate the higher ones. In the authors' opinion, this could mean that the triangle model pictogram does not fully illustrate the magnitude of risk as well as the rating model because no reference to the number of categories was made, making it difficult for the target population to perceive the exact risk. The side-text did not have any added value to the estimated level of danger (experiment 2), implying that the design of the pictogram with the small line of text "your risk in traffic" was self-explanatory and, as a consequence, enough to estimate different levels of risk/danger. Respondents' understanding of different levels of driving risk, given by the pictogram category, was supported by the fact that respondents' intentions to change driving behavior increased with the categories of risk.

In general, respondents evaluated the triangle and the rating model (experiment 1) and the rating model with and with- out side-text (experiment 2) in a similar way. It was, however, expected that the rating model with side-text would have significantly higher evaluation scores than the equivalent model without side-text (experiment 2) to demonstrate the added value of the side-text. This result was unexpected but, simultaneously, indicates that the rating model pictogram was more self-explanatory than the triangle model.

The results of this study should be considered in the light of some limitations and strengths. First, this study was carried out in the general population and not among those patients

who take driving-impairing medicines and are, assuredly, the

most likely target population of the pictograms that were investigated. As presented, there could be an underestimation of the percentage of correct answers about the understanding of the pictogram's message due to the fact that the general population might not be aware of the different levels of risk, failing to give a complete and correct answer. Or, be- cause this was an open question, it could also be reasonable to hypothesize that respondents did not know that they were expected to be so specific about their travel risks; this was investigated, more precisely, with the perceived danger questions, which have shown higher percentages of understanding. Future research should be carried out in users of driving- impairing medicines to evaluate the real interpretation of the pictograms. The sample size, though common in this type of research (Stevens 2002), can also be considered to be small ($N = 270$). Nevertheless, it is believed that the findings of this study, namely, those related to estimated level of driving risk and intention to change driving behaviors, show a rather sound trend that might not change in a larger follow- up study. Another important limitation of the present study deals with the intention to change driving behavior instead of actual behavior. This variable might be affected by social desirability bias, leading to an overestimation of the results. However, it is well defined in the literature that behavioral intention is one of the best determinants of actual behavior (Armitage and Conner 2001). The results of this study showed that the intention to change driving behavior increased with the level of risk (higher categories), especially with the rating model pictogram, which gives consistency to the results achieved. Several studies showed the relevance of pictograms in health (Choi 2011; Dowse and Ehlers 2005; Houts et al.

2006). The present study, however, focuses on the use of pictograms in the field of medicines and driving and, to the best of our knowledge, it is one of the few

(Orriols et al. 2010; Veldhuijzen et al. 2006) in this field and the first one to evaluate the use of such pictograms. Another important strength of the present study is the high response rate and good design.

CONCLUSION

The pictograms in our study were not fully self-explanatory in conveying warnings and safety-related information because the majority of the respondents did not fully understand the meaning of the pictograms. The rating model pictogram generated more correct answers compared to the triangle model used in France. Despite the moderate level of understanding, respondents associated the high categories of risk to more dangerous situations, indicating a good estimation of driving risks. Moreover, in the presence of the pictograms used in this study, respondents were willing to change their driving behaviors by driving less frequently. Future research should focus on how effective pictograms are in communicating a risk message when complementing oral or written information given to patients by health care providers.

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TABLES AND FIGURES

Fig. 1. Triangle model pictogram on medicines and driving (color figure available online).

Fig. 2. Rating model pictogram with side-text: (a) category 1;(b) category 2; and (c) category 3 (color figure available online).
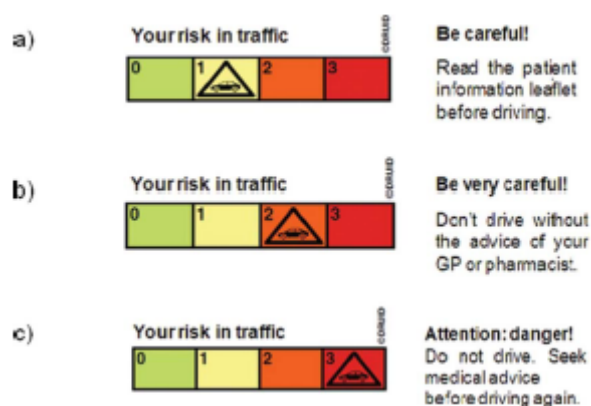
Table 1. Distribution of participants in experiments 1 and 2

Experiment 1—Rating model pictogram versus triangle model pictogram (both with side-text)
A total of 180 participants were included in the analysis where the pictogram with side-text (rating vs. triangle model) and the risk category (category 1, 2, or 3) were manipulated.
   90 participants evaluated the rating model pictogram.[a] Three subgroups were created to analyze each of the categories:
      30 respondents evaluated category 1 of the rating model pictogram.
      30 respondents evaluated category 2 of the rating model pictogram.
      30 respondents evaluated category 3 of the rating model pictogram.
   90 participants evaluated the triangle model. Three subgroups were created to analyze each of the categories:
      30 respondents evaluated category 1 of the triangle model pictogram.
      30 respondents evaluated category 2 of the triangle model pictogram.
      30 respondents evaluated category 3 of the triangle model pictogram.

Experiment 2—Added value of the side-text—Rating model pictogram with side-text versus rating model pictogram without side-text
A total of 180 participants were included in the analysis where the pictogram (rating model pictogram with side-text vs. rating model pictogram without side-text) and the risk category (category 1, 2, or 3) were manipulated.
   90 participants evaluated the rating model pictogram with side-text.[a] Three subgroups were created to analyze each of the categories:
      30 respondents evaluated category 1.
      30 respondents evaluated category 2.
      30 respondents evaluated category 3.
   90 participants evaluated the rating model pictogram without side-text. Three subgroups were created to analyze each of the categories:
      30 respondents evaluated category 1.
      30 respondents evaluated category 2.
      30 respondents evaluated category 3.

[a]Respondents who saw the rating model pictogram with side-text were the same in experiments 1 and 2.

Table 2. Characteristics of the respondents, stratified per pictogram ($N = 270$)

	Triangle model with side-text (experiment 1) ($n = 90$)		Rating model with side-text (experiment 1 and 2) ($n = 90$)		Rating model without side-text (experiment 2) ($n = 90$)		
	N	%	N	%	N	%	P-value
Gender							
Male	42	46.7	50	55.6	45	50.0	.484[a]
Female	48	53.3	40	44.4	45	50.0	
Age (in years)							
Mean ± SD	47.78 ± 14.57		48.19 ± 14.33		49.23 ± 14.52		.785[b]
Minimum	21		20		20		
Maximum	78		75		78		
Educational level							
Low	20	22.2	15	16.7	19	21.1	.865[a]
Intermediate	30	33.3	34	37.8	29	32.2	
High	40	44.4	41	45.6	42	46.7	

[a]P-value calculated using the chi-square test.
[b]P-value calculated using ANOVA.

Fig. 3. Respondents' understanding of the starting pictogram (n = 270; 90 respondents per pictogram group). The numbers presented in the graph are percentages.
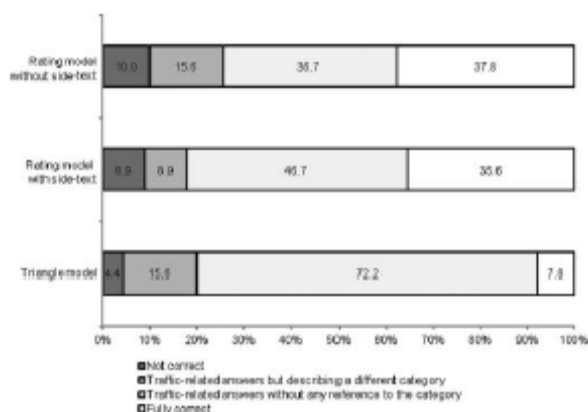

Fig. 4. Evaluation of the pictograms: (a) experiment 1 and (b) experiment 2. Every dot represents the mean evaluation value of 30 participants belonging to each category of the rating and triangle models pictogram. A t-test was conducted to compare differences between a single pictogram category and the pictogram model (experiments 1 and 2). A P-value < .05 was considered to be statistically significant (color figure available online).
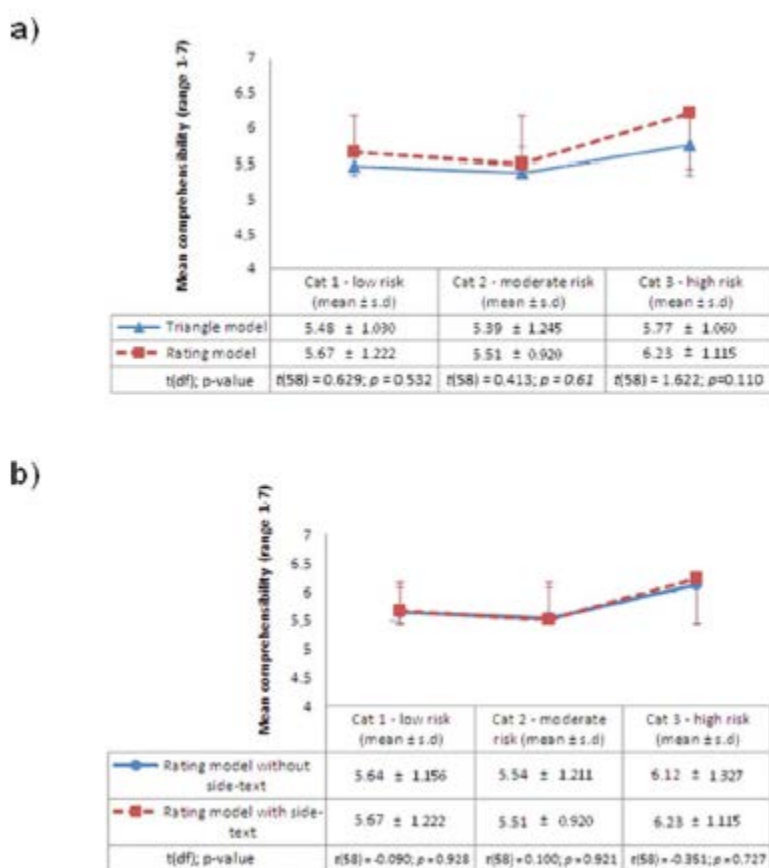
Fig. 5. Estimated level of driving risk: (a) experiment 1 and (b) experiment 2. Every dot represents the mean estimation of risk value of 30 participants belonging to each category of the rating and triangle models pictogram. A t-test was conducted to compare differences between a single pictogram category and the pictogram model (experiments 1 and 2). A P-value < .05 was considered to be statistically significant (color figure available online).
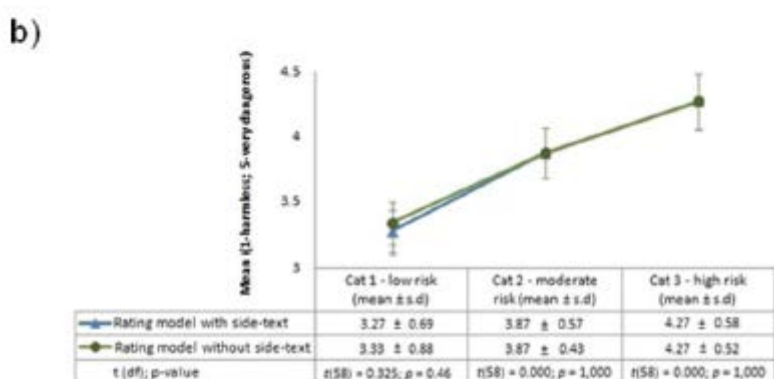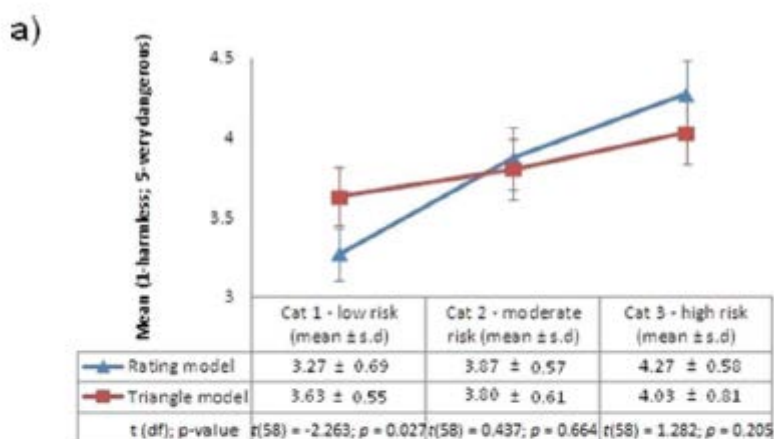
Fig. 6. Respondents' intention to change driving behaviors: (a) experiment 1 and (b) experiment 2. Every dot represents theme an intention value of 30 participants belonging to each category of the rating and triangle models pictogram. A *t*-test was conducted to compare differences between a single pictogram category and the pictogram model (experiments 1 and 2). A *P*-value < .05 was considered to be statistically significant (color figure available online).