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The number of exceptional people: Fewer than 85 per 1 million across key traits

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ABSTRACT

Cognitive biases can lead to overestimating the expected prevalence of exceptional multi-talented candidates, leading to potential dissatisfaction in recruitment contexts. This study aims to accurately estimate the odds of finding individuals who excel across multiple correlated dimensions. According to the literature, the three key individual differences variables are intelligence, conscientiousness, and emotional stability. Consequently, data were simulated using a multivariate normal distribution (N = 20 million), where the three variables were standardized (mean of 0 and *SD* of 1). The correlations were specified as: intelligence with conscientiousness (−0.03), intelligence with emotional stability (0.07), and conscientiousness with emotional stability (0.42). Cases were classified into four categories based on *z*-scores across the three dimensions: notable (≥ 0.0 SD), remarkable (≥ 1.0 SD), exceptional (≥ 2.0 SD), and profoundly exceptional (≥ 3.0 SD). Approximately 16% of cases were classified as notable, 1% as remarkable, and only 0.0085% met the exceptional criterion of 2 *SD*s above the mean. Just one case was identified as profoundly exceptional. These findings highlight the rarity of individuals excelling across multiple traits, suggesting a need to recalibrate recruitment expectations. Even moderately above-average individuals on these key dimensions may merit greater recognition due to their scarcity.

1. Introduction

The challenges of recruiting top-performing employees and graduate students are well-documented (e.g., Pieczyrak, 2015; Sahinidis et al., 2019; Sexton, 2007; Shuster, 2000; Todd & Verbick, 2005). Some have even likened the process of recruiting high-quality individuals to searching for a unicorn (Cappelli, 2012). In the context of recruitment, a cognitive bias may lead to unrealistic expectations about the availability of excellent candidates who excel in multiple areas. This bias arises from the fact that people tend to overestimate the frequency of rare events, especially when those events are combined with other distinctive features (Oeberst & Haberstroh, 2014).

To date, the prevalence of individuals who excel across multiple dimensions predictive of important life outcomes, such as academic and job performance, has not been quantified. While the multiplication rule of probability could offer an initial estimate based on independent dimensions (Grami, 2019), it oversimplifies the complexity when dimensions are inter-correlated. Consequently, this study aims to accurately quantify the percentage of individuals who score at various levels across the three key dimensions most predictive of performance and life outcomes, i.e., intelligence, conscientiousness, and emotional stability, while accounting for their inter-correlations.

1.1. Most Important Dimensions

Numerous differential psychology dimensions have been identified that predict significant life outcomes, including educational attainment, job performance, physical health, relationship satisfaction, and overall well-being (Gottfredson, 2002; Maltby et al., 2022; Roberts & Yoon, 2022). Among these, intelligence, conscientiousness, and emotional stability (low neuroticism) have been described as the most significant predictors of individual success (Barrick & Mount, 2000; Roberts et al., 2007). Intelligence provides information on what people are capable of doing, whereas traits provide insights into likely behaviors. While debates continue over the relative importance of intelligence versus personality (Borghans et al., 2016; Zisman & Ganzach, 2022), a balanced view acknowledges both as important predictors of key life outcomes.

There are also disagreements on whether the effects of these three

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key traits exhibit linear relationships or whether there are threshold effects—i.e., points at which further increases in trait levels no longer enhance positive outcomes and may even become counterproductive (see Brown et al., 2021, for example). For the purposes of this investigation, it is important to distinguish between exceptionality, which denotes rare, elevated levels of these traits, and what may be termed 'context-specific optimality', where average or moderate levels may be ideal for certain roles or environments. This investigation focuses on identifying the prevalence of exceptionality in general terms. A brief overview of the three dimensions and their respective validities is provided below.

1.2. Intelligence

Gignac and Szodorai (2024, p. 2) defined intelligence as a person's "maximal capacity to achieve a novel goal successfully using perceptual-cognitive processes." In part, intelligence likely contributes to positive life outcomes by facilitating efficient learning (Vaci et al., 2019) and effective decision-making (Bruine de Bruin et al., 2020). In addition to general intelligence, crucial dimensions of cognitive functioning include reasoning, verbal comprehension, memory span, visual intelligence, and processing speed (Schneider & McGrew, 2018). Meta-analyses indicate that intelligence is a positive predictor of both academic (Lozano-Blasco et al., 2022) and job performance (Bertua et al., 2005; Sackett et al., 2022). Research also shows that intelligence tends to have a linear association with outcome criteria (Brown et al., 2021), and that job complexity positively moderates the association between intelligence and job performance (Schmidt & Oh, 2023). Moreover, intelligence is highly valued by managers and HR professionals (Tews et al., 2011) and is considered one of the most desirable traits in prospective partners (Gignac et al., 2018).

1.3. Conscientiousness

Conscientiousness has been described as multi-faceted (DeYoung et al., 2007; Roberts et al., 2014), with facets revolving around work ethic (industriousness, achievement striving, orderliness, and self-discipline) and personal responsibility (dutifulness, carefulness, and dependability). These traits combine to shape a personality that values structure, achievement, and trustworthiness in both professional and personal spheres. Across many empirical investigations, conscientiousness has been found to correlate positively with job performance (Wilmot & Ones, 2019), academic success (Poropat, 2009), and overall life satisfaction (Smith et al., 2013). Research indicates that conscientiousness and job performance have a primarily linear relationship in complex roles, though this relationship may be nonlinear in simpler jobs (Le et al., 2011). Barrick and Mount (2000) emphasized that beyond intelligence, conscientiousness was the most pivotal psychological attribute for personnel selection (see also Dumfart & Neubauer, 2016). Correspondingly, managers and human resource professionals rate conscientiousness and related traits, such as ethical awareness and self-motivation, highly in employees across various roles (Jones et al., 2011; Lange & Houran, 2009).

1.4. Emotional stability

Emotional stability, the opposite of neuroticism, reflects calmness, resilience to stress, and emotional composure in difficult situations (Roberts & Yoon, 2022). It fosters positive relationships and makes individuals easier to manage (Ozer & Benet-Martinez, 2006; Suls & Martin, 2005). Emotional stability is positively associated with academic achievement (Munjirin et al., 2023; Seipp, 1991)[1] and job performance (Judge & Bono, 2001). While this relationship may be nonlinear in some contexts, with performance benefits leveling off or even reversing at higher levels (Uppal, 2017), in settings where supervisor support is high, the association between emotional stability and job performance appears to be remain linear (Yuan et al., 2018). Emotional stability also supports adaptive performance in high-stress environments (Huang et al., 2014; Sathar et al., 2020). Research also shows that neuroticism negatively impacts absenteeism, dropout rates, and employee turnover (Chamorro-Premuzic & Furnham, 2003; Mihăilescu et al., 2016; Respondek et al., 2017; Salgado, 2002). It also promotes self-management and commitment, contributing to organizational success (Oriarewo et al., 2018). Finally, Barrick and Mount (2000) argued that alongside intelligence and conscientiousness, emotional stability should be regarded as the next key dimension in personnel selection.

1.5. Correlations between intelligence, conscientiousness, and emotional stability

As noted above, in order to calculate the percentage of people in the population who score at high levels across three dimensions, the possibility of inter-correlations between dimensions needs to be considered. While some debate exists regarding a potential negative correlation between intelligence and conscientiousness (Moutafi et al., 2004; Murray et al., 2014), the most supported conclusion to date suggests that these two dimensions are largely uncorrelated (Nicolau et al., 2023). A similar conclusion has been drawn regarding the correlation between intelligence and emotional stability (Furnham, 2023). Correspondingly, a recent meta-analysis reported correlations of $r = -0.03$ between intelligence and conscientiousness, and $r = -0.07$ between intelligence and neuroticism, in individuals aged 18 to 59—the primary studying and working-age population (Anglim et al., 2022).

In contrast to correlations with intelligence, van der Linden et al. (2010) reported a meta-analytic disattenuated correlation of $r = -0.42$ between conscientiousness and neuroticism as measured by the NEO1.[2] Neuroticism is negatively associated with conscientiousness for arguably several reasons: high neuroticism impairs self-regulation due to emotional instability (Suls & Martin, 2005), it leads to abandoning goals more easily because of anxiety or self-doubt (Chirkina et al., 2023), and it involves rumination and worry, which depletes cognitive resources necessary for planning and organization (Philippot & Brutoux, 2008). Consequently, to estimate how many people score highly across all three traits, the analysis must account for their relationships: intelligence has weak correlations with both conscientiousness ($r = -0.03$) and emotional stability ($r = 0.07$), while conscientiousness and emotional stability show a moderate positive correlation ($r = 0.42$).

1.6. Defining exceptionality

From a psychological assessment standpoint, scores demarcating exceptional ability, performance, or behavior are typically defined as those falling two standard deviations above the mean (Gottfried et al., 1994; Silverman & Golon, 2008). For instance, in IQ testing, where the

[1] Poropat (2009) did not report a significant meta-analytic association between emotional stability and academic achievement, but the included studies tended to rely on GPA as the measure of academic success. Using GPA can be problematic, as it reflects performance across diverse courses that vary among students. Additionally, more anxious students may choose courses that minimize certain assessment types, such as exams, further confounding the results.

[2] A larger correlation of $r = -0.68$ was reported for the NEO2, while a smaller correlation of -0.31 was reported for the IPIP.

normative mean and standard deviation is typically 100 and 15, respectively, scores of 130 or higher are often classified as exceptional or gifted (Colangelo & Davis, 2002; Roid, 2003). Similarly, exceptional trait levels have been operationalized using this approach. For example, Schatz et al. (2022) proposed that a cutoff of 2 *SD*s above the mean may be more clinically informative for identifying exceptional levels of anxiety on the State–Trait Anxiety Inventory (Form Y-1; STAI), compared to the commonly used cutoff score of ≥40 (i.e., 50th to 60th percentile).

In a manner similar to how multiple categories or levels of giftedness have been delineated (Silverman & Golon, 2008), multiple categories of exceptionality could also be described in the context of scores across three differential psychology dimensions. Specifically, at the least stringent level, where a case achieves at least the mean or higher across all three dimensions, they may be considered 'notable'. At a more stringent level, individuals scoring 1 *SD* or more above the mean across all dimensions could be categorized as 'remarkable'. Those achieving 2 *SD*s or higher may be considered 'exceptional', and at the most extreme level, individuals scoring 3 *SD*s above the mean could be classified as 'profoundly exceptional'.

According to the properties of the normal distribution, only about 2.3% of the population (23,000 per 1 million) is expected to score two standard deviations above the mean on any given dimension (Grami, 2019).[3] To gain an intuitive sense of what this level represents, consider that the average heights for American adult women and men are 162.0 cm (*SD* = 7.1 cm) and 175.7 cm (*SD* = 7.5 cm), respectively (Fryar et al., 2018). A height two standard deviations above the mean would be approximately 176.2 cm (5′8“) for women and 190.7 cm (6'2.5") for men. Male celebrities like Jim Carrey, Ted Danson, and Adam Driver, who stand between 6′2“ and 6'3", would be considered tall by most, though perhaps only just barely exceptionally so.

1.7. Approaches to quantifying the prevalence of multivariate exceptionality

Observing scores two standard deviations above the mean across all three dimensions - intelligence, conscientiousness, and emotional stability - rather than just one dimension, is expected to be far rarer. Moreover, consulting the normal distribution alone is insufficient for such calculations. To estimate the likelihood of a multivariate event, the multiplication rule of probability can be applied (Grami, 2019). This rule assumes the events are independent (i.e., uncorrelated), meaning that scoring high on one dimension does not affect the others. For three independent dimensions, the probability of scoring two standard deviations above the mean on all three is approximately 0.0012% (calculated as 0.023 * 0.023 * 0.023), or roughly 12 cases per 1 million.

To estimate the proportion of cases meeting specific criteria across correlated variables, the joint distribution of the variables can be used (Grami, 2019). For normally distributed variables, the joint probability of exceeding a threshold is calculated using the multivariate normal distribution, accounting for correlations. While precise, this method is complex to implement for correlated variables and lacks the ability to visually represent cases in a three-dimensional scatter plot.

An alternative to the analytical approach for estimating the proportion of cases that meet criteria across multiple correlated variables is to use a simulation-based approach. This method involves generating a large dataset with normally distributed variables that reflect the desired correlation structure. Then, the number of cases that meet the criteria are identified.

In a recent investigation using multivariate simulations, Cheek et al. (2023) estimated the predicted prevalence rates for twice-exceptionality, defined as the co-occurrence of exceptional ability alongside a significant disability. Cheek et al. (2023) generated multivariate normal distributions for both giftedness and disability constructs, systematically manipulating key parameters such as the identification criteria (e.g., number of standard deviations from the mean), correlations between constructs, and the reliability of the assessments. Their findings showed that the prevalence of twice-exceptionality varies significantly depending on these factors, with more relaxed criteria (1 *SD* from mean) yielding higher prevalence estimates (up to 14.8%) and stricter criteria (2 *SD*s from mean) reducing the prevalence to as low as 0.39%.

A similar approach to that used by Cheek et al. (2023) could be applied to estimate the number of individuals expected to fall into the four categories of exceptionality described above. Specifically, three variables with a mean of 0 and a standard deviation of 1 could be simulated. The correlations between IQ and conscientiousness and between IQ and emotional stability could be specified at $r = -0.03$ and $r = 0.07$, respectively, while the correlation between conscientiousness and emotional stability could be set at $r = 0.42$, as reviewed above. This simulation-based approach is particularly useful when the correlation structure complicates analytical solutions, allowing for an empirical estimate of the joint distribution based on a large, randomly generated sample. Additionally, a 3D scatter plot could be generated to visually represent the cases that meet the three criteria.

1.8. Simulation procedure

To estimate the prevalence estimates across the four categories of exceptionality, a multivariate normal distribution was simulated in R using the MASS package (Ripley et al., 2013) via the mvrnorm() function (random seed = 123). A total of 20,000,000 cases were generated, with all three variables standardized to a mean of 0 and standard deviation of 1. Conscientiousness and emotional stability were specified to have a positive correlation of $r = 0.42$, while intelligence was set to be correlated with conscientiousness at $r = -0.03$ and emotional stability at $r = 0.07$. The simulated dataset was saved as a CSV file. To identify cases across the four categories of exceptionality, a logical test (in R) was applied to the saved CSV file for each category: scoring at or above 0, 1, 2, and 3 *SD*s in intelligence, conscientiousness, and emotional stability. The extracted cases for each category were then counted to determine the respective prevalence estimates. Data and R scripts are on the OSF: https://osf.io/z9q8k/

1.9. Simulation results

The correlation structure in the simulated data was confirmed as expected: IQ and conscientiousness ($r = -0.03$), IQ and emotional stability ($r = 0.07$), and conscientiousness and emotional stability ($r = 0.42$). Table 1 shows the number and percentage of notable, remarkable, exceptional, and profoundly exceptional cases, along with their respective 95% confidence intervals.

Even at the least stringent criterion, only about 16% of people are expected to achieve a notable combination of scores, defined as a *z*-score of 0 or higher across intelligence, conscientiousness, and emotional stability. For the remarkable category, characterized by a *z*-score of 1 or greater across all three dimensions, the proportion drops to approximately 0.94%, indicating that fewer than 10 out of every 1000 people meet this criterion. In the exceptional category, defined by a *z*-score of 2 or higher across all three dimensions, only about 0.0085% of individuals qualify, meaning that approximately 85 out of every 1 million people would be considered exceptional. Finally, for the profoundly exceptional category, where individuals must score 3 or more standard deviations above the mean on all three dimensions, only one case was identified out of 20 million, highlighting the extreme rarity of this combination. A visual representation of the rarity of exceptional cases (2 *SD*s above the mean) is shown through two 3D scatter plots, offering both frontal and

[3] While few distributions are perfectly normal, scores from valid psychological tests designed to measure individual differences often approximate a normal distribution (de Beurs et al., 2022).

Table 1
Frequencies, Percentages, and Confidence Intervals of Notable, Remarkable, Exceptional, and Profoundly Exceptional Cases.

Category	Percentage	Percentage 95% CIs	Cases per 20 M	Cases per 1 M
Notable (≥ 0.0 *SD*)	16.27	[16.26, 16.29]	3,254,458	162,733
Remarkable (≥ 1.0 *SD*)	0.9366	[0.9324, 0.9409]	187,327	9366
Exceptional (≥ 2.0 *SD*)	0.00853	[0.0081, 0.0089]	1705	85
Profoundly Exceptional (≥ 3.0 *SD*)	0.000005	[0.000000256, 0.0000283]	1	0

Note. Confidence intervals for the percentages were obtained with the Hmisc package for R.

bird's-eye views (see Fig. 1).

2. Discussion

Cheek et al. (2023) found that twice-exceptional individuals, defined as scoring 2 *SD*s above the mean in one domain and 2 *SD*s below the mean in another, are expected to represent only 0.39% of the population. These findings align with the current study, where only 85 individuals per million (0.0085%) are expected to score 2 *SD*s above the mean on intelligence, conscientiousness, and emotional stability, with none expected to score 3 *SD*s above the mean across all three dimensions. While these results are essentially in accordance with the predictions of the well-established multiplication rule of probability (Grami, 2019), people may not intuitively grasp the rarity of individuals who consistently deviate from the mean across multiple traits. As a result, the prevalence of twice-exceptional individuals is often overstated (Cheek et al., 2023), and similarly, there may be a tendency to overestimate the availability of candidates who excel across several domains. This lack of awareness may lead to unrealistic expectations in recruitment processes. Therefore, individuals who consistently score even slightly above average across key traits like intelligence, conscientiousness, and emotional stability may not be fully appreciated for their rarity and value. The aim of this investigation was to help counter this apparent oversight by quantifying the true prevalence of individuals who score average and/or above average across three key differential psychology dimensions.

Admittedly, many other psychological dimensions may also be relevant to important life outcomes (emotional intelligence; competitiveness). Therefore, the estimates of notable to profoundly exceptional individuals should be viewed as upper bounds. As additional dimensions are considered, the prevalence rates would be expected to decrease, based on the multiplication rule of probability (Grami, 2019).

It is also acknowledged that elevated levels of the three selected traits may not always yield positive outcomes. For example, high conscientiousness can lead to perfectionism, which may be counterproductive (Coleman et al., 2023), while elevated emotional stability may correlate with reduced empathy (Carlo et al., 2012). Importantly, however, conceptualizing exceptionality traditionally implies rare, elevated trait levels (Gottfried et al., 1994; Silverman & Golon, 2008). Thus, even if somewhat above-average levels (e.g., $z = 1$) in intelligence, conscientiousness, and emotional stability are ideal for a specific role, they would not meet the standard of 'exceptional' status, reserved here for individuals scoring at $z = 2$ or higher across these dimensions. Supporting this distinction, for complex jobs where greater demands are present, the association between these key traits and job performance may remain largely linear across several contexts (Le et al., 2011; Schmidt & Oh, 2023; Yuan et al., 2018).

In conclusion, the findings highlight in precise terms the rarity of individuals in the population who excel across the dimensions of intelligence, conscientiousness, and emotional stability. For those in recruitment, a recalibration of expectations may be needed. More broadly, establishing these prevalence rates aims to foster a realistic appreciation for individuals who score highly - or even modestly above average - across these key traits.

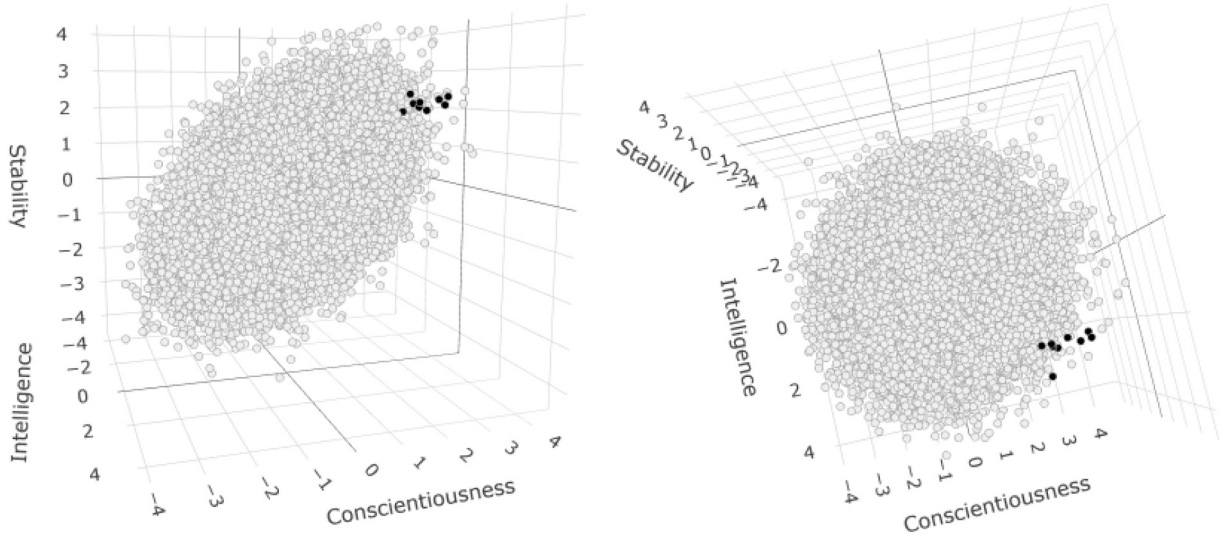

Fig. 1. 3D Scatter Plots Depicting Intelligence, Conscientiousness, and Emotional Stability with Exceptional Cases Marked in Black
Note. $N = 100{,}000$; black markers indicate the seven cases classified as exceptional (i.e., scoring 2 SDs above the mean on all three dimensions). The right image presents the frontal view, while the left shows the bird's-eye view.

Declaration of generative AI and AI-assisted technologies in the writing process

During the preparation of this work the author used ChatGPT, Claude, and Perplexity to help with the generation of *R* scripts, as well as to suggest superior and more concise writing. After using these tools/services, the author reviewed and edited the content as needed and takes full responsibility for the content of the publication.

CRediT authorship contribution statement

Gilles E. Gignac: Writing – review & editing, Writing – original draft, Methodology, Investigation, Data curation, Conceptualization.

Declaration of competing interest

The authors declare that they have no conflict of interest.

Data availability

Data are available on the OSF link provided in the manuscript.

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