

Too fast for these conditions? Factors influencing drivers' choice of speed

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Abstract

The choice of inappropriate speeds by drivers is one of the oldest and most difficult road safety issues. This paper describes the results of two experiments investigating the factors influencing drivers' choice of speeds on rural roads. In the first experiment the influence of trip purpose and individual differences on speed choice was examined. The results showed large differences between speeds chosen for different driving purposes; the lowest speeds were chosen when the goal was economy and the highest when driving for fun. In addition, there were individual differences in speed preferences such that some drivers indicated that their usual speed was above what they believed was a safe speed while others indicated that they usually drove even slower than what they thought was safe. The second experiment investigated the relationship between the visual appearance of rural roads and drivers' choice of speed on those roads. Previous research has shown that how a road looks can affect drivers' perception of their speed, and as a result influence the speed they choose, in some cases without them being aware of it. In this experiment drivers completed a picture sort task and then indicated their preferred speed, safe speed, and likely speed limit for 34 rural road scenes. The results indicated that perceived difficulty was the best predictor of participants' speed choices. The results are discussed in terms of identification of road characteristics that can help distinguish behaviourally relevant road categories and produce better speed compliance independently of enforcement.

Introduction

Traffic crashes represent a worldwide problem and drivers choosing speeds that are too fast for the conditions has been regarded as a main contributor to this problem (af Wåhlberg, 2006). Speed limits and their enforcement have been the most widespread attempt to make drivers choose safe speeds (Elvik, 2010). In spite of enforcement and safety campaigns 50 % of drivers are reported to break the speed limit every day (Yannis, Louca, Vardaki & Kannelaidis, 2013). This non-compliance suggests that other factors are involved in drivers' speed choice.

These factors appear to include some combination of drivers' motivations and purpose for the trip and expectations and habits formed from prior exposure to the roads they are travelling. It has been widely acknowledged that drivers have very different reasons for driving, and that these different goals have a significant influence on drivers' speed choices (Michon, 1985). In one study, roadside interviews revealed that different driving goals (or motives) were associated with substantially different speed choices (Shinar, 2001, cited in Oppenheim & Shinar, 2011). The highest speeds were chosen when drivers were asked to select a speed that would maximise pleasure or the fun of driving. The lowest speed choices occurred when drivers were asked to consider economy or safety.

The visual features of the road, and drivers' familiarity with them, also play an important role in drivers' speed choice. Weller, Schlag, Friedel, and Rammin (2008) asked participants to rate and sort photographs of a variety of rural roads. Participants tended to group rural roads into three broad categories based on lane width and road markings and these categories successfully predicted participants' ratings of the appropriate speed for each road. Investigating the effects of familiarity on driver behaviour, Charlton and Starkey reported that as drivers' amount of practise with a simulated rural road increased, their speed choice became increasingly consistent (Charlton &

Starkey, 2013). Changes to the visual appearance of familiar roads, without any changes to the road geometry, led to increased ratings of driving difficulty and greater speed variability.

Better understanding of these (sometimes conflicting) motivations underlying drivers' speed choices may be a key to addressing the problem of speed heterogeneity and non-compliance with speed limits. The goal of the present research was to extend the research described above by: 1) comparing drivers speed preferences (the speed drivers' like to drive at when motivated by different trip purposes) across a range of familiar rural roads; and 2) to identify the road features that most influence drivers speed choices using picture-sorts and subjective ratings of familiar rural roads.

Experiment 1

Method

193 drivers (96 male, 96 female, 1 who preferred not to indicate gender) were approached in car parks at five locations. Participants' ages ranged from 17 to 85 years ($M = 43$ years, $SD = 15.6$), and the majority of the participants held a full driving license (full license, $n = 160$; restricted license, $n = 27$; and learner's license $n = 3$). Ethical approval for the recruitment and test protocols was received from the School of Psychology Research Ethics Committee at the University of Waikato.

Drivers were approached with a verbal invitation to participate in a short questionnaire as they were walking from their cars. Drivers were then asked several questions about the road they had just used to reach the interview location, including: what speed they had just driven on that road (self-reported speeds); what speeds they would prefer to drive on that road to save money on fuel (eco speed); to drive safely (safe speed); to maximise the fun of driving (fun speed); and their usual speed on that road (usual speed) (as in Oppenheim & Shinar, 2011). Participants were then asked what they thought the posted speed was on that road (speed limit belief).

Results

The participants' speed ratings for roads with 100, 80 and 60 km/h limits are shown in Figure 1. As can be seen in the figure, the speed ratings associated with each speed limit were distinctly different from each other but the five ratings showed the same pattern of responses across the three speed limits. A 3 x 5 mixed design ANOVA showed that the ratings for the three speed limits were significantly different across the five speed ratings (self-reported speed, usual speed, eco speed, safe speed, & fun speed); [$F(2,144) = 121.38, p < .001, \eta_p^2 = .628$]. There was a significant difference between the five ratings [$F(4,576) = 25.26, p < .001, \eta_p^2 = .149$] but no interaction between speed limit and rating type [$F(8,576) = .494, p = .861, \eta_p^2 = .007$]. Bonferroni-adjusted pairwise comparisons indicated that ratings of fun speeds were significantly higher than all other speed ratings [$ps < .001$] while the lowest speed ratings were for eco speeds, which were significantly lower than all other speed ratings [$ps < .05$]. Mean ratings of safe speeds, usual speeds, and the self-reported speed for that day's drive was not significantly different [$ps > .05$].

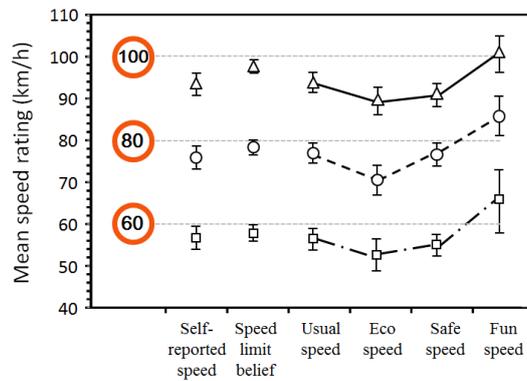


Figure 1. Comparison of mean speed ratings (km/h) for roads with three different speed limits. Lines show 95 % confidence intervals.

Experiment 2

Method

65 participants were recruited for this experiment. One participant requested that her data be withdrawn shortly after her completion. Of the 64 remaining participants (23 male, 41 female), ages ranged from 19 to 70 years of age ($M = 39.1$, $SD = 14.15$) with all but two having a full New Zealand Driving license (exceptions held a restricted licence and a learner's license). Ethical approval for the recruitment and test protocols was received from the School of Psychology Research Ethics Committee at the University of Waikato.

Participants first completed a picture sort task in which they were asked to divide a randomly ordered stack of 34 A3 size photos of roads into piles so that their behaviour on the roads in one pile was the same and different to the roads in a different pile. The 34 photos used in this study were taken from high-definition video recorded from the driver's point of view on rural roads in the local region (and some participants volunteered that they were familiar with the roads in the photos). Following the picture sort the participants were then asked to give several ratings of how it would feel to be driving on the road in each photo including: how comfortable, how difficult, how monotonous (all on a scale of 1 to 5), what speed they would choose, what they thought was a safe speed, what they thought the speed limit was, and how safe they would feel (on a scale of 1 to 10).

Results

The number of times each photo was placed in a pile with each other photo was used to construct a similarity matrix for all 34 photos. The similarity data were used to form a two-dimensional multidimensional scaling solution (normalised raw stress = .056, dispersion accounted for = .944). The similarity data were then used in a hierarchical clustering analysis which was superimposed on the scaling solution in Figure 2 (after Riemersma 1988). The figure identifies six non-overlapping road clusters as follows: C1 = bridges, C2 = merge lanes and intersections, C3 = divided median roads, C4 = two lane straight roads, C5 = gentle horizontal curves, C6 = severe curves. The figure also shows the mean speed choice and difficulty ratings for the six road clusters. A one-way Manova examining all six ratings (comfort, difficulty, monotony, speed choice, safe speed, and risk) indicated the six clusters were significantly different [Wilks' Lambda = .143; $F(30,33) = 27.053$, $p < .001$, $\eta_p^2 = .961$] with the univariate Fs for each rating measure also showing significant differences between the clusters ($ps < .001$).

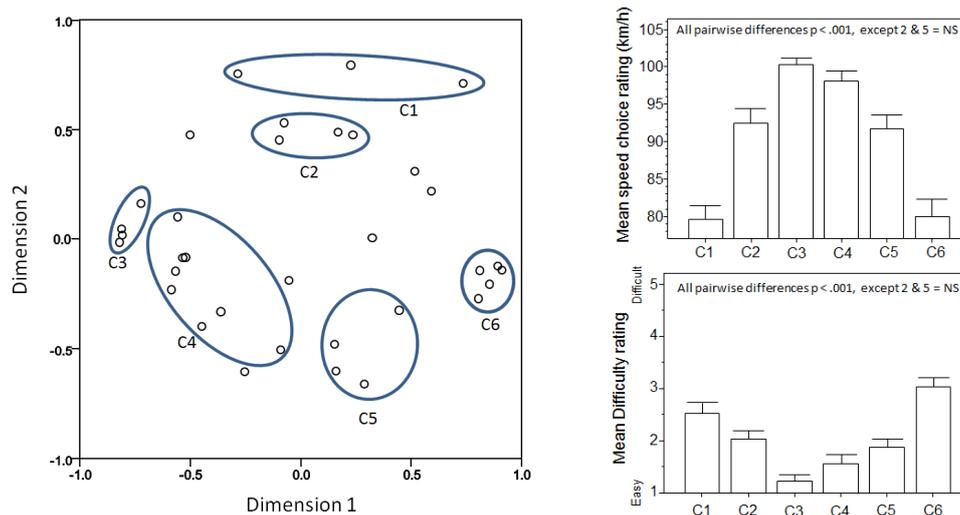


Figure 2. Multidimensional scaling of 34 road photos (left panel). Superimposed is the result of a cluster analysis of the same photos. The right panel shows the speed choice and difficulty ratings for the six road clusters. Lines show 95% confidence intervals.

As can be seen in the figure, the divided median roads (C3) and two lane straight roads (C4) were rated as the lowest in difficulty and the highest chosen speeds. A similar pattern for the clusters was seen across the other rating measures also. A series of multiple regression analyses predicting participants' speed choices for each cluster indicated that the best predictor was the participants' difficulty ratings (all $R^2 > .245$, $ps < .05$). Finally, the speed limit credibility (speed limit belief – speed choice) and safety margin (safe speed rating – speed choice) were calculated for each cluster. The analysis of pairwise differences between the clusters showed that speeds for C1 (bridges) and C6 (sharp curves) had the highest credibility scores and divided median roads the lowest credibility ($ps < .001$). The lowest safety margins, however, were seen for C5 (gentle curves, $p = .016$), followed by C4 (two lane straights, $p = .033$). In the case of C5, drivers actually chose faster mean speeds than what they considered to be safe speeds.

Discussion

There are many different reasons we drive cars, and the first study reported here shows that our motivations while we drive result in a wide range of different speed choices. The results are very similar to the findings reported in an earlier study (Oppenheim & Shinar, 2011) even though the two studies were quite different geographically; drivers chose the highest speeds when their primary motive was to have fun and the lowest speeds when their primary motive was to save money on fuel. The second study suggests that drivers form mental categories of familiar roads, as suggested by Riemersma (1988) and other investigators. This suggestion is supported by the finding that the road categories derived from the picture sort task predicted the speed choices gathered independently. Further, as suggested by Weller et al., (2008), perceived driving difficulty appears to be a key characteristic underlying these mental categories, significantly more so than risk of crashing. Taken together, the findings from these two studies suggest that drivers choose speeds on familiar roads, at least verbally, based on both their immediate trip purpose and mental categories (or road schemata) that they have formed with experience. The finding that the look and feel of roads can influence speed limit credibility suggests that we may be able to identify roads with poor safety margins based on drivers' perceptions and possibly even increase their safety by changing their appearance.

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