



# A predictive hazard perception paradigm differentiates driving experience cross-culturally



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## ABSTRACT

Hazard perception (HP) tests are used in several developed countries as part of the driver licensing process, where they are believed to have improved road safety; however, relatively little HP research has been conducted in developing countries, which account for 80% of the world's road fatalities. Previous research suggests that drivers in these countries may be desensitized to hazardous road situations and thus have increased response latencies to hazards, creating validity issues with the typical HP reaction time paradigm. The present study compared Malaysian and UK drivers' HP skills when watching video clips filmed in both countries, using a predictive paradigm where hazard criterion could not affect performance. Clips filmed in the UK successfully differentiated experience in participants from both countries, however there was no such differentiation in the Malaysian set of videos. Malaysian drivers also predicted hazards less accurately overall, indicating that exposure to a greater number of hazards on Malaysian roads did not have a positive effect on participants' predictive hazard perception skill. Nonetheless the experiential discrimination noted in this predictive paradigm may provide a practical alternative for hazard perception testing in developing countries.

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## 1. Introduction

Among driving-specific skills, very few have been linked to accident likelihood with any reliability. Hazard perception (HP), or the ability to detect dangerous situations on the road, is one of these few. It is typically measured by showing drivers video clips of driving scenarios and asking them to respond as soon as they detect potential hazards. Shorter latencies are generally thought to indicate greater levels of skill, with various studies reporting that experienced drivers detect hazards faster than novices (Borowsky, Shinar, & Oron-Gilad, 2010; Horswill et al., 2008; Scialfa et al., 2011; Wetton, Hill, & Horswill, 2011; Wetton et al., 2010), and others finding a direct link between novice drivers' hazard perception latencies and their later accident involvement (Drummond, 2000; Wells, Tong, Sexton, Grayson, & Jones, 2008). As a result, hazard perception testing has been incorporated into the driver licensing process in several countries, with the UK and parts of Australia using the reaction time paradigm described above, and some researchers argue that evidence suggests this has improved road safety in the UK (Wells et al., 2008).

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While the reaction time paradigm remains the de facto measure of hazard perception, its validity is not entirely without question. For instance, several studies have failed to find latency differences between experienced and novice drivers (Chapman & Underwood, 1998; Sagberg & Bjørnskau, 2006), with some suggesting that the efficacy of hazard perception testing depends largely upon the individual clips used. In one such example, Sagberg and Bjørnskau (2006) found that while their test as a whole did not differentiate between experienced and novice drivers, post hoc examination indicated that certain clips did successfully differentiate experience, and the elements of complexity, surprise and anticipation appeared to be particularly important. Thus far, the elements of a clip that successfully differentiates experience have mainly been suggested post hoc (Borowsky, Oron-Gilad, Meir, & Parmet, 2011; Borowsky, Oron-Gilad, & Parmet, 2009; Sagberg & Bjørnskau, 2006), although others have investigated this more systematically (Crundall et al., 2012; Garay-Vega & Fisher, 2005). In a simulator study investigating different hazard types, Crundall et al. (2012) found that environmental prediction (EP) hazards, when the precursor and hazard were different but indirectly related, were better discriminators of experience than behavioral prediction (BP) hazards, when a hazard's precursor and the hazard itself were the same stimulus. These findings certainly lay the groundwork for a hazard typology, however, a substantial amount of work remains to be done to establish any reliable categorization, and the precise elements that elicit differences of experience have yet to be explored in depth.

While hazard perception has been explored and used in driver training in several developed countries, there has been little research done in low- and middle-income countries, where 80% of the world's road fatalities take place (Toroyan, 2013). For instance, in Malaysia, a middle-income country with a high percentage of car ownership, 2010 road fatalities were roughly seven times that of the UK when accounting for population differences (Toroyan, 2013). Lim, Sheppard, and Crundall (2013) conducted a cross-cultural hazard perception test, comparing latencies between Malaysian and UK drivers when watching video clips filmed in both countries. The study reported that Malaysian drivers had higher latencies than UK drivers across all clips but fixated hazards equally quickly, suggesting that their increased response times were due to an increased criterion for reporting hazards, rather than a difference in their ability to spot the visual cues that ultimately lead to hazard identification. The researchers concluded that reaction time in a Malaysian context was potentially unsuitable as a measure of hazard perception ability, and the possible criterion difference might stem from drivers in more dangerous environments becoming desensitized to hazards. As Malaysia's driving environment is fairly comparable to other developing countries in terms of on-road hazards and traffic fatalities (Toroyan, 2013), this raises the question of whether the traditional hazard perception test is suitable for many developing countries.

Given Lim et al. (2013)'s findings, the present study revisits a cross-cultural comparison between Malaysian and UK drivers, but employs a predictive paradigm unaffected by hazard criterion: the "What Happens Next?" test, previously found to differentiate experience among UK drivers (Jackson, Chapman, & Crundall, 2009). In the original study, drivers watched video clips containing hazards, but the clips were stopped and occluded immediately prior to hazard onset and drivers were asked to predict the events that might have occurred after this point. Jackson et al. (2009) found that experienced drivers predicted events more accurately than novices when all clip information was removed from the screen immediately following the occlusion point.

As the present study utilizes the same video clips as Lim et al. (2013)'s cross-cultural study, this provides an opportunity to draw comparisons between test paradigms. More importantly, it offers a measure of hazard perception that is unaffected by response criterion. Drivers are not asked to decide whether or not a hazard has occurred; they are merely asked to predict an event. The findings should help establish whether the cross-cultural differences seen in the previous study were entirely the result of a criterion difference, or also reflect differences in hazard perception skill. The present study also employs multiple choice questions unlike the original predictive paradigm, which used a free response format; this serves to establish a more viable version of the paradigm for large-scale testing, should it again differentiate experience. We hypothesize that experienced drivers will outperform novices on all clips regardless of where they were filmed, however, as Lim et al. (2013) reported, we also expect this particular advantage to decrease when drivers view clips filmed in their non-home country.

## 2. Methods

### 2.1. Participants

Forty participants were recruited from the UK and 37 from Malaysia, all of whom held full, provisional or learner driving licenses from their respective countries and had normal or corrected-to-normal vision. Participants were split into two further sub-groups consisting of novice and experienced drivers, resulting in four groups in total: 19 UK novice drivers (mean age of 22.9 years and licensing time of 8.25 months, except for three learner drivers who had held their permit for 14, 90 and 48 months respectively), 21 UK experienced drivers (mean age of 23.3 years and licensing time of 54.9 months), 20 Malaysia novice drivers (mean age of 18.0 years and licensing time of 4.5 months) and 17 Malaysia experienced drivers (mean age of 22.5 years and licensing time of 55.8 months). Participants received either monetary compensation or course credit, where the latter was applicable.

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