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The effects of reward and punishment on response inhibition in non-clinical psychopathy

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ABSTRACT

Response inhibition is an important control mechanism in reacting effectively to sudden changes in the environment, and a deficit in this mechanism is thought to be a main feature of various impulse control disorders, including psychopathy. This study investigated the effects of reward and punishment on the inhibitory capabilities of non-clinical participants with both high and low levels of psychopathy. Forty participants performed a stop-signal task under three conditions in a mixed factorial design: a no reward or punishment (N) condition, a low magnitude reward and punishment (L) condition, and a high magnitude reward and punishment (H) condition. Participants with low psychopathy were more inhibited during both reward and punishment conditions as compared to the no reward/punishment condition. On the other hand, participants with high psychopathy showed increased response inhibition only during the L condition. The presence of reward and/or punishment, regardless of magnitude, increases response inhibition in participants with low psychopathy, whereas high levels of reward and/or punishment do not affect response inhibition in high psychopathy participants. These results suggest that a deficit in response inhibition under incentive conditions could constitute a dimensional feature or aspect of clinical and non-clinical psychopathy.

1. Introduction

Response inhibition is the ability to inhibit planned or ongoing actions, and represents an important control mechanism for effectively reacting to sudden changes in the environment. A deficit in this inhibitory capability can induce people to behave impulsively and to react inappropriately. A strong association between response disinhibition and certain mental disorders such as substance abuse or personality disorder is well known (e.g., Miller, Flory, Lynam, & Leukefeld, 2003; Moeller, Barratt, Dougherty, Schmitz, & Swann, 2001). For example, Cleckley (1976) reported that a lack of self-control characterizes psychopathic behavior.

Psychopathy is defined by a constellation of affective, interpersonal, and behavioral characteristics, including egocentricity, impulsivity, irresponsibility, shallow emotions, lack of empathy, guilt, or remorse, pathological lying, manipulativeness, and "the persistent violation of social norms and expectations" (Hare, 1998, p. 188). Hare and Neumann (2008) suggested that psychopathy might be a trait that is continuously distributed within the general population. Some taxometric studies have indicated that psychopathy is indeed a dimensional construct, whether assessed by self-report (Marcus, John, & Edens, 2004) or via clinical ratings using the psychopathy checklist-revised (PCL-R; Hare, 1991, 2003; see Edens, Marcus, Lilienfeld, & Poythress, 2006; Guay, Ruscio, Knight, & Hare, 2007).

Previous research indicates that response disinhibition is characteristic of clinical psychopathy under reward and punishment conditions (Newman & Kosson, 1986). Newman and Kosson (1986) found that non-psychopathic participants showed a greater decrease in commission errors on a response inhibition Go/No-go task, in a reward and punishment situation as compared to a punishment-only condition. In contrast, clinical psychopathy did not alter behavior during the task, regardless of condition. In addition, psychopathic traits appear to be positively associated with sensitivity to reward and negatively associated with sensitivity to punishment (Ross et al., 2007). The presence of reward and/or punishment has a differential influence on response inhibition, depending on degree of psychopathy.

A previous study suggested that the presence of incentive has an influence on response inhibition in people who are prone to risk-taking (Rodrígues-Fornells, Lorenzo-Seva, & Andrés-Pueyo, 2002). Rodrígues-Fornells et al. (2002) concluded that cautious participants, who show less willingness to take risks, become increasingly cautious in the presence of reward or punishment, while risk-taking participants do not alter their behavior as a function of the presence or absence of incentives. However, no study has investigated

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whether response inhibition in non-clinical psychopathy is altered by the presence of reward and/or punishment. Furthermore, no study has examined the effects of reward or punishment magnitude on response inhibition. We investigated the inhibitory capabilities of non-clinical individuals with high and low levels of psychopathy using a stop-signal paradigm (SSP; Logan, 1994; Logan & Cowan, 1984), under three reward and punishment conditions: no reward and punishment (N), low magnitude of reward and punishment (L), and high magnitude of reward and punishment (H).

The SSP provides a useful experimental measure of inhibitory abilities in both normal and clinical samples. In the SSP, participants are engaged in a reaction time task and are occasionally and unpredictably presented with a signal (e.g., a tone or light) that instructs them to inhibit their response to the stimulus. The SSP consists of both non-stop and stop trials, and in the non-stop trials, participants are required to react to certain stimuli as quickly as possible. When a stop-signal is presented, participants have to inhibit their ongoing behavior to the best of their ability. This stop-signal can occur at one of several time delays following the presentation of the stimulus. Unlike a Go/No-Go task, SSP stimuli are not divided into non-stop stimuli and stop stimuli from the very beginning. Thus, the SSP is more suitable as a measure of one's ability to inhibit or stop ongoing reactions (Masui & Nomura, in press).

The purpose of the present study was to examine whether the presence of reward and punishment influences the response inhibition capacities of non-clinical psychopathic individuals. We conducted an SSP task in combination with the provision of rewards and punishments, and our sample included participants with low and high levels of psychopathy. Earlier findings led us to the following hypotheses regarding participants' SSP performance: When participants are required to inhibit responses, low psychopathy participants should show increased inhibitory control under the L and H conditions as compared to the N condition. On the other hand, high psychopathy participants should not show improved response inhibition under incentive conditions.

2. Method

2.1. Participants

Forty participants were recruited to participate in the present experiment from a total initial sample of 145 (106 male and 39 female) Japanese university students who completed the Japanese version of the Levenson Self-Report Psychopathy (LSRP) scale (Levenson, Kiehl, & Fitzpatrick, 1995). We recruited those participants who scored particularly high and low on the LSRP scale: the 20 students who scored highest on the LSRP scale were assigned to the high psychopathy group, and the 20 who scored lowest on the LSRP scale were assigned to the low psychopathy group. All participants were right-handed, in order to standardize the response selection format on the SSP. Half of the participants in both groups were female. Initially, female participants belonging to the high and low psychopathy groups were selected. We then recruited male participants, such that mean LSRP scale scores were comparable to those of the female participants. The data of two participants who could not gain any points during the reward and punishment condition (task details below) were excluded from further analysis.

The mean ages were 19.00 for the high psychopathy group (SD = 0.58) and 19.79 for the low psychopathy group (SD = 3.77).

2.2. Psychopathy assessment

The LSRP scale is a 26-item questionnaire designed to measure psychopathic traits in a healthy population. Each item is a statement that is rated on a four-point Likert-type scale (from strongly disagree to strongly agree). The LSRP scale has two subscales: the primary and secondary psychopathy subscales. The primary psychopathy scale consists of 16 items measuring manipulation, egocentricity, and lack of empathy and remorse, whereas the secondary scale consists of 10 items measuring impulsivity, quick-temperedness, and poor behavioral control. The LSRP scale has moderate reliability and convergent validity with alternative measures of psychopathy (Brinkley, Schmitt, Smith, & Newman, 2001; Lynam, Whiteside, & Jones, 1999). A Japanese version of the LSRP scale was developed through back translation of the items (Sugiura & Sato, 2005), and demonstrates the same factor structure as the original, along with adequate test–retest reliability and construct validity (Osumi, Kanayama, Sugiura, & Ohira, 2007). Coefficient alphas for this study were 0.74 for the total LSRP scale, 0.70 for the primary psychopathy scale, and 0.58 for the secondary psychopathy scale, values approximately equivalent to those provided by Levenson et al. (1995).

The scores on the LPSP scale were 50–69 ($M = 58.21$, SD = 5.43) for the high psychopathy group, and 36–48 ($M = 41.95$, SD = 3.69) for the low psychopathy group. The primary psychopathy scale scores were 28–46 ($M = 35.89$, SD = 4.46) for the high psychopathy group and 19–32 ($M = 25.37$, SD = 3.20) for the low group. For the secondary psychopathy scale, the scores were 17–30 ($M = 22.32$, SD = 3.20) for the high psychopathy group and 13–21 ($M = 16.58$, SD = 2.17) for the low group. There were significant differences in total LSRP scale scores (t (36) = −10.80, $p < 0.001$, $d = 3.50$), primary psychopathy scale scores (t (36) = −8.36, $p < 0.001$, $d = 2.71$), and secondary psychopathy scale scores (t (36) = −6.47, $p < 0.001$, $d = 2.10$) between the two groups.

2.3. Procedure

We used the SSP to measure participants' ability to inhibit actions. As was done in Rodrígues-Fornells et al. (2002), the stimuli used in this study were the uppercase letters V, M, W, and N, viewed on a computer screen at a distance of about 60 cm. The stop-signal was a red triangle that appeared above the letters, for a duration of 150 ms.

The letters V and M were assigned to one hand, and W and N were assigned to the other. Each trial began with a white fixation point presented at the center of the screen for 500 ms. This point then disappeared, and 400 ms later a letter stimulus was presented at the center of the screen for 1.1 s. The screen then went blank for 700 ms. Participants responded by pressing a key corresponding to the hand the letter was assigned to, which was 'Z' (for the left hand) or '/' (for the right hand) on the keyboard. The mapping of letters onto the keys was counterbalanced across participants.

All participants were tested in four separate sessions, one after the other. In the first session, the participants performed a choice RT task for two blocks of 100 trials each. In this task, participants merely had to respond with the appropriate hand to the corresponding letter. This task was used to determine the baseline RT of each participant, in order to accurately set the stop-signal delays. The mean RT (MRT) for the second block of the choice RT task was selected as each participant's baseline. Stop-signal delays were standardized using this MRT time as follows: MRT of 500 ms, MRT of 350 ms, MRT of 250 ms, and MRT of 100 ms (for details, see Solanto et al., 2001).

In the second session, all participants performed the SSP under the N condition. Participants were instructed not to respond to the primary-task stimulus when the red triangle symbol appeared. They were told that the stop-signal would occur in such a way that they would sometimes be able to stop their response, and sometimes not. Participants were instructed to respond as quickly as possible while also maintaining a high level of accuracy. Moreover,