

ABO Blood Type and Personality Traits: Evidence from Large-scale Surveys in Japan with AI

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Abstract

The relationship between blood type and personality has long been one of the more challenging issues of scientific studies. Several large-scale surveys were conducted to address the issue, and some of them had shown statistically significant associations. This study analyzed data from two large-scale surveys (Survey 1: N = 1,000, Survey 2: N = 1,859) to examine the relationship between blood type and personality. ANOVA results indicated that 13 of the total 20 respondents' own blood type characteristic question items scored higher as "fit to my personality" than the averages of the other blood types. The same differences in scores were found in the group who reported no blood type personality knowledge, although the values were smaller. AI predicted blood types of participants more than by chance. We observed a clear and significant relationship between blood type and personality in large-scale surveys.

Keywords

Blood type, personality, large-scale survey, AI

Introduction

Blood Type Personality Theory

Currently, the effect of genetic factors on personality is estimated to be approximately 50% (Ando et. al., 2004; Gerra et al., 2000; Keller, Coventry, Heath & Martin, 2005). The ABO blood group, discovered by Karl Landsteiner in 1901, is a genetically determined and easily measured biological marker. Hence, much research has been conducted not only on health risks, but also on its impact on personality.

The relationship between blood type and personality is studied at an international scale, and the first academic examination using a statistics base was conducted in 1927 by Takeji Furukawa, a Japanese educational psychologist (Furukawa, 1927 & 1930; Nawata, 2014; Rogers & Glendon, 2003; Sato & Watanabe, 1992; Wu, Lindsted & Lee, 2005). Yet, the epoch that most shapes present-day research is a Japanese book (Nomi, 1971) written by Masahiko Nomi, a Japanese independent researcher, as well as an English book (Nomi & Beshner, 1988) written by his son, Toshitaka Nomi, and Alexander Beshner (Nawata, 2014; Rogers & Glendon, 2003; Sato & Watanabe, 1992; Wang, 2014).

Masahiko Nomi adopted the multiple method approach (Table 1) which consisted of a) questionnaires on the characteristics of people's behavior and mindset; b) surveys of blood type distribution for various occupations and specialties; c) observations of people's behavior and statistical analyses. The sample sizes of these studies were claimed to be tens of thousands of people. He also suggested that there was a d) association with disease and physical constitution, such as the idea that type B was resistant to certain cancers (Nomi, 1978; Shirasa & Iguchi, 1993).

Table 1. Blood Type, Personality, High Distribution Rate (Nomi, 1978)

Blood Type	Personality	High Distribution Rate
O	Purpose oriented. Head straight for a target. Great achievement power. However, do not endure meaninglessness. Give up early if no good. Weigh losses against gains correctly. Hold a belief. Articulate and logical, but somewhat straight. Simple minded in part. Emotions are usually stable and do not linger. Deeply moved. Lose heart when cornered.	Prime minister Foreign minister Baseball hitter
A	Cautious about new actions, also pursue stability, but sometimes obsessed and burst into a rage. Desire for molting. Always try to improve. Take a brave action in an emergency. Go step by step after convinced. Formula-like. Prudent judgement, although draw the clear line. Strongly suppressive outside vs violent inside. Recover slowly after got hurt. Concentrate on one at a time.	Education minister High-ranking sumo wrestler
B	Look for a life with much freedom. Particularly dislike rules or formulas. Do not hesitate to take new actions. Tend to be absorbed in strongly interested things. Multitasking and go overboard. Quick and flexible judgements. Pragmatic and do not draw the line. Emphasize scientific accuracy and validity. Feelings sway, moody. Frankly express anger or sorrow.	Baseball hitter

Blood Type	Personality	High Distribution Rate
AB	Good reflexes, business-like efficiency. Quick and easy understanding. Rationality itself. Good critic and analyst, multi-angle interpretation. Duality with a calm, cool stable side and an easily disturbed side with sentimental fragility. Able to do everything accurately. Good at designing but not cleaning up. Smiling and soft, but keep a certain distance from others.	Foreign minister Education minister

Note. Some characteristics seemingly contradict others. Unlike personality psychology, Nomi assumed that responses to stimuli were nonlinear.

His questionnaire results showed that the effect size was small to medium, with differences by blood type ranging from 10-20% in absolute response rates. In studies of blood type distributions, Nomi found that Japanese prime ministers were more likely to be O, foreign ministers O or AB, education ministers more likely A or AB; professional baseball hitters O or B, high-ranking sumo wrestlers A, and so forth; all of which were supported by statistically significant differences. P-values varied widely from below 0.001 to 0.05, dependent upon sample size and other conditions (Nomi, 1978; Kanazawa 2019).

Presently, many Japanese people believe in the relationship between blood type and personality. For example, in a 2015 online questionnaire conducted by Fuji Television Networks, one of the major television networks in Japan, found that 68.7% of a 201,119-person audience believed in the relationship between blood type and personality (Fuji Television Networks, 2015). These results are in accordance with past observations: a 1986 survey conducted by NHK, the Japanese public broadcaster, found that 75% of 1,102 respondents believe in the relationship (NHK Broadcasting Culture Research Institute, 1986).

Results of Academic Studies

Questionnaires by psychologists created the following images of each blood type. Yamazaki and Sakamoto conducted a survey of 177 female undergraduate students on the 24 personality traits in the annual opinion poll data by JNN Data Bank, a department of Tokyo Broadcasting Corporation, which is one of the major television networks in Japan. The results of the top three (yes-no scales, multiple answers) are displayed in Table 2 (Yamazaki & Sakamoto, 1991 & 1992).

Table 2. Blood Type and Its Image of Personality (Yamazaki & Sakamoto, 1991 & 1992)

Blood Type	Personality	Percentage
O	I have a lot of friends. I am ready to keep company with everyone. I cannot be quiet and I make merry when am delighted.	0.909 0.881 0.853
A	I am careful when doing something. I am serious when I should be so. I am often worried about things.	0.932 0.932 0.898

Blood Type	Personality	Percentage
B	I often change my mind. I am not particular about things. I am not worried by what I was told.	0.801 0.774 0.774
AB	I do not change my idea after I present it. I make an effort toward my goal. I sometimes burst into a rage.	0.877 0.677 0.655

Note. Top three responses items were indicated.

Tatsuya Sato, Yukari Miyazaki, and Yoshiyuki Watanabe (1991) surveyed 197 undergraduate students and the result of free responses was shown in Table 3. Yoriko Watanabe (1994) extracted personality traits of each blood type from multiple books and asked 102 undergraduate students whether they were applicable. The results are shown in Table 4. In general, the personality traits by Japanese psychologists were consistent with those of Nomi.

Table 3. Blood Type and Its Image of Personality (Sato, Miyazaki & Watanabe, 1991)

Response	Type A	Type B	Type O	Type AB	Total
Meticulous	111	0	0	0	111
Nervous	111	1	1	3	80
Serious	54	0	0	3	57
Cheerful	4	38	16	1	59
Self-paced	0	33	8	1	42
Individual	0	23	2	6	31
Lukewarm	0	17	0	0	17
Egoistic	0	12	2	1	15
Self-centered	1	11	3	0	15
Optimistic	0	10	8	0	18
Pleasant	0	10	2	1	13
Big-hearted	0	1	90	0	91
Laid back	0	4	25	0	29
Unassuming	0	1	16	0	17
Dual personality	0	0	1	77	78
Two-faced	0	18	2	64	84
Oddball	0	1	0	13	14
Hard to understand	0	0	0	12	12

Note. Only the 10 or more responses from the participants were indicated.

Self-fulfilling Prophecy

Self-fulfilling prophecy refers to the phenomenon in which a person who believes in a prophecy learns to act in accordance with the prophecy, thereby bringing the prophecy to being. An example that psychologists have studied is astrology (Glick & Snyder, 1986; Eysenck and Nias, 1982; Snyder, 1984). If a person's original personality and his/her sign matches, that tendency becomes stronger. Even if the personality and the sign do not initially match, the personality moves toward what has been indicated. In Japan, South Korea, and Taiwan, roughly half of the people feel the relationship between blood type and personality is legitimate

(Cho, Suh & Ro, 2005; Kamise & Matsui, 1994 & 1995; Sato & Watanabe, 1992; Wu, Lindsted & Lee, 2005; Yamaoka, 2009). Logically, the self-fulfilling findings among astrology suggest that one's personality would change in a direction that fits relevant as personality description – of which shown by blood type.

Table 4. Blood Type and Its Image of Personality (Watanabe, 1994)

Blood Type	Personality	Percentage
A	Considerate, careful about everything Polite Esteem principle than practice	0.667 0.569 0.510
B	Lack of prudence Self-paced, less influenced by the surroundings Optimistic	0.471 0.402 0.402
O	Pleasant Positive, person of action Show the utmost courage and guts for the target	0.549 0.294 0.226
AB	Moody and sometimes seen as dual personality Cool and dry Avoid close human relations	0.608 0.510 0.412

Note. Top three responses were indicated.

Utilizing those items (Tables 2-4), several large-scale surveys in Japan were designed or analyzed by psychologists or other academic researchers after 1990, which clearly confirmed self-reported personality traits using ANOVA (Matsui, 1991; Muto et al., 2012; Ryu & Sohn, 2007; Sakamoto and Yamazaki, 2004; Yamaoka, 2009; Yamazaki & Sakamoto, 1991). Archetypical sample sizes of these were 6,660 (Yamaoka, 2009), 11,766 (Matsui, 1991), 32,347 (Sakamoto and Yamazaki, 2004; Yamazaki & Sakamoto, 1991 & 1992 – these three used the same sample) and over 100,000 (Muto et al., 2012; our estimation; the exact number was not specified in this report, although it alluded the size was much larger than preceding ones). These results cannot be explained by the Burnham effect (vague and general descriptions), because the differences in self-reports were not either virtual, vague, nor ambiguous, but supported by definite and real values.

Regardless, statistical differences had not been confirmed in respondents without blood type personality knowledge. Therefore, the current scientific consensus is that these differences are self-fulfilling phenomena induced by the “contamination by knowledge” (Cramer & Imai, 2002; Eysenck & Nias, 1982; Kim, Lee & Lee, 2007; Matsui, 1991; Ryu & Sohn, 2007; Sakamoto & Yamazaki, 2004; Sato & Watanabe, 1992; Yamaoka, 2009; Yamazaki & Sakamoto, 1991 & 1992).

Reliability and Validity of Single- or Two-item Scale

In recent years, scales that attempt to measure psychological constructs with a very small number of items had been developed in various fields, such as scales to measure subjective well-being (Diener, 1984) and self-esteem (Robins, Hendin, & Trzesniewski, 2001) with a single item. Both scales are used in many studies. Similarly, in the Big Five personality test, a very brief measure, 5 and 10-item inventories were developed. For example, Gosling, Rentfrow and Swann (2003) created the Ten Item Personality Inventory (TIPI), which measured the five factors of the Big Five in 10 items, 7-point scale. Later, Oshio, Abe and Cutrone (2012) developed a Japanese version of Ten Item Personality Inventory (TIPI-J). The results of multiple validation tests generally supported the reliability and validity of the two tests: the Cronbach's alphas were 0.40-0.73 (Gosling, Rentfrow & Swann, 2003) and 0.72-0.91 (Oshio, Abe & Cutrone, 2012); test-retest reliabilities were 0.62-0.77 and 0.64-0.84, respectively. Furthermore, according to several studies of psychologists (Cho et al., 2005; Ryu & Sohn, 2007; Wada, 1996), more than ten items of the Big Five scales of personality trait correspond to blood type personality (Appendix B).

Results of Personality Tests

There are many types of personality tests used in psychology, depending on the purpose. The “Big Five” test is generally used for blood type and personality studies. The Big Five personality test, as the name implies, comprehensively describes personality by five factors called the Big Five (Goldberg 1990 & 1992). These five factors are usually called Neuroticism, Extraversion, Openness, Agreeableness, and Conscientiousness. The model collects vocabularies from dictionaries and traditional personality tests, as well as re-analyses of personality scales, and five factors were extracted through factor analysis. Thus, the Big Five does not assume any background theory. In other words, it can be said that the Big Five model was constructed as the result of an attempt to broadly describe personalities with as few factors as possible, without assuming any background theory. Thus, the Big Five models are characterized by the bottom-up process and personality is comprehensively captured by five factors. The NEO-PI-R, commonly used as a Big Five personality test, consists of 60-240 question items, each of which is rated using a five-point scale (Costa & McCrae, 1992; Kunisato, Yamaguchi & Suzuki, 2008; Shiinonaka, Nakazato, Gondo, Takayama, 1998; Wada, 1996).

As mentioned above, the Big Five is a questionnaire-based personality assessment, which consists of answering to multiple questions regarding multiple self-reported personality traits. These traits integrate into five personality factors by statistical processing. In theory, this means that the self-reported answer will either directly or indirectly appear in the result. Although there are many academic studies using personality tests (including the Big Five) on the relationship between blood type and personality, the inconsistency among results (Cattell, Boutourline & Hundleby, 1964; Cho, Suh & Ro, 2005; Cramer & Imai, 2002; Flegr, Preiss & Klose, 2013; Furukawa, 1927 & 1930; Gupta, 1990; Jogawar, 1983; Kim et al., 2007; Lester & Gatto, 1987; Mao, Xu, Mu, Ma & He, 1991; Nawata, 2014; Rogers & Glendon, 2003; Sharifi, Amadian & Jalali, 2015; Sato & Watanabe, 1992; Shimizu & Ishikawa, 2011; Wu, Lindsted & Lee, 2005) has led to the endless academic controversy about whether the relationship is scientifically confirmed. As another example, a 2014 10,000-participant study in Japan and the US re-analyzed data of large-scale social surveys on money and consumer life revealed no meaningful difference (Nawata, 2014).

After 2000, a growing number of studies proved the previously questioned link between blood type and physical constitution, with the exception being in the weak gastrointestinal tract: this demonstration proposed a new approach to medicine (Ewald & Sumner, 2016; Risch, 2000). For example, more than 10 studies had reported a relationship between susceptibility to COVID-19 and blood type (Barnkob et al., 2020; Ellinghaus et al., 2020; Hoiland et al., 2020). According to these studies, type O was the least susceptible, and type A the most.

There had also been several studies on biological factors, which investigated whether physical constitution affected personality (Hobgood, 2011a & 2011b). In 2015, a genotype of blood type and the personality using the Temperament and Character Inventory (TCI) had been determined to be related, as predicted by blood type personality theory (Tsuchimine, Saruwatari, Kaneda & Yasui-Furukori, 2015). In this study, type A was found to be the most “persistent.” The TCI, a top-down personality model, is often used to examine genetic dispositions (Cloninger 1987; Kijima et al., 1996). This personality test built a model for temperament with a physiological basis in the background. The test consists of 240 items using a yes-no scale rating.

Cloninger hypothesized that personality consists of traits that are hereditary and stable throughout life, and traits mature throughout life under the influence of socio-cultural environment. The TCI consists of seven dimensions, including four temperament dimensions (Novelty Seeking, Harm Avoidance, Reward Dependence, and Persistence) and three character dimensions (Self-directedness, Cooperativeness and Self-transcendence). Three of the temperament dimensions have been hypothesized to be associated with monoamine neurotransmitters. Novelty seeking has been hypothesized to be associated with dopaminergic, harm avoidance with serotonergic, and reward dependence with noradrenergic.

Overview of AI Technology

Current AI technology often uses a technique called machine learning. The technology, such as deep learning, is based on a neural network that consists of perceptrons, which simulate the mechanisms of human neurons in a multilayered network. This makes it feasible to learn various characteristics contained in the data with dramatically high accuracy, in comparison with the conventional techniques (LeCun, Bengio & Hilton, 2015). By inputting a large amount of image, voice, and text data into the neural network, the computer system automatically learns the characteristics contained in these data. There are various alternatives other than deep learning, though AI nowadays often refers to the system that uses it.

Objectives of This Study

In this study, therefore, we examined validity and reliability of blood type personality theory using the previously mentioned academic findings and commonly used methodologies in psychology (e.g. ANOVA). In addition, we used the latest artificial intelligence, AI (machine learning), which can theoretically handle nonlinear multi-factor models. Details are outlined in the following methods section.

Methods

Participants

The data used in this study (Supplementary Material File) was collected by the means of crowdsourcing throughout Japan. All samples were allocated by gender, as well as 10-year increments of age. With the intention of avoiding ethical issues, question items on blood type characteristics of this study (Table 5 and Appendix A) were extracted from reviewed academic articles (Sato et al., 1991; Watanabe 1994; Yamazaki & Sakamoto, 1991& 1992 – Tables 2-4). These items were checked again at the previously stated crowdsourcing company which has been passed the Japanese privacy mark (JIS Q 15001). The company confirmed that there was no problem with the question items. It provides customers with anonymized data and obtains informed consent from participants (respondents) prior to its surveys.

Instruments

Survey 1 was conducted in 2018 as a preliminary study with a sample size of 1,000. Japanese single individuals with the age of 20-39 were asked to rate a total of 8 items representing 4 blood type (A, B, O, AB) characteristics, each with scores of 1-5 for their personality traits (the larger the number, the more fitting the trait), and scores of 1 to 4 of relationship and their knowledge on the level between blood type and personality (the larger the number, the more related or informed). Survey 2 was conducted in 2019, and covered 2,000 Japanese people ages 20-59, further expanded blood type characteristics to 12 items, and asked the respondents to answer which blood type they thought these 12 items would categorize. In Survey 2, we added an item of marital status, since the age of participants spanned to 59, which meant that married persons were included.

Each participant's blood type of was determined by self-report, because most Japanese people know their blood type. In Japan, many people know their blood type because, until recently, it had been common practice to test the blood type of newborns. In Survey 1, the dataset included only those who knew their blood type, as previously instructed. Hence, the valid sample size was 1,000. In Survey 2, 141 out of all the 2,000 respondents, or 7.1% of the total, did not know their blood type. Thereby the data of the remaining 1,859 participants with known blood types were used. The distributions of blood types were almost equal to the Japanese average measured by the Japan Red Cross Blood Center; A: 39.1%, B: 21.5%, O: 29.4%, AB: 10.0% (Okubo, 1997).

Table 5. Blood Type Characteristics used for Surveys 1 and 2

Survey	Type A	Type B	Type O	Type AB
Survey 1	Cooperative	Self-paced	Open within peers	Hard to be understood
	Thoughtful & cautious	Optimistic	Big-hearted	Dual Personality
	Meticulous	Self-paced	Positive	Hard to be understood
Survey 2	Serious	Self-centered	Big-hearted	Dual Personality
	Nervous	Cheerful	Laid back	Genius-like

We tried to follow those methods of psychological personality testing, and deliberately selected the most suitable characteristics that would explicitly display the differences: a) images of characteristics were consistent to the preceding academic studies; b) showed large differences in the academic studies and means were close to 50%; c) did not show extreme values; d) images of characteristics were consistent to the preceding surveys of other studies.

Analytical Strategy

Firstly, we confirm whether a single or two-item question made a difference in the preceding academic studies. We also focused our analysis on whether personality self-fulfillment was occurring: with data from participants who “have no knowledge of blood type personality” or “do not believe in the relationship” (hereinafter abbreviated as “no-knowledge group”).

Secondly, we confirm whether AI can predict a persons’ blood type more than chance. We made to reference a facial recognition article written by AI engineers (Nakamura & Iwasada, 2017) aimed at prediction because there was virtually no preceding research available to analyze personality with AI; it was for this reason we utilized AI as an experimental method.

Procedure

Our analytical methods on personality were as follows:

Analysis 1: ANOVA of blood type and personality – Surveys 1 and 2

Analysis 2: ANOVA of blood type and personality for “no-knowledge group” – Survey 2 only

We set the alpha level to 0.05. An analysis of variance (ANOVA) was performed with personality characteristics scores as the dependent variables and self-reported ABO phenotypes (A, B, O and AB). Before ANOVA analyses, the normality of distributions was checked for each personality characteristics score; this showed a normal distribution. Effect sizes (Cohen, 1977) were also calculated. The data were analyzed using jamovi software version 1.2.27 (The jamovi project).

Our analytical method on blood type predictions using AI was as follows:

Analysis 3: Blood type prediction using AI – Survey 2 only

All the data of survey 2 were stored in Amazon S3, and with Amazon Machine Learning, all 12 characteristics, including gender, age, and marital status, were used as training data for prediction targeting for the blood type (since Masahiko Nomi claimed that these elements affected personalities). Multinomial logistic regression algorithm was chosen for the prediction. We divided the whole data into five groups of same sample size. Each group was estimated as the prediction data, the rest four groups as the training data, and then the average of the five predictions was calculated. In these cases, since the sample sizes of the AI training data were small (this means that the prediction errors might become larger if we used the raw data of 1-year increment of age), a dummy variable of 10-year increments was used [20s = 2, 30s = 3, 40s = 4, 50s = 5].

Results

Analysis 1: ANOVA of Blood Type and Personality

Table 6. Survey 1 ANOVA for Characteristics Scores and Blood Type

Q1	Characteristics (Blood type)	Scores by blood type	Scores by blood type	Scores by blood type	Scores by blood type	F	η^2	p
		A (N = 378)	B (N = 216)	O (N = 295)	AB (N = 111)			
a	Cooperative (A)	3.220 (1.191)	3.069 (1.246)	3.288 (1.164)	3.225 (1.093)	1.454	0.004	0.226
b	Open within peers (O)	3.251 (1.185)	3.343 (1.190)	3.349 (1.182)	3.459 (1.166)	1.022	0.003	0.382
c	Hard to be understood (AB)	3.259 (1.039)	3.389 (1.085)	3.132 (1.075)	3.550 (1.134)	5.012	0.015	0.002*
d	Self-paced (B)	3.188 (1.073)	3.407 (1.087)	3.153 (1.094)	3.360 (1.102)	3.092	0.009	0.026
e	Thoughtful & cautious (A)	3.619 (1.067)	3.403 (1.121)	3.454 (1.071)	3.523 (1.069)	2.258	0.007	0.080
f	Dual personality (AB)	2.913 (1.253)	3.162 (1.172)	2.854 (1.176)	3.486 (1.205)	9.344	0.027	< .001
g	Optimistic (B)	2.857 (1.208)	3.185 (1.213)	3.159 (1.237)	3.099 (1.191)	4.908	0.015	0.002*
h	Big-hearted (O)	2.899 (1.170)	3.037 (1.189)	3.383 (1.091)	3.045 (1.115)	10.136	0.030	< .001

Note. Standard deviations are in parentheses. Highest scores that match with blood type characteristics, and $p < 0.05$ are highlighted in bold. * $p < 0.05$ after the Bonferroni's correction.

In Survey 1's ANOVA result (Table 6), 6 of the 8 items showed the same results as those shown for blood type characteristics in the preceding psychology papers (Tables 2-4). Of these, 5 items were statistically significant at $p < 0.05$, or 4 items after the Bonferroni's correction. The magnitude of the difference: partial $\eta^2 = 0.027$ at the maximum, thus all the effect sizes were small.

Table 7. Survey 2 ANOVA for Characteristics Scores and Blood Type

Q1	Characteristics (Blood type)	Blood type	Blood type	Blood type	Blood type	F	η^2	p
		A (N = 692)	B (N = 434)	O (N = 553)	AB (N = 180)			
a	Meticulous (A)	3.522 (0.998)	3.203 (1.055)	3.047 (1.059)	3.228 (1.118)	22.575	0.035	< .001

Q1	Characteristics (Blood type)	Blood type	Blood type	Blood type	Blood type	F	η^2	p
b	Hard to be understood (AB)	3.130 (0.999)	3.311 (1.061)	3.123 (1.003)	3.544 (1.021)	10.687	0.017	< .001
c	Self-paced (B)	3.462 (1.007)	3.873 (0.952)	3.510 (0.978)	3.561 (1.037)	16.942	0.027	< .001
d	Positive (O)	2.903 (1.070)	2.993 (1.126)	3.074 (1.053)	2.922 (1.146)	2.727	0.004	0.043
e	Dual personality (AB)	2.448 (1.086)	2.599 (1.113)	2.409 (1.088)	3.322 (1.122)	34.776	0.053	< .001
f	Big-hearted (O)	3.012 (0.990)	3.025 (1.018)	3.228 (0.998)	2.972 (1.054)	6.160	0.010	< .001
g	Self-centered (B)	3.013 (1.023)	3.276 (1.086)	3.043 (0.992)	3.167 (1.075)	6.647	0.011	< .001
h	Serious (A)	3.671 (0.923)	3.537 (1.044)	3.486 (0.982)	3.656 (0.959)	4.337	0.007	0.005
i	Cheerful (B)	3.132 (1.043)	3.051 (1.018)	3.061 (1.011)	3.067 (1.050)	0.748	0.001	0.523
j	Laid back (O)	3.156 (1.082)	3.288 (1.067)	3.608 (1.003)	3.261 (1.069)	19.534	0.031	< .001
k	Genius-like (AB)	2.230 (1.035)	2.311 (1.091)	2.204 (1.034)	2.639 (1.102)	8.547	0.014	< .001
l	Nervous (A)	3.516 (1.000)	3.249 (1.058)	3.246 (1.050)	3.456 (1.037)	9.669	0.015	< .001

Note. Standard deviations are in parentheses. Highest scores that match with blood type characteristics, and $p < 0.05$ are highlighted in bold. * $p < 0.05$ after the Bonferroni's correction.

On question item “Q2 Do you think blood type and personality are related?”, 8.3% of the respondents answered “strongly related”, 40.6% answered “somewhat related”, 24.6% answered “a little related”, 18.0% answered “not related at all” and 8.5% answered “I don’t know”. On question item “Q3 Do you know the characteristics and compatibility of blood types?”, 9.9% answered “I know well”, 54.6% answered “I know some”, 23.5% answered “I know a little” and 12.0% answered “I don’t know at all.”

In Survey 2’s ANOVA result (Table 7), 11 of the 12 items gave the respondents’ image of blood type and were statistically significant, or 9 items after the Bonferroni’s correction. The magnitude of the difference: $\eta^2 = 0.053$ at the maximum and 0.019 at the average, thus, the effect sizes were intermediate between small and medium. All of the responses were consistent with the most common images of blood types that respondents expected, except “i Cheerful”, which was to be type B in academic studies, but type A got the highest score.

On question item “Q3 Do you think blood type and personality are related?”, 6.1% of the respondents answered “strongly related”, 35.7% answered “somewhat related”, 28.0% answered “a little related”, 20.1% answered “not related at all”, and 10.1% answered “I don’t know”. On question item “Q4 Do you know the characteristics and compatibility of blood types?”, 4.4% answered “I know well”, 41.4% answered “I know some”, 36.1% answered “I know a little”, and 17.5% answered “I don’t know at all.”

Analysis 2: ANOVA of Blood Type and Personality for “No-Knowledge Group”

We used the 520 “no-knowledge” participants of Survey 2, who were free of “self-fulfilling”, because they had no knowledge of blood type personality or did not believe in the relationship. We did not use the 218 “no-knowledge” ones of Survey 1, because the sample size was too small.

Table 8. Survey 2 ANOVA for Characteristics Scores and Blood Type

Blood type character-istics	Total score by blood type	Total score by blood type	Total score by blood type	Total score by blood type	F	η^2	P
	A (N = 191)	B (N = 127)	O (N = 150)	AB (N = 52)			
A	10.246 (2.197)	9.748 (2.917)	9.853 (2.607)	9.327 (2.909)	2.155	0.012	0.092
B	9.408 (2.055)	9.504 (2.400)	9.260 (1.902)	8.846 (2.099)	1.345	0.008	0.259
O	8.859 (2.252)	8.606 (2.848)	9.427 (2.315)	8.635 (2.536)	3.083	0.018	0.027
AB	7.471 (1.970)	7.606 (2.404)	7.720 (2.099)	8.558 (2.508)	3.471	0.020	0.020*

Note. Standard deviations are in parentheses. Highest scores that match with blood type characteristics, and $p < 0.05$ are highlighted in bold. * $p < 0.05$ after the Bonferroni’s correction.

In Analysis 1, we analyzed the results for the individual question items. However, since the sample sizes of the “no-knowledge” group was relatively small, we decided to analyze the total of the result for the same blood type to reduce statistical errors like the TIPI (results for individual items are shown in Appendix C). In Survey 2’s ANOVA result (Table 8), all 4 items showed the same results as those shown for blood type characteristics in the preceding psychology papers (Tables 2-4), and 2 items were statistically significant at $p < 0.05$, and 1 item after the Bonferroni’s correction.

Analysis 3: Blood Type Prediction Using AI

We did not conduct the prediction using the data of Survey 1, because the sample size was too small. In survey 2, the accuracy rates were 45.0% ($F1 = 0.450$) in the group that had good knowledge of blood type characteristics (542 participants with scores equal to 3 or higher in both item Q3 (relation) and item Q4 (knowledge)), and 40.1% ($F1 = 0.401$) in the entire 1,859 participants (Table 9). When gender, age, and marital status were excluded from both the learning and training data, the accuracy rates fell to 42.3% ($F1 = 0.423$), and 39.6% ($F1 = 0.396$) respectively. The most common blood type among Japanese is type A, which accounts for 37.2% (692 persons) in this survey. Hence, the accuracy rate became 37.2% if all the participants were assumed to be the type. Amazon Machine Learning predicted the blood type at a higher accuracy than this value in all cases (presently, there is no standard statistical test for personality analysis using AI).

Table 9. Survey 2 Result of Blood Type Predictions using AI

Learning data	Average accuracy (5 groups)	Average accuracy (5 groups)
	Well knowledge (N=542)	All (N=1859)
Blood type, gender, age and marital status	0.450 (0.393)	0.401 (0.372)
Blood type only	0.423 (0.393)	0.396 (0.372)

Note. Percentages of type A (0.393 and 0.372) are in parentheses.

Discussion

Issues with Personality Tests

In Analysis 1, out of all 20 blood type characteristic items, 13 of them (after the Bonferroni's correction) clearly output the differences as predicted. This study measured self-reported personality, and since many Japanese believe in the relationship between blood type and personality, conventional personality psychology theory suggests the differences among the blood types will certainly appear, as prior mentioned. For the same reason, personality psychology hardly explains that no difference in blood type, or inconsistent results, appeared theoretically (Cattell et al., 1964; Cho et al., 2005; Cramer & Imai, 2002; Flegr et al., 2013; Furukawa, 1927 & 1930; Gupta, 1990; Jogawar, 1983; Kim, Lee & Lee, 2007; Lester & Gatto, 1987; Mao et al., 1991; Nawata, 2014; Rogers & Glendon, 2003; Sharifi et al., 2015; Sato & Watanabe, 1992; Shimizu & Ishikawa, 2011; Wu et al., 2005).

Ryu and Sohn (2007) re-analyzed Cho, Suh and Ro's result of the Big Five test of 40 items (2005), and found statistically significant differences which matched blood type characteristics in 10 individual items. This means that in the case of a "personality factor" composed of multiple items, the difference by the blood type decreases - few significant differences appear. Wada (1996) constructed the Big Five Scales (BFS) of 60 personality trait terms, which matched blood type characteristics in only 3 individual items (Appendix B).

This corresponds to the inconsistent results of many preceding studies conducted by psychologists. In addition, the reason why psychological personality tests did not show differences in blood type (Cattell et al., 1964; Cho et al., 2005; Cramer & Imai, 2002; Flegr et al., 2013; Furukawa, 1927 & 1930; Gupta, 1990; Jogawar, 1983; Kim et al., 2007; Lester & Gatto, 1987; Mao et al., 1991; Nawata, 2014; Rogers & Glendon, 2003; Sharifi et al., 2015; Sato & Watanabe, 1992; Shimizu & Ishikawa, 2011; Wu et al., 2005) was probably due to the halo effect. Kamise and Matsui (1994) said "there exist core characteristics of each blood type, and the entire contents are formed around them" (Appendix D). Thus, the differences by the blood type are heavily depended upon "original" words. In many cases, differences did not appear if "similar" words were selected.

Consistency with Preceding Studies

Preceding research by psychologists had concluded that there appeared no difference in personality among blood types, and that even if there was a difference predicted by the blood type, it was assumed to be the result of self-fulfillment prophecy phenomena (Kim et al., 2007; Sakamoto and Yamazaki, 2004; Yamaoka, 2009; Yamazaki and Sakamoto, 1991 & 1992). However, the same differences in scores were found in the group who reported no blood type personality knowledge ("no-knowledge" group), although the values were smaller; all four items showed the same results as those shown for blood type characteristics in the preceding psychology papers (Sato et al., 1991; Watanabe 1994; Yamazaki & Sakamoto, 1991& 1992 - Tables 2-4). Therefore, it is highly likely that differences by blood type are real, not caused by self-fulfilling prophecy phenomena; no difference in the "no-knowledge" groups were caused by Type II errors.

In addition, backed on this study's AI result, it was suggested that these phenomena occurred not only because of the wording of question items, but also because gender and age were not taken into account (Chart 1). The experimental blood type predictions by AI (Amazon Machine Learning) in this study found that adding non-blood type variables, such as gender or age, to the training data considerably increased the accuracy. Moreover, when performing blood type prediction, AI sometimes failed to build its machine learning models, if gender or age of the training and prediction data were different. In this respect, AI technology may suggest that factors such as gender and age affect the characteristics of blood type. Therefore, gender, age, and other factors may offer a better explanation, even if past data were inconsistent.

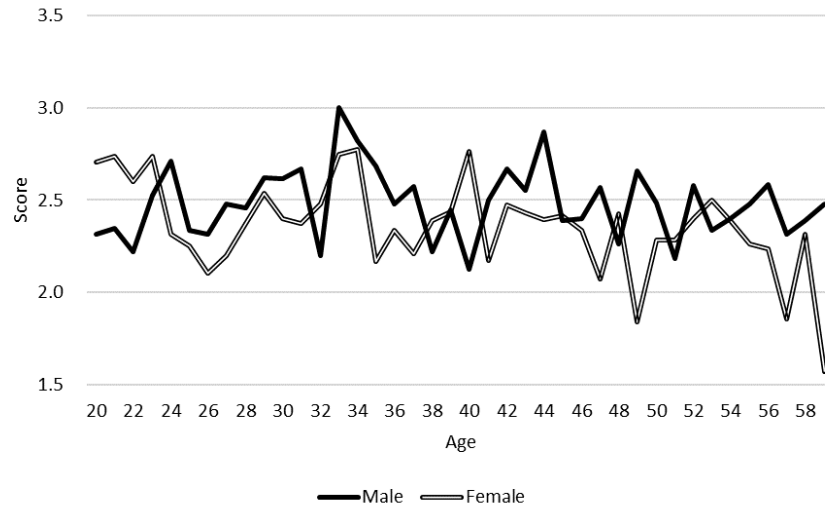


Chart 1. Survey 2 Score of Item h (Serious) by Gender and Age

The issue concerning the difference of human personality affected by gender and age, have been explored in the fields of personality psychology and social psychology. Although some people argue that personalities are affected by gender and age, and the differences are nonlinear (Soto, John, Gosling & Potter, 2011; Kawamoto et al., 2015), others argue that they are not affected (Costa, Terracciano & McCrae, 2001). In any case, many researchers seem to agree upon the existence of differences, at least self-reported. We also believe that there are such differences.

Our study has several points to be improved. Firstly, the participants in this study were limited to Japanese populations only. It is necessary to examine whether the same results can be obtained in samples of other countries. Secondly, we used the 2,000-population AI training data, but this is a relatively small sample size; 10,000 or more persons are desirable. Lastly, researchers have not yet found an appropriate method to utilize AI for personality psychology. In this pilot study, we adopted a facial recognition method (Nakamura & Iwasada, 2017), but better algorithms should be considered.

Conclusion

We found a clear relationship between blood type and the self-reported personality of many single question items, which matches traits previously stated. The effect of blood type on personality was shown as partial $\eta^2 = 0.053$ at the maximum in this study; the effect size small to medium. The same traits were observed in the no-knowledge group, though the difference was smaller. AI predicted the blood type of participants more accurately than chance. Our findings provide a new, if hypothetical, framework of how genes affect human personality.

Meanwhile, the sample in this study was limited to Japanese populations only, the AI training data was small in sample size, and its use experimental. Additional research using a larger, global dataset is needed in order to address true implications, as well as to improve algorithms and methodologies.

Appendix A

Question Items of Survey 1

Participants: 1,000 persons

(single men and women in his/her 20s or 30s, age and gender are equally allocated)

Q1. Please answer the following eight items about your personality.

Answer options

1: It does not fit to me at all <- 3: Cannot say either -> 5: It fits to me well

Question items

a. I am cooperative b. I am open in peers c. Others are hard to understand my personality d. I am self-paced and hardly affected by others e. I am thoughtful and take a cautious attitude toward others f. I have an uneven mood and sometimes it looks like a dual personality g. I am optimistic h. I am big-hearted

Q2. Do you think blood type and personality are related?

1: Not related at all 2: A little related 3: Somewhat related 4: Strongly related 5: I don't know

Q3. Do you know the characteristics and the compatibilities of blood types?

Answer options 1: I don't know at all 2: I know a little 3: I know some 4: I know well

Q4. Lastly, please tell us your blood type.

1: Type A 2: Type B 3: Type O 4: Type AB 5: I don't know

Q5. Gender (based on respondent registration information)

1: Male 2: Female

Q6. Age (depending on respondent registration information)

1: Teen or under 2: 20s 3: 30s 4: 40s 5: 50s 6: 60s 7: 70s or over

Question Items of Survey 2

Participants: 2,000 persons

(men and women in his/her 20s to 50s, age and gender are equally allocated)

Q1. Please answer the following eight items on your personality.

Answer options

1: It does not fit to me at all <- 3: Cannot say either -> 5: It fits to me well

Question items

a. Meticulous b. Hard to understand by others c. Self-paced d. Positive e. Dual personality f. Big-hearted g. Self-centered h. Serious i. Cheerful j. Loose k. Genius-like l. Nervous

Q2. For the 12 items in Question 1, please choose one or more blood type(s) that you think will apply to your image.

1: Type A 2: Type B 3: Type O 4: Type AB

Q3. same as Q2 of Survey 1.

- Q4. same as Q3 of Survey 1.
- Q5. same as Q4 of Survey 1.
- Q6. same as Q5 of Survey 1.
- Q7. same as Q6 of Survey 1.

Appendix B

Cho, Lee & Lee (2005), and Ryu & Sohn (2007)

Ryu and Sohn (2007) re-analyzed Cho, Lee & Lee’s result of the Big Five test of 40 items (2005), and found statistically significant differences which match with blood type characteristics in 10 individual items (Table 1).

Table1. Result of re-analysis of the Big Five Characteristics

Blood Type	Characteristics	Question Items	Differences
A	[Consideration]	Cooperative Warm Kind Admirable	B (p = .001) AB (p = .026) B (p = .046) AB (p = .028)
B	* Non-creative	Non-original	A (p = .040), O (p = .034)
O	[Introversion] [Extraterrestrial] [Instability] [Thinking]	Shy Shy Energy-rich Disordered Cooperative	A (p = .009) A (p = .010), B (p = .013) B (p = .034) B (p = .040) B (p = .047)
AB	[Logicality] [Consideration]	Rational Cooperative	B (p = .018) B (p = .023)

(*) Indication: an item that is not organized into separate categories

Sayuri Wada (1996)

According to 60 items that was constructed the Big Five Scales of personality trait (Wada, 1996), only three items correspond to blood type personality: nervous, self-centered and meticulous.

Appendix C

In Survey 2’s ANOVA result (Table 1), 11 of the 12 items showed the same results as those shown for blood type characteristics in the preceding psychology papers (Tables 2-4 in the text), and 2 items were statistically significant at $p < 0.05$, and 1 item after the Bonferroni’s correction.

Table 1. Survey 2 ANOVA for Characteristics Scores and Blood Type (no-knowledge group)

Q1	Characteristics (Blood type)	Blood type	Blood type	Blood type	Blood type	F	η^2	p
		A (N = 191)	B (N = 127)	O (N = 150)	AB (N = 52)			
a	Meticulous (A)	3.372 (0.986)	3.173 (1.148)	3.133 (1.072)	2.827 (1.216)	3.923	0.022	0.087
b	Hard to be understood (AB)	3.126 (0.997)	3.252 (1.161)	3.252 (1.161)	3.308 (1.094)	0.660	0.004	0.577
c	Self-paced (B)	3.440 (1.008)	3.685 (1.146)	3.473 (1.034)	2.859 (1.014)	1.990	0.011	0.114
d	Positive (O)	2.859 (1.014)	2.740 (1.274)	2.878 (1.096)	2.654 (1.186)	0.860	0.005	0.461
e	Dual personality (AB)	2.209 (1.055)	2.260 (1.128)	2.373 (1.096)	2.962 (1.236)	2.758	0.037	<0.001
f	Big-hearted (O)	2.864 (1.006)	2.866 (1.198)	3.140 (1.017)	2.788 (1.126)	2.612	0.015	0.051
g	Self-centered (B)	3.052 (1.085)	3.087 (1.235)	3.027 (1.010)	2.808 (1.030)	0.851	0.005	0.467
h	Serious (A)	3.440 (0.965)	3.402 (1.262)	3.413 (1.031)	3.269 (1.157)	0.342	0.002	0.795
i	Cheerful (B)	2.916 (1.102)	2.732 (1.057)	2.760 (0.974)	2.712 (1.194)	0.274	0.003	0.844
j	Laid back (O)	3.136 (1.072)	3.000 (1.215)	3.400 (1.036)	3.192 (1.221)	1.114	0.006	0.343
k	Genius-like (AB)	2.136 (1.072)	1.961 (1.057)	2.113 (1.072)	2.228 (1.126)	3.152	0.018	0.025
l	Nervous (A)	3.435 (1.028)	2.094 (1.137)	3.307 (1.049)	3.231 (1.182)	0.419	0.002	0.739

Note. Standard deviations are in parentheses. Highest scores that match with blood type characteristics, and $p < 0.05$ are highlighted in bold.

Appendix D

Kamise and Matsui (1994)

Kamise and Matsui (1994) said “there exist core characteristics of each blood type, and the entire contents are formed around them.” The following is a concrete example given by Yamazaki and Sakamoto (1991), and Matsui (1991).

Yamazaki and Sakamoto (1991), and Matsui (1991)

Only a few “famous traits” were real; the percentages of participants who imagined type A traits and the actual answers did not seem to match (Chart 1 and Table 1).

Percentages who said the image of a trait was type A (Yamazaki and Sakamoto, 1991).

Actual differences from type A people from the averages of other blood types (Matsui, 1991).

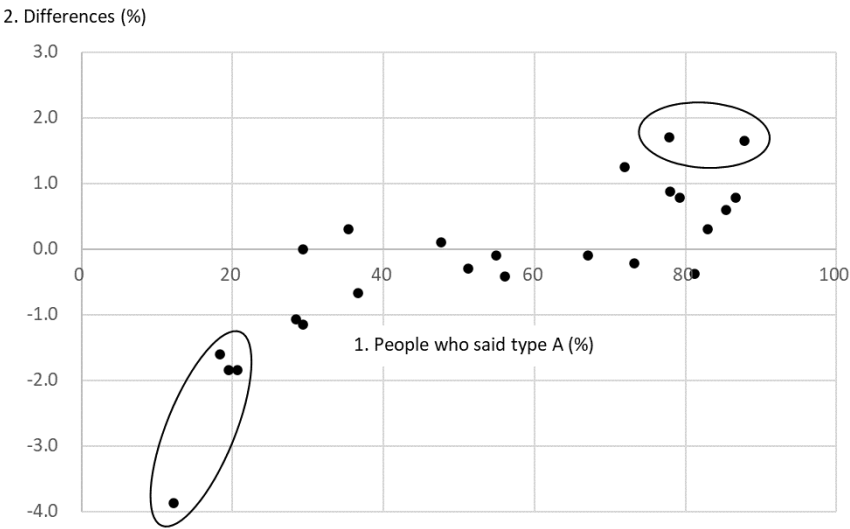


Chart 1. Result of Re-analysis of the Big Five Characteristics

Table 1. Result of re-analysis of the Big Five Characteristics

1. People who said type A (%)	2. Actual differences (%)	Items
87.8 86.6 85.4 83.0 81.2 79.3	1.65 0.78 0.60 0.30 -0.38 0.78	15. I am careful when doing something. 6. I am serious when I should be so. 2. I make an effort toward my goal. 21. I am shy. 5. I do not know how to refresh myself. 23. I like to think deeply alone more than to talk with others. 19. I am persevering. 11. I am often worried about things. 24. I do not like to visit someone without presents. 22. I sometimes burst into a rage. 13. I am not good at getting along with others. 8. I do not change my idea after I present it. 16. I am often moved to tears. 12. I sometimes indulge in fancies. 3. I like to be a leader. 10. I have a lot of friends. 20. I cannot be quiet and I make merry when I am delighted. 18. I am a good loser. 14. I like to have parties in my home. 1. I am ready to keep company with everyone.
78.0 77.8 73.2 72.0 67.1 56.1	0.88 1.70 -0.23 1.25 -0.10 -0.43	7. I often tell jokes to make others laugh. 9. I am not worried by what I was told. 17. I often change my mind. 4. I am not particular about things.
54.9 51.2 47.6 36.6 35.4 29.3	-0.10 -0.30 0.10 -0.68 0.30 -1.15	
29.3 28.4 20.7 19.5 18.3 12.2	0.00 -1.08 -1.85 -1.85 -1.60 -3.88	

Note. Items highlighted in bold are circled in Chart 1 and $p < 0.05$.

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