

Psycho-Technical Tests in the Public Transport

Until recently the psychological diagnostics was studying the degree of dysfunctions in medicine, education or in the processes of upbringing. However, with the rapid technological progress a broadly understood psychological diagnostics became one of basic selection tools, enabling determination of an individual usability to specific professions (including driving a public transport vehicle). The tests from the field of labour psychology in fact consist in the determination of the reliability level of a human being as an element of a 'man – machine' system. Because analysing the reasons of accidents at work or of road accidents the unreliability of machines declines in favour of human unreliability. The paper presents also the instruments used by the Laboratory of Psycho-technical Tests at the Department of Aviation Technologies of the Silesian University of Technology.

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Psycho-technical diagnostics

A sudden development of technical sciences resulted in exceeding the selection limit for components of a traditional 'man – machine' system. As a result, numerous factors assigned so far to the man were shifted to the area of machine operation [2].

The basis of transformations comprised [2]:

- numerous errors made by the human, reducing the level of system effectiveness;
- new design solutions of actuators, capable of partly or entirely taking over the area reserved so far for the human.

The pace of human work is much slower than that of a machine. Also the work rhythm of a human happens to be uneven. This results from personal features, tiredness, motivation level. Machines can be replaced with other ones – the level of work performance will be identical. In the case of people it is not possible. However, it is the man, using the mental processes, including intelligence, who is capable of flexible ad-

aptation of the action to the current situational needs. He can reject a useless predetermined programme and adapt it to changed conditions. So it is not possible to adopt a common definition of the way of operation, effectiveness or reliability for a man and a machine [2].

The testing of psychomotor fitness (i.e. current labour psychology tests, including tests of vehicle drivers) in fact consists in the determination of the reliability level of the man as a component of the mentioned 'man – machine' system. As a result of analysis of accidents at work and of road accidents reasons, the unreliability of machines, including vehicles, declines in favour of human unreliability [2].

The psychological diagnostics used by psychologists in the labour psychology laboratories is based on the one hand on methods used in the clinical psychology, hence and interview, observations as well as various scales and personality questionnaires, which results

► Streszczenie

Jeszcze niedawno diagnostyka psychologiczna odnosiła się wyłącznie do tych działów nauki czy też życia społecznego, które określały rodzaj oraz stopień dysfunkcji – lub patologii – w ogólnie pojętej sferze psychomotorycznej jednostki. Udział wiedzy psychologicznej szczególnie widoczny był w medycynie, szkolnictwie, procesach wychowania. Jednak w miarę rozwoju cywilizacyjnego oraz gwałtownego postępu technologicznego szeroko rozumiana diagnostyka psychologiczna stała się jednym z podstawowych narzędzi selekcyjnych, umożliwiających określenie [1]:

- które z czynników psychofizjologicznych są przydatne (czasami wręcz niezbędne), a które utrudniają (lub całkowicie uniemożliwiają) wykonywanie konkretnych czynności;
- jaki jest poziom nasycenia daną cechą jednostki, którą poddajemy diagnozie.

Nie sposób odpowiedzialnie prowadzić selekcję osób do pełnienia funkcji wymagających specjalnych predyspozycji czy też sprawności psychofizjologicznej bez narzędzi diagnostycznych, które uwzględniają nie tylko jej specyfikę, lecz także szybki rozwój technologiczny i cywilizacyjny, kumulację coraz większej liczby zadań (czynności) w jednostce czasowej [1].

► Summary

Psychotechnical Tests in Public Transport

Until recently, psychological diagnostics referred only to those branches of science or to social life, which defined the type and degree of dysfunction – or pathology – in the general psychomotor domain. The share of psychological knowledge was especially evident in medicine, education, and the processes of upbringing. However, as the development of civilization and the rapid technological advances, psychological diagnosis has become one of the basic selection tools for determining [1]:

- which of the psychophysiological factors are useful (sometimes even necessary) and which make it difficult (or impossible) to perform specific activities.
- what is the level of saturation of a given feature of an individual that we diagnose.

It is not possible to select people for functions requiring special predispositions or psychophysiological efficiency without the use of diagnostic tools, which take into account not only its specificity but also the rapid technological and civilization development, the accumulation of more and more tasks in the unit of time [1].

► **Słowa kluczowe:** transport, bezpieczeństwo, operator

► **Keywords:** transport, safety, operator



Photo Magdalena Wojtyła

are frequently saturated with the social acceptance factor. On the other hand there are instruments for psychomotor and perceptive fitness measurements. These are various instruments enabling e.g. the measurement of response time, measurement of sight-movement coordination fitness or the determination of visual sensitivity threshold. From the technical point of view their design is very much diversified. Part of them are instruments based on purely mechanical solutions, other operated based on the microprocessor technology. Imprecise measuring instruments make impossible a right and reliable diagnosis, which in the best case results in incorrect decisions about the employment (e.g. poor productivity, frequent errors etc.), but can lead also to accidents and disasters ending up with suffering to many people, and even with death [2].

The Laboratory of Psychophysiological Diagnostics of the Department of Aviation Technologies, the Silesian University of Technology, was established on the basis of data from psychological tests on persons performing actions requiring special psychophysical fitness (Psychotronics GE). This applied mainly to persons performing the work under extreme conditions – most often at heights and in excavations, persons employed in underground mines, persons transporting explosive and flammable materials etc.

Technical support in psychological diagnostics

It is possible to assume that a psychological test should be characterised with (at least) the following features [3]:

Only a man is capable of adapting flexibly the action to the current situation needs

- **objectivity**, i.e. various psychologists examining the same person using the same instrument should obtain the same result and interpret this result concurrently;
- **normativeness**, i.e. specific result may be compared to an average result of the total group, which is a peculiar reference system;
- **standardisation**, i.e. testing by means of specific test should proceed always in accordance with identical schema.

The application of a diagnostic measuring instruments ensures objectivity, at least in the field of numerical result generated by this instrument, because the physical measuring process in no way depends on the psychologists performing the test. However, we should distinguish a raw measurement result of a psychomotor variable, being in fact a measure of certain physical process, which we consider basically correlated with this variable – but this correlation not necessarily and not always must be full. Factors such as well-being, exhaustion, or any ailments can affect the result. For example, the passion for computer games (and practice) can be favourable for good results on the Piorkowski apparatus. It is rather difficult to prove that such advantage would be further on favourable at the wheel of a real and not a virtual rail vehicle [3].

So a psychological test is never fully objective – even if various psychologists testing the same per- ▀



Fig. 1. 'Piorkowski' type apparatus



Fig. 2. Meter of sensorimotor fitness

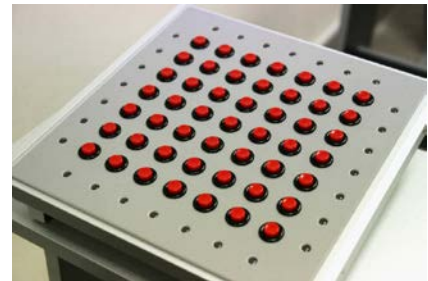


Fig. 3. 'Cross' type apparatus



Fig. 4. Meter of response parameters



Fig. 5. Stereo meter

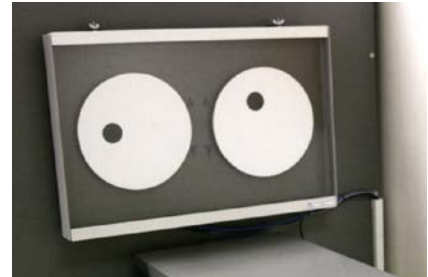


Fig. 6. Rotating discs meter

son would obtain the same measurement results, the interpretation of such data may be (should be?) different. This integrates with a broader context of debate about the qualitative and quantitative approach to the issues of contemporary psychology. The measurement of the response time may be a significant and pretty objective – at all aforementioned reservations – hint related to the operator's capacity to respond to transport incidents. But how is it possible to determine the influence, which in the actual situation can have an experience of participation in a railway incident and the suffered trauma, in a way other than asking questions about subjective feelings? Only such factor as responsibility or temperament can be subject to a subjective (qualitative) assessment of psychologist – which can have a decisive impact on the competence of the examined person as a driver [3].

Taking into consideration the reservations, which have been presented above, we can assume that the measurement data transferred from an instrument provide a consistent, quantitatively expressed image of a specific set of psychomotor variables, which we can treat as at least close to an objective description.

Basic instruments of the Laboratory of Psychotechnical Tests at the Department of Aviation Technologies of the Silesian University of Technology are briefly described below.

'Piorkowski' type apparatus

The 'Piorkowski' type apparatus – model P-03 (Fig. 1) is a modified version of the instrument popular among psychologists to examine the sight-movement coordination and the precision of movements. At the same time it enables measurement of response time parameters. The instrument is microprocessor controlled, is used mainly in the labour psychology diagnostics and also in protected labour establishments to examine the manual fitness.

Meter of sensorimotor fitness

The MSS meter (Fig. 2) is a proprietary device of GPE Psychotronics company, combining functions of traditional 'Piorkowski' type apparatus with 'Cross' type apparatus. Examining the sight-movement coordination at the same time it enables measurement of each response time, including the determination of:

- average response time
- coordination fitness expressed as a percentage,
- the number of received and erroneous stimuli.

'Cross' type apparatus

A modified version of device popular in 1970-s, used mainly by labour psychologists. It is equipped with modern electronics and flexible management software. The instrument allows to design any test programmes and statistical operations (Fig. 3). Useful in labour psychology laboratories – in the current form it may be used also in clinical diagnostics (disorders of CNS).

Meter of response parameters

This is an expanded version of former MRK apparatus. The authors included in the contemporary version – apart from the response time – parameters specifying the response types (e.g. correct, late, neglected etc. responses). Determination of the response threshold related to visual and auditory stimuli. The test results are: the time of individual responses, average time of correct responses, the numbers of correct, late, neglected, and erroneous responses. The software performs preliminary statistical processing – results are presented in the form of a bar chart. The entire set is controlled by a microprocessor – Fig. 4.

Stereo meter

A modern instrument for the diagnostics of spatial differentiation (stereoscopy), and also of visual acuity. The entire set is controlled by a microprocessor – Fig. 5.



Fig. 7. Night vision meter/Landolt ring



Fig. 8. Poppelreuter figures

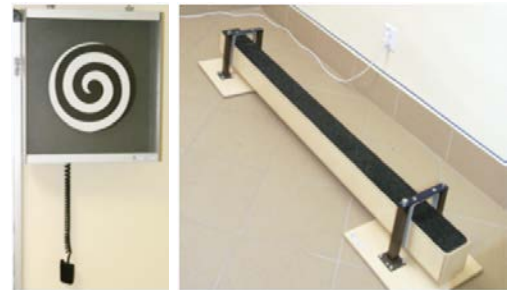


Fig. 9. Balance beam

Rotating discs meter

A stationary instrument to measure difference in rotating discs speeds – Fig. 6. To eliminate the measurement error – mechanical transmission and a traditional drive were entirely given up in the instrument design. To be used in diagnostics of psychological tests for drivers. Results are presented in the form of graphs. It is possible to change the rotation direction and the acceleration. Full adjustment of all parameters. The entire set is controlled by a microprocessor.

Night vision meter

A stationary instrument for psychological diagnostics installed in a dark room or cabin – Fig. 7. It enables determination of the photoreceptor adaptation time after exposure. The entire set is controlled by a microprocessor.

Landolt ring

The Landolt ring is a traditional name of a diagnostic device, enabling determination of the lower threshold for the visual sensitivity – Fig. 7. The entire set is controlled by a microprocessor.

It comprises:

- control panel with an LCD display and a set of buttons,
- display panel,
- illumination system.

The examination is performed in a room without access of daylight. Its interior is covered with a dark matt colour.

Poppelreuter figures

A set of figures together with test sheets of the Poppelreuter test used to measure the concentration and divisibility of attention – Fig. 8. To be used in labour psychology tests (professions that require particular psychophysical fitness) – indispensable in the psychological diagnostics for vehicle drivers.

Balance beam

An RWE-2001E balance beam is a stationary piece of equipment, enabling to diagnose disorders of the sense of equilibrium – Fig. 9. The bearing module is made of metal and wood components.



Fig. 10. Simulator of work under stress

Simulator of work under stress

A proprietary instrument, enabling to determine the level of efficiency and the degree of concentration on a task under conditions of stress caused by disturbing stimuli. The entire set is controlled by a microprocessor – Fig. 10.

Summary

The application of electronic measuring instruments and computer assistance in the psychological diagnostic is beyond a shadow of doubt a valuable tool in the hands of psychologists performing the test. It also can bring them closer to the goal, which is the psychological tests objectivisation. However, even the most sophisticated IT system will not become, at least in the predictable future, an automatic machine to generate the only right and objective psychological diagnoses. Just the other way round – the specific nature of the field is such that all key decisions are made by psychologists and the degree of objectivity – or subjectivity – of their decisions in the lion's share remains a function of their competence [3]. ■



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