

# Human factors in design of car interiors



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In 1977, a comprehensive study of road safety found that human error was the primary cause in 57% of all automobile accidents and was a contributing factor in over 90%.

With this discussion, we must keep in mind that the overall attention MUST be kept on the road and on driving. Many of the accidents that happen are due to lack of enough attention and focus on the road and driving conditions because the driver's attention and focus was on a less significant feature of the car such as the radio. In this study, we will begin by looking at the critical metrics driver-side dashboard, then move onto the steering wheel and to the center/passenger-side dashboard and finally look at the seating arrangements of the front of the vehicle. Many of the features of this proposed design will be an accumulation of good human factors-integrated controls that are already out on the market.

Our primary objectives in this analysis will encompass the following: 1. Built-in features that promote and emphasize safety above all other functionality 2. Reducing potential driving risks and hazards through situational awareness tools, such as reducing blind spots via motion sensors and BirdsView™ displays. 3. Ease of use of all features, tying back to the ease of creating visual maps for reduced attention to secondary features and higher focus/attention given onto road and driving conditions.

Driver-Side Dashboard For the speedometer and RPM information, the displays that will be used will be analog with both US and SI units to accommodate for different driver demographics. On the far left-hand side will be a digital display that will indicate the current gas fuel consumption of

the vehicle, given in terms of MPG. In the middle of the analog semi-circular display for the speedometer will be a digital display showing the total mileage the vehicle has accumulated and directly beneath the total mileage will be the accumulated mileage of the vehicle since the last time it was set at zero. This would be used as an indicator for how much mileage it is during a particular trip or how many miles the vehicle accumulates at full tank.

Right underneath, towards the center of the trip mileage would be a protruded button that the driver presses to reset the trip mileage meter to zero for a new trip. From left to right would be the speedometer, analog gage to measure the rotations of the wheels and on the right side would be symbol displays that would indicate the following: oLow battery oEngine failure oOverheating of the engine oCruise Control Activated oAny other crucial error warnings that the driver needs to be aware of such as transmission problems. All of these error lights would be colored bright LED red and would flash with a voice that would go off from the main computer warning the driver of the type of warning and what to do to resolve the situation. All of these warnings and alarms that are related to the conditions of the vehicle engine and support systems would be displayed as discrete pictures of the part that they are trying to predict. For example, for a battery warning sign would have the following symbol followed by a " LOW BAT" message.

All of the symbols would use LED lighting so that all messages and displays can be seen easily. Of course, under the steering wheel, to the driver's right-side would be a turn-knob that would alter the brightness of all of the displays including the LED-lighted display of the radio/CD/MP3 player stereo

system. Certain symbols are rather universal when it comes to symbols and displays that provide active feedback on the condition of the vehicle. In the proposed design, if this were to be implemented, say in a new Nissan or Toyota or for that matter, any full-sized sedan, then it would add consistency in the memory of the driver when it came to how they could use their previous experiences in a similar sedan to transfer that experience to help them internalize the crucial safety displays and controls in their active working memory. The particular design of these displays is derived from how the driver creates a memory map or construct that allows them to automate where to look for the most critical of information. They would look for warnings and alarm signs in a particular area, rather than it being scattered throughout the primary display panel.

The location of the emergency symbols would be high enough above the bottom of the display panel in case the driver requires extra leg space and pulls the steering wheel up. An example of poor displays with too much proximity with the symbols and a violation of the principle of keeping displays visible and discriminatory are given in Figure 1 below: Figure 1 – Poor Layout of Displays with Low Clarity on Symbols

The above photo does not offer good discriminability for the different symbols since red symbols on white backgrounds will not facilitate easy observation for quick decisive action in case of emergencies. In this case, the symbols should be on the black background like the high-headlights symbol. This also helps with the design of the vehicle controls when it comes to elderly drivers since their visual acuity is lessened with age and can lead to errors where they might mistake the Emergency Brake Sign with the seat-belt reminder symbol.

Steering-Wheel Controls With modern steering wheel, many of the Voice-activated commands of systems like Microsoft SYNC, which connects the onboard computer to a Bluetooth-drive device, are imbedded in along the areas where the thumbs of the drivers would be if they are holding the steering wheel in the 3: 00/6: 00 positions. Many of the other critical secondary features such as cruise control, window wipers, and even headlight controls may also be included. This feature helps in reducing resource competition since the amount of time it takes for the driver to access the controls on the steering wheel to activate their phone or switch on the radio is less than actually reaching out to the central controls and moving around until the correct controls and settings are activated. This feature would be of considerable use when it comes to being able to use the primary hand, whether it be left or right, to still control the steering wheel and access the secondary features. Many of the new Toyota steering wheels have more integrated secondary features such as the Prius as shown in Figure 2.

Figure 2 – Toyota Prius Steering Wheel Controls One of the things that the designer has to be wary of is imbedding too many secondary feature controls on the steering wheel. This could lead to overloading the processing of the user's memory which poses the risk of the user accidentally moving the steering wheel in the wrong direction, which could lead to potentially dangerous situations during high speed traffic activity. The features that would be relevant to place on the steering wheel would be headlights, (with a button for high beam and a button for low beam), remote calling using Bluetooth in-built device as well as a volume up and down key to increase or

decrease volume, and cruise control activation, acceleration and deactivation. A simple press will activate the controls and there are no settings that have to be adjusted, with the exception of the volume controls on the hands-free calling feature.

This way, the amount of time it takes to glance down at the steering wheel while adjusting these controls would be effectively reduced. For the turning signal activation and window wipers, it would be more effective to have them as stick controls like in most traditional sedans. This way, with elderly folks, they would be able to rely on their past memories to translate that crystallized knowledge to their working memory when driving the vehicle. A unique feature that should also be considered is a type of coating on the steering wheel handles so that it would not heat up quickly and risk burning the driver's hands when the vehicle was left out in the sun for a long period of time. Central Dashboard Displays and Controls With the inclusion of OnStar and other navigation systems and Microsoft SYNC systems for hands-free calling, the central displays and controls have radically changed from what some of the elderly drivers have experienced in driving cars.

The 3 primary sets of controls in this section would be for the navigation computer, temperature control, and MP3/CD/radio control features. Each of the sets should have controls that are redundant so that it can be easily automated for drivers of all ages, especially the elderly. Dial controls work the best when it comes to temperature and music controls. An example of this type of redundancy is with the new 2009 Nissan Maxima's interior central controls, shown in Figure 3: Figure 3 – Nissan Interior Central Controls with Redundant Dial Knobs The problem with using traditional knobs such as <https://assignbuster.com/human-factors-in-design-of-car-interiors/>

the ones shown above is that they have a tendency to break off. When the driver is driving over rough road or if they are elderly and have Parkinson's disease, they will not have a steady movement of their hand when one hand is on the steering wheel and the other is adjusting one of these controls. The up and down buckling of the hand as it rotates the dials actually starts damaging the inner plastic locking mechanism between rotary knob and the internal rotating shaft that links to the electronic signal inputs to change a certain setting, for example on the volume controls of the radio.

The lettering and the symbols, as previously explained will be lighted with LED displays on black backgrounds. The height of the text divided by the distance should be greater than 0.007, known as the James Bond rule would be applied to all text labels of controls, such as the ones seen in Figure 3. One of the important things to keep in mind with the controls is how easy they will be to access and to activate during both normal and high-speed driving conditions. The use of haptic cues for tactility and kinesthetic is important.

Sometimes, rather than having an up or down arrow to indicate increase and decrease of a certain setting, having changes in the texture and surface shapes help internalize the control functions and actually may lead to less attention used on glancing at the controls and more attention on the road. A slanted dashboard with the gear-shift in closer reach to the arms would help with the reaction time of elderly drivers. It would also facilitate anthropometry of reaching for controls and reinforce the ability for the driver to quickly get back to controlling the steering wheel. For favorite radio stations and soundtracks, the onboard computer would be able to store that

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in a Favorites folder and play it during a trip without the driver needing to either switch radio stations manually or change CD tracks. With voice-command controls on the steering wheel, the driver would be able to depress the speaker button and normally talk from where he is sitting and be able to use commands such as “ Play Track 2. ” At the beginning of the purchase of the vehicle, the driver would program his voice in so that the computer would easily be able to analyze voice patterns and vibrations to pick up certain enunciations of words so that the proper command is carried out.

With AdaptIQ technology that Bose sound systems produces for voice transceivers, the voice-command system would be able to filter out all of the ambient background noise and only pick up the voice command. The same technology would also be used for in-car conversations through cell-phone integration in Bluetooth connections. To help with elderly drivers with hearing disability, the system would actually send out voice signals to the hearing aids of the drivers and so it would allow them to fully listen to the feedback from the vehicle. One of the issues that must be addressed at this point is that systems like the hands-free phone is that often they are associated with impaired gap judgment, slower response to the braking of the vehicle and increased crash risk. An enforced safety feature which might be introduced is to have the system shut down at high speeds so that it reinforces the user or driver to fully pay attention to the road.

This would be an ethics case since usability and safety would be in direct conflict. For elderly drivers, as well as those who are not acclimated with the area around them, the navigation system will have a unique feature that will

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facilitate navigation. Many times, there is a relapse between the verbal directions that are given and the map on the navigator screen. This can actually lead to a lot of traffic accidents and problems such as nearly missing an exit on the highway. The new navigation system would use outside cameras to feed active images into the screen and highlight paths in red where the car needs to make a turn.

The response time will be just as quick as a normal driver without any long loading times. This would be of tremendous benefit to older drivers who don't have the quick responsiveness to sudden changes in traffic patterns and need active feedback from the screen to show them the path they need to take. So the driver would see the road that he is traveling on as he sees it through the windshield but it would be overlaid with arrows and symbols to indicate the route that needs to be taken to reach a programmed destination. Such a system would enhance their decreased response time.

Interior Seating Biomechanics and anthropometry of the seating is critical for older drivers. Many of them have hip problems and joint issues that can reduce the amount of movement they can make once they are seated. They would also require additional lumbar support so as to reduce the risk of getting lumbar lordosis from improper seating support. The seat controls would be electronic as to reduce the need to pull up or push back to reach the desired proximity to the dashboard and leg room. The angle of incline of the seat would also be electronic, similar to the controls one would find in a hospital bed.

This would facilitate the elderly's inability to use full body to control different seating arrangements. An option that can also be built in is to have the in-board computer system remember the seat settings through a range of numbers, similar to how different people record seating metrics on gym equipment. In this design, there would also be a need for axial height adjustment for drivers that are shorter than the average that is calculated for the sedan. Rather than just pulling up to the dashboard and lowering the steering wheel, this metric would allow the older drivers to have a better view of the windshield.

**Special Concerns for Older Drivers** We have already discussed some of the improvements that can be made to facilitate older drivers due to their reduced response time. One of the biggest improvements that could be made is by replacing the rearview mirror with a camera screen that shows the rear as well as side screens which show the vehicle's blind spots. So, if there is a problem with rear passengers hindering the view of the driver, the driver will still be able to see the rear for traffic conditions without reduced visual field. This system would also be augmented with smart sensors that would detect if the driver was entering a lane where there was another vehicle in the blind spot and alarm the driver to remain in the original lane.

HUD (Head-up displays) would also be of great benefit for older drivers since braking distance increases for them. If there is an obstruction that is ahead of the vehicle and the older driver is unable to react in time, not only would a HUD symbol light up and start blinking but the vehicle would automatically brake in time to stop before colliding with the obstruction. In these analyses, we have assumed that the designer is working on an undesignated amount

of money to integrate these designs. Of course, a cost-benefit analysis needs to be done to ascertain the validity of introducing such measures, especially when it comes to a much older demographic.

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