Roameeo Cognitive Assessment Study

Executive Summary

The study utilizing cognitive data was unable to determine the probability of the driver being involved in a car accident.

- Younger drivers in general have better Cognitive Skills with the important exception of Dividend Attention.
- Based on historical data, Young drivers are the most prone to car accidents.

It was identified that there was no correlation between driving behavior and the cognitive assessment from this study, meaning that AXA is unable to predict the likelihood of drivers to be involved in a car accident based on this combined data set.

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Scope

In order to improve road safety in Singapore, AXA is exploring information from Telematics services combined with Cognitive Assessment. Predicting which drivers have likelihood of having accidents depends on several factors:

- External environment
- Fatigue
- Driving mistakes (influenced by drivers' cognitive skills)

In the sample, 87 of these drivers were monitored for 4 weeks on daily road trips in Singapore, with vehicle telematics data collected from AXA Drive Mobile app.

The 87 volunteers participating in the study represents 4 Driver Types:

- 21 Private car owner
- 22 Taxi drivers
- 22 Uber / Grab drivers
- 22 Commercial drivers

Driver Type cross with Age:

Driver Type/Age	*18-25*	*26-35*	*36-45*	*46++*	*Total*
Private Car	3	4	9	5	21
Taxi	0	0	6	16	22
Uber/Grab	1	5	11	5	22
Commercial Vehicle	2	4	11	5	22
Total	**6**	**13**	**37**	**31**	**87**

Figure 1: Driver Type cross with Age

Driver Type cross with Gender:

Driver Type/Age	*Female*	*Male*	*Total*
Private Car	11	10	21
Taxi	0	22	22
Uber/Grab	3	19	22
Commercial Vehicle	4	18	22
Total	**18**	**69**	**87**

Figure 2: Driver Type cross with Gender

The 87 drivers have participated in a cognitive assessment and a pre-survey followed by driving for 4 weeks with AXA Drive. To conclude the study, they filled a post-survey.

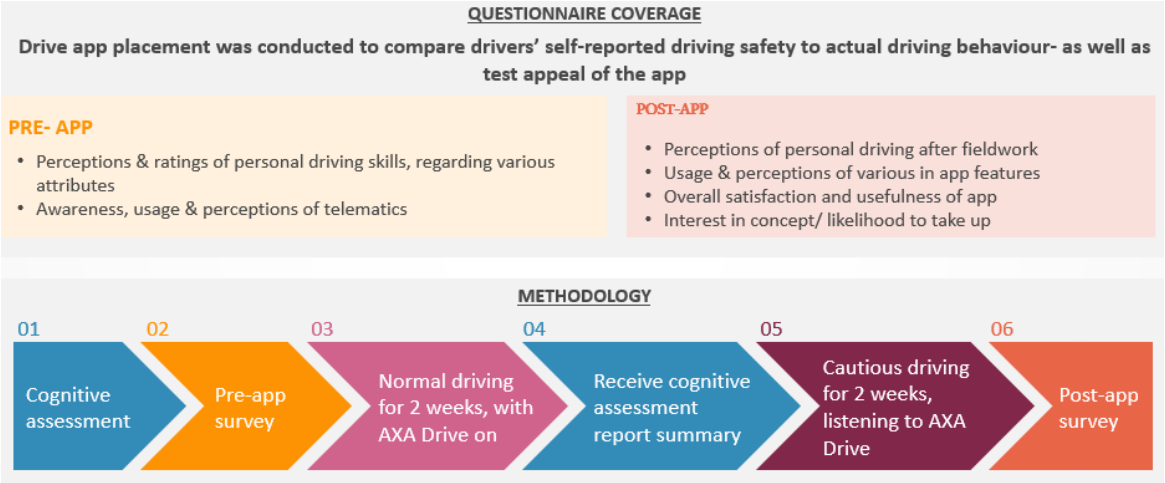

Figure 3: Study methodology

Period of driving: 21/03/2018 – 18/04/2018 (**4 weeks**)

The below report provides comprehensive details of the proof of concept conducted by AXA to test the cognitive assessment solution.

Cognitive Assessment by Roameeo

1. Assessment of Cognitive skills

The capacity to drive safely might come down to these major cognitive areas/skills sets; Attention, Visual, Spatial, Memory and Decision Making.

The 87 participants of the study have been assessed in 7 driving related skills through simple interactive video games:

- **Divided Attention**

Figure 4: Divided attention Test

Divided Attention is your ability to focus on two or more tasks at the same time. Strong divided attention skills help better place yourself to know when to shut out distractions such as tuning a radio, talking to friends, answering a mobile phone.

- **Visual Search**

Figure 5: Visual Search Test

Visual Search is your ability is to locate specific information inside your field of vision. When driving, we use our visual search skills to detect information that may be important to safe driving (road signs, appearance of hazards).

- **Field of View**

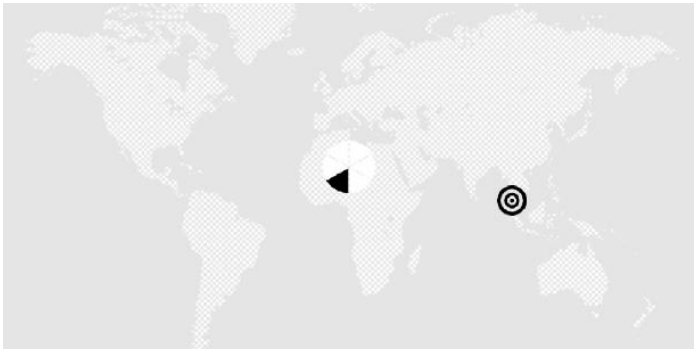

Figure 6: Field of View Test

Field of view is your ability to see objects at the edges of your vision. When driving, we use peripheral vision to detect information that may be important to safe driving (monitor the road on front, whilst you're looking in the rear-view mirror)

- **Pattern Memory**

Figure 7: Pattern Memory Test

Pattern Memory relates to awareness of your environment. It is the ability to identify and recall visual patterns and remember locations. When driving, it's important that you are able to quickly grasp where other vehicles are in relation to you. From a navigation perspective, being better able to remember where locations are – means you have more resources available to focus on the immediate traffic situation.

- **Motion Memory / Spatial Orientation**

Figure 8: Motion Memory / Spatial Orientation Test

Motion Memory is your ability to manipulate the details of an image in your mind. When driving this is important to tasks such as general navigation, merging safely, keeping track of the vehicles around you so that you can leave sufficient time and space, and ensuring that you don't hit low hanging branches/bridges.

- **Response Inhibition / Impulse Control**

Figure 9: Response Inhibition / Impulse Control Test

Response Inhibition refers to your ability to deliberately avoid engaging in an action or response that is routine, fast and habitual – but undermines the task at hand.

- **Processing Accuracy**

Figure 10: Processing Accuracy Test

Processing Accuracy is your ability to quickly take and use information without mistakes.

2. Feedback from participants

The cognitive assessment was relatively easy to understand and overall enjoyable. Respondents were optimistic about its accuracy.

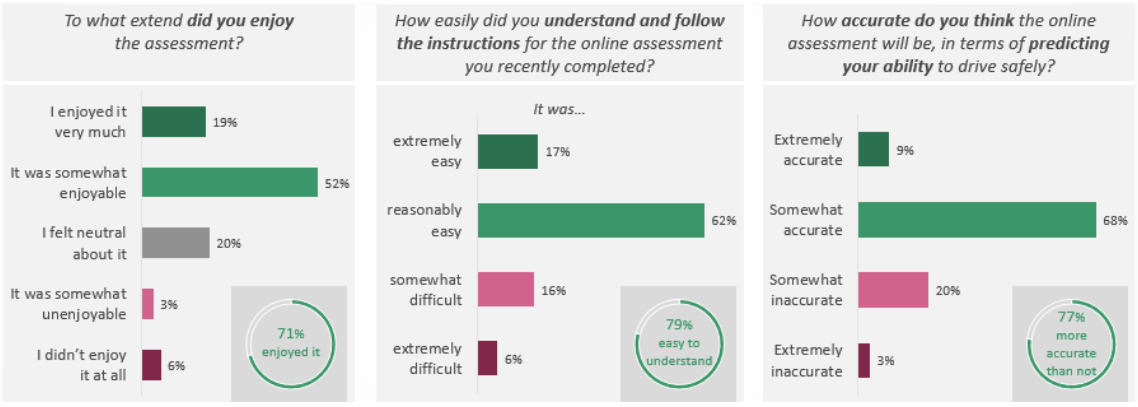

Figure 11: Participant feedback

3. Findings

Using Linear Regression, the Age variable was statistically significant to predict the cognitive score. However, no statistical significances were found for Driver type or the Gender.

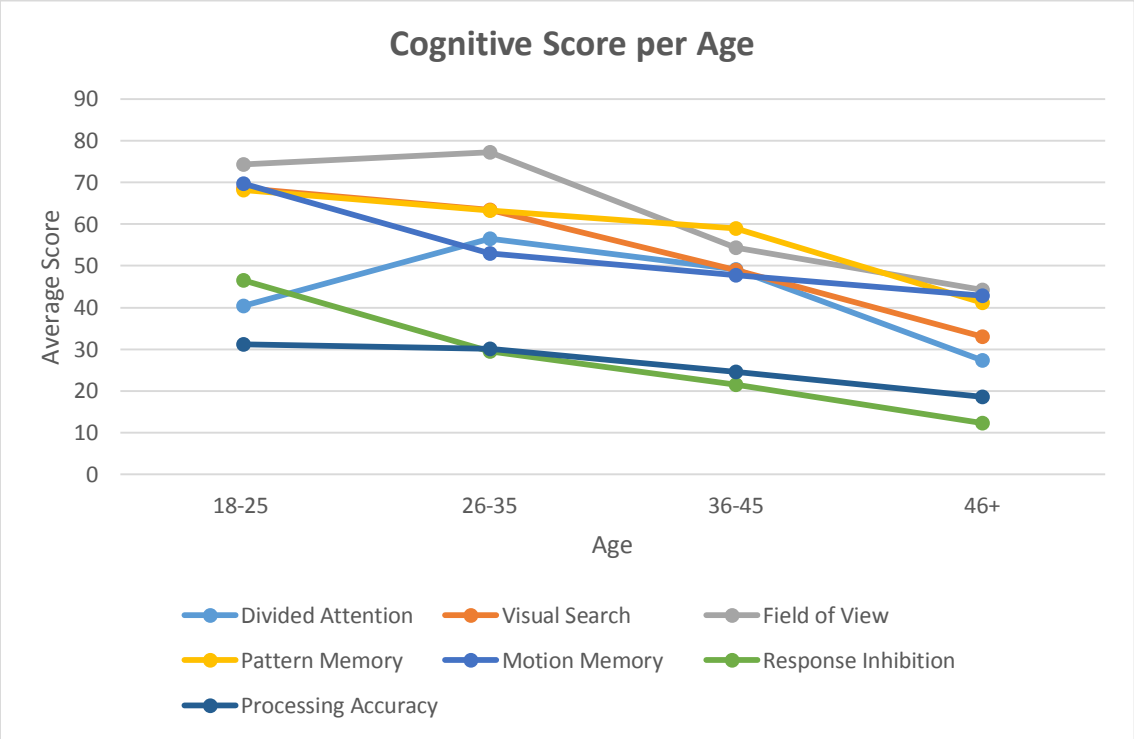

Figure 12: Cognitive Score per Age

Focusing on this, the results imply that the younger the driver, the better are their cognitive abilities.

However, based on AXA motor claims historical data, young/unexperienced drivers were more prone to accidents whereas the general cognitive assessment data is the opposite. Taking into account individual cognitive domains, we do identify that the 26-35 cohort represented superior scores than the 18-25 cohort in the higher-order, and safety critical, cognitive domains of Divided Attention and Field of Vision. Whilst this studies sample population is very small, the lower scores recorded by 18-25 cohorts in these higher-order cognitive domains are consistent with the findings of scientific literature.

Correlating Cognitive Score to AXA Drive Score

AXA Drive

AXA Drive is a mobile application launched by AXA to provide an AXA Drive Score which can be used to assess the driving behavior of a driver and provide discounts for good behavior as part of their motor insurance policy.

The AXA Drive Score is computed from 4 variables, acceleration, cornering, braking and pace.

The first section has already shown that the cognitive assessment gives unexpected results when compared to AXA Claim Data.

The below charts test the correlation between AXA Drive Score and Cognitive scoring:

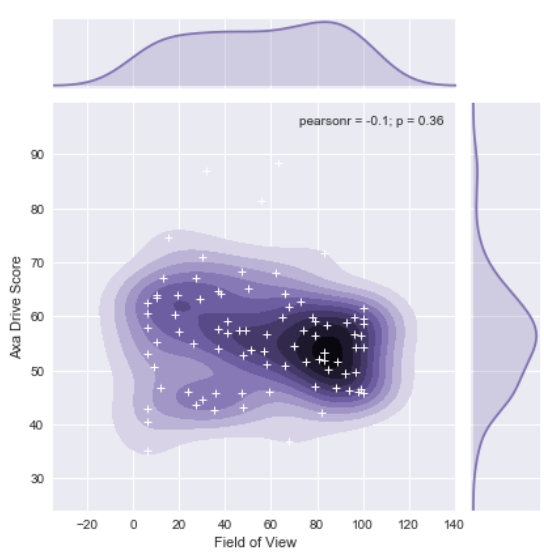

Figure 13: Kernel density of how driver types drive Vs. Field of View

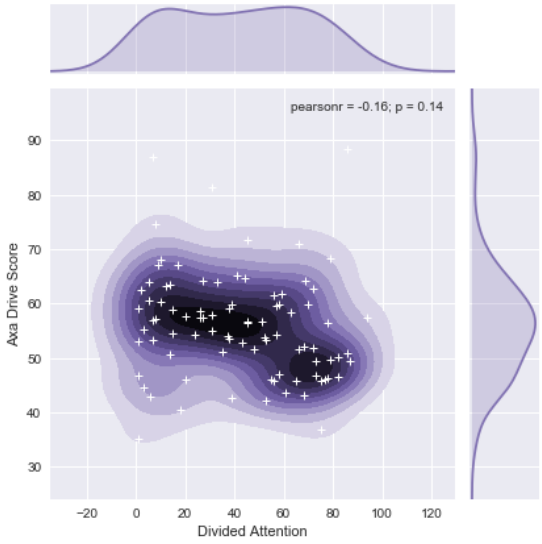

Figure 14: Kernel density of how driver types drive Vs. Divided Attention

A random distribution of the data points can be observed clearly in both the above graphs.

Hence, the hypothesis of correlation between the Cognitive Score and the AXA Drive Score can be rejected. Proving that the cognitive assessment is not an indicator which AXA can use to predict which drivers are more likely to be involved in car accident.

Further Analysis

No clear findings were identified when assessing the Cognitive Score and AXA Drive Score with Gender, Driving experience or Wage.

To further clarify, in order to identify a correlation between the cognitive assessment and the driving behavior, a number of events was recorded by the AXA Drive. However, no correlation was identified between the AXA Drive Score and Cognitive Score.

Roameeo Assessment

1. Cognitive Assessment

The platform utilized for assessment has simple games that are variations on well-established methodologies for assessing cognitive performance across situation awareness in the fields of aviation, sport and driving.

Given the higher propensity for crash incidents in the 18 to 25-years age bracket, it is recommended that in future they are categorized into more granular brackets, with deeper data sets.

It is also recommended that a telematics app that can measure phone use whilst driving to provide a more holistic assessment – especially in the cases when drivers Divided Attention skills are weak.

What we do know from previous studies, is that individuals within age groups differ in their cognitive skills and their cognitive decline. From an insurer perspective, it is not the cohort where the value is immediate, but the outliers. For example, a young person with high Divided Attention scores will have greater coping skills with distraction when driving. Assuming all other factors are the same relative to their peers (similar vehicle, amount of driving, driving environment), they are less likely to have an accident. If a driver over 45+ years of age, has cognitive skills that are more attuned to a 30-year-old, they are going to address in a similar accident scenario a more heightened response than a 45+ year old with a cognitive level attuned to a 55+ driver. Suggesting cognitive data scores be a reflection on the volume of data captured and the nature and complexity of the multiple factors of driving.

Beyond this report's scope, we also know that practicing a cognitive skill (even a specific computer cognitive tasks), improves the neural pathways and this has a positive impact on real world cognitive functions. So, for drivers who are showing declines in cognitive skills, addressing some of these cognitive declines can make a difference to their daily activities including driving capability.

2. Reports and Tips

Difficult to fully determine if the underlying risk was adjusted by the report or suggestion due to the lack of understanding of risk severity.

We are in agreement that the scores did not change following the delivery of the assessment report to the drivers. Does this reflect the quantity of risk events across the different categories or/and the severity of those events? Using Roameeo's own Telematics data, shifts in severity of risk was significant with communication to drivers (reduced from Extreme to caution to moderate) however the volume of risk events remained the same. Also, the type of events moved from speeding and acceleration to braking. This showed that drivers were becoming aware of the need to reduce speed as a key risk factor.

From a risk perspective, this was extremely meaningful. What is difficult to see from the report is whether a driver's awareness of their driving, changed any of the underlying attributes to the driving. This occurred for a particular cohort (age or job), and might be a requirement to assess how drivers are engaging with feedback rather than assuming it's ineffectiveness.

The assessment (self-assessment) that driver's perception of their skills being higher seems logical to human behavior but we have not completed a study around this perception of ones driving hence this was a useful point to understand.

Conclusion

Based on the scope of the study, it has been assessed that there is no correlation between driving behavior and the cognitive assessment. The solution will need to be enhanced we are able to leverage on such assessments to predict the likelihood of accidents incurred by drivers with lower cognitive scores.