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1 **Ruminating on the Nature of Intelligence:**  
2 **Personality predicts Implicit Theories and Educational Persistence**

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21 Psychology, University of Portsmouth.

22 **Highlights**

- 23 • Implicit Theories of Intelligence (ITI) are related to RST personality traits

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- 1 • ITI relate to the commonly used predictor of academic success, Conscientiousness
- 2 • RST persistence and reward interest traits correlate with academic persistence

3

#### 4 **Abstract**

5           Research in schools has shown that those who hold Incremental Theories of  
6 Intelligence (i.e. intelligence can grow and improve) generally outperform those who hold  
7 Entity Theories of Intelligence (i.e. intelligence is ‘fixed’ and cannot improve). Recently,  
8 there have been attempts to establish a stronger theoretical explanation for individual  
9 differences in educational success, by relating the Big Five’s Conscientiousness to higher  
10 school attainment. In this study, we aimed to demonstrate further relationships between  
11 Implicit Theories of Intelligence and a well-known neurologically based theory of  
12 personality, namely Reinforcement Sensitivity Theory (RST). A sample of 319 adults  
13 completed personality measures of RST, the Big Five and Implicit Theories of Intelligence,  
14 as well as a proxy measure for educational persistence (highest academic qualification  
15 achieved). The results showed that participants who hold an Incremental (growth) Theory of  
16 Intelligence score higher on the RST Behavioural Approach System traits oriented toward  
17 future reward and the Big Five’s Conscientiousness. Those that hold an Entity (fixed) Theory  
18 of Intelligence score higher on RST Behavioural Inhibition System and the Big Five  
19 Neuroticism measure. The paper discusses the implications of these relationships and  
20 explores the benefits of the simultaneous use of both theoretically underpinned and applied  
21 measures of individual differences.

22 **Keywords:** Implicit Theories of Intelligence; Reinforcement Sensitivity Theory; Big Five;  
23 Academic Persistence

# **Ruminating on the Nature of Intelligence:**

## **Personality predicts Implicit Theories and Educational Persistence**

### **1. Introduction**

Individuals' approaches to learning and their understanding of intelligence is highly varied. This variance can make the work of teachers and the education system difficult. Because of this, there have been efforts to develop measures that detect and predict individuals' beliefs regarding learning and intelligence. For example, Dweck (1999) developed measures of 'Implicit Theories of Intelligence.' Dweck reported that individuals' generally hold Incremental (intelligence can continually improve) or Entity (intelligence is fixed from birth) beliefs in intelligence. Implicit Theories have previously described individual differences in learning styles (such as Entity beliefs being related to avoiding challenges) but there has not been thorough research on the *source* of Implicit Theories. More recently, data driven trait models, such as the Big Five's Conscientiousness (organisation in thought and behaviour), have been used to predict educational success (Dumfart & Neubauer, 2016). This is important because personality traits have come to be considered behaviour 'generators' (Möttus, 2016) and could be the 'source' of Implicit Theories. In this study, we test for a relationship between Big Five and Implicit Theories measures and also ask if another popular, theoretically driven, personality theory (Reinforcement Sensitivity Theory [RST], see Corr, 2016) relates to Implicit Theories. RST is interesting as it has rarely been used to quantify applied behaviours, but it explains behaviour in approach and avoidance terms, much like the behaviours associated with Implicit Theories.

In education settings, research has demonstrated that academic performance and persistence are often related to an individual's belief about the malleability of their intelligence, referred to as Implicit Theories of Intelligence (Blackwell, Trzesniewski &

1 Dweck, 2007; De Castella & Byrne, 2015; Dweck, 1999; Renaud-Dubé, Guay, Talbot, Taylor  
2 & Koestner, 2015; Robins & Pals, 2002). Dweck (1999) proposed that individuals tend to  
3 ‘theorise’ that intelligence is either an ‘entity,’ in that it is fixed and unchanging, or that  
4 intelligence grows ‘incrementally’ and can be developed through effort and persistence in the  
5 face of challenge (typically, the former are referred to as ‘entity theorists’ and the latter as  
6 ‘incremental theorists’).

7 More recently, Implicit Theories of Intelligence have been used to explain malleability  
8 in social perception (Chiu, Hong & Dweck, 1997; Hong, Chiu, Dweck & Sacks 1997) and  
9 business acumen (Kray & Haselhuhn, 2007). It is a robust finding that incremental theorists  
10 tend to outperform entity theorists (Chen & Pajares, 2010; Dupeyrat & Mariné, 2005;  
11 Rhodewalt, 1994). Further, interventions that train incremental theorising have been shown  
12 to benefit school children’s attainment (Blackwell et al., 2007). The literature demonstrates  
13 that, typically, those that believe in growth, *do* grow and develop; and, thus, they show  
14 superior performance in a range of educational, work and social tasks (Burnette, Boyle,  
15 VanEpps, Pollack & Finkel, 2012). Research demonstrates that those with an entity theory  
16 tend to avoid difficult tasks since failure is a threatening outcome (punishment), rather than a  
17 learning opportunity with an eventual positive outcome of learning (reward). As Dweck and  
18 Leggett (1988) notes, the behavioural consequences of Implicit Theories are similar to  
19 ‘approach’ and ‘avoidance’ learning styles. In Huang’s (2012) meta-analysis it was found  
20 (across 172 samples) that approach learning style was associated with higher academic  
21 achievement. As such, it could be the case that a better understanding of Implicit Theories in  
22 the context of individual differences approach and avoidance behaviours could help explain  
23 the relationship between Implicit Theories and academic behaviour.

24 The idea of individuals being divided based on their tendencies to engage (or approach)  
25 and disengage (or avoid) with opportunities for reward in their environment is not unique to

1 implicit theory research. In fact, neuropsychology literature on personality differences in  
2 approach/avoidance behaviours explores the same phenomenon via ‘Reinforcement  
3 Sensitivity Theory’ (RST, for reviews see Corr, 2004; Leue & Beauducel, 2008). RST  
4 describes the processes by which an individual may show trait tendencies towards *approach*  
5 or *avoid* actions in relation to an aspect of one’s environment. The three main systems of  
6 RST are the Behavioural Inhibition System (BIS, which inhibits approach to a potentially  
7 risky or punishing stimulus in the environment); the Behavioural Approach System (BAS,  
8 which drives a person to seek rewards from the environment); and the Flight-Fight-Freeze  
9 System (FFFS, which drives avoidance of aversive aspects of the environment). The various  
10 RST questionnaires have been tested in the psychological literature: in neuropsychology (e.g.,  
11 Mathews, Yiend & Lawrence, 2004; Sutton & Davidson, 1997) and risk taking (such as,  
12 Franken & Muris, 2005; Voigt, Dillard, Braddock, Anderson, Sopory & Stephenson, 2009)  
13 research. However, RST has rarely been examined in applied settings. Specifically there is no  
14 thorough literature considering how RST may be manifest in an applied setting, such as a  
15 school.

16 We include also the Big Five theory of personality (McCrae & Costa, 1987) in our  
17 study. This theory of personality is the most frequently cited and used theory in personality  
18 psychology. It is important to note that Eysenck and Eysenck’s (1978) work on Extraversion  
19 and Neuroticism is arguably the source of both the Big Five (see McCrae & John, 1992), as  
20 well as RST (see Corr, 2004). The Big Five is frequently used in contemporary education  
21 research, with Conscientiousness being a predictor of success (Dumfart & Neubauer, 2016;  
22 Zhang & Ziegler, 2016). Interestingly, recent research has shown that goal orientation (which  
23 features in both RST and Implicit Theories) mediates the influence of Conscientiousness at  
24 predicting success (Debicki, Kellermanns, Barnett, Pearson & Pearson, 2016). Research has  
25 also shown that the Big Five can relate to education avoidance and achievement (Komarraju

1 & Karau, 2005). It is also known that adults higher in Conscientiousness pursue higher levels  
2 of education (Almlund, Duckworth, Heckman, & Kautz, 2011). If we find that  
3 Conscientiousness correlates with goal directed RST traits (as has been shown elsewhere;  
4 Corr & Cooper, 2016) and Implicit Theories of Intelligence, it could be the case that BAS and  
5 Incremental Theories explain part of the variance in the pursuit of higher education. Thus we  
6 argue that the Big Five measure provides a psychometric and conceptual link between RST  
7 and Implicit Theories of Intelligence, making it worthy of inclusion here.

8         What is clear is that both measures - one theoretically underpinned and the other  
9 informed by application - are conceptually similar and could be related to the same  
10 neurologically-based phenomena that underpin learning and intelligence. The current study  
11 explores this notion. It may well be the case that the applied implicit theory measures share  
12 psychometric properties with the more theoretically underpinned and lab bound RST  
13 approach. Exploring these links could provide a theoretical and neuropsychological  
14 underpinning for Implicit Theories of Intelligence and provide RST with an indication of its  
15 value in an applied setting (e.g. education), which is rare in current RST research.

16         We expect those with more Entity Theories of Intelligence to be more vulnerable to  
17 anxiety and more hesitant to act, for fear of failure (demonstrated by the RST BIS or Big Five  
18 Neuroticism). We would expect those with more Incremental Theories of Intelligence to be  
19 those who engage with more diligently and pursue higher levels of learning (demonstrated by  
20 the RST BAS, Big Five Conscientiousness and measures of educational persistence).

## 21 **2. Method**

22         **2.1 Participants.** Participants were recruited from the general population using online  
23 advertising distributed to volunteers who had signed up to UK University research databases,  
24 with encouraged snowball sampling. They received an automated summary of their  
25 personality traits in return for participation. Our sample ( $N = 319$ ) had an average age of



1 31.16 years ( $SD_{Age} = 11.27$ ; range 18-70 years of age; 8 participants withheld response), were  
2 predominantly female (79.20%) and most had achieved at least a bachelor's degree or  
3 equivalent (38.30% bachelors, 29.70% various postgraduate qualifications).

4 **2.2 Procedure and Materials.** The study was conducted online, using Qualtrics  
5 online survey platform. After providing informed consent, participants reported their age, sex  
6 and highest level of educational attainment - highest level of education served as a proxy for  
7 academic persistence. We coded the highest level of education into four groups: Engagement  
8 with pre-16 years old or *Mandatory Education*, such as 'GCSEs' (which we code as 1),  
9 engaged with post-16 or *Further Education*, such as 'A levels' (coded as 2), engaged with  
10 *Undergraduate* degree or equivalent (3) or pursued *Postgraduate* study, in masters, doctoral  
11 or equivalent (4).

12 The first personality measure completed by the participants was the RST-PQ (Corr &  
13 Cooper, 2016). The response format for the RST-PQ is a four point scale with the anchors  
14 being *Not at all* (1), *Slightly* (2), *Moderately* (3) and *Highly* (4). We computed the mean  
15 response to each of the RST-PQ traits to show average endorsement of the behaviours. The  
16 RST-PQ measures an individual's dispositional anxiety and rumination (BIS, 23 items, in our  
17 dataset the reliability of this factor was  $\alpha = .93$ ), avoidance of aversive stimuli (FFFS, 10  
18 items,  $\alpha = .77$ ), tendency to respond aggressively (Defensive Fight, 8 items,  $\alpha = .81$ ) and there  
19 are four subscales measuring the Behavioural Approach System (BAS): Reward Reactivity  
20 (tendency to spontaneous behaviour; 10 items,  $\alpha = .77$ ); -Impulsivity (fast and unplanned  
21 responding; 8 items,  $\alpha = .70$ ); Goal-Drive Persistence (persistence in striving to achieve goals;  
22 7 items,  $\alpha = .85$ ); and Reward Interest (pursuit of potentially rewarding experiences, 7 items,  
23  $\alpha = .80$ ).

24 Second, participants completed the measures of Implicit Theories of Intelligence. We  
25 used two tools commonly in use: Dweck's (1999) four question for adult implicit theories of

1 intelligence and Abd-El-Fattah and Yates' (2006) Implicit Theories of Intelligence Scale  
2 (ITIS). This scale has been shown to have adequate internal reliability. Participants responded  
3 to both of these measures using the recommended scale of *Strongly Disagree* (1), *Slightly*  
4 *Disagree* (2), *Slightly Agree* (3) and *Strongly Agree* (4). We averaged the responses to the  
5 questions on Dweck's scale to produce a value between 1 and 4 for each participant, where 4  
6 is an endorsement of fixed theories of intelligence and 1 is a sign of a more growth theory of  
7 intelligence (in our dataset the reliability of this factor was  $\alpha = .93$ ). Abd-El-Fattah and Yates'  
8 ITIS has two subscales, one measuring Entity theories of intelligence (7 items,  $\alpha = .62$ ) and  
9 one measuring Incremental (7 items,  $\alpha = .71$ ). Again we use the average score for all items in  
10 both of these subscales (where 4 is strongly agreeing with that sub-factor and 1 is strongly  
11 disagreeing). We also use this value to compute a 'Net Implicit Theory' measure by  
12 subtracting the fixed theory sub-factor from the growth theory subscale which produces a  
13 value showing a scale of preference of fixed implicit theories (-3) to growth implicit theories  
14 (+3). Thirdly, participants responded to a ten item measure of the Big Five (Rammstedt &  
15 John, 2007). Although there are potential risks in losing validity when using short-form  
16 measures (Smith, McCarthy & Anderson, 2000) we include the Big Five in this study only to  
17 investigate how it may relate to our two main measures of interest. This is important as there  
18 is research showing that Conscientiousness relates to educational success (Dumfart &  
19 Neubauer, 2016) just as there is with Implicit Theories (Blackwell et al., 2007), so there may  
20 be similarities in the concept being measures by the ITIS and the Big Five inventories. The  
21 Big Five Inventory-10-item short scale was used to collect responses to Conscientiousness,  
22 Agreeableness, Neuroticism, Openness to Experience and Extraversion. Participants  
23 responded to the two items per dimension using a scale of *Disagree strongly* (1), *Disagree a*  
24 *little* (2), *Neither agree nor disagree* (3) *Agree a little* (4) and *Agree strongly* (5). The  
25 relevant items were reverse scored and an average response to each trait was calculated so

1 that the final value is between 1 and 5 and shows the extent to which the participant generally  
2 agreed with the trait.

### 3 **3. Results**

4 **3.1 Implicit Theory of Intelligence measures.** Our study has four possible indices of  
5 Implicit Theories of Intelligence: Dweck's (1999) measure, the Entity Theory score from the  
6 Implicit Theory of Intelligence Scale (ITIS), the Incremental Theory score from the ITIS, and  
7 the Net Theory score from the ITIS. We investigated in the relationship between the four  
8 measures, with the interest of finding one, overall measure that could represent Implicit  
9 Theories of Intelligence going forward. The Net Theory score from the ITIS was a good  
10 reflection of the responses to the Incremental Theory ( $r_s(319) = .77, 95\% CI [.72, .81]$ ) and  
11 Entity Theory ( $r_s(319) = -.81, 95\% CI [-.85, -.76]$ ) subscales of the ITIS that it was derived  
12 from. The Net Theory measure from the ITIS also showed the strong, expected, correlation  
13 with Dweck's (1999) measure of entity theory endorsement ( $r_s(319) = -.61, 95\% CI [-.68, -$   
14  $.53]$ ). The Net Theory score reflects both the subscales of the ITIS and Dweck's measure and  
15 is computed from a wider pool of information (all 14 items of the ITIS have an influence on  
16 Net Theory). To avoid running tests with multiple variables with the same function, we opt  
17 for the most analytically conservative choice. As Net Theory is an efficient reflection of the  
18 subdomains of the ITIS and is typical of the literature precedent of a unidimensional theory  
19 of implicit theories (Dweck, 1999), we use Net Theory as our main dependent variable of  
20 implicit theories.

21 **3.2 Implicit Theories and Reinforcement Sensitivity Theory.** The correlations  
22 between the factors of the RST-PQ and the ITIS Net score are presented in Table 1. The  
23 strongest correlation between the RST-PQ's traits and Net Theory was with BIS: those who  
24 showed more entity theories of intelligence were more prone to rumination and anxiety. The  
25 RST-PQ scales of FFFS and Defensive Fight did not correlate with Net Theory.



1 Responsiveness shows only one correlation with Conscientiousness and BAS-Impulsivity  
2 negative correlates with Conscientiousness. This result would suggest that Implicit Theory of  
3 Intelligence, BAS-Goal-Drive Persistence and BAS-Reward Interest are more ‘future’  
4 oriented traits, linked to Conscientiousness and belief in growth and incremental  
5 improvement, whereas BAS-Reward Reactivity and BAS-Impulsivity are more ‘immediate’  
6 oriented traits.

7 **3.4 Convergence between the three measures.** Another way to look at the shared  
8 variance between the three measures used in this study is to factor analyse the subscale  
9 scores. An orthogonal (Varimax rotation) factor analysis using Net Theory, all the RST-PQ  
10 factors and the Big Five suggested a five factor solution (eigenvalue = 1.00, explaining  
11 67.35% of variance). This forms a strong group of ‘Nervousness’ factors: Neuroticism (.86),  
12 BIS (.76) and FFFS (.75), with Net Theory appearing to belong to this group (-.36). Net  
13 Theory also shows a similar relationship (.32) with a ‘Determination’ factor:  
14 Conscientiousness (.78), BAS-Goal-Drive Persistence (.83) and BAS-Reward Interest (.65).  
15 Other factors generated by this analysis included a factor centred around BAS-Impulsivity  
16 (.78) and its conceptual cousins of BAS-Reward Reactivity (.68) and Extraversion (.68), and  
17 a factor showing Agreeableness (.83) and disagreeableness in the form of Defensive Fight (-  
18 .65). Openness to Experience strongly loads by itself (.92). This factor analysis shows how  
19 Net Theory is a belief that reflects both goal persistence as well as anxiety. Figure 1 presents  
20 the results of this factor analysis graphically.

21 **[Figure 1 here]**

22 **3.5 Academic Persistence.** We also investigated the relationship between our  
23 ‘academic persistence’ measure and the personality metrics used in this study. This is not a  
24 measure of ‘intelligence’ or academic success, per se, but it is interesting to explore which of  
25 our measures of typical performance predict persistence with optional education. There was

1 no correlation between age and academic persistence ( $r(319) = .03$ , 95% CI [-.09, .14]), but,  
2 as our measure could be sensitive to the age of participant (an older participant has had more  
3 time to pursue higher levels of education), we control for age of participant, using partial  
4 correlations, in the following tests. There was a reasonable positive correlation between BAS  
5 – Goal Drive Persistence ( $r_p(313) = .24$ , 95% CI [.13, .34]) and BAS-Reward Interest  
6 ( $r_p(313) = .22$ , 95% CI [.11, .33]) on Academic Persistence. There was a negative effect of  
7 BAS-Impulsivity on Academic Persistence ( $r_p(313) = -.21$ , 95% CI [-.31, -.10]). All other  
8 personality measures in this study showed smaller relationships with Academic Persistence  
9 (all  $r_p < .10$ ). Altogether this would suggest that the future-oriented aspects of BAS  
10 (persistence of a desired future reward) are the better predictors of pursuing higher education.  
11 Whereas, impulsivity disinclines one from pursuing higher education.

12 The variation in the personality scores of those who have only engaged in *Mandatory*  
13 education was much larger than the other groups, and is important to note. This pattern  
14 existed in the measures that did not predict academic persistence too. This would suggest that  
15 personality predicts persistence but not disengagement from education (see Figure 2).

16 **[Figure 2 here]**

#### 17 **4. Discussion**

18 This paper investigated convergence between measures of Implicit Theories of  
19 Intelligence (Abd-El-Fattah & Yates, 2006; Dweck, 1999), the Reinforcement Sensitivity  
20 Theory traits (Corr, 2016; Corr & Cooper, 2016) and the Big Five personality traits (McCrae  
21 & Costa, 1987; Rammstedt & John, 2007). We find that those who have more of an  
22 Incremental Theory of Intelligence, the belief that intelligence is malleable and can improve  
23 with practice, is positively related to RST BAS measures of activity in pursuit of goals and  
24 Big Five Conscientiousness. We also find that those who hold more Entity Theories of  
25 Intelligence, the belief that intelligence is the fixed attribute of a person and they cannot

1 improve, is associated with anxiety and rumination prone traits, such as the RST's BIS and  
2 the Big Five's Neuroticism. These results demonstrate agreement in theoretically derived  
3 personality tools, such as the RST-PQ, and tools created from investigating individual  
4 differences in applied settings, such as in the education system with the ITIS.

5         Here, we present evidence of implicit theories being associated with core personality  
6 traits. It is generally understood that implicit theories are a pattern of behaviours that are  
7 learned and can be intervened with (see Blackwell et al., 2007). As such, it is logical to infer  
8 that long-term, stable, personality traits (Cobb-Clark & Schurer, 2012) may be, in part,  
9 generators of flexible implicit theories. This is important to consider when it has been  
10 suggested that the implicit theories could be a consequence of teacher's (Mueller & Dweck,  
11 1998) and parents' (Gunderson et al., 2013) choice of praise. It could be the case that implicit  
12 theories of intelligence are also intrinsic theories of intelligence which can then be intervened  
13 on.

14         The results of the current study could inform a more holistic approach to investigating  
15 personality influences in applied settings. For example, the results presented here could  
16 suggest that there are neurological substrates related to beliefs in education. Future research  
17 could investigate the functioning of the post-central gyrus (known to correlate to some  
18 measures of BAS, Sander et al., 2005) or the middle frontal gyrus in the lateral prefrontal  
19 cortex (known to be related to conscientiousness, DeYoung, 2010) in learners who are  
20 planning learning-related behaviours. A better understanding of the neurology of Implicit  
21 Theories could help inform interventions and therapies to benefit those who do not believe  
22 they can improve or change.

23         Our paper also benefits RST research too. Whilst RST has a strong background in  
24 investigating individual differences neuropsychology (such as, Franken & Muris, 2005;  
25 Mathews, Yiend & Lawrence, 2004; Sutton & Davidson, 1997), there are benefits to

1 considering behaviours outside the typical laboratory environment as informative to defining  
2 personality traits. In this study we find that persistence with education was mainly predicted  
3 by BAS measures. This behaviour and others in educational settings could help understand  
4 how RST personality traits manifest in everyday life. It has been suggested that personality  
5 psychology has moved away from its origins in trying to understand the everyday behaviour  
6 of individuals (Furr, 2009). A potential consequence of this can be seen in the fact that  
7 popular theories of personality show weak (albeit reliable) predictions of job performance  
8 (Barrick & Mount, 1991). There is some evidence that more narrow sub-domains of larger  
9 theories, for example the Big Five, can predict applied behaviours (Paunonen & Ashton,  
10 2001), however in order for personality psychology to be of value to applied settings, future  
11 research should continue to bring together more theoretically derived measures of personality  
12 with those typically used in applied settings.

13           Our measure of ‘academic persistence’ was a simple one, but it produced  
14 results which should be discussed. The more long term focused aspects of BAS (Goal-Drive  
15 Persistence and Reward Interest) were the only predictors of academic persistence, with those  
16 who chose to engage with further stages of optional education being those who were more  
17 persistent in their achievement of future reward. Perhaps what was more interesting about this  
18 finding is the spread of personality traits in those who had chosen to engage with Mandatory  
19 education alone. This suggests that there are more important factors than these personality  
20 traits in choosing to pursue optional education.

21           Overall our results also suggest the need for a more broad theory-to-classroom  
22 approach to understanding engagement with learning. Approach and avoidance behaviours,  
23 are essential components in many theories of individual differences beyond RST, such as  
24 attachment theory (Kennedy & Kennedy, 2004) and regulatory focus theory (Keller & Bless,  
25 2008). Our choice was to focus on a theory of approach and avoidance behaviour which



1 would allow future research to relate neurological individuality with behavioural individual  
2 differences (see Corr 2016), however future work could focus on these others theories of  
3 approach and avoidance. The use of many converging theories on one important issue will be  
4 of great benefit to the literature on educational engagement and theories of intelligence.

5 **4.1 Conclusion.** There are similarities in measures of theoretically defined measures  
6 of personality (such as the RST-PQ) and those derived from applied settings (such as Implicit  
7 Theories of Intelligence). This research should encourage further collaboration between  
8 applied and research psychology, with the hope of sharing methods and everyday behaviours  
9 which would benefit research and applied assessment of personality traits.

10

## 1 **References**

- 2 Abd-El-Fattah, S. M., & Yates, G. C. R. (2006, November). Implicit theory of intelligence  
3 scale: Testing for factorial invariance and mean structure. In *Australian Association for*  
4 *Research in Education Conference, Adelaide, South Australia.*
- 5 Almlund, M., Duckworth, A. L., Heckman, J. J., & Kautz, T. D. (2011). Personality  
6 psychology and economics. In E. A. Hanushek, S.Machin, & L.Woessmann (Eds.),  
7 *Handbook of the economics of education* (pp. 1– 181). Amsterdam, Netherlands:  
8 Elsevier. <http://dx.doi.org/10.1016/B978-0-444-53444-6.00001-8>
- 9 Barrick, M. R., & Mount, M. K. (1991). The big five personality dimensions and job  
10 performance: A meta-analysis. *Personnel Psychology*, *44*(1), 1–26. doi:10.1111/j.1744-  
11 6570.1991.tb00688.x
- 12 Blackwell, L. S., Trzesniewski, K. H., & Dweck, C. S. (2007). Implicit theories of  
13 intelligence predict achievement across an adolescent transition: A longitudinal study  
14 and an intervention. *Child development*, *78*(1), 246-263.
- 15 Burnette, J. L., O’Boyle, E. H., VanEpps, E. M., Pollack, J. M., & Finkel, E. J. (2013). Mind-  
16 sets matter: A meta-analytic review of implicit theories and self-regulation.  
17 *Psychological Bulletin*, *139*(3), 655–701. doi:10.1037/a0029531
- 18 Chen, J. A., & Pajares, F. (2010). Implicit theories of ability of Grade 6 science students:  
19 Relation to epistemological beliefs and academic motivation and achievement in  
20 science. *Contemporary Educational Psychology*, *35*(1), 75–87.  
21 doi:10.1016/j.cedpsych.2009.10.003
- 22 Chiu, C. Y., Hong, Y. Y., & Dweck, C. S. (1997). Lay dispositionism and implicit theories of  
23 personality. *Journal of Personality and Social Psychology*, *73*(1), 19.  
24 doi:10.1037/0022-3514.73.1.19

- 1 Cobb-Clark, D. A., & Schurer, S. (2012). The stability of big-five personality  
2 traits. *Economics Letters*, *115*(1), 11-15. doi:10.1016/j.econlet.2011.11.015
- 3 Corr, P. J. (2004). Reinforcement sensitivity theory and personality. *Neuroscience &*  
4 *Biobehavioral Reviews*, *28*(3), 317–332. doi:10.1016/j.neubiorev.2004.01.005
- 5 Corr, P. J. (2016). Reinforcement Sensitivity Theory of Personality Questionnaires: Structural  
6 survey with recommendations. *Personality and Individual Differences*, *89*, 60–64.  
7 doi:10.1016/j.paid.2015.09.045
- 8 Corr, P. J., & Cooper, A. J. (2016). The Reinforcement Sensitivity Theory of Personality  
9 Questionnaire (RST-PQ): Development and validation. *Psychological Assessment*.  
10 doi:10.1037/pas0000273
- 11 De Castella, K., & Byrne, D. (2015). My intelligence may be more malleable than yours: The  
12 revised implicit theories of intelligence (self-theory) scale is a better predictor of  
13 achievement, motivation, and student disengagement. *European Journal of Psychology*  
14 *of Education*, *30*(3), 245-267. doi:10.1007/s10212-015-0244-y
- 15 Debicki, B. J., Kellermanns, F. W., Barnett, T., Pearson, A. W., & Pearson, R. A. (2016).  
16 Beyond the Big Five: The mediating role of goal orientation in the relationship between  
17 core self-evaluations and academic performance. *The International Journal of*  
18 *Management Education*, *14*(3), 273–285. doi:10.1016/j.ijme.2016.05.002
- 19 DeYoung, C. G. (2010). Personality neuroscience and the biology of traits. *Social and*  
20 *Personality Psychology Compass*, *4*(12), 1165–1180. doi:10.1111/j.1751-  
21 9004.2010.00327.x
- 22 Dumfart, B., & Neubauer, A. C. (2016). Conscientiousness Is the most powerful  
23 noncognitive predictor of school achievement in adolescents. *Journal of Individual*  
24 *Differences*, *37*(1), 8–15. doi:10.1027/1614-0001/a000182

- 1 Dupeyrat, C., & Mariné, C. (2005). Implicit theories of intelligence, goal orientation,  
2 cognitive engagement, and achievement: A test of Dweck's model with returning to  
3 school adults. *Contemporary Educational Psychology*, *30*(1), 43–59.  
4 doi:10.1016/j.cedpsych.2004.01.007
- 5 Dweck, C. S. (1999). *Self-theories: Their role in motivation, personality and development*.  
6 Philadelphia: Psychology Press.
- 7 Dweck, C. S., & Leggett, E. L. (1988). A social cognitive approach to motivation and  
8 personality. *Psychological Review*, *95*(2), 256–273. doi:10.1037/0033-295x.95.2.256
- 9 Eysenck, S. B. G., & Eysenck, H. J. (1978). Impulsiveness and venturesomeness: Their  
10 position in a dimensional system of personality description. *Psychological Reports*,  
11 *43*(3), 1247–1255. doi:10.2466/pr0.1978.43.3f.1247
- 12 Franken, I. H. A., & Muris, P. (2005). Individual differences in reward sensitivity are related  
13 to food craving and relative body weight in healthy women. *Appetite*, *45*(2), 198–201.  
14 doi:10.1016/j.appet.2005.04.004
- 15 Furr, R. M. (2009). Personality psychology as a truly behavioural science. *European Journal*  
16 *of Personality*, *23*(5), 369–401. doi:10.1002/per.724
- 17 Gunderson, E. A., Gripshover, S. J., Romero, C., Dweck, C. S., Goldin-Meadow, S., &  
18 Levine, S. C. (2013). Parent praise to 1-to 3-year-olds predicts children's motivational  
19 frameworks 5 years later. *Child Development*, *84*(5), 1526–1541. doi:  
20 10.1111/cdev.12064
- 21 Hong, Y. Y., Chiu, C. Y., Dweck, C. S., & Sacks, R. (1997). Implicit theories and evaluative  
22 processes in person cognition. *Journal of Experimental Social Psychology*, *33*(3), 296-  
23 323. doi:10.1006/jesp.1996.1324

24

- 1 Huang, C. (2012). Discriminant and criterion-related validity of achievement goals in  
2 predicting academic achievement: A meta-analysis. *Journal of Educational*  
3 *Psychology, 104*(1), 48–73. doi:10.1037/a0026223
- 4 Keller, J., & Bless, H. (2008). When positive and negative expectancies disrupt performance:  
5 regulatory focus as a catalyst. *European Journal of Social Psychology, 38*(2), 187–212.  
6 doi:10.1002/ejsp.452
- 7 Kennedy, J. H., & Kennedy, C. E. (2004). Attachment theory: Implications for school  
8 psychology. *Psychology in the Schools, 41*(2), 247–259. doi:10.1002/pits.10153
- 9 Komarraju, M., & Karau, S. J. (2005). The relationship between the big five personality traits  
10 and academic motivation. *Personality and Individual Differences, 39*(3), 557–567.  
11 doi:10.1016/j.paid.2005.02.013
- 12 Kray, L. J., & Haselhuhn, M. P. (2007). Implicit negotiation beliefs and performance:  
13 Experimental and longitudinal evidence. *Journal of Personality and Social*  
14 *Ppsychology, 93*(1), 49. doi:10.1037/0022-3514.93.1.49
- 15 Leue, A., & Beauducel, A. (2008). A Meta-analysis of reinforcement sensitivity theory: On  
16 performance parameters in reinforcement tasks. *Personality and Social Psychology*  
17 *Review, 12*(4), 353–369. doi:10.1177/1088868308316891
- 18 Mathews, A., Yiend, J., & Lawrence, A. D. (2004). Individual differences in the modulation  
19 of fear-related brain activation by attentional control. *Journal of Cognitive*  
20 *Neuroscience, 16*(10), 1683–1694. doi:10.1162/0898929042947810
- 21 McCrae, R. R., & Costa, P. T. (1987). Validation of the five-factor model of personality  
22 across instruments and observers. *Journal of Personality and Social Psychology, 52*(1),  
23 81–90. doi:10.1037/0022-3514.52.1.81

1 McCrae, R. R., & John, O. P. (1992). An Introduction to the Five-Factor Model and Its  
2 Applications. *Journal of Personality*, *60*(2), 175–215. doi:10.1111/j.1467-  
3 6494.1992.tb00970.x

4 Paunonen, S. V., & Ashton, M. C. (2001). Big Five factors and facets and the prediction of  
5 behavior. *Journal of Personality and Social Psychology*, *81*(3), 524–539.  
6 doi:10.1037/0022-3514.81.3.524

7 Rammstedt, B., & John, O. P. (2007). Measuring personality in one minute or less: A 10-item  
8 short version of the Big Five Inventory in English and German. *Journal of Research in*  
9 *Personality*, *41*(1), 203–212. doi:10.1016/j.jrp.2006.02.001

10 Renaud-Dubé, A., Guay, F., Talbot, D., Taylor, G., & Koestner, R. (2015). The relations  
11 between implicit intelligence beliefs, autonomous academic motivation, and school  
12 persistence intentions: a mediation model. *Social Psychology of Education*, *18*(2), 255-  
13 272.

14 Rhodewalt, F. (1994). Conceptions of ability, achievement goals, and individual differences  
15 in self-handicapping behavior: On the application of implicit theories. *Journal of*  
16 *Personality*, *62*(1), 67–85. doi:10.1111/j.1467-6494.1994.tb00795.x

17 Robins, R. W., & Pals, J. L. (2002). Implicit self-theories in the academic domain:  
18 Implications for goal orientation, attributions, affect, and self-esteem change. *Self and*  
19 *Identity*, *1*(4), 313-336. doi:10.1080/15298860290106805

20 Sander, D., Grandjean, D., Pourtois, G., Schwartz, S., Seghier, M. L., Scherer, K. R., &  
21 Vuilleumier, P. (2005). Emotion and attention interactions in social cognition: Brain  
22 regions involved in processing anger prosody. *NeuroImage*, *28*(4), 848–858.  
23 doi:10.1016/j.neuroimage.2005.06.023

1 Smith, G. T., McCarthy, D. M., & Anderson, K. G. (2000). On the sins of short-form  
2 development. *Psychological Assessment*, *12*(1), 102–111. doi:10.1037/1040-  
3 3590.12.1.102

4 Sutton, S. K., & Davidson, R. J. (1997). Prefrontal brain asymmetry: A biological substrate of  
5 the behavioral approach and inhibition systems. *Psychological Science*, *8*(3), 204–210.  
6 doi:10.1111/j.1467-9280.1997.tb00413.x

7 Voigt, D. C., Dillard, J. P., Braddock, K. H., Anderson, J. W., Sopory, P., & Stephenson, M.  
8 T. (2009). BIS/BAS scales and their relationship to risky health behaviours. *Personality*  
9 *and Individual Differences*, *47*(2), 89–93. doi:10.1016/j.paid.2009.02.003

10 Zhang, J., & Ziegler, M. (2016). How do the big five influence scholastic performance? A big  
11 five-narrow traits model or a double mediation model. *Learning and Individual*  
12 *Differences*, *50*, 93–102. doi:10.1016/j.lindif.2016.07.011

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Table 1. The correlations (as Spearman's rho with bias corrected 95% CI in square brackets) between the Implicit Theories of Intelligence Scale, the Reinforcement Sensitivity Theory Personality Questionnaire and the Big Five Inventory-10.

	ITIS	C	A	N	O	E
ITIS	-	.20	.17	-.27	.04	.16
		[.08, .30]	[.07, .28]	[-.38, -.16]	[-.07, .17]	[.05, .27]
BIS	-.37	-.36	-.24	.71	.01	-.26
	[-.47, -.27]	[-.47, -.25]	[-.34, -.13]	[.65, .76]	[-.10, .12]	[-.36, .17]
FFFS	-.11	-.01	-.12	.46	-.08	-.01
	[-.23, .00]	[-.12, .11]	[-.23, .00]	[.36, .55]	[-.19, .04]	[-.12, .10]
DF	.10	-.06	-.21	-.10	.05	.22
	[-.00, .22]	[-.17, .06]	[-.32, -.11]	[-.21, .01]	[-.07, .15]	[.12, .32]
BAS-GDP	.18	.42	.13	-.16	.08	.21
	[.06, .28]	[.33, .50]	[.03, .24]	[-.27, -.05]	[-.04, .19]	[.11, .32]
BAS-RI	.17	.36	.16	-.36	.14	.31
	[.06, .27]	[.27, .45]	[.05, .27]	[-.46, -.26]	[.03, .25]	[.19, .41]
BAS-RR	.16	.01	.10	.00	.19	.31
	[.05, .26]	[-.11, .13]	[-.02, .21]	[-.12, .12]	[.08, .31]	[.21, .42]
BAS-Imp	.04	-.21	-.12	-.00	.12	.36
	[-.07, .15]	[-.33, -.10]	[-.24, -.01]	[-.11, .11]	[.01, .22]	[.26, .44]

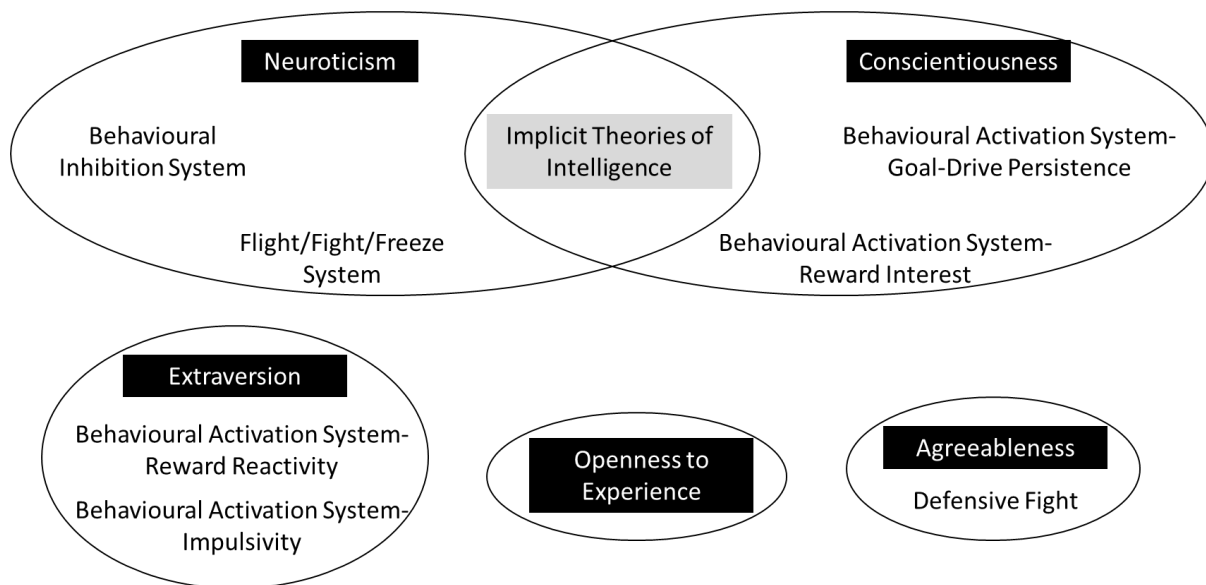
Notes:

ITIS=Implicit Theory of Intelligence Score, where a more positive score is a more Incremental Theory and a more negative score is a more Entity Theory.

C=Conscientiousness, A=Agreeableness, N=Neuroticism, O=Openness to Experience, E=Extraversion

BIS=Behavioural Inhibition System, FFFS=Fight/Flight/Freeze System, DF= Defensive Fight, BAS-GDP= Behavioural Approach System-Goal-Drive Persistence, BAS-RI= Behavioural Approach System-Reward Interest, BAS-RR= Behavioural Approach System-Reward Reactivity, BAS-Imp= Behavioural Approach System-Impulsivity.

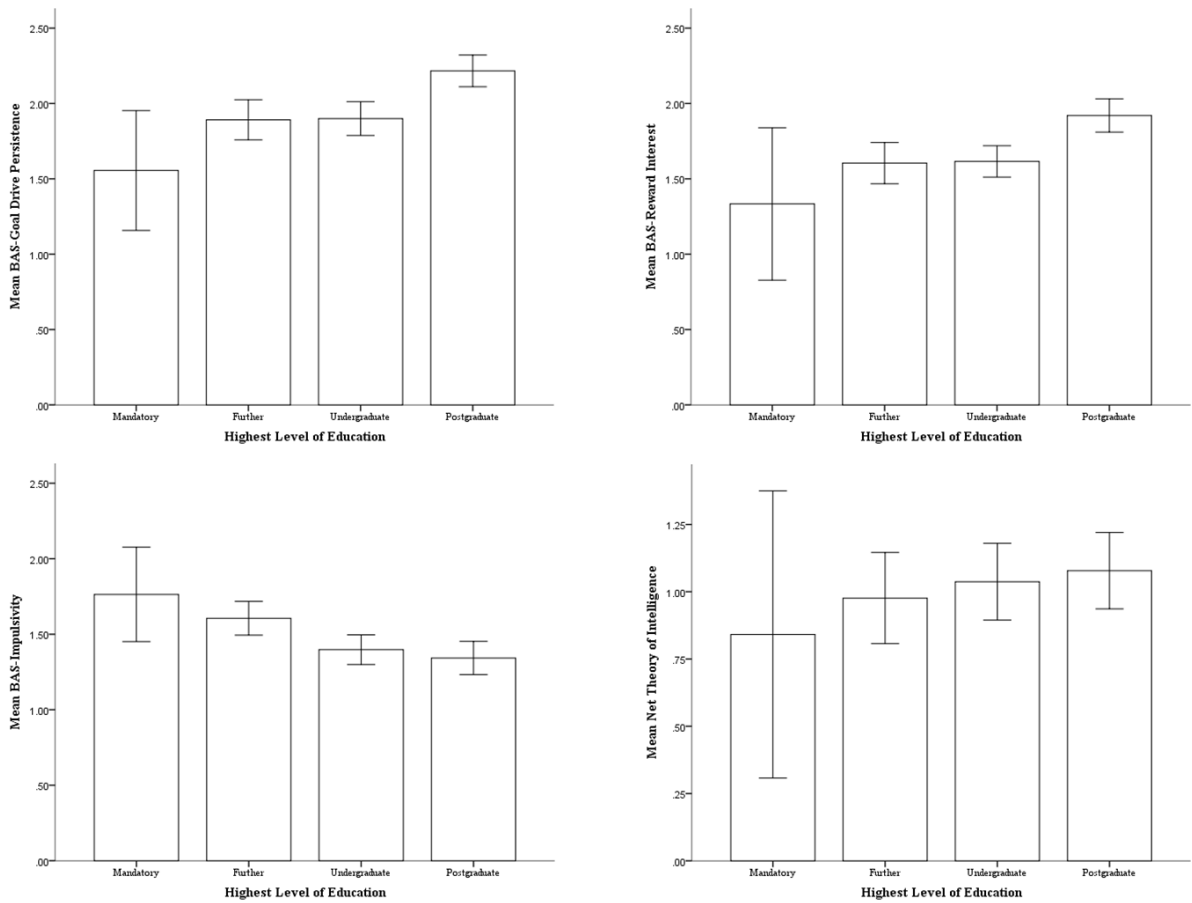




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2 Figure 1. A graphical representation of the factor analysis which grouped the personality

3 traits in this study.



*Figure 2.* The mean personality traits (with 95% CI) of participants reporting different levels of education. Clockwise from the top left these figures show two positive, one neutral and one negative relationship between personality and Academic Persistence. The personality traits are Goal-Drive Persistence (top left), Reward Interest (top right), Net Theory of Intelligence (bottom right) and Impulsivity (bottom left).