Defective somatic markers in subclinical psychopathy

Abstract

Damasio’s (1994) Somatic Marker Hypothesis (SMH) is argued to be specifically applicable to psychopathy, though evidence is meager until now. The principal evidence for the SMH is based on findings in patients with orbitofrontal lesions, showing absent punishment learning on the Iowa gambling task. Interestingly, neuroimaging studies indicate orbitofrontal dysfunction in psychopathy also. Here we investigated the SMH in subjects selected on low and high psychopathic behavioral characteristics from the outer extreme ranges of a large subject pool (n = 525). The low psychopathic subject group (n=16) showed intact punishment learning, suggesting somatic markers came to guide their decisions in the course of the game. In contrast, such punishment learning was not observed in the high psychopathic subject group (n=16), who mimicked the gambling behavior of orbitofrontal patients. These findings provide further evidence for the hypothesized link between psychopathy and orbitofrontal dysfunction.
Introduction

The psychopath is a fearless remorseless predator whose insensitivity to punishment together with a strong reward dependency results in a tendency to commit violent, anti-social acts. An interesting theoretical framework which may apply to the behavior of the psychopath is Damasio's somatic marker hypothesis (1994). This hypothesis has introduced emotion into the neurocognition of decision making: breaking with longstanding dogmas concerning rationality in decision making, it states that cognition depends on emotion to select appropriate behavior. The somatic marker hypothesis states that emotional learning is established by somatic or bodily feelings unconsciously and consciously marking certain behaviors having unpleasant outcomes. These induce inhibition of these punishment (i.e., fear) contingent behavioral choices. An emotion-governed bio-regulatory system modulates and constrains decision making. A line of reasoning not only defying traditional decision making theory, but also at odds with many theoretical models of psychopathology which tend to (over-)emphasize the destructive value of fear (Chorpita & Barlow, 1998).

The most convincing evidence for the somatic marker hypothesis is based on findings with the Iowa gambling task, a paradigm mimicking real-life uncertainty, reward and punishment (Bechara, Damasio, Damasio, & Anderson, 1994). Unaware of strategy, guided by unconscious markers observable as anticipatory skin conductance responses, normal subjects learn to choose advantageously already in the first half of this game (Tranel, Bechara, & Damasio, 2000). However, patients with orbitofrontal lesions develop neither unconscious nor conscious markers, resulting in impaired decision making. That is, orbitofrontal patients continue choosing from the risky punishing decks throughout the game, even after they have become consciously aware that this is a disadvantageous strategy.

Interestingly, although evidence for the somatic marker hypothesis is almost exclusively based on findings in neurological patients, it is suggested to be specifically applicable to the maladaptive consequences of
fearlessness and impulsive reward craving shown in psychopathy (Bechara, Damasio, & Damasio, 2000; Damasio, 1994; Tranel, 2000). Not only does the personality profile of orbitofrontal patients strikingly resemble that of the psychopath, but there is also evidence from neuro-imaging and neuropsychological studies suggesting dysfunctional orbitofrontal circuits in psychopaths (Dinn & Harris, 2000; Raine, Lencz, Birnle, La Casse, & Colletti, 2000; Van Honk et al., 2001). Thus, the somatic marker hypothesis should also apply to the behavior of the psychopath (Bechara et al., 2000; Tranel et al., 2000).

A first attempt to test the somatic marker hypothesis by assessing the Iowa gambling task in incarcerated psychopaths was not successful (Schmitt, Brinkley, & Newman, 1999). The confounding effects of institutionalization in the tested forensic sample and control group might have resulted in this null finding (Dinn & Harris, 2000). Nevertheless, Blair, Colledge, & Mitchell (2001) recently showed impaired performance on the gambling task in boys with psychopathic tendencies.

Here we started from the premise that a genetic predisposition underlying psychopathy is normally distributed in the population (Mealey, 1995), and assessed Iowa gambling task performance in subjects selected on psychopathic personality characteristics from outer extreme ranges of a large subject pool. If impaired decision making on this task assessing orbitofrontal functioning (Bechara et al., 2000; Tranel et al., 2000) might be demonstrated in such a sub-clinical population, further evidence for the hypothetical link between psychopathy and orbitofrontal function would be obtained.

Method

Participants

525 Students at the Utrecht University completed Carver and White’s (1994) orthogonally-dimensioned behavioral inhibition system (BIS) and behavioral activation system (BAS) self-report measures derived from Grays (1987) powerful framework of human personality. Selection of our participants from the large respondent pool was based upon the 2 ex-
treme quadrants along the diagonal in 2-dimensional BIS/BAS space. Medians for BIS and BAS were calculated, respondents scoring within a 3 point range of these parameters were discarded and only participants scoring high BIS/low BAS or low BIS/ high BAS after this restriction were retained for further selection. To obtain a selection of participants with only the strongest punishment-/reward sensitive motivational stances, difference scores BAS minus BIS and BIS minus BAS (range-corrected) were calculated. In this manner, 16 subjects scoring most extremely low on the BIS/high on BAS, and 16 subjects scoring high on BIS/low on BAS were selected for participation (age range = 19-25 years). For both groups female – male ratios were 8 : 8. The BIS is argued to be activated by conditioned signals of punishment, whereas BAS action involves conditioned signals of reward (Avila, 2001). Thus, at an extreme, strong BAS/weak BIS reflects the fearless, reward-craving, punishment insensitive, thus “psychopathic” personality, whereas weak BAS/strong BIS reflects the fearful, punishment sensitive, risk aversive, thus “non-psychopathic” personality (Fowles, 1980; Kring & Barchersowski, 1999). The applicability of the SMH for psychopathy was tested by assessing the computerized version of the Bechara et al. (1994) Iowa gambling task in these subjects in an experimenter-blind design.

Procedure
In the Iowa gambling task players are instructed to try to gain as much money as possible by drawing 100 selections from a choice of four decks, while starting with a fictional loan of 2000 US Dollars. The decisions to choose from the decks should become motivated by reward and punishment schedules inherent in the task. Two of the decks are disadvantageous, producing immediate large rewards but these are (after a pre-punishment phase of about 10-15 cards) accompanied by significant money loss due to extreme punishments. The other two decks are advantageous; reward is modest but more consistent and punishment is low (Bechara et al., 1994).
Results

Performance on the game was divided in 5 periods of 20 card selections (Bechara et al., 1994). A linear ANOVA over these 5 periods of 20 card selections was computed using Group (low vs. high psychopath) and Gender (female vs. male) as between subject factors. There were no significant effects or interactions for Gender [ all Fs < 1 ], therefore Gender was excluded from further analyses. Data showed a highly significant interaction for Group [ F(4,27) = 3.97; p = 0.012 ].

As can be seen from Figure 5.1, the low psychopaths began to choose advantageously almost immediately after the first punishment trials were delivered, gradually choosing more and more from the advantageous decks. The high psychopaths showed no such learning, they continued to make risky disadvantageous decisions throughout the game, resulting in highly significant group difference in the 5th period [ F(1,30) = 10.21; p = 0.003 ]. Finally, some initial gain in the pre-punishment period for the high psychopaths could not prevent significant money loss [ t(15) = 2.93; p = 0.01 ] by the end of the game. On the other hand, though not a significant amount, some money was gained by the low psychopaths [ t(15) = 1.09, p = 0.3 ].

Figure 5.1. Mean scores and SEM for gambling pattern of the subject groups scoring high and low on psychopathy.
Discussion

Here we provide evidence for the applicability of the SMH to psychopathic behavior. As can be seen from Figure 5.1, a significantly different pattern of decision making was observed for the low and the high psychopathic subject-groups. It should furthermore be noted that in earlier research with the gambling task it has been established that the game can be divided in an unconscious and a conscious knowledge stage (Tranel et al., 2000). Until roughly halfway the game (the unconscious stage) patients nor normal control subjects develop any knowledge of the advantageous strategy. From card 50 onwards gradually knowledge about this strategy begins to reach awareness, although the pattern in orbitofrontal patients (approximately 50% reaching full awareness of strategy by the end of the game) differs from normal subjects (approximately 75% reaching full awareness). As might be expected on basis of our subject-selection, post-experimental interview indicated that the latter pattern applied to both our subject groups. This is also in agreement with the fact that performance in the low psychopathic group fairly resembles Iowa gambling of a large group of normal subjects reported by Bechara et al. (2000). Already in the first half of the game, unconscious somatic markers seem to steer decision making towards the advantageous decks, and the proportion of these profitable choices gradually increases during the second half of the game, when the game’s strategy becomes conscious to most of the subjects. However, this pattern of learning is not observed in the high psychopathic group, despite a similar pattern of knowledge about strategy, unconscious nor conscious somatic markers seem to affect their behavior.

This observed pattern of decision making in our high psychopathic subject group mimics Iowa gambling performance of patients with orbitofrontal lesions. A disadvantageous pattern of behavior here however unlikely due to orbitofrontal ‘damage’, but defensibly reflecting a functional difference in affective modulation at the orbitofrontal level, as the Iowa gambling task is a robust marker for orbitofrontal functioning. In sum, already in a sub-clinical manifestation of psychopathy, orbi-
to frontal patient-alike deficient somatic markers can be observed. Since the Iowa gambling task specifically assesses orbitofrontal functioning, this finding provides further evidence for the hypothetical link between psychopathy and orbitofrontal function.
References


