

Electrotraumatism in Russia: Problem and Solutions

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Abstract

The article analyzes the problem of electrotraumatism in Russia, which has demonstrated stable statistics for a long time. An explanation for this fact has been found: attempts to solve the essentially psychological problem by non-psychological methods, which turned out to be consistently unsuccessful. Psychological solutions corresponding to the essence of the problem are proposed. They rely on the laws of perception - the dominance of the first signal system in the regulation of behavior. Images were found that allow to correct the deficiency of sensory orientation in danger and to support meaningful information about the hidden nature of the high-voltage threat - visual illusions. Their use in the design of the manufacture environment as well as in the personnel training allows electricians to realize the main risks and form motivation for self-awareness and safe behavior in an electrical installation.

Keywords: *Electrotraumatism; Orientation Errors; Sensory Deficiency; Underestimation of Risks; Visual Illusions; Safe Behavior Training; Self-Awareness; Safety Motivation*

Introduction

The problem of electrotraumatism in Russia is at least 50 years old. According to the information available since 1964, the index of electrical injuries remains at the same level. According to Gordon G.Yu., Weinstein L.I. [1], the index of electrical injuries in the electric power industry in 1986 was 0.6 and remained at the same level for the previous 20 years (1964-1985).

The data of T. V. Eremina and colleagues show a similar picture for the next period 1991 - 2015 [2]. Finally, the data of Bukhtoyarov V. F. and Rybalchenko K. Yu. for 2002-2014 confirm this pattern: the index of electrotraumatism does not change significantly [3]. The curve of electrotraumatism over a 50-year period looks approximately like a flat line, parallel to the x-axis of time.

The significance of this fact is increased if we take into account that fundamental transformations took place in Russia during this period. The social system, economy, law, and values have changed. A person has changed. The electrotraumatism only remained unchanged. Such is the "island of stability".

Such a "venerable" age of the problem is very special fact in itself, and it requires scientific attention.

Features of electrotraumatism

The analysis showed that the problem is entirely determined by psychological patterns, which distinguishes it from a number of problems of the human factor, which mostly are complex, include economic, organizational, legal and other components.

A distinctive feature of electrotraumatism is that the vast majority of accidents occur as a result of psychological errors. We suggest 3 main factors:

1. Orientation errors. A typical case of electric trauma has received a “name” among specialists: one went the wrong path, climbed the wrong way, took the wrong handle.
2. Extremely risky behavior of victims who neglected warning signs, which forces the coroners investigating the incident to assume intentional suicide first of all.
3. Neglect of someone else’s negative experience, unreasonable carelessness, manifested in magical thinking: “Nothing will happen to me. Inept, disorganized and poorly thinking people get injured from high voltage. This is impossible with me”.

However, the struggle for safety was carried out exclusively by administrative and technical methods: detailing technical descriptions and instructions, increasing control circuits, tougher penalties, unreasonable expansion of responsibility, etc. For example, if the victim had violated safety rules, an extraordinary examination for knowledge of such rules was assigned to the CEO and chief engineer of the organization.

Traditions, the engineering mentality that dominates the management environment, for a long time blocked the awareness of the insurmountable nature of repeated mistakes, the objectivity of the problem. Deep distrust of psychology and psychological methods hindered the solution of the electrotraumatism problem. Stable statistics do not say that the problem was not solved, but that it was solved by inadequate methods. A psychological problem can only have psychological solutions.

Psychological analysis of electrotraumatism

The most important factor manifested in the risky behavior of victims of electrical injuries is the dominance of the 1 signal system (I. Pavlov) - sensory images over information expressed in symbols, or the 2 signal system. Here are some curious examples of such dominance, at first glance, unrelated to electrotraumatism. There is a “bridge of stupidity” in St. Petersburg. Its height is insufficient for the free passage of small trucks of the “Gazelle” type, which is warned by a poster fixed on the bridge with the inscription in large letters “Danger! Low bridge. The Gazelle will not pass”. However, cars get stuck under the bridge regularly. Recently, the bridge “celebrated” the 200th incident.

Other countries have their own “bridges of stupidity” (and not the only ones): a bridge in the USA (Mamaroneck, New York); a bridge in Birmingham, Britain, which marked 120 hits [4], etc. The study of the geography of this issue is fascinating, but goes beyond the academic framework.

The internationality of the “bridges of stupidity” excludes the cultural determination of the phenomenon such of G. Hofstede’s one. The fact is of fundamental meaning: if sensory information contradicts symbolic information, then it is preferred when making a decision (when forming an action).

The explanation for this dominance of sensory information over symbolic information is found in the comparison of the evolutionary experiences of using an images and a signs by a human in regulating behavior - they are disproportionate. The ratio of the pre-written history of mankind (3.2 million years) and written one (6 thousand years) is approximately 540:1. All safety mechanisms were formed long before the appearance of the written sign. And they relied on the perceptual sphere of human. The heat warned of the danger of an open

fire, the roar scared of a colliding with massive bodies. Visual images warned against wild animals, etc. Images saved a person for 3.2 million years, and only the last 6 thousand man were saved, figuratively speaking, by the poster “Danger! Low bridge”. So, when the sign says, “Stop! Danger!”, but the image objects: “It’s okay, I’ll slip through,” then the image wins, and the conflict is resolved in favor of the image. The victims of the traffic accidents were guided by an attention reflex. The reflex is out of control or with great difficulty succumbs to it.

It is common knowledge, evolution has not provided a human with sensitivity to the electrical field. There are no images warning about the threat of high voltage. With the dominant role of the sensory sphere in the regulation of behavior, this fact plays a critical role. The sensory flow when working in an electrical installation does not contain vitally important information, it incorrectly presents risks and threats to life. It disorients and demobilizes. The need to constantly suppress this provoking force of images and act contrary to it and only with the support of consciousness and the electrical circuits presented in it requires special professional qualities and the ability to concentrate attention for a long time. Such a paradoxical orientation is a psychologically difficult skill, it is sensitive to fatigue. That is why orientational errors are the main reason of electrical injury.

Psychological solutions in the prevention of electrical injuries

Obviously, under such initial conditions, an effective solution is possible only based on the essential factors of the problem situation. The psychological task was defined as the need to find (create) and use in a dangerous environment such images that would reflect the main quality of electrical processes - to deceive a person, unreliably display threats and thereby participate in the development of a solution.

Visual illusions turned out to be just such, the most suitable images that carry the idea of deception and distortion in its purest form. “Illusory” and “unreliable” are practically synonyms.

The variety of illusions is great. There are illusions of movement, illusions of shape, size, sound. We chose visual illusions - images that create the effect of movement, as the most appropriate to the task and the most impressive.



Figure 1: Pulsation illusion.

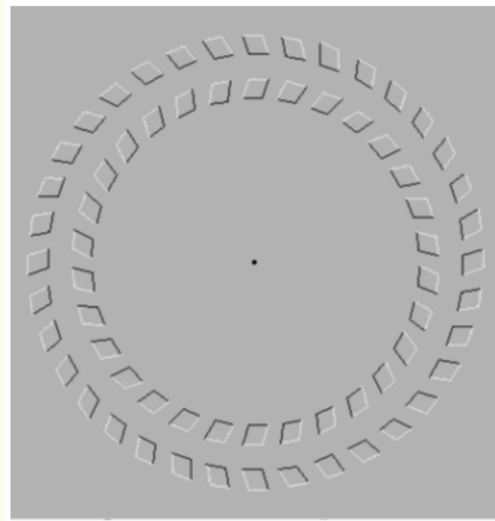


Figure 2: Circles' movement.

We used the illusions depicted in figure 1 and 2, as well as some other illusions, to create warning posters, wall calendars, wallpaper for the design of the work places - offices for conducting safety briefings (Figure 3 and 4).



Figure 3: Warning poster¹.

¹The script means “perceptions deceive, a danger is real”.



Figure 4: Warning poster².

The pulsation poster shown in figure 3 is located at the entrance to the switchyard. Unlike the usual warning posters, it is not addictive and never ends up in a blind spot. The poster is a kind of shout: “Stop! Remember where you’re going! There’s a high voltage here!”.

The illusion shown in figure 4 was also used in the warning poster. It manifests itself when two conditions are met: fixing the gaze on the center of the circle and simultaneously approaching it. The circles begin to rotate in the opposite direction at this moment. These conditions were taken into account when choosing the location of the poster - right in front of the entrance to the occupational safety office, where safety instructions for beginners were conducted. Opening the door, the person immediately sees a poster in front of him, with the “disconnect-check-ground” electrical safety algorithm placed in the center, made in red. His gaze is fixed on him in accordance with the laws of perception described above - this is how the first condition of illusion is ensured. Moving on, he gets closer the poster, thereby fulfilling the second condition under which the illusion works. The circles on the poster begin to move. There has never been a case when the effect of such an impact did not make an impression and did not cause questions: “Wow! What is this?” This moment is extremely convenient to explain convincingly the specifics of the electrician’s work - working in conditions of deficient and distorted information about the threat to life. And immediately identify the security problem as the most important and paramount. Instruction from a routine and boring procedure instantly turns into an express version of motivational training.

Next, the wallpaper was made using the pattern shown in figure 5.

When you move your gaze across the drawing, you can observe the movement of circles with your peripheral vision. Wallpaper was used in the room for duty, they create the effect of a waving surface, which activates, causes an orientation reflex, prevents falling asleep. This is especially important when on duty during the night shift.

²The electric safety algorithm is in the center: “disconnect, check, ground”.

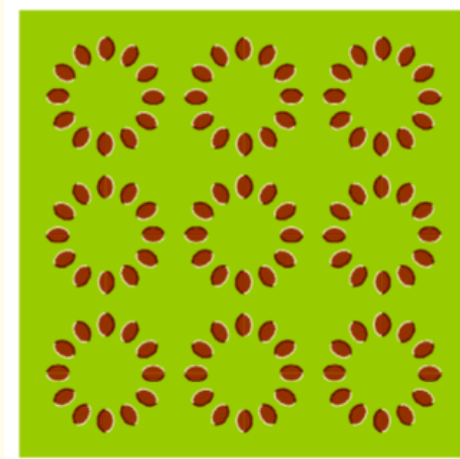


Figure 5: Coffee grains illusion.

Enrichment of the work places with images of hidden danger, which, moreover, are not addictive, unlike symbolic information, acts as a constant factor of attention activation. The cognitive dissonance that arises at the same time is alarming, activates the need to define, clarify, check and recheck - these are exactly the qualities that are professionally significant and ensure safety when working in an electrical installation.

Self-awareness and error prevention training

In order to overcome negative behavioral attitudes that lead to mistakes and accidents, a training of safety skills and self-awareness for operational personnel was developed and implemented at one of the power plant. Its purpose is to make participants aware of the psychological nature of the main risks of electrotraumatism and create sustainable motivation to overcome them.

The psychological task of the training is to destroy the evolutionarily conditioned trust in your senses and realize the need to control not only one's actions, but also their perceptions and decisions.

Adult education is significantly different from that of children. Adults are critical and ready to accept and recognize only what they learn from their own experience. This is the experience of self-knowledge that we organize at trainings.

Participants are offered to perform exercises on memory, attention, size estimation, distances - these are the operations that have to be performed in real professional activity. The exercises, seemingly simple, are almost impossible to perform accurately, which causes a lot of surprise and even cheerful animation. At the same time, they are offered real accidents for analysis, the cause of which were precisely the mistakes that the training participants made while performing the exercises. The coach personifies the result by commenting: "Here you have fun, but John Doe made exactly the same mistake - and there is no one to have fun". Such a comparison destroys the distance between one's own mistakes - "accidental", and those of others - "natural". The participants of the training realize the unreliability of their senses and their vulnerability to danger, discard the magical belief in their unconditional luck.

A detailed scenario of the training with a description of exercises, instructions and an analysis of accidents is given in the book "Psychology for Power Energy" by I.I. Vasileva [5].

The training is constantly being refined, new exercises are included in it. So, an exercise using the Stroop effect makes it possible to convincingly show the power of the image in the construction of behavior.

Stroop effect is a difficulty that occurs when reading words denoting color when the color of the letters that the word is written with does not match its meaning.



Figure 6: Stroop effect.

The test was slightly changed for the training. In the first test, it was proposed to count the number of words printed in the same color. In the second - the number of words that are the same in meaning. In both cases, the task execution time was recorded. In the usual case, the first task is performed quickly and accurately, the fastest results are from 10 seconds. The second task is usually performed with errors and much slower - at least 3 times. The trainer explains these results as follows: the effect of the image (color) on a person is direct, information processing is effective, the reaction is accurate and fast. In the second case, the processing of the meaning of the word (semantic sign information) is carried out much more slowly and with great difficulty, the response to the word is delayed and inaccurate. Images take hold of us rapidly, unlike signs. Including the false images too. When working in an electrical equipment, this creates a steady risk of wrong action. The result obtained during the exercise can be personalized by commenting: "If you were under the aforementioned bridge, the impact of the image for you would be dominant and immediate, and the probability that you would repeat the risky experience of the authors of the accident is not zero. When working in an electrical installation, you are exposed to the same risks of making a mistake".

The general conclusion and belief that the training participant should come to is the following: "Your mentality is your main and insidious enemy, when you get into an electrical installation, you are fighting not with high voltage, but with your nature".

Conclusion

The difficulty of solving the electrotraumatism problem in Russia is explained by long-term attempts to solve it by inadequate methods - engineering and administrative ones. The psychological nature of the problem as a problem of orientation in an environment with hidden dangerous properties, as a problem of incomplete awareness of the essence of risks and threats has long remained beyond understanding. Psychological analysis allowed us to describe mechanisms that explain the behavior of victims of electrical injuries (orientation errors, neglect of other people's experience, ignoring warning signs), and offer adequate solutions. The use of illusions reminding of constant risks of incorrect assess the high-voltage danger in design of work places as well as during staff training, can help worker to aware of psychological risks and form a steady motivation for self-control, verification of their decisions and avoiding errors.

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