

The potential role of smell in self-driving experience of older drivers with mild cognitive impairment

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ABSTRACT

Introduction: Smell is one of the primal human senses that has been directly linked to our survival, as it warns us of potential danger or problems and can direct our behaviour before conscious and processed responses take place. Lately, multi-sensorial and new olfactory technologies are being developed, but the passenger car remains a predominantly visual and auditory-oriented HMI system. Olfactory stimulation can effectively support existing or future visual representation and perception with enhancing the traditional car-driver interaction, especially when the latter deteriorates, as it often happens in older drivers. Individual preferences along with controllability and accuracy of scent delivery are among the most important hindrances in the implementation of scent-based notifications (Maggioni et al., 2019). Autonomous vehicles will play a key role in the future social-inclusive autonomous road environment and will enable older and disabled travellers to remain independent and mobile without restrictions. However, limitations will remain, as this will be a gradual process with road environments being mixed for decades.

Methods: The aim of this study was to investigate the odour preferences of older drivers in accident risk-prone conditions in the three following possible autonomous driving scenarios: a) driver needs to stay alert in complex urban hand-over conditions (i.e. approaching pedestrian crossing), b) users have to 'smoothly' awake from a long overnight trip on the highway (after 8-hours rest) and they have to drive because automation is not available for the next part of the journey, and c) improve/regulate their mood (i.e. after getting frustrating by being 'stuck' in traffic). Short user stories were distributed to older drivers with no health issues (Group A) and individuals with mild cognitive impairment (MCI). 34 male (66±5.09 years) and 11 female (65± 6.27 years) drivers belonged to group A and another 31 male (67±6.87 years) and 17 female drivers (66±4.59 years) to group B. Participants were experienced (38±8.69 years of driving) and frequent (587±138 km/month) drivers. They were blindfolded and presented with 3 different odours per scenario (one soothing, one alerting, and one neutral) from the standardised Sniffin' Sticks Test (Burghardt®, Wedel, Germany), apart from scenario (a), where both positive (peppermint) and negative odours (rubber) were administered. The soothing odour was rose and the neutral was bread.

Results: Significantly higher number of group A drivers (79%) preferred the positive odour compared to the negative in scenario (a) ($p=.021$). On the contrary, most group B participants (66%) selected the bad smell in scenario (a). Higher number of group A participants (69%) preferred the alerting smell over then other two in scenario (b). Higher number of participants selected the smell of rose regardless of group membership (76% and 72% for groups A and B, respectively) in scenario (c).

Conclusion: Cognitive decline is closely related to olfactory deterioration, but it might be also followed by change in odour preferences, which deviate from other older drivers' smell preferences. Such knowledge is important when designing and creating personalised olfactory systems. The outcomes of this study will be implemented to create olfactory-based HMI strategies for older drivers that could be further utilised to create the foundations for a multisensorial design and interaction framework in a connected autonomous transportation environment.