DISCUSSION PAPER SERIES

IZA DP No. 9426

Brain Types and Wages

Nick Drydakis

October 2015

Forschungsinstitut
zur Zukunft der Arbeit
Institute for the Study
of Labor

Brain Types and Wages

Nick Drydakis
Anglia Ruskin University
and IZA

Discussion Paper No. 9426
October 2015

IZA

P.O. Box 7240
53072 Bonn
Germany

Phone: +49-228-3894-0
Fax: +49-228-3894-180
E-mail: iza@iza.org

IZA Discussion Paper No. 9426
October 2015

ABSTRACT

Brain Types and Wages

We examine the association between brain types and wages using the UK Behavioural Study dataset for the period 2011 to 2013 (four waves). By applying Empathising-Systemising Theory (E-S), the estimations suggest that, for men and women, systemising traits are associated with higher wage returns than empathising traits and that a Type-S brain (*also known as a Male-brain*, entailing greater skills in directing systems) is associated with higher wage rewards than a Type-E brain (*also known as a Female-brain*, entailing more social skills). In addition, wage decompositions suggest that systemising traits can explain greater differences in the assigned gender wage gap compared to empathising traits. Interestingly, the estimations suggest that the wage returns of empathising and systemising traits vary by occupation and that each trait might provide an absolute wage-return advantage in certain occupations. Whilst men and women in certain occupations might face positive wage rewards when they have empathising and systemising traits and work atypical of those common to their gender, it would appear that evaluating individuals' empathising, systemising and brain type is perceived to be important for employees' wage returns.

JEL Classification: J24, J31

Keywords: brain-type, empathising-systemising theory, segregation, wages, wage-gap

Corresponding author:

Nick Drydakis
Lord Ashcroft International Business School
Anglia Ruskin University
East Road
Cambridge, CB1 1PT
United Kingdom
E-mail: nick.drydakis@anglia.ac.uk

1. Introduction and background

Empirical studies of cognitive development suggest that the human brain develops fundamental cognitive domains that involve agentive and non-agentive causality thinking patterns (Wellman, 1990; Dunbar, 1998; Wakabayashi et al., 2007). Based on this dichotomy, Baron-Cohen et al. (2003) and Baron et al. (2005) have proposed the E-S theory, which hypothesises two independent drives; namely, empathising (E) and systemising (S) drives. Individuals with Type-E brains are better at empathising than at systemising. Individuals with Type-S brains systemise better than empathise, while individuals with Type-B brains have a balanced brain.

Hence, studies suggest that, (i) a Type-E brain corresponds to higher social skills (Baron et al. 2005; Manning et al., 2010; Billington et al., 2007; Nettle, 2007), (ii) a Type-S brain is a style that predicts interests in science and causality (Baron-Cohen et al., 2003; Nettle, 2007; Goldenfeld et al., 2005), and (iii) a Type-B brain entails interests in causality combined with good social skills (Baron et al. 2005; Manning et al., 2010). In the literature, studies suggest that brain types create a selection pressure for individuals' development, one which can affect their cognitive abilities (Dunbar, 1998; Wakabayashi et al., 2012).

In this study, we address for the first time the potential association between systemising and empathising traits and wages in the UK, using the longitudinal 2011-2013 Behavioural Study dataset (four waves) which measures individuals' brain type using the seminal Empathising and Systemising Questionnaires (see Baron-Cohen et al., 2003). Moreover, we investigate how occupations moderate the association between empathising/systemising and wages. We suggest that empathising/systemising traits might interact differently with each occupation and gender. It might also be possible to find potentially interesting patterns from the point of view of labour economics.

While we aim to examine whether systemising/empathising traits could partly explain the gender wage gap, studies from widespread areas of the world nonetheless conclude that women earn lower wages (Blau, 2012). Moreover, studies suggest that women are more likely to have more empathising traits than systemising traits, while men are more likely to have more systemising traits than empathising traits (Baron-Cohen, 2003; Baron-Cohen and Wheelwright, 2004; Hines, 2004; Baron et al., 2005). Considering these patterns, we are particularly interested in evaluating whether systemising and empathising traits could potentially explain part of the gender gap allowing us to provide complement arguments on the phenomenon.

In addition, after evaluating systemising's and empathising's wage returns on men's and women's wages we examine whether the three brain types could be differently associated with wages, and whether brain types could be differently associated with men's and women's wages. By offering three comparisons - Type-S brain vs Type-E brain, Type-S brain vs Type-B brain, Type-E brain vs Type-B brain – we will address the potential associations between brain types, wage returns and gender. In doing so we empirically examine the trade-off between empathising and systemising and its impact on wages.

Since economists have yet to utilize the E-S theory (Baron-Cohen et al. 2003) to examine potential wage payoffs based on empathising and systemising drivers, all the aforementioned empirical specifications constitute strengths of this study which contribute to providing a complement to the economic literature on (non)-cognitive traits and skills. Indeed, from an economist's perspective, we might envision empathising and systemising drivers as productivity traits able to influence wages, and/or preferences that affect the subject of education, occupational sorting and so future corresponding wages, and/or as characteristics that result in negative or positive workplace evaluations from colleagues, employers and customers (Heckman, et al., 2006; Mueller and Plug, 2006).

In this study, we adopt an economic viewpoint on systemising and empathising drivers as bundles of attributes that might be valued in the labour market. Although this is an exploratory study, we suggest that systemising and empathising traits might meet the workplace expectations of employees and that these traits might be perceived as human capital characteristics signalling productivity assets for an employee (Heckman et al., 2006).

Moreover, if systemising and empathising traits are found to entail different wage returns, then arguments should be employed to evaluate the potential assigned patterns. In addition, we might suggest that although systemising and empathising drivers might play a role as a determinant of wages, at the same time systemising and empathising traits might affect the education choice and occupational sorting of individuals. It is possible that the field of education and the sorting of individuals with different levels of systemising and empathising into occupations requires different levels of empathy or systems direction (Nettle, 2007; Graddy and Yang, 2010; Wright et al., 2015).

Therefore, employees' preferences might be related to empathising and systemising and it might be possible that these traits influence wages indirectly through field of education and occupational choice processes. For instance, since women are characterised by more empathising traits/skills, and these traits are more valuable in female-oriented jobs - which are less well paid jobs compared to male-oriented jobs - we might suggest that empathy might be

associated with wages due to individual occupational shorting (Manning et al., 2010; Graddy and Yang, 2010). Thus, the relation between systemising and empathising and wages might be driven not only by employees' traits but also by their occupational preferences driven in turn by systemising and empathising.

While, differences in wages may be driven by labour market evaluations against people having empathising or systemising traits, either due to tastes or employer uncertainty regarding the productivity and work commitment of individuals possessing certain traits (Becker, 1993; Arrow, 1998). For instance, since men seem generally to have less empathising traits (Baron-Cohen and Wheelwright, 2004), those men characterised by more empathising traits might receive biased evaluations from workplaces for deviating gender typical identities. Comparable arguments might hold for those women who are characterised by gender atypical traits.

With these arguments in mind - i.e. differences in productivity/traits, differences in preferences and a labour market bias, the focus of our study will be on estimating whether men's and women's wage payoffs are associated with empathising and systemising traits and the corresponding brain type.

The panel data estimations will reveal that both empathising and systemising traits are positively associated with wages. However, for both genders, systemising traits are associated with higher wage returns than empathising traits. In the same vein, the estimation will also evaluate whether a Type-S brain is associated with higher wage rewards than a Type-E brain. In addition, the estimations will show that systemising traits can explain greater differences in the assigned gender wage gap compared to empathising traits. Importantly, the estimations will further suggest that empathising and systemising traits of wage returns vary by occupation and that each trait might provide an absolute wage-return advantage in certain occupations. In the meanwhile, the results will suggest that men and women in certain occupations face positive wage rewards when they have empathising and systemising traits and work atypical of those common to their gender. We will conclude that the successful combination of empathising and systemising traits and occupations might be associated with higher payoffs.

The rest of the paper is organised as follows. The next section presents an overview of the E-S theory and its implications. Section 3 describes the dataset and variables. Section 4 presents the estimation framework. Section 5 offers the descriptive statistics, while Section 6 presents the study's estimations. The last section offers a discussion and concludes the paper.

2. Empathising, systemising and brain types

Baron-Cohen et al. (2003) have developed a concept of cognition that proposes the interplay of two major dimensions: empathising and systemising. Every human being is considered to dispose of both dimensions, but normally on a different level for each. E-S theory categorises individual brain types as Type-S when empathising traits are lower than systemising traits, Type-E when systemising traits are lower than empathising traits, or Type-B (i.e. balanced brain) when systemising traits equal empathising traits. Empathising and systemising are very different types of processes. The former is of great importance in the ability to address the interaction between systems and users, the latter is equally important in constructing and understanding systems (Baron-Cohen et al., 2005).

Empathising attempts to identify and respond to the thoughts and emotions of other people by inferring their mental states and responding to them with an appropriate emotion (Baron-Cohen et al., 2003). Moreover, empathising corresponds to the consciousness of the mental world and has both a cognitive and an affective component (Baron-Cohen and Wheelwright, 2004). The cognitive component involves understanding another person's thoughts and feelings and is also referred to as "using a theory of mind" (Wellman, 1990). The affective component of empathising involves an emotional response that arises as a result of the comprehension of another individual's emotional state (Eisenberg, 2002).

Empathising is held to be humans' most powerful way of understanding and predicting the social world (Baron-Cohen et al., 2005). Those who score high in empathy have larger circles of friends and more individuals they can turn to for social support compared to low scorers (see, Manning et al., 2010). Arts and humanities students tend to be characterised by Type-E brains (Billington et al., 2007). Nettle (2007; 2006) estimates that Type-E brain traits have a high positive correlation with agreeableness and a moderate positive correlation with extraversion dimensions in the Big Five factor model of personality (Costa and McCrae, 1992). Importantly, the origins of a Type-E brain are attributed to sexually dimorphic abilities in domains such as theory of mind, while personality differences, in contrast, are usually explained in terms of affective systems (Nettle, 2007; Baron-Cohen et al., 2003). However, the proposition that cognitive research, theory of mind and personality theory converge on a similar construct for evaluation proves to be a novel prediction (see, Nettle, 2007).

Conversely, systemising is driven to analyse, construct and control rule-based systems (which can be mechanical, natural, abstract or other). Systemising corresponds to the consciousness of the physical world and tries to understand any system that is deterministic,

law-like and bounded (Billington et al., 2007). Systemising is not only used to predict the behaviour of systems but also to control them, and it has been explicitly linked to talent and interests in the fields of science, mathematics, engineering and economics (see, Graddy and Yang, 2010; Summers, 2005; Billington et al., 2007). Nettle (2007; 2006) finds that Type-S brains are weakly positively correlated with the openness and conscientiousness dimensions in the Big Five factor model of personality (Costa and McCrae, 1992). However, studies suggest that a Type-S brain has abundant unique variations compared to the Big Five-factor model of personality and that a Type-S brain is not easily reducible to existing personality constructs (Nettle, 2007; 2006).

While, individuals with a Type-B brain (balanced brain) may be able to draw on the strengths of both empathising and systemising traits depending upon a given situation (Baron-Cohen et al., 2005), interests in science and causality combined with social skills may describe individuals with a Type-B brain (Baron-Cohen et al., 2003; Nettle, 2007; Goldenfeld et al., 2005). In addition, studies indicate that individuals whose systemising is normal or even hyper-developed, but whose empathising is hypo-developed, are an extreme of Type-S. Based on the work of Baron-Cohen et al. (2005), people with an extreme type of Type-S brain may be talented systemisers, but at the same time, they may be mind-blind, possessing lower emotional intelligence. In contrast, individuals who have normal or even hyper-developed empathising skills while their systemising skills are hypodeveloped may be system-blind (Baron-Cohen, 1995; Baron-Cohen et al., 2003).

To test the E-S theory, scientists use the Empathising and Systemising Questionnaire (see Baron-Cohen et al., 2003; Baron-Cohen and Wheelwright, 2004; Nettle, 2007). Each one of the questionnaires was comprised 60 questions. The empathising (systemising) questionnaire was comprised of 40 questions assessing empathising (systemising) and 20 filler control items. Approximately half of the items were worded to produce a “disagree” response and half were worded to produce an “agree” response for the systemising (empathising) items. This construct aims to avoid a response bias either way. Furthermore, items were randomised.

The systemising questionnaire included systematic approaches towards various other life-world domains, such as items concerned with systemising cognition in various domains of everyday life, including dealing with maps, reading books about technology, playing games and being fascinated by how machines work. In contrast, the empathising questionnaire included approaches concerned with empathising cognitions, such as caring for other people, predicting how one will feel and working out what another person might want to

talk about. An individual scored 2 points if he/she strongly displayed a systemising (empathising) response, 1 point if he/she slightly displayed a systemising/empathising response, and zero in all other cases (Baron-Cohen and Wheelwright, 2004).

Almost all of the studies estimate that men score significantly higher than women on the systemising questionnaire, while men score significantly lower than women on the empathising questionnaire (Nettle, 2007). As a result, a Type-S brain is also called a Male-brain, while a Type-E brain is also called a Female-brain. This claim only applies on average; thus, there will always be individuals who are atypical for their gender (Billington et al., 2007). Importantly, systemising and emphasising drives compete neutrally in the brain (Goldenfeld et al., 2005). This observation suggests that, overall, neither gender is superior (Goldenfeld et al., 2005). Moreover, this suggests that women's relatively high empathising scores compensate for their less-developed systemising scores, and conversely, that men's high systemising scores compensate for their less-developed empathising scores (Goldenfeld et al., 2005).

The evidence for women possessing a Type-E brain type is reviewed by scholar reports (see Baron-Cohen et al., 2005; Manning et al., 2010; Billington et al., 2007) and includes the findings that women are better at decoding non-verbal communication, picking up subtle nuances from tone of voice or facial expression, or judging a person's character. When 1-day-old babies are presented with either a live face or a mechanical mobile, girls spend more time looking at the face, whereas boys prefer the mechanical object. Women score higher in social sensitivity, emotion recognition and verbal fluency, and they are more likely to play with dolls as children (see Baron-Cohen et al., 2005).

The evidence for men's Type-S brain type includes the findings that mathematics, physics and engineering, which all require a high degree of systemising skills, are largely male-dominated fields (Baron-Cohen et al., 2005; 2003). Men are more likely to play with mechanical toys as children, and male adults score higher in engineering and physics problems (Baron-Cohen et al., 2005; 2003). In addition, differences favouring men are seen in the mental rotation test, spatial navigation and map reading, as well as in targeting (Baron-Cohen et al., 2005). Although these differences arise from experiential factors, experiments in animals suggest a biological foundation (see Baron-Cohen et al., 2005; Baron-Cohen et al., 2003). Prenatal testosterone appears to produce sex differences in the neural structure and function of the brain that might last a lifetime (Baron-Cohen et al., 2005) and higher prenatal testosterone seems to be associated with higher systemising and lower empathising (Baron-Cohen et al., 2004).

3. Data collection and variables

The current research was administered as part of the Longitudinal Labour Market Study (LMS) at Anglia Ruskin University in the UK. The outcome of this study is the construction of the ongoing Behavioural Study dataset. The data gathering strategy was designed as follows. In October 2011 (first wave), 600 questionnaires per each UK region (12 regions) were sent to random addresses (7,200 questionnaires in total) identified using a lottery address generation software. The survey contained information regarding several demographic, socioeconomic and (non)cognitive questions.[1] The Empathising and Systemising Questionnaires were included amongst the questions, (Baron-Cohen et al., 2003). The cover letter kindly asked one member of the household to participate in the university study, which would be repeated every semester. Instructions were provided, and we asked that participants be between 18 and 65 years of age and not students (for these restrictions, see also Shin and Solon, 2011 and Ziliak et al., 2011). The cover letter provided information regarding the names and contact details of each member of the research team and welcomed any communication for further clarifications. Meanwhile, pre-paid envelopes for each region were provided.

To secure anonymity, the following guidelines were provided: participants were not to identify their names either on the questionnaire or on the pre-paid envelope. In each questionnaire, a code and an address were assigned, and once a completed questionnaire was received by the research team, the next questionnaire was mailed to the participant in April 2012 (second wave), October 2012 (third wave) and in April 2013 (fourth wave). At the end of each questionnaire, participants had the chance to evaluate whether they had experienced any unpleasant emotional experience during their participation in the study. In none of the cases did we receive such a complaint.

Apart from empathising and systemising traits, and brain types, the variables used to explain the formation of wages in the current study are those most frequently used in socioeconomic studies (Lemieux, 2006; Triventi, 2013). These variables are an individual's age, ethnicity, health status and level of higher education. In addition, there was also consideration an individual's years of actual work experience, their occupations, senior appointments and promotion in the previous semester, as well as regions and time effects.

The controls for human capital ensured that we are able to capture more easily the potential additional association of empathising/systemising on wages. Moreover, in checking

[1] Each questionnaire required approximately 15 to 20 minutes to be completed.

for occupations we attempt to control for the unobserved association of occupational decisions/sorting and heterogeneity in regard to the phenomenon under consideration. Moreover, systemising and empathising drivers are said to be determined biologically, even prenatally and to be quite stable over time (Auyeung et al., 2006; Baron-Cohen and Wheelwright, 2004). However, in checking for the possibility that one might hold a senior appointment in her/his current job, we might be able to check for the possibility that higher (lower) systemising traits are driven by senior appointments (lack of senior appointments) and the corresponding higher (lower) wages of this status. Thus, a potential channel of causality; i.e. from senior appointment/higher wages to more systemising might be perceived to have been verified. In the same vein, in checking for those who got promotion in the previous semester, we will attempt to deal with relevant endogeneity patterns that might impact on the aims of this study.

In this study, the combined effect of a random effect modelling and a large number of key controls will enable us to offer an indication of the association between of empathising/systemising drivers and wages. Appendix I offers the details of the coding of the variables.

4. Estimation strategy

The 2011-2013 Behavioural Study dataset enables us to use random-effect models, as performed by Dustmann et al. (2007) to deal with potential unobserved heterogeneity and causality. Cross-sectional analysis may suggest a relationship between empathising/systemising drivers and wages. However, in practice at least some of the cross-sectional difference is likely to be attributable to unobservable heterogeneities and/or causality. Random effect models which consider several periods can capture unobservable heterogeneities and verify whether changes in empathising/systemising coincide with changes in wages. Moreover, by utilising random effect models we can include time invariant characteristics in the regression stage, such as ethnicity, health status, education and occupations that might be partially associated with wages.

For the working men and women, the traditional wage model is given by:

$$lnW_m = X'_m b_{1m} + E'_m b_{2m} + S'_m b_{3m} + u_m \quad (1)$$

$$lnW_f = X'_f b_{1f} + E'_f b_{2f} + S'_f b_{3f} + u_f \quad (2)$$

where W is a vector of wages, X is a vector of individual characteristics (i.e. ethnicity, education, health etc.), E measures empathising traits (continuous variable), S measures

systemising traits (continuous variable), and m and f refer to men and women, respectively. The error terms, u_m and u_f, are independent and identically distributed.

In reality, several unobservable variables can genuinely influence wages; thus, a random effect model (Dustmann et al., 2007) can be employed to address this issue:

$$lnW_{it} = X'_{it}b_{i1t} + E'_{it}b_{i2t} + S'_{it}\,b_{i3t} + A'_i g_i + u^*_{it} \quad (3)$$

The longitudinal observations enable the inclusion of term A, which is the unobservable component of an individual's (i=m,f) characteristics, while t measures time and u^*_{it} is the error component that varies over both individuals and time. Although a fixed-effect model is an alternative possible specification, a Hausman test reveals that this alternative is not supported by the data and that a random-effect model is therefore preferred.

In addition, the wages of those who choose to work may not necessarily give valid estimates of the potential wages of those who did not work by estimating a labour force participation equation. In view of this fact, we will construct an Inverse Mills Ratio term (**λ**) that serves as a statistical correction for the wage equation (lnW). To help the identification of the labour force participation model, the highest educational attainment of the respondent's father is included in the participation equation (vector C). The expanded wage equation takes the following form:

$$lnW_{it} = X'_{it}b_{i1t} + E'_{it}b_{i2t} + S'_{it}\,b_{i3t} + A'_i g_i + \lambda'_i(C_i) + u^*_{it} \quad (4)$$

In the analysis of the relevant results, we present and evaluate the predicted effect of a one point rise in the specified variable (from the mean value for continuous variables and from zero to one for the dummy variables) on wages, with other regressors evaluated at the sample means. In all the specifications, sandwich estimators are used to compute the robust standard errors.

We run separate regression per gender to allow this to study the wage formation based on empathising and systemising without the confounding effect of gender bias. In addition, to distinguish between empathising, systemising and human capital, and so also to test the robustness of our estimations, the regressions outcomes are reported sequentially. The first includes the individual's age, ethnicity, health status, time and region effects, followed by additional covariates that capture human capital and expertise indexes such as higher education, actual working experience, occupational sorting/heterogeneity, senior appointments and promotion.

We should notice that, in all specifications, both empathising and systemising indexes are included. Thus, the estimations to be presented provide the average association between

empathising/systemising and wages having considering important inter-relations between empathising and systemising. In addition, in order to evaluate whether empathising and systemising traits could partly explain the gender wage gap, the usual Oaxaca (1973) type wage decomposition is performed where the wage differential is decomposed into three components: (i) a part that is due to different productivity characteristics; (ii) a part explained by selectivity bias; and (iii) a part that is due to differences in parameters that reward men and women.

Moreover, in the current study, after evaluating the association between empathising, systematising and wages, we offer additional full-informed estimations by examining the association between the three brain types and wages. By focusing on those cases where employees have either a Type-S or a Type- E brain (and utilising the corresponding dichotomous variable: 1=Type-S brain, 0=Type-E brain) we will empirically examine which brain type is associated with higher wage rewards. In the same vein, focusing on those cases where employees have either a Type-S or a Type-B brain (; 1=Type-S, 0=Type-B) we can then offer comparable estimations. Similarly, focusing on those cases where employees have either a Type-E or a Type-B brain (; 1=Type-E, 0=Type-B) additional evaluations on brain types rewards are also to be performed. In so doing, the patterns presented will demonstrate the nature of the multifaceted relationships and the need to explore them carefully.

In the next section, the descriptive statistics of the variables will be presented, followed by the correlation matrix analysis and the regression analysis.

5. Descriptive statistics and correlation analysis

The average response rate for the period 2011-2013 was 63.2%. We dropped questionnaires from self-employed individuals and questionnaires with missing data (10.8%). The total base sample size for the period as a whole is an unbalanced panel of approximately 7,339 person-wave observations for men (45.2%) and 8,895 person-wave observations for women (54.7%). In Table 1 we offer the longitudinal descriptive statistics while, for clarity, in Appendix II, Tables A and B we offer the descriptive statistics for each one of the four waves.

As shown in Table 1, the average age for men is 33.0, while for women it is 35.4 years. The vast majority for both genders are White-British (82%). Men face lower probabilities of having health limitations or disabilities compared to women (12.4% versus 18.3%, respectively). Moreover, men in the sample have a slightly lower probability of holding a higher education degree compared to women (30.0% versus 31.4%, respectively).

Regarding employment patterns, men in the sample are more likely to be employed than women (76.1% versus 66.5%, respectively). In addition, men have less probability of being inactive compared to women (15.6% versus 24.3%, respectively). Furthermore, men have more years of actual work experience than women (11.9 versus 8.0, respectively), while men receive higher annual wages pro-rata compared to women (£32,987.6 versus £26,614.3, respectively). In addition, men work more hours every week than women (41.2 versus 37.7, respectively).

In the current study, the employed individuals were grouped into nine occupations, where we can observe differences between genders. For instance, the men in the sample are more likely to work in IT administration, engineering, banking and consultancy than women. In contrast, women face a higher probability of working in education (primary), social care and sales compared to men. Meanwhile, regional variation in participation rates also exists.

[Table 1]

In regard to the empathising (E) and systemising (S) questionnaire results, the patterns are comparable to those of other studies (Baron et al. 2005; Nettle, 2007). That is, men possess more systemising traits than empathising traits (47.3 versus 39.2, respectively). In contrast, women possess more empathising traits than systemising traits (42.6 versus 28.4, respectively). In terms of brain-type percentages, 30.2% of men in the sample have a Type-E brain (i.e., E>S), while 48.2% of women have a Type-E brain. In addition, 47.2% of men have a Type-S brain (i.e., S>E), while 15.5% of women have a Type-S brain. Moreover, 22.4% of men have a Type-B brain (i.e., S=E), while 36.10% of women have a Type-B brain. The longitudinal dataset provides us with a unique advantage in examining the individuals' variation in brain types conditional on time. In Table 2, we present the variations in the empathising and systemising indexes, as well as variations in the brain types and annual wages for the employed population, separately for each of the four waves. The outcomes suggest that, although wages increase with time, differences in individuals' empathising and systemising skills, as well as in brain types, were not observed. These outcomes hold for both genders.

[Table 2]

In Table 3, we offer the correlation matrix results for the employed individuals (Maadooliat et al., 2013). We observe that annual wages are positively correlated with men, suggesting that men earn higher wages in every occupation compared to women. In addition, we observe that systemising traits are negatively correlated with empathising traits. All the

studies highlight this pattern, suggesting that there is some trade-off between these two types of traits in individuals' brains (Baron Cohen and Whellwright, 2004).

In addition, the results suggest that there is a negative correlation between empathising traits and men, while a positive correlation between men and systemising traits. Indeed, all the studies suggest that men possess more systemising traits and fewer empathising traits, indicating a negative correlation between men and empathising traits. The opposite holds for women. In addition, annual wages are slightly positively correlated with empathising traits and strongly correlated with systemising traits.

Importantly, we observe here that education, social care provision and sales/customer service occupations are strongly positively correlated with empathising traits and weakly positively correlated with systemising traits. Conversely, the remainder of the occupations are highly positively correlated with systemising traits and weakly positively correlated with empathising traits. This outcome is in line with the conclusions of Manning et al. (2010), who suggest that, in certain occupations, it is possible to identify those employees with more empathising traits.

Moreover, the correlation analysis suggests that there is a gender segregation pattern insofar as there is a negative correlation between men and primary education, social care provision and sales/customer service occupations. However, there is a positive correlation between men and IT administration, management, engineering, banking, other professional services and elementary occupations. On average, an association between genders, segregation and empathising-systemising traits may be identified. On the one hand, each gender is segregated in relation to certain occupations. On the other hand, an empathising-systemising trait-based segregation has also been observed. Hence, a multivariate analysis that takes into consideration all these effects is important for estimating the relation between wages and brain types.

[Table 3]

6. Regression results

6.1 Basic results

In Table 4, Panels I and II present random-effect estimations for men, and Panels III and IV present random-effect estimations for women. Panels I and III present tests for empathising, systemising, age, ethnicity, health status, time and region effects. In Panels II and IV, tests are also presented for higher education, work experience, senior appointments, promotion, and occupations.

In Panel I, it is observed that empathising traits are associated with higher wages on the order 3.3 percentage points. Moreover, systemising traits are associated with positive wage rewards on the order 5.4 percentage points. That is, the outcomes suggest that a one point rise in empathising (systemising) traits is associated with 3.3 (5.4) percentage point higher wages. Both estimations are statistically significant. It seems that, for men, empathising and systemising are associated with higher wages.

A Wald test shows that the impact of systemising on wages is higher than the impact of empathising (W-test=7.3, $p<0.01$). In Panel II, including human capital indicators, occupational sorting/heterogeneity, senior appointments and promotion, although the magnitude of the empathising and systemising coefficient is lower, the results continue to be statistically significant. Based on the new estimations, empathising is associated with higher wages by 2.1 percentage points whereas systemising is associated with higher wages by 3.7 percentage points. The new outcomes are statistically significant and a Wald test shows that the impact of systemising on wages is higher than the impact of empathising (W-test=5.4, $p<0.03$). While, it seems also that the additional covariates can moderate the relation between empathising, systemising and wages. Hence, including the additional variables in the regression turned out to be crucial in order to reduce heterogeneities.

[Table 4]

In Table 4, Panel III presents estimations for women. In Panel I, it can be observed that empathising is associated with higher wages by 3.8 percentage points. In addition, systemising is associated with higher wages by 4.6 percentage points. In all cases, the estimations are significant. The empathising-systemising difference is estimated to be statistically significant (W-test=5.6, $p<0.03$). In Panel IV, when adding more covariates qualitative the same patterns are observed. It can thus be observed that empathising is associated with higher wages by 2.5 percentage points whereas systemising is associated with wage rewards of the order of 3.2 percentage points. The coefficients are statistically significant, whereas, and the empathising-systemising difference is also estimated to be statistically significant (W-test=5.2, $p<0.03$).

From the men/women estimations, it can be observed that empathising is associated with higher wages for women than for men. On the other hand, systemising is associated with higher wage returns for men than for women. Full-informed estimations for both men and women are presented in Appendix III. The interaction effect between men and empathising (men x empathising) generates a statistically insignificant pattern; that is, empathising entails qualitatively the same wage rewards regardless of the employees' sex. On the other hand, the

interaction effect between men and systemising (men x systemising) shows that systemising is associated with higher wages for men than women of the order of 1.1 percentage points. Here, the estimation is statistically significant.

In regard to the rest of the covariates, the outcomes are as expected. For both genders, the wage returns are in line with established theoretical and applied knowledge (Lemieux, 2006). The factors of age, being British, healthy, educated, with more working experience, holding a senior appointment and having been promoted in the previous semester are all positively associated with wages. In addition, those who work in management and banking occupations experience the highest wage returns, while those in sales are estimated to receive the lowest wage returns. These patterns are also observed in the UK's national statistics (Office for National Statistics, 2012). In regard to occupation coefficients, we may observe that, in all categories, women experience lower wage returns compared to men. This outcome suggests that women earn less than men when employed in the same occupation. Studies suggest that within-occupation wage differentials are also a predominant explanation for the wage penalty that women face, in addition to segregation and gender differences in wage returns in proportion to education and working experience (Cobb-Clark and Tan, 2011; Bettio, 2002). Finally, statistically insignificant Inverse Mills Ratios were also estimated.[2]

6.2 Occupations interaction-effects

In Table 4, in Panels II and IV, we present also the interactions between occupations and systemising/empathising for men and women, respectively. Based on full-informed estimations, we observe that wage returns for both empathising and systemising vary by occupation. From the interaction of empathising and systemising and occupations, 16 new results emerge. In Panel II, we observe that, for men, empathising is associated with higher wages in social care provision, education and in sales and customer services compared to systemising. To be specific, the wage returns are 3.3, 3.5 and 2.9 percentage points, respectively. For the same occupations, the systemising wage returns are 2.1, 2.7 and 2.2 percentage points, respectively. Wald tests show that the differences between brain types are significant at least at the 0.05 level.

[2] We should also notice that we have run preliminary two-step Heckman models to test for potential attrition bias. The first model was a regression model that addressed the research question. The second model was a logit model with the dependent variable being a dichotomous variable indicating either continued participation or nonparticipation in the study. The variable used to account for systematic attrition (instrument) was health, mental health status and whether the participants rent or owned the property in the first wave. Statistically insignificant Inverse Mills Ratios were then estimated.

Conversely, in IT administration, management, engineering, and in banking, systemising is associated with higher wage returns than empathising. For instance, systemising in IT administration is associate with wage returns on the order of 3.1 percentage points, while empathising is associated with a wage return on the order of 3.9 percentage points. Wald tests also show that the differences per occupation are significant at least at the 0.05 level. In Panel II, we observe comparable qualitative patterns for women.

6.3 Wage decomposition

In Table 5, by employing the Oaxaca (1973) decomposition technique, we observe that the gender wage gap against women is on the order of 21.1 percentage points. Regarding brain-type decomposition results, we find that 2.3 percentage points of the gender wage gap can be attributed to differences in mean empathising traits. Additionally, 5.2 percentage points of the gender wage gap can be attributed to differences in mean systemising traits. While the contribution of brain types to explaining the variance in the gender wage gap is rather modest, the decomposition outcomes suggest that differences in systemising traits can more adequately explain differences in the men-women wage gap compared to empathising traits.

This outcome is easy to interpret when considering two patterns. First, the vast majority of women have more empathising traits, while most men have more systemizing traits (see Table 1). Second, systemising is associated with higher wage returns compared to empathising traits (see Table 5). Importantly, however, this outcome does not apply universally. As has been estimated for certain occupations, empathy is associated with higher wage returns. Thus, the occupational variation seems to differentiate systemising/empathising wage returns.

[Table 5]

6.4 Brain types

In Table 6, Specification 1, we present estimations when restrict the sample into those employees who are classified as having either a Type-S brain or Type-E brain. In Panel I, the full-informative estimations for men suggest that a Type-S brain is associated with higher wages by 9.8 percentage points compared to Type-E brain. The estimation is statistically significant. This result verifies the general pattern in this study that systemising traits might be associated with higher wage rewards than empathising traits.

Moreover, Specification 2 presents estimations when restricting the sample into those employees who are classified as having either a Type-S or a Type-B brain. As is observed in Panel I, the new estimations for men suggest that a Type-S brain is associated with higher wages by 6.3 percentage points compared to Type-B brain. The outcome is statistically significant. This pattern might suggest that employees having more systemising traits might face higher wage rewards than those employees with a balanced brain. In other words, the wage return competitive advantage of systemising traits has again been verified.

Furthermore, in Specification 3 we restrict the sample into those employees who are classified as having either a Type-E or a Type-B brain. In Panel I, the estimations suggest that, for men, a Type-E brain is associated with lower wages by 3.7 percentage points compared to Type-B brain. The new outcome is statistically significant. This pattern might suggest that employees having equivalent empathising and systemising traits are better off in terms of higher wages than those employees who have less systemising traits than empathising traits. The pattern re-highlights the role systemising traits play in driving higher wage rewards. The afore-mentioned three specifications might suggest that a Type-S brain is associated with higher wages than a Type-B brain; and that a Type-B brain is associated with higher wages than a Type-E brain. In Panel II, qualitative comparable estimations are observed for women.

[Table 6]

7. Discussion

The patterns of this study suggest that empathising and systemising traits, as well as the corresponding brain type, might be important in predicting individuals' wage rewards. The first pattern realised in this study is that both empathising and systemising traits are positively associated with wages. However, the fact that systemising is found to be associated with higher wage returns compared to empathising and can explain the appearance of more differences in the gender wage gap (compared to empathising) could suggest that, in the UK labour market, when more systemising traits characterise an employee, then these traits are more rewarded. The results seem to be robust being that random effect estimations were utilised, a sample selection was considered, and we checked for several human capital and occupational heterogeneities.

In addition, this study has found that, for certain occupations, and for both genders, empathising might be associated with higher wage rewards compared to systemising. Indeed, the second pattern realised in this study suggests that empathising traits are associated with

higher wage rewards in education, social care provision and in sales and customer services than systemising traits. Empathising traits are related to counselling and advising (Baron et al., 2003). For these professions, caring for other people, being warm and offering advice are important characteristics of an employee. Empathising traits may be a better fit for these jobs' requirements, and therefore positively associated with employees' productivity and wages.

Furthermore, the results of this study show that systemising traits are associated with higher wage rewards in management, IT administration, engineering, and in banking than empathising traits. We would suggest that, because these employees have to deal with organisational systems, systemising traits might function better in administrating, evaluating, adapting and changing these systems within these occupations. We would therefore conclude that job circumstances do vary; while some occupations mainly require empathising traits, other jobs mainly require systemising traits. These patterns are comparable for both genders, providing support to our conclusion.

Parallel to this reasoning, the notion that men and women employees with empathising traits might face lower wage returns in management, IT administration, engineering and in banking, compared to men and women employees with higher systemising traits in the same occupations, highlights the conclusion that these two traits might be associated with an advantage for certain occupations rewarded in the labour market. Empathy can be perceived as a less rewarded advantage for managers and engineers. Perhaps these employees have then to be very direct in their communication and administration and they have to operate their firms' systems, while difficult decisions are also required of them.

In contrast, men and women employees with systemising traits experience lower wage returns in education, social care provision and sales compared to employees with more empathising traits in the same occupations. Based on the assigned patterns, we might conclude that employees may have an advantage in jobs where systemising (empathising) is more important than empathising (systemising) and is rewarded as a productivity trait. Perhaps, it might be the case that some brain traits are more valued in certain occupations than in others.

Importantly, the third pattern realised in this study suggests that although women are more likely, on average, to have more empathising than systemising traits, in certain occupations (i.e. management) systemising traits are associated with higher wage rewards than empathising traits. This pattern suggests that in certain occupations, women experience higher wage rewards when they have systemising traits and work atypical of their gender. Moreover, for men, although they are more likely on average to have more systemising than

empathising traits, in certain occupations (i.e. education) empathising traits are associated with higher wage rewards than systemising traits. Thus, in addition to an employee's gender, one should deal with an employee's systemising and empathising traits.

E-S theory provides a new dimension for the employment discipline that social scientists should focus upon in order to make evaluations. However, we have importantly to highlight that when firms construct gender identities based on societal stereotypes, gender sorting and wage inequality may result (Skuratowicz and Hunter, 2004; Watts, 2009; Guerrier et al., 2009). If the gender balance weighs heavily towards men in a particular occupation, the norms and behaviours of that occupation will reflect gender-based norms, which are less supportive of women applicants and employees (Watts, 2009).

In general, it is probable that norms may systemise women to face unfavourable treatment within jobs that are atypical of their brain type traits. Bias against women may start before they enter the labour market. That is, women may be discouraged from entering fields of studies that are non-traditional of their gender, such as engineering and technical professions. Such gender stereotyping may later confine women to traditional female-type occupations with generally lower wages.

Currently, job openings and internal job postings for promotions highlight the traits of a desirable applicant. Evaluating individuals' brain types seems to be important for individuals' labour market returns, as well as for firms' productivity. Employees' matching and search criteria and firms' screening criteria could both be clarified by focusing on the E-S theory. Employees' brains are some of the most important productivity resources a firm has for its present and future survival, and the E-S theory might provide predictions for each potential employee. This focus on empathising and systemising might be extremely important because management of people is valuable not only for focusing on areas of difficulty, but also for focusing on areas of strength.

Finally, we have to emphasise that the reported results and the analysis presented are simply an indication of the association between empathising, systemising and wage returns. Empirical approaches to address potential causality and omitted variable bias problems would add to this domain. The E-S theory introduces new dimensions in the study of labour, and several key research questions need therefore to be evaluated. How each brain type is correlated to each and every demographic characteristic and how these interactions associate with wage returns is of great importance for further study. In addition, a dataset that has information regarding specific job activities, such as social skills and problem solving, would

clarify the nature of each job's tasks, enabling additional interactions between brain type and wage returns and making evaluations more robust.

References

Arrow, K. J. (1998). What Has Economics to Say about Racial Discrimination? *Journal of Economic Perspectives*, 12:91-100.

Auyeung, B. Baron-Cohen, S. Chapman, E. Knickmeyer, R. Taylor, K. AND Hackett, G. (2006). Foetal Testosterone and the Child Systemising Quotient (SQ-C). *European Journal of Endocrinology*, 155: 123-130.

Baron-Cohen, S. Richler, J. Bisarya, D. Gurunathan, N. Wheelwright, S. (2003). The Systemising Quotient: An Investigation of Adults with Asperger Syndrome or High-Functioning Autism and Normal Sex Differences. *Philosophical Transactions of the Royal Society*, 352: 361-374.

Baron-Cohen, S. and Wheelwright, S. (2004). The Empathy Quotient: An Investigation of Adults with Asperger Syndrome or High-Functioning Autism, and Normal Sex Differences. *Journal of Autism and Developmental Disorders*, 34: 163-175.

Baron-Cohen, S. Knickmeyer, R. C., Belmonte, M. K. (2005). Sex Differences in the Brain: Implications for Explaining Autism. *Science*, 310: 819-823.

Becker, G. S. (1993). Nobel Lecture: The Economic Way of Looking at Behavior. Journal of Political Economy: 101: 385-409.

Bettio, F. (2002). The Pros and Cons of Occupational Gender Segregation in Europe. *Canadian Public Policy*, XXVIII: 65-84.

Billington, J. Baron-Cohen, S. and Wheelwright, S. (2007). Cognitive Style Predicts Entry Into Physical Sciences and Humanities: Questionnaire and Performance Tests of Empathy and Systemising. *Learning and Individual Differences*, 17: 260-268.

Blau, F. (2012). *Gender Inequality and Wages*. Oxford: Oxford University Press.

Cobb-Clark, D. A. and Tan, M. Noncognitive Skills, Occupational Attainment, and Relative Wages. *Labour Economics*, 18:1-13.

Cost, P. T. and McCrae, R. (1992). Four Ways Five Factors are Basic. Personality and Individual Differences, 135: 653-665.

Dunbar, R. I. M. (1998). The Social Brain Hypothesis. *Evolutionary Anthropology*, 6: 178-190.

Dustmann, C. Engracia, M. and Barrachina, R. (2007). Selection Correction in Panel Data Models: An Application to the Estimation of Women' Wage Equations. *Econometric Journal*, 10: 263-293.

Eisenberg, N. (2002). Empathy-Related Emotional Responses, Altruism, and their Socialization. In *Visions of Compassion: Western Scientists and Tibetan Buddhists Examine Human Nature* (PP. 131-164), Davidson, R. J. and Harrington, A. (Eds). London: Oxford University Press.

Goldenfeld, N. Baron-Cohen, S. and Wheelwright, S. (2005). Empathising and Systemising in Mens, Women and Autism. *International Journal of Clinical Neuropsychology*, 2: 338-345.

Guerrier, Y. Evand, C. Glover, J. and Wilson, C. (2009). 'Technical, But Not Very..': Constructing Gendered Identities in IT-Related Employment. *Work, Employment and Society*, 23: 494-511.

Graddy, D. B. and Yang, F. (2010). Brain-Type, Gender and Student Success in the Principles of Economics. *Journal of Economics and Finance Education*, 9: 20-30.

Heckman, J. J. Stixrud, J. and Urzua, S. (2006). The Effects of Cognitive and Noncognitive Abilities on Labor Market Outcomes and Social Behavior. Journal of Labor Economics, 24: 411-482.

Hines, M. (2004). *Brain Gender*. New York: Oxford University Press.

Lemieux, T. (2006). The Mincer Equation Thirty Years after Schooling, Experience, and Earnings, in Grossbard-Shechtman, S. (Ed.), *Jacob Mincer, A Pioneer of Modern Labor Economics* Springer Verlag.

Maadooliat, M. Pourahmadi, M. and Huang, J. (2013). Robust Estimation of the Correlation Matrix of Longitudinal Data. *Statistics and Computing*, 23: 17-28.

Machin, S. McIntosh, S. Vignoles, A. and Viitanen, T. (2001). Basic Skills, Soft Skills and Labour Market Outcomes: Secondary Analysis of the National Child Development Study. Research Report No. 250. London: DFEE Research Centre.

Manning, J. T. Reimers, S. Baron-Cohen, S. Wheelwright, S. Fink, B. (2010). Sexually Dimorphic Traits (Digit Ratio, Body Height, Systemising-Empathising Scores) and Gender Segregation between Occupations: Evidence from BBC Internet Study. *Personality and Individual Differences*, 49: 511-515.

Mueller, G. and Plug, E. (2006). Estimating the Effects of Personality on Men and Women Earnings. *Industrial and Labor Relations Reviews*, 60: 3-22.

Nettle, D. (2006). Psychological Profiles of Professional Actors. *Personality and Individual Differences*, 40: 375-383.

Nettle, D. (2007). Empathising and Systemising: What are they, and What Do they Contribute to Our Understanding of Psychological Sex Differences? *British Journal of Psychology*, 98: 237-255.

Office for National Statistics. (2012). *Annual Survey of Hours and Earnings - 2012.* Newport: Office for National Statistics.

Shin, D. and Solon, G. (2011). Trends in Men's Earnings Volatility: What Does the Panel Study of Income Dynamics Show? *Journal of Public Economics*, 95: 973–982.

Skuratowicz, E. and Hunter, L. (2004). Where Do Women's Jobs Come From. *Work and Occupation*, 31: 73-110.

Summers, L. H. (2005). Remarks on Diversifying the Sciencs and Engineering Workforce. Cambridge, MA: National Bureau of Economic and Research.

Triventi, M. (2013). The Gender Wage Gap and its Institutional Context: A Comparative Analysis of European Graduates. *Work, Employment and Society*, doi: 10.1177/0950017012460322 .

Wakabayashi, A. Sasaki, J. and Ogawa, Y. (2012). Sex Differences in Two Fundamental Cognitive Domains. Empathising and Systemising in Children and Adults. *Journal of Individual Differences*, 33: 24-34.

Watts, J. (2009). Allowed Into a Man's World. Meanings of Work Life Balance. Perspectives of Woman Civil Engineers as Minority Workers in Construction. *Gender, Work and Organization*, 16: 37-57.

Wellman, H. (1990). *The Child's Theory of Mind*. Cambridge, MA: MIT Press.

Wright, D. B. Eaton, A. A. and Skagerberg, E. (2015). Occupational Segregation and Psychological Gender Differences: How Empathising and Systemising Help Explain the Distribution of Men and Women into Some Occupations. *Journal of Research in Personality*, 54: 30-39.

Ziliak, J. P. Hardy, B. and Bollinger, C. (2011). Earnings Volatility in America: Evidence from Matched CPS. *Labour Economics*, 18: 742–754.

Table 1. Descriptive Statistics (Longitudinal): Mean and Standard Deviation

	Men		Women	
Variables	**Mean**	**Standard Deviation**	**Mean**	**Standard Deviation**
Empathising (continuous)	39.25	11.76	42.61	9.71
Systemising (continuous)	47.31	9.73	28.40	8.32
Type-E brain (%)	30.28	0.46	48.28	0.48
Type-S brain (%)	47.22	0.47	15.54	0.37
Type-B brain (%)	22.44	0.42	36.10	0.47
Age (continuous)	33.09	10.38	35.40	10.18
White-British (%)	82.32	0.38	81.76	0.38
Health status (%)	12.41	0.32	18.30	0.40
Higher education (%)	30.09	0.45	31.49	0.46
Labour force (%)	84.44	0.36	75.67	0.39
Employed (%)	76.19	0.42	66.56	0.40
Annual wages (continuous)	32,987.69	10,794.66	26,614.35	10,340.12
Weekly working hours (continuous)	41.26	3.28	37.52	2.33
Work experience (continuous)	11.96	8.05	8.01	5.48
Senior appointment (%)	22.63	0.67	10.13	0.59
Promotion (%)	11.14	0.32	6.22	0.30
Father's higher education (%)	25.09	0.43	24.24	0.42
Occupations:				
Education (primary) (%)	5.67	0.22	9.37	0.27
Social care provision (%)	7.48	0.25	16.67	0.43
IT administration (%)	8.87	0.28	5.43	0.20
Management and administration (%)	13.45	0.34	8.50	0.25
Engineering and technical professions (%)	12.39	0.29	6.36	0.20
Banking, finance and consultancy (%)	10.27	0.28	8.39	0.27
Other professional services (%)	15.30	0.37	13.65	0.31
Sales and customer services (%)	11.28	0.23	18.82	0.43
Elementary occupations (%)	15.20	0.39	12.70	0.33
Regions:				
East Midlands (%)	8.92	0.28	7.25	0.26
East of England (%)	7.36	0.25	8.10	0.28
London (%)	9.20	0.29	9.12	0.29
North East (%)	8.29	0.28	7.57	0.26
North West (%)	7.22	0.25	7.12	0.24
Northern Ireland (%)	9.30	0.29	9.20	0.29
Scotland (%)	9.39	0.29	9.24	0.29
South East (%)	7,03	0.25	8.28	0.28
South West (%)	7.21	0.26	8.38	0.28
Wales (%)	9.28	0.29	7.38	0.25
West Midlands (%)	9.26	0.29	8.91	0.28
Yorkshire and the Humber (%)	7.50	0.27	9.22	0.29
Person-waves observations	7,339		8,895	

Notes: UK Behavioural Study Data Set (2011-2013; four waves).

Table 2. Empathising and Systemising: Mean and Standard Deviation; Employed Individuals

	2011 Second semester	**2012 First semester**	**2012 Second semester**	**2013 First semester**
			Men	
Empathising -continuous	39.31 (11.91)	39.28 (11.83)	39.34 (11.87)	39.32 (11.84)
Systemising -continuous	47.23 (9.59)	47.32 (9.61)	47.30 (9.58)	47.31 (9.59)
Type-E brain -%	30.30 (0.45)	30.30 (0.45)	30.30 (0.45)	30.30 (0.45)
Type-S brain -%	47.23 (0.49)	47.23 (0.49)	47.23 (0.49)	47.23 (0.49)
Type-B brain -%	22.46 (0.41)	22.46 (0.41)	22.46 (0.41)	22.46 (0.41)
Annual Wages -continuous	32,257.5 (10,762.4)	32,892.3 (10,816.2)	33,138.5 (10,859.2)	33,748.3 (10,938.2)
Observations	1,395	1,412	1,418	1,421
			Women	
Empathising -continuous	42.63 (9.79)	42.58 (9.73)	42.59 (9.75)	42.58 (9.70)
Systemising -continuous	28.90 (8.47)	28.42 (8.34)	28.96 (8.55)	28.98 (8.62)
Type-E brain -%	48.30 (0.49)	48.30 (0.49)	48.30 (0.49)	48.30 (0.49)
Type-S brain -%	15.61 (0.36)	15.61 (0.36)	15.61 (0.36)	15.61 (0.36)
Type-B brain -%	36.07 (0.48)	36.07 (0.48)	36.07 (0.48)	36.07 (0.48)
Annual Wages -continuous	26,614.2 (10,340.5)	27,032.5 (10,396.5)	27,201.3 (10,421.8)	27,656.7 (10,505.4)
Observations	1,429	1,436	1,444	1,452

Notes: UK Behavioural Study Data Set (2011-2013; four waves).Standard deviations are in parenthesis.

Table 3. Correlation Matrix (Longitudinal); Employed Men and Women

	Empathising	Systemising	Men	Annual Wages	Education	Social care provision	IT administration	Management and administration	Engineering and technical professions	Banking, finance and consultancy	**Other professional services**	Sales and customer services	Elementary occupations
Empathising	1												
Systemising	-0.213**	1											
Men	-0.202**	0.295***	1										
Annual Wages	0.109*	0.548***	0.232***	1									
Education	0.377*	0.264***	-0.162**	0.343***	1								
Social care provision	0.383*	0.245***	-0.264*	0.328***	-0.059	1							
IT administration	0.244***	0.563***	0.656***	0.422***	-0.042	-0.048	1						
Management and administration	0.216**	0.434***	0.635***	0.528***	-0.064	-0.035	-0.069	1					
Engineering and technical professions	0.197**	0.627***	0.537***	0.431***	-0.046	-0.059	-0.020	-0.079	1				
Banking, finance and consultancy	0.251**	0.386***	0.538***	0.472***	-0.073	-0.060	-0.041	-0.038	-0.067	1			
Other professional services	0.219**	0.338***	0.442***	0.429***	-0.069	-0.077	-0.037	-0.073	-0.088	-0.065	1		
Sales and customer services	0.455***	0.240***	-0.276***	0.230***	-0.039	-0.035	-0.085	-0.066	-0.084	-0.077	-0.054	1	
Elementary occupations	0.157**	0.255**	0.105*	0.249***	-0.071	-0.040	-0.039	-0.075	-0.054	-0.070	-0.067	-0.063	1

*Notes: UK Behavioural Study Data Set (2011-2013; four waves). Pearson, and Phi correlation coefficients. *** Significant at the 10% level. ** Significant at the 5% level. * Significant at the 1% level.*

Table 4. Longitudinal Hourly Wage (Log) Estimations

	Panel I Men	Panel II Men	Panel III Women	Panel IV Women
Empathising	0.033 (0.006)***	0.021 (0.008)***	0.038 (0.012)***	0.025 (0.010)***
Systemising	0.054 (0.012)***	0.037 (0.015)***	0.046 (0.013)***	0.032 (0.015)***
Age	0.013 (0.0004)***	0.011 (0.0006)***	0.011 (0.0021)***	0.009 (0.0014)***
Age^2	-0.000 (0.0002)***	-0.000 (0.0002)***	-0.000 (0.0002)***	-0.000 (0.0002)***
White-British	0.068 (0.0014)***	0.054 (0.0012)***	0.061 (0.013)***	0.051 (0.021)***
Health status	-0.086 (0.019)***	-0.083 (0.019)***	-0.153 (0.014)***	-0.121 (0.025)***
Higher education	-	0.321 (0.014)***	-	0.201 (0.037)***
Work experience	-	0.013 (0.004)***	-	0.011 (0.005)***
Work $experience^2$	-	-0.000 (0.0001)***	-	-0.000 (0.0001)***
Senior appointment	-	0.115 (0.027)***	-	0.085 (0.033)***
Promotion	-	0.073 (0.019)***	-	0.070 (0.024)***
Education (primary)	-	0.065 (0.010)***	-	0.062 (0.014)***
Education (primary) x Empathising	-	0.035 (0.010)***	-	0.037 (0.009)***
Education (primary) x Systemising	-	0.027 (0.012)***	-	0.023 (0.011)***
Social care provision	-	0.061 (0.023)***	-	0.058 (0.018)***
Social care provision x Empathising	-	0.033 (0.012)***	-	0.038 (0.010)***
Social care provision x Systemising	-	0.021 (0.013)**	-	0.027 (0.010)***
IT administration	-	0.091 (0.010)***	-	0.070 (0.011)***
IT administration x Empathising	-	0.031 (0.012)***	-	0.028 (0.012)***
IT administration x Systemising	-	0.039 (0.010)***	-	0.034 (0.015)***
Management and administration	-	0.107 (0.019)***	-	0.080 (0.017)***
Management and administration x Empathising	-	0.025 (0.010)***	-	0.026 (0.010)***
Management and administration x Systemising	-	0.041 (0.018)***	-	0.037 (0.012)***
Engineering and technical professions	-	0.070 (0.011)***	-	0.065 (0.013)***
Engineering and technical professions x Empathising	-	0.022 (0.010)***	-	0.027 (0.012)***
Engineering and technical professions x Systemising	-	0.041 (0.012)***	-	0.034 (0.010)***
Banking, finance and consultancy	-	0.094 (0.014)***	-	0.081 (0.016)***
Banking, finance and consultancy x Empathising	-	0.023 (0.010)***	-	0.025 (0.009)***
Banking, finance and consultancy x Systemising	-	0.043 (0.014)***	-	0.032 (0.015)***
Other professional services	-	0.068 (0.014)***	-	0.063 (0.017)***
Other professional services x Empathising	-	0.028 (0.012)***	-	0.025 (0.010)***
Other professional services x Systemising	-	0.035 (0.015)***	-	0.031 (0.013)***
Sales and customer services	-	0.034 (0.018)**	-	0.025 (0.010)***
Sales and customer services x Empathising	-	0.029 (0.010)***	-	0.030 (0.011)***
Sales and customer services x Systemising	-	0.022 (0.007)***	-	0.020 (0.012)**
Regional controls	Yes	Yes	Yes	Yes
Time controls	Yes	Yes	Yes	Yes
Inverse Mills Ratio	-0.097 (0.065)	-0.095 (0.065)	- 0.111 (0.090)	- 0.111 (0.090)
Wald x^2	264.656	311.392	274.493	284.403
Prob>x^2	0.000	0.000	0.000	0.000
Person-waves observations	5,646	5,646	5,761	5,761

*Notes: UK Behavioural Study Data Set (2011-2013; four waves). We use a random effect estimator to capture unobserved heterogeneity. The estimations are corrected for sample selection bias. We control for a standard set of variables that help the identification of the labour force participation model, including: the highest educational attainment of the respondent's father. Elementary occupations, East Midlands and the 2011-second-semester-time-period are the reference categories (excluded categories).Robust standard errors clustered at the occupation level are presented. ** Significant at the 5% level. *** Significant at the 1% level.*

Table 5. Oaxaca Decomposition Results for Brain Types

Description	Coefficient	Standard error	Wage effects as a proportion (percentage points) of the gross differential
Difference:			
(1) Log hourly wages	0.211		
Differences due to:			
(2) Endowments	0.138	(0.012)***	65.41%
(3) Coefficients	0.035	(0.008)***	16.58%
(4) Other characteristics (Inverse Mills Ratio, Interactions)	0.038	(0.011)***	18.01%
Differences due to empathising characteristics:			
(5) Endowments	0.005	(0.002)***	2.36%
(6) Coefficients	0.004	(0.002)***	1.89%
Differences due to systemising coefficients:			
(6) Endowments	0.011	(0.004)***	5.21%
(7) Coefficients	0.007	(0.002)***	3.31%
Controls:			
Age, White-British, Health status, Higher education, Working experience, Occupations, Senior Appointments, Promotion, Regions, Time	Yes		

*Notes: UK Behavioural Study Data Set (2011-2013; four waves). *** Significant at the 1% level.*

Table 6. Longitudinal wage estimations

	Panel I Men	**Panel II Women**
Specification 1.		
Employees having either a Type-S or a Type-E brain		
Type-S brain *(vs Type-E brain)*	0.098 (0.021)***	0.063 (0.018)***
Inverse Mills Ratio	-0.095 (0.075)	-0.118 (0.094)
Wald x^2	303.437	244.115
Prob>x^2	0.000	0.000
Person-waves observations	4,346	3,629
Specification 2.		
Employees having either a Type-S or a Type-B brain		
Type-S brain *(vs Type-B brain)*	0.063 (0.005)***	0.041 (0.006)***
Inverse Mills Ratio	-0.091 (0.078)	-0.112 (0.085)
Wald x^2	312.862	243.423
Prob>x^2	0.000	0.000
Person-waves observations	3,895	2,937
Specification 3.		
Employees having either a Type-E or a Type-B brain		
Type-E brain *(vs Type-B brain)*	-0.037 (0.010)***	-0.029 (0.006)***
Inverse Mills Ratio	-0.085 (0.074)	-0.106 (0.097)
Wald x^2	299.834	232.977
Prob>x^2	0.000	0.000
Person-waves observations	2,935	4,838

*Notes: UK Behavioural Study Data Set (2011-2013; four waves). We use a random effect estimator to capture unobserved heterogeneity. The estimations are corrected for sample selection bias. We control for a standard set of variables that help the identification of the labour force participation model, including: the highest educational attainment of the respondent's father. Elementary occupations, East Midlands and the 2011-second-semester-time-period are the reference categories (excluded categories). Each panel controls for age, ethnicity, health status, higher-education, work experience, senior appointment, promotion, occupations, regional and time controls. Robust standard errors clustered at the occupation level are presented. *** Significant at the 1% level.*

Appendix I
Variables Coding

Variables	Coding
Hourly wages	Natural logarithm of hourly wages
Empathising	Index based on the empathising questionnaire; continuous variable
Systemising	Index based on the systemising questionnaire; continuous variable
Type-E brain	Those whose empathy is at a statistically significant higher level than their systemising
Type-S brain	Those whose systemising is at a statistically significant higher level than their empathy
Type-B brain	Those whose empathy is at the same level as their systemising (i.e. statistically insignificant difference between empathy and systemising)
Age	Years of age
White-British	1 if the individual is White-British; 0 otherwise
Health status	1 if the individual has a health limitation or disability; 0 otherwise
Higher education	1 if the individual has university diploma; 0 otherwise
Labour force	1 if the individual is employed or unemployed; 0 otherwise (i.e. inactive)
Employed	1 if the individual is employed; 0 otherwise
Work experience	Years of actual working experience
Senior appointment	1 if the individual holds a senior appointment in his/her current work; 0 otherwise
Promotion	1 if the individual got a promotion in the previous semester; 0 otherwise
Father's higher education	1 if individual's father has university diploma; 0 otherwise
Education (primary)	1 if individual's occupation is in primary education; 0 otherwise
Social care provision	1 if individual's occupation is in social care provision; 0 otherwise
IT administration	1 if individual's occupation is in IT-administration; 0 otherwise
Management and administrative	1 if individual's occupation is in management and administrative; 0 otherwise
Engineering and technical professions	1 if individual's occupation is in engineering and technical professions; 0 otherwise
Banking, finance and consultancy	1 if individual's occupation is in banking, finance and consultancy; 0 otherwise
Other professional services	1 if individual's occupation is in other professional services; 0 otherwise
Sales and customer services	1 if individual's occupation is in sales and customer services; 0 otherwise
Elementary occupations	Reference category (for the occupations)
East of England	1 if the individual lives in East of England; 0 otherwise
London	1 if the individual lives in London; 0 otherwise
North East	1 if the individual lives in North East; 0 otherwise
North West	1 if the individual lives in North West; 0 otherwise
Northern Ireland	1 if the individual lives in Northern Ireland; 0 otherwise
Scotland	1 if the individual lives in Scotland; 0 otherwise
South East	1 if the individual lives in South East; 0 otherwise
South West	1 if the individual lives in South West; 0 otherwise
Wales	1 if the individual lives in Wales; 0 otherwise
West Midlands	1 if the individual lives in West Midlands; 0 otherwise
Yorkshire and the Humber	1 if the individual lives in Yorkshire and the Humber; 0 otherwise
East Midlands	Reference category (for the regions)
2011 second semester	Reference category (for the time periods)
2012 first semester	1 if the observations correspondent to the second wave; 0 otherwise
2012 second semester	1 if the observations correspondent to the third wave; 0 otherwise
2013 first semester	1 if the observations correspondent to the fourth wave; 0 otherwise

Appendix II

Table A. Descriptive Statistics (per wave): Men

Variables	**2011 Second semester**	**2012 First semester**	**2012 Second semester**	**2013 First semester**
Empathising (continuous)	39.32	39.18	39.76	39.27
Systemising (continuous)	46.76	47.21	46.93	47.13
Type-E brain (%)	30.21	30.34	30.25	30.24
Type-S brain (%)	47.35	46.92	47.27	47.21
Type-B brain (%)	22.44	22.74	22.48	22.55
Age (continuous)	32.11	33.08	33.19	34.16
White-British (%)	82.32	82.32	82.32	82.32
Health status (%)	12.57	12.34	12.14	12.53
Higher education (%)	29.94	30.17	30.17	30.17
Labour force (%)	84.46	84.45	84.51	84.42
Employed (%)	76.11	76.03	76.23	76.19
Annual wages (continuous)	32,257.53	32,892.37	33,138.52	33,748.39
Weekly working hours (continuous)	41.38	41.18	41.22	41.23
Work experience (continuous)	10.69	11.49	11.94	12.47
Senior appointment (%)	22.61	22.64	22.64	22.68
Promotion (%)	11.14	11.15	11.15	11.17
Father's higher education (%)	25.09	25.09	25.09	25.09
Occupations:				
Education (primary) (%)	5.67	5.67	5.67	5.67
Social care provision (%)	7.48	7.48	7.45	7.50
IT administration (%)	8.88	8.88	8.88	8.88
Management and administration (%)	13.45	13.42	13.42	13.45
Engineering and technical professions (%)	12.38	12.38	12.38	12.39
Banking, finance and consultancy (%)	10.26	10.29	10.25	10.28
Other professional services (%)	15.29	15.29	15.33	15.31
Sales and customer services (%)	11.28	11.28	11.31	11.30
Elementary occupations (%)	15.20	15.20	15.20	15.15
Regions:				
East Midlands (%)	8.92	8.92	8.92	8.92
East of England (%)	7.36	7.36	7.36	7.36
London (%)	9.20	9.20	9.20	9.20
North East (%)	8.29	8.29	8.29	8.29
North West (%)	7.22	7.22	7.22	7.22
Northern Ireland (%)	9.30	9.30	9.30	9.30
Scotland (%)	9.39	9.39	9.39	9.39
South East (%)	7,03	7,03	7,03	7,03
South West (%)	7.21	7.21	7.21	7.21
Wales (%)	9.28	9.28	9.28	9.28
West Midlands (%)	9.26	9.26	9.26	9.26
Yorkshire and the Humber (%)	7.50	7.50	7.50	7.50
Observations	1,815	1,864	1,825	1,835

Notes: UK Behavioural Study Data Set (2011-2013; four waves).

Appendix II

Table B. Descriptive Statistics (per wave): Women

Variables	2011 Second semester	2012 First semester	2012 Second semester	2013 First semester
Empathising (continuous)	42.63	42.58	42.89	42.55
Systemising (continuous)	28.37	28.46	28.41	28.37
Type-E brain (%)	48.16	48.29	48.37	48.25
Type-S brain (%)	15.62	15.59	15.48	15.55
Type-B brain (%)	36.22	36.12	36.15	36.20
Age (continuous)	34.67	35.17	35.68	36.15
White-British (%)	81.76	81.76	81.76	81.76
Health status (%)	18.27	18.36	18.31	18.33
Higher education (%)	31.45	31.52	3.54	31.54
Labour force (%)	75.63	75.72	75.61	75.72
Employed (%)	66.37	66.52	66.72	66.58
Annual wages (continuous)	26,614.28	27,032.55	27,201.38	27,656.76
Weekly working hours (continuous)	37.46	37.54	37.52	37.48
Work experience (continuous)	7.26	7.97	8.54	8.94
Senior appointment (%)	11.11	11.13	11.13	10.13
Promotion (%)	6.21	6.22	6.22	6.22
Father's higher education (%)	24.24	24.24	24.24	24.24
Occupations:				
Education (primary) (%)	9.37	9.37	9.37	9.37
Social care provision (%)	16.60	16.65	16.65	16.64
IT administration (%)	5.43	5.43	5.40	5.38
Management and administration (%)	8.50	8.52	8.52	8.53
Engineering and technical professions (%)	6.38	6.36	6.37	6.37
Banking, finance and consultancy (%)	8.39	8.37	8.37	8.39
Other professional services (%)	13.70	13.65	13.67	13.67
Sales and customer services (%)	18.82	18.84	18.82	18.82
Elementary occupations (%)	12.70	12.70	12.72	12.72
Regions:				
East Midlands (%)	7.25	7.25	7.25	7.25
East of England (%)	8.10	8.10	8.10	8.10
London (%)	9.12	9.12	9.12	9.12
North East (%)	7.57	7.57	7.57	7.57
North West (%)	7.12	7.12	7.12	7.12
Northern Ireland (%)	9.20	9.20	9.20	9.20
Scotland (%)	9.24	9.24	9.24	9.24
South East (%)	8.28	8.28	8.28	8.28
South West (%)	8.38	8.38	8.38	8.38
Wales (%)	7.38	7.38	7.38	7.38
West Midlands (%)	8.91	8.91	8.91	8.91
Yorkshire and the Humber (%)	9.22	9.22	9.22	9.22
Observations	2,209	2,193	2,256	2,234

Notes: UK Behavioural Study Data Set (2011-2013; four waves).

Appendix III. Longitudinal wage estimations

	Panel I **Men and Women**
Men	0.121 (0.026)***
Men x empathising	-0.006 (0.004)
Men x systemising	0.011 (0.003)***
Inverse Mills Ratio	-0.271 (0.155)
Wald x^2	384.727
Prob>x^2	0.000
Person-waves observations	11,407

*Notes: UK Behavioural Study Data Set (2011-2013; four waves). We use a random effect estimator to capture unobserved heterogeneity. The estimations are corrected for sample selection bias. We control for a standard set of variables that help the identification of the labour force participation model, including: the highest educational attainment of the respondent's father. Elementary occupations, East Midlands and the 2011-second-semester-time-period are the reference categories (excluded categories). Each panel controls for age, ethnicity, health status, higher-education, work experience, senior appointment, promotion, occupations, regional and time controls. Robust standard errors clustered at the occupation level are presented. *** Significant at the 1% level.*