

# **The relationship between Revised Reinforcement Sensitivity Theory (rRST), handedness and indecision**

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## **Abstract**

Indecisiveness is an inability to make a decision, manifest across a number of behaviours. We explore the influence that both direction and strength of hand preference may have on this construct, examining it in relation to the revised Reinforcement Sensitivity Theory (rRST). Frost and Shows' (1993) Indecisiveness Scale was administered to 328 undergraduates (221 females), alongside the Edinburgh Handedness Inventory (Oldfield, 1971) and Carver and White's (1994) BIS/BAS scales. Simple correlations showed left-handers had a positive relationship between strength of handedness and BIS. In right-handers, strength and aversive indecision were positively correlated. Regression analysis demonstrated no significant relationship between hand strength and indecision, but that indecision was related to all three measures of rRST. Consistent with previous work, BIS was positively related to all indecision but particularly aversive, while BAS was negatively related to indecision but most strongly the avoidant category. We found that FFFS is more closely related to aversive than avoidant indecision. The relationship between rRST and indecision may be influenced by handedness; for right-handers the same pattern was found, but in left-handers BAS was not a significant predictor of indecision, BIS only predicted aversive indecision and FFFS predicted all three categories.

## 1. Introduction

Indecision is the act of delaying or not making a decision, and is the subject of a substantive body of research in a number of fields such as management (Mulki, Jaramillo, Malhotra, & Locander, 2012), decision making in groups (Patalano & LeClair, 2011) and career choice (Germeijs & Verschueren, 2011a). Chronic indecisiveness has been implicated in clinical anxiety conditions such as Obsessive Compulsive Disorder (Gayton, Clavin, Clavin & Broida, 1994) and depression (van Randenborgh, de Jong-Meyer & Hüffmeier, 2010). In the context of career choice, using their own instrument, Germeijs and colleagues examined the relationship indecisiveness has to the Big Five personality factors (Germeijs & Verschueren, 2011a) and anxiety (Germeijs & Verschueren, 2011b). This work established that indecisiveness is a trait-like tendency to have decision-making problems, and is separate from other constructs such as personality and anxiety. However, this measure has not been widely adopted outside of the career context and its' wider suitability is unclear.

Perhaps the largest body of indecision research has been based on Frost and Shows' (1993) measure. Their Indecisiveness Scale (IS), is a 15-item self-report questionnaire which is arguably the most valid and useful measure of indecisiveness. It correlates positively with tasks measuring indecisiveness (Rassin, Muris, Booster & Kolsloot, 2008) and females are generally more indecisive than males (Rassin & Muris, 2005). Questions have been raised about its' optimal length and factor structure and Rassin, Muris, Franken, Smit and Wong (2007) conducted an extensive evaluation of the IS, proposing an amended 11-item version. Using this version, Spunt, Rassin and Epstein (2009) argued on empirical and theoretical grounds that two classes of indecision should be found; avoidant (not making decisions, general motivation towards avoiding decisions) and aversive (aversion orientated towards threatening aspects and negative emotions).

Although an alternative subdivision exists, with categories of 'General' and 'Planning' indecisiveness (Patalano & Wengrovitz, 2006), this was based on the original 15-item version. Taking this into account, we feel that the Spunt et al. (2009) categorisation of 11-items into aversive and avoidant indecisiveness is a better conceptual fit with the handedness literature (e.g. Wright, Hardie & Wilson, 2009; Wright & Hardie, 2011), has an acceptable factor structure, and is therefore adopted in the current study.

Research by Davidson and Colleagues (e.g. Sutton & Davidson, 1997; Maxwell & Davidson, 2007) argues that the right-hemisphere (RH) is specialised for withdrawal/negative affect, while the left-hemisphere (LH) is specialised for approach/positive affect. Rutherford and Lindell (2011) recently reviewed evidence and strongly supported the view that motivational systems underlying approach and avoidance exist in parallel and are lateralised in the brain.

How does this relate to decision making? Hecht, Walsh and Lavidor (2010) argue that evidence points to the LH being more involved in actively making a decision. For example, Hecht (2010) examined this experimentally using transcranial direct current stimulation, enhancing activation in one frontal region when simultaneously suppressing the other. This showed LH stimulation to result in a quicker choice to actively pursue a goal or decision. To date, this lateralised model has been mainly based on right-handers, and although existing evidence supports a lateralised motivational system, it is unclear how this relates to left-handers. Some evidence supports a strong association between the RH and problems with negative affect when making decisions. In non-clinical populations, worry proneness, depressive and obsessive-compulsive symptoms and trait anxiety have all been linked to indecision (Frost & Shows, 1993; Rassin & Muris, 2005; Rassin et al., 2007), and these characteristics themselves have been related to the RH and left-handedness (Wright et al., 2009; Wright & Hardie, 2012).

Indeed, based on a series of experiments, Wright & colleagues have shown left-handedness to be associated with an increased degree of avoidance compared to right-handers. Specifically, left-handers show themselves to be behaviourally avoidant, taking significantly longer than right-handers to initiate a novel task (Wright, Hardie & Rodway, 2004; Wright & Hardie, 2011), exhibit a higher degree of state anxiety when confronted with such tasks (Wright & Hardie, 2012), and report themselves to be more behaviourally inhibited (Wright et al., 2009). It is possible that left-handers may express more inhibition and worry compared to right-handers, manifesting this as difficulties in decision making, leading to indecisiveness. Thus we would predict that left-handers would demonstrate higher indecision scores.

*H1: Direction of handedness is associated with indecision, where those with a right-hand preference will show less indecision than those with a left-hand preference.*

Another link between indecisiveness and laterality can be made on the basis of degree of lateralisation, where strength of handedness could be an indication of cross-hemisphere interaction. This allows mixed-handers to draw on resources from both hemispheres (Christman, Jasper, Sontam & Cooil, 2007). Niebauer (2004) demonstrated that strong hand preference (regardless of direction) is related to rumination, with mixed-handers showing more self-reflection, thus indicating a different approach to dealing with information. Their sample was mainly right and mixed right-handers (7% left), suggesting little is known about how left-handers respond. In a decision making task, McElroy and Corbin (2010) found mixed-handers were more likely to impose a negative frame, and more inhibited response, compared to strong (mainly right) handers. This work implies that more strongly lateralised individuals may show lower indecisiveness when compared to less strongly lateralised individuals.

*H2: Strength of handedness is associated with degree of indecision, where those with a stronger hand preference will show less indecision*

Spunt et al. (2009) linked their indecisiveness categories to the revised Reinforcement Sensitivity Theory (rRST) of personality. As argued by Gray and McNaughton (2000), rRST contains an approach or behavioural activation system (BAS), an avoidant or behavioural inhibition system (BIS), and a Fight-Flight-Freeze system (FFFS). The BAS motivates individuals to act to achieve positive outcomes, to approach a situation, and also the system promoting impulsive behaviour. The FFFS mediates inhibitory responses, such as prompting the emotion of fear in dangerous situations and the individual will decide to fight for protection, withdraw or freeze. The BIS is a system dealing with conflict both within and between the other two systems (Corr, 2011) and is essentially a mediator for goal conflict resolution. When approaching conflicting situations BIS is activated, inhibiting any further actions and directing attention towards reaching an outcome. In effect, BIS activation may represent the process of indecision, at least until the conflict is resolved and a decision is made. BIS activation causes the individual to experience feelings of anxiety until an appropriate course of action has been decided upon. Spunt et al. (2009) found BIS to be strongly and positively related to indecision, especially aversive indecision. Avoidant indecision was negatively linked to BAS scores. The BAS is linked to left-hemisphere activity (Sutton & Davidson, 1997) and as the left-hemisphere is strongly implicated in speed of making decisions (Hecht, 2010); high BAS individuals and right-handers are more likely to approach situations quickly. Unfortunately Spunt et al. (2009) did not examine the role of FFFS but it may link to both types of indecision, as indecisiveness presumably relates to conflicting tendencies of approach (BAS) and avoidance (FFFS). FFFS is also derived from the BIS scale, suggesting a relationship to aversive indecision may be stronger than to avoidant indecision.

*H3: BIS scores will be related to handedness and indecision, where left-handers scoring higher on BIS will show more indecision, particularly aversive indecision.*

*H4: BAS scores will be related to handedness and indecision, where right-handers and low scorers on BAS will show less indecision, particularly avoidant indecision.*

*H5: FFS scores will be related to indecision, particularly aversive indecision.*

As gender has been shown to be a contributory factor in previous indecision research (e.g. Rassin & Muris, 2005; Rassin et al., 2007) it will be examined as an additional independent variable in the current study.

## **2. Method**

### **2.1 Participants**

328 participants took part; the majority were young undergraduate students (75% in the 18-29 years category). There were 107 males and 221 females, mainly (90%) from the United Kingdom.

### **2.2 Measurement**

Demographics were collected at the start, including age category (18-29, 30-39, 40-49, 50-59, 60-69, 70+ years) and gender. Hand preference was measured using the Edinburgh Handedness Inventory (Oldfield, 1971), and participants indicated which hand they would normally use in each of ten tasks. The choices were Left Always, Left Mostly, Either, Right Mostly, Right Always, and were scored as -10, -5, 0, 5, 10 respectively. Overall hand-preference was a summation of

individual scores, ranging from -100 (completely left-handed) to +100 (completely right-handed). A score of zero indicated no overall preference. Participants scoring  $<0$  were categorised as left-handed and if  $>0$ , right-handed (Wright et al., 2009). Two participants scored 0 and were excluded from analyses based on hand category. Absolute value of score (0-100) indicated strength of hand preference.

Behavioural Inhibition (BIS), Behavioural Approach (BAS) and Fight-Flight-Freeze system (FFFS) scores were measured using Carver & White's (1994) BIS/BAS scale. This consists of 20 items sub-divided into four categories. One category measures BIS sensitivity (e.g. 'Criticism, or scolding hurts me quite a bit'), and three measure BAS. BAS is sub-divided into Fun Seeking (e.g. 'I crave excitement and new experiences'), Reward Responsiveness (e.g. 'It would excite me to win a contest') and Drive (e.g. 'I go out of my way to get things I want'). In all cases, questions were answered as one of four options, ranging from 'Very true for me', to 'Very false for me', and scored as per Carver and White (1994). We combined the three BAS scales to give a composite measure of approach. Although the BIS/BAS scale was based on an earlier version, it does map onto rRST (Gray & McNaughton, 2000) and the BIS scale can be divided into FFFS (questions 2 & 22) and BIS (remaining 5 BIS questions), for details see Corr and McNaughton (2008).

We used the Spunt et al. (2009) 11-item version of the Indecisiveness Scale (Frost & Shows, 1993), which divided questions into the 5-item (questions 5,7,8,9,10) Aversive Scale (e.g. 'I become anxious when making a decision') and the 6-item (questions 1,2,3,4,6,11) Avoidant Scale (e.g. 'I try to put off making decisions'). Scoring was on a 5-point scale, ranging from 'Strongly agree' to 'Strongly disagree'.

## 2.3 Procedure

Participants were recruited via email and face-to-face contact, and were given the questionnaires in a random order.

## **3. Results**

### **3.1 Descriptive analyses, reliability and simple correlations**

Females scored significantly more positively (strongly right-handed) than males on EHI scores ( $F_{(1, 326)} = 7.68, p < .001; \eta_p^2 = .023, \text{power} = .8$ ), although there were no absolute strength differences.

Females also scored significantly higher on both BIS ( $F_{(1, 326)} = 21.9, p < .001; \eta_p^2 = .06, \text{power} = 1$ ) and FFFS ( $F_{(1, 326)} = 16.9, p < .001; \eta_p^2 = .05, \text{power} = 1$ ), but were not significantly different in terms of BAS scores.

Females scored significantly higher on all three measures of indecision. Therefore gender needs to be taken into account when examining the relationship between other factors. Overall scale reliability coefficients are presented in Table 1. All scales were deemed reliable, although the FFFS scale and sub-scales of aversive and avoidant indecision were noticeably lower than the others.

### **[Table 1 here]**

Simple correlations were calculated between the main variables. Indecision was not significantly correlated with relative hand preference (EHI scores), but hand strength was significantly positively correlated with BIS score and aversive indecision. BIS and FFFS correlated positively with measures of indecision, and BAS was significantly negatively correlated with all types of indecision. Correlations were also compared across handedness groups. Most correlations were still significant for both groups, with the following exceptions: Hand Strength and BIS were only

significantly correlated for left-handers (N=79,  $r=.321$ ,  $p=.004$ ) but not right-handers (N=247,  $r = .092$ ,  $p = .151$ ), while the opposite pattern was found for the correlation between BAS and aversive indecision. In left-handers hand strength is positively linked to BIS score (avoidance), and for right-handers it is negatively linked with BAS (approach). The largest single correlation coefficient was between FFFS and indecisiveness for left-handers (N=79,  $r=.537$ ,  $p<.0001$ ).

**[Table 2 here]**

### **3.2 Regression**

As gender was related to most of these measures, stepwise multiple regression was used to examine the relationship between handedness and indecision.

For each dataset, step one was to regress indecision on gender. In step two, the measure of hand strength was introduced. A significant increase in  $R^2$  when comparing the first to second step would indicate that handedness accounts for variance in indecision over and above that related to gender. These measures are used to examine the first two hypotheses. Beta weights provide the basis for examining any relationships. A third step included BIS and BAS which are known to relate to indecisiveness, plus FFFS which should also relate to indecision. The final step includes interactions between hand strength and BIS, BAS & FFFS. These measures were individually mean centred and these values were multiplied together to create a composite measure. Specifically Absolute Strength x BIS and Absolute Strength x BAS Absolute Strength x FFFS are entered, in order to provide a way of examining hypotheses 3-5. Again, the key data is  $R^2$  change and individual beta weights for the variables of interest. To examine the relationship between handedness and indecision, separate regressions were undertaken for left and right-handers.

In all three cases (complete dataset, left-handers, right-handers) the model predicted indecisiveness but only step 3 (introduction of BIS, BAS & FFFS) significantly improved it. Strength of handedness (Step 2) was not a significant predictor in any of the regression models, failing to support hypothesis 2. All interaction terms were also non-significant (Step 4).

**[Table 3 here]**

Across the whole dataset, BIS, BAS and FFFS were significant predictors of all indecision. This was the case for the 11-item scale,  $F(3,321) = 49.2$ ,  $p < .001$ ,  $\Delta R^2 = 0.300$ , the Aversive scale  $F(3,321) = 56.98$ ,  $p < .001$ ,  $\Delta R^2 = 0.333$  and the Avoidant scale  $F(3,321) = 25.43$ ,  $p < .001$ ,  $\Delta R^2 = 0.183$ .

Introduction of BIS, BAS and FFFS was a significant improvement for the prediction of indecision, but was largest for aversive indecision. BIS was a significant positive predictor and was the strongest individual predictor for both the 11-item and aversive scale.

In avoidant indecisiveness, BIS was a weaker predictor than in the other two measures and was not this scales' strongest individual predictor. FFFS was a significant positive predictor for all indecision, but was strongest for aversive and was poorest at prediction of avoidant indecision. BAS was a significant negative predictor, where a high score on BAS was associated with a low score on the all scales, but particularly the avoidant scale where it was the largest single predictor. Therefore BAS is more strongly related to avoidant indecision while FFFS and BIS are more strongly related to aversive indecision. These results support the role of rRST measures (BIS, FFFS & BAS) as predictors of indecisiveness and partially support hypotheses 3, 4 and 5.

Considering hand categories separately, right-handers still showed an almost identical pattern of results (Table 3). However, hand preference influences the relationship between rRST and indecision. Specifically, left-handers had some key differences; FFFS was the only significant

predictor of the 11-item scale ( $\beta = .422, p=.001$ ), and neither BIS ( $\beta = .209, p=.091$ ) nor BAS ( $\beta = -.152, p=.124$ ) were significant predictors of overall indecision score. For aversive indecision, both BIS and FFFS are positive predictors for left-handers, with FFFS the strongest predictor ( $\beta = .369, p=.003$ ), followed by BIS ( $\beta = .304, p=.016$ ), but BAS does not predict this type of indecision. So, for left-handers aversive indecision is not negatively linked to approach motivation. For avoidant indecision, only FFFS was a significant predictor, although BAS approached significance ( $\beta = -.205, p=.053$ ).

To investigate their unique contribution, both types of indecision were simultaneously regressed against BIS, FFFS and BAS. For BIS, avoidant indecision was not a significant predictor ( $\beta = -.027, t(325)= -.476, p= .634$ ) but aversive indecision was ( $\beta = .541, t(325)= 9.5, p< .001$ ). For FFFS, aversive indecision was also a significant predictor ( $\beta = .444, t(325)= 7.6, p< .001$ ), while avoidant indecision was not ( $\beta = .074, t(325)= .127, p= .204$ ). Examining BAS the opposite was found, aversive indecision was not a significant predictor ( $\beta = -.313, t(325)= -.413, p= .680$ ) but avoidant indecision was ( $\beta = -.313, t(325)= -4.938, P<.001$ ). Regressions were also conducted separately by handedness group. BIS and BAS findings were identical for each group; however FFFS scores highlighted a difference. For right-handers, only aversive indecision was a significant predictor ( $\beta = .490, t(244)= 7.2, p< .001$ ), while for left-handers both aversive ( $\beta = .346, t(76)= 3.2, p= .002$ ) and avoidant indecision ( $\beta = .281, t(76)= 2.6, p= .012$ ) were significant.

#### **4. Discussion**

The current study has replicated and extended the findings of Spunt et al. (2009). Firstly, it independently confirmed that BAS relates strongly to avoidant indecision and BIS to aversive indecision. Secondly, it shows that FFFS relates to indecision, but most strongly to aversive indecision. The relationship between indecision and BIS was expected given that by definition BIS

involves inhibiting behaviour and acting towards resolving conflict (Gray & McNaughton, 2000; Corr, 2011). Behavioural inhibition also underlies differences in ability to resolve uncertainty, with an increased degree of BIS activity related to an increase in self-reported perfectionism (Randles, Flett, Nash, McGregor & Hewitt, 2010). Thus, BIS sensitivity can be seen as a predictor of perceived decision making efficiency, and fits well with response differences linked to rRST (Wright & Hardie, 2011). The relationship between both BIS and FFFS to indecisiveness was strongest for aversive indecision. This was expected, linking to work arguing that BIS is strongly linked to rumination (McGregor, Gailliot, Vasquez & Nash, 2007); supporting the concept that BIS prompts individuals towards worrying about potential threats or punishment, while FFFS is directly involved with the processing of aversive stimuli (Corr, 2011). It is important to remember that BIS is not a system of avoidance per se, but an evaluation of the situation before making decisions and Wright and Hardie (2011) have likened high BIS sensitivity to a 'look before you leap' tendency. This fits with aversive indecision which, supported by a strong link to FFFS, focuses on negative aspects of situations and where uncertainty is interpreted negatively. Indeed, this scale specifically asks about 'wrong choice', 'worry' and confidence in the decision and all these reflect ongoing conflict, anxiety and rumination – which are characteristics of BIS.

As BAS mediates approach towards reward (Gray & McNaughton, 2000), it was not surprising that BAS has a strong negative relationship with indecision. BAS has also been linked to impulsivity (Gray & McNaughton, 2000, but see Corr, 2011), while approach behaviour includes the tendency to make rapid decisions (Sutton & Davidson, 1997). High BAS is related to goal-directed efforts and seeking to achieve this goal (Corr, 2011) and is the polar opposite of indecision. Low BAS scorers have a lower hedonic reactivity than high scorers (Simon et al., 2010) implying that they are less likely to actively seek out goals, and this could easily extend into motivation towards decision making. BAS also links to risk, as in the Iowa Gambling Task, high BAS individuals have an

over-confidence in their own betting and a greater expectation of winning in the next trial (Kim & Lee, 2011). As avoidant indecision focuses on decision-making approach, rather than quality of decision making (Spunt et al., 2009), it is not surprising that the relationship to BAS was strongest for this scale. The scale includes words relating to how 'quickly', 'easy' and confident you are at making decisions. Thus, high BAS individuals will jump in quickly, making fast decisions and with their confidence, impulsivity and risk taking will not seek to avoid making the decision.

What can handedness add to this relationship? We did not find an overall relationship between hand preference and indecision but found hand preference influenced the relationship between measures of rRST and indecision. Left-handers had a stronger relationship between BIS and strength of handedness, but the failure to translate this into an indecision difference is interesting. One possibility is that left-handers may only show a delay in decision making in circumstances where their responsiveness differences occur. Wright and Hardie (2012) demonstrated that left-handers show a proportionately higher state but not trait anxiety response when confronted with a novel situation. Perhaps the trait nature of the indecisiveness measure may miss initial reactivity differences, or that the real focus for investigation should examine how the relationship between handedness and rRST predicts behaviour. Brookshire and Casasanto (2012) have given us another possibility, showing that the avoidance systems of left and right-handers may actually be reversed and linked to dominant hand. For approach motivation, brain activity associated with approach was significantly left lateralised in right-handers but right lateralised in left-handers. Arguably, rRST systems may be arranged differently in both groups, certainly as far as approach motivation is concerned. There is no comparable evidence for inhibitory motivation (BIS & FFFS), giving the intriguing possibility that either both systems are switched in left-handers or that only approach is switched. Whatever the outcome, it might be in

someway linked to both behavioural (Wright et al., 2004; Wright & Hardie, 2012) and self-reported (Wright et al., 2009) inhibitory/aversive tendencies in left-handers.

It is clear that left-handers appear to have a different relationship between rRST and indecisiveness, compared to right handers. For them, indecision may not simply be a 'lack' of approach motivation, but may involve an increased aversive response, compared to right-handers (Wright & Hardie, 2012). For avoidant indecision although FFFS was the strongest predictor, suggesting that a fearful response was driving this relationship, BAS did approach significance. Taken together, we argue that the relationship between handedness and rRST and the resultant influence of expressed behaviour is a new and exciting area worthy of further study.

## References

Brookshire, G., & Casasanto, D. (2012). Motivation and Motor Control: Hemispheric Specialization for Approach Motivation Reverses with Handedness. *PLoS ONE*, *7*(4): e36036.

DOI:10.1371/journal.pone.0036036

Carver, C.S., & White, T.L. (1994). Behavioral inhibition, behavioral activation, and affective responses to impending reward and punishment: The BIS/BAS scales. *Journal of Personality and Social Psychology*, *67*, 319-333. DOI:10.1037/0022-3514.67.2.319

- Christman, S.D., Jasper, J.D., Sontam, V., & Cooil, B. (2007). Individual differences in risk perception versus risk taking: Handedness and interhemispheric interaction. *Brain and Cognition*, 63, 51–58. DOI:10.1068/p6131
- Corr, P.J. (2011). Anxiety: Splitting the phenomenological atom. *Personality and Individual Differences*, 50, 889–897. DOI:10.1016/j.paid.2010.09.013
- Corr, P.J., & McNaughton, N. (2008). Reinforcement sensitivity theory and personality. In P.J. Corr (Ed.), *The reinforcement sensitivity theory of personality* (pp. 155-87). Cambridge: Cambridge University Press.
- Frost, R.O., & Shows, D.L. (1993). The nature and measurement of compulsive indecisiveness. *Behaviour Research and Therapy*, 31(7), 683–692. DOI:10.1016/0005-7967(93)90121-A
- Gayton, W.F., Clavin, R.H., Clavin, S.L., & Broida, J. (1994). Further validation of the indecisiveness scale. *Psychological Reports*, 75, 1631–1634.
- Germeijs, V., & Verschueren, K. (2011a). Indecisiveness and Big Five personality factors: Relationship and specificity. *Personality and Individual Differences*, 50, 1023-1028. DOI:10.1016/j.paid.2011.10.017
- Germeijs, V., & Verschueren, K. (2011b). Indecisiveness: Specificity and predictive validity. *European Journal of Personality*, 25(5), 295-305. DOI:10.1002/per.786

- Gray, J.A., & McNaughton, N. (2000) (2<sup>nd</sup> ed.). *The neuropsychology of anxiety: An enquiry into the functions of the septo-hippocampal System*. Oxford, UK: Oxford University Press.
- Hecht, D. (2010). Depression and the hyperactive right-hemisphere. *Neuroscience Research*, *68*, 77–87. DOI:10.1016/j.neures.2010.06.013
- Hecht, D., Walsh, V., & Lavidor, M. (2010). Transcranial direct current stimulation facilitates decision making in a probabilistic guessing task. *The Journal of Neuroscience*, *30*, 4241–4245. DOI:10.1523/JNEUROSCI.2924-09.2010
- Kim, D-Y., & Lee, J-H. (2011). Effects of the BAS and BIS on decision-making in a gambling task. *Personality and Individual Differences*, *50*, 1131–1135. DOI:10.1016/j.paid.2011.01.041
- Maxwell, J.S., & Davidson, R.J. (2007). Emotion as motion: Asymmetries in approach and avoidant actions. *Psychological Science*, *18*(12), 1113-1139. DOI:10.1111/j.1467-9280.2007.02033.x
- McElroy, T., & Corbin, J. (2010). Affective imposition influences risky-choice: Handedness points to the hemispheres. *Laterality*, *15*, 426-438. DOI:10.1080/13576500902953823
- McGregor, I., Gailliot, M.T., Vasquez, N., & Nash, K. (2007). Ideological and personal zeal reactions to threat among people with high self-esteem: Motivated promotion focus. *Personality and Social Psychology Bulletin*, *33*, 1587-1599. DOI:10.1177/0146167207306280

- Mulki, J.P., Jaramillo, F., Malhotra, S., & Locander, W.B. (2012). Reluctant employees and felt stress: The moderating impact of manager decisiveness. *Journal of Business Research*, *65*, 77–83. DOI:10.1016/j.jbusres.2011.01.019
- Niebauer, C.L. (2004). Handedness and the fringe of consciousness: Strong handers ruminate while mixed handers self-reflect. *Consciousness and Cognition*, *13*, 730–745. DOI:10.1016/j.concog.2004.07.003
- Oldfield, R.C. (1971). The assessment and analysis of handedness: The Edinburgh inventory. *Neuropsychologia*, *9*, 97-113. DOI:10.1016/0028-3932(71)90067-4
- Patalano, A.L., & LeClair, Z. (2011). The influence of group decision making on indecisiveness-related decisional confidence. *Judgment and Decision Making*, *6*, 163-175.
- Patalano, A.L., & Wengrovitz, S.M. (2006). Cross-cultural exploration of the Indecisiveness Scale: A comparison of Chinese and American men and women. *Personality and Individual Differences*, *41*, 813–824. DOI:10.1016/j.paid.2006.03.023
- Randles, D., Flett, G.L., Nash, K.A., McGregor, I.D., & Hewitt, P.L. (2010). Dimensions of perfectionism, behavioral inhibition, and rumination. *Personality and Individual Differences*, *49*, 83-87. DOI:10.1016/j.paid.2010.03.002
- Rassin, E., & Muris, P. (2005). To be or not to be indecisive: Gender differences, correlations with obsessive-compulsive complaints, and behavioural manifestation. *Personality and Individual Differences*, *38*, 1175–1181. DOI:10.1016/j.paid.2004.07.014

- Rassin, E., Muris, P., Booster, E., & Kolsloot, I. (2008). Indecisiveness and informational tunnel vision. *Personality and Individual Differences, 45*, 96–102. DOI:10.1016/j.paid.2008.03.006
- Rassin, E., Muris, P., Franken, I., Smit, M., & Wong, M. (2007). Measuring general indecisiveness. *Journal of Psychopathology and Behavioral Assessment, 29(1)*, 61–68.  
DOI:10.1007/s10862-006-9023-z
- Rutherford, H., & Lindell, A. (2011). Thriving and surviving: Approach and avoidance motivation and lateralization. *Emotion Review, 3*, 333–343. DOI:10.1177/1754073911402392
- Simon, J.J., Walther, S., Fiebach, C.J., Friedrich, H-C., Stippich, C., Weisbrod, M., & Kaiser, S. (2010). Neural reward processing is modulated by approach- and avoidance-related personality traits. *NeuroImage, 49*, 1868-1874. DOI:10.1016/j.neuroimage.2009.09.016
- Spunt, R.P., Rassin, E., & Epstein, L.M. (2009). Aversive and avoidant indecisiveness: Roles for regret proneness, maximization, and BIS/BAS sensitivities. *Personality and Individual Differences, 47*, 256-261. DOI:10.1016/j.paid.2009.03.009
- Sutton, S.K., & Davidson, R.J. (1997). Prefrontal brain asymmetry: A biological substrate of the behavioral approach and inhibition systems. *Psychological Science, 8*, 204–210.  
DOI:10.1111/j.1467-9280.1997.tb00413

- van Randenborgh, A., de Jong-Meyer, R. & Hüffmeier, J. (2010). Decision making in depression: differences in decisional conflict between healthy and depressed individuals. *Clinical Psychology & Psychotherapy*, 17, 285–298. DOI:10.1002/cpp.651
- Wright, L., & Hardie, S.M. (2011). "Not ready to sort it yet." Revised Reinforcement Sensitivity Theory (rRST) predicts left-handed behavioural inhibition during a manual sorting task. *Laterality*, 16(6), 753-767. DOI:10.1080/1357650X.2010.521752
- Wright, L., & Hardie, S.M. (2012). Are left handers really more anxious? *Laterality*, 17(5), 629-642. DOI:10.1080/1357650X.2011.615126
- Wright, L., Hardie, S.M. & Rodway, P. (2004). Pause before you respond: Handedness influences response style on the Tower of Hanoi task. *Laterality*, 9(2), 133-147. DOI:10.1080/13576500244000265
- Wright, L., Hardie, S.M. & Wilson, K. (2009). Handedness and Behavioural Inhibition: Left-handed females show most inhibition as measured by BIS/BAS self-report. *Personality and Individual Differences*, 46, 20-24. DOI:10.1016/j.paid.2008.08.019

**Table 1: Hand preference, BIS, BAS, FFFS and Indecision scores for males and females.**

	Mean	SD	$\alpha$	Females N=221		Males N=107	
EHI Score	40.4	62.1	0.95	46.9*	58.5	26.8	67.4
Absolute Strength	68.9	27.2	0.82	69.2	28.7	68.1	24.0
BIS	15.3	3.2	0.79	15.9**	2.9	14.2	3.4
BAS	39.1	5.1	0.80	38.8	5.1	39.7	5.4
FFFS	5.6	1.5	0.63	5.9**	1.5	5.2	1.4
Indecision	32.7	7.7	0.83	33.8**	7.7	30.4	7.4
Aversive	14.7	4.2	0.76	15.2*	4.2	13.7	4.0
Avoidant	18.0	4.6	0.75	18.6**	4.6	16.7	4.3

\* $p < 0.01$ , \*\* $p < 0.001$

**Table 2 Correlations between variables used in the study (N= 328)**

	BIS	BAS	FFFS	Indecisiveness	Aversive	Avoidant
EHI	-.27	-.12	.094	-.40	.00	.068
Hand Strength	<b>.164**</b>	-.007	.099	.031	<b>.110*</b>	-.048
BIS		.009	<b>.46***</b>	<b>.447***</b>	<b>.526***</b>	<b>.276***</b>
BAS			<b>-.185**</b>	<b>-.302***</b>	<b>-.201***</b>	<b>-.327***</b>
FFFS				<b>.453***</b>	<b>.486***</b>	<b>.323***</b>

\*p<0.05, \*\*p<0.01, \*\*\*p<0.001

**Table 3 Results from multiple regressions, showing BIS, BAS & FFFS (Step 3) and their influence on measures of indecisiveness, showing hand preference categories.**

Factor	Hand	df1	df2	$R^2$	$\Delta R^2$	BIS			FFFS			BAS		
						$\beta$	t	p	$\beta$	t	p	$\beta$	t	p
Indecisiveness	Both	3	321	.336	.305	.333	6.35	<.0001	.248	4.74	<.0001	-.256	-5.55	<.0001
	Right	3	241	.376	.313	.351	5.94	<.0001	.219	3.77	<.0001	-.301	-5.75	<.0001
	Left	3	73	.344	.328	.209	1.71	<b>.091</b>	.422	3.49	.001	-.152	-1.56	<b>.124</b>
Aversive	Both	3	321	.375	.337	.402	7.85	<.0001	.273	5.33	<.0001	-.155	-3.43	.001
	Right	3	241	.425	.355	.421	7.4	<.0001	.263	4.7	<.0001	-.205	-4.08	<.0001
	Left	3	73	.337	.323	.304	2.47	.016	.369	3.04	.003	-.046	-.47	<b>.641</b>
Avoidant	Both	3	321	.226	.186	.196	3.44	.001	.170	2.99	.003	-.292	-5.8	<.0001
	Right	3	241	.236	.191	.212	3.24	.001	.133	2.07	.039	-.325	-5.6	<.0001
	Left	3	73	.246	.204	.070	.54	<b>.595</b>	.356	2.75	.008	-.205	-1.96	<b>.053</b>

