

# Dysfunctional Love in Psychopathic Criminals: The Neural Basis

Barbara Gawda

## ABSTRACT

This study focused on the description of love by individuals diagnosed with psychopathy and antisocial personality disorder (ASPD). The aim of the study was to test the hypothesis that psychopathic individuals have ambiguous, ambivalent, and dysfunctional representation of love, which is expressed in their emotional language. The study participants consisted of 60 prison inmates with ASPD, 40 prison inmates without ASPD, and 60 men without antisocial tendencies who described situations involving love. The descriptions of love expressed in the narratives were analyzed, and a comparison of the three groups revealed differences between inmates with psychopathy and ASPD, inmates without psychopathy and ASPD, and the control group. The psychopathic individuals described love as an unclear complex emotion, strong, and with and inappropriate valence and high self-concentration. The description of love showed the lack of clear understanding of the situation of love, people involved in this situation, and the results. This dysfunctional form of love presented by individuals with psychopathy has been discussed in terms of their neurobiological deficits related to the prefrontal cortex, temporal lobes, amygdala, grey matter structure, and limbic abnormalities.

**Key Words:** love, psychopathy, neurobiological abnormalities

NeuroQuantology 2012; 4: 725-732

## 1. Introduction

Love is one of the most powerful human feelings. Love is a complex emotion which contains positive elements, such as joy, satisfaction, happiness, and contentment. Love also contains some negative emotions and sensations, such as fear, sadness, jealousy, and anger. The general overview of love is positive. Love has a lot of positive functions in human life. Love is an important factor in human relationships, development, self-confidence, health, and the sense of existence. People who are able create mutual relationships with another person are happier, more mature, more empathic, and emotionally more competent. Love is experienced by humans in varied styles and ways. The form of love is determined by mental representations of love

and other cultural, as well as individual factors (Sternberg, 2006). There are different problems related to the experience of love. Some dysfunctional forms of love are caused by personality disorders or other mental disorders. One of the serious cases is love in psychopathic individuals. The literature presents little information about the experience of love in psychopathic individuals. Researchers have described the incapacity for love and egocentricity amongst psychopaths (Hare, 1998, 2003; Brinkley, Schmitt and Newman, 2005). Psychopaths are unable to create relationships based on love (Lorenz and Newman, 2002). Affective functioning of psychopaths and individuals with antisocial personality is characterized by ruthlessness, narcissism, hostility, manipulation, and sensation-seeking (Pauthus and Williams, 2002; Hiatt and Newman, 2007; Lykken, 2007). Such individuals have more extensively developed representations of hostility, anger, hate, contempt, or violence than love or happiness (Blair *et al.*, 1997; Grann 1998), but

Corresponding author: Barbara Gawda, Ph.D.

Address: Department of Psychology, Maria Curie-Skłodowska University, Plac Litewski 5, 20-080 Lublin, Poland  
✉ bgawda@wp.pl

Received Sept 10, 2012. Revised Sept 29, 2012. Accepted Nov 2, 2012.  
eISSN 1303-5150



undeveloped schemas of sensitivity, empathy, and mutuality (Beck, 2004). The love scripts in psychopaths and individuals with antisocial personality are undeveloped. Thus, their mental representation of love is marked by inappropriate elements (Gawda, 2008). Probably, psychopaths and individuals with antisocial personality are able to experience love, but this experience is dysfunctional. Similarly, for instance, the data concerning lack of anxiety among psychopaths is inconsistent, and the most recent findings have indicated that individuals with psychopathy do not exhibit a lack of anxiety (Lynam and Derefinko, 2007). The data about emotional language of psychopaths show that they are able to describe love situations, their linguistic forms are rich, but their language is replete with negations, pauses, and other specific syntactic elements (Gawda, 2010).

Thus, the aim of the current study was to present the descriptions of love made by psychopathic individuals, and show how their perception of love and love schemas are dysfunctional. The dysfunctions in love will be analyzed in terms of the neurobiological abnormalities.

## 1. Materials and Methods

Three groups of participants were examined. The first group (I) consisted of 60 psychopathic prisoners (also with a diagnosis of antisocial personality disorder [ASPD]). The second group (II) consisted of 40 prisoners with low scores on the psychopathy scale (MMPI) and without ASPD. The third group (III) was recruited from 60 non-prisoners without psychopathic and antisocial traits. The three groups of subjects were similar in terms of the lack of other psychological and psychiatric impairments; the diagnosis was based on the records of the individuals using the DSM-IV-TR criteria. The ages were not significantly different between the 3 groups, as follows:  $M_I = 35.5$ ,  $SD_I = 11$ ;  $M_{II} = 34.2$ ,  $SD_{II} = 10$ ; and  $M_{III} = 33.5$ ,  $SD_{III} = 1.45$ . There were no statistically significant differences between the 3 groups in education ( $M_I = 10.27$ ,  $SD_I = 1.80$ ;  $M_{II} = 10.40$ ,  $SD_{II} = 1.50$ ; and  $M_{III} = 10.44$ ,  $SD_{III} = 1.50$ ) or intelligence (full scale of WAIS-R [ $M_I = 102$ ,  $SD_I = 10$ ;  $M_{II} = 99$ ,  $SD_{II} = 9$ ; and  $M_{III} = 100$ ,  $SD_{III} = 9$ ]). The prisoners (I and II) had been convicted of multiple serious crimes against health, life, and public order. The examinations were executed in the state

prisons. All of the prisoners were recidivists. The control group (III) consisted of 60 adult male students with low scores on the psychopathy and hypomania scales of the MMPI who did not display ASPD.

## 2.2. Procedure

### Pilot study

The aim of the pilot study was to choose one photograph from eight photographs which best expressed love (each photograph presented a couple hugging each other). The participants in the pilot study rated the photographs. The photograph which exhibited the highest levels of inter-rater agreement was selected for the main study (Kendall's  $W = 0.93$ ).

### Main study

The first phase of the investigation was conducted in the prisons, and the second phase was conducted in the schools. After the prisoner records were analyzed, interviews were conducted and background data were collected. The following three measures were obtained: WAIS-R; psychopathy scale of the MMPI; and the narrative productions about love. Then, in the main study, every participant was asked to write a story about love. The photograph chosen during the pilot study was shown separately, and the participant was given the following instructions: "Look at this picture. Imagine that you are in the picture, how you would feel, and then write a story about the photograph." The participants produced 160 stories describing love. The time allowed for writing was not limited, but controlled. Three psychologists analyzed the narratives.

## 2.3. Measures

The psychopathy and hypomania scales from the MMPI were used in the study for the selection of the group.

The Wechsler Adult Intelligence Scale-Revised (WAIS-R; Wechsler, 1981) is a general test of intelligence with verbal and performance components. There are 11 subtests, and the verbal component consists of 6 verbal subtests. The verbal and performance scores were employed in the analysis, and the Working Memory Index and Verbal Comprehension Index were also taken into consideration. The WAIS-R was used for the selection of the group.



The narrative analysis was used as the main technique for description of love by psychopathic individuals. All indicators were counted and recorded in all stories about love. The following indicators of love were analyzed: the number of positive emotional words (e.g., *happy* and *joyful*); the number of negative emotional words (e.g., *disappointed* and *unhappy*); the number of intense expressions (e.g., *I am extremely happy*); the number of phrases related to the level of “self-concentration,” as measured by the number of verbs in the first person singular (e.g., *I feel* and *I want*) and pronouns and other parts of speech referring to the 1<sup>st</sup> person singular (e.g., *my* and *me*); the level of concentration on others, as measured by the number of phrases related to others (e.g., *she is pretty*); and the

level of simultaneous concentration on self and others, as measured by the number of phrases related to both self and others (e.g., *I want to be with her*).

## 2. Results and discussion

Intelligence, education, and age in the three groups were compared to exclude the potential impact on narrative productions. The level of verbal intelligence in the groups was similar, thus we suggest that the differences between groups in the descriptions of love were due to emotional and personality characteristics. To test this hypothesis, the Kruskal-Wallis analysis was used, and then the scores in the two scales of the MMPI (psychopathy and hypomania) were correlated with linguistic markers of love.

**Table 1.** Differences in the descriptions of love made by psychopathic prisoners (N = 60), non-psychopathic prisoners (N = 40), and controls (N = 60).

Lexical aspects: Love	I (PSY) M (SD)	II (Non-PSY) M (SD)	III(CONT) M (SD)	H <sub>(2)</sub>
Positive descriptions	5.86 (0.69)a	2.50 (1.40)b	4.93 (1.16)c	6,65 **
Negative descriptions	1.02 (1.03)a	.47 (.41)b	.37 (.21)b	16,86***
Intense expressions	3.26 (.79)a	1.26 (.89)b	1.40 (.71)b	13.50***
Self	3.80 (3.40)a	1.58(1.81)b	2.25(2.31)b	13.03***
Others	2.56 (1.04)a	2.67(1.98)a	2.92(1.01)a	1.29
Self and others	.46 (.23)a	1.02 (.68)b	3.06 (1.78)c	9.60**

\*\*p<.01, \*\*\* p<.001

The psychopathic prisoners used more positive emotional words in their stories about love, as well as more negative words than prisoners without psychopathic traits and controls. The psychopathic prisoners repeated that they are good, honest, and compromise (“*I am good...*”). The descriptions of love made by psychopathic criminals were more expressive and intense (e.g., “*I am so happy...*” and “*It is very fantastic...*”) than the descriptions made by participants from two other groups. The stories about love written by psychopaths were dynamic and persuasive. The psychopathic prisoners presented love with high emotional involvement, and at the same time with uncertainty. The psychopathic prisoners were involved in this situation more strongly than were the criminals without psychopathic personalities and the controls. This involvement was not related to the isolation because the non-psychopathic inmates did not present such tendencies in their descriptions of love. The prisoners with psychopathy used self-references and pronouns (e.g., “*me, my,*

and *mine*”) or verbs in the 1<sup>st</sup> person singular (e.g., *I am. I want, I wish, I have never been...*) in their narratives about love more frequently. In their stories about love, the number of phrases related to others was similar to the stories written by criminals without psychopathic traits and controls. An interesting finding concerned the number of phrases related simultaneously to self and others. The psychopathic subjects used these types of descriptions less frequently. The psychopathic subjects were unable to concentrate on themselves and on the others in the same time. The high self-concentration of psychopathic subjects was significantly different than the high concentration on self and others in controls, which is very symptomatic for psychopathic personality.

After having compared the descriptions of love made by psychopathic participants, non-psychopathic participants, and controls, the correlations between the psychopathy scale and hypomania and the love linguistic markers were estimated. The psychopathic prisoners



diagnosed with ASPD have been characterized by high scores on two scales (psychopathy and hypomania of the MMPI). The correlations

between the other scales of the MMPI were not counted because the psychopathic individuals did not show higher scores on the other scales.

**Table 2.** Correlations between MMPI results (psychopathy, hypomania), and linguistic markers of love ( $\tau$  – Kendal correlation).

Scales MMPI	Love Positive	Negative	Intense	Self	Others	Self and Others
Psychopathy (Pd)	.36**	.20*	.43**	.35**	.12	-.43**
Hypomania (Ma)	.19*	.04	.18*	.12	.13	.13

\* $p < .05$ , \*\*  $p < .01$ .

There were many correlations between psychopathy and use of specific descriptions in love stories. Psychopathy correlated significantly with the use of positive descriptions in love stories and negative descriptions. Then, the higher psychopathy was linked to more intense expressions in love stories. The same tendency was observed between psychopathy and self-concentration. No correlations were found between psychopathy and the number of phrases related to the others, but negative correlation was found between psychopathy and simultaneous concentration on self and others. In sum, love is perceived by psychopathic individuals as strong and ambivalent feeling (both positive and negative). Psychopathic individuals are unable to recognize the appropriate valence of this complex emotion. This ambivalence may be due to the unsuccessful inhibition of two systems (behavioral activation system [BAS] and behavioral inhibition system [BIS]; Levenson *et al.*, 1995, Levenson *et al.*, 2000; Newman *et al.*, 2005). Thus, psychopaths display high positive activation, and at the same time the reduced inhibition of negative activation (Sutker and Allain, 2001). This unclear recognition of activation was observed in several studies in psychopaths (Bradley *et al.*, 1996; Levenson *et al.*, 2000; Müller *et al.*, 2003).

The psychopaths presented high concentration on themselves and low simultaneous concentration on self and others, which is a key concentration for mutual relationships. The capacity for simultaneous concentration on self and others is a basis for close relationships, facilitating access for the experience of others, their perception, and their ways of understanding. This component is an integral part of empathy. The

participants with psychopathy have the possibility to observe and understand another person, but their overdeveloped self-concentration makes their emotional experience unclear. High egocentricity reported by many researchers is the mechanism which blocks them from the creation of mutual relationships and blocks the opportunity for the emotional resonance required for deep empathy (Brinkley *et al.*, 2005; Hare, 1998, 2003).

The analysis of emotional language of psychopaths helped us better understand the affect of persons diagnosed with psychopathy. Love for psychopaths is a very important strong emotion, but at the same time ambivalent with an abundance of contradictions. Psychopaths perceive themselves as extremely important in this emotional situation. Psychopaths consider that this moment is the most important in their life, and their partner is also extremely important. At the same time, psychopaths are expressing all these needs; they are staying at the position to be highly concentrated on themselves.

This dysfunctional perception of love is consistent with previous neurobiological data which demonstrates the abnormal neural processing in psychopathic individuals. The ventromedial prefrontal cortex (vmPFC) may underlie aspects of self-processing, such as self-reflection and rumination, which has an impact on guilt and embarrassment (Mitchell *et al.*, 2005; Beer *et al.*, 2006; Qin and Northoff, 2011), and has an important role in the regulation of emotions. A second area of the PFC which may be important for psychopathy is the anterior cingulate cortex (ACC). The ACC is regarded as the main area related to cognitive and affective mechanisms of motivation, such as punishment, reward,



pain, negative emotions, empathy, and cognitive control (Etkin *et al.*, 2011; Shackman *et al.*, 2011) There is a functional link between the ACC and vmPFC, with dense reciprocal connections between the two areas, which underlie their importance for social and emotional behaviors (Ongur and Price, 2000). These subregions of the PFC interact and interconnect with dorsal and lateral sectors of the PFC, which is also related to important functions.

Research on the grey matter (GM) structure of the PFC in psychopaths has yielded interesting findings. The volume of the GM across the entire PFC in psychopathic offenders (“unsuccessful”) is lower than non-psychopaths. The (“successful”) psychopaths and non-psychopaths did not differ in the volume of the GM. The reduced volume of the lateral and ventral PFC was found in “unsuccessful” psychopaths (Yang *et al.*, 2005). In a separate study, reduced cortical thickness in psychopathic adult males was found (Yang *et al.*, 2009). De Oliveira-Souza *et al.* (2008) found the reduced GM volume in the frontopolar cortex with the area of the vmPFC and orbitofrontal cortex. The reduction in the GM in the right dorsal ACC and dorsolateral PFC bilaterally was confirmed by Muller *et al.* (2008). Many other studies have confirmed that psychopathy is associated with a reduction in the prefrontal GM, especially in the subregions of the vmPFC and ACC (Boccardi *et al.*, 2011; Ly *et al.*, 2012; Ermer *et al.*, 2012).

Two studies based on small samples showed the reduced integrity of the uncinate fasciculus (examination of white matter structure), which is a major tract connecting the PFC with a subcortical structure, such as the amygdala (Craig *et al.*, 2009; Motzkin *et al.*, 2011), confirming the dysfunction of the PFC in psychopaths. There are also studies which report the reduced functional connectivity between the vmPFC and amygdala in psychopaths (Motzkin *et al.*, 2011), as well as between the ACC and insula (Ly *et al.*, 2012). The associations between psychopathy and PFC abnormalities have been found in a large number of studies, such as affective theory of mind (Sommer *et al.*, 2010), viewing facial expression of emotions (Dolan and Fullam, 2009), or recognition of facial expression (Gordon *et al.*, 2004). All of the

studies report abnormalities of the PFC, especially in regions of the vmPFC and ACC.

Not only PFC abnormalities are associated with psychopathy. Some data present abnormalities in the anterior temporal cortex in psychopaths (Raine *et al.*, 2000). Recent data has shown that motor cortex excitability (MNS) is related to psychopathic personality traits, especially the coldheartedness scale (PPI, Lilienfeld and Andrews, 1996). Individuals with the highest level of coldheartedness displayed the greatest reduction in the amplitude of the MEP (Fecteau *et al.*, 2008). These results are particularly interesting because they support the thesis that psychopathic individuals possess an ability to understand the affective or sensory state of another individual. The problem is that “motor empathy” and emotional empathy are unaffected in psychopaths, according to the theory of empathy as described by Blair (2005).

There is a large number of studies that have reported that subcortical regions are linked to psychopathy. Specifically, the abnormal size, shape, and activity of the amygdala are associated with psychopathy (Blair, 2007; Dolan and Fullam 2009; Glenn *et al.*, 2009; Harenski *et al.*, 2009; Yang *et al.*, 2009, Ly *et al.*, 2012). Other frequently mentioned abnormal regions in psychopathic people are the hippocampus (Boccardi *et al.*, 2010), insula (de Oliveira-Souza *et al.*, 2008; Ly *et al.*, 2012), and striatum (Buckholtz *et al.*, 2010; Glen *et al.*, 2010).

The dysfunctions in neural processes in psychopaths are the basis of the dysfunctions in recognizing, differentiating, and analyzing affective information. The results of these impairments are the difficulties in insight in affective states. The dysfunctional insight has extremely serious and negative consequences, such as inability to take a victim perspective (Hiatt and Newmann, 2007).

### 3. Conclusion and Outlook

Functional magnetic resonance imaging (fMRI) focusing on the neural basis of love confirm that the same region of the brain which are dysfunctional in psychopath are considerable for love. Bartels and Zeki (2004) and Zeki (2007) reported that maternal love activated several regions in the brain, as follows: middle insula; rostro-dorsal ACC;



caudate nucleus (dorsal head); putamen/globus pallidus; thalamus; posterior hippocampus; lateral orbitofrontal cortex; right substantia nigra; and right periaqueductal gray. Romantic love was associated with activation of the middle PFC, parieto-occipital junction/superior temporal sulcus, medial prefrontal/paracingulate cortex, temporal poles, posterior singulate gyrus, medial cuneus, and amygdaloid region (Bartels and Zeki, 2000). Similar regions of the brain were associated with unconditional love (Beauregard *et al.*, 2009). These forms of love share common neural mechanisms. Of note, the caudate nucleus and putamen represent major components of the reward system in the brain. A rostral ACC is involved in empathy for pain (Singer *et al.*, 2006), and interoceptive as well as exteroceptive detection of emotional signals (Lane *et al.*, 1998). The role of rostral ACC in emotional awareness was confirmed. The insula is implicated in the representation of bodily states; this area has been found activated in many emotional states. The insula plays an important role in the process of insight in emotions (Critchley *et al.*, 2004).

In conclusion, the regions of the brain associated with love are dysfunctional in psychopathic individuals. Future studies should focus on describing neural representation of love in psychopaths. This interesting examination may take into consideration the comparisons between neural mechanism of love in subjects with psychopathy and without this disorder. A

better understanding of the psychobiological basis of the affective dysfunctions in psychopaths is valuable for future diagnosis and more effective treatment. Doing so is important because the population of psychopaths causes significant societal costs, which are the result of typical characteristics, such as remorselessness, antisocial behavior, and criminal recidivism.

#### About the Author

Barbara Gawda received her PhD in Psychology in 1998 at the University of Maria Curie-Skłodowska, Faculty of Pedagogy and Psychology in Lublin, Poland. She works as associative professor at Institute of Psychology at the same University. She is interested in personality disorders, emotions and motivation, narrative analysis, cognitive psychology, and cognitive neuropsychology. She has published many scientific articles and 6 books. The examples of her articles: Gawda B. (2007). Neuroticism, extraversion and paralinguistic expression. *Psychological Reports*. 100, 3, 721-726. Gawda B. (2008). Gender differences in verbal expression of love schema. *Sex Roles: Journal of Research*. 58, 814-821. Gawda B. (2008). Love scripts of persons with antisocial personality. *Psychological Reports*, 103, 371-380. Gawda, B. is a member of International Society for the Study of Individual Differences.



## References

- Bartels A, Zeki S. The neural basis of romantic love. *Neuroreport* 2000; 11(17): 3829-3834.
- Bartels A, Zeki S. The neural correlates of maternal and romantic love. *Neuroimaging* 2004; 21(3): 1155-1166.
- Beauregard M, Courtemanche J, Paquette V, Landry St-Pierre E. The neural basis of unconditional love. *Psychiatry Res Neuroimaging* 2009;172: 93-98.
- Beck AT, Freeman A, Davis DD. *The cognitive therapy of personality disorders*. New York: Guilford, 2004.
- Beer JS, John OP, Scabini D, Knight RT. Orbitofrontal cortex and social behavior: integrating self-monitoring and emotion-cognition interactions. *J Cogn Neurosci* 2006; 18: 871-879.
- Blair RJ, Jones L, Clark F, Smith M. The psychopathic individual: a lack of responsiveness to distress cues?, *Psychoph* 1997; 34, 192-198.
- Blair RJ. Responding to the emotions of others: dissociating forms of empathy through the study of typical and psychiatric populations. *Conscious and Cognition* 2005; 14: 698-718.
- Blair RJ. The amygdala and ventromedial prefrontal cortex in morality and psychopathy. *Trends Cogn Sci* 2007; 11: 387-392.
- Boccardi M, Frisoni GB, Hare RD, Cavedo E. et al. Cortex and amygdala morphology in psychopathy. *Psychiatry Res* 2011; 193: 85-92.
- Boccardi M, Ganzola R, Rossi R, Sabattoli F. et al. Abnormal hippocampal shape in offenders with psychopathy. *Hum Brain Mapp* 2010; 31:438-447.
- Bradley MM, Cuthbert BN, Lang PJ. Picture media and emotion: Effects of a sustained affective context. *Psychoph* 1996; 33: 662-670.
- Brinkley CA, Schmitt WA, Newman JP. Semantic processing in psychopathic offenders. *Pers and Individual Differences* 2005; 38, 5, 1047-1057.
- Buckholtz JW, Treadway MT, Cowan RL, Woodward ND. et al. Mesolimbic dopamine reward system hypersensitivity in individuals with psychopathic traits. *Nat Neurosci* 2010; 13: 419-421.
- Craig MC, Catani M, Deeley Q, Latham R, et al. Altered connections on the road to psychopathy. *Mol Psychiatry* 2009; 14: 946-953.
- Critchley HD, Wiens S, Rotshtein P, Ohman A, Dolan RJ. Neural system supporting interoceptive awareness. *Nat Neurosci* 2004; 7: 189-195.
- De Oliveira-Souza R, Hare RD, Bramati IE, Garrido GJ, et al. Psychopathy as a disorder of the moral brain: fronto-temporo-limbic grey matter reductions demonstrated by voxel-based morphometry. *Neuroimage* 2008; 40: 1202-1213.
- Dolan M, Fullam R. Memory for emotional events in violent offenders with antisocial personality disorder. *Pers and Individual Differences* 2005; 38: 1657-1669.
- Dolan MC, Fullam RS. Psychopathy and functional magnetic resonances to emotional faces in violent patients with schizophrenia. *Biol Psychiatry* 2009; 66: 570-577.
- Ermer E, Cope LM, Nyalakanti PK, Calhoun VD, Kiehl KA. Aberrant paralimbic gray matter in criminal psychopathy. *J Abnorm Psychol* 2012; 121: 649-658.
- Etkin A, Egner T, Kalisch R. Emotional processing in anterior cingulate and medial prefrontal cortex. *Trends Cogn Sci* 2011; 15: 85-93.
- Fecteau S, Pascual-Leone A, Theoret H. Psychopathy and the mirror neuron system: preliminary funding from a non-psychiatric sample. *Psychiatry Res* 2008; 160: 137-144.
- Gawda B. (2010). Syntax of emotional narratives of persons diagnosed with antisocial personality. *J of Psycholinguistic Res* 2010; 39 (4): 273-283.
- Gawda B. Love scripts of persons with antisocial personality. *Psychol Rep* 2008; 103, 371-380.
- Glenn AL, Raine A, Schug RA. The neural correlates of moral decision-making in psychopathy. *Mol Psychiatry* 2009; 14: 5-6.
- Glenn AL, Raine A, Yaralian PS, Yang Y. Increased volume of the striatum in psychopathic individuals. *Biol Psychiatry* 2010; 67: 52-58.
- Gordon HL, Baird AA, End A. Functional differences among those high and low on a trait measure of psychopathy. *Biol Psychiatry* 2004; 56: 516-521.
- Grann M. *Personality Disorder and Violent Criminality. A Follow-Up Study with Special reference to Psychopathy and Risk Assessment*. Stockholm: RiproPrint, 1998.
- Hare RD. Psychopathy, affect and behavior In *Psychopathy: Theory, research and implications for society*, Cooke, DJ, Hare RD & Forth A (eds.), The Netherlands: Kluwers Academic Publishers, 1998; pp. 105-137.
- Hare RD. *Manual for the Psychopathy Checklist-Revised (3rd ed.)*. Toronto: Multi-Health System, Inc., 2003.
- Harenski CL, Harenski KA, Shane MS, Kiehl KA. Aberrant neural processing of moral violations in criminal psychopaths. *J Abnorm Psychol* 2010; 119: 863-874.
- Hiatt KD, Newman JP. Understanding psychopathy: The cognitive side, In *Handbook of Psychopathy*, Patrick JC (ed.), New York, London: The Guilford Press, 2007; pp. 334-352.
- Kiehl KA, Laurens KR, Bates AT, Liddle PF. (2006). Psychopathy and semantic processing: An examination of the N400. *Pers and Individual Differences* 2006; 40: 293-304.
- Lane RD, Reiman EM, Axelford B, et al. Neural correlates of levels of emotional awareness. Evidence of an interaction between emotion and attention in the anterior cingulate cortex. *J of Cogn Neur* 1998; 10: 525-535.
- Levenson MR, Kiehl KA, Fitzpatrick CM. (1995). Assessing psychopathic attributes in a non institutionalized population. *J of Pers and Social Psychology* 1995; 68: 151-158.
- Levenston GK, Patrick CJ, Bradley MM, Lang PJ. The psychopath as observer: emotion and attention in picture processing. *J of Abnorm Psychol* 2000; 109: 726-733.
- Lilienfeld SO, Andrews BP. Development and preliminary validation of a self-report measure of psychopathic personality traits in noncriminal populations. *J Pers Assess* 1996; 66: 488-524.
- Lorenz AR, Newman JP. Deficient response modulation and emotion processing in low-anxious psychopathic offenders: Results from a lexical decision task. *Emotion* 2002; 2: 91-104.
- Ly M, Motzkin JC, Philippi C, Kirk GR, Newman JP, et al. Cortical thinning in psychopathy. *Am J Psychiatry* 2012; 169: 743-149.
- Lykken DT. Psychopathic personality: the scope of the problem. In *Handbook of Psychopathy*, Patrick CJ (ed.), New York, London: The Guilford Press, 2007; pp. 3-13.
- Lynam DR, Derefinko KJ. Psychopathy and personality. In *Handbook of Psychopathy*, Patrick CJ. (ed.), New York. London: The Guilford Press, 2007; pp. 133-155.
- Mitchell JP, Banaji MR, Macrae CN. The link between social cognition and self-referential thought in the medial prefrontal cortex. *J Cogn Neurosci* 2005; 17: 1306-1315.
- Motzkin JC, Newman JP, Kiehl KA, Koenings M. reduced prefrontal connectivity in psychopathy. *J Neurosci* 2011; 31: 17348-17357.
- Muller JL, Ganssbauer S, Sommer M, Dohnel K. et al. Grey matter changes in right superior temporal gyrus in criminal psychopaths. Evidence voxelbased morphometry. *Psychiatry Res* 2008; 163: 313-222.
- Müller JL, Sommer M, Wagner et al. Abnormalities in Emotion Processing within Cortical and Subcortical Regions in Criminal Psychopaths: Evidence from a Functional Magnetic Resonance Imaging Study Using



- Pictures with Emotional Content. *Biological Psychiatry* 2003; 54: 152-162.
- Newman JP, MacCoon DG, Vaughn LJ, Sadeh N. (2005). Validating a distinction between primary and secondary psychopathy with measures of Gray's BIS and BAS constructs. *Journal of Abnor Psych* 2005; 114: 319-323.
- Ongur D, Pice JL. The organization of networks within the orbital and medial prefrontal cortex of rats, monkeys and humans. *Cereb Cortex* 2000; 10: 206-219.
- Pauthus DL, Williams KM. The Dark Triad of personality: Narcissism, Machiavellianism and Psychopathy. *J of Res in Personality* 2002;36 (6): 556- 563.
- Qin P, Northoff G. How is our self related to midline regions and the default-mode network? *Neuroimage* 2011; 57: 1221-1233.
- Raine A, Lencz T, Bihrlle S, LaCasse L, Colletti P. Reduced prefrontal gray matter volume and reduced autonomic activity in antisocial personality disorder. *Arch Gen Psychiatry* 2000; 57: 119-127.
- Shackman AJ, Salomons TV, Slagter HA, Fox AS, et al. The integration of negative affect, pain and cognitive control in the cingulate cortex. *Nat Rev Neurosci* 2011; 12: 154-167.
- Singer T, Seymour B, O'Doberry JP, et al. Empathy neural responses are modulated by the perceived fairness of others. *Nature* 2006; 439: 466-469.
- Sommer M, Sodian B, Dohnel K, Schwerdtner J, et al. In psychopathic patients emotion attribution modulates activity in outcome-related brain areas. *Psychiatry res* 2010; 182: 88-95.
- Sternberg R J. Two-component theory of love. In *New psychology of love*, Sternberg RJ & Weis K. (eds.), New Haven: Yale University, 2006; pp. 275-297.
- Sutker PB, Allain AN. Jr. Antisocial personality disorder. In *Comprehensive handbook of psychopathology*, Sutker PB & Adams HE (eds.), New York: Kluwer Academic/Plenum Publishers, 2001; pp. 445-490.
- Wechsler D. *WAIS-R manual: Wechsler Adult Intelligence Scale-Revised*. New York: The Psychological Corporation, 1981.
- Yang Y, Raine A, Colletti P, Toga AW, Narr KL. Abnormal temporal and prefrontal cortical gray matter thinning in psychopaths. *Mol Psychiatry* 2009; 14: 561-562.
- Yang Y, Raine A, Lencz T, Bihrlle S, et al. Volume reduction in prefrontal gray matter in unsuccessful criminal psychopaths. *Biol Psychiatry* 2005; 57: 1103-1108.
- Zeki S. The neurobiology of love. *FEBS Letters* 2007; 581: 2575-2579.

