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Sources of bias in examination of forensic traces

Summary

Every human being has a cognitive apparatus that he/she uses every day. Due to its limitations, we are susceptible to all kinds of cognitive errors that affect the observation of the world and decision making. Also forensic experts are not immune to external and internal factors that may cause issuing false opinions. The aim of the article is to show the multilevel problem of prevalence and susceptibility to any cognitive biases in the expertise of forensic analysts, and an attempt to systematise the cases described in the latest research works using the pyramid structure of bias sources. As regards the practical aspect of the discussed subject, in some cases solutions were also proposed that could improve the work of experts and contribute to its greater integrity.

Key words: forensic science, cognitive errors, bias, forensic expert report

Introductory notes

All living creatures have a cognitive apparatus that retrieves information from the environment allowing them to function properly in the surrounding world. Biological equipment of a human enables the senses to receive stimuli, which are then interpreted by the mind. To function properly our cognitive system has to make some compromises, which simplifies the world we get to know so that it can be effective and fast even when there is not enough information in the environment.

Every human activity performed depends on external and internal factors. On a daily basis one is exposed, for example, to tiredness at work, emotions associated with your personal life or even the pressure exerted by one's superiors. However, little attention is paid to all kinds of biases, i.e. tendencies that unfavourably influence both the observations of the world we perceive and – sometimes – the decision-making process.

There are in particular such professions that in addition to the required extensive and expert knowledge are also endowed with above-average trust from the public (medical doctors, forensic experts, aircraft pilots). The decisions of those professionals have a direct impact on people's lives. Forensic experts play an important role in court proceedings by providing evaluation of evidence and their opinions should be impartial and accurate. Importantly, repeated analysis of the same evidence should always produce the same results.

This problem is broadly elaborated on in English-language literature. While a lot of information can be found, also in Polish, on bias as such, studies specifically related to cognitive aspects of forensic investigations began to emerge only at the beginning of the 21st century. However, with each subsequent year, more and more articles have been devoted to them, and awareness of problems resulting from the functioning of human cognition has improved (Dror, 2017).

The discipline dealing with the influence of the human cognitive apparatus on the interpretation of forensic traces in foreign literature occurs under the name *cognitive forensics*. The most attention in research is devoted to fingerprint experts. It is suggested, however, that these results can be extrapolated on other areas of forensic science (Dror, Rosenthal, 2008). It should also be noted that such experiments are extremely difficult to conduct. Forensic expert's tasks are time-consuming, and in addition to that, an expert should not be informed that he/she is being under research (Dror, Rosenthal, 2008).

To systematise the presented subject, Zapf and Dror (2017) proposed differentiating seven levels of bias sources. At the very bottom of the pyramid there are the most human-related factors: the brain and cognitive architecture (Dror, 2017). With each next level the factors are more and more related to the environment. At the top of the pyramid there are only aspects directly related to a given case and the evidence considered in its context (Figure 1). In the following sections each of level will be discussed in detail.

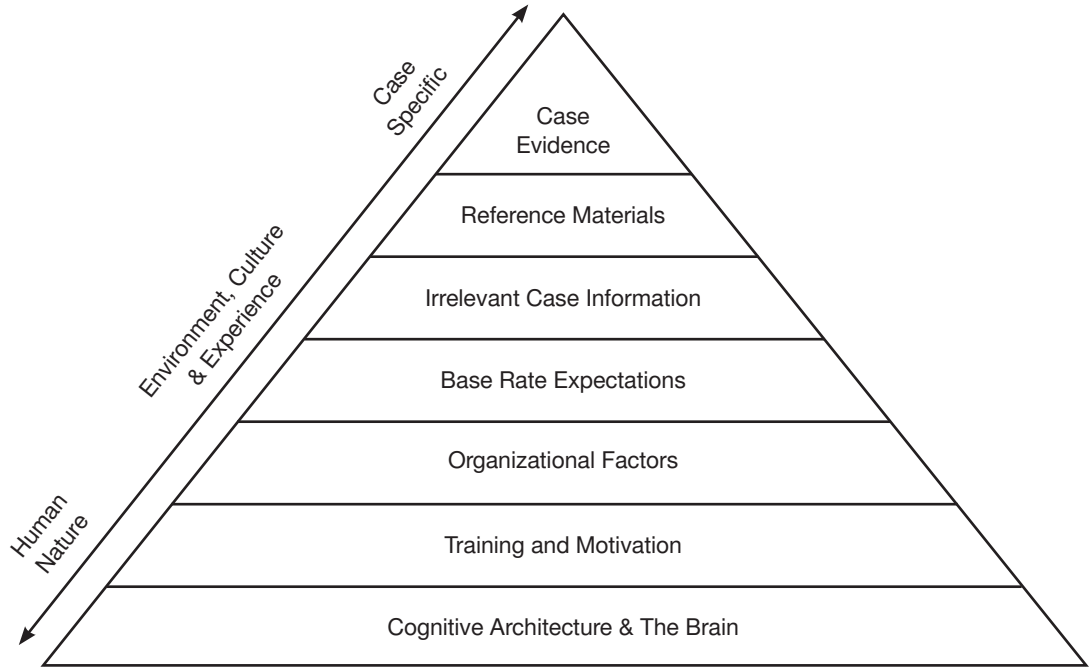

Fig. 1. Pyramid of bias sources.

Dror, Morgan, Rando and Nakhaeizadeh (2017) introduced two concepts to describe the phenomena occurring between the levels of cognitive error sources. The first of them is the bias cascade. It is a situation in which information unnecessary for the analysis of an evidence gets from one stage to another, e.g. from the stage of gathering evidence to the stage of its interpretation, thus resulting in cognitive bias. The other concept is the bias snowball, which consists in the fact that cognitive biases not only pass between levels, but also their intensity increases due to other interacting factors.

Although the mind and brain are the most human-related factors and they lay at the foundation of each successive layer in the proposed pyramid, from the forensic perspective the most interesting are those problems that are directly related a case in question. For this reason, the description the levels will begin from the top of the pyramid.

Case evidence

Already at the level of evidence recovered at the crime scene one may encounter additional information that might interfere with the objective analysis. An example of that can be the content of an audio recording that influences the requested analysis of sound, type of bite that may reveal additional data on the manner of committing a crime, or even the entire content of a letter in case when only verification of its signature is required (Dror, 2017). In some cases, it is possible to isolate such a factor – the content of the letter can be separated from the signature – in others it is unfeasible, as in the case of a bite mark.

It should be noted that persons preforming recovery of material evidence try to contaminate them as little as possible (Dror, 2015). Contaminated exhibits or illegible traces are difficult or even impossible to analyse and to take an unambiguous decision. By analogy, another mandatory stage should be minimizing bias, that is cutting down any irrelevant information that is unnecessary for the expert to analyse the evidence (Dror, 2015).

Problem of referential material

There are also many forensic disciplines, in which the highest evidential value is represented by opinions from the comparative analysis of evidence with comparative material. For example, in odontology, very often recovered exhibits are of poor quality, so the number of possible hypotheses is significant. In such a situation a contrast effect may occur, i.e. a tendency to change the standards of assessment of evidence after multiple exposure to the same stimulus. This takes place especially in cases of conducting comparisons of a subjective nature. Having made several analyses, an expert begins to see a connection between the evidence and the comparative material, which, obviously, is not there (Page et al., 2012).

It is also notable that such comparative studies are particularly susceptible to analysis “from suspect to evidence” (Dror, 2015). The case of Brandon Mayfield (Kassin, Dror, Kukucka, 2013) was among to the most media covered examples of error in the form of such a reverse analysis. Fingerprints were not initially analysed and described by experts, but immediately compared to the comparative material from the selected

person. The effect of the context influenced the experts, which resulted in charging a misidentified perpetrator.

One of the suggested solutions to this problem is sequential unmasking. It is assumed that some of the information that is unnecessary for trace analysis can be hidden so that cognitive biases do not occur. Moreover, it is suggested that this important information may then be sequentially disclosed (Dror, 2012). In such cases, several combinations of procedures can be considered. One of them is a double analysis: the expert first checks the track "normally" and again with some additional, unnecessary or relevant context. Then, he/she compares both results and eventually comes to other conclusions. Another version involves two experts who independently examine a given evidence. Then one of them considers the unadulterated evidence, and the other one can freely manipulate the material. Finally, both opinions are compared (Dror, 2012).

Dror et al. (2015), in turn, propose Linear Sequential Unmasking – LSU. In this approach, the possibility of revision (sometimes even a total revision) of the previous decision should be limited by introducing a numerical limit of changes or only the possibility of adding further observations to the analysis, but without removing or modifying the previously prepared opinion. While the idea of these solutions is the most noble, other aspects, such as the additional cost or time of expertise, unfortunately, do not make it an optimal procedure.

Case information irrelevant to the expert

In the first two categories, the contamination was closely related to the analysed evidence. In the case of information irrelevant to the expert, it refers to situations, in which an expert is reached by data or facts are not directly related to the analysis of the trace, but generally to the crime in question. What's more, it is sometimes difficult to set a boundary line between useful and useless information (Zapf, Dror, 2017). An example of such influences is communication with the police or other authorities that provide additional information on a given case (even the most subtle ones). Also, the mere fact that a suspect has a criminal history may influence the analysis of evidence.

One of the studies tested the susceptibility of fingerprint experts to such external factors (Dror, Rosenthal, 2008). The respondents were given crime scene finger marks and comparative material for analysis, which had already been the subject of their examination and the basis for the expert report. The examiners were divided into two groups: the first one was the control group and the other one, in which a manipulation was applied consisting in in providing a distracting external factor, e.g. information on the fact that the suspect from whom the trace originated had an alibi or that the suspect had pleaded guilty. The results obtained in the study were then referred to expert opinions drawn up in the past. It turned out that experts made significantly more mistakes when they are influenced by context manipulation.

One of the problems with comparing finger marks and fingerprints is that even when experts analyse the same prints another time once they are not infallible and it happens they make mistakes. Such examination of evidence may thus be even more susceptible to external factors and as a result the number of mistakes increases (Kassin, Dror, Kukucka, 2013).

It should be observed that the concept of sequential unmasking can also be used at the level of information irrelevant for an expert.

Base rate expectations

The next level of cognitive error sources is no longer directly related to a given case. In the category of expectations resulting from previous knowledge – base rate expectations we talk about certain regularities that influence one's perception of the world (Dror, 2015). The key consequence is expecting a certain result, based on previous experience, statistics or even superstitions (Dror, 2009).

In literature of the subject the issue of verifying the work of other experts is called upon (Dror, 2013). In this situation, the verifying expert also performs the expertise of the same evidence, however, he has information about the result obtained by the predecessor. Consequently, there is a high probability of a decision confirming the previous result. In this case the solution is very simple – verification should be carried out without providing information about the previous decision. It is also proposed to transfer the burden of opinion control to the prosecutor or judge using a, so-called, holistic appraisal of the expertise, which should take into account both the conclusions and the justification drawn up by the expert (Kwiatkowska-Darul, 2008).

It would seem that with technological progress and the emergence of new possibilities in the field of IT forensic systems, the contribution of cognitive factors that could unfavourably affect the objectivity of results ought to be minimised (Dror et al., 2012). One of the available solutions is the AFIS (Automated Fingerprint Identification System), which allows to search the database of tenprint cards and unsolved latent finger marks and indicate which ones are the most similar to the examined evidence. The expert obtains a list of the most likely candidates in an appropriate decreasing order and decides if any of them is sufficiently consistent with the evidence. This manifestation of cooperation between man and computer shows, however, that bias may also occur here. In addition, it should be emphasised that AFIS has a very large pool of records, so it is not difficult to find similar but non-identical images (Dror, Cole, 2010).

Contrary to appearances, a quite trivial thing, namely the order of results on the candidate list in the AFIS system actually has an impact on decision making. In one study, the order of results was manipulated to

check whether the change of position, e.g. from the first to the last on the list, would affect the decision of the expert (Dror et al., 2012). As it turned out, regardless of the entire order, there is a tendency to prefer the first position on the list. As a result, if the compliant comparative material places high on the list the expert should not have a problem with identifying and making the right decision. However, when this material appears at the end of the list, there is a higher probability of misinterpretation.

Although technology is slowly starting to replace some of cognitive human work, the result is still prone to errors. On the one hand, solutions of this type facilitate and speed up the work, but on the other hand, they create new problems or simply replace one problem with another.

Such base expectations can be extremely easily overcome conceptually. All you need is a good counter-example that contradicts certain regularities, or an exception that does not confirm the rule (Dror, 2017). In the case of AFIS, it should be mandatory to present the candidates on the list in a random order.

Organisational factors, work environment, culture

The next quite broad category includes factors that create the relation between an expert with one of the authorities – his working conditions or even the ideas he professes (Dror, 2017).

One of the most characteristic mistakes at this level is the bias associated with the authority on whose request the expert opinion is prepared (adversarial allegiance) (Dror, 2015). In one of the studies identical evidence was presented to the experts, but some of them were convinced that they were working for defence, and the others were told that they were working for the prosecution (Murrie et al., 2013). The results showed that the expertise was biased in favour of the party for which the experts had been working. What is more, it is expected that the effect may be the stronger the longer the expert has been related to a given case or if it is based on a larger amount of information. The exact reason for this bias is, unfortunately, not known yet. Among the expert's working conditions, there are many factors that will positively or unfavourably influence the analysis of traces: workload, pressing deadlines, long hours of work, low pay, impact of technology or different priority of the cases under examination (Jeanguenat, Dror, 2017). Due to the nature of their work, experts are also exposed to expectations from the entities requesting expert opinions. It may even come to a situation where marks are sent back to be re-examined due to the fact that the conclusions from the analysis were not consistent with the suppositions of the customer (Kassin, Dror, Kukucka, 2013).

An extremely interesting aspect is also the language used by the expert. The manner, in which the experts express the conclusions from the analysis of evidence, in particular the type of vocabulary used or even the dialect, may affect how we perceive and interpret the information (Zapf, Dror, 2017). From this perspective, the saying "as many languages you know, as many times you are a human being " appears not as far removed from reality as it might have seem. At the same time, this topic does not seem to be a priority, given the opinion that the expertise is increasingly focused on the multimedia form with minimal explanations, and less on a strictly written one (Taracha, 2008). Over time, new ways of visualizing applications should play a greater role (e.g. multimedia presentations or computer animations), so it can be expected that the influence of the language used will be decreasing.

Training and motivation

During the training, candidates for experts are also susceptible to many cognitive errors (Dror, 2017). This fact is interesting because the training itself usually takes place a long time before starting the actual work (Dror, 2015). There are three aspects of human cognition here. The first one refers to the ability to collect information and acquire skills. The second is the general predisposition of memory. After all, there is no benefit from completing the course, when the acquired knowledge is quickly forgotten. The third aspect is the ability to use the acquired competences in the analysis of evidence, that is, first and foremost, the application of theory in practice. Therefore, the person conducting the training is responsible for the proper preparation and transfer of knowledge during the classes: correct selection of examples, the order in which they are presented or the use of various memory techniques.

At the same time, it is necessary to provide experts with knowledge about the existing bias. Some people may be characterised by an attitude in which the experts will think that they are immune to any external factors in their work and, consequently, impeccably objective (Dror, 2013). This approach is called bias blind spot (Page et al., 2012). It should be remembered that there are no people who are not sensitive to cognitive errors.

A similar problem is overconfidence of experts. Experts who regularly and routinely perform their duties are more susceptible to external factors and, consequently, they analyse the evidence less accurately (Page et al., 2012).

As regards motivational factors, one of the studies involved an interview with experts conducted in order to obtain information on emotions accompanying them at work (Charlton, Fraser-Mackenzie, Dror, 2010). It was found that the motivation to find the perpetrator might influence the reduction of the decision threshold that would normally have to be exceeded to definitively and unambiguously determine the consistence of a mark with the comparative material. What's more, the satisfaction of a seemingly well-done job would mask the fact that the analysis had not been carried out in a one hundred percent reliable way. Also, the need to

deal with high profile, sometimes media-present cases and the resulting greater reward, can lower the level of the decision threshold. On the other hand, the fear of making a mistake and bearing possible consequences causes that experts need more certainty in order to make a clear decision. Interestingly, the experts argued that it is less harmful to overlook an identification than to make false identification of the perpetrator. This is due to the fact that the second action is more deteriorating to the expert's authority.

Let us also reflect on the fact that the emotional state of the expert may additionally reinforce the undesirable impact of the context if the case concerns matters that are particularly important or repulsive to him/her or, such as e.g. including paedophilia (Archer, Wallman, 2016).

Cognitive architecture and the brain

At the lowest level the most human-related factors are considered. They include a number of features that directly undermine our perception of reality: limitations in information processing, selective attention or processes responsible for understanding information in a given context (Zapf, Dror, 2017). Due to the nature of this category, it also affects all the higher levels of the bias sources pyramid.

An interesting concept is creation of a cognitive profile for each field of forensic examination (Dror, 2015). It would make a set of requirements that a potential expert would have to meet to be taken into consideration during recruitment. Features that have a particular impact on expertise include: an ability to allocate attention and mental rotation or the appropriate level of visual search mechanisms. As regards the fingerprint expert, several types of tasks can mentioned that could be check the cognitive competence to compare fingerprints (Bucht, 2010), such as:

- ability to spot curves,
- ability to assess rotation,
- ability to assess whether a smaller pattern appears within a larger pattern,
- skin ridges tracking skills,
- ability to deal with disturbances from the environment,
- ability to separate superimposed images.

Of course, to check whether a candidate meets the requirements, appropriate tests should be designed. A careful selection of future experts with adequate cognitive profiles and appropriate training may reduce errors in the analysis of forensic evidence (Dror et al., 2011). This is not a completely unreal idea. Complaints about of the lack of adequate verification of forensic experts have often been made. Verification, modelled on other countries, at the moment of entering examiners on the list of expert witnesses has been postulated (Tomaszewski, Rzeszotarski, 2008). This problem can be solved comprehensively and, in addition to the competence tests, cognitive ability tests may be implemented.

Cases of absence of bias

It is worth to mention a few studies, in which the impact of bias was not detected. In one of them 12 policemen were examined who were experts in the field of traseology (Kerstholt, Paashuis, Sjerps, 2007). They showed them photographs of shoe marks and photographs of footwear from several cases. The context was manipulated: in half of the cases, the plain history of burglary and the origin of the mark were provided, and the remaining part of the group were given an additional context. The examiners considered simple cases, in which the traces were legible and difficult ones when they were of inferior quality (e.g. due to shoe rotation). The results showed lack of any effect of the context in the study. Only the quality of the trace affected the correctness of the comparison. One of the proposed explanations for this situation is the strict procedure, which is in force in traseological examinations in the Netherlands, where the experiment was carried out. When analysing such marks an expert describes in detail the characteristics of the footwear and then assigns to them appropriate numerical values in accordance with the instructions in the Guide.

In another study with a similar procedure 70 experts examined finger marks (Hall, Player, 2008). The context was manipulated: in half of the cases the case was presented as forgery which was to be synonymous with the low effect of emotional impact, and in the remaining ones as homicide, which, of course, was supposed to have a stronger impact on the examiners. Finally, the respondents were also asked if they were aware of the fact that the information on the case could have influenced their analysis. The results demonstrated that the level of context did not affect the decision made. However, half of the experts from the group with a high emotional affinity to the case said that additional information could have affected their analysis. This would mean that the cognitive error occurred during the observation and analysis of the traces, however, it did not affect the final decision. It is true that the respondents knew that they were taking part in the experiment, so it could be a factor influencing the decision-making process. Therefore the results are not unambiguous.

In the last of the experiments 6 firearm experts were tested. They were presented with pairs of projectiles twice: first in neutral conditions, when it was suggested that there were two perpetrators and two crime scenes, and then after a few months with an additional context: one perpetrator and one crime scene (Kerstholt et al., 2010). The examiners had to determine if both projectiles came from one weapon. The results again showed no impact of the context on decision making. Also in that case, however, there was a reservation caused by the fact the participants were aware they were participating in an experiment, as well as by a small number of cases and participants.

Discussion

Above, the Author has presented the research studies on the occurrence bias and its consequences in the work of a forensic expert. As this is a practical problem, the question arises how to limit or reduce the presence of this factor. In some cases, solutions have already been proposed that refer to the very nature of the conducted research (strict adherence to the procedure, isolation of irrelevant evidence). Unfortunately, they are not always used due to the higher costs of examination, longer time of its execution or involvement of larger human resources.

The pyramid of bias sources precisely shows the problems that experts face. This hierarchy demonstrates that the occurrence of cognitive biases does not always have to be a separated incident. Each level in the pyramid reveal how many activities and phenomena entail potential sources of cognitive bias that an experts cannot escape from. However, it is known that there are people more or less susceptible to internal and external factors affecting forensic examinations. This is all the more important because a forensic experts constitutes an extremely important link in court proceedings and it often depends on his report what the final decision of the court will be.

One of the key aspects on which the vulnerability to cognitive biases may depend is the cognitive profile. There is a lack of empirical data that would indicate if there are any cognitive or psychological predispositions that would increase resistance to undesirable internal and external influences in the expert's work. Possibly, conclusions might be drawn on the basis of general knowledge from studies on experts in other fields, e.g. aircraft pilots (Kosslyn, Waag, Dror, 1993), and one might predict that similar relationships will apply to forensic experts. Of course, this is not an ideal solution. Due to the expansive nature of this problem the number of newly discovered cognitive biases increases every year. It is therefore necessary to continue research on the impact of the human cognitive apparatus on the interpretation of forensic traces, as well as on methods and tools that could improve the work of expert witnesses.

Sources of figure:
Fig. 1: *Zapf, Dror, 2017*

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