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Handedness and behavioural inhibition: Left-handed females show most inhibition as measured by BIS/BAS self-report

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ABSTRACT

This study investigated the relationship between handedness, gender and behavioural approach and inhibition using Carver and White's (1994) BIS/BAS Scale. 112 participants took part: 46 left-handers and 66 right-handers. All participants completed Peters' (1998) handedness questionnaire followed by the self-report BIS/BAS Scale. Significant effects of both handedness and gender on the BIS scores were found, with left-handers and females scoring significantly higher on inhibition. BIS scores were re-examined to include FFFS scores, which showed a significant effect of gender. Revised BIS scores replicated the original BIS findings. These findings are discussed in relation to handedness research.

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1. Introduction

Converging evidence suggests the right hemisphere of the brain is more involved in processing negative emotional information and right hemisphere activation is associated with temperamental shyness, anxiety, and behavioural inhibition in human infants (Schmidt, Fox, Schulkin, & Gold, 1999), and behavioural inhibition in primates' motor responses to novel objects (e.g. Cameron & Rogers, 1999). Thus, research consistently indicates that right hemisphere dominance, or activation, can result in behavioural inhibition. This has been supported by work relating physiology to emotional asymmetry (e.g. Davidson, 1985, 1998). Gray (1982) originally suggested that we have two independent neural behavioural systems – the behavioural inhibition system (BIS) and the behavioural activation system (BAS). These two systems are motivational systems that influence our underlying behaviour, relating to either anxiety (BIS) or impulsivity (BAS). The BIS system relates to avoidance behaviour while the BAS relates to approach behaviour (Carver & White, 1994). Individuals can experience a number of combinations of BIS/BAS sensitivity (e.g. high BAS sensitivity but low BIS sensitivity or low BIS and low BAS sensitivity). Therefore if one specific stimulus was shown to a group of people they would react in a number of different ways depending on which of the behavioural systems were activated and to what extent (Gray, 1981). Carver and White (1994) state that when the BIS is activated

the individual may become behaviourally inhibited. One reason cited for the activation of the BIS system is to avoid any form of confrontation or negative outcome but by doing so the individual may miss the chance to gain positive outcomes or rewards. Gray (1981) states that BIS activation makes the individual experience negative feelings such as frustration, fear and anxiety and this, in turn, will influence behaviour. Stuetgen, Hennig, Reuter, and Netter (2005) report that individuals with high BIS scores may be prone to high levels of anxiety, adding that these individuals possibly adopt a series of behavioural coping strategies in order to reduce their anxiety levels.

Behavioural response style differences have been linked to hemispheric differences. Davidson (1985, 1998) proposed that the BIS system was a withdrawal system, predominantly linked to the right hemisphere relating to inhibition of behaviour and negative affect. He argues that the left hemisphere is an activation system, linked to positive affect and approach. Other evidence suggests that BIS is more related to processing of threat, rather than anxiety per se (e.g. Avila & Torrubia, 2006), and is arguably a threat detection system. This suggests that BIS is not purely a measure of anxiety but a system related to behavioural inhibition that may be influenced by anxiety levels. Linking this to the BIS/BAS questionnaire, several studies have shown that cortical activity in the left frontal lobe has been linked to increased BAS scores (Coan & Allen, 2003; Sutton & Davidson, 1997). Taken together, this suggests that Carver and White's (1994) BIS/BAS questionnaire is tapping into a measure of response style (i.e. approach/avoidance) that is intrinsically linked to hemispheric activation. This allows the prediction of dispositional differences related to handedness differences.

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To our knowledge, very little previous research exists linking handedness and behavioural inhibition/activation. However, several have investigated the relationship between anxiety and handedness. Hicks and Pellegrini (1978), Davidson and Schaffer (1983) and Wright (2005) reported that left-handers were more anxious than right-handers, whereas studies such as Beaton and Moseley (1984) and Merckelbach, de Ruiter, and Olff (1989) have found no relationship between anxiety and handedness. It is therefore interesting to investigate any possible relationship between handedness and behavioural inhibition given the strong link between behavioural inhibition and anxiety. Previous studies have investigated the relationship between handedness and behavioural response through approach and avoidance behaviour (e.g. Cameron & Rogers, 1999; Wright, Hardie, & Rodway, 2004). A strong link between left-handedness and avoidance behaviour was reported, where left-handed participants took significantly longer to approach an object or task than right-handed individuals. One explanation given in the study by Cameron and Rogers (1999) is that the novelty of a situation might have influenced left-handers more than right-handers. Wright et al. (2004) also reported that the task novelty may have been related to the avoidance behaviour shown by left-handed participants in their study. This effect of novelty and avoidance can be related to behavioural inhibition. Quilty, Oakman, and Farvolden (2007) state that behavioural inhibition is positively related to a preference for familiarity and behavioural activation is negatively associated with familiarity, with novelty seeking being one central feature of the BAS system. Thus this association would cause us to speculate that there might be a link between handedness and approach and avoidance behaviour as measured by the BIS/BAS scale.

Recent work (e.g. Smillie, Pickering, & Jackson, 2006) has argued that Carver and White's scale does not reflect the extensive theoretical changes since Gray's original theory. Specifically, Gray and McNaughton (2000) extended the original idea of impulsivity (BAS) and anxiety (BIS) into a three system theory. This revised theory (now generally referred to as reinforcement sensitivity theory, RST) both modified the original BIS concept, and added a fight-flight-freeze system (FFFS), which was thought to relate to how to respond to aversive stimuli, mainly via avoidance, either defensive (fear) or escape (panic). The BAS system is still defined as an approach system, but the BIS system is now not an avoidance system per se, but is re-defined as a system related to resolving goal conflict (e.g. approach vs. avoidance) which includes conflict both within and between the systems. Thus BIS can be considered to be inhibiting ongoing behaviour (FFFS and BAS mediated behaviour) and at the same time directing attention and arousal towards the stimuli causing the conflict (Smillie et al., 2006). This generates a state of anxiety and leads to the assessment of risk and resolution of the conflict (see Corr & McNaughton, 2008).

Therefore, the clearest implication of this work is that there should be a distinction between fear (via FFFS) and anxiety (via BIS), and applying this to handedness might help to explain behavioural differences. For example, when left-handers take longer to start a task (e.g. Wright et al., 2004), we will be able to hypothesise about the relative role of fear and anxiety in terms of what may be creating the delay to action. A higher BIS score would support the idea of left-handers being more anxious about wanting to approach it, rather than showing fear from the stimuli.

To date, however, few studies have tested the revised RST (mainly due to Carver and White's (1994) BIS/BAS scales not mapping directly onto it), but recent work (Corr & McNaughton, 2008) has shown that FFFS scores can be derived from BIS questions. This will be explored in the current study.

A link can also be made between gender and behavioural inhibition. Numerous studies report a relationship between gender and anxiety, and it is clear that females are more anxious than males

(e.g. Feingold, 1994; MacKinaw-Koons & Vasey, 2000). Several studies have investigated the possible relationship between gender and behavioural inhibition, and have consistently shown that females score higher on BIS scores (Carver & White, 1994; Leone, Perugini, Bagozzi, Pierro, & Mannetti, 2001). In addition, while Mardaga and Hansenne (2007) also reported that females scored significantly higher on the BIS scale they found that their BAS scores were very similar to males (overall and for all 3 sub-scales). Similarly, Jorm et al. (1999) reported the same pattern in BIS scores but found that females scored higher on the BAS reward responsiveness scale while males scored significantly higher on the BAS drive scale. This suggests that there is usually a clear gender difference in BIS scores, but no consistent pattern in BAS scores.

The present study examines the relationship between handedness, gender and self-report BIS/BAS (including a derived measure of FFFS to reflect revisions to RST) using Peters' (1998) handedness questionnaire and Carver and White's (1994) BIS/BAS scale. As left-handers exhibit right hemisphere dominance, linked to the brains' inhibitory system, it is hypothesised that the BIS scores of left-handers will be higher than those of right-handers. As right-handers exhibit left hemisphere dominance linked to the behavioural activation system, it is hypothesised that right-handers will score higher on BAS. Additionally, it is hypothesised that females will have higher BIS scores.

2. Method

2.1. Participants

One hundred and twelve participants took part in this study – 54 males and 58 females. Forty six participants were left-handed (24 males and 22 females) and 66 participants were right-handed (33 males and 33 females). All were University students with an age range from 18 to 52 years.

2.2. Materials

Peters' (1998) handedness questionnaire was used to measure participant's handedness. This is a 25 item scale scored using a 5 point Likert scale (left-hand always, left-hand mostly, either hand, right-hand mostly and right-hand always). The five points on the scale are assigned values from –2 (always use the left-hand) through to 2 (always use the right-hand) and each item is scored individually then totalled to give an overall handedness score. A total positive value indicates a right-hand preference and a total negative value indicates a left-hand preference. The BIS/BAS questionnaire (Carver & White, 1994) consisted of a list of 24 statements which participants were asked whether they agreed or disagreed with (using a 4-point Likert scale). Examples of statements are 'criticism or scolding hurts me quite a bit' and 'when good things happen to me, it affects me strongly'. Participants were instructed to respond to all items and not leave any blank. The scoring system measured the participants' behavioural activation levels (3 sub-sections) and behavioural inhibition levels.

2.3. Procedure

Participants were asked to complete the handedness questionnaire followed by the BIS/BAS questionnaire. Participants were asked to read the instructions carefully and were informed that there was no time limit. Total BAS, BAS drive, BAS fun seeking, BAS reward and BIS scores were calculated along with handedness questionnaire scores. Additionally, the BIS scale was broken down, and scored, into FFFS (questions 2 and 22) and BIS components (remaining 5 original BIS questions) (see Corr & McNaughton,

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