Ergonomics in Automotive Design
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Module - 07
Lecture - 09
Driver Distraction and Driving Performance Measurement

Welcome to the course Ergonomics in Automotive Design.

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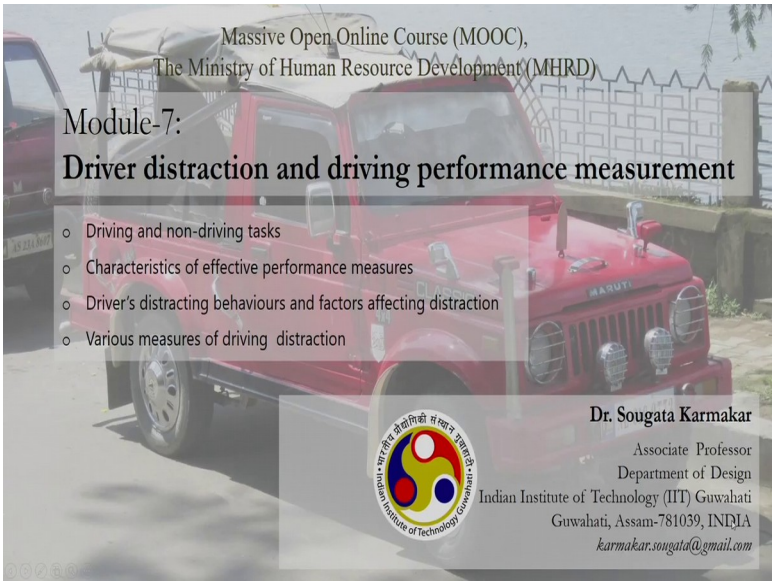

Now, we are going to discuss our seventh module, that is; driver distraction and driving performance measurement. So, under this module; we are going to discuss four topics; first one - driving and non-driving tasks; second - characteristics of effective performance measures, third one – driver's distracting behaviors and factors affecting distraction, and the last - various measures of driving distraction.

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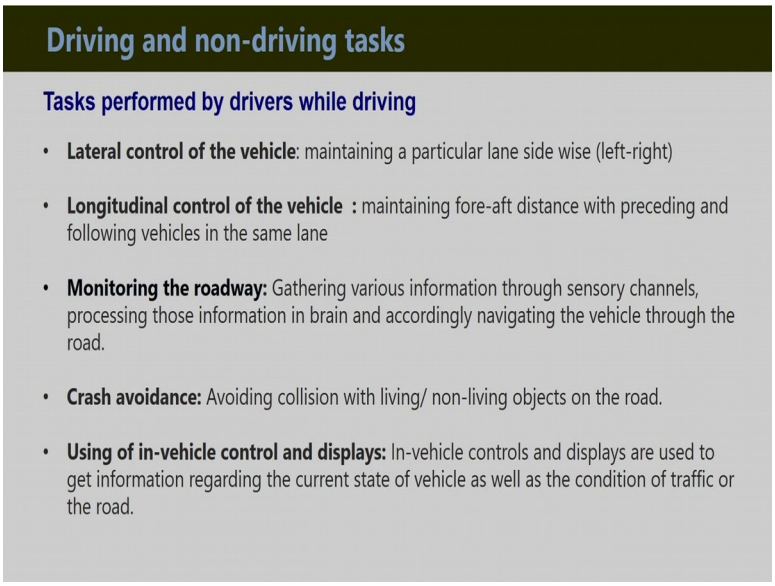

Now, first we should know; what is driving and non-driving tasks. Generally, during driving; drivers perform various activities, many of these activities may be or may not be related to driving.

So, first; let us see; which are the tasks which are directly related to driving and which helps the drivers to maintain their lane, driving in safe order. So, for that purpose; the first one is lateral control of the vehicle. So, first; lateral control of the vehicle. So, while the driver is driving, then it is important for him or her to maintain the lateral position in the lane, means, left-right or sidewise movement of the vehicle in relation to the lane.

Second is the; longitudinal control of the vehicle. Drivers also have to maintain the fore-aft distance with preceding as well as following vehicles in the same lane, so that, there is no chance of collision. So, maintaining longitudinal control as well as lateral control is very important in terms of driving tasks. Third one; monitoring the roadway. While the driver is driving for safe navigation and reaching the destination; drivers need to gather various information through different sensory channels, and that information is being processed in the brain, and accordingly, the response is selected.

In all these activities; ultimately, information is processed in the brain, and thus, drivers can navigate the vehicles safely through the road. The fourth one; is crash avoidance. So, while the driver is driving; he or she needs to maintain the proper lane, as we discussed

earlier, to avoid any crash or any hit with other objects, that may be living objects or non-living objects on the road.

Say, for example, pedestrian, some animals which are crossing the road or other vehicles which is forward to the vehicle or which is at the rear of the particular vehicle. So, one important task related to driving is the avoidance of crash or near-crash. Next; use of in-vehicle control and displays. So, while the driver is driving, he receives information from different control and displays that are placed inside the vehicle to get the information; regarding current state of the vehicle as well as the condition of the traffic, and the condition or situation of the road.

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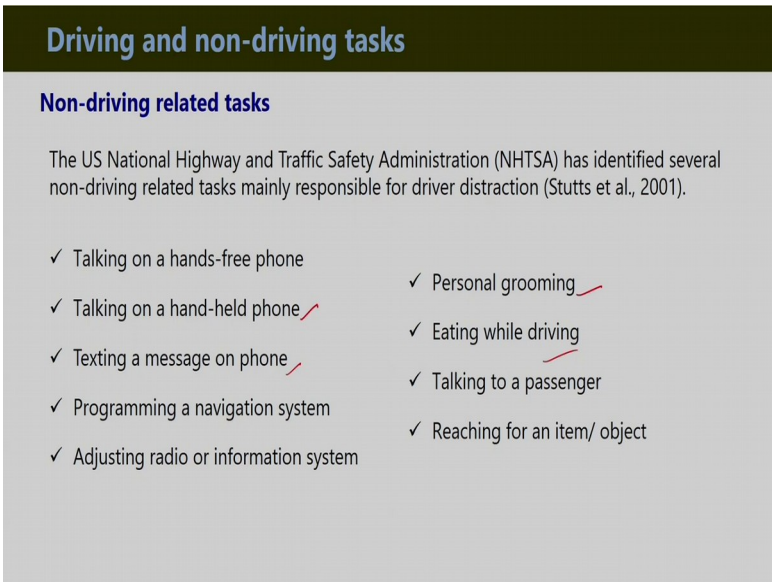

Next, apart from these various activities which we have discussed; which are directly related to a driving task, which we mention as the primary driving task. Apart from that; there are different secondary tasks; which are not directly related to driving or which are not helping in driving.

The US National Highway and Traffic Safety Administration (NHTSA) has identified several non-driving related tasks; mainly responsible for driver distraction, as reported by Stutts et al. (2001). So, out of these types of activities; we can mention; talking on hands-free phone, talking on a hand-held phone, texting a message on the phone, then programming a navigation system - setting the destination, from which point to which

point that driver have to drive or in between if he or she needs to stop, so, the whole program of the route, he or she has to plan on a navigation system.

Then, adjusting the radio or infotainment system, then apart from that, controlling various other controls related to AC, air conditioning or other controls which is not directly related to driving, then personal grooming, eating while driving or talking with the co-passengers; so, these are the non-driving related activities, and reaching for an item or object. And while; he or she is reaching or extending body parts and not concentrating on the road, then there is also a chance of accident and errors.

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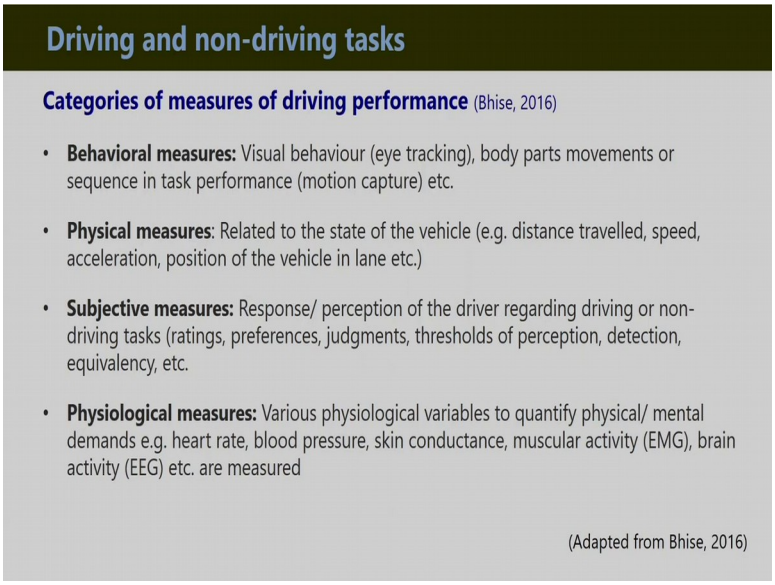

Now, categories of measures of driving performance. So, various driving performance-related measures are there, which we can broadly categorize under various sub-headings. So, the first one is behavioral measures. We can measure driver's visual behavior, body movements or body parts movement, the sequence of task performance.

So, for this purpose, for visual behavior, we can use an eye-tracking instrument; for movements of body or gross body movements or body parts movement; for that purpose, we can use motion capture. So, this type of measure also helps us to understand the driving performance, and or how the driver is performing the driving activities. Then, physical measures; these are related to the state of the vehicle, like distance traveled, speed, acceleration, position of the vehicle in the lane and so on. Then, another subcategory is a subjective measure.

So, these types of measures are responses or perception of the drivers regarding the driving condition, driving task. So, generally for this purpose of data collection; we use a rating scale, then we collect the preferences, judgments, threshold perception, detection, equivalency etcetera from the drivers. And generally, scaled data are collected on a Likert scale or semantic-differential scale for subjective measurements of driver's perception about various aspects of driving-related tasks or the various instruments which are helping in driving activities.

That may be a control operation, that may be different types of display wherefrom the driver is getting the information; that may be internal, or that may be outside the vehicle. Another set of variables are related to physiological measures. So, various physiological variables to quantify physical and mental demands. For example, heart rate, blood pressure, skin conductance, muscular activity using electromyography technique or brain activity using electroencephalography; all these measures are also collected for measuring driving performance, under a certain condition.

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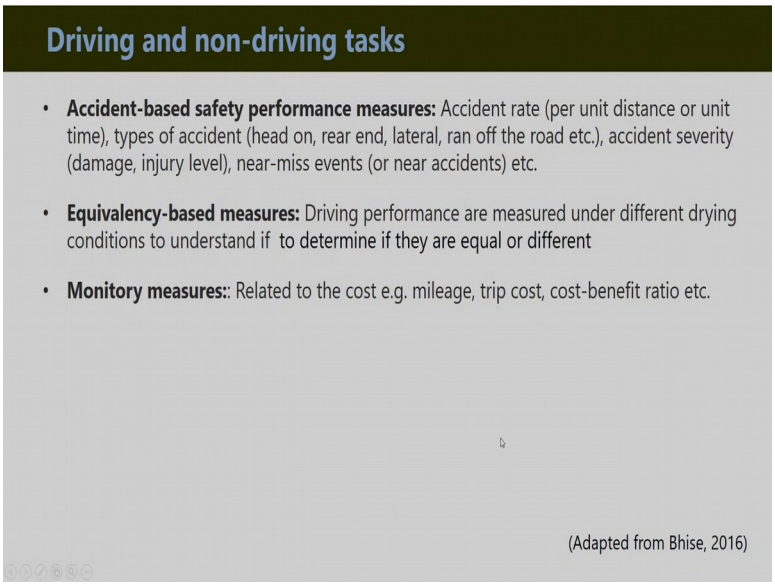

Then, accident-based safety performance measures. For measuring driving performance; there are other variables or other measures that are related to the accident. So, for this purpose, generally, we measure accident rate per unit time or say, per hour how many; or per, say, 1000 hours, how many accidents are happening, or per 1000 kilometers, how many accidents are happening.

So, these are; either per unit time or unit distance, how many accidents are happening. Similarly, types of accidents; head-on accident or rear-end or lateral or ran off the road. So, different types of accidents are also there. Then, accident severity; damage, injury level, near-miss events, or near-accident. So, all these accident-related variables are also measured to quantify the driving performance.

In equivalency-based measures, generally driving performance is measured under different driving conditions to understand, to determine if they are equal or different. Then, there are other aspects; like, monitory measures. In monitory measures, these are related to cost; for example, mileage, trip-cost, cost-benefit ratio etcetera are measured for the quantification of driving performance.

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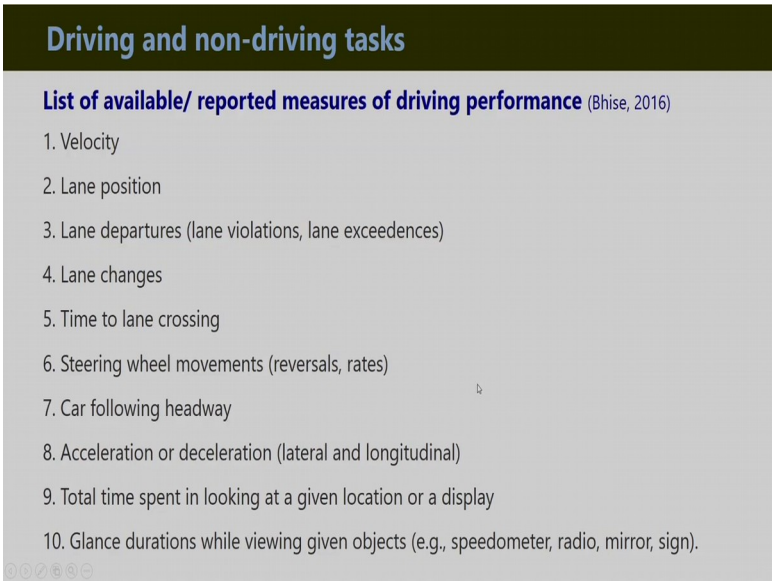

Now, the list of variables reported in the literature by various authors or researchers who are dealing with the driving performance. So, this list I have taken from the book written by Bhise, 2016 on Automotive Ergonomics.

So, the first one is the; the velocity of the vehicle, then position of the vehicle in the lane, the third one - lane departure (lane violations, lane exceedances), then lane changes, time to lane crossing, then steering wheel matrix (steering wheel angle, steering wheel movements). So, various positions of the steering wheel and hand position on the steering wheel.

Then, car following headway; the car in front of the vehicle being studied or the vehicle which is behind the particular vehicle. Then, acceleration or deceleration; lateral or longitudinal, that is also measured as the measuring variables for driving performance. Then, the total time spent looking at a given location or display. Another important measure is the glance duration while viewing an object, that may be inside the vehicle or outside the vehicle; like, inside the vehicle - speedometer, radio, mirror. Different types of signages on the road or various road scenarios, which are outside the vehicle.

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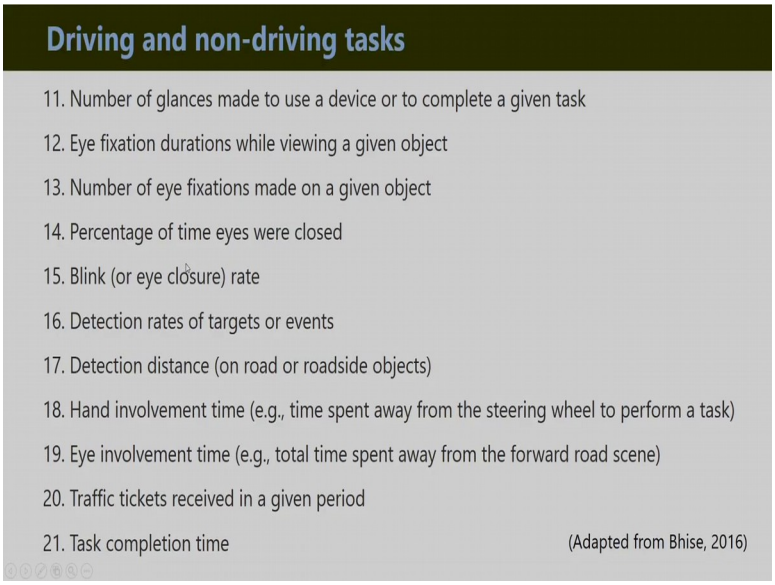

And for each of these scenarios; how much time is taken for a glance to receive visual information. The next measure is; number of glances made to use a device or to complete a given task. So, how many glances required for performing a particular task or acquiring information, that is also measured as a performance measuring of driving task.

The next; eye fixation duration while viewing an object. So, how much is the duration of a visual glance or eye fixation, that is also measured as the variable for measuring driving performance. Then, the percentage of time eyes were closed, then blink rate, blink duration, detection rates of targets, or events. Then, detection distance - on-road or roadside objects. So, how much time is taken for detecting a particular object, that may be inside or outside the vehicle. Then, hand movement time (time spent away from the steering wheel to perform a particular task). Then, eye movement time (total time spent away from the forward road scene). Then, traffic tickets received in a given period.

So, how many times the driver violated the traffic rule and accordingly, he got some traffic tickets. Then, task competition time. So, these are various driving performance-related measures.

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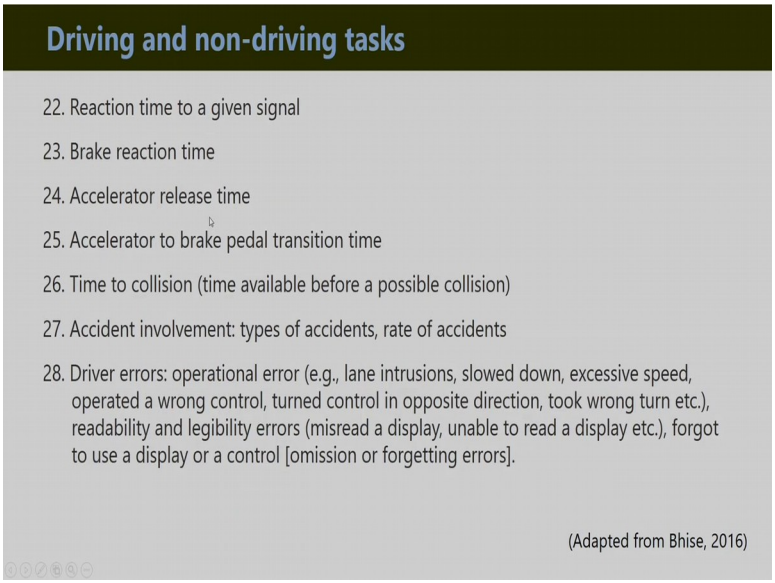

Apart from all these; there are, reaction time to a given signal; another is brake reaction time, accelerator release time, accelerator to brake pedal transition time. So, how much time it is taking to shifting the foot from the accelerator to the brake. So, this type of different driving performance-related measures are being reported by various authors in their research. Time to collision (time available before a possible collision) that is also measured. Then, accident involvement, as we discussed earlier also; the types of accident, rate of accident.

So, these are the various variables that are also measured as the indicator of driving performance. Then driver errors; operational errors, for example, (lane intrusion, then slowed down, excessive speed, operated a wrong control, turned control in the opposite direction, took wrong turn). So, these are different types of operational errors committed by the drivers. So, those can also be used as a measure of driving tasks.

Apart from that, there are issues related to readability, legibility of a particular display or some other signages on the roadway, then, forgot to use a display or control, which is an omission or forgetting errors. So, this type of different driver's committed errors are also measured to quantify the driving performance.

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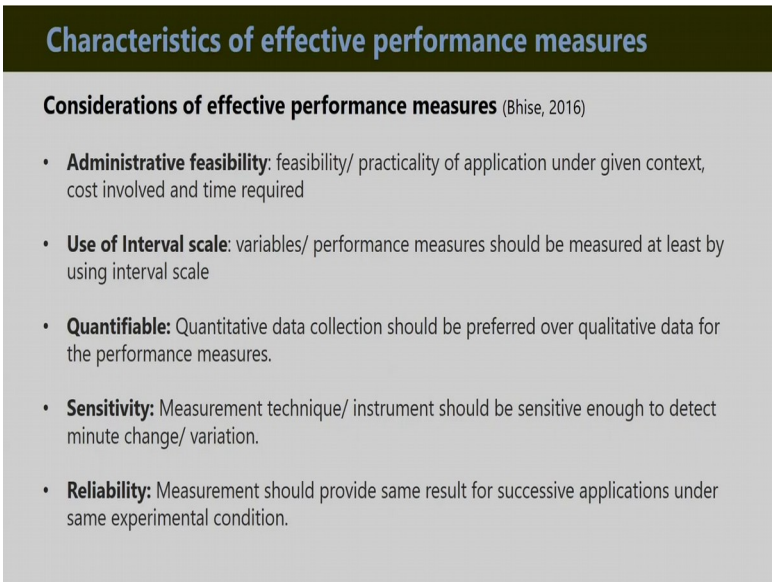

Next, consideration of effective performance measures. So, while we are deciding that, how we can measure the driving performance, then we need to think, which will be an important consideration for selecting a particular performance measure.

So; obviously, that driving measure variables or the technique should be checked in terms of administrative feasibility. So, that measuring techniques or measuring variables should be feasible; they must have feasibility, and practicality of application under the given context. At the same time, we also need to check how much cost and time is involved in applying that type of performance measuring technique or performing measuring variables.

Then, use of interval scale. There are different types of scale for the subjective response of the drivers. So, for that purpose, we can use a nominal scale, ordinal scale, interval scale, then ratio scale; so different types of scales are available. Out of these scales, as I mentioned in that sequence; starting from nominal, ordinal, interval and ratio; gradually, they are the collected data in terms of quantification and higher statistical analysis; they have the superiority.

So, in this case, we need to use at least an interval scale, means, not only nominal or ordinal, but we should go for an interval scale so that we can go for higher statistical analysis of the response provided by the drivers. Then, the measures should be quantifiable; quantitative data collection should be preferred over the qualitative data for

performance measures. Then, the techniques or the measures should be sensitive; so measurement techniques or instruments should be sensitive enough to detect a minute change or variation.

So, when there are minute changes, the instrument or the technique or the measuring variables should be sensitive enough to identify that one. Then reliability; measurement should provide the same result for successive application under the same experimental condition. So, what is this reliability? So, under the same experimental condition over time; the result of the experiment should be same. Then, we can mention that measuring techniques or measurement process is reliable.

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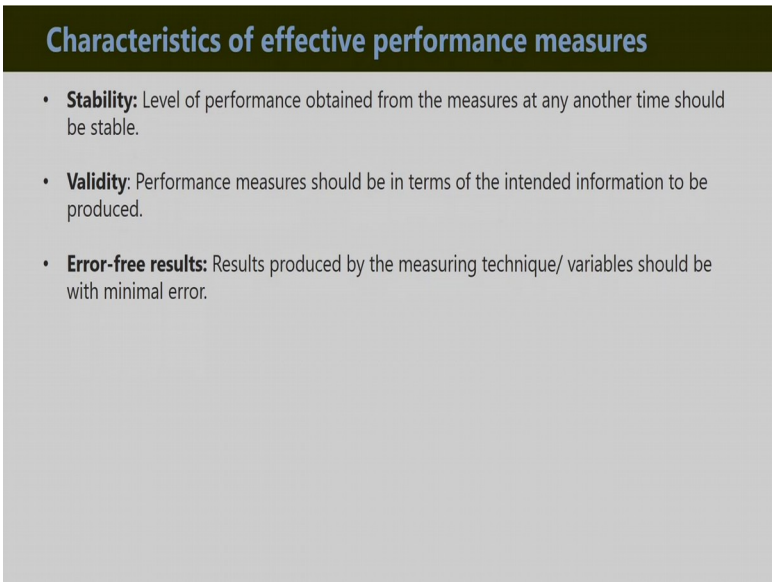

Then, the stability of driving performance measures. So, the level of performance obtained from measures at any other time should be stable; so, there should be no change. Then, Validity; performance measures should be in terms of intended information to be produced.

So, we have to select a performance measuring technique which should be valid, and which should give the intended result or intended information. Then, error-free results, the good characteristic of an effective performance measure is the error-free results. Although, it is not possible to avoid the error 100 percent, but we have to try to select measuring techniques; which have a minimal error rate.

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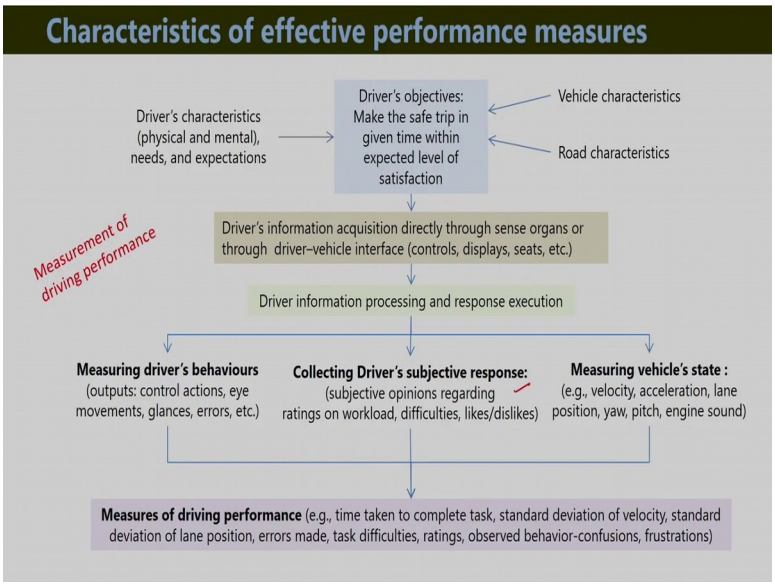

Now, we are going to discuss about measures of driving performance. While the driver is going for a particular distance or setting a particular goal from one-point A to point B; then, various factors are actually affecting the driver's performance. So, these influencing factors include; driver's own characteristics, his body dimension, his anthropometric/biomechanical characteristics, then needs, his expectation, his mental condition, means, whether he or she is mentally fatigued or physically fatigued.

So, all these factors actually affect the driving performance; not only the driver's characteristics but also the vehicle characteristics. The size of the vehicle, types of the vehicle, then instruments available in the vehicle; all these are also affecting the driving performance. Apart from these two variables; driver characteristics and vehicle characteristics, there are other factors; like road condition; traffic condition, then various other aspects; illumination level of the road, then weather condition. So, all these factors are also responsible for determining; how will be the driving performance.

So, while the driver is driving; driver's information acquisition is directly coming through various sensory channels as well as indirectly they receive various other information about the vehicle state; from in-vehicle; driver-vehicle interfaces, like various controls, displays, seat location etcetera.

So, all this information is actually processed in the brain of the driver for response execution. Whether; they will speed up the vehicle or reduce the speed, whether they will

press the brake or accelerator or gear or they will move the steering wheel. So, various types of activities; drivers have to decide based on the information processed in the brain. Now, when that information is being processed; then, how a driver's performance we can measure? So, we can measure the driver's performance while driver's is driving; in terms of measuring driver's behavior; we can also collect driver's subjective response; then, measuring the vehicle state.

So, while we measure driver's behavior; then we measure the control actions, eye movement, glances, errors. As we discussed earlier, that is related to driver's behavior, means visual behavior; where drivers are looking, what type of information he or she is collecting through visual channels, how is the glance duration, then fixation duration, fixation frequency. So, all these factors are coming under visual behavior.

Similarly, movement of the body parts, motion analysis, task analysis; so, these are performed as the measures of driver's behavior. Then, collecting the drivers' subjective response; during collection of driving subjective response; so questionnaires are prepared, or it may be an open-ended questionnaire, closed-ended questionnaire or structured or unstructured questionnaire, where different types of information are collected; this information may be a rating, on a rating scale or ranking.

So, various information is gathered, related to workload, difficulties, liking, disliking related to the driving performance, driving tasks, various components of the vehicle. So, these types of information are collected from the drivers, and these responses are used as the measure of driving performance measures.

Then, measurement of vehicle state. So, the velocity of the vehicle, lane position, yaw, pitch, engine sound. So, various types of vehicle-related variables are also collected using different types of instruments, which also helps in measuring the performance of the driving. So, all this information is ultimately helping in measures of driving performance. So, various variables are used for this purpose. So, time taken to complete the task, standard deviation of velocity, standard deviation of lane positions, errors made, task difficulties, ratings, observed behavior, confusions, frustrations. So, these are the various aspects of driving performance measures.

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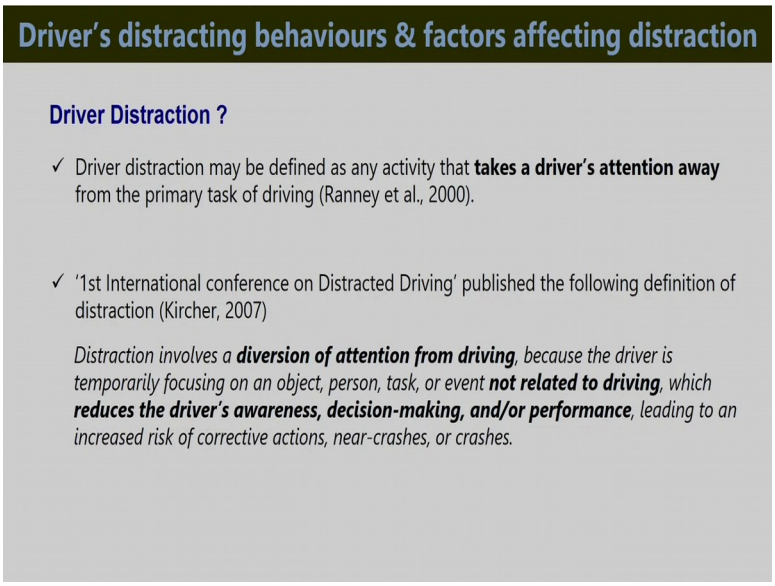

Now, we are going to discuss; what is distraction or driver distraction? Driver distraction may be defined as any activity that takes the driver's attention away from the primary task of driving; as suggested by Ranney et al. (2000). So, according to him; any activity which is diverting the attention from the primary task of driving, that is called distraction.

The first international conference on distracted driving; published the following definition, as reported by Kircher, 2007. So, accordingly; what is the definition of driver distraction? So, distraction involves a diversion of attention from driving because the driver is temporarily focusing on an object, person, task or event; that is not related to driving, which reduces the driver's awareness, decision making, and performance; leading to an increased risk of corrective actions, near-crashes or crashes.

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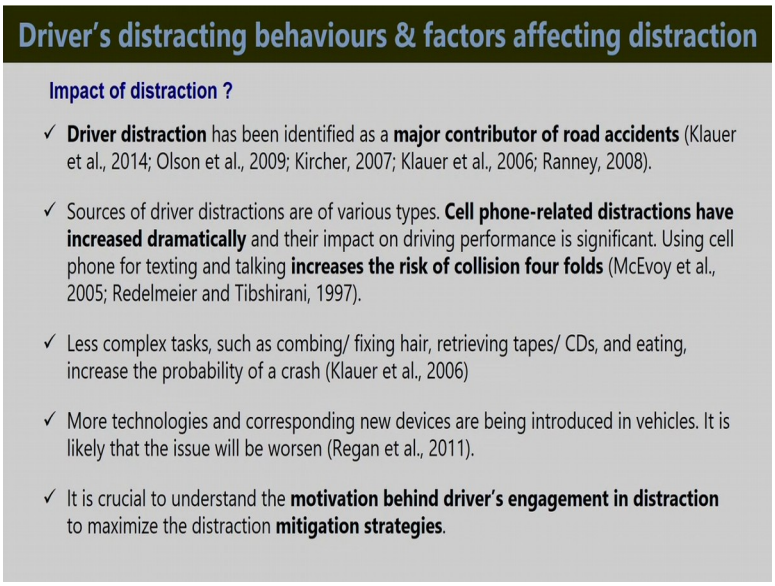

Now, the impact of distraction; what actually happens due to this distraction? So, driver distraction has been identified as the major contribution of road accidents; reported by various authors in their research papers, as already mentioned here. So, you can go through these.

Sources of driver distractions are of various types; out of these various types of driver distractions; cell phone-related distraction has increased dramatically, and their impact on driving performance is significant; as reported by various authors. Using cell phones for texting, talking, increases the risk of collision four-folds, means, it increases the risk four times as reported by McEvoy et al. (2005); Redelmeier and Tibshirani, (1997).

Less complex tasks, such as combing, fixing hairs, retrieving tapes or CDs and eating, increases the probability of crash because at that time drivers feel they are relaxed, they are safe, and they can do other activities. And when they have diverted their mind or attention from the primary task, there is an increase in the chance of error and accidents. More technologies and corresponding new devices are being installed in the vehicles, and these are likely to increase the situation in worse direction as reported by Regan et al. (2011).

So, these situations; this type of new-new instruments or devices inside the vehicle; these devices are actually increasing the chance of an accident. It is crucial to understand the motivation behind driver's engagement in distracting activities to maximize the

distraction mitigation strategies. So, why we are discussing about the driver distraction? Because if we understand the scenario of driver distraction; which are the influencing factors, then automatically it will help us in making the strategy for mitigating this type of distraction-related crashes or near-crashes, accident incidents.

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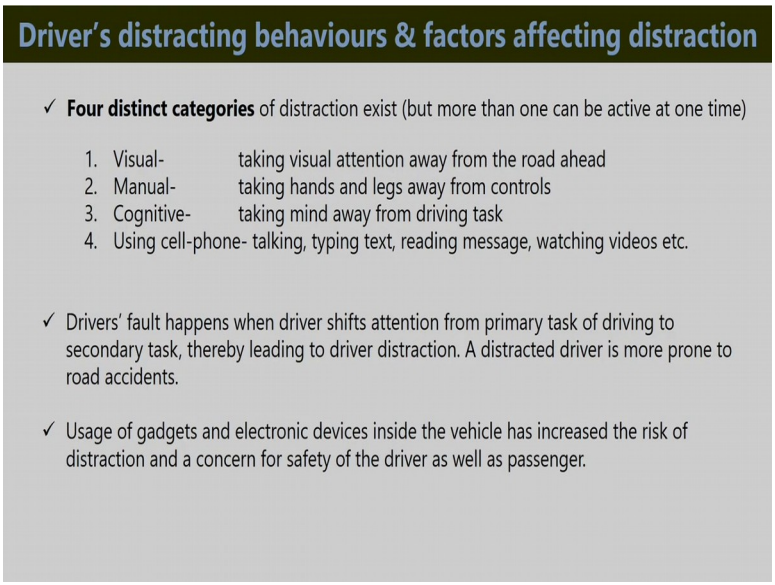

Then, for driver distraction, we can mainly categorize under these broad categories; one is visual, then manual, cognitive and using cell-phone. So, visual related; taking visual attention away from the road; manual is dealing with taking hands and legs away from the controls; either from the steering wheel or from the foot-controls, like accelerator, brake, clutches.

Then, cognitive; taking the mind away, means, attention diversion from the driving task and more recently which is very common, that is the use of cell-phone for talking, typing text, reading messages, watching videos and also use the mobile as the navigation system. These are the major categories of distraction which we observe in our day to day life. The driver's fault happens; when the driver shifts attention from primary task of driving to secondary task; thereby leading to driver distraction.

A distracted driver is more prone to a road accident. So, when there is a distraction; obviously, there is more possibility of road accidents. Uses of gadgets, electronic devices inside the vehicle have increased the risk of distraction and the concern for safety of the driver as well as the passengers.

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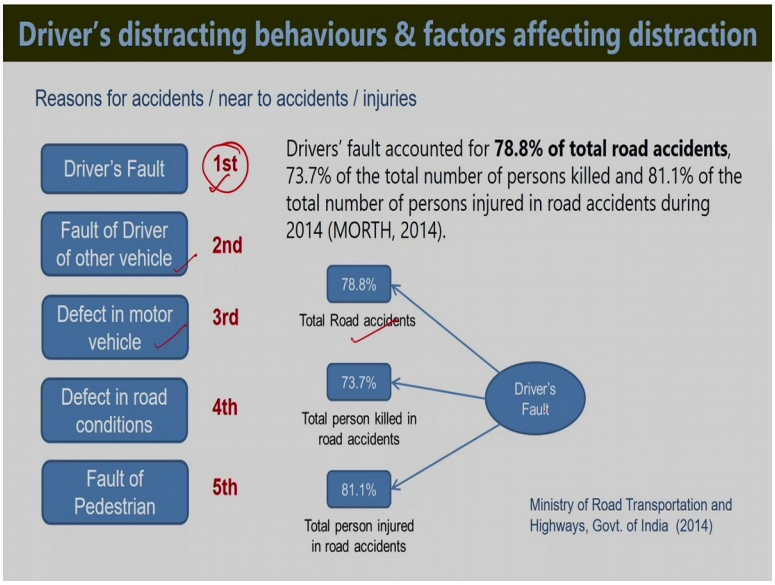

Now, if we look at the reasons for accidents, near to accidents or injuries. So, what are the reasons? Out of various reasons, if we segregate those reasons, and arrange them in rank order; then what is coming. The 1st responsible factor is the driver's fault, 2nd one is the fault of the driver of other vehicles, 3rd one is the defective motor vehicle, 4th one - defect in the road condition or there is some problem related to road or road condition, 5th one is the fault of the pedestrian.

Out of the various reasons, the most important one is the driver's fault; this is the first one, or its rank is the one. Now, according to Ministry of Road Transportation and Highways; Government of India, 2014 report; driver's fault - that first one; is actually, leading to 78.8 percent of the total road accident. And 73.7 percent of the total persons are killed due to the driver's faults and 81.1 percent of total person injured in road accident, that is also due to driver's fault.

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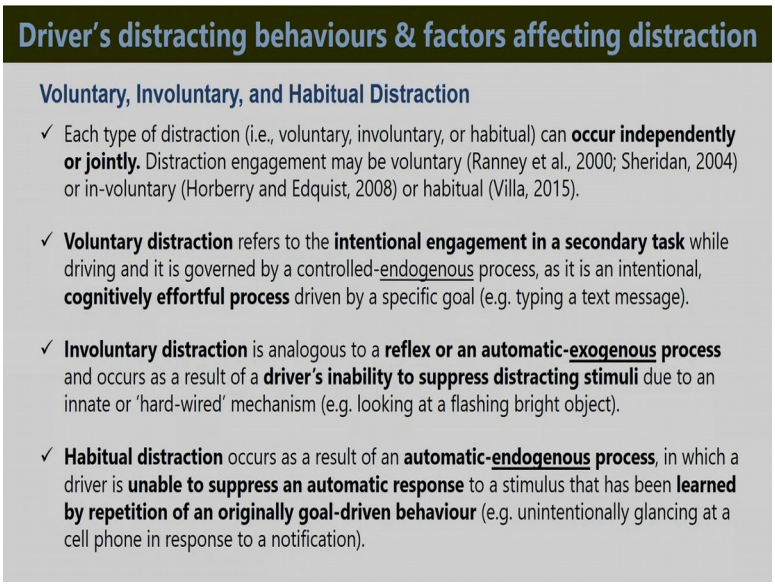

Now, types of driver distracting behavior; mainly we can categorize into three categories. So, one is the voluntary, second involuntary and the third one is habitual distraction. Each type of distraction can occur independently or jointly; distraction engagement may be voluntary, involuntary or habitual as we already mentioned.

Now, voluntary distraction needs to know; what are the differences among these different types of distraction. So, voluntary distraction refers to the intentional engagement in the secondary task. So, in this case, drivers are being engaged in a secondary task intentionally; while he or she is driving and it is governed by the endogenous control process. So, this is controlled by the endogenous process, means, from within the driver's neural path.

It is an intentional cognitive effortful process driven by a specific goal. For example, typing a text message on the mobile. The second type is the involuntary distraction; it is analogous to the reflex or automatic exogenous process. So, earlier it was endogenous, but in case of involuntary; this is exogenous process and occurs as a result of driver's inability to suppress the distracting stimuli due to an innate or hard-wired mechanism; so, looking at a flashing bright light; so, this is the example of involuntary distraction.

So, in case of involuntary distraction; what is happening? Drivers cannot, or the driver is unable to suppress the distracting stimuli. Unintentionally, he or she is looking or attending that distracting stimuli and responding accordingly. The third one is the

habitual distraction; this occurs as a result of automatic endogenous process. Again, this one is the endogenous; in which the driver is unable to suppress an automatic response to stimuli, that have been learned by repetition of an originally goal-driven behavior.

So, this behavior or habitual distraction is happening due to their repetition or practice in earlier situations. For example, unintentionally glancing at a cell-phone in response to notification; so generally, we are habituated when there is a notification; we are habituated to look at the cell-phone. So, this also unintentionally happen during the driving process; when the driver is carrying the mobile phone.

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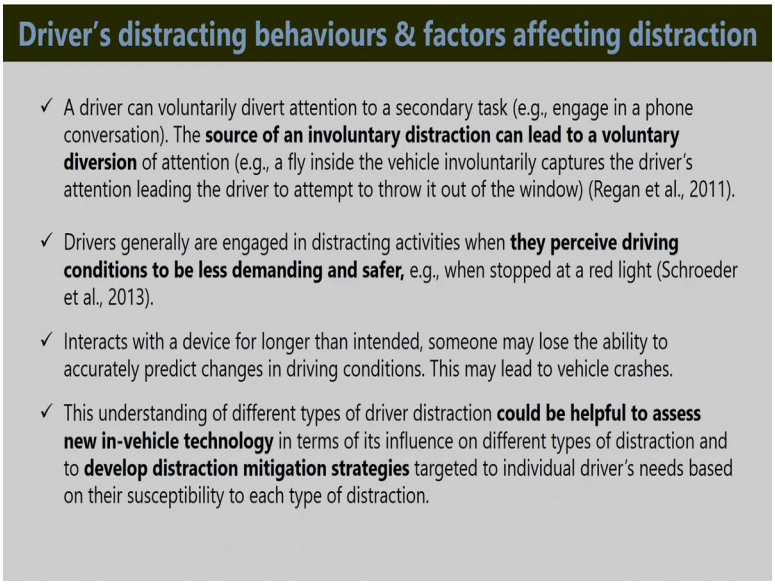

A driver can voluntarily divert attention to a secondary task. For example, engage in a phone conversation. The source of an involuntary distraction can lead to voluntary diversion; so, initially the source is leading to involuntary distraction, but after that driver is being engaged as involving the voluntary diversion of attention. Then, drivers are generally engaged in distracting activities when they perceive the condition to be less demanding and safer.

So, from these various researchers report; for example, Schroeder et al. (2013); the drivers are generally being involved in distracting activities or other secondary driving tasks; when they perceive the driving condition to be less demanding and safe. Then; interacts with the device for longer than the intended duration, sometimes may lose the

ability to accurately predict the changes in a driving condition, and this may lead to a vehicle crash.

So, while the driver is looking inside the instrument panel or control panel; then what is happening? If the duration is more than 2 to 4 seconds, then during that 2 to 4-second duration driver's visual attention is away from the road scene. And, after these 2 to 4 second times, while driver is looking at the road; the road condition actually changes. And, accordingly reacting on the road scenario is many a time becoming difficult for the drivers; which leads to accident or near-crash accident.

This understanding of the different types of driver distraction could be helpful to assess new-vehicle technology; in terms of its influence on different types of distraction and to develop distraction mitigating strategies, targeted to individual driver's needs, based on their susceptibility to each type of distraction.

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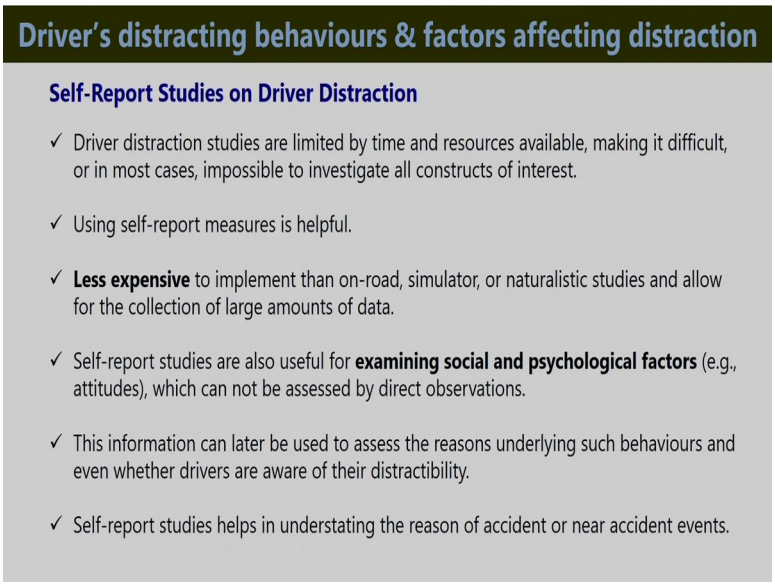

Now, self-reported studies on driver distraction, as we discussed earlier, which are the characteristics of good driving performance measures.

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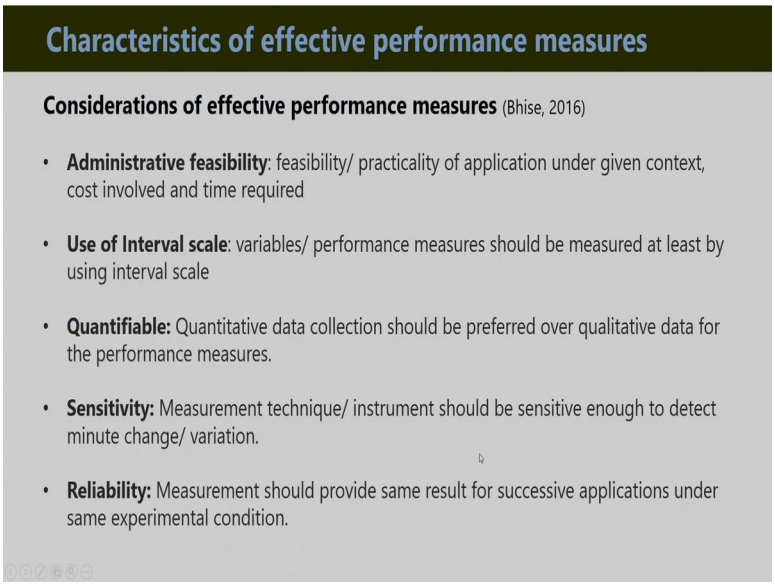

So, there we mentioned various characteristics; like reliability, administrative feasibility, use of interval scale, quantifiable, sensitivity, reliability, stability, validity, error-free results. So, these are the various aspects of effective performance measures.

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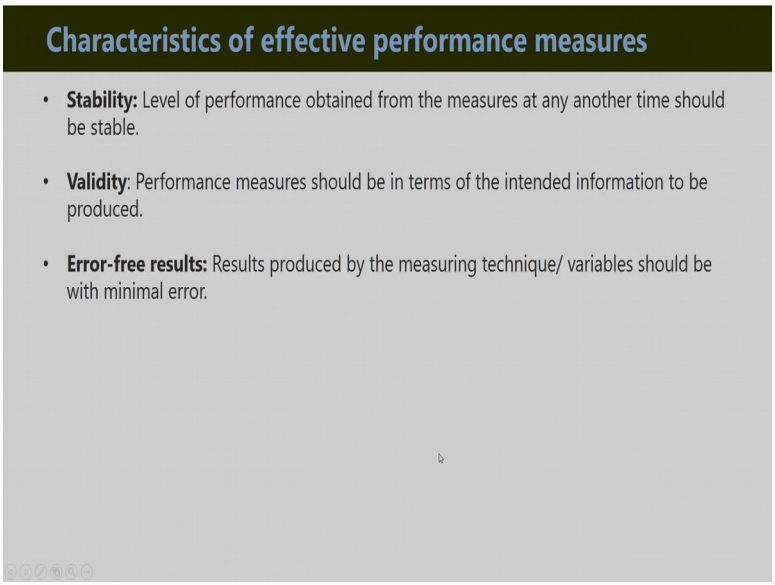

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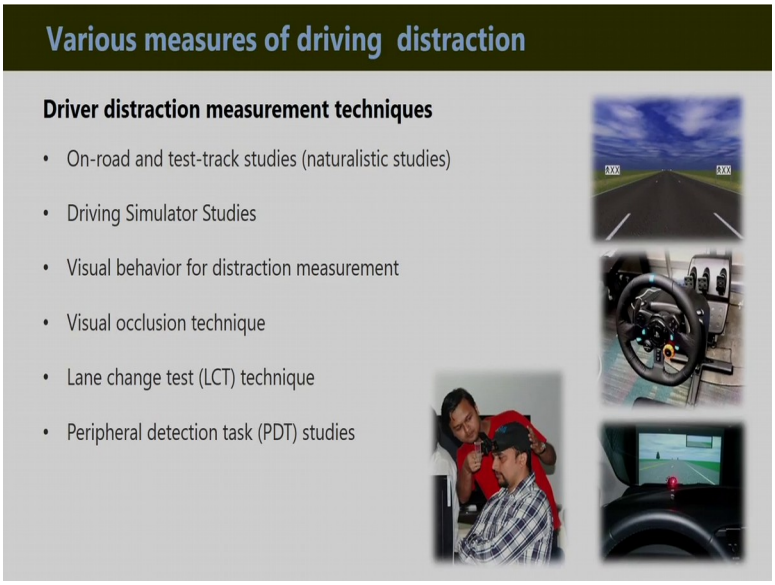

As the first one; that, administrative feasibility; many times, it is difficult to administer that particular technique or particular measures. So, in that scenario; self-report studies of driver distractions are very useful. Driver distraction studies are limited by time and resources available, making it difficult or in most cases, impossible to investigate all constructs of interest. For that purpose, using self-report measures are very much helpful; these are less expensive to implement than on-road driving, then simulator, naturalistic studies and allow for the collection of large amounts of data.

Self-reported studies are also useful for examining social and psychological factors; for example, attitudes, which can be assessed by direct observations. This information from the self-reported studies can later be used to assess the reasons underlying such behaviors and even whether the drivers are aware of their distractibility.

Self-reported studies help in understanding the reason for accident or near-accident events. So, this type of accident and near-accident events are difficult to study in other driving performance measuring techniques; like simulator, naturalistic driving because there is less chance of happening the accident and near-accident incidents, or it is very time-consuming to study in natural driving scenario or on-road studies to find out this type of accident or near-accident event.

Now, various measures of driving distractions. Following the literature review, it is found that various researchers have developed and adopted different types of driving

performance measurement techniques. One of them is on-road and test-track studies; that is called naturalistic studies; on real-scenario, on real-road condition. Then, driving simulator; in laboratory condition using the simulators.

Then, the visual behavior of distracted measurement. Then, visual occlusion techniques; where visual occlusion or visual obscuration are created by using specific types of visual glass. Then, a lane change test technique and the last one is the Peripheral Detection Task or PDT. So, these are the various techniques that are currently being used for measuring the distraction of the driver.

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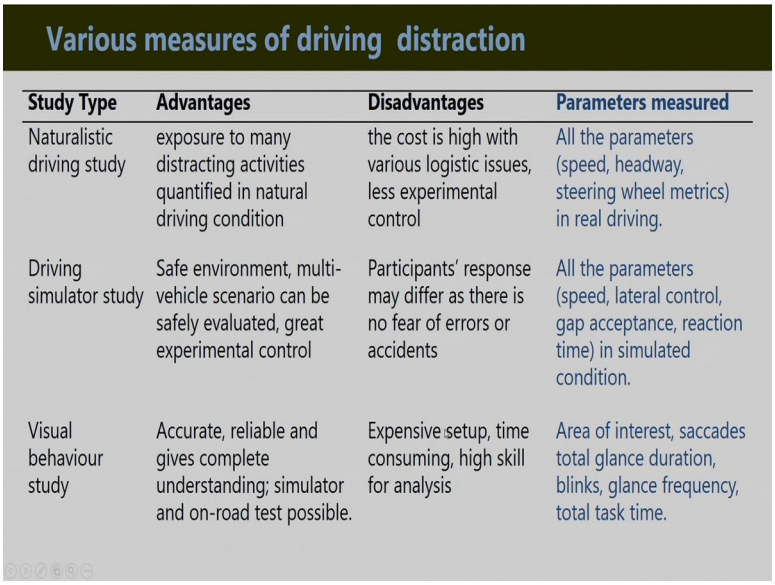

All these techniques have various advantages and disadvantages, and also if we look at this table, then we can see the list of advantages of a particular technique; what are the disadvantages, at the same time which are the variables or measures, we can get from that particular distraction measuring techniques.

So, the first one is the naturalistic driving study; advantages are - exposure to many distracting activities quantified in a natural driving condition, whereas the disadvantages include; the cost is high with various logistic issues, less experimental control. But this type of study is allowing measurement of all parameters related to speed, headway, steering wheel metrics in real driving condition.

Second technique; driving simulator study. So in terms of advantage; that is safe environment, multiple-vehicle scenario can be safely evaluated, great experimental control, we can change different types of variables, road-scenario, road-condition. So, that is possible, that is under the control of the experimenter, but disadvantages include; participant response may differ as they are well aware that they are not in real-driving condition. So, there is no fear of error or accident, and variables are measured, generally, all the parameters related to speed, lateral control, gap acceptance, reaction time; so these are measured under the simulated condition.

The third technique is the visual behavior study; which is accurate, reliable and this gives complete understanding. Simulators and on-road test is also possible. So, in visual behavior study; how is a driver's visual behavior; how visual information is being captured, that it can be measured accurately, reliably and complete understanding of the visual information processing behavior is possible. And, this technique is applicable in case of both; naturalistic driving scenario, as well as for driving simulator study.

But the disadvantages are; expensive set-up, time-consuming, high skill for analysis is required. And parameters that are involved in this type of study include; areas of interest, saccades, total glance duration, blinks, glance frequency, total task time.

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Various measures of driving distraction

Study Type	Advantages	Disadvantages	Parameters measured
Visual Occlusion ✓	Easier and less costly than eye glance measurement, applied in early stages of system prototype	Short <1sec, dynamic moving element task are out of scope	Total task time, occlusion time, inspection time, total shutter open time, total shutter closed time
Lane change test	Simple, cost-efficient, reliable, sophisticate and expensive equipment not required	Learning effect of driving simulator may happen	Mean deviation, lane change initiation, task duration.
Peripheral detection task ✓	Reliable, sensitive to variety of secondary task, low cost and easy setup, simulator as well as on-road test possible.	Affect visual behaviour when simultaneously performed.	Hit rate, reaction time.

In visual occlusion type of study; advantages are; easier and less costly than eye glance measurement, applied in early stages of system prototype. Whereas disadvantages

include; its duration is short - less than 1 second, then dynamic moving element tasks are out of the scope. And which are the parameters measured? One is total task time, occlusion time, inspection time, total shutter open time, total shutter closed time.

So, in visual occlusion time; so, these are the various variables which are measured using the instrument like; as I mentioned that, there is an equipment or like a speck or which helps in visual occlusion for a certain duration. Then, lane change test; this is simple, cost-effective, reliable, sophisticated and expensive equipment is not required, and disadvantages include; learning, effect of driving simulator may happen. So, in this case, the learning effects may affect driving performance.

Thus, it is becoming biased in case of lane change tasks, and parameters measured in this case include; mean deviation, lane change initiation, task duration. The next technique is the peripheral detection task. So, this is reliable, sensitive to variety of secondary tasks; low cost, easy set-up, simulator, as well as on-road test, is possible. But disadvantages include; affect visual behavior when simultaneously performed, and parameters measured in these techniques are hit rate, reaction time.

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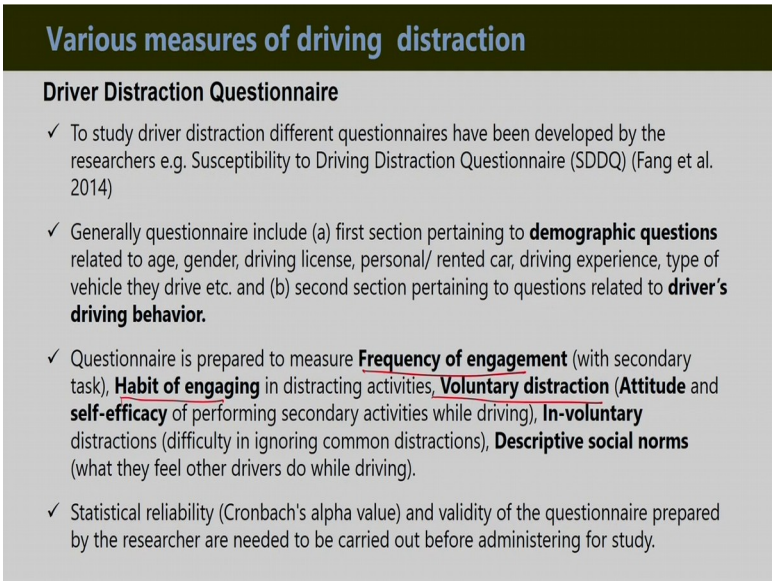

Now, apart from these various measurement techniques, as we mentioned subjective measurements is also possible, where we use questionnaire. To study driver distraction, a different questionnaire has been developed by the researchers.

For example, Susceptibility to Driving Distraction Questionnaire (SDDQ), as reported by Fang et al. (2014). Generally, questionnaires include; first section - pertaining to demographic questions (related to age, gender, driving license, personal or rented car, driving experience, types of vehicle etcetera). And, second part of the questionnaire includes; driver's driving behavior related issues.

The questionnaire is prepared to measure the frequency of engagement with secondary tasks, habit of engaging. So, first is the frequency of engagement; second is the habit of engaging in distracting activities, voluntary distraction (attitude and self-efficacy) of performing secondary activities while driving. Then, involuntary distraction (difficulty in ignoring common distractions); then, descriptive social norms; what they feel, means, what drivers feel about other drivers do while driving?

So, what drivers feel about other drivers do, while driving? So, this can also be recorded using questionnaire study; under descriptive social norms. Then, statistical reliability and validity of the questionnaire prepared by the researchers are also needed to be carried out before introducing or implementing that questionnaire for the actual study.

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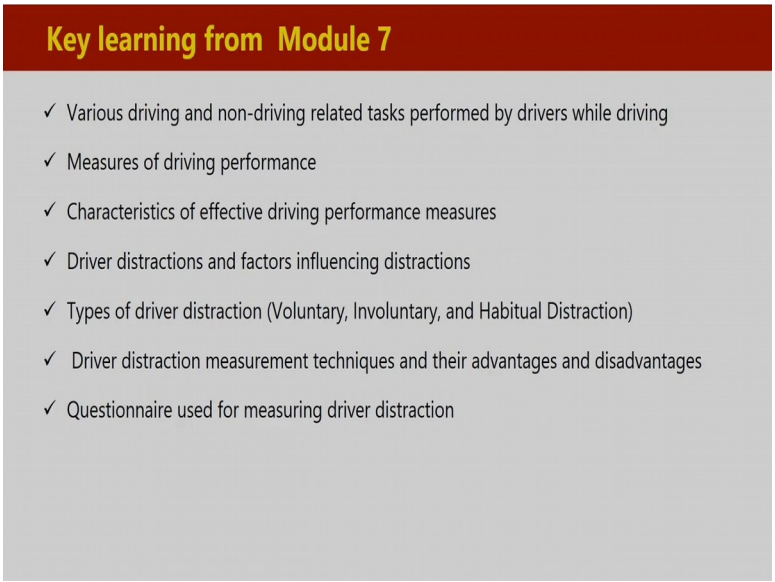

So, after discussing these various aspects of driving, non-driving tasks, and driving distractions; so now, we are summarizing; what we learnt from this particular module; that is module seven. So, we learnt about various driving and non-driving related tasks performed by the drivers while they are driving.

Then, measures of driving performance; various types of measures, their categories, then the list of various measures as reported by the various researchers, we also discussed about the characteristics of effective driving performance measures. So, which should we follow before identifying a particular driving performance-related measures; what should be the characteristics; we discussed in details.

Then, driver distractions and factors influencing the distraction activities, then types of driver distraction (voluntary, involuntary, and habitual distraction); their definition, their differences were also discussed in this module. Driver distraction measurement techniques and their advantages and disadvantages. Finally, we discussed about the questionnaires used for measuring driving distraction.

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These are the list of references, which have been used in various slides of this module seven.

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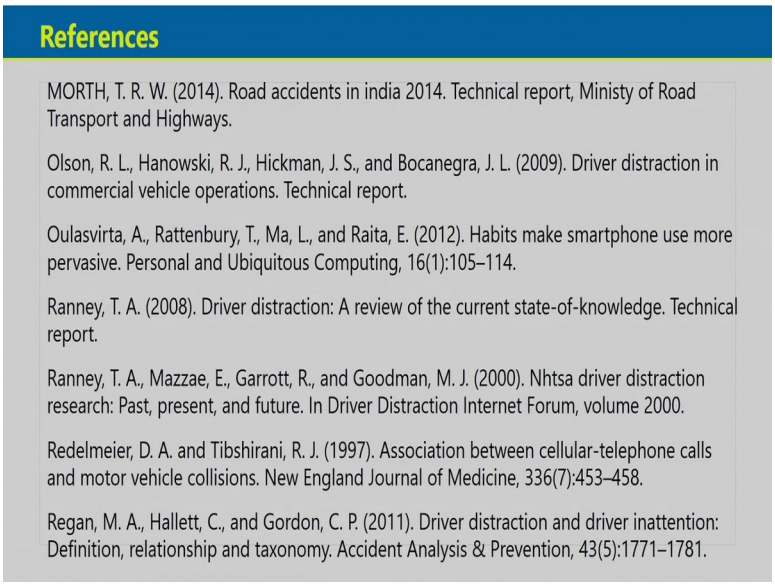

So, you can go through many of these references to understand the topic deeper and in a deeper way, and you can learn more information regarding driver distraction and driver distraction measurement techniques.

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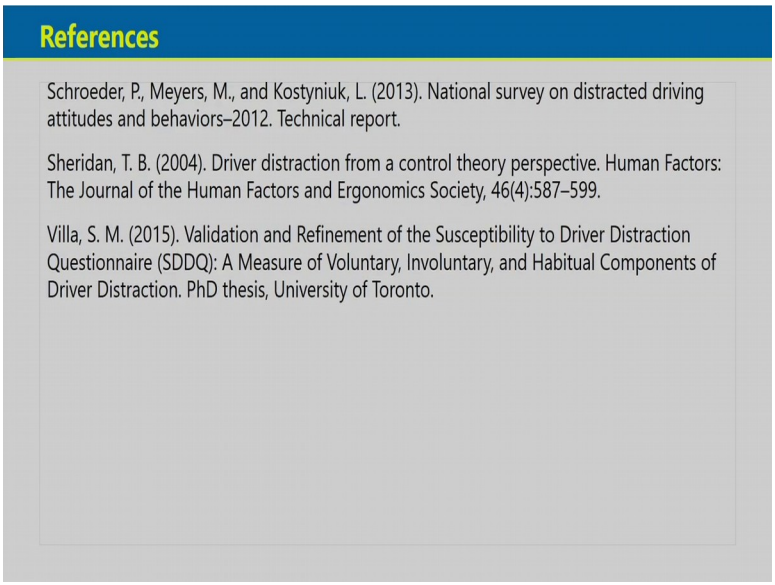

Thank you.