Personality Affects 'Fidgeting' in the Laboratory: Implications for Experimental Design

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ABSTRACT

Eysenck suggested that extraverts are chronically cortically under aroused in comparison to introverts. However, many psychophysiological studies do not show the predicted differences. Gale's (1969) explanation is that extraverts engage in compensatory behaviour in the laboratory to increase their level of arousal which would reduce differences between extraverts and introverts. We tested this hypothesis by comparing the amount of movement exhibited by introverts and extraverts in the laboratory. Stelmack has suggested that movement is fundamental to differences between introverts and extraverts. We measured movement using a pressure mat system located in the seat of the chair but unknown to the participant. There were two conditions: a no activity condition; and an activity condition where the participant could self-stimulate by pressing a keyboard to hear various sounds. We found that more extraverted and more neurotic individuals moved more but this difference was confined to the no activity condition. We conclude that in the laboratory, as in 'real' life, people may use behaviour to manipulate their levels of arousal even if they are unaware that they are doing so. Furthermore, this finding may partially explain failures to find predicted differences in 'resting' levels of cortical arousal associated with extraversion in the laboratory.

Keywords: Extraversion, arousal, Stelmack, psychophysiology, movement

1. INTRODUCTION

This study investigates how personality influences a behaviour that for the majority of the time is not under conscious, voluntary control. We measure how much participants move (or fidget) when in the laboratory. Fidgeting could be employed unconsciously as a means of regulating levels of physiological arousal in the laboratory. This may be important as self-regulation of arousal using behaviour, could mediate the effects of personality and extraversion in particular on task performance and levels of physiological activation in the laboratory. Just as people use their behaviour to regulate arousal in everyday life, as they do with drugs and external stimulation, participants may be involved in unconscious self-regulation of arousal, using behaviour, in the laboratory environment.

Some variant of trait extraversion is common to a wide variety of both human and non-human models of personality (e.g. Ashton, Lee & Paunonen, 2002; Catell, 1957; Corr & Cooper, 2016; Costa & McCrae, 1992; Eysenck & Eysenck, 1963; Gosling, 2001). Extraversion is important as it has been a useful heuristic for explaining many behaviours including success or failure in a variety of social and cognitive tasks. Eysenck developed the first widely known (and still deeply influential) trait model to include extraversion as a key component, although both the concept and term have a longer history (Dumont, 2010). Eysenck developed his model of extraversion during his career; in his early version of extraversion (Eysenck & Eysenck, 1968) impulsivity was an important component of extraversion, whereas in his revised model (Eysenck & Eysenck, 1975) impulsivity was largely removed from extraversion (Rocklin & Revelle, 1981). In the more contemporary literature there have been vigorous debates about the precise nature of extraversion. For example, there has been an on-going debate between the supporters of Gray and the supporters of Eysenck about the role of anxiety in extraversion (Corr, Pickering & Gray,

1997). However, regardless of the precise nature of extraversion, some version of extraversion is found in almost all trait models of personality.

One of the enduring attractions of Eysenck's model of personality is that it integrates cognition, behaviour and physiology. The model has also generated clear, testable hypotheses attractive to research psychologists. Eysenck claimed that the physiological basis of extraversion was a difference in arousability between introverts and extraverts. Eysenck suggested that extraverts had higher thresholds for arousal and had an associated lower level of cortical arousal at rest. This difference in arousability is itself a function of differences found in the ascending reticular activating system of introverts and extraverts. He predicted that there would measureable differences the in levels of cortical activation found in introverts and extraverts as a function of basic central nervous system physiology. Extraverts should be chronically cortically under aroused whereas introverts should be chronically over aroused. However, despite an intense, sustained and continuing research effort the results have not been consistent; a wide range of influences on the relationships between extraversion, arousal and experimental context have been identified (Gale, 1983; Hahn, Buttaccio, Hahn, & Lee,2015; Korjus et al. 2015; Lei & Yang, 2015; Matthews & Gilliland, 1999; Stelmack, 1990; 1997; Schweckendiek & Klucken, 2016; Zuckerman, 2005). Gale (1983) suggested that the failure to find consistent findings was due to variation in conditions of testing. He argued that a moderately arousing experimental environment was necessary to produce the hypothesised difference in activation levels between introverts and extraverts; in either high or low arousing conditions participants could use adaptive countermeasures to regulate their level of arousal (Gale, 1983; Sternberg, 1992) so reducing any difference in levels of cortical arousal. However, O'Gorman (1984) argued that the failure to find consistent findings was most likely attributable to problems with the personality measures used.

In addition to the research focused on resting levels of physiological activation associated with extraversion, there is robust evidence that there are differences in sensory sensitivity (Stelmack & Campbell, 1974; Stelmack, 1990) and motor function (Doucet & Stelmack, 1997) associated with extraversion. Stelmack (1997) has highlighted a number of differences between extraverts and introverts associated with motor function including faster movement times, more frequent movements (Stelmack, Houlihan, & McGarry-Roberts, 1993) and greater restlessness (Gale, 1969) in extraverts. The increased motor restlessness shown by extraverts may be the mechanism used as the unconscious adaptive countermeasure to regulate arousal in a boring laboratory environment. Bob Stelmack has been seminal in this important literature on movement and extraversion, and this special issue dedicated to him recognises this fact

The purpose of the current study is to investigate whether or not participants with varying levels of extraversion do indeed use adaptive (although unconscious) countermeasures to regulate their level of arousal in the laboratory. We tested participants in two conditions. In one condition participants simply did nothing, and in the other condition the participant had the opportunity to use an activity to self-stimulate by using a keyboard to hear sounds. The "task" was chosen as Gale (1969) had found differences in activity on the task between introverts and extraverts. The task would allow a measure of overt activity as a function of level of extraversion. Therefore, in the no activity, low arousing condition, we predicted that extraverts would move much more than the introverts in an attempt to increase their levels of arousal to a more hedonically satisfying level. In the activity condition we predicted that extraverts would self-stimulate (by pressing the keys to hear sounds) more than introverts and that the differences in movement between conditions would be reduced. The movement difference would be smaller because the extraverts would be able to self-stimulate

using the sounds. The movement measure is novel so we also explored the relationship between movement and psychoticism, and movement and neuroticism.

2. METHOD

2.1 *Participants*

An opportunity sample of fifty three participants (40 females, 13 males) was used in the study. All participants were university psychology students (M_{age} = 19.85, SD_{age} = 4.81). Participants were recruited through the departmental participant pool (a system for recruiting students to participate in studies) and were rewarded for participation with course credit.

2.2 *Design*

This study employed a correlational design. The personality scores of participants were correlated with the amount of movement in the no activity condition, the amount of movement in the activity condition and the difference in movement between the activity and no activity conditions. The design could also be regarded as a 2 x 2 mixed factorial design where the independent groups variable was personality (extraversion vs. introversion) and the repeated measures variable was condition (no activity condition vs. activity condition [can press keyboard to obtain different sounds]). Order of presentation of the conditions was counterbalanced. The primary dependant variable was how much the participant moved, however, stimulus hunger was also examined in the experimental condition by examining behaviour on the computer.

2.3 *Materials*

Measurement of extraversion was conducted using an adaptation (Francis, Brown & Philipchalk, 1991) of the Eysenck Personality Questionnaire (Eysenck & Eysenck, 1975). To measure the fidgeting of the participant, a pressure mat (Body Pressure Mat System,

dimensions 539.2 mm x 618.4 mm, produced by Tekscan) was located in the fabric of a standard office chair. Participants were unaware of the presence of the pressure mat. We measured the magnitude (in x – y space) of the change of the centre of mass on the mat second by second to provide an indication of how much the participant was moving on the chair. An Eprime software computer program was used to record the number and length of key presses to four different sounds in the activity condition. The sound lasted for as long as the key was held down. The four sounds were 30 dB of white noise, 60dB 4,000 Hz continuous wave, 60dB 4,000 Hz (modulated at 2 cps) continuous wave, 60dB 4,000 Hz (modulated at 2 cps) continuous wave.

2.4 *Procedure*

Participants sat in an empty room and were told that they would take part in two conditions. In the experimental condition, participants were provided with the computer program on a laptop, and were told that they could either press keys A, S, D or F, with each key making a different sound. They were told that they could press the keys as much or as little as they liked. In the control condition, they were instructed to not do anything for ten minutes and they were only informed that it was a control condition. The duration of both conditions was ten minutes, and in both cases the investigator left the participant alone in the room. Participants then completed the personality inventory. Ten minutes was selected as we considered that asking participants to spend more than ten minutes doing nothing was unreasonable in terms of ethics, and there was no reason to suppose that personality effects would not manifest themselves in the ten minute period.

2.5 *Ethics statement*

144 The protocol had received ethical approval. Participants provided written informed consent
145 and the study was conducted in accordance the code of ethics of the world medical
146 association (Declaration of Helsinki).

147 ## 3.0 RESULTS

148 We correlated extraversion, neuroticism and psychoticism scores with the amount of
149 movement in the no activity condition, the activity condition, and difference scores for each
150 individual between the activity and no activity condition (see Table 1.).

151 *Insert table 1. About here*

152 There were significant, moderate, positive correlations between extraversion and
153 amount of movement in the no activity condition, and extraversion and the difference in the
154 amount of movement between conditions. There was also a significant, moderate, positive
155 correlation between neuroticism and the difference between movement scores in the activity
156 and no activity conditions. There were no significant correlations associated with
157 psychoticism and movement, or movement and personality measures in the activity
158 condition. The correlations between extraversion and the difference score, and neuroticism
159 and the extraversion scores suggest that more extraverted and neurotic individuals exhibit the
160 largest increases in movement between the activity and no activity condition. This is perhaps
161 most clearly represented in a 2 x 2 interaction graph where one factor is condition (activity
162 vs. no activity) and the other factor is extraversion (median split).

163 *Insert Figure 1. About here*

164 It is worth noting that despite the loss of power associated with using a median split the
165 interaction was still significant with a medium effect size $F(1,51) = 5.44$, $p = .024$, $\eta_p^2 = .096$
166 Simple main effects analysis confirmed this interpretation as there was a significant

difference for extraverts but not for introverts, $p < .05$. Precisely the same pattern is observed for neuroticism where there is no difference between condition for more stable participants but a significant difference for more neurotic participants, $F(1,51) = 4.12$, $p = .046$, $\eta_p^2 = .076$.

There were no significant correlations between personality measures and keyboard behaviour. However, with reference to extraversion all measures (total number of button presses, number of changes of sound, total time, mean listening time per press [total listening time per subject divided by total number of presses]) correlations were in the predicted direction with extraverts having higher scores.

The standard deviations for number of button presses and total time were significantly higher for extraverts (button presses $SD = 496.81$; total time $SD = 87.08$) than introverts (button presses $SD = 307.08$; total time $SD = 56.58$), $F_{\text{button presses}} = 10.29$, $p = .002$, $F_{\text{total time}} = 6.22$, $p = .016$. There were no differences with reference to standard deviations for neuroticism and psychoticism.

One aspect of the button pressing data that is striking is the range of the results, the minimum number of times the button was pressed was 4 and the maximum 1740 ($SD = 511.72$) with a large positive skew (1.40).

We also conducted a series of partial correlations where we correlated the extraversion, neuroticism and psychoticism scores with the amount of movement in the experimental condition, controlling for the various measures of keyboard behaviour. No significant changes in the magnitude of the correlations between personality variables and movement were observed when controlling for the different measures of keyboard behaviour.

4.0 DISCUSSION

We found that more extraverted and more neurotic individuals moved more but only in the no activity condition. We did not find any relationship in the amount of keyboard activity with any of the personality. Furthermore, we did not find that any personality variable was related to movement when controlling for amount of keyboard activity. Extraverts were significantly more variable in the amount of keyboard behaviour in the activity condition than introverts. It is perhaps notable that participants did actually use the keyboard to self-stimulate and there was a huge range in the amount of activity observed.

The differences in the amount of movement provide evidence for Gale's hypothesis that extraverts may engage in unconscious 'counter measures' in the laboratory in order to increase their level of cortical arousal. Extraverts may indeed be moving more in order to self-stimulate and raise their baseline level of cortical arousal. This would help to explain why there has been a failure to find a consistent relationship between resting measures of cortical activation and extraversion. Extraverts have comparable levels of cortical arousal in the laboratory because they are unconsciously stimulating themselves using fidgeting to raise their arousal to a more hedonically satisfying level. One advantage of the methodology employed was that the result cannot be a function of any demand characteristics as the participant was unaware that their movement was being recorded and quantified. The effect sizes were not insubstantial. We suggest that the result gives qualified support to Gale's hypothesis. However, we do not have any information about how the amount of movement may impact on levels of arousal.

The results would have provided even stronger evidence for Gale's hypothesis if the expected relationship between extraversion and the amount of keyboard activity had been replicated. Gale (1969) had found differences between introverts and extraverts using a similar button pressing paradigm. All of the measures were in the predicted direction but not one of the correlations achieved statistical significance. We think the explanation for the

failure to replicate the results could be due to differences in methods largely driven by advances in technology. In Gale's experiment the participant pressed morse keys and the experimenter selected the appropriate sound; furthermore, the experimenter was in the laboratory with the participant separated by a blanket. In the current study the recording process was automated. We cannot think of the precise mechanism that would explain the differences in results between the two studies, but the differences in methods are sufficient that a failure to replicate is not completely unsurprising. Furthermore, the support for Gale's hypothesis would have been yet more compelling if an association between extraversion and movement had been found in the experimental condition when the amount of overt behaviour (i.e. pressing keys on the computer) had been partialed out. However, our finding with regard to the size of the standard deviations in experimental condition are consistent with other findings which show that extraverts have greater variability than introverts in other activities such as reaction time tasks (Hundleby, Pawlik & Cattell, 1965).

The results also provide another source of evidence for Stelmack's hypothesis (Stelmack, 1990) that one of the basic differences between extraverts and introverts is related to motor function. Stelmack and Doucet (1997) commented that there is no obvious link to the hypothesised cortical origins (Eysenck, 1967) of extraversion and many of the observed difference in motor activity between introverts and extraverts. Stelmack attributes the observed differences in motor function in his studies to fundamental differences in sensory-motor processing (Doucet & Stelmack, 2000; Houlihan & Stelmack, 2011); we find it difficult to reconcile our findings with the specifics of Stelmack's theory. Our participants are not processing information, they are initiating motor activity even though it is not through conscious volition. Therefore, we would agree with Stelmack that there may be fundamental differences in motor activity as a function of extraversion, however, we think the mechanisms that underpin such differences may be very different with reference to different types of

motor activity. Stelmack's studies (Doucet & Stelmack, 1997; 2000; Houlihan & Stelmack, 2011) focus on responses to discreet stimuli revealing interesting differences between extraverts and introverts, for example, extraverts have faster initiation of movement than introverts but are less efficient at processing stimulus signals. However, we speculate that other types of motor behaviour (e.g. the observation that extraverts simply move more than introverts [Howarth, 1964]) may be the result of motivational processes rather than sensory-motor processing.

In the activity condition one aspect of the results is particularly striking. There was huge variation in the behaviour of the participants. The situation is so unstructured that intuitively it seems reasonable that such wide variations in behaviour must reflect some personality trait. We did conduct some exploratory analysis which we did not report in the results section as it formed no part of the original rationale for the study. The only suggestion of a relationship between personality measures and the movement was a negative correlation of -.25 between number of button presses and neuroticism scores which approached statistical significance. Although there is no obvious theoretical explanation for such a relationship if such a relationship is indeed robust. Gale (1969) did not report means or standard deviations so it is not possible to compare our results with his results. A measure producing such wide variations might be worthy of further investigation.

The classic Eysenck model of extraversion is being increasingly superseded by developments emerging from Gray's model of personality. Empirical evidence from a variety of sources has demonstrated the superior explanatory power of variations of reinforcement sensitivity theory (Corr, 2008). However, we found it difficult to interpret the findings of this study within the context of these more recent theories. It might be the case the Eysenck's and Gray's theories relate to different processes; for example, extraversion/arousal might be the

result of the joint effects of the BIS, BAS and FFFS. Such an analysis is given support by the finding that neuroticism was also positively correlated with movement.

One possible implication of our findings is that movement artefacts in psychophysiological studies of personality may be confounded with personality with consequences that may be difficult to quantify. If extraverts move more they may produce more movement artefacts. Many psychophysiological techniques (particularly the electroencephalogram) are sensitive to movement artefacts and the data associated with obvious movement artefacts is routinely removed from the data. However, the extent to which smaller movements may contaminate data is difficult to quantify (Iriarte, et al. 2003). Furthermore, it is difficult to know if such contamination may reduce or accentuate differences in the physiological data recorded from different personality types. It may also be reasonable to assume that movement (and therefore movement artefacts) could also change as a function of task demands in an experiment; therefore movement artefacts may be confounded with different tasks. Bob Stelmack's work points us in these novel research directions.

In conclusion, we found that with a relatively small sample extraverts do indeed fidget or move more when they do not have anything else to do in the laboratory. Participants also do engage in self-stimulating behaviour and this behaviour is highly variable between participants, but this variation was not related to any of the personality variables recorded. We think the results of this study may help to explain why the predicted difference between resting levels of arousal of extraverts and introverts are not reliably found in the laboratory. Furthermore, the results should encourage researchers to reflect on the activities that participants engage in the laboratory that are not the focus of their studies. Such activities may not be problematic if they are uncorrelated with the independent variables being studied and may just be another source of extraneous variance. However, there may be circumstances

where such behaviours may be confounded with the independent variables of interest with unpredictable results. Finally, the volume and variability in both voluntary and involuntary behaviours observed in the study give support to Stelmack's observations that motor activity may have a clear link to personality.

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Table 1.

Correlations between personality and movement variables

Personality variable	Move (activity)	Move (no activity)	Move (difference
Extraversion	-.05	.30*	.27*
Psychoticism	-.04	.25	.24
Neuroticism	-.16	.16	.30*

- = p <.05

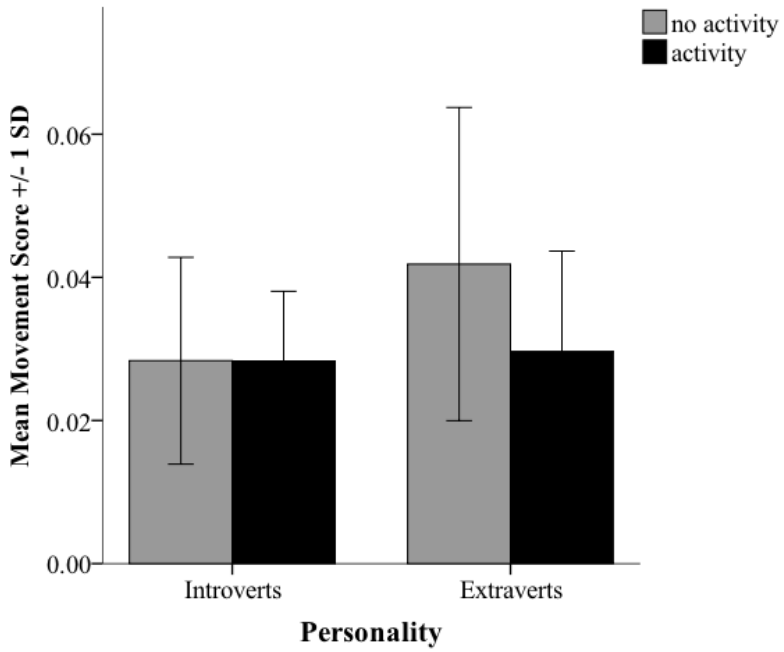

Figure 1. Movement as a function of personality and condition