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New evidence for differences in fluid intelligence between north and south Italy and against school resources as an explanation for the north–south IQ differential

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ABSTRACT

The north–south difference in Italy in PISA 2006 scores in reading comprehension, mathematical and science abilities of 15-year-olds has been attributed by Lynn (2010a) to a difference of approximately 10 IQ points in intelligence and by critics to differences in educational resources. New evidence for differences between north and south Italy in the PISA 2012 Creative Problem Solving test as a measure of fluid intelligence shows a 9.2 IQ point between the north–west and the south and confirms Lynn's theory. New data are presented for genetic differences between the populations of north and south Italy.

1. Introduction

It has been proposed by Lynn (2010a) that there is a north–south gradient of intelligence in Italy such that average IQs are approximately 10 IQ points higher in the north than that in the south. This conclusion was based largely on the 2006 PISA (Program for International Student Assessment) data for the reading comprehension, mathematical and science abilities of 15-year-olds in 52 countries and 12 Italian regions. The justification for the use of these scores as a proxy for intelligence has been given by Rindermann (2007, 2008), who has shown that they are highly correlated with IQs across nations. Lynn proposed that these north–south differences in IQs in Italy explain much of the differences in average incomes, literacy, education, stature, infant mortality and the numbers of individuals who have achieved eminence in the arts and sciences.

Lynn's thesis has been criticized by Beraldo (2010), Cornoldi, Belacchi, Giofre, Martini, and Tressoldi (2010), Felice and Giugliano (2011) and Cornoldi, Giofrè, and Martini (2013) on the grounds that the PISA scores for reading comprehension, mathematics and science are measures of educational attainment determined by differences in teaching quality and educational resources and cannot be used as measures of intelligence. These critics have been answered by Lynn (2010b), who gave data for Raven's Progressive Matrices and an Internet test showing IQs in the north approximately 10 points higher than in the south, and by Lynn (2012a) who presented data from PISA 2009 and from the INVALSI study of math and language abilities providing futher evidence for higher cognitive abilities in the north.

Lynn's thesis has also been criticized by Robinson, Saggino, and Tommasi (2011) on the grounds that tests reading and math show much smaller north–south differences and by D'Amico, Cardaci, Di Nuovo, and Naglieri (2012) that other cognitive tests show no north–south differences. In a more recent paper, Cornoldi et al. (2013) presented data showing that the north–south difference in PISA 2009 was smaller than in PISA 2006, which they attributed to an improvement in schools in the south, and they also presented data showing that

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north–south differences in language and math abilities in the INVALSI study varied among the second, fifth, sixth and tenth grade school students from −0.03 to 0.33*d* (SD units) averaging 0.15 equivalent to 2.25 IQ points. Cornoldi et al. (2013, p. 29) conclude their discussion of the studies of north–south differences in Italy in intelligence and educational attainment by observing that "variations in the different studies are so high to legitimate radically different conclusions, suggesting that further evidence is needed to reach unquestionable conclusions."

Lynn (2010a) argued further that the north–south IQ differences in Italy are attributable in part to immigration from North Africa and the Middle East in the more southerly regions in historical times, and that the genetic legacy of this has been to reduce the IQs of the populations. This hypothesis has been supported by Templer (2012), who showed that there are significant genetic differences between north and south Italy with higher percentages of the population with black hair and eyes in the south indicating greater admixture of North African and Middle Eastern genes. This hypothesis has been further supported by Lynn (2012b) in a study showing that north–south differences in intelligence are also present in Spain with the north having higher IQs, educational attainment, per capita income, literacy, life expectancy and employment and lower frequencies of alleles of the Near East and North Africa.

In this paper, we present new data that provide a test of Lynn's (2010a) hypothesis that the north–south difference in Italy in PISA scores in reading comprehension, mathematical and science abilities of 15-year-olds are attributable to differences in intelligence and the competing hypothesis of critics that they are attributable to differences in educational resources, and of Lynn's hypothesis that the north–south difference in intelligence is attributable in part to greater genetic admixture in the south from Near East and North Africa.

2. Methods

The OECD (2014) has recently published data for 2012 for the performance of 15-year-old students in the PISA Creative Problem Solving, a measure of the ability to solve problems in "non-routine situations" defined as "situations that require at least 30 minutes to find a good solution" (p. 26). The solution of these problems requires the ability "to think flexibly and creatively about how to overcome the barriers that stand in the way of a solution" (p. 26). A "ready-made strategy" or a mastery of facts and procedures is not sufficient for the solution of these problems. The Creative Problem Solving test assesses "students' general reasoning skills, their ability to regulate problem-solving processes, and their willingness to do so, by confronting students with problems that do not require expert knowledge to solve." The test measures the ability to solve problems in "situations that students may encounter outside of school as part of their everyday experience" (e.g., technology devices, unfamiliar spaces, food or drink) (p. 31) and "an individual's capacity to engage in cognitive processing to understand and resolve problem situations where a method of solution is not immediately obvious" (p. 32) involving "scenarios related to real life problems" in the four areas described as technology, non-technology, personal and social. For example, in a technological problem, the student is given a technological device and has to figure out how it works and which buttons have to be pressed to change the volume or change the type of music (e.g., "Describe how you could change the way the MP3 player works so that there is no need to have the bottom button," "Find whether each control influences temperature and humidity by changing the sliders" and "Use the controls to set the temperature and humidity to the target levels"). In a non-technological and social problem, the student is given a map showing travel time on each section of a road. An example item is "Pepi is at Sakharov and wants to travel to Emerald. He wants to complete his trip as quickly as possible. What is the shortest time for his trip?" In terms of Cattell's (1971) concepts of fluid and crystallized intelligence, the Creative Problem Solving test is a measure of fluid intelligence defined as the ability to think logically and solve problems in novel situations, independent of acquired knowledge, while the PISA tests of reading comprehension, mathematical and science abilities are measures of crystallized intelligence.

3. Results

The mean scores of student performance on the Creative Problem Solving test for five Italian macro-regions extracted from OECD (2014, Table v2.b2, p. 226) are given in Table 1. The five Italian macro-regions consist of the northeast (Bolzano, Emilia Romano, Friuli Venezia, Tentino and Veneto), the northwest (Liguria, Lombardy, Piedmont and Valle d'Aosta), the center (Marche, Lazio, Tuscany and Umbria), the south (Abruzzo, Campania, Molise and Puglia) and the South Islands (Sicily and Sardinia, and—curiously—Basilicata and Calabria).

Table 1 gives the mean scores, standard errors and standard deviations for the five Italian macro-regions in the PISA creative problem solving test, followed by the scores converted to "Greenwich IQs," calculated with the British mean = 517 and SD = 96 (the OECD average) equal to an IQ of 100 and SD = 15. The formula for the conversion to Greenwich IQs is thus $[(X - 517) / 96] \times 15 + 100$, where X is the PISA score. The right-hand column headed PISA-RMS 2006 gives the Greenwich IQs for approximately the same regions for the PISA 2006 results for reading, mathematics and science calculated from the data given in Lynn (2010a).

The OECD report states that the number of students tested in Italy was approximately 1,300 but does not give the numbers for the five regions, so it is not possible to calculate the statistical significance of the differences between the regions. Nevertheless, it will be seen that there are substantial differences of around 8 IQ points between the highest mean scores in the two northern regions and the lowest scores in the south and south islands.

Table 1
Mean scores, standard errors and standard deviations and Greenwich IQs in student performance in the Italian regions in the PISA creative problem solving test (PISA-CPS 2012) and Greenwich IQs in student performance in the PISA 2006 tests of reading, mathematics and science (PISA-RMS 2006).

Italian regions	Mean score (SE)	SD	PISA-CPS 2012	PISA-RMS 2006
Northeast	527 (6.4)	91	101.56	101.25
Northwest	533 (8.6)	83	102.50	99.00
Center	514 (10.8)	93	99.53	—
South	474 (8.4)	82	93.28	91.00
South Islands	486 (8.5)	90	95.15	90.30

Table 2 shows the mean score regional differences for the low and high (5th and 95th) percentiles. It will be seen that the north–south gradient is present at both these percentiles. The biggest difference among the regions for the 5th percentile is 53 (north–west–south islands), and for the 95th percentile (north–east–south) is 66.

Table 3 shows the relative performance of Italian students in the five regions compared with students in the other countries with similar scores in reading, mathematics and science in the PISA 2012 tests (i.e., "the difference between the actual performance and the fitted value from a regression using a second-degree polynomial as regression function") extracted from OECD (2014, Table B2.v3). It can be seen that in all five regions, the Italian students score relatively better at the Creative Problem Solving test than at the reading, mathematics and science tests.

4. Discussion

There are seven points of interest in this study. First, the results confirm Lynn's (2010a) thesis that there is a difference of approximately 10 IQ points in intelligence in Italy between the north and the south. In his first paper, Lynn (2010a) estimated a difference of 10.25 IQ points between the northwest and the south; in his second paper, Lynn (2010b) presented data for an intelligence test and estimated a difference of 12.7 IQ points between Friuli-Venezia in the northeast and Sicily in the south, and in the present paper, we estimate a difference of 9.20 IQ points between the northwest and the south. Scores for individual regions were not published, but it is to be expected that the difference between the highest and the lowest scoring region is greater than the differences between the macro-regions, as within each macro-region there are small differences between individual regions.

Second, the present results provide a test of the competing hypotheses that the north–south differences in cognitive ability in Italy found in the PISA 2006 scores for reading comprehension, mathematics and science are measures of educational attainment determined by differences in educational resources, as argued by Beraldo (2010), Cornoldi et al. (2010), Felice and Giugliano (2011) and Cornoldi et al. (2013) and by Lynn's (2010a) thesis in that the PISA scores are measures of intelligence. The present results showing that the north–south difference in cognitive ability is present in the PISA 2012 Creative Problem Solving test as a measure of fluid intelligence designed to be independent of the school curriculum and educationally acquired knowledge supports the Lynn hypothesis.

Table 2
Mean scores in student performance in creative problem solving in the bottom (5th) and top (95th) percentiles in Italian regions.

Italian regions	Bottom (5th)	Top (95th)
Italy: all	356	649
Northeast	367	665
Northwest	392	661
Center	345	653
South	344	599
South Islands	339	634

Table 3
Relative performance of Italian regions in creative problem solving and in reading, mathematics and science (PISA 2012).

Regions	Actual minus expected score (SE)
Northeast	4 (4.9)
Northwest	15 (8.4)
Center	11 (7.2)
South	10 (7.5)
South Islands	9 (8.2)

Third, there is now a substantial body of research showing that the IQ in the north of Italy is approximately 10 points higher than in the south. This has been reported for the PISA 2006 and PISA 2009 tests of reading comprehension, mathematics and science minimizing knowledge of the curriculum (Lynn, 2010a, 2012a), Raven's Progressive Matrices and an Internet test of intelligence (Lynn, 2010b), and the PISA 2012 Creative Problem Solving test of fluid intelligence (this study). The north–south differences are smaller on tests of reading and math cited by Robinson et al. (2011) and in the INVALSI study in which they average only 0.15*d* (SD units) (Cornoldi et al., 2013). Thus, children in the south perform much better on tests of educational attainment measured in the INVALSI study than they perform on tests of intelligence. These results suggest that poor educational resources in the south, including the poorly trained teachers cited by Cornoldi et al. (2013, p. 30), make only a minor contribution to the lower performance in cognitive tests.

Fourth, the results given in Table 1 show that the Italian students scored slightly higher in the PISA 2012 Creative Problem Solving test than in the PISA 2006 reading comprehension, mathematics and science tests. To the extent that the skills required to solve novel complex problems are less reliant upon knowledge and cognitive strategies acquired through formal instruction, this suggests that Italian students do not perform at their full potential in the reading, mathematics and science tests, and this may be attributable to poorer teaching quality.

Fifth, the data given in Table 2 show that the north–south gradient in PISA scores for creative problem solving ability is present not only in the means (shown in Table 1) but at the high level of ability represented by the 95th percentile and at the low level of ability represented by the 5th percentile. The north–south differences at the lowest and highest percentiles (5th and 95th) are of similar magnitude, although there is a tendency for scores at the higher percentiles to show a greater difference between north and south compared to the difference at the lowest percentiles (66 vs 53).

Sixth, the results provide data on the theory that selective migration from the south to the north may have contributed to the north–south IQ disparity. There has been massive migration from the poor south to the wealthy north, particularly in the 20th century, and several studies have shown that migrants from poor regions to more affluent regions have above average IQs. For instance, Tolnay (1998) and Vigdor (2002) have reported that in the United States, Blacks who migrated from the southern states to the northern states had greater educational attainment (a proxy for intelligence) than those who remained in the south, and Maxwell (1967) reported that

emigrants from Scotland had an IQ of 8.1 points higher than that of the population.

In Italy, migration from the south has been largely to the metropolitan areas and cities of Milan, Turin and Genoa in the northwest. The data given in Table 1 show that there was little difference in IQs between northwest and northeast in the creative problem solving ability results (102.50 and 101.56, respectively), while in the PISA 2006 IQs for reading comprehension, mathematics and science the northeast scored 2.25 IQ points higher than the northwest (101.25 and 99.0, respectively). Taking the two results together shows there is virtually no difference between the IQs in the northwest and northeast. This suggests that migrants from southern Italy have not affected the IQ of the population of the northwest. It may be that in Italy, selective migration from the south to the northwest has reduced the IQ in the south. A likely scenario is that migrants from the south to the northwest had an average IQ about the same as that of the northwest. This would have lowered the IQ of the populations in the south and left the IQ of northwest unchanged. This scenario implies that the historic IQ differences between north and south Italy documented by Lynn (2010a) have been increased by selective migration.

Seventh, there are new data that bear on the theory proposed by Lynn (2010a) that genetic admixture with North African and Middle East peoples in the population of south Italy has been responsible for the lower IQ in the south. These new data suggest that admixture with African populations is unlikely as an explanation because southern Italians have only around 1% of African genes (compared to near zero for northern Italians) (Eurogenes K13), but recent data have confirmed that the percentage of Middle Eastern and South West Asian genes inferred from Eurogenes K13 (East Med + Red Sea + West Asian) is higher in the south (31.82 + 5.12 + 15.02 = 51.96%) than that in the north (19.58 + 2.78 + 6.9 = 29.26%). Conversely, the percentage of North European (Western European + Baltic) genes in the north (31.67 + 11.92 = 43.59) is higher than in the south (16.71 + 5.91 = 22.62%) (Eurogenes K13).

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