

Cognitive function among the Ainu people

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ABSTRACT

The Ainu are an ethnic minority in northern Japan. Their overall IQ was estimated to be somewhat below that of the Japanese (97.2) from the meta-analysis of mostly pre-war Japanese data ($N = 975$). Moreover, they may have higher cranial capacity than Japanese and their IQ profile is leaning toward non-verbal skills, which suggest a genetic relationship to Arctic peoples.

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1. Introduction

The Ainu are an ethnic minority who are indigenous to Hokkaido and parts of Russia, such as Sakhalin and the Kuril Islands. Although these lands were inhabited by the Ainu for a thousand years, the imperial governments of nineteenth-century Russia and Japan annexed their territory and they were forced to gradually assimilate into Japanese or Russian societies. Hence, there are few extant materials about the estimated intelligence level of the Ainu that are readily available to IQ researchers. This paper examines and integrates most available data about the IQ and measured cranial capacity of the Ainu, together with information on their current academic and economic performance. The genetic relationship between Ainu and Arctic peoples, such as the Mongol-Tungus has been especially focused on.

Before we delve into the available data and psychological characteristics of the Ainu, let us briefly review their history. Archaeological and genetic studies suggest that the Ainu formed their own ethnic culture from two distinct traditions;

first, the hunter-gatherer Okhotsk culture from the sixth to the tenth centuries, which originated in Sakhalin and the Amur River Basin (Lee & Hasegawa, 2013; Sato et al., 2007; Sato, Amano, Ono, Ishida, & Kodera, 2009) and second, the agriculture-oriented tradition of the Satsumon or epi-Jomon cultures, which were directly descended from the earlier Jomon Japanese culture (Tajima et al., 2004). Although the Ainu sporadically appeared in Japanese historical documents from the seventh century, they were described in the thirteenth century as invaders of the Nivkhi land (Amur River Basin), which was controlled by the Yuan Dynasty of China at the time. The Ainu battled the Mongol army in 1264, and later lived mostly in what is now Hokkaido, Sakhalin and the Kuril Islands. They had their own spoken language, mythology, and animistic religion, but no written language. They also traded with Japan until the latter half of the eighteenth century, when imperial Japan confiscated their land and forced them to assimilate (Nakamura, 1997, 2010). In 1873, the Japanese government registered 18,644 Ainu individuals as Japanese citizens.

After that, there was extreme discrimination against the Ainu, and they were forced to assimilate. In 2008, only 23,782 Japanese citizens identified themselves as Ainu, although at least several times more mixed-blooded Ainu were estimated

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to be living in Hokkaido and Tokyo ([Hokkaido Prefectural Government, 2006](#)).

2. Methods

In this paper, we utilized nine research results from five databases ([J-STAGE](#); [NDL-OPAC](#); [Webcat Plus](#); [CiNii-Books](#); [Web of Science](#)) in addition to a separate, nonsystematic review of Ainu IQ conducted by the second author. Five of these results ([Kubo, 1926](#); [Porteus, 1937](#); [Tanaka, 1939](#); [Ishibashi et al., 1942](#); [Hilger, Klett, & Watson, 1976](#)) are IQ estimates ($N_s = 22 - 1,158$).

2.1. Direct estimates of Ainu IQ

After World War II, there was a backlash against pre-war racism that led to IQ tests being effectively abandoned by Japanese psychologists. For the current estimates of the Ainu IQ, we used proxies of academic performance, such as high-school graduation and college entrance ratios, and average household income. These statistics were obtained from “Ainu Report: The Hokkaido Ainu Living Conditions Survey” published in 2012 by Hokkaido University.

[Kubo \(1926\)](#) was the first researcher to investigate Ainu children with his translation of a standardized intelligence test. In July 1924, he conducted the test with 53 Ainu students (24 males, 29 females) in the small village of Shirahama in Sakhalin and with 49 Japanese controls (21 males, 28 females) from a similar small school in the same region. His test consisted of eleven subtests. The first six were non-verbal, similar to the Army Beta in the US, and the latter five required linguistic knowledge, similar to the Army Alpha. He reported only the mean scores and average deviations from the respective means of Ainu and Japanese children in a tabular form, without calculating the IQ. Therefore, we derived IQ estimates by utilizing the average raw scores and standard deviations for 12 student categories (grades 1–6 for Ainu and Japanese). For each grade, the N -weighted average of the standard deviations in both ethnicities was calculated to make an overall standard deviation of the grade. This common standard deviation for each grade was then used to compute the Ainu IQ. Finally, the N -weighted average of these IQ scores of six grades was calculated for an overall Ainu IQ estimate.

When calculating IQ estimates in comparison with Japanese controls, in this study, we calculated the Ainu IQ by assuming the local Japanese IQ to be 104 ([Lynn, 2006](#); [Lynn & Vanhanen, 2006, 2012](#)). Justification for using this method, rather than the absolute IQ of the Ainu, is explained below.

[Porteus](#) estimated the Ainu IQ using the Porteus maze test, which was explained in [Porteus \(1950\)](#). The test was administered to 93 Ainu (9 boys, 17 girls, 51 men, 16 women) and the results were reported in [Porteus \(1937\)](#). He presented the IQ scores for each category of Ainu subjects, whereas we have calculated IQs for the Ainu as a whole using N -weighted means across the different categories of Ainu.

[Tanaka \(1939\)](#) reported the IQ estimate of 172 Ainu students (45 pure-blooded boys, 50 pure-blooded girls, 30 mixed-blooded boys, 47 mixed-blooded girls) from 14

schools in the 4 regions of Hokkaido, and he tested 1174 Japanese students as control sample. He had developed his own nonlinguistic Tanaka–Binet Intelligence Test, which was standardized with the student samples in the mainland. Although both Ainu and Japanese students in rural Hokkaido scored much lower than those in urban mainland cities, the Ainu's performance was lower than that of the Japanese. We calculated the Ainu IQ estimate from the averages and standard deviations of these Hokkaido samples.

[Ishibashi et al.'s \(1942\)](#) study was the largest and most thorough on the IQ of the Ainu. A team of professional medical scholars administered four tests to students in 48 schools throughout Hokkaido and Sakhalin. These students included 1158 Ainu (788 pure-blooded, 370 mixed-blooded) and 1321 Japanese controls, tested from July 1934 to July 1936. They administered the Goodenough Drawing Test to students in the first and second grades (ages 6–8). Because they reported only the raw scores of each ethnic and age group, we calculated Ainu IQ estimates by comparing the averages and standard deviations for each age group. They conducted four types of tests for the students from third to ninth grades (ages 8–14). The first was the National Intelligence Test, which was widely used in Japan at the time. This test was designed to measure subjects' verbal ability. The second was the Kraepelin addition test, which required subjects to simply add two numbers printed on the test sheet for 20 min. The third was the intelligence test by Kirihara, which was intended to measure spatial and logical ability independent of verbal knowledge. This test provided a different estimate of the Ainu IQ from that of the National Intelligence Test. The interpretation of this discrepancy is discussed in detail in the following chapter. The fourth test was the Bourdon test, which requires subjects to cross out as many letters as possible. All of these four tests were included in our review.

Finally, [Hilger et al. \(1976\)](#) administered the Goodenough–Harris Drawing Test to 22 Ainu and 30 Japanese children in Hokkaido; all children were six years old. The paper reported the average scores and the standard deviations of Ainu and Japanese, from which we calculated the IQ estimate.

2.2. Ainu cranial capacity

[Koganei \(1894\)](#) reported the average capacity of 76 adult male and 51 adult female Ainu crania. [Kodama \(1970\)](#) collected 121 Ainu crania from seven regions and compared them with those from mainland Japan (Osaka–Kyoto region). He also obtained 19 cranial weight datapoints from autopsies.

2.3. Ainu educational achievement

The Center for Ainu and Indigenous Studies at Hokkaido University published, “Ainu Report: The Hokkaido Ainu Living Conditions Survey,” ([Onai, 2010](#)). This survey was administered to 3438 households (8685 individuals included) and 7306 individuals previously identified as Ainu. In total, the subjects included approximately 40% of the Ainu population in Hokkaido. Of these potential subjects, 2903 households and 5703 individuals returned the questionnaires.

3. IQ test results

3.1. IQ estimate of the Ainu

To date, five research results were weighted with their respective numbers of subjects and averaged to obtain the overall IQ estimate of the Ainu people (Table 1). Of these five studies, Tanaka (1939) and Ishibashi et al. (1942) had a distinct category of mixed-blooded individuals. It seems to have been highly consistent that Ainu IQ estimates were several points below those of the Japanese. Except for the Goodenough test in Ishibashi et al. (1942), Japanese scores and pure-, and mixed-blooded Ainu scores were in the expected order. The differences between pure Ainu and Japanese were significant at .001 levels.

The IQ estimates in the previous section were calculated under the assumption that Japanese control students had an IQ of 104, as estimated in Lynn and Vanhanen (2012). However, all of the Japanese papers (Kubo, Tanaka, Ishibashi et al.) found substantial gaps in IQ scores between Japanese students in the cities and those in rural areas. Moreover, they suggested that the Ainu IQ should only be compared with the regional controls to obtain precise estimates. Table 2 shows these considerable differences.

On average, IQ of Ainu was 71.7, while that of the Japanese in the same regions was 82.6 when compared with the control subjects from the mainland, who were the original standardization samples of these IQ tests. It is noteworthy that scores in Kubo's study (1926) were well below the others. Although Kubo's research was 10 years older, the discrepancy is probably because the scores were obtained from an extremely primitive village in Sakhalin. Poor cognitive stimuli with a simple and monotonous life, insufficient food with low nutritional value, micronutrient deficiencies, environmental poisonings, and prevalent parasites and infectious diseases are known to cause depressed IQs among the most disadvantaged villages. These problems, however, had been overcome by the turn of this century, since a single IQ gradient exists from north to south and no gradient from urban to rural (Kura, 2013). This is why we used the relative and not absolute IQ of the Ainu.

3.2. IQ profile of the Ainu

Table 3 shows their IQ profile of the Ainu obtained from Kubo and Ishibashi et al., both of which examined verbal and

Table 1
IQ estimates of the Ainu.

Reference	Pure Ainu (n)	Mixed-Ainu (n)	n of Japanese controls
Kubo (1926)	97.6 (54)	–	49
Porteus (1937)	94.7 (93)	–	–
Tanaka (1939)	93.0 (95)	93.7 (77)	1174
Ishibashi et al. (1942) ave.	98.2 (711)	102.9 (332)	1302
Age 9–14, nonverbal	99.2 (411)	102.6 (210)	661
Age 8–14, verbal	96.7 (475)	102.6 (248)	775
Age 6–8, Goodenough	101.1 (300)	101.0 (122)	534
Age 8–14, Kraepelin	96.4 (467)	103.9 (247)	775
Age 8–14, Bourdon	100.4 (479)	103.6 (247)	764
Hilger et al. (1976)	93.7 (22)	–	32
Average	97.2 (975)	101.2 (409)	

Table 2
IQ difference between urban and rural students.

Reference	Ainu (n)	Local Japanese (n)	Controls (place)
Kubo (1926)	58.6 (54)	71.7 (49)	Mainland
Tanaka (1939)	74.1 (95)	83.8 (1346)	Mainland
Ishibashi et al. (1942)	72.4 (711)	81.7 (1302)	Tokyo, Osaka
Average	71.7	82.6	104

non-verbal IQ tests. As indicated in Table 3, the Ainu were apparently weaker in verbal ability in comparison with their non-verbal ability.

Kubo did not administer a verbal test to the first-graders; hence, non-verbal tests were taken by 54 students, while verbal tests were taken by 45. In Ishibashi et al. (1942), the verbal IQ test was administered to children over the age of eight ($N = 475$), and the non-verbal IQ test to children over the age of nine ($N = 411$). The Ainu showed stronger non-verbal skills, mostly logical and spatial, than verbal. As the control group was Japanese, who show strong visuospatial and weak verbal skills, it is surprising that the Ainu's IQ profile is further tilted toward non-verbal skills. This profile is similar to that of Arctic people like the Inuit (Kleinfeld, 1971; Lynn, 2006; Taylor & Skanes, 1976; Vernon, 1969), consistent with the genetic similarity between the Ainu and Arctic peoples.

It could be said that because the Ainu had their own language, it was natural that they were less competent in verbal IQ tests. However, the Japanese government enforced compulsory Japanese language education on the Ainu as early as 1871, along with other methods of forced assimilations. The use of Ainu language was banned in Japanese schools in 1899. As Ishibashi et al. (1942) wrote, “[a verbal test] would be unfair to those who do not fully understand the instruction language. This is the reason we considered conducting the Kirihara non-verbal IQ test in addition to the National Intelligence Test. However, Ainu language is no longer the mother tongue for Ainu students. It is Japanese that they most often listen to and speak, and for many of them, Ainu language is extinct. They are not effectively different from Japanese students.” (p. 290) (Translated by the present authors.)

The Ainu verbal IQ seems to become weaker as individuals age, compared with the Japanese. Fig. 1 suggests a cumulative decline of the Ainu verbal achievement. Although this is also compatible with a cumulative deficit effect (e.g., Tsie Chin Jong, 2013), it is suggested that Arctic peoples constitute the prototype of Mongoloids (north-east Asians) as they are comparatively stronger in non-verbal skills and they have larger crania.

Table 3
Ainu IQ estimates for verbal and non-verbal tests.

Reference	Verbal (n)	Non-verbal (n)
Kubo (1926)	86.3*** (45)	98.2 (54)
Ishibashi et al. (1942)	96.6*** (475)	99.2 (411)

*** $p < .001$.

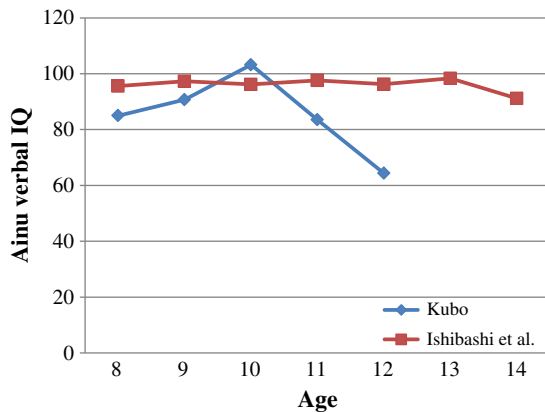


Fig. 1. AINU verbal IQ (Japanese = 104).

4. Cranial volume

If we assume that a genetic relationship exists between the AINU and Arctic peoples, it is expected that both populations would share some characteristics, such as large crania. We explore this assumption below.

Koganei (1894) was the first physical anthropologist to investigate the average cranial capacities of the AINU in Hokkaido and the Kuril Islands. As an anatomy professor at the University of Tokyo, he reported 1462 cc for 76 adult males and 1308 cc for 51 adult females. These figures are similar to those of Japanese (for male samples, 1499.5 cc (Miyamoto, 1924); 1551.8 cc (Morita, 1950); 1495 cc (Suzuki, 1969); 1474.8 cc (von Bonin, 1931)). Kodama, also an anatomy professor at Hokkaido University, collected 121 AINU skulls from Hokkaido, Kuril, and Sakhalin. The average volume of his collection was 1491.3 cc, which was also similar to that of the Japanese. However, closer examinations of these figures showed that samples from three areas with the most AINU inhabitants (Hidaka, Otoshibe, and Tokachi) had average cranial capacities (1582, 1538, and 1514 cc respectively), which were larger than the Japanese average.

Moreover, Kodama (1970) brought 19 AINU and 629 Japanese male corpses to his anatomy laboratory at Hokkaido University and measured their cerebrum weights at the time of autopsy (Table 4). He concluded that “(f)rom these data it may be concluded that the weight of the AINU brain surpasses distinctly that of the Japanese” (p. 184). AINU samples showed larger standard deviations than the Japanese and the mean brain weight of the AINU exceeded that of the Japanese ($p < .01$).

Table 4

Cranial weights of the AINU and Japanese.

Category	AINU (SD) (grams)	Japanese (SD) (grams)
All	1427.7 (16.26)**	1384.7 (3.23)
Adults	1460.9 (13.2)**	1404.5 (4.81)

Note. For the AINU samples, the total autopsy data were 19 (ages 15–69), of which 13 were adults (ages 20–59). Japanese data were 629 (ages 15–89), of which 298 were adult (ages 25–59).

** $p < .01$.

The AINU are genetically similar to Arctic peoples, who generally have the largest crania of any human group (Beals, Smith, & Dodd, 1984; Smith & Beals, 1990). For example, it has been reported that the Mongols have an average cranial volume of 1573 cc, and Alaskan Indians have 1560 cc (CA expedition, 1928; Woo & Morant, 1932). The large cranial capacity of the AINU can be interpreted as evidence that they had some genetic admixture from the Siberian mainland (Okhotsk culture) and possibly from Alewt and Alaska. It is noteworthy in this respect that it has been reported that the AINU are the genetically closest extant population to Kennewick Man, who lived off marine mammals in the coastal regions of North America (Chatters, 2000; Powell & Rose, 2011). It is also possible, though, that the AINU independently evolved their large skulls.

5. Educational achievements

There is no test score available on the academic achievement of AINU students. Nonetheless, if we assume that IQ distributions of the AINU and Japanese are identical except for their means (i.e., that their standard deviations are identical), we can estimate IQs of populations from the statistics such as high school graduation and college enrollment ratios of the populations (La Griffe du Lion, 2007). In the Hokkaido Prefectural Government survey, educational attainments of contemporary AINU are also reported. In 2006, 93.5% of AINU students graduated from high school, compared with 98.3% of Japanese. In addition, 20.4% of the AINU high school graduates attend universities, compared with 39.5% of the Japanese living in the same regions (Table 5).

The z-scores in Table 5 show that 93.5% and 98.3% of high school graduation rates in the AINU and Japanese populations, respectively, translate to those of student at the -1.51 standard deviation. The AINU population has the same achievement level as a student at the -2.12 standard deviations in the Japanese population. Thus, the mean difference of these two populations is .61 standard deviations. Similarly, the difference between these two populations from the university enrollment data is equivalent to .56 standard deviations. The average achievement difference is .58 standard deviations, which is equivalent to 8.7 IQ points. The smaller percentage of AINU graduates going to university must be partly due to the lower average income of their parents, as discussed in the next section. However, as going to public high schools does not incur a substantial economic burden in Japan, it is not reasonable to assume that this difference in academic achievements is completely caused by their harder economic environments.

Table 5

Educational achievement of AINU students.

Category	High school graduates (z-score)	Entered universities (z-score)
AINU	93.5% (-1.51)	20.4% (.83)
Japanese	98.3% (-2.12)	39.5% (.27)
Difference	.61	.56

6. Household income

The Ainu households' income is 84% of that of Japanese (Table 6). If we assume that one IQ point equals 2.5% more annual earnings in Japan (Kura, 2013), the earnings ratios of Ainu households to Japanese households translate into 7.0 IQ points, which is similar to the overall Ainu IQ from pre-war intelligence studies described above. However, because the Ainu are genetically distinct from the Japanese, they may experience social discrimination in the workplace. Therefore, this estimate should be treated as an upper limit of the IQ difference.

7. Discussion

As described at the beginning of this paper, the Ainu formed their ethnic identity through the merging of the Okhotsk and epi-Jomon cultures. As the Okhotsk region is semi-arctic and too cold for agriculture, people were heavily dependent on hunting marine mammals such as seals, sea lions, and whales. Moreover, the Jomon people are considered to have had northern ancestry as they belong to the Y-DNA haplogroup of mostly D2 (Hammer et al., 2006), which characterizes the northern people of Asia. Thus, despite their morphological similarities to Caucasians (Kodama, 1970; Siddle, 1996), the Ainu are essentially of northern Asiatic origin, most likely around Siberia and Mongolia. In fact, Cavalli-Sforza, Menozzi, and Piazza (1994) reported that the Modified Nei genetic distance of Ainu is closest to Mongol-Tungus and second-closest to Japanese (32 and 34, respectively), although their F_{ST} genetic distance gives different results (338 and 222, respectively) (see also Tajima et al., 2004). It is noteworthy that the Mongolians show an unmistakable IQ profile leaning toward visuospatial ability (Lynn, 2007) similar to the Ainu.

Modern mainland Japanese possess heavy genetic admixture from mainland China and the Korean peninsula, estimated to be 60–70% (Hammer et al., 2006). This is presumably the reason that the Japanese are more East-Asian looking than Ainu and Ryukyuan. If the Asian IQ profile of high spatial and low verbal ability is an evolutionary product of long hunting journeys in the Arctic terrain (as suggested by Lynn, 1987, 2006), the even lower verbal ability of the Ainu compared with that of the Japanese can be considered further evidence of the Ainu's Arctic origin.

Another noteworthy finding was the cranial capacity of the Ainu. The Ainu groups living in Hidaka, Ootshibe, and Tokachi have larger crania than the Japanese, which also suggests the genetic relationship with Arctic peoples who are known to have the largest crania.

The capacities of extant crania are highly correlated with distance from the equator ($r = .62$), and Arctic peoples have the largest crania (Beals et al., 1984). They initially suggested that spherical larger crania have evolved as an adaptation to colder climates because of their minimal thermal diffusion,

which is the primary reason for the variety of cranial volumes. However, this could not be the most important reason, because the brain is metabolically such a costly organ that it consumes 20% of the body's energy. In fact, people with larger cranial volumes tend to have higher IQs both within a population and across populations (Rushton, 1997; Rushton & Ankney, 1996, 2009). The fact that Arctic peoples do not have the highest IQs despite their largest cranial capacities is an anomaly.

As Miller (1995) and Lynn (2006) suggested, this anomaly is possibly due to the fact that rare beneficial mutations that have been fixed in the larger populations of Chinese and Europeans either did not appear or were not fixed in smaller populations of Arctic peoples. For example, the gene frequency of apolipoprotein *APOE-ε4* is known to be associated with Alzheimer's disease (Corder et al., 1993; Strittmatter et al., 1993) and is also harmful to the cognitive ability and lowers population IQ ($r = -.82$) (Piffer, 2013). The average frequency of this polymorphism among Chinese, Korean, and Japanese is .085, while that of Buryat, Chukchi, Inuit, Greenlanders, and Alaskan Indians is .20 ($p < .001$) (ALFRED, 2014). This may be a gene that could partly explain the lower IQs in the northern-most people compared with that of northern Europeans and northeast Asians. It could also be from spatial ability being more metabolically/brain-volume expensive (Lynn, 1987, 1994, 2007).

Further, it is possible that the Ainu have relatively low IQs owing to poor education, which is consistent with their lower verbal IQs (e.g., Cahan & Cohen, 1989; Lynn, 1987, 1990). Alternatively, the low IQs of Arctic peoples might be related to the absence of historical eugenic selection (e.g., Clark, 2007; Woodley, 2012). Current data do not definitively resolve the issue. Further psychometric and genetic research of the Ainu and other Arctic peoples should provide fruitful insights on these topics.

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Table 6

Average household incomes of Ainu and Japanese in 2006.

Category	Average household incomes	Number of households
Ainu	3692 (1000 yen)	2433
Japanese	4406 (1000 yen)	100

¹ Studies marked with an asterisk directly supplied Ainu IQ scores.

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