# Comparative Analysis of Drivers' Distraction Assessment Methods


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The distraction of driver's attention during the implementation of the driving task is not simply a theory. It is a procedure which is activated and developed depended on many factors. It is detected at all drivers with floating extentand and frequency of appearance, but in every case the results of this distraction are intensely for the driving task, the driver's safety and finally for the rest of road users.

The importance of this issue emerges from data which show distraction as a cause for serious accidents as well as crashes. A characteristic research is carried out by the Virginia Tech Transportation Institute (VTTI) for NHTSA, the "100- Car Naturalistic Driving Study" (2006). According to that research driver's distraction while driving, caused from a secondary task, was reported in the 33% of the crashes and in the 27% of the near crashes. This research is confirmed by the data of accidents of many countries despite the fact that a big percentage of these accidents is reported as an accident of an unknown cause. As a result nobody can be incurious attending all these high percentages.

Thus, we refer to a problem of road safety and not just to a phenomenon that is observed during the execution of the driving task. We refer to a road safety problem with reasons, variables, factors of influence, results. We refer to an equalization that needs a solution.

For the accomplishment of an objective and effective solution, it's necessary to detect and define the causes and the way that factors influence each driver separately. After the correct completion of that procedure, this major problem can be eliminated where it starts or at least it can be derogated.

The first step to a right approach is to understand the basic characteristics of distraction. Distraction can have the following four forms. Visual, cognitive, biomechanical and auditory (Ranney, Garrott & Goodman, 2001). An activity can constitute combination of the above form of distraction.

In the first International Conference on Distracted Driving (2005) the scientific community agreed on a definition for driver's distraction. According to this definition "Distraction involves a diversion of attention from driving, because the driver is temporarily focusing on an object, person, task, or event not related to driving, which reduces the driver's awareness, decision-making, and/or

performance, leading to an increased risk of corrective actions, near-crashes, or crashes" (Hedlund, Simpson & Mayew, 2006, p.2).

The following clarifications are given:

- Distractions exclude pre-existing conditions, including impairment by alcohol or drugs, fatigue, and psychological state; however, any of these can make it easier for a driver to be distracted or can change the effect of a distraction.
- Distractions are affected by personal characteristics such as age and medical conditions.
- Distractions are affected by driving conditions and situations.
- Distractions need not produce immediate consequences such as corrective actions or crashes, but do increase the risk of these consequences.

The only certain way for the researcher to detect driver's distraction is via the results that this action produces. These effects can be crashes, speed changes, loss of control and exit from the lane lines.

The effects of distraction can be measured using many different methods. The most popular among them are included in three basic categories:

- Studies based on elements of accidents
- Experimental studies with of driving performance
- Studies of observation

Furthermore, there are some kinds of methods that are not included in any of the previous categories but they will be referred below.

All the essential types of data should be used in order to carry out an integrated research. The collected data can be:

- exposure data, using direct observations of driving or observations taken from outside of vehicles, to determine the frequency and risks associated with different distractions;
- crash data from special studies (preferably with investigators arriving at the crash scene to interview participants), or from "black box" crash recorders, to more accurately determine the role of distractions in crashes;
- data from simulator, test track, and on-road studies to investigate the effects of different distractions on driving related tasks and actual driving performance; and
- Focus group and survey data, to gauge driver knowledge and attitudes.

However in order to collect all these data, the use of standardized methods of data collection, as well as specification distraction definitions are required. The use of standardized methods gives the researchers the possibility to exchange data, conclusions and good practices with a view to promote the research on this particular subject. Therefore, it is necessary to detect the use of suitable method of collection of data (Young & Regan, 2007). This aim can be achieved via a comparative study between the allocated methods examining the impossible and possible points of every method separately, as well as the usefulness and necessity of results that it produces.

# 1. Studies based on elements of accidents

The execution of these particular studies requires from the researcher to study the elements of accidents that already have taken place in a certain time or place and come to conclusions with regard to which of them were caused due to driver's distraction. Furthermore, the researcher

can collect his own elements by observing the accidents in his region of interest at the time interval of his research. Advantages and disadvantages of the two methods are marked.

## Advantages of method

Important advantage of this particular method, if the reason of the accident is driver's distraction, is that there is no doubt regarding the venturousness of particular form of distraction that causes the accident. The researches deal with accidents hence lead to secure conclusions concerning the effectiveness of lack of attention.

In the first case where the past accident action is examined, if the police has maintained a full data base, then automatically useful information is collected. In the second case, the researcher through personal interviews from the participants in the accident and from witnesses as well, can collect precisely all the useful information that may needed.

## Disadvantages of method

An important disadvantage of this method is that it is quite difficult to be determined through the elements of accidents if the cause of accident was driver's distraction or any other type of lack of attention (Ranney, 2008). The police officers many times do not describe this information in their documents and furthermore there are a lot of drivers who do not admit that they were distracted and lost the control of their vehicle. Additionally, there are not certain elements in an accident in order to connect the result with the distraction as cause. Thus, if someone is based exclusively in this method it is possible to underestimate the driver's distraction as cause of challenge of accidents (Trezise et al., 2006: Stutts et al, 2001: McCartt et al., 2006).

Some other disadvantages of the method is that the size of sample depends on the size of the data base and the quality of this depends on its completeness. Also, studying the data base can someone accomplish to connect one type of distraction with the accident, without however knowing the frequency of appearance during a normal driving situation (Kircher, 2007).

The direct interview demands enough educated available stuff and availability of time as well, because the collection of satisfactory size of sample can last a lomg interval of time.

# 2. Experimental studies

There are studies that take place in an absolutely controlled environment under controlled conditions and regulations. There are two types of studies in this category. The studies that include simulator and take place in laboratory and those for which a test track is constructed(Ranney, 2008). Both of them have the same target during their transaction; to measure the possibility of driver's distraction relating to the level of driving task (primary subject), due to the fact this could be a possible distraction (secondary subject).

## 2.1 Studies with simulator

Inside a laboratorial environment a simulator is placed which can be a simple screen of computer with a seat for the driver. It can include a moved base or have the skeleton and the interior of

regular vehicle in order to become more persuasive for the participant in the experiment aiming at an accurate acquisition of driving sense.

This method has been preferred occasionally by researchers because of its advantages. However, the disadvantages in many cases can influence the result.

### Advantages of method

A basic advantage of simulator use in laboratorial environment is the fact that the conditions of experiments are absolutely controlled by the researcher giving him the possibility to focus his observations on anything he considers most important. The trip, the weather conditions, the external situations that could distract the driver's attention are factors that are predetermined and the entire experiment is organized around them. Besides, there is always the possibility the above mentioned factors to alter due to the fact that the simulator gives the possibility to experiment in many different scenarios according to the variety offered. Another important advantage that is connected with the above is that the researcher can study dangerous driving situations, something which is difficult to be implemented in studies in real driving environment, because the most important issue is the participant's safety.

The repetition of the same scenarios for each participant ensures the objectivity of results, as all of them are examined under the same conditions, in the same driving environment and in the same incidents. The validity, the precision of results and the availability of value that the system of simulator offers, suggest extra advantages.

### Disadvantages of method

The most important disadvantage of this method is the fact that each participant in the experiment is suspicious regarding the experiment so he is more retained in his driving behavior and he is not identified with his daily driving in a real driving environment. Also the time for the participants is usually limited and the possibility to become familiar with the environment and to feel comfortable after a certain time interval, is almost excluded. Finally, the number of the participants is limited and accordingly a carefully selected sample is required.

Examining more carefully the main points of the method, emphasis has to be given to the fact that there are no real incidents that cause a real distraction and especially if it is combined with the already influenced driver's behavior, then, it will create mistaken results in certain cases. Also it is not easy for the researcher to increase the distraction by artificial ways in order to examine it. Thus, the motive factors that influence the willingness of the driver to be involved in secondary tasks rarely exist and that rarely has the essential time to the driver been given, in order to develop this desire.

Finally the cost appears to be a big issue, even if this depends on the quality of simulator. The quality, though, is not something that can be overlooked because the better simulator is used, the more valid and precise results will emerge.

## 2.2 Studies in test track

Test tracks are closer to the reality. The vehicles are real but the route is closed and has been disposed exclusively for this aim. This means that the vehicles are there for the needs of the experiment.

### Advantages of method

The controlled situations constitute also in this category of studies an important advantage. As it is usual in studies with simulator, the trip and the external situations that could distract the attention of the driver are factors that are predetermined. Of course the weather conditions could not be determined and naturally the alternation of different scenarios is not feasible in the same way as in simulator. The dangerous situations can be studied, even if there is traffic of other vehicles, this traffic is programmed and included in the experiment.

### Disadvantages of method

The disadvantages of this method are almost the same with the disadvantages mentioned in the study in laboratorial environment with the use of a simulator. The participant in the experiment is suspicious regarding the experiment and the fact that he drives in a laboratorial environment and being observed by the researchers, makes him more careful and continuously in vigilance. The required time, in order to feel comfortable in the environment, is not available and the number of the participants is also in this case limited(Kircher, 2007).

Additionally, the cost can differ from the cost that the acquisition of a modern and completely equipped simulator demands, but continues to be big.

Finally, it is useless for the researcher to wait for the driver's natural distraction and thus in many cases he proceeds in use of artificial methods so as to study the distraction and its characteristics.

## 3. Studies of observation/ Field stydies

Observation studies are the studies in which the researcher observes the driver and extracts conclusions about his distraction from the driving task. Basic characteristic of this category of studies is the fact that they are carried out in the field that is in traffic roads with the use of real vehicle. They are closer to real driving and the most discreet of all methods.

Those studies can be conducted either by observing the passing vehicles from a certain point of the route or by using specially equipped vehicles whereas the researcher can be either inside or outside the vehicle.

### 3.1. Observation of determined point

In this case a static observer records the reactions and the characteristics of drivers as they pass through a specific point.

### Advantages of method

The cost as well as the duration of the specific method is quite limited. In case the venturousness of a certain point is being examined, because of elements that cause the distraction of drivers, this method certainly can offer useful conclusions.

### Disadvantages of method

The validity of results is subjective because it depends exclusively on the observer's critical glance and perceptive abilities. Furthermore, it is difficult to extract conclusions about the drivers' behavior and the method does not facilitate the in-depth investigation of the phenomenon, but only offers a general view of the effects of distraction in a specific point of the route.

## 3.2. Use of special equipment vehicles

They are naturalistic studies in which drivers volunteer participate to the experiment. The vehicles are equipped with cameras and sensors in order to check the driver's distraction continuously. There are two ways to carry out these researches. In one case the vehicle is given to the driver, or the same equipment is placed in the driver's vehicle, for a long period of time. In the other case every participant drives the equipped vehicle for a certain distance under the researcher's supervision.

In both cases certain positive points and weaknesses can be identified that are worth mentioning.

### Advantages of method

The most important advantage of the method, as expected, is the fact that it approaches real driving more than any other method. For this reason the results are characterized by high degree of validity and reliability.

The time frame in which each measurement is executed is not limited. It can be one trip or even a long period for each driver. This gives the possibility for a more precise study by collecting all the data that is required and not just this that the time allows to be collected. It, also, gives the opportunity to the participant to have an adjustment period with the vehicle in order to obtain a normal driving behavior. Finally, the lack of time restriction helps the investigation of long-term effects of specific measures as well as the elaboration of "before and after" studies.

The number of participants is determined by the needs of research and there is no restriction in this. Their behavior is natural even in this case affected by the fact that their movements are observed and recorded, but this idea is withdrawn if they are given the essential time in order to get familiar with the vehicle and even more if the equipment is as discreet and well hidden as possible. Also in the cases where the researcher is not inside the vehicle and the driver is not informed about the nature of the research the driving approaches reality even better.

### Disadvantages of method

The small possibility of the researcher to control the situations and create desirable driving scenarios is among the disadvantages of this method. The environmental conditions, also, cannot be controlled.

The majority of daily driving behavior does not include a lot of snapshots of distraction that lead to events worth studying. The participating drivers do not easily get involved in dangerous situations and for this reason there is need for the collection of big volume of data so as to have the opportunity to extract sufficient material that will be useful in the research (Ranney, 2008). This has as a result the increase of cost because of the continuous recording and examination of drivers.

## 4. Questionnaires

The syntaxis of a complete questionnaire and the conduct of interviews can help the research. The questionnaire can be used, either in telephone interviews, or addressed to specific groups of population, or in the sites of accidents as it was reported previously.

### Advantages of method

The collection of data with the use of this method is easy and it can be implemented by many participants. The anonymity that the method guarantees is an element in favor of the participant's sincerity as it is difficult for the distracted driver to admit his distraction. Finally, the low cost is the third positive element of this kind of researches.

### Disadvantages of method

A basic disadvantage of the method is the fact that the research cannot be carried out in detail, leading to the extraction of conclusions regarding general indicators that concern distraction. Also, the probability that the selected sample is not representative, downgrades the reliability of the research. This can also be generated by the fact that many participants lie either because they do not dare tell the truth, or because they don't fully understand the question and the meaning of the term distraction. Still it is difficult for someone to recall in his memory all those moments that he was distracted from the driving task.

## 5. Peripheral detection task (Pdt)

. This method can be applied both in a simulator and in the field. It measures the ability of the driver to locate an optical stimulus, usually a red stain that is being revealed for 1-2 seconds 11° to 23° left in his optical field. The driver shows that he located the stimulus by pressing a button which is placed in the middle finger of his good hand (Kircher, 2007). Thus, the researcher, judging by the reaction time and the time needed until he pressed the button, can decide whether the driving task has increased requirement or not.

### Advantages of method

It has been proved that this method is adequately sensitive not only for the intellectual but also for the optical distraction of attention. This method even though it constitutes secondary subject compared to the driving task, it is not demanding. The data extracted for analysis is simple enough and the equipment needed is economic and functional.

### Disadvantages of method

A core disadvantage is the fact that the method itself constitutes a secondary work that the driver is called to carry out. Also in case another secondary task has to be executed with the hand occupied with the button, then confusion may be created. Furthermore, the system should be adapted for left-handed or right-handed drivers respectively.

In general, however, this method estimates mainly the requirements of the driving task although it might also lead to conclusions about driver's distraction.

## 6. Visual occlusion

According to the method the sight of driver is obscured for a short time period and by this way the optical requirements of driving task can be studied but also the distraction can be simulated in order to understand which visual occlusion has destructive results for the driving task (Kircher, 2007). The parameters that the researcher estimates are the time of appearance of subject and the time of darkness.

### Advantages of method

The advantages of this method include the fact that the drivers can select the time interval in which they wish the subject to be visible, but also the researchers, having predetermined the parameters' prices, can observe the change in behavior.

### Disadvantages of method

The fact that the safety of the drivers does not allow application of method in the field is one of the method's disadvantages. Therefore, the researcher has also in this case, an experiment instead of objective data for analysis. Finally, as experimental process in simulator, it epitomizes all the disadvantages of the method, including the limited number of participants.

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