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PLANNING AND INHIBITORY ABILITIES IN CRIMINALS WITH ANTISOCIAL PERSONALITY DISORDER

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SUMMARY

Background: The aim of our study was to analyze planning and executive control in aggressive offenders diagnosed with antisocial personality disorder (ASPD). The problem of inner diversity in the psychopathic population referring to these executive functions was examined, as well as the impact of executive functions on aggressiveness.

Material/ Methods: Our research involved a group of 130 male subjects: 65 ASPD criminals in the clinical groups and the same number of non-criminals as a control gorup. The Violent Rating Scale and DSM-IV criteria for ASPD were applied; the neuropsychological instruments administered included the Stroop Test and the Tower of London Test;.

Results: Our results confirmed the hypothesis that the level of executive functioning was lower in ASPD criminals in relation to both examined cognitive activities: planning and inhibitory control. Surprisingly, no associations were found between the executive indicators and the level of violence. Further investigation led to the conclusion that the ASPD population is heterogeneous in respect to planning capacities.

Conclusions: Our findings are consistent with a majority of the scientific reports on executive functioning in the ASPD group, but shed more light on the problematic area of cognitive diversity within psychopaths. One important result from our study for forensic-clinical practice is that Stroop Test evinced better discriminatory power, and thus may be a better tool for determining if a suspected criminal is properly accused.

Key words: executive functions, offenders, psychopathy, aggression

INTRODUCTION

Recently a number of neuroscientists and neuropsychologists have been investigating personality disorder, exclusively focusing on neuropsychological functioning in individuals with antisocial personality disorder (ASPD), conduct disorder (CD) and psychopathy (Pickersgill, 2011). Their research, reflecting the diversity within the neurosciences and neuropsychology, has centered upon such issues as:

- the ratio of volumes of white to grey matter in the brain (Pemment, 2012; Yang et al., 2010);
- the functioning and volume of the amygdala (Yang et al., 2010), corpus callosum and striatum (Glenn, Yang, 2012);
- the action of neurotransmitters (Blair et al., 2006).

Investigators also employ a range of methods, including neuropsychological tests focusing on identifying various cognitive impairments, positron emission tomography (PET) and functional magnetic resonance imaging (fMRI), which make it possible to visualize the functioning of processes within brain.

Different studies within the field have been conducted on samples of people displaying various types of diagnosis connected with violent and/or antisocial behavior, including ASPD, CD, and psychopathy. CD and ASPD are listed as DSM-IV diagnoses, where CD is considered to be applicable to antisocial individuals younger than 18 years of age. CD and ASPD are both diagnosed on a behavioral basis in individuals who show a disturbance of conduct lasting at least 6 months, which features at least three different forms of antisocial behavior (APA, 2000). The concept of psychopathy is not synonymous with diagnoses of CD or ASPD, but represents an extension. Psychopathy can be defined by high scores on clinically-based rating scales. For adult individuals, the most commonly used scale is the Revised Psychopathy Checklist (PCL-R; Hare, 1991).

A great number of studies have been undertaken to investigate the performance of individuals diagnosed with CD, ASPD or psychopathy on measure of executive functioning (EF) (Kandel & Freed, 1989; Pennington & Ozonoff, 1996; Dolan, 2012). Although it seems that executive dysfunction is not necessarily a cause in the development of ASPD (Blair & Frith, 2000), it can contribute to increased displays of violence. Executive dysfunction can lead to a higher risk of engaging in different types of violent and antisocial behaviour through decreasing behavioral inhibition, limiting the ability to anticipate the consequences of one's behavior, as well as the capability to display socially appropriate behavior (Ishikawa & Raine, 2003; Seguin, 2008).

The term "executive functions" (EF) represents various cognitive processes that regulate the ability to organize a flow of information, thoughts and actions, prioritize tasks, manage time in an efficient manner, and take part in decision-making. EFs control the ability to coordinate thought and action and direct it toward obtaining goals. They are essential to overcoming local barriers, planning and orchestrating complex sequences of behavior (Miller & Wallis, 2009). There-

fore EF also refers to the ability to maintain an adequate problem-solving set with a view towards fulfillment of a goal (Luria, 1966). EF contrasts with automatic forms of brain processing (Miller, Wallis, 2009), and enables the individual to inhibit inappropriate action or behavior. Executive function deficits have been found to be associated with various cognitive, developmental and psychological disorders.

There are various ways for evaluating EFs using neuropsychological testing. The measures that are most commonly used include:

- the Wisconsin Card Sorting Test;
- the Stroop Test;
- the Tower of London Test;
- the Tower of Hanoi Test;
- the Porteus Maze Test.

All these methods cover a wide variety of EFs, involving planning, monitoring and inhibiting prepotent responses. EF can be defined as a process that involves the delineation, organization and integration of behaviors needed to operationalize an intent or achieve a goal, it requires the ability to conceptualize a change, respond objectively, generate and select alternatives and sustain attention (Lezak, Howeison & Loring, 2004). Behavioral inhibition is related to three mutually interrelated processes: the inhibition of the initial response to an event, the extinction of an ongoing response, or a delay in taking a decision and the protection of the period of delay from competing events and responses, known also as interference control (Barkley, 1997). Behavioral inhibition can been measured by assessing physiological processes, including heart patterns, cortisol levels, and amygdala activity on fMRIs.

Various studies have explored the performance of individuals with ASPD, CD and psychopathy on measures of EF (see: Blair, Frith, 2000, Brower & Price, 2001, Ishikawa & Raine, 2003, Seguin, 2008). Most of these studies have shown that executive dysfunctions are connected with antisocial traits. An analysis of different studies focusing on this issue was conducted in 2000 by Morgan and Lilienfeld, and in 2011 by Ogilvie et al. The results of both of these studies indicated that a robust and consistent association existed between anti-social behavior (ASB) and executive dysfunction, which held across varying study methodologies. Morgan and Lilienfeld (2000) examined a total of 39 studies including 4,589 participants. The included studies used at least one of six measures of EF sensitive to frontal damage, and grouped individuals according to ASB and comparison groups (groups of psychopathic personalities, individuals with ASPD or CD, criminals, delinquents, and psychiatric or normal comparison groups). The results of this meta-analysis showed that the grand mean weighted effect size for all the studies that were examined was a difference of .62 standard deviations between antisocial and comparison groups on all EF measures. According to these results, antisocial individuals scored significantly worse on EF measures compared with individuals from comparison groups. At the same time, the results of this meta-analysis showed that the effect sizes varied in different studies according to the type of ASB. The largest effects were found for crimi-

nality (d=.09) and delinquency (d=.86), and small-to-medium effects were found for CD (d=.40) and psychopathy (d=.29) (Morgan & Lilienfeld, 2000). The meta-analysis conducted by Ogilvie et al. (2011) in general supported the results obtained earlier by Morgan and Lilienfeld.

The results of both of the above mentioned studies lead to the conclusion that antisocial individuals may not constitute a homogeneous group with regard to the specific nature of possible EF impairments. In contrast, it is possible that EF impairments may be more significant in particular groups and subgroups of antisocial individuals and for particular forms of ASB (e.g., a certain level of aggression, the type of crime committed). One of several studies that support this idea is the one conducted by Barker et al. (2007) within the ASB category of CD. Their results revealed that EF impairments were connected with physical aggression, but were not connected with theft. Such results highlight the importance of further examining the heterogeneity in EF impairments within the group of people diagnosed with antisocial traits in personality and behavior. So far, however, most of the studies have not covered this issue. At the same time, among many studies devoted to EF in groups of people displaying antisocial behavior in general, there are only very few neuropsychological studies addressing the problem of prefrontal functions in offenders meeting criteria for ASPD compared to healthy controls. Therefore, we designed and conducted a study in which a sample of offenders with ASPD and a control group were compared on chosen EF measures. One of the major aims of the study was to determine whether it is possible to divide people with ASPD into different subgroups on the basis of the specific nature of any possible EF impairments.

MATERIAL AND METHODS

The study involved 130 adult men, 21-76 years of age, constituting two groups: the clinical group and the control group (CG). The clinical group consisted of imprisoned offenders diagnosed with ASPD. The diagnosis of ASPD originated from previous forensic psychiatric assessment or was given for the purpose of the study on the basis of analysis of penitentiary files. Usually penitentiary files contain data describing the life history, style of life, clinical symptoms, psychological test results, and other information that may contribute to a diagnosis of ASPD. The diagnosis was consistent with the requirements described in DSM-IV (APA, 2000); thus it was given only to those individuals who met the criteria A-D, and within the A criterion at least three different symptoms from the list below:

1. failure to conform to social norms with respect to lawful behaviors as indicated by repeatedly performing acts that are grounds for arrest;
2. deception, as indicated by repeatedly lying use of aliases, or conning others for personal profit or pleasure;
3. impulsiveness or failure to plan ahead;
4. irritability and aggressiveness, as indicated by repeated physical fights or assaults;

5. reckless disregard for the safety of self or others;
6. consistent irresponsibility, as indicated by repeated failure to sustain consistent work behavior or honor financial obligations;
7. lack of remorse, as indicated by being indifferent to or rationalizing having hurt, mistreated, or stolen from another (APA, 2000).

The sample of 65 individuals with ASPD was selected for the clinical group from a larger sample of 191 prisoners, whose penitentiary files were explored. The final clinical group consisted of ASPD subjects who had been convicted for one of four different types of crimes:

- murder (n=6);
- assault (n=13);
- rape (n=17);
- child sexual offenses (n=27).

The control group (CG) was formed by the matching according to age and education. These men were recruited from the general population. Subjects with any criminal past were excluded from the CG.

The study reported in this paper was part of a larger research project, designed at the Adam Mickiewicz University by A. Roszyk, to search for the neuropsychological determinants of sexual crimes. The whole study employed eighteen methods, both neuropsychological and psychological. The assessments were conducted in nine prisons located across Poland.

In this paper the results of the following methods were used:

Stroop Color-Word Test – The basic two-trial paper version of the classic Stroop Test, developed by J. Ridley Stroop in 1935, was administered. The first trial required the participant to read written color names, and the time of reading was measured. In the second trial, the participant is required to name the color of the letters, regardless of the written word, and the time of color-naming is measured. The color-naming task is considered demanding, because the participant must suppress the automatically enforced reaction of reading the word. The time of delay in reaction in this task is thought to indicate a cognitive control process, the inhibitory function, while mistakes in the color naming trial are interpreted as impulsive reactions (the automatic response is not suppressed).

The *Tower of London Test (ToL^{TXTM})* was applied, in the version of the test published by W. C. Culbertson and E. A. Zillmer from Drexel University (Culbertson & Zillmer, 2010). This instrument was originally developed by Shallice in 1982 for the assessment of adult patients with frontal lobe damage. It is a useful and widely used tool to assess executive planning. It consists of 10 test problems. The tool delivers a set of indicators referring to the planning process and cognitive control and their supporting components of attentive allocation, response inhibition, working memory, mental flexibility and motor speed. The data collected during the test administration are as follows:

- total correct score – number of test problems solved in a minimum number of moves;
- move score – number of moves utilized to solve the problem;

- initiation time – the time that is assumed to be intended for cognitive deliberation on the move sequence needed to solve the problem, counted from the moment of presentation of the stimulus to the participant's first move in behavioral execution of the task;
- execution time – the time of exact behavioral performance in the test;
- problem solving time – time for both cognitive planning and behavioral execution in the task;
- time violation score – the number of task in which the examinee exceeded the time limit;
- rule violation score – number of accidents of rule infringements, and is thought to measure the ability to govern and control executive planning and problem solving in accordance with rule constraints.

More efficient executive planners are expected to solve ToL problems with fewer move scores in less executive time, while they are expected to show a longer initiation time, since this is thought to be an indicator of cognitive planning. Rule violation is interpreted as an indicator for impulsiveness and poor self-control.

The *Physical Violence Rating Scale* is a clinical-experimental tool to access the severity of violence applied in a criminal act for which the offender has been convicted. It is designed on the basis of M. Beisert's (2012) violence rating scales for sexual offending behavior. Criminal acts are estimated on the basis of the descriptions contained in penitentiary and forensic files, on a 8-step scale ranging from 0 (no physical violence) to 8 (extreme violence resulting in serious injuries leading to invalidity or death). The assessment procedure involved competent judges.

RESULTS

One possible approach to the problem of the neuropsychological background of ASPD considers frontal dysfunctions within the group of these individuals. Particularly, the planning function and inhibitory abilities are presumed to be impaired in this group. Accordingly, more impulsive acts and a higher level of aggression are expected to occur within the ASPD group.

In order to verify the difference hypothesis referring to planning and inhibitory functions, the t-test for dependent samples was administered for various indicators of selected executive functions deriving from the applied methods. Criminal ASPD participants were compared with subjects from the general adult population, recruited using matching method for age and education. One subject from the ASPD group was excluded from this analysis due to the fact that he performed the Reading Trial in a much longer time than the Color-Naming Trial. This suggests that in his case reading abilities were not automatic, and consequently the Stroop Test could not have been diagnostic for the inhibition of automated activities for this subject. Four cases lacked data (the subjects did not accomplish the trial). The results of the comparisons of indicators of inhibitory function measured with the Stroop Test are presented in Table 1.

The t-test for dependent samples showed that subjects with ASPD revealed significantly more difficulties in the Stroop Test, which indicates stronger impairments of the inhibitory functions. Particularly, the ASPD group displayed longer times to perform the Color-Naming Test in comparison with the CG (t=3.72, p=0.000) and made significantly more mistakes in the Color-Naming Test (t=.72, p = 0.000). The groups revealed the largest differences in the case of time of performance in Color-Naming Test, as the Cohen's d estimator indicates (d=.53, medium size effect). The Cohen's d estimator for differences in number of mistakes in this trail (impulsive intrusions of automatic behavior) is also satisfying (d=0,47).

The observation that the ASPD subjects displayed a longer time of reading in the Reading part of the Stroop Test was not used in further analyses individually. A longer time of reading in the Reading part of the Stroop Test may suggest that the ASPD subjects were in general slower in cognitive tasks, and therefore the longer time of performance in the Color-Naming task in comparison with the CG may have been the result of this general impairment rather than only of impairment in the inhibitory function. In order to ascertain this, another indicator was calculated, that is, the Delay in Color Naming comparing to Reading. This indicator was calculated for each subject according to the following formula:

Stroop Delay in Color Naming Test = (Stroop Color-Naming Test –Time) – (Stroop Reading Test – Time)

Even then, the ASPD subjects showed a higher time of delay, suggesting actual higher impairments in inhibitory functions in comparison to the CG.

The results of the comparisons of ASPD individuals with their matched controls referring to planning abilities measures with Tower of London Test are shown in Table 2.

The t-test for dependent samples showed that subjects with ASPD revealed statistically more difficulties in the Tower of London Test in comparison with the CG,

Table 1. The level of inhibitory functions in the research groups

	ASPD group		control group		significance			
	M	SD	M	SD	t	df	p	d
Stroop Reading Test - Time	27.61	12.56	22.92	6.51	2.61	61	0.011*	0.33
Stroop Reading Test – Mistakes	0.45	1.04	0.27	0.63	1.06	61	0.291	0.14
Stroop Color-Naming Test – Time	64.69	23.23	52.16	11.70	4.16	61	0.000***	0.53
Stroop Color-Naming Test - Mistakes	4.40	3.91	2.23	2.07	3.72	61	0.000***	0.47
Stroop Delay in Color Naming Test	37.08	18.65	29.24	12.03	3.07	61	0.003**	0.39

*p<0.05; **p<0.01; ***p<0.001

Table 2. The level of planning indicators and rule-bound control in the compared groups

	ASPD group		control group		significance			
	M	SD	M	SD	t	df	p	d
ToL Total Correct Score	2.95	1.82	3.33	1.75	-1.20	63.00	0.233	-0.15
ToL Total Move Score	44.08	23.38	33.73	17.05	2.91	63.00	0.005**	0.36
ToL Total Initiation Time	31.39	20.75	33.61	26.70	-0.54	63.00	0.593	-0.07
ToL Total Execution Time	229.64	137.70	180.66	70.51	2.78	63.00	0.007**	0.35
ToL Total Problem-Solving Time	261.53	148.73	214.23	83.09	2.47	63.00	0.016*	0.31
ToL Total Time Violations	0.81	1.64	0.28	0.70	2.47	63.00	0.016*	0.31
ToL Total Rule Violations	1.05	1.33	0.61	0.90	2.14	63.00	0.036*	0.27

*p<0.05; **p<0.01; ***p<0.001

which indicates stronger impairments in planning functions in the ASPD group. In the case of all but two executive function indicators of the Tower of London Test, the ASPD group had significantly lower soces. They performed the test in a higher number of moves (t=2.91, p=0.005), needed more time to cope with the task (t=2.78, p=0.007; t = 2.47, p=0.016), more often exceeded the time limits, and more often acted impulsively, violating the given rules. However, the size effects for these differences were small, with d=0.36 for the Move Score indicator, d=0.35 for the Execution Time indicator, d=0.31 for both the Problem-Solving Time indicator and the Total Time Violations indicator, and d=0.27 for the Rule Violations indicator.

Since one of the major goals of our study was to determine whether the ASPD group is heterogeneous with regard to EF, cluster analysis was conducted. For the cluster analysis only the most diagnostic of EF indicators from both of the applied methods were taken into account. From the Stroop Test, this was delay in color-naming trail and the number of mistakes made in the color-naming trail. From the Tower of London test this was the total number of moves, the total problem-solving time, and the total number of rule violations. Conducting the cluster analysis, we assumed that there might be two different subgroups of ASPD criminals differentiated in the level of EF. Our attempt to extract two clusters and further application of the t-test in order to verify the differences between the clusters obtained led to the conclusion that the ASPD group can be divided into two significantly distinct subgroups only in regard to planning functions. Two subgroups of better and worse planners emerged from the whole ASPD group. However, the subgroup of worse planners was relatively small (n=7). The other variables did not divide ASPD participants into significantly different subgroups. The results of the cluster analysis are shown in Table 3.

Finally, we tried to investigate associations between planning and inhibitory functions and the level of aggression characterizing the crime committed. None

Table 3. Cluster analysis results

	Claster 1 n=52		Claster 2 n=7		Significance		
	M	SD	M	SD	t	df	p
ASPD Stroop Delay in Color Naming Test	34.61	15.48	54.00	31.57	-1.60	6.37	0.158
ASPD Stroop Color-Naming Test – Mistakes	4.16	3.96	5.43	3.46	-0.81	61.00	0.422
ASPD ToLTotal Move	40.23	20.59	67.00	24.43	-3.18	61.00	0.002**
ASPD ToL Total Problem-Solving Time	214.45	73.61	623.29	86.04	-13.61	61.00	0.000***
ASPD ToL Total Rule Violations	56.00	0.91	7.00	1.86	-1.83	61.00	0.072

*p<0.05; **p<0.01; ***p<0.001

Table 4. Spearman correlations between level of physical violence in the criminal acts and executive function indicators

				Correlations	
Measures				ASPD Level of Physical Violence	
	N	M	SD	Rho Spearman	Sig. (2-tailed)
ASPD Level of Physical Violence	59	4.22	2.15	1	
ASPD Stroop Delay in Color Naming Test	59	36.69	18.48	-0.06	0.65
ASPD Stroop Color-Naming Test - Mistakes	59	4.33	3.88	-0.10	0.45
ASPD ToL Total Move	59	44.08	23.38	-0.08	0.56
ASPD ToL Total Time	59	261.53	148.73	-0.05	0.70
ASPD ToLTotal Rule Violations	59	1.05	1.33	0.08	0.54

*p<0.05; **p<0.01; ***p<0.001

of the obtained correlations achieved statistical significance. Table 4 presents the results of the correlation method for the basic indicators of the selected EFs.

DISCUSSION

Most of the studies in the research literature indicate that there are statistically significant differences between ASPD and comparison groups in the level of performance in executive functions. Individuals with ASPD are considered to show higher impairments in such EFs as planning or inhibitory abilities. The results obtained in our research support this assumption. The ASPD offenders included in our study achieved significantly lower scores in measures both of the functions, planning and inhibiting. The size effect was larger in the case of the function of inhibition measured with the Stroop Test (d=0.33 to d=0.53) than in case of planning function (d=0.27 to d=0.36), measured with the Tower of London test. These results are in accordance with the findings obtained in the meta-analysis

conducted by Ogilvie et al. (2011), where the effect sizes for the Stroop Test were also higher than for the Tower of London across different analyzed studies. These results may, to some extent, explain the background of aggressive acts displayed by ASPD individuals. Impulsivity and difficulty in planning can contribute to poorer social relationships, impair the ability to create harmonious social relations, the ability to control emotions and impulses, the ability to satisfy one's needs and achieve one's aims in a socially accepted way. Therefore, the probability of antisocial and/or violent behavior rises.

Our analysis of the literature on the subject led to the expectation of heterogeneity within the ASPD group with regard to EF. In order to show this, cluster analysis was conducted in the examined sample, including the planning and inhibitory functions. Consequently, two subgroups of ASPD subjects were isolated. However, the only statistically significant difference between the two clusters were those related to the level of planning, that is, the cluster of ASPD with higher planning impairments and the cluster of ASPD with lower planning impairments. Nevertheless, the cluster of ASPD with lower planning impairments consisted of only 7 subjects. Therefore, the achieved results might as well be interpreted as indicators of very low variance of the examined group with regard to the measured EF. This result is not in accordance with expectations based on the diversity of size effects revealed in the both meta-analyses described earlier in the article.

One possible explanation of the low level of variance within the ASPD group in regard to the measured EFs may be related to the fact that it consisted only of a sample of offenders with ASPD. Although this inclusion criterion was intended to add to the rigor of the study, it may also have resulted in lower diversity of different variables, including EF, within the sample. Several different types of offenders were included, but the range of ASPD types still may have been too little. It is worth pointing out that a very recent study of white-collar criminals with psychopathic traits delivered the observatios that the subjects in this group reflected even enhanced cognitive and attentive functioning (Raine et al., 2012). The authors of the study point out that good abilities in the field of making, attention, and social perspective taking support the strong adaptation of this specific type of criminals to effective functioning in organizations.

On the basis of the results of studies conducted earlier (see: Morgan & Lilienfeld, 2000; Ogilvie et al., 2011) it may be concluded that individuals with a specific level of different types of EF impairments may also differ in terms of variables such as the forms and characteristics of ASB. With regard to this, the correlations between the level of aggressiveness characterizing the crime and the level of performance in measured executive functions, that is planning and inhibitory functions, were interesting but not conclusive.

The obtained results do not support the hypothesis of association between the level of aggressiveness of the criminal act and the level of planning and inhibition functions. Therefore, these results are not consistent with many previous findings, especially those related to inhibitory functions. Most of the research on the basis of their findings suggest that individuals with inhibitory impairments are at risk for

showing increased levels of violence (e.g. Burgess & Wood, 1990, see also: Blair & Frith, 2000). Moreover, there have been studies which have showed that even those individuals who are not diagnosed with an antisocial personality disorder, but display high levels of violence, show poor performance on executive function measures (Kandel & Freed, 1989). While analysing the described results of the study, one should take into consideration that this correlation concerned the level of the aggressiveness of the criminal act, not the aggressiveness of the individual in general. Accordingly, it is possible that many of the examined subjects displayed criminal behaviors of a high level of aggressiveness, but this aggression was instrumental rather than impulsive/reactive. The presence of this type of subject with preserved ability both to plan actions and to inhibit impulses within the sample may have contributed to the lack of statistically significant correlation between the level of aggressiveness of the criminal act and the level of executive dysfunction.

A range of methodological limitations has been identified in research devoted to EF disturbances in ASPD groups. Ogilvie et al. (2011), among others, pointed to poorly specified operationalizations of ASB and EF, small samples, failure to control adequately for confounding factors and poor comparison group selection. In order to reduce the impact of at least some of these limitations, we designed an experiment with carefully defined inclusion criteria. Similarly, two types of EF were clearly specified and measured with well-acknowledged and widely-used neuropsychological instruments. A comparison group of non-criminals was selected, without the diagnosis of ASPD, based on matching for age and education. At the same time, our study has some significant limitations, such as failure to control adequately for confounding factors of substance abuse/dependence and ADHD comorbidity, which has been proved to be significantly associated with both ASB and EF impairments. Secondly, since the main focus was on the group of offenders, they may not be representative of community samples with ASPD. It would seem advisable for future research on the topic to take into consideration both the moderating role of abuse/dependence and ADHD comorbidity, and to include a wider diversity of ASPD individuals: more types of criminals, and also non-criminals.

CONCLUSIONS

Despite the limitations of our study, a statistically significant difference in performance on EF measures between the ASPD and comparison groups was observed. An essential outcome of the study is that Stroop Test displasy better discriminative power; therefore, in forensic practice it might be a better tool to distinguish criminals from those falsely accused.

At the same time, our findings suggest that, although in general offenders with ASPD show impairments in both planning ability and inhibitory function compared to the control group, this deficit is not associated with the level of physical aggression of their criminal acts. This may be a result of the fact that in case of some offenders who are highly aggressive in their criminal acts, this aggression might not be the result of their limited ability of planning or inhibition, but may as well be of an instru-

mental nature. Our research in general failed to reveal the heterogeneity of ASPD offenders with regard to the specific nature of the measured EF impairments.

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