



Sex differences in the Dark Triad are sensitive to socioeconomic conditions: the adaptive value of narcissism in the UK, Greece, and China

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Abstract

Research has shown that levels of the Dark Triad (i.e., traits of Machiavellianism, narcissism, and psychopathy) vary across sex and age, with males and younger people reporting higher scores. The Dark Triad has also been found to be associated with personal economic status. We investigated whether sex and age differences in the Dark Triad varied across countries of different socioeconomic conditions. We further explored whether the dark traits predicted personal income to different extent across countries. We utilized three samples from the UK, Greece, and China (*total N* = 5,854), whose socioeconomic status varied from more to less developed according to the Human Development Index. Men scored higher than women on the Dark Triad, with the magnitude of sex differences being largest in the UK, followed by Greece and China. Younger people scored higher than older people on the Dark Triad, with the effect of age varying across countries. Narcissism positively predicted income, with its predictive power being significant in China and Greece but null in the UK. The results are consistent with the view that Dark Triad traits may be adaptive responses to environmental challenges. Specifically, the results suggest that sex differences in the Dark Triad and the relation between narcissism and personal income are responsive to socioeconomic conditions at the country level.

Keywords Dark Triad · Cross-cultural · Income · Sex difference · Age difference

Introduction

In the last two decades, the Dark Triad, has attracted

increasing attention (Muris et al., 2017). The Dark Triad refers to traits of Machiavellianism, narcissism, and psychopathy (Paulhus & Williams, 2002). Machiavellianism is characterized by a manipulative interpersonal style, a cynical disregard for morality, and a focus on self-interest and personal gain. The construct was developed, based on statements from Machiavelli's books, by Christie and Ge (1970) who framed it as a normal personality trait, which can be reliably observed in laboratories and real world. Narcissism has been first introduced to psychological literature by psychoanalysts such as Sigmund Freud; and since then, it has been viewed as a personality disorder. However, since 1979, a normal or subclinical version of narcissism has been proposed to describe a personality which blends grandiose and superior self-views, desires for others' attention and compliment, motives for entitlement and dominance, and vulnerabilities to psychological distress when self-enhancement fails (Raskin & Hall, 1979). Psychopathy has its roots in psychiatry and forensics, but in the recent

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decades, it has been also used to describe personality characteristics among subclinical and non-forensic populations (Lilienfeld & Andrews, 1996). Psychopathy features lack of empathy and remorse, manipulation of others, disinhibited lifestyle, bold and even antisocial behavior, and sometimes superficial charm.

Recent research has uncovered that despite differences in manifestation and etiology Machiavellianism, narcissism, and psychopathy share a common core, that is, diminished empathy, exploitation of others (Jones & Figueredo, 2013), and a predisposition to high antagonism (Truhan et al., 2020). Indeed, the three traits are positively interrelated to a moderate-to-large extent (r s: 0.34–0.58; Muris et al., 2017). Moreover, all the three traits have been frequently associated with various negative outcomes, especially those in interpersonal domains, such as aggression, cheating, and sense of entitlement (for reviews see, Furnham et al., 2013; Muris et al., 2017). There is also evidence suggesting positive sides of the dark traits, such as lower levels of psychopathology in people with higher narcissism (Papageorgiou et al., 2019a, b), increased attractiveness in people that score higher on a composite measure of the Dark Triad (Hotzman & Strube, 2013), and higher creativity in people that score higher in facets of psychopathy (Galang et al., 2016). Such positive outcomes may at least partially explain why the Dark Triad traits persist across time and country (Jonason et al., 2020; Twenge et al., 2008). One way to gain further insights into these traits is to take the life history approach.

Life history view of the Dark Triad traits

Existing work on the adaptive value of the Dark Triad traits is heavily based on the evolutionary framework of life history theory, that describes the strategic allocation of bioenergetic and material resources toward various life tasks, such as growth, mating, and parenting (Del Giudice & Belsky, 2011). Unpredictable, harsh environments tend to energize fast life history strategies, where individuals mature early, produce more offspring, but invest less in those offspring. By contrast, predictable, affluent environments tend to elicit slow life history strategies, where individuals mature and reproduce at a later age, produce fewer offspring, and invest heavily in those offspring. Although the distinction between fast and slow life history strategies was originally used to account for cross-species differences in reproduction, it is also useful for understanding within-species differences. For example, when applied to humans, life history theory characterizes individual differences in reproductive behaviors and it also describes individual differences in a broad range of traits and behaviors including personality, cognition, social functions, and mental health (Del Giudice & Belsky, 2011; Figueredo et al., 2006; Hengartner, 2017).

Accumulating evidence indicates that the Dark Triad traits capture individual differences in the psychological features that are closer to fast life history strategies. These strategies include but not limited to a preference for short-term mating (Jonason et al., 2010), unrestricted sexuality (Book et al., 2015), low parenting efforts (Valentova et al., 2020), and risk-taking (Crysel et al., 2013). However, evidence is mixed in regard to the adaptive value of the Dark Triad traits and their links with life history strategies.

Recently, a complex pattern has emerged with evidence to suggest that, among the three dark traits, psychopathy is the strongest predictor of a fast life strategy, whereas narcissism and Machiavellianism contain a *mélange* of fast and slow components (Davis et al., 2019; Jonason et al., 2017). Furthermore, the role of the strategies adopted by individuals that score high on the Dark Triad in reproductive success is unclear. Some research has suggested a possible link between the Dark Triad and reproductive success in males but not in females (Carter et al., 2018; Jonason & Lavertu, 2017).

Sex differences in the Dark Triad traits

When it comes to reproduction, male and female individuals diverge in their available strategic options and in the related costs and benefits. According to the life history theory, males in general favor fast life history strategies (e.g., more mating but less parenting), whereas females often prefer slow life history strategies (e.g., less mating but more parenting of their offspring) when high-level risks are absent in the local environment (Del Giudice, 2009; Del Giudice & Belsky, 2011). Given that the Dark Triad traits approximate fast instead of slow life history strategies to a greater extent, men are more likely to manifest the dark traits than do women. This line of reasoning is consistent with the results of a meta-analysis of 50 studies including 25,930 participants that has revealed sex difference with men scoring higher on Machiavellian, narcissistic, and psychopathic traits than women (Muris et al., 2017). These differences seem to be irrespective of the measure that was used in a particular study to assess the Dark Triad.

However, a recent cross-cultural study has shown that sex differences in the Dark Triad traits vary across countries in terms of effect size or even direction (Jonason et al., 2020): (1) males scored higher in all three Dark Triad traits with moderate-to-large effect sizes in most out of 49 countries (e.g., Slovakia, South Africa, United States) and with relatively small effects in other countries (e.g., Algeria, Australia, France); (2) females scored higher in narcissism in several countries with small effects (e.g., Armenia, Korea, United Kingdom); (3) and only in one case females

scored higher in all three Dark triad traits, but the effect was very weak (Togo).

From an evolutionary perspective, variations of effects in sex differences across countries are possibly conditioned by the stability and resources of the local environment (Del Giudice, 2009; Schmitt et al., 2017). According to the life history theory, although females usually prefer slow life history strategies, when the risk in environments elevates, females can adopt fast life history strategies to increase their reproductive success (Del Giudice, 2009). Thus, in societies facing greater challenges such as gross wealth inequality, women are more likely to exhibit the Dark Triad traits in order to gain access to additional economic resources for themselves and their offspring. This phenomenon may contribute to closing the gap in scores on the dark traits between males and females, who live in more challenging societal conditions.

The most recent cross-cultural study on this topic (Jonason et al., 2020) has supported this hypothesis: larger sex differences have been found in more developed countries (i.e., countries with better scores in terms of human development, economic and gender equality, and other indices); and smaller sex differences have been found in less developed countries. However, this pattern has been found only for narcissism and psychopathy, but not for Machiavellianism. Additionally, the generalizability of this study's conclusions is limited as its samples were exclusively university students.

Age differences in the Dark Triad traits

In addition to sex, age may also be a factor contributing to individual differences in the Dark Triad traits. Moving from adolescence to young and middle adulthood, in order to fulfill one's age-related social roles (e.g., becoming a parent) and societal expectations (e.g., taking good care of one's children), people's personality becomes more socially mature, that is, being more responsible, self-controlled, communal, nurturing, etc. (Roberts et al., 2008). This trend may be also reflected in the reduction of dark triad traits. A large-scale cross-sectional study, including 1,118,643 participants aged between 10 and 67 years, revealed that Machiavellianism rises during the transition from late childhood to adolescence, when it peaks, and then it steadily declines throughout adulthood, reaching an overall minimum at age 65 (Götz et al., 2019). The decline of Machiavellianism during adulthood has been also shown in two cross-sectional studies which spanned a broad range of ages from 18 to 74 years (Barlett & Barlett, 2015; Kawamoto et al., 2020).

For narcissism, a longitudinal study showed that narcissism increases from ages 14 to 18 and is stable from 18 to 23 (Carlson & Gjerde, 2009). Several cross-sectional studies

suggested that narcissism either declines moderately during adulthood, or remains stable (Barlett & Barlett, 2015; Foster et al., 2003; Kawamoto et al., 2020).

Regarding psychopathy, one cross-sectional study of male prison inmates between the ages of 16 and 69 showed that the mean levels of some facets of psychopathy declined with age, whereas some other facets remained comparable across age (Harpur & Hare, 1994). Recently, two studies targeting the general population demonstrated that psychopathy decreases with age throughout adulthood (Barlett & Barlett, 2015; Kawamoto et al., 2020).

Research has suggested that the developmental trends for the Dark Triad are similar for men and women (Götz et al., 2019; Grijalva et al., 2015). However, previous studies did not test if age effects on the Dark Triad traits varied across countries of different socioeconomic conditions.

The Dark Triad traits and income

Several studies have found income to positively correlate with Machiavellianism, narcissism, or psychopathy, with small-to-moderate effect sizes Aziz, 2004; Foster et al., 2003; Garcia et al., 2012; Leckelt et al., 2018). A possible explanation for this is that individuals scoring higher on Machiavellianism, narcissism, or psychopathy tend to strive for "getting ahead" instead of "getting along" in the workplace (for a review see, Furnham et al., 2013), which in turn could contribute to immediate benefits, such as achieving higher income (for a review, see O'Boyle et al., 2012).

However, the relationship between the Dark Triad traits and income become less homogeneous when all the three traits were considered simultaneously. A study involving German employees showed that Machiavellianism was weakly and positively associated with employees' monthly salary (Spurk et al., 2016). This association decreased to be null, when narcissism and psychopathy were considered simultaneously in the same model. The study also reported that narcissism was positively and significantly related to salary regardless of whether demographic and work-related confounds were controlled for. Lastly, the study found a significant and negative correlation between psychopathy and salary after confounding variables were controlled for. These findings have been replicated by a study in an Austrian sample of employees (Paleczek et al., 2018). Finally, another study replicated the positive correlation between narcissism and annual income in an Australian sample (Jonason et al., 2018). While the correlation between Machiavellianism and annual income was not significant, the study reported a modest but positive relation between psychopathy and annual income.

Overall, previous studies have suggested a positive association between narcissism and personal income. This

relationship complies with the agency model of narcissism (Campbell & Foster, 2007). According to this model, narcissists are motivated to be successful and powerful; thus, they will use all sorts of strategies (e.g., appearing assertive in a group) to get what they want, such as greater salary or position.

Nevertheless, existing evidence is not sufficient to understand the complex interrelations between the dark triad traits and income, as previous research has suffered from a number of limitations. Most existing studies included samples from economically developed countries; focused on individualistic cultures (i.e., cultures prioritizing the individual over the entire group and personal achievements over interpersonal relationships); and did not directly compare results from different countries. Meanwhile, in those studies involving all the three dark traits, they adopted a multivariate statistical approach by regressing income on all the three traits simultaneously in order to examine the unique variance accounted for by each dark trait. In the case of substantially interrelated variables like the three dark traits, multivariate regression can result in residual variables whose content is difficult to interpret and differs from that of the original variables (Miller et al., 2019).

The present study

The present study extends previous research by investigating the effects of sex and age on the Dark Triad personality characteristics in three countries of different socioeconomic conditions. To evaluate the adaptive values of the Dark Triad traits, we tested whether these traits, especially narcissism, are associated with individuals' annual income.

To fulfill these goals, we utilized three large cross-cultural samples (*total N* = 5,854) drawn from the general population in the United Kingdom (UK), Greece, and China. The three countries differ substantially on the Human Development Index (HDI) – a comprehensive indicator of economic, political, educational, and health conditions in each country. According to the latest report on HDI, from 2014 to 2019 which largely overlapped with the period when the present study was conducted (2015–2020), socioeconomic conditions were ranked very high in the UK (13th), moderately high in Greece (29th / 32nd), and around the medium in China (97th / 85th), among 189 countries in the world (UNDP, 2020). The gender inequality was relatively small in the UK (index = 0.118) and Greece (0.116), but larger in China (0.168) (UNDP, 2020).

First, we expected to replicate previous findings on sex differences in the Dark Triad, with males reporting generally higher scores than females (Hypothesis 1a). However, our main aim was to explore the degree to which sex differences in the Dark Triad would vary in strength across the

three countries, possibly as a function of national socioeconomic conditions. Based on previous cross-cultural research (Jonason et al., 2020), we expected to find the weakest sex differences in the Dark Triad traits in China, followed by Greece and the UK (Hypothesis 1b).

Furthermore, we tested whether age effect on the Dark Triad traits would vary across the three countries in our study. Given that the levels of the Dark Triad traits declined with age in most previous studies (Barlett & Barlett, 2015; Foster et al., 2003; Harpur & Hare, 1994; Kawamoto et al., 2020), we hypothesized that age would associate negatively with the Dark Triad (Hypothesis 2a). In addition, the effect of age on the Dark Triad scores would be weaker in less developed countries (Hypothesis 2b). This is because if the dark traits acting as adaptive responses to adverse socioeconomic conditions as previously suggested (Jonason et al., 2020), individuals living in such conditions may exhibit greater levels of the Dark Triad characteristics for a longer period during their lifetime.

Finally, in line with previous findings (Jonason et al., 2018; Paleczek et al., 2018; Spurk et al., 2016), we hypothesized that narcissism would predict income positively (Hypothesis 3a). As a potential response to challenging environments, narcissism will have a stronger association with personal income in countries with worse socioeconomic conditions (Del Giudice & Belsky, 2011; Figueredo et al., 2006; Jonason et al., 2020) – reflecting increased usefulness of narcissism in such conditions. This is in line with the view that narcissism may be created by scarcity (Campbell & Žemojtel-Piotrowska, 2017; Papageorgiou et al., 2019a, b). Specifically, in countries that are less developed, there is likely a greater degree of scarcity increasing competition for resources. Narcissism, as an agentic trait (Gebauer & Sedikides, 2018), would enable people to compete over these scarce resources. Thus, we expected that this relationship would be stronger in less developed countries (Hypothesis 3b). We also explored the roles of Machiavellianism and psychopathy in predicting income across countries, but we did not formulate any specific hypotheses given the inconsistencies in previous findings.

Method

Participants and Procedure

Cross-cultural samples

We recruited participants from the UK, Greece, and China. The UK sample was recruited online through advertisements on social networks as well as through word of mouth between 2015 and 2020, as part of several projects that

incorporated an assessment of the Dark Triad. All participants aged 18 and above could participate. However, among the participants, six persons self-reported age as 17, and thus were deemed unqualified. The final sample included 1,752 participants (Table 1). Of those participants, 129 chose not to report their age. We assessed income in a subset of the UK sample ($N=533$), which still had a desirable power to test our hypothesis (3a). As such, the analyses involving the variables income and age are based on a subset of the UK sample.

The Greek sample was recruited online through advertisements on social networks and through word of mouth between 2019 and 2020 as part of a larger cross-cultural project involving data collection of various self-report measures. All participants aged 18 and above could participate. However, among the participants, 11 persons self-reported age as 17, and thus were deemed unqualified. The Greek sample included 1,036 participants (Table 1). Three participants did not report their age, so their data were excluded from analyses involving age.

The Chinese sample was recruited between 2019 and 2020 through the website of a personal genomics company (www.wegene.com), a Chinese company equivalent to 23andMe. As the present study was part of a genome-wide association study (GWAS), only customers who had completed genetic testing in this company could enroll in the online survey. Initially, 4,561 participants volunteered to participate in the survey. But 1,441 failed the attention check during the survey (i.e., giving a wrong answer to “Please select ‘moderately agree’ for this item.”) and were excluded from all the analyses. To keep in line with the UK and Greek samples, we excluded another 54 participants who were younger than 18 from any analyses. Thus, the final sample included 3,066 participants (Table 1).

The samples were of sufficient power to test all formu-

Measures

Demographics

All the participants were asked to report their age, sex, and current annual income. UK and Greek participants reported their income by choosing from six categories, with a unit of pounds for the UK sample and Euros for the Greek sample: $\leq 10,000$; $> 10,000$ but $\leq 30,000$; $> 30,000$ but $\leq 60,000$; $> 60,000$ but $\leq 100,000$; $> 100,000$ but $\leq 200,000$; $> 200,000$. As participants reporting income above 30,000 pounds/Euros were few, we combined the upper four categories together so that participants’ annual income was classified into three ordinal categories: low ($\leq 10,000$), middle ($> 10,000$ but $\leq 30,000$), and high ($> 30,000$) (Table 1). Chinese participants reported their income by choosing from eight brackets, with a unit of Chinese yuan: $\leq 20,000$; $> 20,000$ but $\leq 60,000$; $> 60,000$ but $\leq 120,000$; $> 120,000$ but $\leq 200,000$; $> 200,000$ but $\leq 400,000$; $> 400,000$ but $\leq 600,000$; $> 600,000$ but $\leq 1,000,000$; $> 1,000,000$. To facilitate a cross-country comparison, we collapsed the eight brackets into three broader categories of income: low ($\leq 60,000$), middle ($> 60,000$ but $\leq 200,000$), and high ($> 200,000$) (Table 1). As such, the income categories of the Chinese sample were approximately comparable to those of the UK and Greek samples in terms of purchasing power.¹

The Dark Triad

The Short Dark Triad (SD3) questionnaire (Jones & Paulhus, 2014) was used to collect data in the UK. The SD3 includes three subscales, each of which includes nine statements: Machiavellianism (e.g., “You should wait for the right time to get back at people”); narcissism (e.g., “People see me as a natural leader”); and psychopathy (e.g., “I like

Table 1 Demographic Characteristics of the Three Samples

	Age (years)		Sex (<i>N</i>)		Income (<i>N</i>)		
	<i>M</i> (<i>SD</i>)	Range	Female	Male	Low	Middle	High
UK	28.85 (11.50)	18–79	1137	615	281	171	81
Greece	35.55 (12.92)	18–86	733	303	558	400	78
China	28.74 (7.05)	18–70	1763	1303	1134	1235	697

Note. For the UK and Greek samples, low, middle, and high annual income corresponds to $\leq 10,000$ pounds/euros, $> 10,000$ but $\leq 30,000$ pounds/euros, and $> 30,000$ pounds/euros. For Chinese sample, low, middle, and high annual income corresponds to $\leq 60,000$ yuan, $> 60,000$ but $\leq 200,000$ yuan, and $> 200,000$ yuan

lated hypotheses. Information on estimation of statistical power is presented in Supplementary Information.

¹ Based on the statistics of purchasing power parities in dollars (PPP \$) reported by the OECD (<https://data.oecd.org/conversion/purchasing-power-parities-ppp.htm#indicator-chart>), we converted 10,000 and 30,000 pounds/euros to the amount of Chinese yuan with equal purchasing power. During 2019 and 2020, 10,000 pounds or euros were equivalent to 60,740–75,678 yuan, and 30,000 pounds or euros were equivalent to 182,220–227,034 yuan. These numbers approximated 60,000 and 200,000 yuan, which were two cutoffs included in the original measure of income in the Chinese sample.

to get revenge on authorities”). Participants reported their agreement with these statements on a 5-point Likert scale (1 = *strongly disagree*, 5 = *strongly agree*). After reversing the scores of 3 items for narcissism and 2 items for psychopathy, items were averaged to create an overall score of Machiavellianism, narcissism, and psychopathy (Table 2). In order to collect data in Greece, the SD3 was translated into Greek and back translated by a native speaker, and then checked by two co-authors. In the Chinese sample, we used a Chinese version of the SD3, which has been adapted for use with Chinese participants recently and returned comparable validity and reliability estimates to the original version (Zhang et al., 2019).

When measuring the Dark Triad among the Greek and UK samples, we replaced two items of the SD3 with two items that were included in the original 41-item set but not in the final 27-item version (Jones & Paulhus, 2014). Specifically, “*I like to use clever manipulation to get my way*” was replaced by “*Generally speaking, people won’t work hard unless they have to*” in the Machiavellianism subscale; and “*I enjoy having sex with people I hardly know*” was replaced by “*I like to pick on losers*” in the Psychopathy subscale. This is because in pilot and other studies, it was noticed a high tendency for participants not to complete these items. Thus, there were two items (one item for Machiavellianism and one item for psychopathy) that differed between the three samples, whereas the remaining 25 items were the same across samples. We conducted all the main analyses based on the 25 items. Results are shown in Table S6–S12. As we can see, the results based on the 25 items are very close to those results based on the whole SD3.

Data analysis

We examined the measurement invariance (MI) of the SD3 across country and sex (details of the MI testing method

are included in Supplementary Information). Then, we tested our hypotheses by performing mean comparisons and regression analyses using R statistical language (R Core Team, 2020). Following the latest recommendation of caution against multivariate statistical approaches in studying the Dark Triad (Miller et al., 2019), we carried out all the major analyses separately for each dark trait.

Results

Descriptive statistics, zero-order correlations and measurement invariance

Table 2 presents reliability coefficients and descriptive statistics for the Dark Triad traits in the UK, Greek and Chinese samples. Skewness and Kurtosis indicated that the distribution of the dark traits did not deviate substantially from normality in any of the samples. Table 2 also displays zero-order correlations among the three dark traits for each country. Consistent with previous studies (for a review, see Muris et al., 2017), we observed positive correlations among the three dark traits in all the countries ($r = .26$ – 0.48 , $p < .001$).

Prior to hypothesis testing, it was important to ascertain the measurement invariance (MI) of the SD3 across country and sex. The SD3 showed scalar invariance across sexes, allowing us to make between-sex comparisons. The SD3 showed metric (but not scalar) invariance across countries. These justified comparisons of regression coefficients (or other equivalent statistics) across countries but did not permit meaningful comparisons of latent means across countries (Davidov et al., 2014). Therefore, we decided not to compare means of the dark traits across countries. However, the patterns of results were similar across the countries, with Machiavellianism being the highest (3.00–3.79), followed

Table 2 Reliability Coefficients, Descriptive Statistics, and Zero-Order Correlations for the Dark Triad Traits of Each Country

Measure	Reliability		Mean (SD)	Skew	Kurt	Correlation	
	α	ω				M	N
UK							
Machiavellianism	0.78	0.78	3.07 (0.67)	-0.06	-0.11		
Narcissism	0.74	0.75	2.70 (0.63)	0.10	-0.15	0.31	
Psychopathy	0.77	0.79	2.07 (0.64)	0.66	0.36	0.48	0.40
Greece							
Machiavellianism	0.70	0.71	3.00 (0.58)	0.31	0.12		
Narcissism	0.61	0.62	2.95 (0.49)	0.18	0.24	0.26	
Psychopathy	0.74	0.74	1.99 (0.56)	0.52	0.22	0.40	0.32
China							
Machiavellianism	0.83	0.83	3.79 (0.66)	-0.43	0.38		
Narcissism	0.75	0.75	2.76 (0.67)	0.26	0.04	0.32	
Psychopathy	0.65	0.67	2.10 (0.60)	0.47	-0.05	0.40	0.35

Note. M = Machiavellianism; N = narcissism. All correlations were significant at $p < .001$

by Narcissism (2.70–2.95) and psychopathy (1.99–2.10). SDs for all measures were very similar across countries. Further results of the MI testing are included in Supplementary Information.

Sex and age differences in the Dark Triad traits

To test the hypotheses concerning sex and age differences in the dark traits (i.e., H1a, H1b, H2a, and H2b), we performed multiple linear regression with age, sex (female = 0, male = 1), country (because the Chinese sample was largest in size, it was set as the reference group in dummy coding; UK dummy code: UK = 1, Greece = 0, China = 0; Greece dummy code: UK = 0, Greece = 1, China = 0), age by country interactions, and sex by country interactions as predictors of scores on the dark traits. For all the three traits, we observed significant interactions between sex and country as well as between age and country ($p < .05$ for at least one of the two interactions between country and sex or age; Supplementary Information, Table S3). To understand these interactions, for each dark trait, we separately tested the simple effects of sex and age by country.

Sex differences across countries

We compared mean scores for men and women on each dark trait (Table 3). In all the countries, men were more Machiavellian than women ($p < .001$), with the magnitude of sex differences to be the largest in UK ($d = 0.54$),

and psychopathy ($d = 0.66, 0.54, 0.48$). Sex differences in narcissism were non-significant for Chinese participants ($p = .877$)².

Age differences across countries

We analyzed the effect of age on each dark trait by country (Table 3). Greater age was associated with lower scores on Machiavellianism ($\beta = -0.11, -0.11, p < .001$), narcissism ($\beta = -0.15, -0.07, p < .001$) and psychopathy ($\beta = -0.11, -0.18, p < .001$), in the UK and China. There was not a significant association between age and dark traits in Greece ($\beta = -0.00, -0.03, p > .05$). All effects were small.

The Dark Triad traits and annual income

We examined the role of the Dark Triad traits in predicting annual income (i.e., H3a, H3b). For each dark trait, we performed an ordinal logistic regression with the following predictors: the dark trait, country (UK dummy code: UK = 1, Greece = 0, China = 0; Greece dummy code: UK = 0, Greece = 1, China = 0), and country by trait interactions (Supplementary Information, Table S4). To partial out the confounding effects of age and sex on income, we included age, sex (female = 0, male = 1), and their interactions with country as covariates in the regression model (Table S4). Results showed that Machiavellianism and its interaction with country significantly predicted income ($p < .05$). Narcissism but not its interactions with country significantly

Table 3 Age and Sex differences in The Dark Triad Traits Across Countries

	Sex differences				Age differences	
	Men <i>M</i> (<i>SD</i>)	Women <i>M</i> (<i>SD</i>)	<i>t</i>	<i>d</i>	B (SE)	β [95% CI]
Machiavellianism						
UK	3.30 (0.68)	2.95 (0.63)	10.57	0.54***	-0.01 (0.00)***	-0.11 [-0.16, -0.06]
Greece	3.19 (0.62)	2.93 (0.55)	6.22	0.45***	-0.00 (0.00)	-0.01 [-0.07, 0.05]
China	3.86 (0.65)	3.73 (0.67)	5.72	0.21***	-0.01 (0.00)***	-0.11 [-0.14, -0.07]
Narcissism						
UK	2.88 (0.63)	2.61 (0.61)	8.51	0.43***	-0.01 (0.00)***	-0.15 [-0.20, -0.10]
Greece	3.03 (0.52)	2.92 (0.47)	3.11	0.22**	-0.00 (0.00)	-0.03 [-0.09, 0.03]
China	2.77 (0.67)	2.76 (0.67)	0.16	0.01	-0.01 (0.00)***	-0.07 [-0.10, -0.03]
Psychopathy						
UK	2.33 (0.65)	1.93 (0.59)	12.72	0.66***	-0.01 (0.00)***	-0.11 [-0.16, -0.07]
Greece	2.20 (0.58)	1.90 (0.53)	7.61	0.54***	-0.01 (0.00)***	-0.18 [-0.24, -0.12]
China	2.26 (0.61)	1.98 (0.56)	13.03	0.48***	-0.00 (0.00)**	-0.05 [-0.09, -0.02]

Note. *d*: Cohen's *d*; B: unstandardized regression coefficient; SE: standard errors; β : standardized regression coefficient; CI: confidence interval. * $p < .05$; ** $p < .01$; *** $p < .001$

followed by Greece ($d = 0.45$) and China ($d = 0.21$). Similar patterns appeared for narcissism ($d = 0.43, 0.22, 0.01$)

² Additional analysis showed that Chinese people from different regions (city versus countryside and town) displayed similar patterns of sex differences in the Dark Triad (see details in Supplementary Information). Such cross-regional consistency was also observed on age differences and relations between the dark traits and income.

predicted income ($p < .001$). In contrast, neither psychopathy nor its interactions with country were significant in predicting income ($p > .05$).

To further understand the relationship between the Dark Triad traits and income in each country, we performed post-hoc analyses. Given that age and sex interacted with country to predict income (Table S4), we controlled for potential confounding effects of age and sex. We carried out ordinal logistic regression with one of the three dark traits as the predictor and age and sex as covariates (Table 4). Machiavellianism was associated with income in China (odds ratio [OR]=1.26, $p < .001$), but not in Greece and the UK ($p > .10$). Narcissism predicted income in Greece and China ($p < .01$) but not in the UK ($p = .088$). The probability of individuals with higher narcissism having greater income was slightly higher in China (1.65) than in Greece (1.52). Psychopathy was positively predictive of income in the UK (OR = 1.42, $p = .040$); but not predictive of income in Greece and China ($p > .05$).

Discussion

The Dark Triad has been often associated with various negative outcomes (for reviews see, Furnham et al., 2013; Muris et al., 2017). Though noxious by nature, the Dark Triad traits are prevalent across country and time (Jonason et al., 2020; Twenge et al., 2008). This paradox suggests that some aspects of these traits may have adaptive properties in certain contexts. According to life history theories, the Dark Triad traits, which more or less feature fast life

strategies, may have some adaptive properties in adverse environments (Del Giudice & Belsky, 2011; Figueredo et al., 2006; Jonason et al., 2020). We intended to add to this literature by exploring sex and age differences in the Dark Triad in three countries that differ substantially on socioeconomic conditions, as indicated by the HDI. According to the HDI, the UK is the most developed country out of the three followed by Greece and China (UNDP, 2020). Furthermore, we wanted to investigate whether the dark traits predict individual income; and the degree to which this association differs across the three countries.

Sex differences in the Dark Triad

Firstly, we replicated previous findings (e.g., Muris et al., 2017) of higher scores in males than females on the Dark Triad, supporting H1a. Secondly, in support of H1b, we found that sex differences in the Dark Triad were smaller in China as compared to Greece and the UK; and smaller in Greece as compared to the UK. This effect was particularly prominent for narcissism, where group means of narcissism were close for Chinese men and women. Previous studies using the SD3 for narcissism assessment among large Chinese samples ($Ns > 900$) have also observed minimal sex differences (Cohen's $d = 0.18/0.15$, lower than the threshold for small effects at $d = 0.20$; Li et al., 2020; Zhang et al., 2019). These previous findings and our findings together indicate that sex differences in dark traits are smaller in societies with worse socioeconomic conditions (Jonason et al., 2020). We extended these findings for narcissism and psychopathy to Machiavellianism, thus demonstrating a consistent pattern

Table 4 Logistic Regression of Annual Income on each Dark Triad Trait, Age, and Sex for Each Country

	Machiavellianism			Narcissism			Psychopathy		
	B (SE)	<i>t</i>	OR [95% CI]	B (SE)	<i>t</i>	OR [95% CI]	B (SE)	<i>t</i>	OR [95% CI]
UK ($N = 533$)									
Trait	0.02 (0.17)	0.10	1.02 [0.73, 1.41]	0.28 (0.17)	1.71	1.33 [0.96, 1.84]	0.35 (0.17)*	2.06	1.42 [1.01, 1.98]
Age	0.11 (0.01)***	11.61	1.12 [1.10, 1.14]	0.11 (0.01)***	11.71	1.12 [1.10, 1.14]	0.11 (0.01)***	11.79	1.12 [1.10, 1.14]
Sex	1.28 (0.21)***	6.13	3.61 [2.40, 5.46]	1.24 (0.20)***	6.17	3.46 [2.34, 5.16]	1.14 (0.21)***	5.34	3.11 [2.05, 4.73]
Greece ($N = 1033$)									
Trait	-0.06 (0.12)	-0.46	0.95 [0.75, 1.19]	0.42 (0.14)**	2.95	1.52 [1.15, 2.01]	-0.02 (0.13)	-0.16	0.98 [0.76, 1.26]
Age	0.09 (0.01)***	15.81	1.10 [1.08, 1.11]	0.09 (0.01)***	15.87	1.10 [1.09, 1.12]	0.09 (0.01)***	15.60	1.10 [1.08, 1.11]
Sex	0.62 (0.15)***	4.15	1.86 [1.39, 2.50]	0.56 (0.15)***	3.83	1.76 [1.32, 2.35]	0.61 (0.15)***	4.05	1.85 [1.37, 2.49]
China ($N = 3066$)									
Trait	0.23 (0.05)***	4.30	1.26 [1.13, 1.40]	0.50 (0.05)***	9.32	1.65 [1.49, 1.84]	0.10 (0.06)	1.69	1.11 [0.98, 1.25]
Age	0.15 (0.01)***	23.76	1.16 [1.15, 1.18]	0.15 (0.01)***	24.11	1.17 [1.15, 1.18]	0.15 (0.01)***	23.54	1.16 [1.14, 1.17]
Sex	0.06 (0.07)	0.82	1.06 [0.92, 1.22]	0.10 (0.07)***	1.35	1.10 [0.96, 1.26]	0.06 (0.07)	0.83	1.06 [0.92, 1.22]

Note. B: unstandardized regression coefficient; SE: standard errors; OR: odds ratio; CI: confidence interval. Sex is dummy coded as female = 0, male = 1

for a possible moderating effect of socioeconomic conditions on sex differences for all Dark Triad traits. In addition, among the three countries, larger sex differences in Dark Triad traits were observed in countries with less gender inequality (i.e., UK and Greece; UNDP, 2020). This pattern is consistent with findings of more pronounced sex differences in most aspects of personality, including the Big Five and the Dark Triad, in countries with smaller gender gap (Schmitt et al., 2017).

The attenuation of sex differences in the Dark Triad traits in less developed countries may reflect adaptive value of Machiavellian, narcissistic, or psychopathic traits in adverse environments. Specifically, fast life strategies, associated with Dark Triad traits, may be a way to cope with harsh socioeconomic conditions (Del Giudice, 2009). As a result, females may exhibit similar levels of Dark Triad traits to males in the presence of greater environmental challenges. To secure sufficient resources for themselves and their offspring, women living in less prosperous places or/and places with higher gender inequality are more likely to behave more manipulatively, callously, and/or selfishly, eventually resulting in diminished sex differences in the Dark Triad in such societies.

Age differences in the Dark Triad

In addition to sex differences, we also explored age effects on the expression on the Dark Triad traits and its interactions with country. The results showed that age associated negatively with scores on the Dark Triad across the three samples, which supported H2a and replicated previous findings Barlett & Barlett, 2015; Foster et al., 2003; Götz et al., 2019; Harpur & Hare 1994; Kawamoto et al., 2020). In general, the decrease in malevolent traits during adulthood aligns with the maturity principle; that is, personality may change in a way to be more socially mature (i.e., emotionally stable, agreeable, and conscientious), communal, responsible, and self-controlled (Roberts et al., 2008).

Furthermore, we found that the Dark Triad scores declined with age by varying degrees in the three samples: for every dark trait, the smallest attenuation was observed either in China or in Greece, though the largest attenuation was not always observed in the UK. These results provide partial support for our hypothesis that the reverse correlations between age and the Dark Triad traits would be weaker in countries with worse socioeconomic conditions (H2b). Furthermore, these results are in line with life history theories: individuals living in adverse environments may need to exhibit higher Dark Triad traits longer in their lifetime, as a way to compete for resources. In that sense, our finding implied that cross-country variation in the association between age and dark traits may reflect socioeconomic

conditions. However, further exploration of this effect is needed using cross-cultural and longitudinal data.

The Dark Triad and income

Finally, we found positive associations between narcissism and personal income, a proxy measure of individual's socioeconomic status. This finding, supporting Hypothesis 3a, replicates previous reports of narcissism as a positive predictor of income (Jonason et al., 2018; Paleczek et al., 2018; Spurk et al., 2016). Furthermore, we found a trend that the strength of the association tended to be higher in China followed by Greece and the UK. However, given that country did not significantly interact with narcissism in predicting income, our evidence supporting Hypothesis 3b is preliminary. Overall, our results are consistent with the agency model of narcissism, which posits narcissism as an integration of motives, strategies, and skills that point to pursue success, power, and status (Campbell & Foster, 2007). The tendency of a stronger association between narcissism and income in less developed countries aligns with the proposal that being more narcissistic may help people to survive or even thrive in competitive environments (Jonason et al., 2020). However, the direction of effect between narcissism and income may be opposite: people with higher income may become more narcissistic (Leckelt et al., 2018). The relationship between narcissism and income can also be reciprocal. Longitudinal studies that allow for the investigation of the origin of the relationship between narcissism and wealth is warranted.

Machiavellianism predicted income in the Chinese sample but not in the other two countries, whereas psychopathy predicted income in the UK but not in Greece and China. These mixed findings largely mirror the inconsistencies in the literature (Götz et al., 2019; Jonason et al., 2018; Paleczek et al., 2018; Spurk et al., 2016). Such inconsistency in the literature may be due to the competing effects of Machiavellianism and psychopathy on success: on the one hand, they energize the tendency to manipulate others and the motive for “getting ahead”; on the other hand, they may backfire on work behavior such as number of complaints filed against co-workers, days of unexcused absences, and abusive supervision (O’Boyle et al., 2012). The two influences may compete against each other and result in an unstable relationship with income on the sample level.

Put together, the distinct roles of the three dark traits in predicting income may arise from their differential sensitivity to country-level socioeconomic conditions (Jonason et al., 2020). Narcissism appears to be the most adaptive trait of the three, at least when it comes to their positive associations with income.

A reflection on the life history view

So far, we have interpreted our findings through the perspective of life history theory. As mentioned before, while this theory has been originally used to explain variation in survival and reproductive behaviors at species levels, it has recently been applied to explain human's individual differences in a broad range of traits and behaviors (Jonason et al., 2010). However, to evaluate life histories, a number of biological, social, and cultural contexts need to be considered; and when it comes to an individual, there are likely to be unexpected trade-offs based on one's idiosyncratic characteristics and situations (Stearns, 1992). Thus, predicting individuals' behaviors directly from life histories would be a long shot.

A relevant issue is that we used the macro socioeconomic conditions (indicated by the HDI and purchasing power) of the countries as a proxy for local environments of each participant. Effects of such macro socioeconomic conditions on every citizen's life are likely to interact with other factors. For example, country level employment-to-population ratio does not directly describe circumstances of individual, as it differs for representatives of different professions. Consequently, individuals may resort to different strategies in securing jobs, such as more narcissistic or Machiavellian behaviours in particularly competitive fields.

In addition, the three countries under study diverge on other dimensions, such as individualism (vs. collectivism) and power distance (Power distance Index measures the extent to which the less powerful members of society accept and expect that power is distributed unequally). According to a global survey (Hofstede, 2001), the UK is highest on individualism among the three countries, followed by Greece and China. Power distance index was largest in China (80; indicating relatively high acceptance of hierarchy and power inequality), medium in Greece (60), and smallest in the UK (35; <http://clearlycultural.com/geert-hofstede-cultural-dimensions/power-distance-index/>). Individualistic cultures encourage people to express self and realize internal attributes, and thus people can express uniqueness and diversity in their beliefs and doings. More collectivistic cultures, however, emphasize harmony with others and respect for authority, and thus people need to fit in the social context and conform to social norms. These cross-cultural differences may partly explain gender differences in personality traits (Jonason et al., 2020; Schmitt et al., 2017). Specifically, sex differences in the Dark Triad observed across China, Greece, and the UK may be attributed to variation on the individualism/collectivism spectrum. Nevertheless, it is hard to disentangle the effects of economic and cultural factors in the present study, as these factors were correlated: the UK is the highest on socioeconomic conditions,

individualism, and power equality, whereas Greece is medium on all of them and China is lowest on all of them.

In summary, life history theories offer a perspective to understand the adaptive value of the Dark Triad at societal levels. But such theories may not be suitable to predict a particular individual's personality traits and outcomes, given that so many factors at micro, intermediate, or macro levels contribute to one's personality or outcomes. To understand how macro-environments contribute to individuals' dark personality traits, follow-up studies can examine the roles of some intermediate factors, which can be more characteristic of each individual's local environment. Future studies can also benefit from including countries with more diverse socioeconomic and cultural conditions so as to differentiate the impacts of socioeconomic and cultural influences (Jonason et al., 2020).

Limitations and Future Research

Our findings should be interpreted in light of several limitations. First, the self-report data may be influenced by common-method variance and social desirability, particularly in the context of the assessment of dark traits. Second, the associations between age and the Dark Triad were assessed cross-sectionally. Cross-sectional designs are sensitive to cohort effects (i.e., effects due to differences in the historical and sociocultural contexts that members of different age groups in the sample were born into and lived through). The use of other (than self-report) measures to assess dark personality, combined with longitudinal design are needed to address these limitations.

Third, we used convenience samples, which were from countries with high-to-medium socioeconomic conditions. This left countries with low socioeconomic conditions uninvestigated. Thus, whether our findings can be generalized to low-income countries is unknown. In addition, comparing to Greek and Chinese samples, the UK sample was collected in a longer period (2015–2020). During the five years, the UK's HDI remained stable and relatively high (13th place in the world ranking; (UNDP, 2020). Despite this, it is possible that the exit from the European Union which occurred during this time, may have led to some changes in the social, political, and/or economic conditions that are not captured by the HDI in 2020 report but can manifest in a longer run.

Fourth, the measurement of income may not be equivalent in different countries. We categorized the income based on purchasing power parities so that the corresponding range would be of similar purchasing power across country. However, the objective value of a certain amount of income is not perfectly matched between the three countries. Moreover, it is possible that the subjective value of even equivalent income varies in different countries, as they

differ on many socio-economic conditions. Thus, follow-up studies can overcome this limitation by assessing not only the objective value of income but also the subjective value of income.

Fifth, the Short Dark Triad (SD3) showed scalar invariance across sexes in the present study, but it showed only metric invariance across countries. Reaching metric invariance allowed us to compare the regression coefficients, such as those for the associations between the SD3 scores and age or income, across countries. But the lack of scalar invariance across countries limited our capacity to directly compare mean levels of traits across samples. In addition, as we also compared the age effects on the SD3 scores across countries, it would be desirable to establish the measurement invariance of the measures across age groups. However, this was circumscribed by the uneven distribution of ages in our samples (e.g., only two participants were aged 67 but 282 participants were aged 27). In future, studies of cross-cultural or age variation in the Dark Triad can be enhanced by using measures with scalar invariance across countries (e.g., Rogoza et al., 2020) and age groups.

The sixth limitation concerns the unresolved structure of the Dark Triad. Recent evidence suggested a multifactorial structure for dark traits, with each factor incorporating several facets. For instance, Truhan et al., (2020) has recently applied network analyses to various existing measures of the Dark Triad and reported eight facets for narcissism; six facets for psychopathy; four facets for Machiavellianism; and four Dark Triad factors (as grandiose and vulnerable narcissism formed two separate expressions of narcissism). As such, the SD3 may not be the best available measure for studying the adaptive aspects of the Dark Triad cross-culturally. Using measures that assess the dark traits as multifactorial traits is necessary, particularly in research that aims to detect the adaptive versus maladaptive aspects of the Dark Triad across groups (e.g., males and females) and countries.

Conclusions

Cross-cultural research has great potential for uncovering the adaptive and maladaptive aspects of the Dark Triad in men and women across contexts. Our findings replicate: (1) the existence of sex differences in Dark Triad, with males on average reporting higher scores than females; (2) the negative association between age and the Dark Triad; and (3) the positive association between narcissism and income. Furthermore, we extend previous findings by showing that: sex differences (and possibly age differences) in the Dark Triad may be sensitive to socioeconomic conditions; and out of the three traits, narcissism (at least its grandiose expression) has the highest correlation with individual income.

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Author contributions Yu L. L. Luo, Yulia Kovas, and Kostas A. Papageorgiou conceived the idea of this study; Yu L. L. Luo and Kostas A. Papageorgiou designed the survey; Lizhong Wang, Anastasios Stalikas, Theodoros A. Kyriazos, and Foteini-Maria Gianniou collected the data; Yu L. L. Luo analyzed the data; Yu L. L. Luo, Kostas A. Papageorgiou, Maxim V. Likhhanov, and Yulia Kovas draft the manuscript; all authors provided critical comments on the manuscript.

Materials and Data Availability Statement The measures used in the UK and Chinese samples are published and are publicly accessible (Jones & Paulhus, 2014; Zheng et al., 2019). The measure for the Greek sample, the analysis code, the data of the UK and Greek sample, and the codebook for the data file can be accessed from OSF (https://osf.io/f35zc/?view_only=35cd343c181640e7b34f82f2e06a2e36). The data of the Chinese sample was collected by a personal genomic testing company, WeGene, who has confidentiality agreements with their customers. Hence, the data of the Chinese sample cannot be shared publicly, but will be made available through WeGene to qualified researchers under an agreement with WeGene that protects the privacy of the WeGene participants. Please contact LizhongWang (wanglz@wegene.com) for more information and to apply for data access.

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Ethics approval Data collection in China was approved by the Ethics Committee of Institute of Psychology, Chinese Academy of Sciences under the protocol (H18028). Data collection in Greece and the UK was approved by the Ethics Committee of Queen's University Belfast.

Consent to participate Informed consent was obtained from all individual participants included in the study.

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