Use of Mobile Phone and Road Safety: A Literature Review

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1 Overview

A driver's attention is one of the most influential factors on road safety. Any external visual, auditory or cognitive distraction can divert the driver's attention which can lead to slower reactions and more misses. While there are many sources of distraction even as small as distraction due to a roadside advertisement, use of mobile phone is one of the most common causes of distraction, which is a global issue in road safety perspective, that especially involves pedestrians.

Mobile phone can cause physical distraction where the driver has to simultaneously operate the mobile as well the vehicle, or it can cause cognitive distraction where a part of driver's attention is diverted towards it.

2 The Study

Tracking crash frequency is one of the most common ways to study a safety related issue. For scale of severity, one can use the count of road accidents along with number of injuries and number if deaths due to it.

While the study of our interest [1] uses the 'Risk Perception' as representation for people's subjective judgement of the end-states of a driver, which are accidents, near miss and erratic driving due to mobile use. The study also keeps track of the corresponding measure of mobile usage. This study is carried out by conducting a survey from people of different age groups and driving experience within a district about their views on various safety related traits related to distractions caused by mobile phones and modelling them with the Risk Perception.

There are various factors and conditions on which risk due to mobile phone depends upon, few of which are:

- Roads with high traffic is likely to be riskier.
- High speed will lead to even lesser handling over the vehicle, and hence riskier.
- Age and experience of driver matters too. Younger drivers are more addicted to using phones. Also, how experienced a driver is also affects how well are they able to handle distractions.
- Handheld or Hands-free: Handheld phones are likely to be more dangerous.
- Type of phone conversation, whether it is a normal or an intense conversation.

Considering these and post categorizing them, the types of safety-related traits which can be used for modelling and incorporated in the study are:

1. Distraction due to mobile: Hand Activity (handheld), Listening (hands-free)
2. Human Factors: Age, Experience, Emotion, Behaviour
3. Driver Space: Controls, Meter, Music, Light
4. Driver Conditions: Speed, Duration, Traffic

'Human Factors', 'Driving Conditions' and 'Driver Space' influence the driver's 'Distraction due to mobile'. The driver's response while driving with these results in accidents, near miss and erratic driving. This is represented by 'Risk Perception' in this study.

The modelling technique used for this study is Structural Equation Model (SEM). SEM involves the construction of a model where different variables are theorized to be related to one another with a structure designed with symbols and arrows [2]. The structure implies statistical relationship between variables in terms of Standardized regression coefficient which is also equal to the correlation between the variables [3] and their p-values. The Standardized regression coefficient (correlations) are measured among different variables and measurement model is transformed into structural model to get results to test the hypotheses stated.

Few of the Goodness-of-fit metrics used in the study to check the model fitness are Comparative Fit Index (CFI), Adjusted Goodness of Fit Index (AGFI), Root Mean Square Error of Approximation (RMSEA). The value of AFGI and CFI should be greater than 0.9 indicating good fit and an acceptable model. RMSEA ranges from 0 to 1. Smaller values of RMSEA indicates better fit. A value of 0.06 or less is an indicator of good fit. [1]

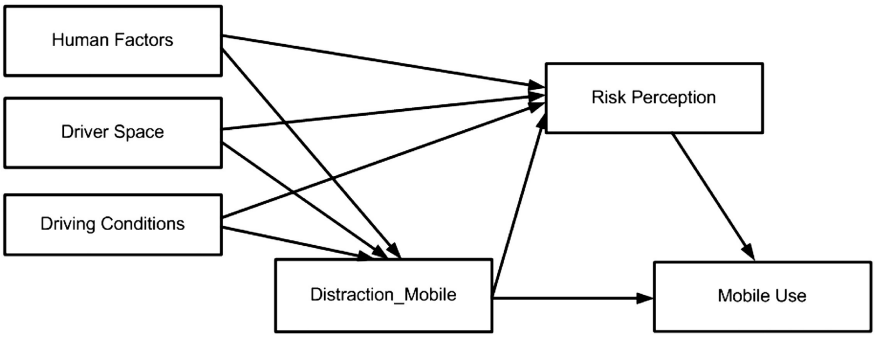

Figure 1: Mobile phone distracted driving model [1]

The following are the key hypotheses to be tested in the model:

1. Compared to the handheld phones, hands-free phones don't cause much distraction.
2. Unsuitable Driver Space, Human Factors and Driving Conditions enables greater distraction perception due to mobile phone usage.
3. Stronger perception of distraction due to mobile use implies a higher safety-risk perception.
4. Driver Space, Human Factors and Driving Conditions dimensions leads to stronger perception of risk due to mobile phones.
5. Stronger perception of distraction and risk due to mobile phones reduce its usage.

3 Key Safety Related Findings

The default SEM of risk perception due to mobile phone distraction is shown in below:

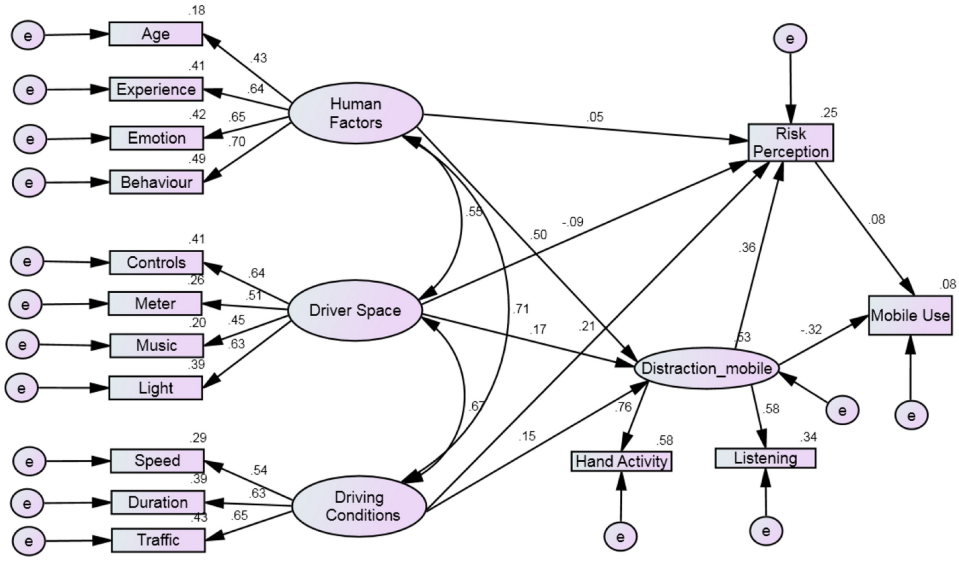

Figure 2: Default SEM [1]

Modifying the model: The links 'Driver Space - Risk Perception', 'Human Factors - Risk Perception', 'Risk Perception - Mobile Use' and 'Driving condition - Distraction_mobile' are insignificant and hence removed. The error terms of 'emotion' and 'behaviour', and of 'duration' and 'speed' are covaried to improve the fitness of the model.

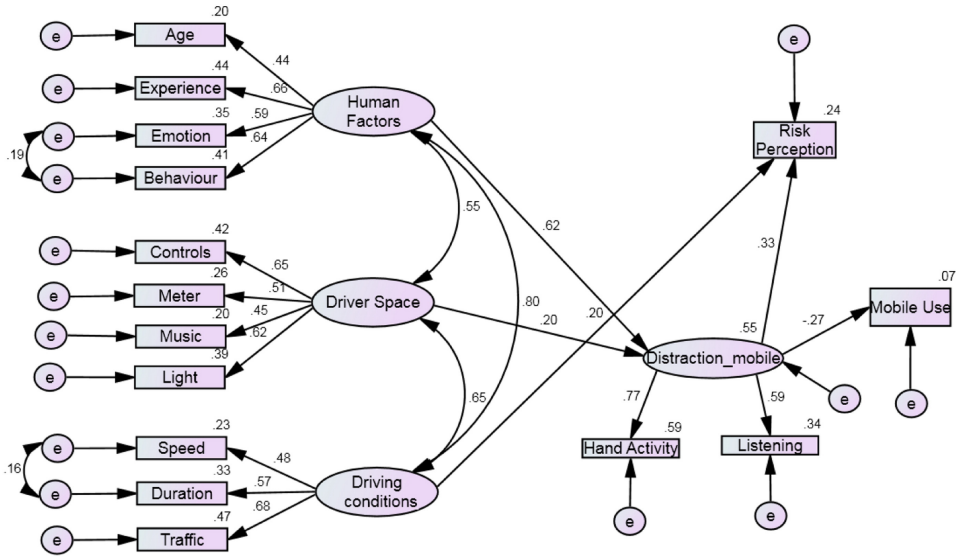

Figure 3: Modified SEM [1]

Following table represents Values of goodness of fit of the model prior and post modification: [1]

Model	AGFI	CFI	RMSEA
Default Model	0.930	0.917	0.057
Modified Model	0.936	0.925	0.053

Following are the findings and results about our hypothesis which we stated earlier:

1. However distraction due to hands-free mobile (0.34) is lesser than handheld phone (0.59), but it is significant.
2. The correlation of 0.62 between Human Factors and Distraction_mobile shows high contribution of human factors like age, experience on distraction due to mobile. Effect of driver space on distraction is also significant (0.2). However, unexpectedly driving conditions shows lesser impact on the distraction (0.15).
3. Correlation between Distraction_mobile and Risk Perception is 0.33 indicating that perceived distraction due to mobile does increase the risk perception.
4. Human factors (0.05) and driver space (-0.09) turns out to be insignificant enablers to high risk perception. Interestingly driver space shows inverse but insignificant relation with risk perception. Only driving conditions (0.2) has significant correlation with safety-risk perception due to mobile phones.
5. As hypothesised, perception of high distraction due to mobile leads to reduced mobile use (-0.27). However, safety risk perception has insignificant impact on mobile use (0.08) which means people still have a habit of using mobile phones while driving even after perceiving the risks.

4 Analysis in India

While Indian perspective is concerned, there are few more factors that can be considered:

- Region-wise study: 93% of the fatalities in the world occur in low and middle income countries, regardless of the fact that these countries have approximately 60% of the world's vehicles [4]. Considering this, we can conduct the analysis for different states within India with it's average income as an explanatory variable. Also, richer states are likely to be more habited towards using phone. So it would be interesting to observe how risk varies.
- Cars vs Bikes: In the year 2019, around 75% of total vehicles in India were two-wheelers [5]. With this higher count, it would be interesting to observe whether using phone while driving bikes is riskier than while driving cars.
- Number of lanes: Roads with lesser number of lanes are likely to be more risky due to mobile phone usage.
- Type of roads (rural, urban, highways): Rural roads will be more accident prone due to poor road conditions and a lot of pedestrians, while urban roads or highways will have faster roads and lesser number of pedestrians on road.
- Day vs Night: Driving during night time requires greater amount of attention than during day time. Using mobile phones is likely to cause more distraction during night than that at day time, and hence riskier.

5 References

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