

Stalking: a neurobiological perspective

Stalking: una prospettiva neurobiologica

DONATELLA MARAZZITI, VALENTINA FALASCHI, AMEDEO LOMBARDI,
FRANCESCO MUNGAI, LILIANA DELL'OSSO

E-mail: dmarazzi@psico.med.unipi.it

Dipartimento di Medicina Clinica e Sperimentale, Sezione di Psichiatria, Università di Pisa

RIASSUNTO. Lo stalking sta diventando una vera e propria emergenza sociale perché è spesso alla base di gravi comportamenti etero- e autoaggressivi. Non esistono al momento ipotesi che possano spiegare in maniera esaustiva un fenomeno così complesso, anche se le descrizioni dettagliate di alcune sue caratteristiche permettono di formulare alcune considerazioni e proposte di lavoro. Probabilmente nello stalking sono coinvolti i sistemi che regolano il cervello sociale e la formazione della coppia, vale a dire i processi di attaccamento/separazione, attrazione/innamoramento/gratificazione. Sul piano biochimico entrerebbero in gioco un'iperattività del sistema dopaminergico e un'ipofunzionalità di quello serotoninergico. Naturalmente, si tratta solo di suggerimenti, ma è indubbio che la prevenzione delle gravi conseguenze dello stalking passi anche attraverso l'esplorazione e l'approfondimento delle sue possibili basi neurobiologiche.

PAROLE CHIAVE: stalking, neurobiologia, attaccamento, serotonina, dopamina.

SUMMARY. Nowadays stalking is becoming a real social emergency, as it may often fuel severe aggressive behaviours. No exhaustive aetiological hypothesis is still available regarding this complex phenomenon. However, the detailed descriptions of some of its peculiar features allow to draw with cautions some general suggestions. Probably stalking may arise from the derangement of those neural networks subserving the so-called social brain and the pair bonding formation, in particular the processes of attachment/separation, attraction/romantic love/reward. In addition, it seems to be modulated by excessive functioning of the dopamine system coupled with decreased serotonin tone. It is believed that the investigation and deepening of its possible neurobiological substrates may be helpful in the prevention of the severe consequences of stalking.

KEY WORDS: stalking, neurobiology, attachment, serotonin, dopamine.

INTRODUCTION

Stalking is considered a criminal behaviour and, as such, sanctioned by specific legislation in North America, Australia, New Zealand and many European countries, including Italy.

There are two types of stalking behaviours: 1) persecution of a previous sexual partner by an individual who has been left or rejected, and 2) constant harassment perpetrated by an individual who is infatuated with a stranger or an acquaintance, who, however, does not return the approaches and advances.

Despite the controversies over the definition of stalking within both legal and psychological/scientific field, a certain behaviour amounts to the crime of stalking when there are the following features: a set of stalking and harassing episodes, and real threats and induction of fear in the victim^{1,2}. Other distinctive elements of stalking are: excessive interest and desire to "move too quickly" in order to achieve proximity or intimacy with the victim which in itself generates fear and anxiety, a violation of privacy, as well as spying or persecuting using a third party, limitation of freedom such

as abduction. Finally, an undergoing, gradual escalation of aggressiveness towards the victim, towards the stalker him/herself or others and which may lead to damage of the victim's goods and property.

Although no reliable data are available on the prevalence of stalking, or if, as it seems, this is a growing phenomenon, undoubtedly, it is a social and legal problem that only recently has fully emerged in all its relevance and severity. It is estimated that between 8 and 15% of women, and between 2 and 4% of men get haunted by a stalker at some point in their life in the US, Britain, Australia and Italy, countries where several epidemiological studies have been carried out². In Italy, a dedicated organisation, the National Observatory for Stalking, has been founded in order to monitor and investigate what is considered a growing phenomenon³. In fact, it is estimated that the official figures unveil only a small proportion of this problem, which remains mostly unknown in its own proportion^{4,5}. The majority of victims tends not to report the offence, due to lengthy legal processes and the minimal level of protection granted. Not least, the risk of being exposed to the extreme outbursts of aggressiveness^{3,6}. The vast majority of stalkers are usually men, often but not

Stalking: a neurobiological perspective

necessarily isolated, lonely and of a low socio-cultural extraction, while the victims are women¹. However, there are also female stalkers who represent about 15-20% of the total⁷ and have specific characteristics, such as a diagnosis of borderline personality disorder, and less likely than male stalkers, present with a history of violent crime (12.5% vs. 31.3%) or substance abuse (7.5% vs. 28%). In addition, stalking behaviour of women often tends to be directed towards ex-partners rather than strangers. Moreover, several meta-analyses indicate that approximately 80% of cases of stalking occur towards acquaintances and that 50% originate at the end of a previous relationship⁸.

Psychiatrists, psychologists and psychotherapists are at high risk of being victims of stalking from lonely and/or disturbed individuals who may easily misinterpret empathy and attention and mistake them for romantic-love or attraction.

The frequency of violent behaviours committed by stalkers towards their victims is high, generally between 25% and 40% of cases⁹, and anyway higher than other groups, such as, for example, psychiatric patients with substance abuse¹⁰. These figures increase dramatically when stalkers of former sexual partners are considered. Five independent research groups, based in three different continents, have recently confirmed that finding in a percentage varying between 55 and 89%¹¹⁻¹⁵. It is important to note that the significant increase in violence of stalkers amongst former sexual partners, suggests that sexual intimacy can accentuate abnormal attachment reactions and exaggerate emotional reactions, when the relationship is questioned or broken.

In these cases, the violence, is defined as “emotional” by some authors and it is characterized by intense arousal, anger and/or fear of an impending rejection which is experienced as threatening^{1,16}. The victim is usually attacked without weapons or blunt objects, grabbed, shaken, hit, slapped, kicked or punched^{11,17}. The risk of homicide in stalking cases is estimated as around 0.25%⁷, although more recent data suggest that stalking may represent an important predictor of marital homicide¹⁸.

Several classifications of stalking exist. Apart from the classification distinguishing simply between psychotic and non-psychotic^{2,20} or the Meloy and Gothard's term “obsessive harasser”²¹, according to Zona et al.²², who have assessed 74 cases, stalkers might be divided in three groups: erotomaniac, love-obsessed and obsessed. An alternative classification has been based on two axis, the first axis distinguishing the attachment style ranging between affectionate/loving or persecutory/raging, the second axis defining the nature of the relationship²³. Other authors identify four types of stalkers such as those in search of attachment, those in search of identity, those who exacerbate after a rejection and delusional stalkers²⁴. Mullen et al.²⁵ in an accurate study on a sample of 145 stalkers identified a few categories and described specific characteristics of these individuals: rejected, intimacy seekers, incompetents, resentful and predators.

The underlying causes of stalking behaviour are unknown and, to date, investigations on its aetiology have been limited to the exploration and description of some psychological characteristics and traits of stalkers and their victims, as well as the socio-cultural context in which the phenomenon is expressed^{1,2,20,21,26}. In the process of reviewing the scientific literature on the subject we have collected more than 100 stud-

ies referring to a total of over 70,000 subjects assessed, but only a minority of authors have attempted to propose a theory about plausible psychobiological substrates which may underlie or contribute to the development of stalking²⁷. Obviously, it is not easy to study the biological correlates of any human behaviour, which per se always represents quite a complex task, more so in case of an abnormal behaviour such as stalking. In this case the risk of reductionism is high, in other words, the risk of attributing the cause of a certain behaviour to a definite biological mechanism, neglecting the equally important psychological, cultural and social motivations. On the other hand, it is also true that there is now a wide acceptance of the existence of specific neural systems underlying human behaviour and in certain cases, specific neural networks have been identified.

The aim of this paper is to review the available literature on the biology of stalking, though limited to date, and to put forward some theoretical models that could provide the basis for carrying out specific studies and research rather than unnecessary empirical measures, as often happens in science when we deal with the lack of a leading reference theory.

WHERE TO START FOR A NEUROBIOLOGICAL MODEL OF STALKER

The conceptualisation of any neurobiological model (or models) of a particular behaviour should not abstract from a few preliminary considerations. In case of stalking, we can consider some specific characteristics that allow us to anticipate some hypotheses. Probably the stalker presents with an abnormal structure of emotional relationship concept, often supported by an obsessive thinking mode that leads to reiterate either behavioural and affective-emotional components up to a loss of control resulting in reactions of rage and aggressiveness, with partial or no insight over the consequences of their behaviour. If we want to get to the neurobiological roots of stalking we need to focus on those systems assumed to underlie different components of the formation of human bonding (the couple): attraction, attachment/separation, and perhaps even jealousy which is deemed to represent a “healthy” component of love and stems from the fear associated with the prospect of losing the partner²⁷. However, it is necessary to point out that although the two types of stalking, one involving former partners and the other against strangers, may share common biological basis, in the latter the thought disorder is not only obsessive, but frankly delusional and shares many similarities with De Clerembault's syndrome, thus with psychosis. However, in both cases, it can be assumed that there is an inability to elaborate the break up of a true relationship (stalking of the first type) or an imagined one (stalking of the second type); this aspect is suggestive of an attachment disorder, which will be our first topic.

Then we will be examining the stalker thought processes and in particular the obsessionality which is the most characterising feature and the possible psychotic drift along with the emotional and affective specificities such as anxiety, rage, aggressiveness and jealousy. Of each of these components, we will point out the possible neurobiological substrate with reference to literature data.

ATTACHMENT AND STALKING

Attachment is a system or a dimension of human mind which is formed and organized starting from the first interactions the child has with the caregivers, in general the mother, and it is characterized by emotions, cognitive processes and behavioral aspects^{19,28,29}. The mother-infant interactions structure what is defined as attachment system, a guiding system that even during adult life continue to influence social and emotional interactions, as it remains substantially unchanged throughout life.

Each individual has a particular attachment style that characterizes his/her affective interactions (relationship of the couple, intimate relationships, etc.), and that in turn, affects the attachment style of his/her offspring. Not surprisingly, given the evidence of common features shared by parent-child and adult-adult interactions, attachment theory was rapidly extended to emotional relationships of adults showing that these relationships involve the integration of three behavioral systems: attachment, caregiving, and sexual mating and imply the element of reciprocity. In fact, the request of availability from him or her often requires exclusivity: for this reason, according to some authors, the possibility of being abandoned and the fear of losing an exclusive partner would trigger jealousy which not rarely is the origin of severely aggressive behaviours³⁰.

What do we know about attachment in stalking?

Traditionally attachment styles are divided into two categories, secure and insecure; secure adult attachment is characterized by the expectation of availability and responsiveness of others, the ability to tolerate and to mitigate the negative emotions and to feel at ease during intimacy with the other. Insecure attachment, inversely, has been linked to an inadequate caregiving in childhood, characterized by intrusiveness of the attachment figure, the experience of being threatened by his/her behaviour, negligence or carelessness. Since the quality of attachment seems to organize emotional and behavioral responses^{31,32}, it is reasonable to assume that insecure attachment, though not in itself pathological, may be considered as such in conjunction with a greater predisposition to anxiety and mood disorders throughout life³³⁻³⁵. Data available on stalking are still very limited, but some studies suggest that this phenomenon could be caused by an insecure and anxious attachment style^{2,36-45}, resulting from abandonment, neglect or abuse perpetrated by parents during 'childhood', or the loss of a primary caregiver²⁰. The adult stalker harbours a negative perception of him/herself and positive of others, takes the blame for the lack of love and is very dependent on the attempts to gain approval and acceptance from others. Dutton⁴⁶ has empirically shown that this disturbance of attachment, combined with extreme shame and victimization, as it happens in children, may contribute to the formation of a borderline personality in the adult male. This personality organization is capable of stimulating "anger of intimacy" during a relationship, a proneness to experience "anxiety of rejection" and "anger of abandonment" in case of an imminent partner loss. These attachment styles indicate that the stalker is constantly living in anxiety related to the fear of abandonment and loss, either when it happens or it is perceived as such; this leads to a phase of uncontrollable and endless protest, which is unable to reach a state of resignation. After separation from an attachment ob-

ject, normally the "Protest" and "Frustration" phases develop which, in case of a romantic relationship, are likely to have evolved in order to motivate the lover to entice the subject of the refusal to resume the relationship. The following abandonment and anger feelings might serve to help the disappointed lover to start the search for a new partner. The following resignation phase conversely would aim to send clear and genuine signals to family and friends about the need of moral support that he/she has at a time of intense psychological pain or to rest, retreat, and "lick his/her wounds"⁴⁷.

These mechanisms allow to overcome rejection either of a broken relationship and avoid wasting of time with unworthy individuals. In general, even people considered as normal, who have been rejected, tend to spend what appears to be an unreasonable amount of time and energy to respond to the loss of partners. Those behaviours are explained by evolutionary theories as follows: individuals in general often waste precious energies and time in courtship, but with the partner loss they see their reproductive future as compromised, together with social relationships, personal happiness, self-esteem and sometimes their reputation. Rejection has psychological and social consequences, but there are specific neural systems able to manage it. The rejected or requested stalker seems to lack or fail to activate these cerebral systems in an appropriate way in order to reach resignation and focus his/her interests elsewhere. On the contrary, he/she persists in harassing a reluctant partner.

As far as the attachment neurobiology is concerned, a growing body of research over the last 20 years highlighted a key-role for two pituitary peptides: oxytocin and vasopressin. The involvement of oxytocin and vasopressin in different forms of attachment, in children, parents and in the "couple", has raised the hypothesis of the existence of a single neural circuit, already present at birth, able to adjust the various types of attachment throughout life based on social context and endocrine systems. However, data available from research in this field, suggest the involvement of different circuits belonging to what has been named as "the social brain", in particular the amygdala, the lateral septum and its projections to the rostral hypothalamus (medial-preoptic area)⁴⁸⁻⁵⁰. In functional magnetic resonance studies, adults who watched the image of the partner compared with adults who watched the image of a friend, showed bilateral activation of the anterior cingulate gyrus (Brodmann area 24), the medial insula (Brodmann area 14), the caudate and the putamen, the orbitofrontal cortex, medial prefrontal cortex⁵¹ and the right ventral tegmental area (VTA), area where dopamine is produced⁵². Another MRI study in subjects who had been in love since a long time confirmed the activation of the same areas and the amygdala deactivation, which is the integrating centre for reaction of anxiety and fear⁵³. It has been hypothesised that the process of falling in love may be linked to a sudden amygdala activation which starts a chain reaction amongst all the connected cerebral areas. Oxytocin is responsible for the activation of the dopaminergic reward circuit, which leads to the normalisation of the amygdala level of functioning, together with the serotonin from the raphe of the mesencephalon, and possibly neurotrophins^{54,55}.

Combining these data together, we can cautiously put forward some speculations regarding the stalker neurobiology. These individuals are likely to have a "reaction" of love towards the victim, as shown by the hyperactivity, the euphoria

Stalking: a neurobiological perspective

(at least at the beginning), the anxiety and the narrow focused attention on the relationship, the other person and the motivation to meet him/her^{56,57}. The activation of subcortical dopaminergic pathways in the caudate nucleus and the VTA and the inhibition of the serotonergic pathways may determine that generalised and intense agitation state which is experienced in the initial phase of falling in love, either by normal individuals and by stalkers. It is possible to hypothesise that the continuous activation of subcortical dopaminergic pathways, sustained by the persistent amygdala firing, may imply some peculiar traits of the rejected or unrequited stalker, amongst which his/her tireless energy, the narrow and focused attention and the intense motivation to harass the victim. The hyperactivation of the amygdala that hijacks most of the brain in order to modulate the output of its responses may explain the inexhaustible protest phase which follows the separation from the object of love and which leads to rage and aggressiveness. At the same time, the deactivation of cognitive processes that take place when we fall in love (even though this is a short lived process!), may imply a sort of stalker blindness to understand the risks involved and the consequences of his/her behaviour, and the misconception that he/she might be able to change the victim's feelings via the persistence, harassment and constraints.

THE NEUROBIOLOGICAL BASES OF COGNITIVE-AFFECTIVE ASPECTS OF STALKING

Obsessionality and impulsivity

From a cognitive/thinking point of view, the stalker presents immaturity and magical thinking, sustained by the distorted belief of being able to change the emotions of the victim with his harassing behaviour. As it has been pointed out by several authors, the stalker thinks constantly about his/her victim, without exerting any significant resistance^{58,59}, this thought is egosyntonic in nature and voluntarily recalled, thus lacking the typical subjective suffering of patients suffering from obsessive-compulsive disorder (OCD). Therefore, it would be more appropriate to talk of overvalued ideas, similar to those experienced in the early stages of falling in love⁶⁰⁻⁶³. This typical way of thinking has been associated with a reduced activity of the serotonergic system, as it occurs in OCD patients⁶⁴. The serotonergic system inhibits the activity of the amygdala and several other cortical areas, when its level of functioning is reduced, the likelihood of impulse responses increases, as it happens in lovers and in stalkers. Since the serotonergic and dopaminergic systems interact through a negative feedback, when the activity of one reduces the activity of the other increases, so that low central serotonergic activity provokes high activity of dopaminergic pathways and vice versa^{65,66}.

The content of conscious thoughts of the stalker varies from case to case, although it is generally characterized by paradoxes and contradictions, such as the overlap of idealization and devaluation of the victim, the conflicting desire for freedom and absolute control over the victim, or it may present with concomitant writings/statements of boundless love with anger and aggression. The contradictions that characterize the stalker thinking mode may arise from the fan-

tasies evoked during the first real or imagined contact with the victim, as it happens in the early stages of falling in love⁶⁷. However, in the case of the stalker, it clashes immediately with rejection triggering feelings of intense humiliation which the stalker expresses with anger towards the victim. In normal individuals of both sexes, rejection frequently triggers feelings of pain, anger and sadness, and usually results in finding a new love object, conversely in those subjects in which the pathological narcissism is a problem, as it is in stalkers, the loss is intolerable and it unleashes stalking behaviours, compulsively repeated with inexhaustible energy, perhaps due to low serotonin and high dopamine levels. This neurobiological mechanism could even explain the elements of dysphoria and irritability that characterize many stalkers.

Anger and aggression

As already mentioned, one of the most typical emotions expressed by stalkers is anger coming mostly from the refusal from the victim, who at the beginning was idealized^{1,25,68,69}. Anger can also cover feelings of shame and humiliation, loneliness, isolation, difficulties in social relationships, social incompetence, which tantamount the inability to attract partners. No doubt, it is the most intense emotion that triggers persecution and harassment, in response to impulse and desire to damage or destroy what cannot be possessed, to inflict pain to those responsible for their suffering, or to exert full control over the victim⁷⁰. These considerations can be the substrate for aggressive reactions, facilitated by a low level of serotonergic functioning and dopaminergic hyperactivity.

Jealousy

Jealousy is a complex emotion that involves the perceived threat for the loss of a person involved in an important emotional relationship^{71,72}. It is characterized by cognitive and behavioral emotional components. It is a heterogeneous condition ranging from normal to pathological expressions, with varying degrees of intensity, persistence and insight⁷³⁻⁷⁵. Pathological jealousy is always predictive of stalking⁷⁶, it may easily reach delusional proportions when the threat is based on a false belief and, in these cases, can lead to aggression and violence^{25,69,77}. Jealousy can also trigger motivation to dominate and isolate the victim before the beginning of stalking behaviours. The psychological defences used by stalkers are denial, projection of guilt and projective identification³⁸, but if these defences fail the stalker is vulnerable to develop feelings of persecution, which can be intensified by the intervention of a third party, who might be generally considered as interference or threat⁷⁸.

The identification of the biological basis of jealousy, to date still unknown and poorly investigated, could have a significant impact on prevention of stalking behaviours⁷⁹. Only in one study it has been reported that obsessive jealousy is associated with a specific alteration of the platelet serotonin transporter, which may be suggestive of a possible involvement of serotonergic system⁸⁰. In another functional-RNM study performed during a behavioral task involving jealousy-triggering scenarios, it has been observed that men and

women recruited different areas of the brain⁸¹. More recently, we have proposed a theory that may explain the transition from normal to delusional jealousy, which is common among stalkers; the theory derives from the observation that dopamine agonists can induce delusional jealousy in patients with Parkinson's disease⁸². This may be due to the fact that dopamine agonists can trigger the phenomenon of aberrant attribution of salience⁸³, a phenomenon that is hypothesized to underlie the development of delusions. According to us delusional jealousy probably would arise from at least three simultaneous conditions: an aberrant salience related to the relationship with the loved one, aberrant representations of the partner's feelings, thoughts and behaviours, and aberrant scenarios related to the potential loss of the relationship, triggered by an excess of dopamine, that can be primary or secondary to a low serotonergic tone, which promotes the connections between the prefrontal cortex and dorsal striatum at the expense of those of the ventral striatum⁸².

Stalking as addiction

For completeness sake we would like to mention that stalking, in parallel with "falling in love", was also approached and described as a form of addiction; these two conditions in fact present features of tolerance, dependence, craving, abstinence and relapse^{60,62,84}. The stalker shows tolerance towards the victim and want to see and interact with him/her more often. If the relationship breaks up a series of specific symptoms may present, particularly depression, anxiety, insomnia or hypersomnia, loss of appetite or binge eating, irritability and feelings of loneliness. Long after the love affair is over, events, people, places, memories (even songs) associated with the beloved can reactivate the irrepressible desire for the partner and the subject may start engaging in obsessive thinking and/or compulsive search through phonecalls and written messages, aiming to re-create a contact with the loved one. The rejected or unrequited stalker acts in a manner and with such actions that are well above the accepted social norm in order to get his drugs, that is the victim. This emotional and physical dependence is most likely associated with a high activity of the subcortical dopaminergic pathways that are part of the brain reward system. This behavioral pattern is similar to that described for all substances of abuse, which is associated with a physical and emotional dependence and increase in dopaminergic activity^{85,86}.

CONCLUSIONS

Originally stalking was a term used by the media to describe the intrusion of fans with mental disorders into the lives of famous people; currently it is considered a crime in many Western Countries and is increasingly taking on the characteristics of a social emergency, because it is often the origin of aggressive behaviours leading to acts with extreme consequences.

Currently there are no specific hypotheses able to fully explain the phenomenon of stalking²⁷, although the available studies suggest some common features in these subjects; in particular it has been pointed out immaturity, loneliness or isolation,

difficulty in social relationships or in attracting a partner in stalkers; the presence of a narcissistic trait can also be very important and explain the level of indifference towards the suffering of the victim. Another constant feature of the stalker would be a form of insecure or anxious attachment. The mood, after an initial elation phase, may turn into dysphoria, resentment, anger, and sometimes aggressiveness, impulsivity, which can be sustained by an apparently inexhaustible energy. At cognitive-ideational level the stalker may experience magical thinking and obsessionality, always presenting with a narrow focus on the victim which leads to disregard for the consequences of his/her behaviours and the possibility of psychotic drifts which can also be triggered by jealousy.

The hypotheses on the neurobiology of stalking are virtually non-existent, apart from the paper of Meloy and Fisher of 2005 that represents one of the few comprehensive reviews on this topic²⁷. Starting from what already published, we can make some very cautious general observations and suggestions, relying mainly on what are the characteristics of the phenomenon. If in stalking there are any changes, it is likely that these involve systems that regulate the so-called "social brain" which represents the background for the formation of the couple as well as the process of falling in love and attachment. As an individual "in love" or a drug addict, the stalker is constantly anxious, hyperactive and obsessively thinks about the victim, regardless of his/her returning feelings, or the consequences of his harassment. Studies with fMRI in lovers showed an activation of brain areas primary involved in the regulation of emotions (amygdala, limbic lobe, hypothalamus) and a deactivation of certain cortical areas, which is also likely to be typical of the stalkers. However, compared to lovers, stalker would present an abnormal persistence of this pattern. From a biochemical point of view these conditions may be explained with a hyperactivity of dopaminergic pathways and a reduction of the serotonergic system. This particular neurobiological arrangement could provide a biochemical explanation for the peculiarities of the stalker, as mentioned above, and explain the constant risk that the obsessive thoughts may become frankly delusional and result in violence and aggression. On one side, a low serotonergic tone would represent a vulnerability factor towards the emergence of a broad range of behavioral disturbances, such as impulsive, compulsive, and aggressive acts⁸⁷. On the other, the related high dopaminergic activity, may hence contribute to the loss of behavioral control and insight.

There is no doubt that prevention of stalking should include comprehensive social, cultural and legislative projects. Nevertheless, we believe that a better understanding of its possible biological correlates may lead to early identification of those individuals at risk. This would enhance the possibility to implement appropriate measures to avoid those dramatic events that increasingly and too often fill the crime pages.

REFERENCES

1. Mullen P, Pathé M, Purcell R. Stalkers and their victims. New York: Cambridge University Press, 2000.
2. Dressing H, Foerster K, Gass P. Are stalkers disordered or criminal? Thoughts on the psychopathology of stalking. *Psychopathology* 2011; 44: 277-82.
3. Osservatorio Nazionale sullo Stalking. *Bollettino* 2011.

Stalking: a neurobiological perspective

4. Pomilla A, D'Argenio A, Mastronardi V. Stalking: clinical and criminological considerations through the results of a research contribution. *Riv Psichiatr* 2012; 47 (4 suppl): 46-51.
5. Grattagliano I, Cassibba R, Greco R, Laudisa A, Torres A, Mastroromano A. Stalking: old behaviour new crime. Reflections on 11 cases assessed in the judicial district of Bari. *Riv Psichiatr* 2012; 47: 65-72.
6. Davis JA. Stalking crimes and victim protection. Boca Raton: CRC Press, 2001.
7. Meloy JR, Boyd C. Female stalkers and their victims. *Am Acad Psychiatry Law* 2003; 31: 211-9.
8. Spitzberg B. The tactical topography of stalking victimization and management. *Trauma Violence Abuse* 2002; 3: 261-6.
9. Meloy JR. Stalking and violence. In: Boon J, Sheridan L (eds). *Stalking and psychosexual obsession*. London: John Wiley & Sons, 2002.
10. Steadman H, Mulvey E, Monahan J, et al. Violence by people discharged from acute psychiatric inpatient facilities and by others in the same neighborhoods. *Arch Gen Psychiatry* 1998; 55: 393-401.
11. Harmon R, Rosner R, Owens H. Sex and violence in a forensic population of obsessional harassers. *Psychol Public Policy Law* 1998; 4: 236-49.
12. Mullen P, Pathé M, Purcell R, Stuart GW. Study of stalker. *Am J Psychiatry* 1999; 156: 1244-9.
13. Palarea R, Zona M, Lane J, Langhinrichsen-Rohling J. The dangerous nature of intimate relationship stalking: threats, violence and associated risk factors. *Behav Sci Law* 1999; 17: 269-83.
14. Boon J, Sheridan L. Stalker typologies: a law enforcement perspective. *J Threat Assessment* 2001; 1: 75-97.
15. Meloy JR. The psychology of stalking: clinical and forensic perspectives. San Diego, CA: Academic Press, 1998.
16. Meloy JR. When stalkers become violent: the threat to public figures and private lives. *Psychiatric Annals* 2003; 33: 659-65.
17. Pathé R, Mullen P. The impact of stalkers on their victims. *Br J Psychiatry* 1997; 170: 12-7.
18. McFarlane J, Campbell J, Watson K. Intimate partner stalking and femicide: urgent implications for women's safety. *Behav Sci Law* 2002; 20: 51-68.
19. Bowlby J. Attachment and loss: attachment. New York: Basic Books, 1969.
20. Kienlen KK, Birmingham DL, Solberg KB, O'Regan JT, Meloy JR. A comparative study of psychotic and non psychotic stalking. *J Am Acad Psychiatry Law* 1997; 25: 317-34.
21. Meloy JR, Gothard S. Demographic and clinical comparison of obsessional followers and offenders with mental disorders. *Am J Psychiatry* 1995; 152: 258-63.
22. Zona M, Sharma K, Lane J. A comparative study of erotomanic and obsessional subjects in a forensic sample. *J Forensic Sci* 1993; 38: 894-903.
23. Harmon R, Rosner R, Owens H. Obsessional harassment and erotomania in a clinical court population. *J Forensic Sci* 1995; 40: 188-96.
24. Orion D. I know you really love me: A Psychiatrist's journal of erotomania, stalking and obsessive love. New York: Macmillan, 1997.
25. Mullen P, Pathé M, Purecel R, Stuart GW. Study of stalkers. *Am J Psychiatry* 1999; 156: 1244-9.
26. Meloy JR. The psychology of stalking: clinical and forensic perspectives. San Diego, CA: Academic Press, 1998.
27. Meloy RI, Fisher H. Some thoughts on the neurobiology of stalking. *J Forensic Sci* 2005; 50: 1-9.
28. Bowlby J. Attachment and loss. Separation: anxiety and anger. New York: Basic Books, 1973.
29. Bowlby J. Attachment and Loss: loss, sadness and depression. New York: Basic Books, 1980.
30. Guerrero L. Attachment-style differences in the experience and expression of romantic jealousy. *Pers Relationships* 1998; 5: 273-91.
31. Brennan KA, Clark CL, Shaver PR. Self-report measurement of adult attachment: an integrative overview. In: Simpson JA, Rholes WS (eds). *Attachment theory and close relationships*. New York: Guilford Press, 1998.
32. Grossman KE, Grossman K. Attachment quality as an organizer of emotional and behavioural responses in a longitudinal perspective. In: Parkes CM, Stevenson-Hinde J, Marris P (eds). *Attachment across the life cycle*. London: Routledge, 1991.
33. Amini F, Lewis T, Lannon L, et al. Affect, attachment, memory: contributions toward psychobiologic integration. *Psychiatry* 1996; 59: 213-39.
34. Goldberg D. Vulnerability, destabilization and restitution in anxious depression. *Acta Psychiatr Scand* (suppl. 2) 2003; 418: 81-2.
35. Marazziti D, Dell'Osso B, Catena Dell'Osso M, et al. Romantic attachment in patients with mood and anxiety disorders. *CNS Spectr* 2007; 12: 751-8.
36. Meloy JR. Unrequited love and the wish to kill: diagnosis and treatment of borderline erotomania. *Bull Menninger Clinic* 1989; 53: 477-92.
37. Holtzworth-Munroe A, Stuart G, Hutchinson G. Violent versus nonviolent husbands: differences in attachment patterns, dependency, and jealousy. *J Family Psychol* 1997; 11: 314-31.
38. Meloy JR. Violent attachments. Northvale, NJ: Jason Aronson, 1992.
39. Mechanic M, Weaver T, Resick P. Intimate partner violence and stalking behavior: explorations of patterns and correlates in a sample of acutely battered women. *Violence and Victims* 2000; 15: 55-72.
40. Babcock J, Jacobson N, Gottman J, Yerington T. Attachment, emotional regulation, and the function of marital violence: differences between secure, preoccupied and dismissing violent and non violent husbands. *J Family Violence* 2000; 15: 391-409.
41. Dutton D, Saunders K, Starzomski A, Bartholomew K. Intimacy-anger and insecure attachment as precursors of abuse in intimate relationships. *J Applied Social Psychology* 1994; 24: 1367-86.
42. Holtzworth-Munroe A, Stuart G, Hutchinson G. Violent versus non violent husbands: differences in attachment patterns, dependency, and jealousy. *J Family Psychology* 1997; 11: 314-31.
43. Langhinrichsen-Rohling J, Palarea R, Cohen J, Rohling M. Breaking up is hard to do: unwanted pursuit behaviors following the dissolution of a romantic relationship. *Violence Vict* 2000; 15: 73-90.
44. Lewis S, Fremouw W, Del Ben K, Farr C. An investigation of the psychological characteristics of stalkers: empathy, problem-solving, attachment and borderline personality features. *J Forensic Sci* 2001; 46: 80-4.
45. Roberts KA. Stalking following the breakup of romantic relationships: characteristics of stalking former partners. *J Forensic Sci* 2002; 47: 1070-977.
46. Dutton D. The abusive personality. New York: Guilford Press, 1998.
47. Fisher HE. Why we love: the nature and chemistry of romantic love. New York: Henry Holt, 2004.
48. Young LJ, Wang Z. The neurobiology of pair bonding. *Nat Neurosci* 2004; 7: 1048-54.
49. Schultz W. Multiple reward signals in the brain. *Nat Rev Neurosci* 2000; 1: 199-207.
50. Martin-Soelch C, Leenders KL, Chevalley AF, et al. Reward mechanisms in the brain and their role in dependence: evidence

- from from neurophysiological and neuroimaging studies. *Brain Res Rev* 2001; 36: 139-49.
51. Bartels A, Zeki S. The neural basis of romantic love. *Neuroreport* 2000; 11: 3829-34.
52. Bartels A, Zeki S. The neural correlates of maternal and romantic love. *Neuroimage* 2004; 21: 1155-66.
53. Acevedo BP, Aron A, Fisher HE, Brown LL. Neural correlates of long-term intense romantic love. *Soc Cogn Affect Neurosci* 2012; 7: 145-59.
54. Marazziti D, Canale D. Hormonal changes when falling in love. *Psychoneuroendocrinology* 2004; 29: 931-6.
55. Emanuele E, Politi P, Bianchi M, Minoretti P, Bertona M, Geroldi D. Raised plasma nerve growth factor levels associated with early-stage romantic love. *Psychoneuroendocrinology* 2006; 31: 288-94.
56. Wise RA. Brain dopamine and reward. *Ann Rev Psychology* 1989; 40: 191-225.
57. Pfaff DW. Drive: neural and molecular mechanism for sexual motivation. Cambridge, MA: The MIT Press, 1999.
58. Meloy JR. Stalking (obsessional following): a review of some preliminary studies. *Aggress Violent Behav* 1996; 1: 147-62.
59. Meloy JR, Rivers L, Siegel L, Gothard S, Naimark D, Nicolini R. A replication study of obsessional followers and offenders with mental disorders. *J Forensic Sci* 2000; 45: 147-52.
60. Fisher HE. Lust, attraction, and attachment in mammalian reproduction. *Human Nature* 1998; 9: 23-52.
61. Hatfield E, Sprecher S. Measuring passionate love in intimate relationships. *J Adolescence* 1986; 9: 383-410.
62. Tennov D. Love and limerence: the experience of being in love. New York: Stein and Day, 1979.
63. Fisher HE. Lust, attraction, and attachment in mammalian reproduction. *Human Nature* 1998; 9: 23-52.
64. Marazziti D, Akiskal HS, Rossi A, Cassano GB. Alteration of the platelet serotonin transporter in romantic love. *Psychol Med* 1999; 29: 741-5.
65. Meston CM, Frohlic PF. The neurobiology of sexual function. *Arch Gen Psychiatry* 2000; 57: 1012-30.
66. Luciana M, Collins PF, Depue RA. Opposing roles for dopamine and serotonin in the modulation of human spatial working memory function. *Cerebral Cortex* 1998; 8: 218-26.
67. Person E. Dreams of love and fateful encounters: the power of romantic passion. New York: Norton, 1988.
68. Roberts KA. Stalking following the breakup of romantic relationships: characteristics of stalking former partners. *J Forensic Sci* 2002; 47: 1070-7.
69. Silva JA, Derecho D, Leong G, Ferrari M. Stalking behavior in delusional jealousy. *J Forensic Sci* 2000; 45: 77-82.
70. Klein M. Envy and gratitude. New York: The Free Press, 1975.
71. Mullen PE. Jealousy: the pathology of passion. *Br J Psychiatry* 1991; 158: 593-601.
72. Buss DM. Sex differences in human mate preferences: evolutionary hypotheses tested in 37 cultures. *Behav Brain Sci* 1989; 12: 12-49.
73. Robbins TW, Gillan CM, Smith DG, et al. Neurocognitive endophenotypes of impulsivity and compulsivity: towards dimensional psychiatry. *Trends Cogn Sci* 2012; 16: 81-91.
74. Marazziti D, Di Nasso E, Masala, et al. Normal and obsessional jealousy: a study in a population of young adults. *Eur Psychiatry* 2003; 18: 106-11.
75. Mullen PE, Martin J. Jealousy: a community study. *Br J Psychiatry* 1994; 34: 35-43.
76. Derntl B, Habel U. Deficits in social cognition: a marker for psychiatric disorders? *Eur Arch Psychiatry Clin Neurosci* 2011; 261 (S2): S145-S149.
77. Roberts KA. Stalking following the breakup of romantic relationships: characteristics of stalking former partners. *J Forensic Sci* 2002; 47: 1070-7.
78. Meloy JR. Erotomania, triangulation, and homicide. *J Forensic Sci* 1999; 44: 421-4.
79. Hart SL, Legerstee M (eds). Handbook of jealousy: theory, research and multidisciplinary approaches. West Suzzex, UK: Blackwell Publishing, 2010.
80. Marazziti D, Rucci P, Di Nasso E, et al. Jealousy and subthreshold psychopathology: a serotonergic link. *Neuropsychobiology* 2003; 47: 12-6.
81. Takahashi H, Matsuura M, Yahata N, Koeda M, Suhara T, Okubo Y. Men and women show distinct brain activations during imagery of sexual and emotional infidelity. *Neuroimage* 2006; 32: 1299-307.
82. Marazziti D, Poletti M, Dell'Osso L, Baroni S, Bonuccelli U. Prefrontal cortex, dopamine, and jealousy endophenotype. *CNS Spectr* 2013; 18: 6-14.
83. Kapur S. Psychosis as a state of aberrant salience: a framework linking biology, phenomenology and pharmacology in schizophrenia. *Am J Psychiatry* 2003; 160: 13-23.
84. Peele S. Love and addiction. New York: Taplinger Publishing Company, 1975.
85. Schultz W, Dayan P, Montague PR. A neural substrate of prediction and reward. *Science* 1997; 275: 1593-815.
86. Wise RA. Neurobiology of addiction. *Curr Opin Neurobiol* 1996; 6: 243-7.
87. Hollander E. Understanding the difference between impulsivity and compulsivity. *Psychiatric Time* 2008; 25: 1-22.