

## Introduction:

The characteristic „personality picture“ of the psychopath, also called sociopath or antisocial personality, is of specific relevance in the forensic setting. This serious disorder is primarily attributed to severe disturbances in early relations, such as the internalization of experienced parental violence and cruelty or negative parental models with regard to moral standards and values. But even an environment extremely lacking in support and consistency may hamper the development of basic skills. Since similar behavioural problems are observed over generations, the importance of the hereditary factor for the development of an antisocial personality disorder is also frequently discussed [4].

Several investigations have identified specific personality characteristics which are associated with high recidivism in delinquent behavior. The psychopathic personality is a constellation of personality traits including such features as lack of remorse or sincerity, dishonesty, egocentricity and impoverished affective reactions. Psychopaths are a specific subgroup of antisocial personalities and are characterized by high risk of violence and criminal recidivism [1]. Psychopaths show reduced electrodermal reactions to aversive stimuli as compared to non-psychopaths. Several investigators have demonstrated further psychophysiological discrepancies in these subjects, and meanwhile significant neuroanatomical correlates are reported as well. In a study by Adrian Raine published in Archives of General Psychiatry in February 2000 [5] a sample of subjects with antisocial personality disorder showed a reduced volume of prefrontal grey matter as well as reduced autonomic activity. In stress situations they showed significantly smaller heart rates and electrodermal responses as well as startle reflexes as compared both to normal controls and patients suffering from psychosis or addiction.

The prefrontal cortex is part of a neural circuit that is central to fear conditioning and response to stress. Poor conditioning is theoretically associated with poor development of conscience. When subjected to social criticism and other aversive stimuli, a person with low arousal could be less susceptible to socialization. Psychological and social factors interact with the multiple brain systems to produce behavior. Deficits in autonomic and central nervous system arousal may make a person seek stimulation and engage in antisocial behavior to compensate for the underarousal.

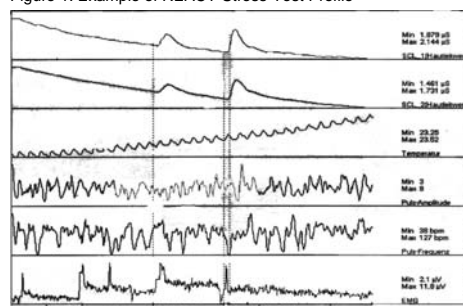
Low resting heart rate is thought to be the best-replicated biological correlate of antisocial and aggressive behavior in child and adolescent populations and may reflect reduced noradrenergic functioning and a fearless, stimulation-seeking temperament. Stimulation-seeking theory argues that low arousal represents an unpleasant physiological state; antisocial individuals seek stimulation in order to increase their arousal levels to an optimal or normal level. Physiological explanations of the heart rate - antisocial relationship involve arousal theory, vagal tone, norepinephrine, and also right hemisphere dysfunction. Poor right hemisphere functioning (particularly the anterior regions) has been associated with deficits in the withdrawal system, a system that promotes retreat from aversive and dangerous situations.

## Material:

In forensic practice there is an urgent need for criteria which separate personalities with a high risk for violent behaviour from those less likely to cause complications upon discharge or relaxed enforcement. Based upon a sample of over 138 expert opinions on conditional discharge from imprisonment, especially violent offenders and the diagnostic groups of personality disorders and substance abuse were investigated. Dangerousness and risk assessment was based on the criteria of the Psychopathy-Check-List (PCL-SV). The majority of violent offences occurred under the influence of substances. A strong craving for alcohol and drugs, antisocial personality traits and aggressive outbursts were characteristic of a distinct typology. Impulsivity and suicidality as well as a traumatized childhood hampered further prognosis. Psychopathy had a high coincidence with addiction, hyperkinetic disorders and antisocial behaviour. The findings in our follow-up-study (after four years time at risk) show that upon discharge especially those offenders who had committed their last crime under the influence of substances became recidivists most fastly [3].

In a subsample of 64 male offenders a standardized psychophysiological stress test was administered. Physiological indices consisted of skin conductance, heart rate, skin temperature and muscle tension (frontalis). The REACT-Stress-Test (Figure 1) from **Insight Instruments** consists of four test stages, during which physiological activation levels are measured (baseline, warning stage, stress stage, recovery stage). During baseline the habitual resting level is measured. The second warning stage demonstrates if the subject responds physiologically already in expectation of the stress stimulus. The stress stage itself consists of a short visuo-acoustic startle stimulus. In the recovery phase reduced arousal levels are expected [2].

Figure 1: Example of REACT-Stress-Test Profile

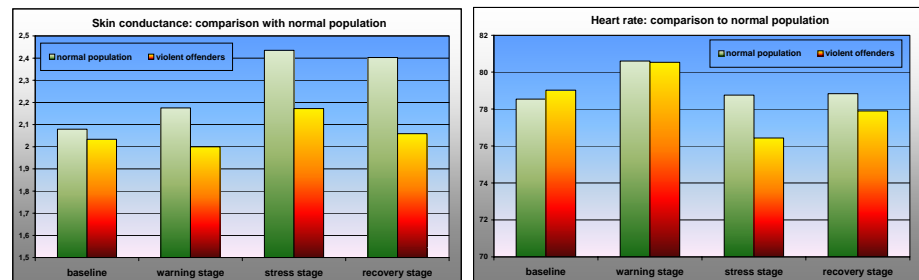


The standardized psychodiagnostic assessment contained further tests on intelligence (WIP), attention & concentration (vigilance), personality inventories (FPI-R), proneness to aggressive behaviour (FAF), paranoid-depression-scale (PDS). Diagnoses are based on DSM-IV criteria for personality disorders (SKID-II), dangerousness and risk assessment was based on the criteria of the Psychopathy-Check-List (PCL-SV).

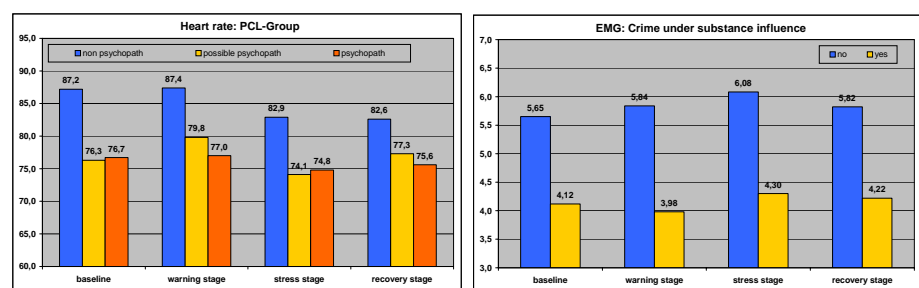
The subsample of 64 male subjects was between 22 and 65 years old, with a mean age of 39 years. In appointment by the local court they were subjected to an extensive psychological and neurological-psychiatric assessment at the Salzburg Department of Forensic Neuropsychiatry with regard to conditional discharge from imprisonment. Main diagnoses were personality disorders and substance abuse. In 80 % of this cases a violent crime was the prime cause for being in custody.

## Results:

Initially the total sample was compared to a normal control group. The subsample „violent offenders“ (n=52) shows a markedly reduced skin conductance compared to normals, especially during the warning, stress and recovery stages. The heart rate response is similar during baseline and signal stages, but in the stress situation itself significantly lower (reflex bradycardia). Moreover, the values for these subjects show less differences throughout the test interval as compared to controls. Thus, the hypothesis was confirmed that violent criminals show underarousal defined as reduced activation levels and/or stress reactivity in comparison to a normal population. This effect was most markedly demonstrated by the parameters skin conductance and heart rate.



Furthermore, a comparison within the criminal sample showed that those offenders diagnosed as psychopaths (PCL-SV) had a significantly lower heart rate response than the non-psychopathic criminals.



However, the factor *substance-abuse* itself yielded no significant differences. In general it could be said, that substance abuse shifted measured responses in the direction of normal values. Since the recidivists exclusively belonged to the group of offenders, who committed their last crime under substances, this factor was investigated separately. In fact, these offenders showed a significantly reduced muscle tension as compared to the second group of offenders committing their last crime without substances.

## Correlations:

- ⇒ Higher life satisfaction values (FPI 1) correlate with higher heart rate responses during the warning and stress stages ( $r=.25$  and  $r=.30$ , respectively). Social orientation (FPI 12) corresponds with the amount of change in skin conductance (mental stress resistance) between baseline and stress stage ( $r=.25$ ).
- ⇒ More inhibited subjects (FPI 4) also show higher muscle tension (EMG) during baseline ( $r=.24$ ). A higher subjective excitability (FPI 5, FAF 3) correlates with lower heart rate values during baseline and stress stages ( $r=-.25$  and  $r=-.35$ , respectively), but higher muscle tension values (EMG) at baseline and warning stages ( $r=.23$  and  $r=.24$ , respectively).
- ⇒ More emotional subjects (FPI 12) show lower heart rates during warning and stress stages ( $r=-.25$  and  $r=-.40$ , respectively), but higher temperature scores in all 4 stages ( $r=.23$  to  $r=.25$ ).
- ⇒ High scores on self-aggressiveness (FAF 4 – „depression“) correlate with low heart rate responses during the warning stage ( $r=-.26$ ), also with less EMG changes between baseline and warning stages ( $r=-.23$ ), but with higher temperature values in all 4 stages ( $r=.33$  to  $r=.34$ ).
- ⇒ A stronger aggression inhibition (FAF 5) correlates with higher skin conductance values at all 4 stages ( $r=.22$  to  $r=.23$ ).
- ⇒ A stronger aggression potential (FAF 6) is associated with a lower heart rate during stress ( $r=-.28$ ) but with more marked changes in muscle tension (EMG) between baseline and stress stages ( $r=.22$ ).

With regard to the cognitive variables the strongest correlations were obtained between achievement on the visuo-spatial task „Mosaiktest“ (MT) and EMG values (n=45) in all 4 test stages:

- EMG 1 (baseline):  $r = -.35$
- EMG2 (warning stage):  $r = -.31$
- EMG3 (stress stage):  $r = -.36$
- EMG4 (recovery stage):  $r = -.34$

MT results correlate negatively with muscle tension (EMG). Thus, better achievement on this visuo-spatial task is associated with lower muscle tension during all stages measured.

## Hypothesis:

In our sample investigated the following differences in dangerousness (PCL-SV) with respect to muscle tension and visuo-spatial task achievement (MT) are postulated: Subjects with high muscle tension (EMG) and lower achievement on the visuo-spatial task (MT) are more dangerous as defined by PCL scores compared to subjects with less tension and better visuo-spatial achievement.

## Method:

This hypothesis was tested according to a two-factorial analysis of variance with the dependent variable dangerousness (PCL-SV) and the independent variables muscle tension (EMG) and visuo-spatial task achievement (MT). Both main effects due to tension and visuo-spatial task achievement and the corresponding interaction effects were analyzed. Dangerousness was scored according to the total PCL-SV score. Additionally, both PCL subscales (factor 1, 2) as well as single items were included in the analysis. Muscle tension was measured by EMG (frontalis) during all 4 test stages as well as respective changes between each stage. All obtained measures were averaged (median) and accordingly two groups with low vs. high muscle tension (EMG low / EMG high) were formed. Visuo-spatial task achievement data (MT) was similarly divided into two groups (MT low / MT high).

Table 1: Analysis of variance results for PCL total score

Source	df	MS	F-value	sign.
Mosaic Test (MT)	1	9,50	0,44	.508
EMG (recovery stage)	1	17,39	0,81	.371
MT * EMG	1	70,43	3,29	.074

⇒ (weak) significant interaction effect:  
*subjects with low spatial intelligence and less tension (measured during recovery) are less dangerous than subjects with low spatial intelligence and high tension, whereas subjects with high spatial intelligence and high tension tend to be less dangerous*

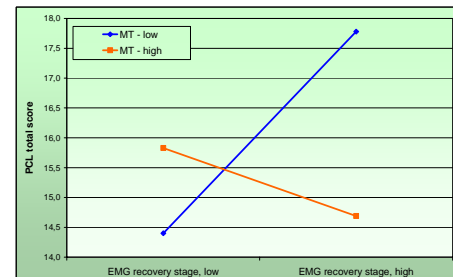


Table 2: Analysis of variance results for PCL- SV1 „superficial“

Source	df	MS	F-value	sign.
Mosaic Test (MT)	1	1,04	4,59	.036
EMG (recovery)	1	0,72	3,18	.080
MT * EMG	1	0,36	1,59	.212

⇒ significant main effect for spatial intelligence:  
*subjects with high spatial intelligence are more superficial than subject with lower spatial intelligence*  
⇒ (weak) significant main effect for tension:  
*subjects with high tension are more superficial than subjects with low tension*

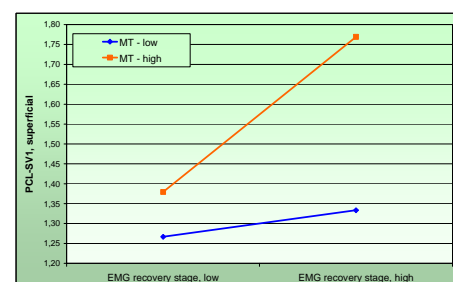


Table 3: Analysis of variance results for PCL-SV7 „impulsivity“

Source	df	MS	F-value	sign.
Mosaic Test (MT)	1	0,21	0,71	.402
EMG (baseline)	1	1,51	5,18	.026
MT * EMG	1	1,11	1,11	.056

⇒ significant main effect for tension:  
*subjects with low tension are less impulsive than subjects with high tension*  
⇒ (weak) significant interaction effect:  
*subjects with low spatial intelligence and low tension (baseline values) tend to be less impulsive than subjects with low spatial intelligence but high tension, whereas subjects with high spatial intelligence and low muscle tension tend to be more impulsive.*

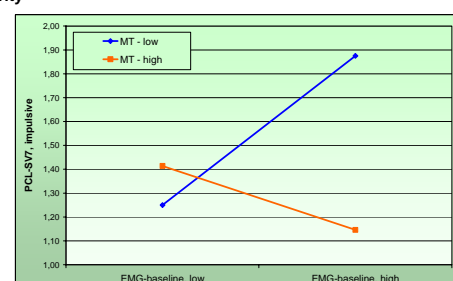


Table 4: Analysis of variance results for PCL-SV12 „antisocial adult behavior“

Source	df	MS	F-value	sign.
Mosaic Test (MT)	1	0,13	0,29	.590
EMG (Baseline)	1	2,04	4,75	.033
MT * EMG	1	1,18	2,76	.102

⇒ significant main effect for tension:  
*subjects with high tension show more antisocial behavior as adults than subject with less tension*

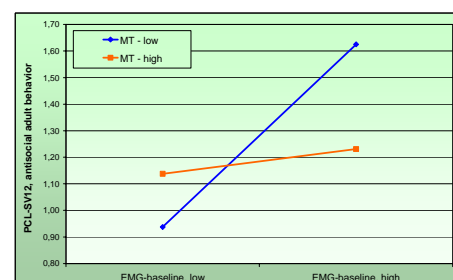
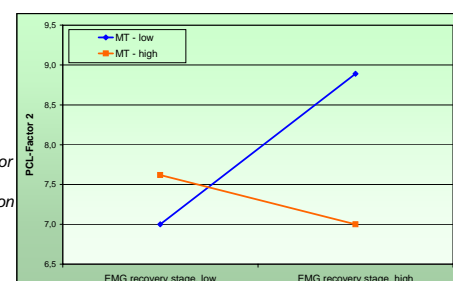


Table 5: Analysis of variance results for PCL Factor 2

Source	df	MS	F-value	sign.
Mosaic Test (MT)	1	5,56	1,03	.315
EMG (recovery)	1	5,56	1,03	.315
MT * EMG	1	21,78	4,02	.049

⇒ (weak) significant interaction effect:  
*subjects with low spatial intelligence and low tension (measured during recovery) show lower scores on PCL Factor 2 than subjects with low spatial intelligence but high tension, whereas subjects with high spatial intelligence and low tension generally score higher on this factor.*



## Discussion:

As expected, offenders showed overall reduced autonomic responding in comparison to a normal population. Within-group correlations between physiological indices and psychological test data also yielded expected results. For instance, dissatisfaction and low social orientation corresponded to reduced skin conductance and heart rate responding. Moreover, subjective excitability, aggressiveness and emotionality correlated with underarousal in these physiological indices.

The results obtained from our sample confirm the postulated hypothesis. Accordingly, the muscle tension effects varied in relation to the factor „constructive intelligence“ (as measured by the visuospatial task MT). The combination of low constructive intelligence with high muscle tension definitely yielded the highest mean PCL values, whereas higher intelligence and tension scores rather corresponded to lower PCL values as compared to subjects with high MT-intelligence and low muscle tension. Generally, most marked differences were obtained for the PCL Factor 2 (items 7 to 12). Eventually there are implications for a neuropsychological training and therapy for these subjects.

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