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Monteiro, S.P.; van Weert, J.C.M.; de Gier, J.J.; van Dijk, L.

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Age and education related preferences for pictograms concerning driving-impairing medicines

Susana P. Monteiro[1,2,3], Julia C.M. van Weert[4*], Johan J. de Gier[1,2] and Liset van Dijk[3]

[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, the Netherlands

[3]NIVEL, Netherlands Institute for Health Services Research, Utrecht, the Netherlands

[4]Amsterdam School of Communication Research / ASCoR, Department of Communication Science, University of Amsterdam, Amsterdam, the Netherlands

Abstract

Purpose: Pictograms can increase public awareness about driving-impairing effects of medicines. However, pictograms that are not clear will negatively affect the comprehension of the message. Older and low educated adults are particularly vulnerable to misunderstandings. Comprehension is expected to be influenced by preference for the type of pictograph, but little is known about the preference of pictograms among drivers of different age groups and education levels. This study aims to investigate older and lower educated adults' preference for a pictogram (triangle model pictogram *versus* rating model pictogram) related to the influence of taking driving-impairing medicines on driving fitness.

Methods: Interviews among 270 drivers visiting a pharmacy were conducted. Participants were asked about their preference for the best pictogram expressing a warning message and expressing levels of impairment. A comparison between a pictogram with a more complex design (rating model) and an already implemented one (triangle model) was made.

Results: 74.4% of the participants preferred the rating model to express warning messages and 82.6% preferred this model to express levels of impairment. However, older and low educated participants were more likely to prefer the triangle model over the more complex rating model. Age was the strongest predictor influencing participants' preference for pictograms to express a warning message and levels of impairment. Young participants (18-39 years old) with high education level had the highest preference for the rating model, whereas older participants ($\geq$ 60 years old) with low education level showed the lowest preference for this pictogram system.

Conclusion: Age and education level are sensitive factors to be considered when designing a pictogram. In order to be equally well understood by older and low educated adults, pictograms should have a simple design and make use of familiar objects.

Introduction

Older patients (over 65 years) consume about one third of all prescribed medicines [1]. A substantial part of these patients use psychoactive substances, mainly benzodiazepines and opioid analgesics. These medicines act on the central nervous system and, thus, are likely to impair fitness to drive. The driving-impairing effects of such substances vary greatly, and several (pharmaco)epidemiological studies have shown an increased traffic accident risk associated with its use [2-4]. It has also been reported that older drivers lack awareness of the effects of psychoactive medicines on driving fitness [5]. The same holds true for adults with low education level. A recent study showed that patients with low education level had less knowledge about the influence of driving-impairing medicines than patients with high education level [6]. Raising older and lower educated adult's awareness of medicines and psychomotor fitness to drive safely is positively associated with driving self-regulating behaviours [7,8].

As an attempt to increase public awareness and knowledge of the driving-impairing effects of certain medicines [9,10] pictograms related to the influence of driving-impairing medicines on driving fitness were developed and implemented in some European countries, like the Netherlands, Denmark, Finland, Norway and, more recently, France and Spain [11]. The pictogram developed in France (triangle model) was considered to be a step forward, as it encompassed a 3-tier labelling system with a side-text (Figure 1). This system allowed making a distinction between different levels of impairment (category 1,2 or 3) of a medicine on driving fitness, but it failed to give an overall perspective of all the existent levels of risks in one single pictogram. To overcome this gap, a new pictogram (rating model) was designed within the European project DRUID – Driving Under the Influence of Drugs, alcohol and medicines [12], aiming at providing users of driving-impairing medicines with a straightforward and clear grading system (Figure 1). In comparison, the triangle model pictogram appears to have a simpler design than the rating model pictogram. Complex pictograms might be more difficult to understand, indicating that the rating model pictogram could be harder to understand. However, a recent study comparing these two pictograms found that the rating model was on average better understood than the triangle model [13].

When designing a pictogram it is important to recognize and take into consideration the preferences of the target population so that

Correspondence to: Julia C.M. van Weert, Amsterdam School of Communication Research / ASCoR, University of Amsterdam, P.O. Box 15791, 1001 NG Amsterdam, The Netherlands, Tel.: +31 20 5252091; E-mail: j.c.m.vanweert@uva.nl

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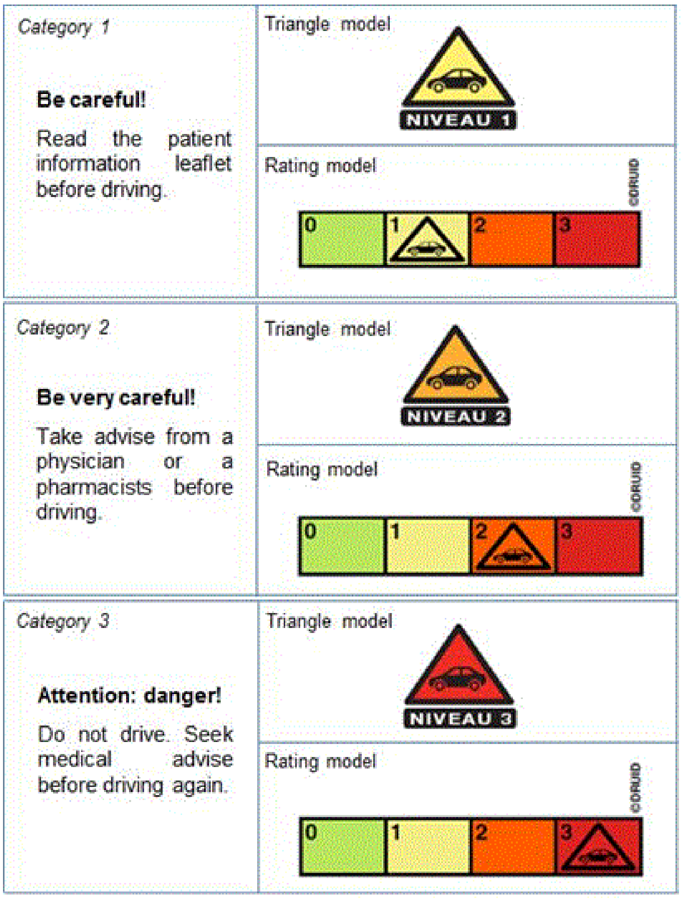

Figure 1. Representation of how participants were shown the pictograms that allowed them to answer the questions: "which pictogram better expresses the warning message?" and "which pictogram better express different levels of impairment?". The warning message for each category is presented on the left-side. For each category of impairment, participants were shown the correspondent triangle and rating pictogram at the same time.

the pictogram catches the target group's attention. According to the Elaboration Likelihood Model (ELM) of persuasion [14], an individual is more likely to find motivation and ability to centrally process information when the message contains relevant elements [14,15]. In other words, information that is tailored to individual preferences and interests is processed more deeply [16], which is expected to improve comprehension and recall of information [14,17,18].

Despite some advantages associated to its use, especially in conveying warning messages [9,10,19-25], pictograms are figures representing ideas and concepts which may not always be clear to all, affecting the comprehension of the message [26,27]. Older and low educated adults are recognized to be particularly vulnerable to misunderstandings and often times have difficulties interpreting the message being conveyed [26-32]. Regardless of the growing number of pictograms related to driving-impairing medicines that have been developed in the past few years, to the best of our knowledge no published studies investigated the preference for driving-impairing pictograms by older adults or people with low education levels. In order to fill this existent gap, this research aims to investigate older and lower educated adults' preference for a pictogram related to driving-impairing medicines (triangle model pictogram *versus* rating model pictogram).

Methods

Study design

This study among patients with a driving license visiting a pharmacy was part of a larger study existing of an experiment with a 2 (rating model pictogram versus triangle model pictogram) by 3 (categories of impairment: minor driving risk versus moderate driving risk versus severe driving risk) between-subjects design, followed by an interview. Ninety participants were interviewed per pictogram category (category 1, 2 or 3), in total 270 participants. As illustrated in Figure 1, participants were shown at the same time the same category of the triangle and rating model pictograms with the side-text message next to it. A pre-test was conducted in a small sample ($n = 20$) of patients visiting a community pharmacy, not part of the actual study. The pre-test served to test the clarity of the questions asked and to estimate the time needed to complete the interview. No adjustments were necessary after the pre-test.

The study was conducted in four selected Dutch community pharmacies located in Groningen, the Netherlands. Inclusion criteria were 1) actively participating in traffic with motorized vehicles; 2) aged 18 years or older and 3) being able to speak and read Dutch. The interview was carried out in Dutch and participants were interviewed in the waiting area of the pharmacy by a research associate. The interview consisted of four distinct parts: 1) socio-demographic characteristics of the participant, 2) general knowledge about medicines and driving, 3) specific questions about the pictogram, and 4) comparison between 2 pictograms. The current study only focuses on the first and the fourth part of the interview. For parts 2 and 3, participants were randomly exposed to only one out of three possible pictograms (triangle model, rating model with side-text and rating model without side-text) to investigate the pictograms' effectiveness in understanding the message. The results have been published elsewhere [13]. In total, 270 participants were needed for this study. Data-collection stopped once this number was reached (see results for response rates).

In the Netherlands, no approval from the Medical Ethic Committee is needed for studies like this, since it only included an interview about interpretation of pictograms in a general context (not related to medication received) after explicitly asking for patients' informed consent. Moreover, all healthcare professionals and participants involved were adequately informed about the nature of the study, participated voluntarily and anonymously.

Measurements

The pictogram preference (triangle or rating model pictograms) was investigated by asking participants "which pictogram better expresses the warning message?" and "which pictogram better expresses different levels of impairment?". For both questions, participants were shown at the same time the triangle and the rating model corresponding to one pictogram category (category 1,2 or 3) and had to select the pictogram of their choice, i.e., only one pictogram could be of their preference (Figure 1). Despite their association (X^2 (1, 270) = 121.8; $p < 0.001$), the two items were used as two separate dependent variables, as we believed that, in case participants do have different preferences with regard to the warning level and the level of impairment, this would be helpful to draw conclusions about the best pictogram. Additionally, it allowed us to investigate who were the participants that changed their preference depending on the pictogram message.

Age and education level were the main independent variables. To assess age differences in the outcomes, the following age intervals were used: younger participants (18-39 years), middle aged participants (40-59 years), and older participants (60 years and older) [33,34]. Education level included low (not completed primary school, completed primary school, lower professional education), intermediate (moderate professional education) and high (higher educational or university degree) levels.

Gender (male, female), pictogram risk category (1,2 or 3) and pictogram shown at the start of the interview (triangle model, rating model with or without side-text) were used as control variables.

Statistical analysis

Descriptive analysis was conducted on participants' characteristics, such as age, education level and gender. ANOVA and chi-square tests of independence were used, where appropriate, to investigate differences in age, education level and gender between participants exposed to different conditions, i.e., pictogram systems (triangle model, rating model with side-text, rating model without side-text).

Chi-square tests of independence were conducted to investigate differences in participants' preference for one pictogram to express a warning message and to express levels of impairment. Univariate analysis was used to investigate whether there were age and education level differences in the preference for one pictogram system (triangle or rating model pictograms).

Multiple logistic regression analysis was used to assess the influence of age and education level on participants' preference for the pictogram in expressing a warning message (model 1) and on levels of impairment (model 2). These models were controlled for gender, pictogram's category, and pictogram shown at the start of the interview. A p-value of < 0.05 was considered to be statistically significant.

Results

A total of 360 persons were approached; 32 (of whom 75% females) did not possess a driving license and were excluded. Of the remaining 328 persons, 58 (62.1% females) did not want to take part in 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%; 270 out of 328 eligible persons were included in this study.

The total study population was equally distributed in terms of gender (n = 137; 50.7% males). The mean age of the participants was 48 years-old (sd = 14.4; range 20-78 years; 27.4% (n=74) "18-39"; 46.7% (n=126) "40-59" and 25.9% (n=70) "69-79"). Regarding education level, 20.0% (n=54) of the participants had low education, 34.4% (n=93) had intermediate level and 45.6% (n=123) had high education. No significant differences were found between age (F (2, 270) = 0.242, p = 0.785), education level (X^2 (4, 270) = 1.278, p = 0.865), and gender X^2 (2, 270) = 1.452, p = 0.484) between conditions.

The percentage of participants preferring the rating model (201 out of 270; 74.4%) to express a warning message was significantly higher than those preferring the triangle model (69 out of 270; 25.6%), X^2(1,270) = 12.6, p < 0.001. Statistically significant differences between preference for one pictogram and age were found, F (2, 267) = 6.39, p = 0.002; older adults (> 60 years old) were more likely to prefer the triangle model pictogram over the rating model. This group significantly differed from middle aged participants (p = 0.035) and younger participants (p = 0.002) which have shown preference for the rating model pictogram to express a warning message. Statistically significant differences were found, F (2,267) = 4.67, p = 0.01, between pictogram preference and education level; participants with lower education were more likely to prefer the triangle model whereas participants with intermediate and high education levels preferred the rating model pictogram to express a warning message.

Results from the multiple logistic regression (Table 1) confirmed the previous results and showed that age was the strongest predictor influencing preference for pictograms expressing warning messages. The independent variables explained 17.6% of the variance for pictogram preference in explaining warning messages.

As for the best pictogram expressing levels of impairment, 82.6% (223 out of 270) of the participants preferred the rating model pictogram. Results indicated statistically significant differences between pictogram preference and age, F (2, 267) = 14.21, p < 0.001, and between education level and the condition, F (2, 267) = 7.62, p = 0.001. According to the multiple regression model (Table 1), age was the strongest predictor influencing preference. Participants between 20-39 years-old and 40-59 were, respectively, 11 and almost 4 times more likely to prefer the rating model pictogram over the triangle one when compared to participants between 60-79 years-old (reference group). Educational level also had an impact: participants with intermediate and high level of education were, respectively, 2 and 3 times more likely to prefer the rating model to express different levels of impairment than those with low education level. The independent variables explained 26.7% of the variance.

Participants preferred the rating model to express both a warning message and levels of impairment, but the percentage decreased among elderly and participants with lower educational level.

Combining the influence of age and education level in participants' preference for the rating model pictogram (Figure 2), it can be depicted that participants in the category "younger (18-39 years old) with high education level" (n=46) had the highest preference for the rating model pictogram in expressing a warning message, whereas participants in the category "older (> 60 years old) with low education level" (n=10) showed the lowest preference for this pictogram system. Similar results were found regarding the preference for the rating model system in expressing levels of impairment (Figure 2). No interaction effects between age and education level were found, F (4, 270) = 0.81, p = 0.52.

Some participants shifted their preference between pictograms (Figure 2). From those who preferred the triangle model to express a warning message, 39.0% (27 out of 69) considered that the rating model pictogram was best to express levels of impairment. Those who preferred the rating model to express a warning message, 2.5% (5 out of 201) considered that the triangle model pictogram was best to express levels of impairment. Table 2 displays the characteristics (age and education level) of the participants who did and who did not changed their preference for one pictogram depending on the message being conveyed.

Discussion

This research investigated participants' preference for one pictogram related to driving-impairing medicines and its risk in traffic. Both pictograms conveyed the same message but differed in the design. The rating model pictogram was more complex than the triangle model, requiring more complex cognitive aspects to process and integrate the information. Even so, the rating model pictogram was preferred over the triangle model pictogram to express both a warning message and

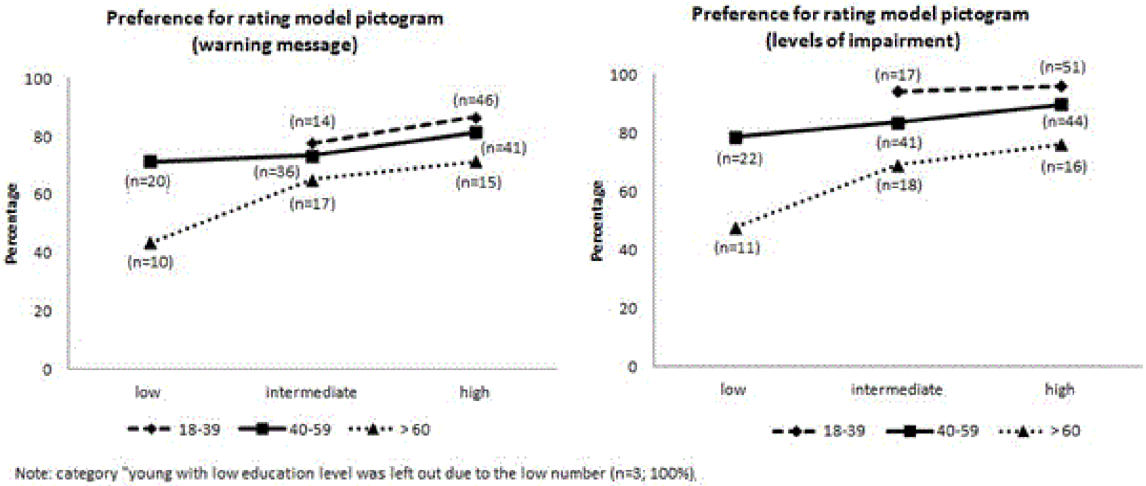

Figure 2. Preferences for the rating model to express a warning message and levels of impairment depending on participants' age and education level.

Table 1. Factors influencing participants' preference for one pictogram in expressing warning messages and levels of impairment: multiple logistic regression analysis. [a]0=Triangle model; 1=Rating model. *P-value < 0.05 considered to be statistically significant.

	Preference for pictogram model in expressing a warning message (N=270)[a]			Preference for pictogram model in expressing levels of impairment (N=270)[a]		
Independent variables	Odds-Ratio	95% CI for OR		Odds-Ratio	95% CI for OR	
	Ratio	lower	upper	Ratio	lower	upper
Age Categories (60-79 used as reference)						
20-39	3.11*	1.27	7.63	11.26*	2.94	43.12
40-59	2.30*	1.15	4.62	3.72*	1.7	8.15
Education level (low level as reference)						
Intermediate	1.35	0.63	2.89	1.94	0.82	4.56
High	2.08	0.93	4.62	2.81*	1.12	7.06
Control variables						
Gender (0=female; 1=male)	1.08	0.58	2.00	1.33	0.63	2.79
Pictogram category (category 3 as reference)						
Category 1	1.91	0.95	3.88	2.44*	1.02	5.83
Category 2	2.35*	1.12	4.94	1.71	0.72	4.05
Pictogram shown at the start of the interview (triangle model as reference)						
Rating model with side text	2.83*	1.39	5.77	2.30*	1.01	5.20
Rating model without side text	2.99*	1.46	6.12	4.16*	1.68	10.31
Nagelkerke R2	0.176 (17.6%)			0.267 (26.7%)		
p-value (model)	< 0.001*			< 0.001*		

Table 2. Participants' preferred pictogram to express warning messages and levels of impairment.

	Preferred pictogram to express a warning message → Preferred pictogram to express levels of impairment				
	Triangle n (%)	Rating n (%)	Rating n (%)	Triangle n (%)	P-value
Age categories					
20-39 (N=74)	3 (4.1)	63 (85.1)	8 (10.8)	0	
40-59 (N=126)	16 (12.7)	93 (73.8)	14 (11.1)	3 (2.4)	< 0.001
60-79 (N=70)	23 (32.9)	40 (57.1)	5 (7.1)	2 (2.9)	
Education level					
Low (N=54)	18 (33.3)	33 (61.1)	3(5.6)	0	
Intermediate (N=93)	13 (14.0)	63 (67.7)	13 (14.0)	4 (4.3)	< 0.001
High (N=123)	11 (8.9)	100 (81.3)	11 (8.9)	1 (0.8)	

levels of impairment in all age groups and education levels. However, older and low educated participants demonstrated to have less preference for the more complex rating model and they were also less likely to change their opinion towards this more complicated model. This study confirmed that both age and education level are sensitive aspects to be considered when designing a pictogram to be equally well understood by older adults and those who have a low education level.

Adults over 65 years old represent a substantial and increasing proportion of drivers [35]. This group is also known to chronically take several medications, some of them recognized to impair driving fitness [35]. Considering that this group of the general population is not always fully aware of the risks posed by their medication intake [1,35], it is important to find strategies that will help these patients, not only to be fully aware of the risks of taking driving-impairing medicines, but also to be able to discuss these issues with a health care provider.

Assuming that preference can help understanding, since the use of familiar objects or messages can foster information processes (Elaboration Likelihood Model of persuasion [14]), hypothetically it could be argued that a pictogram that is preferred has a higher chance of being well understood and, therefore, effective in conveying messages. Results from this study indicate that the rating model pictogram was preferred over the triangle model and, therefore, can be seen as an effective tool to communicate the risk of driving under the influence of driving-impairing medicines to patients throughout all ages and education levels. Additionally, in another study, the warning message conveyed by this pictogram model was better understood than the triangle model [13].

However, the proportion of participants above 60 years old and with low education preferring the pictogram model to express warning messages and levels of impairment decreased. This indicates that the rating model pictogram seems more suitable to younger and high educated participants than to older and low educated participants. A possible explanation for this deals with the fact that the design of the rating model pictogram, though more complete than the triangle model, is more complex and, therefore, may be more difficult to understand. This result is not surprising as, nowadays, complex pictograms and signs are widespread and part of daily life routines. Those who are younger and higher educated tend to be more prone to understand and follow those instructions, making them more adjustable to unfamiliar and complex pictograms. On the other hand, older and low educated adults respond better to what they are used to [36] and are highly penalized when they are requested to interpret icons with complex messages that require more cognitive resources for interpretation [36]. Applying this to the present study, it is reasonable to assume that familiarity influenced older and low educated participants' preference for the triangle model pictogram. A stand-alone triangle (triangle model pictogram), can be more familiar than a rating scale with a triangle inside (rating mode pictogram) as it may recall caution or dangerous situations. Additionally, triangles are commonly used in traffic. Familiarity can equally explain why old and low educated participants were more reluctant to change their preference, as they were less likely to prefer a different pictogram to explain different information.

Despite the encouraging results of the rating model pictogram, which seem to be well designed and able to convey a warning message and different levels of warning risk, attention should be paid to the fact that results on another study using on the understanding of the rating pictogram showed that 35.6% (32 out of 90) of the participants were able to fully understand the meaning of the pictogram, i.e., were able to identify a traffic-related message and made a reference to the risk category [13] Worth mentioning that, in that same study, the percentage of participants who fully understood the message conveyed by the triangle model was notoriously lower (7,8%, 7 out of 90). This re-enforces the message that pictograms should, at all times, be accompanied by other information given to patients at the time of consultation, by a healthcare provider. In this way, the efficacy of the message given to the patient can be improved.

This study should be seen in the light of some limitations and strengths. The main limitation of the study deals with the fact that the population might not be representative of the general population as this study was conducted in a small convenient sample (N=270) in the North of the Netherlands. Nevertheless, results from this study confirm that attention should be paid to specific target groups, namely older people and those with low education level, when designing pictograms which are known to be particularly useful for these two specific target groups. Another limitation deals with the fact that participants were shown one of the pictograms prior to being asked to indicate the one of their preference. Albeit this variable had been controlled for, it could have had an impact in the preference for one pictogram. Previous research indicated that familiarization plays an important role in understanding, as discussed above. The present study is, to be best of authors' knowledge, the first one attempting to compare two pictograms related to the use of driving-impairing medicines and to investigate which one better illustrates warning messages in participants' opinion.

Conclusion

The more complex rating model pictogram was preferred over the triangle model throughout the whole population, but this preference is more emphasized among younger adults and those with high education levels. Age and education level were among the tested predictors, the ones influencing the most preference for one pictogram. Clearly, young and high educated respondents preferred the rating model, with a more complex design, whereas older adults and those with lower education levels preferred the triangle model.

Future research should evaluate the rating and triangle model pictograms among different target groups who take driving-impairing medicines and drive. If a pictogram related to driving-impairing medicines is to be implemented, specific training to healthcare providers regarding this topic should be given, as the pictogram may raise some questions from patients which need to be answered. It is equally important that health care providers are aware that older and low educated patients need special attention as they are particularly sensitive to pictograms and their understanding of the meaning of the pictograms is not always straightforward.

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Disclosure

The authors do not have any conflict of interest to declare.

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