



THE GENETICS OF PERSONALITY REVEALED BY ISLAND POPULATION DYNAMICS

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**THE ADAPTIVE VALUE OF PERSONALITY DIFFERENCES REVEALED BY SMALL
ISLAND POPULATION DYNAMICS**

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Abstract

Whether differences in personality among populations really exist and, if so, whether they are due only to cultural and linguistic differences or have a genetically selected adaptive value, is a controversial issue. In this research, we compared three Italian populations living on three small archipelagos in the Tyrrhenian Sea (n=993), with their corresponding neighbouring mainlanders (n=598), i.e., sharing the same geographical origin, culture and language. We used an adjective-based Big Five questionnaire in order to measure personality traits in four categories of individuals for each archipelago/mainland population: 1) original islanders; 2) non-original islanders; 3) mainlanders; 4) immigrants to the islands. We further analysed original and non-original islanders who had or had not emigrated from the islands. We found that islanders had different personality traits from mainlanders, the former being more *conscientious* and *emotionally stable* and less *extroverted* and *open to experience*. We also found that the subgroup of islanders whose ancestors had inhabited their island for about 20 generations in isolation (original islanders, n=624) were less *extroverted* and *open to experience* than immigrants (n=193). In contrast, immigrants retained the typical personality profile of the mainland populations. Lastly, emigrants from the islands (n=209) were significantly more *extroverted* and *open to experience* than original and non-original islanders who had never left their island (n=741). We hypothesise that population differences in *extroversion* and *openness to experience* are more probably related to genetic differences which evolved rapidly, presumably through an active gene flow produced by selective emigration from the islands.

Keywords: personality traits, gene flow, small islands, selective emigration.

THE ADAPTIVE VALUE OF PERSONALITY DIFFERENCES REVEALED BY SMALL ISLAND POPULATION DYNAMICS

Introduction

This study focuses on a set of theoretical issues referring to the ongoing controversy about the personality profiles of different populations. Variability in personality traits among individuals is well-established (McCrae and Costa, 1987) and has a considerable (30-60%) genetic component (Bergeman et al., 1988; Tellegen et al., 1988; Bouchard et al., 1990; Cloninger et al., 1993; Plomin et al., 1994; Benjamin et al., 1996; Ebstein et al., 1996; Jang et al., 2002), but personality differences among populations are questioned. For example, Portinga et al. (2002) argue that a genetic explanation for group differences in personality traits is unlikely, because there is no compelling reason why certain traits should be differentially selected in various groups.

However, within the framework of evolutionary psychology, differences in personality among populations may be due to genetic differences which have an adaptive value to the environment and the local social structure (Tooby and Cosmides, 1990; Lohelin and Rowe, 1992; Turkheimer, 1998; Berezkei, 2000). For example, McCrae et al. (1998) reported significant differences in personality profiles between Hong Kong and North American undergraduates, which suggest the effect of linguistic and cultural differences, but do not exclude genetic components. Later, however, Allik and McCrae (2004) suggested that personality is relatively stable and that at present there is no compelling evidence that culture affects personality structure (Allik & McCrae 2002, 2004b). Data indicating genetic differences are also drawn from cross-cultural studies which found that personality differences among populations were correlated with blood group (Eysenck, 1982). These findings have been criticised in a number of ways. It has been noted that comparisons between populations with largely differing histories and cultures are not ideal for studying whether personality differences are due to genetic components, phenotypic flexibility, the environment, or even cultural effects (Lojk et al., 1979; Eysenck, 1982; Eysenck and Yanai, 1985;).

Possible genetic differences can best be identified when differences in language, culture, geographic location and demographic variables are minimal, as in people coming from the same area and linguistic origin (Eysenck and Yanai, 1985; Turkheimer, 1998). It has also been noted that large populations are not at all suited for studying the possible adaptive value of personality differences (Buss, 1999). Therefore, the partly negative results reported above may stem from the fact that they were sought among large populations with different languages, cultures and geographical origins.

For these reasons, we take here a different approach, by comparing populations within the same identical culture and language (Camperio Ciani et al., 2004). We examine personality differences in small Italian populations, all living in archipelagos made up of several small islands, and compare them with control groups from villages on the mainland facing the same archipelagos. Our selection of these particular populations was given by the following assumptions:

- possible differences between populations are better observed in small populations (Buss, 1999);
- the robustness of possible personality differences between populations is guaranteed by choosing three different pairs of archipelago/mainland populations;
- studying each archipelago population with the corresponding population from villages on the mainland opposite minimises differences in culture, language and other environmental factors;
- studying these populations from three archipelagos isolated from each other, where people have been living in isolation for the last 400 years with minimal immigration, may highlight possible genetic differences better.

Research overview

The first theoretical issue concerns the existence of differences in personality traits between small populations within the same cultural, historical, geographic and linguistic environment, and states that such differences are measurable. The second theoretical issue addresses which personality differences are due to an individual flexible response to the environment and which are due to stable personality traits, of possible genetic origin. The third theoretical issue addresses which mechanisms lie at the origin of these differences.

Study Populations

The Italian islands in question are all in the Tyrrhenian Sea: Giglio (northern archipelago), Ponza and Ventotene (centre), and the seven Aeolian islands (south) (Fig. 1). We compared the populations of each of these archipelagos with those of three small mainland villages facing the archipelagos: Castiglione della Pescaia (north, at a distance of 25 sea miles), Gaeta (centre, at 30 sea miles) and Milazzo (south, at 20-40 sea miles). We examined 1784 subjects from the populations living in the three archipelagos and the three mainland villages. As may be seen in Fig. 1, each archipelago is sufficiently far from the others to be considered an independent sample. No significant movement of people has been reported between the islands of the three archipelagos,

either in the present or in the past, whereas movements of people within the archipelagos have been common, due to the relatively short distance between islands (Roani Villani, 1993).

(insert Figure 1 about here)

(insert Table 1 about here)

When compared with the populations of the corresponding mainland, the islands selected in each archipelago all meet the required conditions of isolation, showing the effect, if any, of adaptation on personality traits: i) they are all small, between 10 and 40 miles offshore, and have only a few old villages; ii) the islanders were forced to resettle from mainland villages before the 16th century, and for at least 20 generations they have been considerably isolated from their respective mainland; iii) in the past, population growth on each island was limited by available space, and therefore the population constantly underwent high levels of emigration all over Italy and, more recently, to North and South America and to Australia. Immigration to the same islands was minimal until quite recently. These isolated conditions are confirmed by both surname analysis and study of historical parish records of births, marriages and deaths (Roani Villani, 1993; De Fabrizio 2000).

In addition, the natural environment offers scarce, not easily accessible resources, both on land and at sea. The social environment is limited by the small size of the village communities, which do not interact much with the outside world, although improved connections with the mainland and tourism have attracted some immigrants in recent decades. The presence of recent immigrants allowed us to test the effect of phenotypic flexibility to environmental requirements on personality traits.

Assessment of personality

In order to assess personality traits, we used an adjective-based Big Five questionnaire (Norman, 1963). According to the Big Five theory of personality, five basic independent dimensions of personality may be identified: *extroversion*, *agreeableness*, *conscientiousness*, *emotional stability* and *openness to experience* (Goldberg, 1990; Costa and McCrae, 1992; McCrae and Costa, 1987, 1999). Research on individuals of several different cultures and languages have identified this same personality structure in all of them (Norman, 1963; Goldberg, 1993). Personality is also shown to be stable over time when assessed within this framework (Caprara et al., 1993; Costa and McCrae, 1994, 1997) and all personality dimensions show inheritable components relatively untouched by life experiences (Plomin and Nesselroade, 1990; Buss, 1991; Plomin and Rende, 1991; Lohelin et al., 1998; Plomin & Caspi, 1999). The Big Five personality

analysis framework is thus particularly suitable for an evolutionary personality investigation, like the one conducted here (Buss, 1996).

Subjects were required to rate to what extent a given adjective described them, on a 7-point scale. A set of 50 adjectives with high loading in each factor was used, according to the validation study with Italian subjects by Perugini and Leone (1994). This set belongs to a pool of adjectives widely used for personality assessment of Italian subjects (Di Blas & Perugini, 2002; Perugini & Di Blas, 2002) and further validated by another Italian group (Piconi, 1998). There were 10 adjectives for each of the five personality dimensions, five with positive and five with negative polarity. Individual scores were derived by summing all response values for each factor, after complementing the negative polarity adjectives. Then all individual scores were averaged in order to obtain values of the five dimensions for the sample population.

Subjects were interviewed in their original locations between 1997 and 2000, by home visits. A snowball method was used to cover most of the population (Cicchitelli et al. 1992). All subjects were interviewed by a team of trained interviewers (6 for Giglio, 7 for Ponza and Ventotene, 12 for the Aeolian islands), all unaware of the aims of the present study.

First theoretical issue:

Are there differences in personality traits between islanders and mainlanders?

The aim of this study was to establish whether such differences exist.

Methods

We compared a total of 993 islanders with their corresponding control group of mainlanders (n=598). Selected islanders had been born on their islands. Since many studies have shown a correlation between personality traits and sex, age and education level (Caprara et al., 1993; Feingold, 1994; Goldberg et al., 1998; Costa et al., 2001), a preliminary stepwise regression analysis was conducted (Table 2) and showed that living on islands - and, as expected, also sex, age and education level - had a significant effect on personality traits. Therefore, all the results reported hereafter refer to MANCOVA analysis of variance with sex, age, and education level as covariates.

(Insert Table 2 about here)

Results

After eliminating the effect of the above three variables, islanders turned out to have significantly different scores from those of control mainlanders: islanders had higher levels of

conscientiousness and *emotional stability* and lower levels of *extroversion* and *openness*. No significant difference was found as regards *agreeableness* (Fig. 2, Table 3).

(Insert Figure 2 about here)

All three archipelago/mainland population pairs showed a similar pattern of results. No significant differences among the three archipelago scores, standardised against mainland scores, were found for any personality trait ¹.

(Insert Table 3 about here)

Discussion

These results show that islanders from three distinct archipelagos isolated from each other share consistent, distinctive personality profiles. They differ from their respective mainlanders in being more *conscientious* and *emotionally stable*, and less *extroverted* and *open*. As expected, these differences were not very large, since all values fall within the range of the Italian population (Piconi, 1998); however, they were significant and consistently observed in all the archipelago/mainland population pairs studied.

These results were observed after adjustment for differences due to sex, age and education level, and therefore these variables cannot be advocated to explain them, nor can they be due to major cultural or linguistic differences, because our study was designed to compare only people coming from the same latitudinal, linguistic, cultural and ethnic groups, all sharing the same social norms, historical background, education system, media availability, religious beliefs, housing, food, and other facilities of the mainland. This differs sharply from the results of other studies, which compared populations geographically and ethnically or linguistically far apart (Lojk *et al.* 1979; Eysenck, 1982; Eysenck & Yanai, 1985). Lastly, the observed differences could not be explained by Wright's (1931) model of island founder effect and drift, according to which, when small populations isolated from each other are sampled, significant differences should be expected at random. This was why we studied three different archipelago/mainland population pairs. Unlike expectations according to a neutral founder effect or drift, we found the same differences in the same direction in all three populations. This suggests adaptive differences rather than neutral drift.

¹ A preliminary 3x2 MANCOVA, with Location (North vs. Centre vs. South) by Island/Mainland as factors, showed no significant differences in Big Five scores due to Location, and no significant interaction of Location by Island/Mainland, for any of the dimensions.

Second theoretical issue:

Are these differences explained only by an environmental hypothesis, or must a genetic one also complement them?

At least two different hypotheses may explain the differences in personality profiles listed above: i) they originated by prolonged exposure to peculiar situations producing phenotypic flexibility to the environment (*environmental hypothesis*, e.g., Newcomb et al., 1967); ii) they were progressively selected in the genetic structure of islanders (*genetic hypothesis*, e.g., Plomin et al., 1994).

When individuals who emigrated from the mainland at an early age and who lived on the islands for a long time are compared with islanders with long-lasting insular ancestry, different predictions arise from the two hypotheses. According to the *environmental hypothesis*, immigrants adjust their personality traits to those of islanders who have lived there for many generations, because they all share the common island environment. The *genetic hypothesis* assigns less importance to the environmental influence, and predicts that immigrants - by sharing their genotypes with the mainland population - also maintain the phenotypes of mainlanders' personality traits, being relatively untouched by the experience of island life. Therefore, their traits are distinguishable from those of islanders and similar to those of mainlanders, even if they have not shared the same environment with them since they emigrated.

Method

To test these hypotheses, we identified a subset of islanders from our total sample, termed *original islanders*. These subjects were not only born on the island but also all four grandparents were born there too. Since immigration to these islands is a recent phenomenon, subjects with all four grandparents from the island can confidently be considered to have long-lasting insular ancestry, as confirmed by parish registers. We then compared these original islanders (n=624) with immigrants (n=193 subjects, with no grandparents coming from the island, who immigrated at mean=22.37 years ago; st.dev.=15.50 years) and mainlanders (n=598). Data were analysed by MANCOVA, with age, sex and education level as covariates.

Results

Immigrants and mainlanders did not differ in any of the five personality dimensions (Table 3, Figure 3). This means that the personality profiles of individuals who emigrated or were born to people who had long emigrated from the mainland to the island did not differ from those of

mainlanders. In contrast, immigrants differed significantly from original islanders in three personality dimensions, being more *extroverted*, *agreeable* and *open* than islanders. Again, this pattern of results was similar in all three archipelago/mainland pairs.

(Insert Figure 3 about here)

Discussion

The similarity in personality profiles between immigrants and mainlanders does not confirm the *environmental hypothesis*, which predicts the flexibility of personality traits in response to environmental changes. However, we cannot rule out a variant of it, i.e., early experience may still influence immigrants, since some immigrants spent a few years on the mainland prior to moving to the island (Forgas and Van Heck, 1992). Immigrants may well have had early experiences in their mainland environment that influenced their personality profile, which was not subsequently influenced by island life. On the basis of our data, we cannot rule out the early experience possibility, and are planning a further study to compare these immigrants with individuals born on the island with two immigrant parents. Only by comparing these two immigrant populations can we finally clarify this point. Our data merely show that, once on the island, individuals who immigrate do not acquire the personality traits which characterise the original islanders, even though they have, on average, shared the same insular environment with them for over 20 years.

Scores on *extroversion*, *openness* and *agreeableness* were higher in immigrant descendants than in original islanders. These data are consistent with the *genetic hypothesis*, which predicts that even though all subjects have been living on the island for a very long time, immigrants and immigrant descendants do not acquire the original islander phenotype, except through inter-marriage.

Together with molecular evidence, these data strongly suggest that genetic factors influence personality. For instance, the molecular genetics of *extroversion* have been partly investigated. Ebstein et al. (1996) showed that long alleles of polymorphic exon III repeat sequences of the D4DR dopamine receptor gene on chromosome 11 are associated with high levels of a personality trait called *novelty-seeking* (Ebstein et al., 1996, 1997; Malhotra et al., 1996; Ono et al., 1997, Ekelund et al., 1999), for negative findings, see Herbst et al., (2000). Kluger et al., (2002), and Schinka et al., (2002) both carried out meta-analysis suggesting partially contradicting results. Benjamin et al. (1996) showed that *novelty-seeking* is positively correlated with *extroversion*. If confirmed, this would also clarify why individuals who emigrated from their original country are more novelty-seekers. Lynn (1981) was the first to note that nations like Australia, Canada and the

United States - whose populations are almost entirely made up of relatively recent immigrants - tend to have higher extroversion scores than the European countries from which they largely came. The absence of any significant differences between immigrants and immigrant descendants, original islanders and mainlander populations as regards *conscientiousness* and *emotional stability* does not distinguish among the two hypotheses, and the differences in these two traits between islanders and mainlanders still remain to be explained.

Third theoretical issue:

Which is the biological force by means of which these genetic differences were selected?

The aim of this study was to examine the process through which islander personality adaptation may take place. Adaptation occurs when the following three conditions are met: i) personality traits are inherited; ii) environmental conditions favour the selection of some but not other alleles influencing personality traits; iii) a process altering genetic frequencies is identified (Lohelin and Rowe, 1992).

As regards the first condition, heritability has been demonstrated in several empirical studies, including molecular, pedigree and twin studies (Bergeman et al., 1988; Tellegen et al., 1988; Cloninger et al., 1993; Plomin et al., 1994; Benjamin et al., 1996; Ebstein et al., 1996; Jang et al., 2002;). Second, the insular environment may provide specific conditions for highlighting possible personality adaptation, such as a long history of isolation, a restricted, harsh environment with well-defined boundaries, and a limited social environment. Third, a process which alters genetic frequencies may eliminate the less well adapted, through selective mortality, non-assortative mating or, again, through emigration and its consequent gene flow. It should be noted that the small but significant personality differences observed in our archipelago populations must have occurred over the last 20 generations. Historical documents reveal that these islands were subjected to severe attacks by Moorish pirates, who raided the whole Tyrrhenian coast from Sicily to Elba around 1580 A.D., after which all the small island populations were deported to Tunis, where they were sold as slaves. All the islands were subsequently repopulated around the end of the 16th century by the Grand Duke of Loreen (Giglio), the Roman Catholic State (Ponza and Ventotene) and the Bourbons (Aeolian islands). The typical repopulation procedure of those times was to force the populations of a few nearby mainland villages to resettle on the islands (Corvisieri, 1985; Roani Villani, 1993).

This negates the possibility that, right from the beginning, the personality traits of the founding populations on the islands were different from those of the original mainlanders. It is even more difficult to imagine that in all three archipelagos, all founding populations exhibited coincidentally similar patterns of extroversion and openness.

Chen et al. (1999) have advocated *selective mortality* to explain personality evolution. These authors examined large samples of populations world-wide, who had emigrated several thousand miles during human history (hundreds of generations). They suggest that people scoring high in novelty-seeking survived better in migrating societies, in which they could explore and exploit environments better, thus accumulating new resources essential to their improved survival. Conversely, sedentary populations obtained resources not by exploring new environments, but by developing intensive methods for using limited amounts of land (Netting, 1993). Within these societies, novelty-seeking and exploratory behaviour would involve increased mortality and would not be selected. Chen et al. (1999) hypothesise that differences between these populations were produced by slow Darwinian natural selection of differential mortality of less well adapted individuals in the two population types - a process expected to take place over hundreds of generations.

In contrast, we propose that gene flows explain the differences in the personality profiles shown in the present research, caused by large-scale emigration. If adaptation to the environment took place by means of a progressive gene flow after strong emigration, then we predict that islanders rapidly become less *extroverted* over a few generations. In effect, *extroverted* individuals like novelty-seekers (Benjamin et al. 1996) are expected to be more emigration-prone, since they have a more outgoing attitude and are more curious about new environments; thus, their alleles fade away, since they leave no descendants on the island. Islanders also become less *open to experience*, due to the fact that life on small islands is more repetitive than on the mainland, and individuals with high levels of *openness* find less cultural, social or intellectual stimulation in such confined spaces. All these factors may induce *extrovert* and *open* individuals to leave the island.

To summarise, if the *gene flow hypothesis* is correct, individuals who decide to leave the island (emigrants) differ in personality from islanders who do not emigrate and, by having different allele frequencies, gradually remove alleles influencing particular personality traits from the island population. In contrast, the *selective mortality hypothesis* entails a very slow process of average personality shift within each archipelago population, and does not predict any important differences in personality traits between emigrants and non-emigrants.

Methods

We compared the scores of personality traits in islanders who were born on the islands and then chose to emigrate (emigrants, n=209) with those of islanders born on the islands who decided to remain (non-emigrants, n=741; 43 other islanders did not respond and were excluded from analysis). The first two groups did not necessarily have all four grandparents from the island

(see second theoretical issue). The emigrants examined here were observed in their archipelago of origin during visits to relatives still living on the islands. It was not possible to locate and interview emigrants who had never returned to the island after emigrating. Each subject filled in an anonymous questionnaire on age, sex, place of birth, profession, education level, and emigration from the island, and were given the Big Five questionnaire. Data were analysed by MANCOVA with age, sex and education level as covariates.

Results

The population of individuals who emigrated from the small archipelagos were significantly more *extrovert* and *open* than islanders who did not emigrate (Figure 4, Table 3). Again, no significant difference was observed between the three archipelago populations and their corresponding mainland populations, as previously reported.

(Insert Figure 4 about here)

Discussion

We found that individuals who decided to emigrate from the islands are more *extroverted* and *open*. As regards the mechanism that alters the genetic frequency of personality traits, our data do not confirm the *selective mortality* hypothesis, which predicts no differences between individuals who emigrate and those who choose to remain. Further differential mortality between individuals with different personalities would entail several hundreds of generations to show a measurable effect - an excessively long time in our case (De Fabrizio, 2000). Wilson (1975) observed that, theoretically, it is possible to have measurable natural selective changes in as little as 40 generations in humans, but only in very small populations (a few dozen individuals) with extremely high mortality. In church records of births and deaths, dating back to the 16th century, De Fabrizio (2000) could not find any evidence of notably high infant mortality in the islands. However, by considering as emigrants all those individuals who were registered as having been born on the island but who were never registered as having died, this author suggests an average emigration rate per generation of around 30% of the population in the last 400 years.

Instead, the *gene flow* hypothesis does predict the observed differing personality profiles. In order to occur, gene flow requires three different conditions: i) environmental conditions induce emigration of individuals who are highly extroverted and open; (ii) those personality traits which resist changes make individuals more emigration-prone; iii) immigration in the population of new individuals is minimal. Given these conditions, if emigration is high, the gene flow will rapidly

drain the set of alleles influencing high *extroversion* and *openness* from the island's gene pool. Consequently, the remaining island population will become, on average, progressively less *open* and *extrovert*. In our case, emigration and gene flow are strong, as confirmed by the fact that we found that almost one-third of the sample population had emigrated in the last generation, confirming historical data (De Fabrizio, 2000). In contrast, immigration - which may have counteracted this flow effect - was historically virtually absent on these small islands until the last century (Roani Villani, 1993; De Fabrizio, 2000).

We can indirectly exclude the possibility that emigrants became more *open* and *extrovert* after emigration. Since people who emigrated from the mainland to the islands retained their original personalities, island emigrants should not change their personalities after emigrating to their new environment either (see also McCrae and Costa, 1999). These data suggest that individuals who emigrated from the three archipelagos were already more *extroverted* and *open*, rather than becoming so.

General discussion

There is conflicting evidence on the issue of personality differences among populations. To address this issue, we studied the populations of three Italian archipelagos and three corresponding sites on the mainland opposite the ten islands.

Populations from the islands were significantly different in four of the five personality dimensions, as shown by an adjective-based personality questionnaire designed to measure the Big Five personality traits. Islanders were less *extroverted* and *open to experience* and more *conscientious* and *emotionally stable* when compared with the corresponding mainland controls.

These results provide very strong support for the five-factor theory, which differs from other personality theories in its controversial claim that traits are endogenous, changing only in response to either intrinsic maturation or other biological inputs (McCrae & Costa, 1999).

This result cannot be considered a by-product of cultural and language differences, since the linguistic, ethnic, social norms and cultural environment of islanders were similar to those of the mainlanders used as controls, who all lived near the coast.

One limitation of our research is that we cannot exclude subtle cultural effects, like a widespread prejudice or stereotype between islanders and mainlanders, which might induce islanders to overestimate or underestimate their own traits. These would not be present in either immigrants or emigrants, since all these individuals were exposed to the genuine mainlander personality. At the present level of analysis, this interpretation cannot be excluded, but it seems unlikely for two reasons: first, we did not inform any islander that we were comparing them with

mainlanders, and, second, it is hard to believe that all three archipelagos, geographically isolated and far apart from each other, would just by chance show the same prejudice or stereotype, and in the same direction.

Addressing our second and third theoretical issues, we found that: i) immigrant descendants were more *extroverted* and *open* than original islanders; and ii) islanders who emigrated scored higher on *extroversion* and *openness* than islanders who stayed. We suggest that large-scale emigration of *extroverted* and *open* individuals caused a gene flow which drained the set of alleles influencing these traits from the island gene pool, and that this gene flow produced personality profiles which are adapted to the geographically and socially restricted island environment, in the sense that *closed* and *introverted* individuals do not leave, whereas *extroverted* and *open* individuals search for a new, more suitable environment rather than the insular one. According to evolutionary psychologists, subjects who have high scores on *extroversion* and *openness* are more likely to pursue short-term mating (Buss, 2003), and opportunities for short-term mating are probably much fewer on small islands than on the mainland. This may induce further emigration of *extrovert* and *open* individuals, thus promoting the gene flow. If confirmed, these findings may offer new perspectives to evolutionary psychologists, who are still puzzled by the existence of large individual differences in personality traits. Various proposals have been made to explain why most alleles influencing personality are generally not selected out of populations (Thiessen, 1972; Tooby and Cosmides, 1990; Buss, 1991, 1997, 1999; Mealey, 1995). Our research suggests that gene flow helps to explain why a large variety of individual personality differences are preserved in large populations with many different social and ecological environments available. The various alleles, which produce personality differences, seem to be very efficient at preserving themselves (Dawkins, 1977), since individuals with different personality traits actively search for a suitable environment (Barrick and Mount, 1991; Hettema and Kenrick, 1992; Scarr and McCartney, 1983; Tett et al., 1991). This explains why alleles influencing these personality traits are eliminated with difficulty through natural selection, thus preserving high population variability.

Only particular environments with very few alternative niches, such as the small islands in the archipelagos studied here or in other isolated communities, induce certain alleles to be drained from the gene pool, through emigration (gene flow), leaving only the best adapted individuals and thus highlighting the genetic component of personality differences at population level. In conclusion, although on one hand culture may have a marginal or even null influence on personality traits (e.g., Allik & McCrae, 2004a), on the other our study indicates that a genetic process of adaptation to particular restricted socio-ecological niches, through gene flow, produces measurable personality differences.

It should again be noted that differences in personality due to the island effect are small although significant (Table 3), but this was largely to be expected in a population study, as reported in recent large cross-cultural comparative samples (Terracciano et al., 2005). This is because we are dealing with personality traits which may be considered phenotypic but extremely variable and constantly influenced by the non-shared environment. Consequently, large individual variability increases variance and reduces the effect size of genetic differences (Bergman et al., 1988; Lang et al., 1998; Lohelin et al., 1998). However, islanders with progressively fewer grandparents born on the island (non-original islanders) differ from original islanders, showing traits closer to those of immigrants and mainlanders, even though all of them were born on the islands and had lived on them all their lives - thus further suggesting that at least a genetic influence on personality traits may be a biological fact. Obviously, the personality differences we found are small, far from being considered pathological, but still significant. According to Edwards' (2003) contention, a large individual difference does not obscure a significant difference between populations. Edwards (2003), highlighting Lewontin's (1972) fallacy, also stated: "It is a dangerous mistake to premise the moral equality of human beings on biological similarity, because dissimilarity, once revealed, then becomes an argument of moral inequality". This particularly applies to our population study on personality traits. Although we found that personality traits may be genetically selected and that some populations show adaptation of these traits to different environments, this does not at all mean that these populations are not morally equal.

We acknowledge that this is only a preliminary study, providing no conclusive genetic evidence; only further replications in similarly isolated populations can confirm our findings. Our conclusions are tentatively based on indirect evidence obtained using classical methods of population genetics, which may be validated by direct DNA analysis. At present, a direct genetic test for this type of finding still awaits detailed investigation.

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Table 1. Number of subjects studied, by origin, geographic location, gender and age.

Origin	Geographic Location	Young		Age Adult		Elderly		Total	
		M	F	M	F	M	F	M	F
MAINLANDERS*	Gender								
	North	27	23	51	35	34	15	112	73
	Centre	33	29	37	28	27	15	97	72
	South	71	59	48	31	22	13	141	103
	Sub-total	131	111	136	94	83	43	350	248
IMMIGRANTS**	North	2	2	6	3	1	1	9	6
	Centre	7	8	20	13	8	4	35	25
	South	15	9	38	32	14	10	67	51
	Sub-total	24	19	64	48	23	15	111	82
NON-ORIGINAL ISLANDERS***	North	8	7	14	17	3	1	25	25
	Centre	25	33	31	20	18	18	74	71
	South	41	40	39	27	18	9	98	76
	Sub-total	74	80	84	64	39	28	197	172
ORIGINAL ISLANDERS****	North	9	9	26	14	14	4	49	27
	Centre	52	39	50	53	37	38	139	130
	South	53	43	72	50	36	25	161	118
	Sub-total	114	91	148	117	87	67	349	275
	Total							1784	

* Subjects resident and born in three villages facing each archipelago.

** Subjects resident in archipelago with no grandparents born on islands.

*** Subjects resident in archipelago with 1 to 3 grandparents born on islands.

**** Subjects resident in archipelago with 4 grandparents born on islands.

Table 2. Preliminary stepwise regression. Significant effect of age, sex and education level on most personality traits.

	<i>Step</i>	<i>Variable</i>	<i>Std. Beta</i>	<i>Sig.</i>	<i>Partial correl.</i>	<i>R² change</i>	<i>Adjusted R²</i>
EXTROVERSION	1	age	-.221	.000	-.221	.052	.051
	2	island/ mainland	-.064	.015	-.065	.004	.054
AGREEABLENESS	1	gender	.171	.000	.174	.023	.023
	2	age	.190	.000	.183	.019	.041
	3	illiterate	-.156	.000	-.157	.024	.064
CONSCIENTIOUSNESS	1	age	.319	.000	.321	.102	.102
	2	gender	.107	.000	.113	.012	.113
	3	island/ mainland	.072	.004	.077	.005	.117
EMOTIONAL STABILITY	1	gender	-.274	.000	-.277	.078	.077
	2	age	.090	.001	.092	.011	.088
	3	secondary school	-.059	.025	-.060	.003	.090
	4	island/ mainland	.055	.032	.058	.003	.092
OPENNESS	1	age	-.312	.000	-.318	.131	.130
	2	high school	.206	.000	.212	.032	.162
	3	university	.154	.000	.166	.028	.188
	4	gender	-.102	.000	-.114	.011	.198
	5	island/ mainland	-.077	.002	-.085	.006	.204

N=1377 (214 subjects with missing data on any variable were excluded listwise from analysis).

DF (total) for all models: 1376.

Gender code: 0 = male, 1 = female.

Table 3. MANCOVA analysis of variance, with age, gender and education level as covariates. Effect sizes (Cohen's *d*) for each comparison also reported**.

		<i>N</i> (*)	EXTROVERSION			AGREEABLENESS			CONSCIENTIOUSNESS			EMOTIONAL STABILITY			OPENNESS		
			<i>d</i>	<i>F</i>	<i>Sig.</i>	<i>d</i>	<i>F</i>	<i>Sig.</i>	<i>d</i>	<i>F</i>	<i>Sig.</i>	<i>d</i>	<i>F</i>	<i>Sig.</i>	<i>d</i>	<i>F</i>	<i>Sig.</i>
1	Islanders/	923 (70)	-.17	4.46	.035	.00	0.76	.385	.21	9.65	.002	.10	5.26	.022	-.24	9.04	.003
	Mainlanders	454 (144)															
2	Immigrants /	173 (20)	.20	5.56	.019	.23	6.65	.010	-.05	0.30	.584	.04	0.40	.528	.33	12.97	.000
	Original Islanders	576 (48)															
	Immigrants/	173 (20)															
	Mainlanders	454 (144)															
3	Original Islanders/	576 (48)	-.22	7.33	.007	-.01	0.50	.478	.21	6.37	.012	.14	5.71	.017	-.32	11.32	.001
	Mainlanders	454 (144)															
3	Emigrants/	196 (13)	.09	5.69	.017	.10	1.18	.278	.04	0.69	.408	.15	0.41	.840	.01	8.04	.005
	Non Emigrants	700 (41)															

* Subjects with incomplete data on any covariate were excluded listwise from analysis.

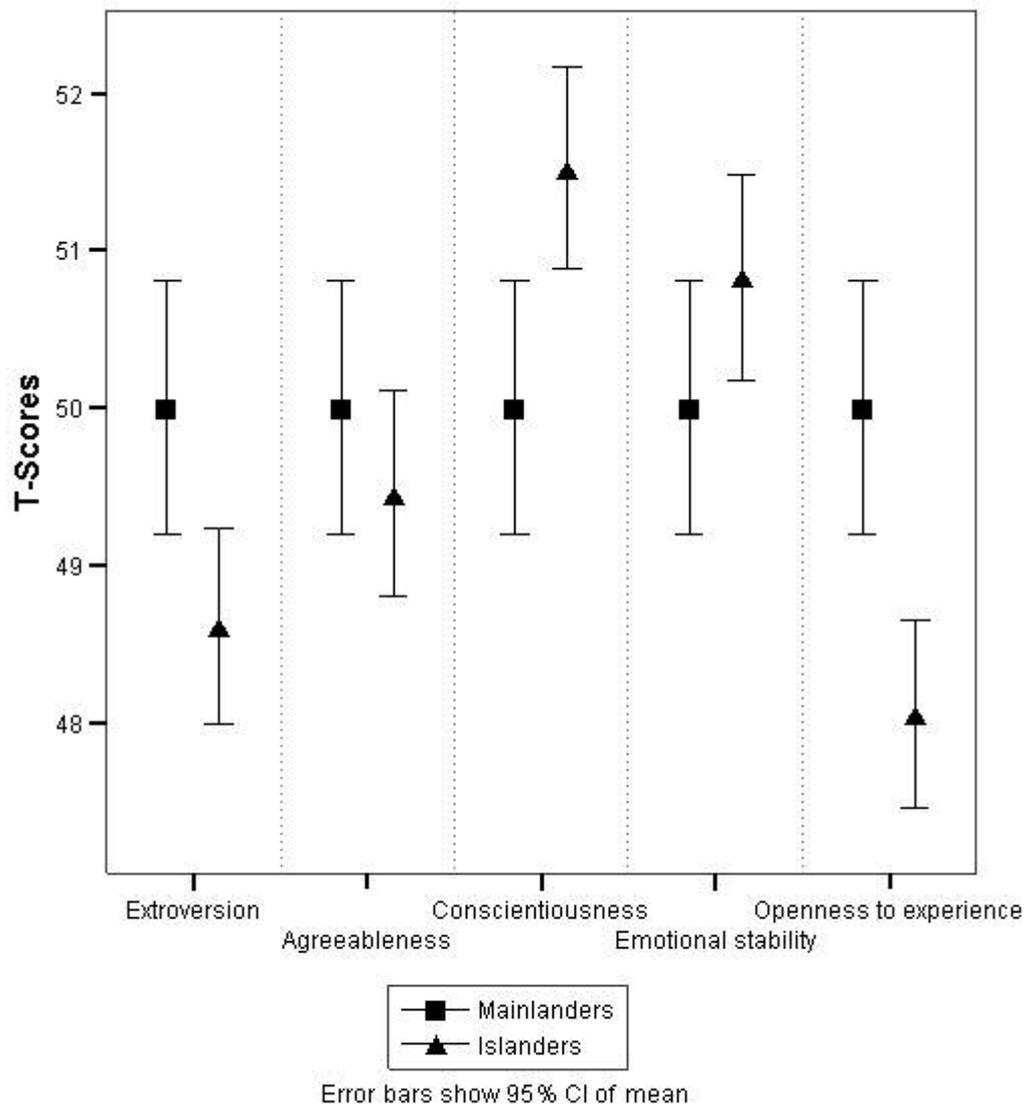
** Cohen's *d* is a univariate effect size measure, MANCOVA eliminates effect of covariates, thus explaining how a small effect (according to *d*) may be significant in MANCOVA (and vice versa), as in our third comparison. By eliminating the effect of different group compositions by age, gender and education level, the multivariate model reveals the significant difference of *openness* between emigrating and non-emigrating islanders, unidentifiable by group means (47.65 vs. 47.56) and undetected by the effect size calculated by univariate statistic ($d=.01$). In particular, people who emigrated were mostly men (66%), 11 years older and had lower education level than non-emigrants.

Figure 1. Geographic location of three archipelagos in the Italian Tyrrhenian Sea.

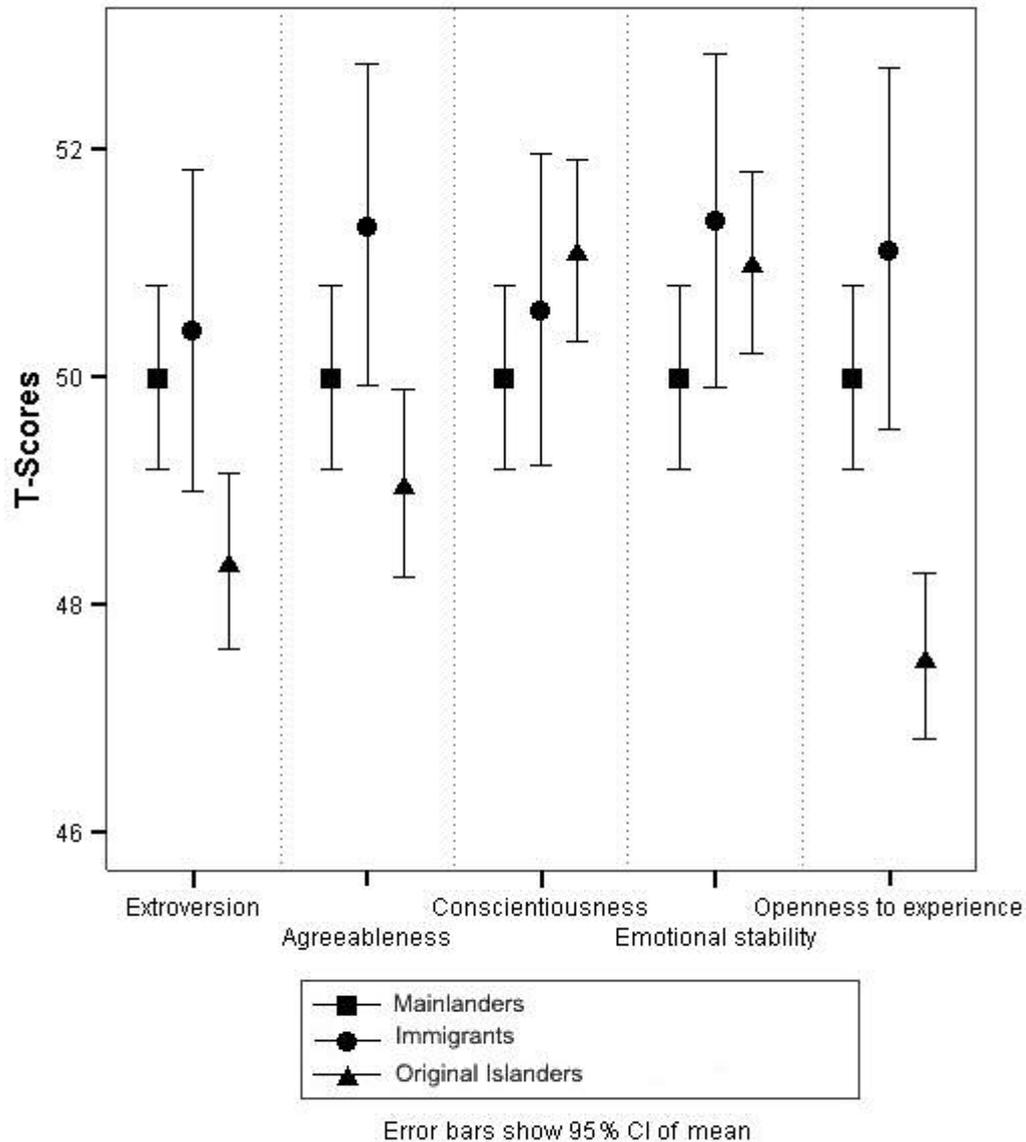


Island populations studied were: Giglio (northern archipelago), Ponza and Ventotene (centre), and all seven Aeolian islands (south).

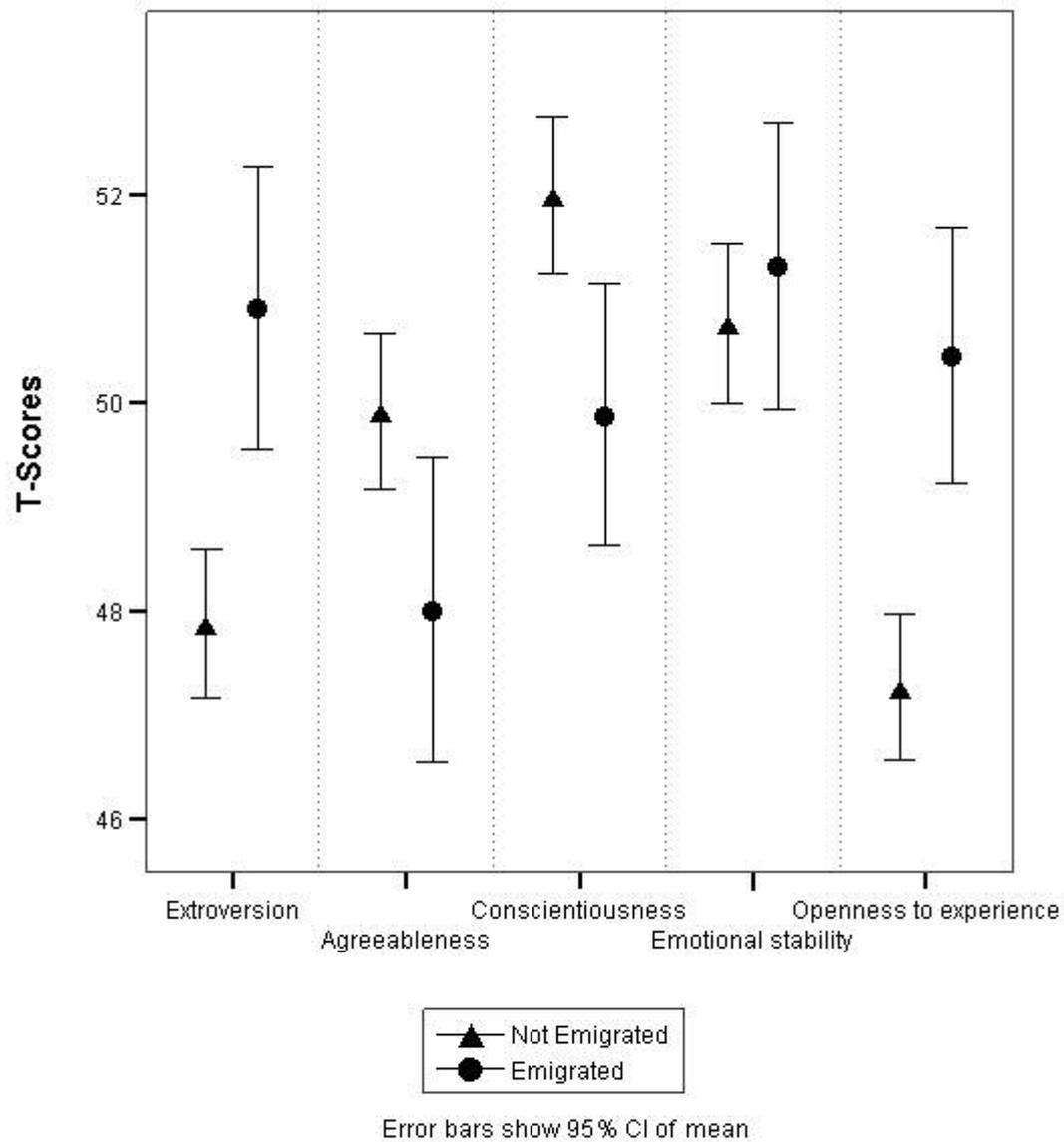
Each archipelago was matched with one small mainland village facing the islands: Castiglione della Pescaia (facing the northern archipelago, at a distance of 25 sea miles), Gaeta (facing central archipelago, at 30 miles) and Milazzo (facing southern archipelago, 20-40 miles).

Figure 2. Big Five scores of islanders and mainlanders.

Means and confidence intervals for each personality trait. Personality test scores are given as T-scores. T-scores reported here were corrected for age, gender and education level. Mainlanders=598, Islanders=993.

Figure 3. Big Five scores of immigrants, original islanders and mainlanders.

Means and confidence intervals for each personality trait. Personality test scores are given as T-scores. T-scores reported here were corrected for age, gender and education level. Mainlanders=598, immigrant islanders=193, non-original islanders=369, original islanders=624.

Figure 4. Big Five scores of emigrants and non-emigrants.

Means and confidence intervals for each personality trait. Personality test scores are given as T-scores. T-scores reported here were corrected for age, gender and education level. Emigrants=209, non-emigrants=741.