Influences of lateral preference and personality on behaviour towards a manual sorting task

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Abstract

Differences in task behaviour between left- and right-handers and left- and right-eared individuals have been reported (e.g. Wright, Hardie & Rodway, 2004; Jackson, 2008) with left-handers taking longer to begin a task and right-eared individuals having a more disinhibited approach. Personality measurements are also important when examining approach behaviour. Jackson (2008) reported that those with higher neuroticism levels and a right-ear preference react faster to tasks. The current study investigated the effects of lateral preference and personality on behaviour towards a manual sorting task. Eighty-five participants completed laterality and personality scales and a card-sorting task. Degree of hand preference was found to influence behaviour towards the task with strong left-handers taking longer to begin. Those with a left congruent lateral preference (left-hand, left-ear) took significantly longer to begin the task than those with a right congruent preference. Neither neuroticism nor extraversion influenced task approach. We concluded that hand preference, and more specifically a strong left-hand preference is a good predictor of a longer initiation time on a manual task. Ear preference on its own does not predict initiation time.

Keywords: Handedness, ear-preference, neuroticism, approach behaviour, sorting task, strength of handedness

1. Introduction

Lateral preferences can be useful indicators of hemispheric preferences (e.g. Kinsbourne, 1997; Jackson, 2008) where dominant hand and ear preferences indicate contralateral hemispheric dominance. Evidence suggests that right hemisphere dominance is related to negative information processing and is associated with increased levels of behavioural inhibition, neuroticism and anxiety (Wright, Hardie & Wilson, 2009; Elliot & Thrash, 2002) while left hemisphere dominance is associated with positive information processing, extraversion and approach behaviour (e.g. Sutton & Davidson, 1997; 2000). This hemispheric specialisation of emotional processing forms the basis for the approach-avoidance model.

Handedness and ear preference are two overt measures of laterality which allow us to investigate an individual's interaction with the world. Previous research examining handedness and behavioural response style has shown that left-handed primates take longer to approach and interact with novel tasks and situations. For example, Cameron and Rogers (1998) found that left-handed common marmosets took longer to approach a novel piece of apparatus, while Hopkins and Bennett (1994) reported that right-handed chimpanzees were faster to approach and touch novel objects than non right-handed chimpanzees. More recently, Braccini and Caine (2009) investigated the behaviour of Geoffrey's marmosets towards novel foods and found that left-handed marmosets were slower to explore the food and took longer to emerge from freeze responses.

Human parallels with this work have been conducted and in accordance with previous findings left-handed individuals were found to take longer to approach novel tasks. For example Wright, Hardie and Rodway (2004) found that left-handers took significantly longer

to begin the Tower of Hanoi task, and left-handers have reported themselves to feel more behaviourally inhibited and anxious than right-handers (Wright, Hardie & Wilson, 2009; Wright & Hardie, 2012). Thus it can be postulated that aspects of temperament, personality and behaviour related to left-handedness can be associated with a more cautious response to tasks and situations (Lyle, Hanaver-Torrez, Hacklander & Edlin, 2012).

Previous research examining the relationship between handedness and personality is inconclusive. For example, Camposano, Corail and Lolas (1991) found no association between handedness and Eysenck's personality dimensions. More recently Beratis, Rabavilas, Papadimitriou and Papageorgiou (2011) found that right-handers showed a positive association between neuroticism levels and four out of nine symptom scales on the SCL-90 (for example anxiety and obsessive-compulsive disorder). However, left-handers showed a positive association between neuroticism and eight out of nine symptom scales on the SCL-90 (such as phobic anxiety and interpersonal sensitivity). Furnham (1983) reported that left-handers were more extraverted than right-handers but there was no difference in neuroticism scores.

Jackson (2005; 2008) proposed a model of disinhibition related to asymmetries of ear preference. This focused on the relationship between ear preference and neuroticism as a predictor of disinhibition (disinhibition in this model relates to the conflict between approach and avoidance motivation). Jackson found that individuals with a right-ear preference and high levels of neuroticism are more likely to approach a situation and are more disinhibited. To explain this further individuals with left-hemisphere dominance (right-ear preference) and high neuroticism are more susceptible to increased negative affect and they reduce this by reacting quickly, thus resolving their approach-avoidance conflict (Gullo, Jackson & Dawe, 2010). In support of this model, Gullo et al. (2010) found that individuals

with a right-ear preference and higher levels of neuroticism had faster reaction times on a reversal learning task, while those with a left-ear preference and high neuroticism had slower reaction times.

The role of extraversion in models of disinhibition has also been investigated. Patterson and Newman (1993) proposed that high levels of neuroticism and extraversion underlie disinhibition while Arnett, Smith and Newman (1997) argued that high levels of extraversion and low levels of neuroticism underlie disinhibition. Extraversion and neuroticism are related to models of approach and avoidance, for example, individuals high in extraversion and low in neuroticism are more likely to display approach behaviour and respond faster while individuals high in neuroticism and low in extraversion are more likely to display avoidance behaviour (Derryberry, 1987; Elliot & Thrash, 2002; 2010; Robinson, Wilkowski & Meier, 2008). If we contextualise this in terms of how someone approaches a task we would predict that someone high in neuroticism and low in extraversion would take longer to approach than someone high in extraversion and low in neuroticism.

Thus we argue that there is a strong body of evidence emerging which links left-hand preference (right-hemisphere dominance) to increased anxious and aversive behaviour (Cameron & Rogers, 1998; Wright et al. 2009; Wright & Hardie, 2012) and right-ear preference (left-hemisphere dominance) to disinhibited and action seeking behaviour (Jackson, 2008; Gardiner & Jackson, 2010). Also, given the strong influence that neuroticism has on approach/avoidance behaviour (Jackson, 2008) and the conflicting evidence of the roles of high and low levels of neuroticism in models of approach and avoidance behaviour (e.g. Arnett et al., 1997) it is important to consider these personality measures in this model.

The current study examines the relationship between hand- and ear-preference and personality on a novel, manual task. If right-eared people are more disinhibited and left-handed people are more inhibited, is someone with a left-hand and left-ear preference somewhat more inhibited in their approach to a task? We hypothesise that right-hemisphere dominant individuals (as indicated by left-hand and left-ear preference) will take longer to begin the manual sorting task; that strength of lateral preference will influence initiation time and that neuroticism will interact with lateral preference to influence initiation time. Additionally, it is hypothesised that the interaction between neuroticism and extraversion will predict initiation time on the manual task.

2. Method

2.1. Participants

Eighty-five university students participated: 28 males (12 left-handed and 16 right-handed) and 57 females (21 left-handed and 36 right-handed). Thirty-four participants had a left-ear preference and 51 participants had a right-ear preference. Many of the left-handed participants were recruited through posters advertising specifically for left-handers.

2.2. Materials & Apparatus

2.2.1. Lateral preference

Jackson's (2008) Hand, Eye and Ear Preference questionnaire (HEEP) was administered to measure hand and ear preference. There were seven ear preference questions, for example 'In which ear would you place the earphone of a transistor radio?' and ten hand preference questions, for example 'With which hand do you use to brush your teeth?' Participants responded on a five-point Likert scale (LA=left always, LM=left mostly, E=either, RM=right mostly and RA=right always) and the scoring ranged from -2 for a left always answer to +2

for a right always answer. A total negative score on a scale indicated a left preference and a total positive score indicated a right preference.

2.2.2. Personality

The Neuroticism and Extraversion scales of the revised-Eysenck Personality Questionnaire (Eysenck, Eysenck & Barrett, 1985) were administered. The Neuroticism scale consists of 12 statements such as 'Are your feelings easily hurt?' The Extraversion scale consists of 12 statements such as 'Are you rather lively?' A maximum of 12 points could be scored for each scale and a higher score indicated higher levels of neuroticism and extraversion.

2.2.3. Manual sorting task

The manual sorting task consisted of a sorting board divided into quadrants labelled category one through to four (see Wright & Hardie, 2011 for further details) and a set of 20 coloured picture cards depicting a variety of animals, e.g. lion, shark, and dog. The aim of the task was to sort the cards in to four categories each consisting of five cards which had to be labelled at the end of the task. A split time function stopwatch was used to record task initiation and completion times. Initiation time was recorded as the time taken to move the first card of the task after it was unveiled to participants.

2.3. Procedure

Participants were asked to complete the sorting task. They were instructed that they would see 20 cards depicting a number of animals and they should categorise these into four groups of their choice, each containing five cards and these should be labelled at the end of the task. The cards were covered until the task began and they were unveiled when participants indicated they were ready to begin. The time taken to move the first card (initiation time) was recorded along with the time taken to sort the cards in to four

categories (completion time). Upon completion of the task participants were asked to write down the four categories they made. Participants then completed the HEEP scale and the neuroticism and extraversion questions of the EPQ in a randomised order.

3. Results

In order to address the first hypothesis a 'lateral preference' variable was created where a left-hand and left-ear preference was treated as an overall left lateral preference; a right-hand and right-ear preference was treated as an overall right lateral preference and any incongruent combination of left/right hand and ear preference was treated as a mixed lateral preference.

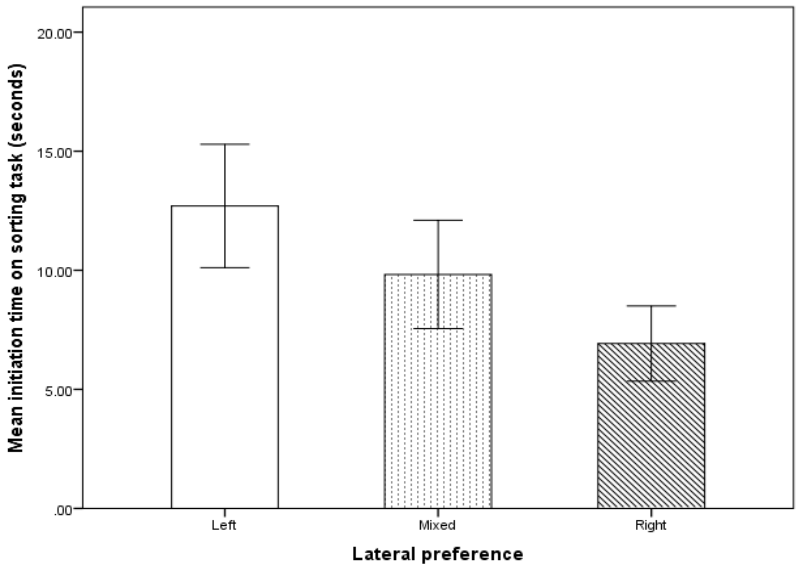

Figure 1: Influence of lateral preference category on task initiation time

Figure 1 shows that those with a congruent left lateral preference took the longest to begin the task (average 12.7 seconds).

To examine the effects of lateral preference category on initiation time a 1 X 3 between subjects ANOVA was carried out. There was a significant main effect of lateral preference category on initiation time $F(2, 82) = 7.91$, $p = .001$, partial $\eta^2 = .16$, observed power = .95.

Bonferroni post hoc tests were carried out to examine this effect further. The difference in initiation time between overall left lateral preference and overall right lateral preference individuals was significant ($p = .001$). Left lateral preference individuals took significantly longer to begin the task (12.7 vs. 6.9 seconds). No other comparisons were significant ($p > .05$).

Table 1.

Correlations between variables in study (N = 85)

	2.	*3.*	*4.*	*5.*	*6.*	***7.***
1. Initiation time	.02	- .39**	- .28**	- .43**	.32**	- .09
2. Completion time		- .14	.09	- .06	.01	- . 01
3. Hand score			.28**	.88**	-.37**	.20
4. Ear score		.		.7**	- .17	.16
5. Laterality score (hand/ear)					- .36**	.22
6. Neuroticism score						- .26*
7. Extraversion score						

* $p < .05$

** $p < .01$

Simple correlations were calculated between the main variables of interest, initiation time, completion time, hand score, ear score, lateral preference (laterality) score, neuroticism score and extraversion score. Completion time did not correlate with any other variable. Initiation time correlated positively with neuroticism score and negatively with hand, ear and laterality scores. Neuroticism itself correlated negatively with both hand and lateral preference score but was not significantly correlated with ear score. As several variables correlated with each other, a series of partial correlations were carried out. Hand score still correlated significantly with initiation time ($r = -.27$, $p = .02$) when controlling for neuroticism and ear score. Ear score did not correlate significantly with initiation time when controlling for hand score and neuroticism ($r = -.18$, $p = .10$). Neuroticism did not correlate significantly with initiation time ($r = .20$, $p = .08$) when controlling for hand and ear scores. Lateral preference was still significantly correlated with initiation time when controlling for neuroticism ($r = -.35$, $p = .001$).

Moderated multiple regression of lateral preference (hand, ear and overall lateral preference) and personality (neuroticism and extraversion) was used to predict initiation time on the manual sorting task. The overall model was significant $F(10, 74) = 2.50$, $p = .01$.

Table 2

Summary of Moderated Regression Analysis for Variables Predicting Initiation Time on a Manual Sorting Task (N=85).

Variable*	β	t	p
Hand Score	-.277	-2.401	.019
Ear Score	-.198	-1.834	.071
Laterality Score	-.111	-.954	.343
Neuroticism Score	.209	1.784	.078
Extraversion Score	.050	.463	.645
Hand Score x Neuroticism	.039	.323	.748
Ear Score x Neuroticism	-.010	-.081	.936
Hand Score x Extraversion	.016	.119	.905
Ear Score x Extraversion	-.141	-1.164	.248
Extraversion x Neuroticism	.038	.331	.742

*All variables were mean centred, and interaction terms were created by multiplying the individual mean centred values of both variables together.

In support of H2, Table 2 demonstrates that strength of hand preference was a significant predictor of initiation time (β = - .28, p = .02) indicating that those with a lower handedness score (i.e. a stronger left-hand preference) took longer to begin the task. Strength of ear preference was not a significant predictor (β = - .19, p = .07) although the direction of the findings suggested that those with a stronger left-ear preference took longer to begin the task. Neuroticism and extraversion were not significant predictors of task initiation time (β = .21, p = .08 and β = .05, p= .65 respectively). No interaction terms were significant predictors.

3.5. Completion time

All four variables (hand-preference, ear-preference, extraversion and neuroticism scores) were regressed with completion time. There were no significant predictors (p> .05).

4. Discussion

Based on previous research (Wright, Hardie & Rodway, 2004; Jackson, 2008) we predicted that lateral preference would influence how individuals initiate a manual task. We found that degree of hand preference influenced behaviour towards the task with strong left-handers taking longer to begin. This handedness finding supports previous research (e.g. Cameron & Rogers, 1998; Wright & Hardie, 2011) which reports that left-handed human and non-human primates take longer to approach or begin a task. Somewhat more complex is the relationship between ear-preference and task approach. Jackson (2008) reported that the interaction between ear-preference and neuroticism can influence how an individual approaches a task. He found that those with a right-ear preference and high levels of neuroticism have a more disinhibited approach to tasks, i.e. they jump in to things quicker. In the current study we found that ear preference was not a significant predictor of initiation time, however, we found it did correlate negatively with initiation time. Ear preference did not correlate with neuroticism, nor was there an interaction between ear preference and neuroticism in our regression model. The failure to find a relationship between ear score and neuroticism means that our current work does not support Jackson's (2008) findings. It should be noted that handedness was the main focus of our work, therefore our sample presumably contains a higher proportion (39%) of left-handers than in any of Jackson's (2008) eight studies. There is now a body of research from Casasanto and colleagues on embodied cognition, which suggest that hand preference differences can lead to differences in neurocognitive representations of actions. For example, Brookshire & Casasanto (2012) reported that approach motivation is differentially lateralised in right and left-handers, and is ipsilateral to the preferred hand. Willems, Toni, Hagoort and Casasanto (2009) asked participants to imagine complex hand actions, and found that right-handers showed activation in areas of the left cortex linked to motor planning and execution, while left-handers showed the opposite pattern. These studies suggest that planning an action is

linked to hand preference, and hemisphere of choice for planning of motor actions may be strongly related to hand, rather than ear, preference. It is possible that this inverted motor planning may have had an effect, perhaps due to a greater influence of negative affect in the right-hemisphere of left-handers (Sutton & Davidson, 1997).

Another possibility is that perhaps because Jackson (2008) examined the relationship between ear-preference and neuroticism on a series of *aural* tasks then the type of task itself is a factor which needs to be considered.

In our study neuroticism itself, or in combination with hand preference, was not a significant predictor of initiation time. However, we did find that neuroticism positively correlated with initiation time and negatively with hand score, but that neuroticism was not significantly correlated when the influence of hand score was removed. This suggests that neuroticism may explain some of the delay in initiation time, but this is not as clear an explanation as hand score. It is somewhat surprising that neuroticism did not interact with hand score, as the relationship between neuroticism and anxiety is an established finding (e.g. Muris, Roelofs, Rassin, Franken & Mayer, 2005) and there is evidence that left-handers are more anxious than their right-handed counterparts (e.g. Davidson & Schaffer, 1983). However, Wright & Hardie (2012) recently demonstrated that left-handers and right-handers only differ in state and not trait anxiety. In a similar vein, Beckman, Beckman, Minbashian and Birney (2013) have shown that trait neuroticism was not a significant predictor of performance in solving complex cognitive tasks, but that state neuroticism was. This suggests that perhaps the link between handedness and problem-solving is more likely to be influenced by a state rather than a trait measure.

We investigated whether strength of hand- and ear-preference were significant predictors of initiation time and found that only hand-preference was a significant predictor (those with a stronger left-hand preference took longer to begin the task), and that the correlation between hand score and initiation time was still significant when controlling for ear preference. Phoebe, Thurlow and McNaughton (2011) offer a potential explanation for this, as they strongly linked motor inhibition to BIS and inhibition of motor action. It may be that differences related to ear preference have a weaker relationship with motor inhibition, as although BIS relates to inhibition of all action, the correspondence between lateral preference and response style may be clearest when corresponding to responses within the same domain (i.e. aural preference more strongly related to verbal or auditory inhibition). Presumably this is why we did not find an ear preference difference on this motor task. Focussing on handedness, Christman, Jasper, Sontam and Cooil (2007) argue that the right-hemisphere of the brain has been shown to be more aversive and sensitive to risk compared to the left-hemisphere. This could mean that in this study, the greater right-hemisphere influence on strong left-handers may cause them to evaluate the potential riskiness of a situation more than right-handers. This is largely untested, as Christman et al. (2007) argued that mixed-handers actually have greater access to right-hemisphere processing than strong handers. However, much of this literature does not separate left- and right-handers in their sample and indeed Christman et al. (2007) only focussed on 'comparisons of mixed versus strongly right-handed individuals' (p52). With this in mind, their data did not show greater risk aversion in mixed-handers but did find that this group were more focused on perceived risk than strong right-handers. It remains to be seen if an increased risk aversion in left-handers is the driving force behind these differences.

Wright & Hardie (2012) showed that state anxiety reactivity in left-handers during a novel situation is relatively higher than right-handers, even when controlling for endogenous

(trait) levels of anxiety. In short, the left-handers show more anxiety than right-handers. This may well be a sign of either increased worry about the situation (more risk conscious) or the output of increased behavioural inhibition action. This idea is supported by Beratis et al. (2011), as left-handers had a stronger association with neuroticism and extreme worry, such as paranoid ideation, psychoticism, interpersonal sensitivity, phobic anxiety and somatisation. This could therefore support the idea that left-handers seem to contextualise the situation in terms of how it may influence them personally, in a way that right-handers do not seem to do.

Based on the work of Patterson and Newman (1993) and Arnett et al. (1997) we investigated whether neuroticism and extraversion levels influenced initiation time on the manual sorting task. We found that those with high neuroticism levels took longer to begin the task but there was no difference in approach style between those with high and low levels of extraversion. Thus we support the work of Arnett et al. who found that those with low levels of neuroticism have a more disinhibited approach and we also support the finding that individuals high in neuroticism are more likely to display avoidance behaviour (e.g. Elliot & Thrash, 2002; Robinson et al., 2008). It seems that extraversion does not influence approach on this task but perhaps if this were a test of speed or reaction time then extraversion might play a greater role. Neuroticism has been found to influence task approach, however, in our current findings neuroticism seems to be linked to a more anxious and cautious approach which inhibits the behaviour of the individual (e.g. Wright & Hardie, 2012) rather than acting as a stressor which can be resolved by jumping in to a task (e.g. Jackson, 2008).

Thus taking all of the findings in to account it seems on a manual task that left-hand preference, left-ear preference and high levels of neuroticism are correlated with longer initiation times while right-hand preference, right-ear preference and low levels of

neuroticism are correlated with faster initiation times. The current work was carried out using a manual sorting task and found a handedness effect while Jackson (2008) used a series of aural tasks and reported a disinhibited approach by right-eared, high neuroticism individuals. Future work will therefore combine different types of task (particularly a direct comparison between manual and aural tasks) along with hand, ear and personality measurements to investigate whether task type influences task approach and also whether hand preference or ear preference is a stronger predictor depending on the type of task. Future work can also examine whether gender influences this approach.

Limitations

One limitation is that the overall sample size was modest, although it did contain a relatively large proportion of left-handers (39%), this could be tested on a much larger sample. Also, the way that lateral preference was measured may influence results, as some of the ear preference items (e.g. transistor radio) may not be well known to the current generation of students.

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