Hazards caused by driver aggressive and nontolerant behavior

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Abstract: - The safety of human population in almost permanently endangered by many hazards coming not only from external natural causes, but very often also from human own activities, necessary for its survival.
The transportation realized by vehicles on roads belongs to some of most important. We cannot live without it.
Unfortunately, all the road transportation activities around the world are followed by very many accidents causing terrible losses, not only on economy, but also on human health and lives.
Beside other causes of road accidents, those resulting from human behavior unreliability, driving faults and sometime also bad will is the aggressiveness of driver very serious.
Therefore, the driver aggressive behavior and possibilities of its prevention and minimization is chosen as topic of this contribution.

Key-Words: - Human caused hazards, aggressive behavior, driver aggressiveness, road accidents, electro-encephalography, bio-feedback stimulation, random factors influences, uncertainty appearance effects

1 Introduction

In this contribution the influences of aggressive driving behavior factor are investigated, analyzed, classified and some possible ways for its limitation based on the brain waves testing and the use biofeedback based driver influencing are discussed.

Aggressive habits in human brain cause difficulties also in many other areas, not only when driving a road vehicle. Though their reasons are investigated already many years, still a large number of problems remain open.

One of them is the influence of randomly acting impacts on the body and brain of the human subject, which can be taken as uncertainly appearing factor.

In human brain exist various mechanisms simplifying the subject behavior in complicated situations. These mechanisms are generally known as habits. Some of them are good, helping to subject operation, but some others are bad, causing the danger not only for other subjects, but often also for the considered subject itself.

For quite long time is known, that the aggressive forms of human behavior have to be considered as one of the worse brain bad habits.

Briefly speaking one can estimate the total world losses in road transportation to about 4000 billion USD per year, from which about 5% comes from EU. This is really a lot. Therefore, a high interest was in recent years given to diminishing of this figure. Though many accepted national and international plans were at least partially successful, still the resulted data are behind plans. This stimulates the needs for improvement.

In general, one can estimate, that the majority of these losses is caused not by technical faults, but from human reasons (about 95%). From this about 50 % comes from attention decreases and delayed reactions and the rest, about 1:1 are responsible the influences of alcohol and other drugs and the drive aggressive behavior.

Nevertheless, the remaining sum of about 950 billion USD of losses caused by driver aggressive behavior is still too high and needs to be minimized as soon as possible.

In general, the driver aggressive behavior is still not enough investigated and our knowledge in this area is still introductory.

We also do not have at this moment at the disposal methods, by which we could measure and classify the level of driver tendency to behave aggressive and to eventually warn him/her in advance.

The for considerably long time made analysis of the frequency of appearance of aggressive behavior events of drivers on the road shows the existence of the following main open tasks:

Analysis of reasons for sudden conversions of driver behavior from tolerant to aggressive form shows the existence of the following typical categories,

o Modeling of aggressive behavior of drivers on simulators,

o Development of warning systems for drivers against aggressive behavior,

o Investigation of factors causing conversion from tolerance to aggressive behavior,

o Investigation of possibilities, how to train drivers to be more resistant to aggressive behavior causing influences (maybe by combination of simulation methods with advanced on EEG and other suitable neuro-psychological signals based biofeedback technology),

o Education of driver population in understanding the danger of driving aggressive behavior and for more tolerant behavior.

All these aspects are important, but those concerning the reasons of unexpected behavior causes seem to be very fundamental, because the improvement of our knowledge in this respect can show the way also for others. May be, that the latest published results (see reached in research simple animal brains photo-stimulation - see [3] e.g.) could be a basis also for progress as concerns the reasons for human behavior changes.

The first two categories were investigated recently, at least partially.

The frequency of appearance of aggressive events on the roads of the Czech Republic was analyzed for many years. It was found that in average, one can meet some such event almost each 8 minutes of his/her driving. Actually the permanent testing seemed to be necessary.

The significance of such activity underline the appearance of some serious accidents. For detection of the driver aggressive behavior we have used the method of so called "floating cars", equipped by video cameras recording automatically besides the road scenario also the floating car position, its speed, acceleration or deceleration, trajectory etc. Now, there is at disposal a rich basis of aggressive events records. Of course, the evaluation and classification of them is very laborious

Till now there in not enough known why similar, not quite rare events happen, why somebody becomes suddenly aggressive and what are the stimulations for it. Many problems remain still open in this area.

This concerns namely the possibilities of replacing these aggressive kinds of behavior and of course the same also of some other bad habits.

Such operations are important in many areas but especial significant are in road traffic, where the changes in driver behavior, appearing either suddenly or rising slow from many various reasons can be the cause of many ugly traffic accidents

bringing not only many large technical and economic losses, but also health and life damages. Such kind of human behavior called usually the driver aggressiveness can be considered as typical bad habit increasing transportation hazards.

Habit formation is in general the process by which some kind of behavior resulting in positive feeling of particular subject can through its repetition become to be automatic or habitual.

In each human behavior exist many kinds of such habits which all together form a tool simplifying our activity. For habitual activity a large and long mentation is not in general necessary. This kind of operation can be modeled by an increase of realized habitual impacts, which are than transformed into automaticity.

The process of habit formation can be however sometime considerably slow.

Lally et al. (2010) found that the average time for to reach the asymptote of automaticity realized habit was 66 days for one habit supporting event per day with the spread range of 18–254 days. Of course the speed of habit creation depends on many factors, before all on habit supporting event intensity and on particular person sensitivity to habit (namely the bad ones) creation.

The habits can be formed principally in three kinds:

• the cue,

• the habit pre-cursing tendencies in behavior, and

• heavy habit.

The cue is the considerably light stage in which are caused situations triggering the habitual behavior. This could be anything that one's mind associates with that behavioral event and which will automatically let a habit come to the surface of respective person behavioral level.

The behavior than can be so influenced by positive feeling, which can lead the respective person to continue in the "habit loop".

A habit may initially be triggered by some instant goal, but over time that goal becomes less necessary and the habit appearance becomes more automatic.

Many habits concern very often the process of vehicle driving as one of the most complicated kind of the human behavior. Without such driving habits the control of vehicle operation, without respect to its level of control supporting aids is problematic.

The driver behavioral habits can be however also very often negatively tuned and can be the cause of many serious accidents.

In general, the driver behavior negative changes can be divided into two large categories:

a)   The faults in driver vigilance and attention, namely the attention decreases,

b)   The driver aggressive acts appearing either almost randomly or also systematically.

The faults falling in the category a) were investigated considerably very long and some almost acceptable effect in development of methods for their prevention was reached.

The faults falling in the second category though appearing also very long time, have however more complicated reasons.

Aggressive behavior of vehicle drivers causes in all countries daily a very high number of serious accidents.

It is very interesting to minimize the frequency of driver dangerous aggressive events. For to reach this is however necessary to analyze the main kinds of driver aggressive behaviors and the problems of its appearance.

2 Classification of driver aggressive defects in behavior

The detours of driver behavior from the standard, modest and careful form to the aggressive one can appear:

➢   Exceptionally, stimulated by some unusual coincidence of not normally existing internal and external conditions,

➢   Randomly, when some set of specific stimuli impact the driver mind, which is sensitive on them,

➢   Systematically, when the drivers mind is defected so that he reacts aggressively also on the standardly appearing external stimuli.

The dangerousness of these three main groups of the driver behavior detours is of course different.

The lowest is evidently in the case a), nevertheless that it does not mean that the eventual losses cannot be very high, even if their frequency is rare.

More problematic is to decide between the dangerousness of the second and third group because though the second case can be of lower frequency. The uncertainty in aggressive behavior appearance can cause higher losses than the almost ever evident tendency to aggressive behavior in the case three. The aggressive behaviors appearing unexpected as uncertain effect can be more dangerous than those which provides the chronic aggressive driver from the first moment of the move of his vehicle, because his/her aggressive nature is usually quite easy observable.
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3 Randomly appearing aggressive behavior of drivers.

Suppose that some driver has certain slight tendency to aggressive behavior, however in normal conditions he/she is able to compensate it and drives standardly. Nevertheless, under influence of some specific factors – which can be of many various kinds and number, in various combinations and time intervals he/she starts to be stimulated to realize some aggressive event.

Its realization, if it is without any accidental result, can be for him/her as outlet for ventilation of actually in their body, before all the brain existing psychical pressure which by realization of this aggressive act this act decreases. Usually, after that the behavior of particular driver is again standard, till the next possible state when eventually cumulate the aggressive stimuli above for him/her actual critical level.

Therefore, in the course of the particular driver further driving, such process can have random character and is quite uncertain if and when the next his/her aggressive event appears. The prediction is very problematic and the situation has to be considered as typically uncertain.

There are two possibilities for improvement such situation.

One is in advance made neurological investigation if exist some symptoms in particular driver body, before all in the brain, significant for stimulation his/her aggressive behavior. This is of course possible, but is expensive and time consuming.

Theoretically, such investigation can be worth for all drivers, not only for those who had already the experience with aggressive events. Unfortunately, this is however quite unrealistic.

The second possibility is to try change the level of cumulating aggressive stimuli impacting the particular driver, at which his/her aggressive behavior starts.

By the use of combination of specific neurological investigation and training on the base of specific bio-feedback methods this is possible. Of course this also requires high expenses and lot of time, but still it can be cheaper than the next eventual accident.

Later in this contribution, we present some approaches which can be used in this respect.

4 Systematically appearing aggressive behavior

There exist some specific groups of people who have the tendency to react aggressively in almost all situations.

This must not to be only the case of drivers, such aggressive reacting people exist in all parts of human society. For some professions of regional communities this can be typical and somewhere more over required (e.g. for certain groups of military or police people).

As concerns drivers there is possible to recognize the overall tendency to aggressive behavior of almost everybody when he/she sits behind the wheel and starts driving. This is considerably easy possible on advanced driving simulators, equipped by specific virtual scenarios and specific measuring equipment.

In the scenarios must be included both scenes requiring fast reactions and also those in which the tested driver has to be very careful for considerably long time.

As concerns the measurement, there is necessary to measure quite accurate the time for driver reactions together with his/her basic humoral data (breath frequency, heart beets, blood pressure, eye blinking, hand vibrations on wheel, sitting movements etc.) and also his/her electroencephalographic (EEG) signals and signals in near infrared region (NIRS).

All this has to be carefully recorded while from the combination of these records can skilled neurologist recognize the eventually tendency of particular driver to spontaneous aggressive behavior.

5 Limitations of possibilities to analyze systematic aggressive behavior

The detection of systematic aggressive effects seems to be at first glance quite easy, however there exist several significant barriers which have to be replaced.

At first, many tendencies to systematic aggressive behavior can be kept by the particular driver as hidden behind the curtain of his/her will and intellect.

This effect appears especially when the particular driver is tested on any advanced driving simulator, where usually in the course of few several rounds the tested person is able to keep successfully his/her tendency to be aggressive as secret.

For lifting up of this his/her psychical curtain is usually necessary to provide much more testing rounds, so long till the tested driver will lose his/her carefulness and starts behave as it is in his/her natural. This can be however sometimes after very long time and the transition to this psychically free state must not be stable. Such psychical variations can repeat several-times.

Of course, this tendency to keep the private aggressive natural hidden, increase the expenses of such investigation.

Some possibility how to detect the investigated driver approaching to his/her natural psychical state can be seen in analysis of the development of variations of his/her reactions in the course of repeated testing rounds. However, this is very expensive way.

Another one can the partial compensation of these tendencies by some his/her stimulations on clear detection of respective natural stage. Some experts recommend to use for this the way of rewards and punishment, however the finding of proper kind of this is not easy.

Also other complication in this aggressive tendencies analysis consist in its quite large time variability.

Many subjects being in principle systematic aggressive can change in the course of time of driving the level of their aggressive behavior without the driver will. This appears both at simulator testing and also in real driving.

Therefore, the structure of the spontaneous aggressive driving can be almost similar like structure of driving with random appearing aggressive behavior. The only difference is in the set of the aggressive state stimulating impacts. In the case of randomly appearing aggressive behavior these must exist and eventually cumulate, while in the case of systematic provided aggressive behavior these can be very few or even no.

6 Some specific symptoms of spontaneous at driving aggressive behavior

As simple example of symptoms for spontaneous aggressive behavior can be mentioned before all the impulsive reactions and their high speed also out of road vehicle. Such people have very often the tendency to behave aggressively also driving the road vehicle.

Such circumstance is hardly measurable, but the skilled investigator can recognize it considerably easy observing the general type of investigated person behavior.

Another factor which appearance can signalize the possibility of eventual spontaneously aggressive driving is the too high sovereignty and masterfulness of respective person. Such people very often very easy fall in the feeling to be the so called kings of the road, having in their deformed psychology the right to punish other participants of

traffic if the made even the small fault or eventually also without any such event. On simulator such stage is not easy to detect but the too high tested driver feeling to know everything can be a good warning that respective person can belong to this category.

This concerns also the tendency to neglect the in on simulator projected scenario included warning signals. Such tested person behavior can be detected considerably easy and fast and has to be taken as recommendation to be careful in dealing with this particular person.

7 Some possibilities of anti-aggressive training

In general, the systematically appearing aggressive behavior has to be taken as much more dangerous as the two previously mentioned typed, i.e. the exceptionally and randomly appearing. These two can be tried to minimize by the use of some physical tools but for the third one another approach has to be used. Nevertheless, also these lighter forms can appear with significant uncertainty, making them hardly predicable. For this reason, the systematic analysis of aggressive behavior of drivers on roads is extremely important. For many years our research group provides it by the methodology of video-recording from floating cars equipped by special cameras. Nevertheless, the final analysis of reached records is very laborious, but is necessary basis for further recommendations. These can be of various character, concerning the road construction, vehicle furnishing and drivers preventive training.

Therefore, in each case the ways for anti-aggressive driver training have to be searched.

These consist before all in long lasting anti-aggressive training made either after some aggressive event with accidental results or better realized preventively. Such training is in any case long lasting and expensive. One of its problem is to be seen in human subject individuality and in uncertainty of his/her kinds of reactions. This is one of reasons, why the use of self (at least partially) training based methods have to be taken as high important.

Besides many approaches very significant are those using self-organization of neuronal field, which principle was found by Farley and Clark already in 1953 (and later almost forgotten). In principle, their approach can be projected in the methods of so called bio-feedback, provided on special furnished simulators. These seems to be of very high importance.

In simple version, developed by Sterman and Friaer in the USA already at end of nineties, on the tested person screen is projected a profile of road in which runs a schematic picture of car, which has the tendency to decline to the left side of road. The driver task is to keep it in the middle ad if possible to overhead the picture of the car ahead. This principle is shown in Fig.1.
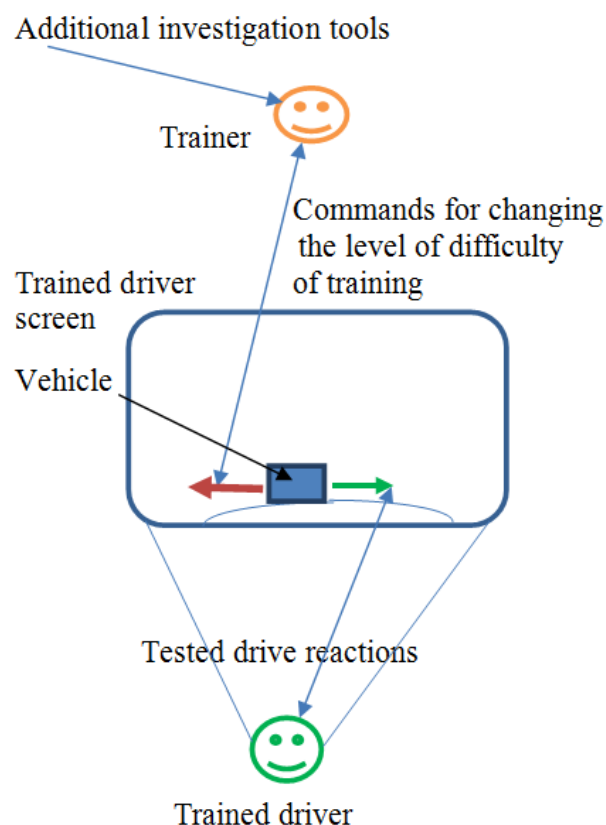

Fig. 1: Simple structure of bio-feedback training.

In this figure are not presented the parts serving for analysis of the trained person reactions and for the trainer decisions if he/she has to be rewarded or punished.

The primary neural network in the trained person cortex which is responsible for solving some selected task is originally organized mainly random and operating chaotic, is here subsequently transformed in simplified structure corresponding to solving some specific task.

In the well use of suitable increase of the rewards and punishment is however the key to well efficient bio-feedback training. The choice of these acts, their sequence, frequency and intensity is very important and must be done by very skilled supervisor.

In general, in this area all experiences with human subjects education and the good knowledge of this art has basic influence on the efficiency of the mentioned training for bad habits minimization.

These mentioned bio-feedback methods are based on presenting the special adaptable scenario to the tested person, which he/she can modify according the trainer hints for to reach either the reward or to be punished.

Such training can lead after many to subsequently improving repetitions the trained person resistivity to decease of his/her attention reductions and also to decrease of tendency to aggressive driving.

If the trained subject succeeds, is rewarded, if no is punished.

The not neglect-able role of trainer is to evaluate the driving quality and according it to adjust the difficulty of training and the intensity of reward or punishment.

However, in more advanced bio-feedback methodologies also the whole set of other kinds of impacts on the trained person behavior can be used.

In novel versions of the fundamental bio-feedback the investigation of other driver neurophysiological factors can be added, namely the breath, hearth beats analysis, the EEG and eventually also the NIRS signals analysis, temperature measurement etc.

The more complex bio-feedback investigations are of course more laborious, however allows much deeper investigations and higher effectivity of training.

The testing of possibilities of intelligent interactions of human brain with vehicle was in last years studied quite intensively, especially with respect to expected advent of autonomous vehicles (see [8] e.g.). However, some authors e.g. [7] had critically mentioned, the uncertain aspects and irrational tendencies in human behavior resulting un-expectable from interactions of many subjects with modern advanced communication tools will probably require the development of quite new vehicle control methods.

For reaching such goal considerably long intensive investigations will be necessary.

8 Conclusion

What has to be underlined is, that in all these investigations of driver tendencies to aggressive behavior behind the wheel, even in their training to limitation of these trends play extraordinary important role the factors of uncertainties. For this a novel information background is necessary.

The low or no respecting of this necessity can highly disregard all the credibility of all reached results.

The aggressive behavior aspects of drivers appear often from quite in time uncertain reasons, which significantly complicates both their detection and investigation.

These facts lead to the necessity take high care to these uncertainty factors especially because the level of knowledge of them is still not high enough.

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