

*Stepanov O., Doctor of Technical Sciences, Professor of the Department of KhNADU, Kharkiv, ORCID : 0000-0003-4954-2532,
Yarmak T., Phd Sociology of KhNADU, Kharkiv, ORCID : 0000-0003-4140-8283,
Venger A., Postgraduate student of KhNADU, Kharkiv*

*Степанов О.В., д.техн.н., професор кафедри ХНАДУ, м. Харків,
Ярмак Т.В., кандидат соціології, ХНАДУ, м. Харків,
Венгер А.С., аспірант ХНАДУ, м. Харків*

TRAFFIC CONFLICT

ДОРОЖНІЙ КОНФЛІКТ

The article is devoted to the conceptual consideration of the formation and development of the theory of transport conflicts in the transport process. The early studies of transport conflicts by foreign scientists are shown. The authors come to the conclusion that traffic conflicts depend on the psychophysiology of road users, which must be taken into account in the psychology of traffic conflicts.

Key words: *psychology, driver, road users, traffic conflict, car.*

Стаття присвячена розгляду формування та розвитку теорії транспортних конфліктів у транспортному процесі. Аналіз різнопланових роботи з дослідження конфліктів показує, що даною тематикою займаються: психологія, соціологія, філософія, педагогіка, історія, правознавство, технічні та військові науки й ін. Виходячи з цього поняття «конфлікт» відноситься до широкого кола різних конфліктуючих сторін і розуміється як «випадок загострення протиріч». Не виключенням є і сфера автомобільного транспорту.

Робота водія за кермом автомобіля вимагає постійної пильності та його психофізіологічної надійності. Остання обставина часто призводить до зміни психоемоційного стану водія і стає причиною конфліктних ситуацій, що в кінцевому підсумку може призвести до дорожньо-транспортних пригод.

Дорожній конфлікт розглядається як породження ряду факторів, серед яких – конфліктонебезпечна особа водія і неналежна дорожня комунікація, яка спирається на певні етнічні традиції. Відповідно, є два дослідницьких підходу: особистісний та комунікативний або соціально-психологічний. Дослідження дорожнього конфлікту передбачає розгляд дорожнього руху з соціально-психологічної точки зору, розкриття його комунікативної природи.

Учасники конфлікту – водії різних транспортних засобів і пішоходи, що характеризуються більшою або меншою схильністю і готовністю до конфліктної поведінки, а також деякою комунікативною компетентністю. Усі ці особи переслідую-

ють свої цілі і діють за відповідними мотивами. Усі вони відрізняються відомим інтелектом, який визначає рівень спілкування, кількість і значущість помилок. Люди в конфлікті грають певні ролі, які по ходу розвитку конфлікту можуть змінюватися. Автори приходять до висновку про те, що дорожні конфлікти залежать від психофізіології учасників дорожнього руху, яку необхідно враховувати в психології транспортних конфліктів.

Ключові слова: психологія, водій, учасники дорожнього руху, дорожній конфлікт, автомобіль.

Introduction. The concept of conflict refers to the wide range of phenomena, any field of science or practice. The analysis of the diverse work on the study of conflicts shows that this topic is being dealt with: psychology, sociology, philosophy, pedagogy, history, jurisprudence, technical and military sciences, etc. Based on this, the concept of "conflict" refers to the wide range of different conflicting parties and is understood as "an extreme case of exacerbation of contradictions" (Philosophical Encyclopedia, 1964, p. 55). The field of road transport is no exception.

The driver's work behind the wheel of the car requires constant care and psychophysiological reliability. The latter circumstance often leads to the change in the psychological and emotional state of the driver and becomes the cause of conflict situations, which ultimately can lead to road traffic accidents (RTA).

Analysis of research and publications. Issues of the formation and development of traffic conflicts (TC) and conflict situations (CS), taking into account the aspects of collision time at regulated and non-regulated intersections of the transport network, are considered in the works of B. Allen, D. Archer, P. Bovey, V. Gütinger, R. McFarland, M. Minderhaud, N. Muhlrud, T. Syed, A. Svensson, T. Forbes, H. Hayden, A. Horst etc.

The concept of traffic conflicts and their impact on road safety (RS) are considered in the works of V. F. Babkov, G. I. Klinkovshtein, E. M. Lobanov, A. M. Plotnikov, A. A. Rybalchenko, D. S. Samoilo, S. A. Seliverstov, M. S. Fishelson, V. A. Yudina etc. In the diverse works of scientists, the psychophysiology of the driver, his professional reliability for ensuring road safety is investigated, however, the issues of the psychology of traffic conflicts and conflict situations require further research.

Formulation of the problem. Consider the concept of the formation and development of the philosophy of transport conflicts and conflict situations in the field of road transport.

Research materials. Analyzing the role of the human factor in road safety in order to prevent road accidents, R. McFarland (1954) drew attention to the actions of drivers during the movement of motor vehicles (MV) [16]. Later, these actions were called "dangerous maneuvers," "dangerous driving," "dangerous encounters" [23]. R. McFarland interpreted them as "emergency situations" that can cause road acci-

dents.

Based on the analysis of road accidents due to "dangerous driving", T.V. Forbes (1957) identified the relationship between the behavior of drivers of vehicles and the potential danger of road accidents [9]. In the middle of the twentieth century, experts began to study the situations of "dangerous convergence" between motor vehicles, which were later named as "transport conflicts" [21]. Consider some research on the formation and development of traffic conflicts.

On instructions from General Motors, specialists (S.R. Perkins, J.I. Harris) formulated the concept of traffic conflicts as the potentially emergency situation that leads drivers to "evasive" actions in the form of braking or turning towards the motor vehicle [19]. At the same time, traffic conflicts were divided into two categories: firstly, for the actions of road users (RU) to avoid collisions and, secondly, for violations by road users of traffic rules (TR). At the same time, five classes of traffic conflicts were allocated with respect to the drivers of the motor vehicles [20].

Based on the analysis of road accidents, V.A. Güttinger proposed the method for traffic conflicts with the participation of children-pedestrians and motor vehicles in residential areas. Later H. Hayden tried to simplify V.A. Güttinger's method with the different definition of traffic conflicts. He proposed to increase the critical value of the "time to collision" value, which experts accepted as to 1.0 sec, to 1.5 sec [11].

Continuing his research, H. Hayden pointed out the existence of the common measurable degree of severity for all traffic conflicts that occur with the motor vehicles during movement. He proposed the "Traffic Event Continuum Model" from traffic without interference to fatal road accidents [13].

The model described the relationship between the severity of "traffic events", i.e. transport conflicts and the frequency of their occurrence. According to this model, the higher the severity of the event that occurred as a result of traffic conflicts, the lower the frequency of occurrence of such events. In this case, the concept of the severity of transport conflicts is determined by its consequences, for example, the number of deaths and injuries in road accidents or costs in monetary terms [13].

The measure of "time to accident" (TTA) was adopted as a measure of the severity of traffic conflicts, from "motion without interference" to "accident". The concept of TTA in the scientific and practical aspect has a wider scope than the concept of "time to collision" (TTC) used by H. Hayden in his early studies [13]. According to the works of H. Hayden, TTA is the time of the beginning of the evasion maneuver from the accident of one of the road user under the condition of its inevitability, if the motor vehicle drives at the same speed and in compliance with the previous trajectory [13].

Thus, the severity of the conflict should reflect the likelihood of the collision, and the threshold level (TTA = 1.5 sec should represent the border of the transition from the "small" conflict to the "severe" conflict [13]. This statement is obvious, but not entirely true, since at low collision speeds it is much easier to avoid collisions

than at high ones, taking into account the same TTA value.

Based on the results of the study [7], five alternative versions of determining the severity of the conflict were selected for testing. All five versions differed from each other in speed and time before the accident. Based on the research, H. Hayden came to the conclusion that the threshold level between the serious and less serious conflict should take into account both the speed of the motor vehicle and the road user. At the same time, he introduced the critical values depending on the speed [13].

Since 1977, international research has been launched in the field of analysis and development methods of transport conflicts. At the first conference on the methods of traffic conflicts in Oslo (1977), the general definition of the transport conflicts was adopted: “a transport conflict is an observed situation in which two or more road users approach each other in space and time to such extent that there is a risk of collision if their trajectories remain unchanged ...” [6].

The International Committee on Traffic Conflict Techniques (ICTCT) in 1983 began its research on the traffic conflicts (Paris, Leidsendam) [10, 15]. At the same time, studies of conflict situations (CS) of road traffic at various intersections were carried out. In particular, significant advances have been made in comparing different methods.

It was found that in the process of road traffic situations arise when road users barely let each other pass at high speed without significant changes in the course of movement or speed, while not on the collision course. Under such circumstances, there is still a real chance of collision. That is, even a small change in the movement process can lead to the actual collision. B.L. Allen and a group of specialists often recorded this type of collision when the motor vehicle was performing a left turn maneuver at controlled intersections [5].

Based on the analysis of collisions and conflicts at one control intersection, B.L. Allen and others concluded that Post-Encroachment-Time is significant (PET), i.e. measure of the determining the conflict situations [12]. PET was defined as the time between the moment when the first road user leaves the course of the second at the moment when the second road user reaches the course of the first [12]. In this way, the PET measure expresses the value of how close the participants of the traffic movement avoided the collision in its final phase.

In contrast to the TTC, the PET measure consists of only one value, which is the final timing before the collision between both road users. The lower the PET value, the greater the chance of collision.

At the second international conference on the methods of traffic conflicts (Trautenfels, 1986), S. Oppé made the assumption that the PET measure is most effective when studying at regulated intersections [18]. Later, the concept of PET was widely used as an integral part of Dutch method for the analysis of traffic conflicts in road traffic [14].

The different understanding of the concept of the PET measure was proposed

in relation to the assessment of road safety near pedestrian crossings and intersections (zebra stripes). This concept is called Time-to-Zebra (TTZ). The TTZ indicator was used in the work of A. Varkheli to assess the frequency and severity of critical encounters between motor vehicles approaching the pedestrian crossing and crossings [22]. Based on this study, it was concluded that many motor vehicle drivers do not slow down when approaching pedestrian crossings and do not take into account the potential risk of collision with the pedestrian. These studies were conducted in Sweden, where the motor vehicle drivers were advised to significantly slow down or stop to allow pedestrians and cyclists to cross the pedestrian crossing [7].

Later, Dutch researchers M.M. Minderhaud and P. Bovi proposed two alternative safety indicators based on the general principles of the concept of calculating the TTC measure [17]. The first of these is referred to as the time exposed TTC, which is the measure of the length of the TTC below the designated TTC threshold.

This means that the lower the time exposed TTC value, the less time the motor vehicle is in the conflict situation and, thus, the safer the situation. Note that the disadvantage of the ICE indicator is that any value of the PET lower than the threshold (critical) is not included in the calculation, therefore, to eliminate this discrepancy, the second indicator was proposed, which is called the time integrated TTC. This indicator is the integral of TTC over time below the threshold value and is calculated as the surface area between the threshold value of TTC and the real value of TTC [8].

Let's look at the concept of road conflicts and their influence on road safety from the point of view of their psychology.

A road conflict is viewed as a product of a list of factors, among which are: conflict prone personality of the driver and improper road communication, including that based on certain ethnic traditions. Therefore, there are two approaches to the research: personality-based and communicative, or social psychology based. Road conflict research assumes viewing traffic from the social psychology point of view, investigation of its communicative nature.

A particular step in the development of the social psychology view on traffic behavior and its conflict studies is represented by D. Klebelsberg's works. He starts with the idea that in its historical development road traffic changed from individual to social, i.e. into people's interaction, their social behavior. The approach of individual behavior to social reflects the intensification of transport and pedestrian traffic. At the same time, the social behavior of people starts being characterized by a "limited ability" for mutual understanding between road users, which is the reason for road safety violations. According to D. Klebelsberg, the formation of social nature of road traffic has two steps, which he calls "symbolic" and "realistic" which are reproduced in the individual process of a driver's development.

D. Klebelsberg uses the concept of a "conflict situation" (road conflict) by viewing it as opposite tendencies in behavior of road users. However in a number of cases the concept of conflict becomes less defined, covering "a comparatively large

number of deviations from normal behavior”.

A conflict situation, according to D. Klebelsberg, is created by actions such as hard braking undertaken in order to give way to an unexpectedly appearing vehicle, change of traffic lanes, untimely braking, sharp deceleration, rapid evasion (to avoid a collision), emergency braking etc. The reason for the conflict is non-normative behavior on part of one of the road users. Psychologically the reason for the conflict is a sharp change of emotional state of at least one road user. Conflict is one of the four primary road situations: error, traffic rules violation (legal offense), conflict and traffic accident.

Additionally, D. Klebelsberg singles out “critical events” that remain within safety limits (untimely or inappropriate braking, extreme acceleration, rapid maneuvers, particular forms of emotional expression, gesticulation). Errors are the smallest deviation from norm. Traffic rules violations happen much more often than traffic accidents. The frequency of conflicts is larger than the frequency of traffic accidents as well. This is why it’s road conflicts and not traffic accidents that should be a measure of road traffic danger.

Systematic registration and study of conflict situations allow for identification of their material preconditions which can be removed. Most phenomena of road interaction described by D. Klebelsberg falls under the classification of “aggression”. Some differences between aggression outside of road situations and aggression during driving have been found. Greater anonymity in road traffic predisposes towards lesser control and greater aggression. Nonetheless there is a connection between aggressive behavior in both types of circumstances.

One of the primary questions in road conflict research is related to understanding its psychological structure.

So, V. M. Sidenko and A. A. Rybalchenko (1978) developed the complex indicator of road safety conditions, which takes into account various safety factors of the integrated system "Driver-Vehicle-Road-Environment" (DVRE) [4].

E.M. Lobanov (1980) proposed the methodology for assessing the index of conflict, which takes into account the degree of danger of the conflict point, depending on the intensity of conflicting traffic flows, visibility conditions for road users, the state of the coverage of the considered section of the road network and the trajectory of the maneuver of road user [2].

V.F. Babkov (1993), improving the aspects of road safety, proposed the final accident rate, which makes it possible to identify the most dangerous sections of highways [1].

A. M. Plotnikov (2011) developed the innovative algorithm for "optimizing the capacity at single-level controlled intersections", which assumes "adaptive assessment of the danger of conflict intersections ..." [3]. This algorithm allows you to maximize the throughput of the controlled intersection and increases road safety at nodal intersections.

Scientists have proven that the structure of conflict as a communicative phenomenon reproduces the structure of communication and psychological structure of persons participating in it, consisting of a set of interconnected cognitive, emotional and motivational and behavioral properties and processes.

Cognitive links of the road conflict structure are determined by dynamic conditions of transmission and reception of information by the drivers. Functions of cognitive processes including in road conflict are to build the interacting images of the conflict situation, including images of the object of road conflict, the opponent and the self, and searching for a way out of the dead end on this basis. In all of the above questions the primary role is played by visual perception. As is well known, as the speed of movement increases, the field of vision narrows, which leaves a large amount of information outside perception. People involved in traffic accidents often state that they simply did not see the person or object they then collided with.

A driver needs quick and precise perception covering both the objective part of the situation and the social part. Weakness of social perception is a precondition for conflict, it is the first sign of a person's communicative incompetence. A socially mature driver perceives not only a vehicle, but the person in it who possesses properties important for the development of the situation.

Thought processes leading to conflict or complicating its resolution are often mistaken or thoughtless decisions resulting from incompetence, slowness, weakness of social intellect, and its suppression by emotions, which happens in the event of low psychological stability.

Emotional components of road conflict structure consist of open exchange of emotions carrying an aggressive charge, which performs the function of influence and emotional release. The latter circumstance explains certain tolerance of drivers towards rude phrasing of comments and interpersonal evaluations. In competitive conflict emotions are a motivating factor, the goal of the contest.

Motivational and behavioral components of conflict communication are the interpersonal set of motivations such as the urge of road users to control, remove, get ahead, dictate, punish, defend, retaliate, demonstrate on the road, humiliate, protect own self-esteem, and to assert their right for priority passage. Motivational structure of a socially mature conflict includes the desire to prevent disorder or reinstate the normal mode of traffic.

Thus the sides of conflict form images of the conflict situation, including the images of self and each other. Formation of these images happens under influence of a number of internal and external factors. Internal factors include: the image of an unacceptable driver, stereotypes of various categories of road users. External factors include perceptive information, which is to say the results of immediate perception of the road behavior of the opponent, the results of attribution, i.e. ascribing the opponent particular traits and motivations, and immediate emotional reactions to the conflict event. Each of the mentioned factors can dominate in the process of creat-

ing an image of the opposing party. Insufficient communicative competence of opponents leads to images they create being inadequate and not allowing for a productive debate.

Conclusions. Having considered the formation and development of traffic conflicts, we can conclude that conflict situations in the complex DVRE system depend on the human factor. At the same time, the technical and computer equipment of the motor vehicle cannot exclude the role of the human factor in the transport process.

With the rapid growth of motorization, the reaction of the road user to road safety has noticeably deteriorated, which is reflected in the traffic conflicts. In this regard, it became necessary to study the human factor of the road user system "driver - operating the vehicle - road users" from the point of view of the psychology of traffic conflicts.

Participants of the conflict – drivers of various vehicles and pedestrians – are characterized by greater or lesser tendency and willingness towards conflict behavior, as well as particular communicative competence. All of these people pursue their goals and act on corresponding motives. All of them have particular intellect, which determines the level of communication, number and importance of errors. In a conflict people play certain roles which can change along the course of development of the conflict. They are also representatives of particular groups and carry their values.

Motorization has led to the need to consider road safety issues as the social problem in the sphere of social life. At the same time, the issues of the reaction of road users to road safety require general attention, education, management and special culture. In particular, there is a need to develop a new direction to ensure road traffic - the psychology of road safety and the promotion of road safety culture, which is an urgent issue for further research.

References:

1. Babkov V.F. Dorozhnye usloviya i bezopasnost dvizheniya: uchebnik dlya vuzov. M.: Transport, 1993. 272 s.
2. Lobanov E.M. Proektirovanie dorog i organizaciya dvizheniya s uchetom psihofiziologii voditelya. M.: Transport, 1980. 310 s.
3. Plotnikov A.M. Algoritmy i tehicheskie sredstva povysheniya bezopasnosti dvizheniya na reguliruemym perehrestkah. Transport Rossijskoj federacii. 2011. №5 (36). S. 28–30
4. Sidenko, V.M. Kompleksnyj metod ocenki bezopasnosti dorozhnogo dvizheniya / V.M. Sidenko, A.A. Rybalchenko // Avtodorozhnik Ukrainy: nauch.-teh. sbornik. 1978. №3. – S. 42–43.
5. Allen, B.L. Analysis of traffic conflicts and collisions / B.L. Allen, B.T. Shin, P.J. Cooper. Dept. of Civil Engineering, McMaster University, Hamilton.
6. Amundsen, F.H.E. Proceeding of First Workshop on Traffic Conflicts /F.H.E Amundsen, C. Hyden. Institution of Transport Economics. Oslo/Lund Institute of Technology. Oslo. 1977.
7. Archer, J. Indicators for traffic safety assessment and prediction and their application in micro-simulation modelling: A study of urban and suburban intersections / J. Archer,

- J. Doctoral Dissertation Royal Institute of Technology Stockholm, Sweden 2005. 273 p.
8. Cunto, F.J.C. Assessing Safety Performance of Transportation Systems using Microscopic Simulation / F.J.C. Cunto. Waterloo, Ontario, Canada, 2008. 190 p.
 9. Forbes, T.W. Analysis of near-accident reports. HRB Bull. 152 /T.W. Forbes // Transportation Res. Bd. –1957. 23-35pp.
 10. Grayson, G.B. The Malmo Study: A calibration of Traffic Conflict Techniques / G.B. Grayson. Report R-84-12. Institute for Road Safety Research SWOV, Leidschendam. 1984.
 11. Hayward, J.Ch. Near miss determination through use of a scale of danger / J.Ch. Hayward. Report no. TTSC 7115. The Pennsylvania State University, Pennsylvania. 1972.
 12. Horst, A.R.A. van der. A Time-based analysis of road user behaviour in normal and critical encounters / A.R.A. van der Horst. Delft University of Technology. 1990. 183 p.
 13. Hyden, Ch. The development of a method for traffic safety evaluation: The Swedish Traffic Conflicts Technique / Ch. Hyden // Bulletin 70, University of Lund, Lund Institute of Technology, Dept. of Traffic Planning and Engineering, Lund. 1987
 14. Kraay, J.H. Manual conflict observation technique DOCTOR (Dutch Objective Conflict Technique for Operation and Research) / J.H. Kraay, A.R.A. van der Horst, S. Oppe. Foundation Road safety for all The Netherlands. 2013. 86 p.
 15. Kraay, J.H. Proceedings of the third international workshop on traffic conflicts techniques, organised by the international committee on traffic conflicts techniques ICTCT , Leidschendam, The Netherlands /J.H. Kraay. Institute for Road Safety Research SWOV, The Netherlands. April 1982, 98 p.
 16. McFarland, R.A. Human Factors in Highway Transport Safety. / R. McFarland, A.L. Moseley. Harvard School of Public Health. Boston. Mass., 1954.
 17. Minderhoud, M. M. Extended Time-to-Collision Measures for Road Traffic Safety Assessment / MM. Minderhoud, P.H.L. Bovy // Accident Analysis and Prevention, Vol 33, pp.89-97.
 18. Oppe, S. The International Calibration of Conflicts: A Summary of the results / S. Oppe // In Proceeding of Workshop on Traffic Conflicts and Other Intermediate Measures in Safety Evaluation. September 8-10. Institute for Transport Sciences. – Budapest. 1986.
 19. Perkins, S.R. Traffic Conflict Characteristics – Accident 7. Potential at Intersections /S.R. Perkins, J. Harris. HRB Rec. 225. – Highway Res. Bd. – 1968. 35-44pp.
 20. Perkins, S.R. GMR Traffic Conflicts Procedures Manual / S.R. Perkins. GMR-895/ General Motors Research Publication, Aug., 1969.
 21. Perkins, S.R. Criteria for traffic conflict characteristics signalized intersection / S.R. Perkins, J.L. Harris. Rep№ GMR - 632. General Motors Corporation, Warren, Michigan. 1967. 22p.
 22. Várhelyi, A. Dynamic Speed Adaptation Based on Information Technology – A Theoretical Background / A. Várhelyi // Bulletin 142, Dept. of Traffic Planning and Engineering. – Lund University, Lund, Sweden. 1996.
 23. Williams, M.J. Validity of the traffic conflicts technique / M. J. Williams. Accid. Anal. & Prec. Vol. 13, pp. 133-145. 1981.