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RESEARCH ARTICLE

Assessing Chimpanzee Personality and Subjective Well-Being in Japan

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We tested whether the cultural background of raters influenced ratings of chimpanzee personality. Our study involved comparing personality and subjective well-being ratings of 146 chimpanzees in Japan that were housed in zoos, research institutes, and a retirement sanctuary to ratings of chimpanzees in US and Australian zoos. Personality ratings were made on a translated and expanded version of a questionnaire used to rate chimpanzees in the US and Australia. Subjective well-being ratings were made on a translated version of a questionnaire used to rate chimpanzees in the US and Australia. The mean interrater reliabilities of the 43 original adjectives did not markedly differ between the present sample and the original sample of 100 zoo chimpanzees in the US. Interrater reliabilities of these samples were highly correlated, suggesting that their rank order was preserved. Comparison of the factor structures for the Japanese sample and for the original sample of chimpanzees in US zoos indicated that the overall structure was replicated and that the Dominance, Extraversion, Conscientiousness, and Agreeableness domains clearly generalized. Consistent with earlier studies, older chimpanzees had higher Dominance and lower Extraversion and Openness scores. Correlations between the six domain scores and subjective well-being were comparable to those for chimpanzees housed in the US and Australia. These findings suggest that chimpanzee personality ratings are not affected by the culture of the raters. Am. J. Primatol. 71:283–292, 2009.

Key words: chimpanzee; personality; well-being; culture; age; sex

INTRODUCTION

Personality describes behaviors, emotions, and cognitive styles that are stable across situations and throughout life [McCrae & Costa, 2003]. Personality researchers have increasingly accepted the Five-Factor Model (FFM), which posits that five broad factors or domains—Neuroticism, Extraversion, Openness to Experience, Agreeableness, and Conscientiousness—underlie human personality variation [Digman, 1990]. Later research showed that the FFM is not an artifact of the implicit personality theories of raters [see Borkenau, 1992 for a review] and that the factors and their facets are heritable [see Bouchard & Loehlin, 2001 for a review]. The FFM is also a human universal. A study of personality ratings from 50 Western and non-Western cultures found the FFM in all cultures; a consistent pattern in which women had higher scores in all five domains, especially Neuroticism and Agreeableness; and age-related differences suggesting declines in Neuroticism, Extraversion, and Openness and increases in Agreeableness and Conscientiousness [McCrae et al., 2005].

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Although early laboratory primatologists noted the importance of personality and often described the personality of their chimpanzees [e.g. Yerkes, 1939], later attempts to describe chimpanzees or other nonhuman species as similar to humans has elicited howls of anthropomorphism [Povinelli, 1997]. However, evidence is emerging that analogs of some or all of the five domains found in humans exist in several nonhuman species and that, like human domains, these domains display high interrater reliabilities, construct validities, and internal consistencies [see for reviews Gosling, 2001; Gosling & Vazire, 2002].

Most notably, King and Figueredo [1997] obtained chimpanzee personality ratings on a questionnaire containing adjectival descriptors of the human FFM [Goldberg, 1990]. They found evidence for five chimpanzee personality domains resembling the FFM and a chimpanzee-specific domain related to competitive prowess, which they named Dominance. One could argue that a questionnaire containing items sampling the five human domains would cause those same domains to emerge regardless of the species rated. A proposed solution to this possible problem is to use a bottom-up approach, beginning with broadly based and species-relevant behavior observations as a basis for later inference of higher level traits [Uher, 2008].

However, evidence is emerging that the previously identified chimpanzee personality domains are not questionnaire-based artifacts, including the emergence of the Dominance domain [King & Figueredo, 1997], the correlation with observed behaviors [Pederson et al., 2005], and the heritability of the Dominance domain [Weiss et al., 2000]. Moreover, just as the domains of the FFM are related to human subjective well-being [DeNeve & Cooper, 1998; Steel et al., 2008], Dominance and Extraversion in chimpanzees are positively related to a measure of subjective well-being [King and Landau, 2003].

Two recent studies indicate that chimpanzee personality domains generalize beyond zoo environments. The first study compared zoo chimpanzees with chimpanzees living in a naturalistic African sanctuary and found that Dominance (D_{CH}), Extraversion (E_{CH}), Conscientiousness (C_{CH}), and Agreeableness (A_{CH}) replicated whereas Neuroticism (N_{CH}) and Openness (O_{CH}) did not [King et al., 2005]. The second study comparing chimpanzees in zoos with those at the Yerkes National Primate Research Center [Weiss et al., 2007] found that the same four domains replicated.

A fundamental question related to the generalizability of chimpanzee personality domains across settings is the extent to which these personality domains generalize across raters with different cultural, historical, and linguistic backgrounds. We addressed this question by collecting ratings of chimpanzees in Japan. Although the Japanese and American raters had similar socioeconomic and educational backgrounds, cultural differences no doubt remained. One potential difference is that the Japanese may be more likely to accept the notion of nonhuman primate personality, perhaps as a consequence of Japanese religious traditions, that, in contrast to the Judeo–Christian traditions, allow animals to be imbued by a soul [Asquith, 1986]. In addition, early Japanese biologists including Imanishi [2002] emphasized that animals were individuals as well as representatives of a species. Another cultural difference may result from a greater awareness of primate behavior in Japan as there is a primate species native to Japan [de Waal, 2001].

In addition, cross-cultural studies have revealed several differences between the US and Japan that may influence ratings [Hofstede, 2001]. Compared with American culture, Japanese culture is more collectivistic. Thus, ties among individuals outside their immediate family are stronger. Japanese culture is also higher in masculinity. Uncertainty avoidance is higher in Japan, indicating a reduced tolerance for ambiguity and a greater need for structure and predictability. Finally, long-term orientation is higher among the Japanese resulting in an emphasis on thrift and perseverance.

Although prior research has examined the personality of chimpanzees in Japan [Inoue-Murayama et al., 2006], because this research was based on a different questionnaire, these ratings cannot be compared with those obtained in the US. Therefore, in this study we obtained personality ratings of chimpanzees using a translated version of questionnaires first used to rate chimpanzees in the US [King & Figueredo, 1997]. The study thus addressed four questions concerning the influence of cultural differences in the perception of chimpanzee personality. First, we determined whether interrater reliabilities for item ratings differed across cultures. Second, we determined whether culture-specific assumptions about trait intercorrelations influenced ratings, by comparing personality structures based on Japanese and on US ratings. Third, to assess the impact of culture influences on the perception of sex or age differences, we examined sex and age effects. Fourth, because cultural differences might be reflected in how chimpanzee personality is perceived to be related to subjective well-being, we compared correlations between the personality domains and subjective well-being for chimpanzees in Japan and in the US and Australia.

METHODS

The study was noninvasive. The research complied with regulations and guidelines prescribed by The University of Edinburgh and participating zoos, research institutes, and the sanctuary.

Subjects

Subjects were 146 chimpanzees housed in seven zoos ($N = 46$), two research institutes ($N = 20$), and one sanctuary ($N = 80$) in Japan. Chimpanzees ranged in age from 0.2 to 51.7 years ($M = 22.0$; SD = 10.5) with the 60 males ranging in age from 1.9 to 43.3 years ($M = 21.3$; SD = 9.1) and the 86 females ranging in age from 0.2 to 51.7 years ($M = 22.5$; SD = 11.5).

Instruments

Hominoid Personality Questionnaire

The Hominoid Personality Questionnaire (HPQ) contains 54 adjectives, each followed by one to three sentences that define the adjective within the context of chimpanzee behavior. Of these items, 43 had been used to identify the FFM plus Dominance in chimpanzees [King & Figueredo, 1997]. Forty-one of these adjectives, but not the clarifying sentences, were taken from adjectives of the 75 subscales of the Goldberg's Big Five [Table 3, 1990]. Two additional items, *clumsy* and *autistic*, as well as the clarifying sentences, were created by King and Figueredo [1997].

As neither N_{CH} nor O_{CH} clearly replicated across habitats [King et al., 2005; Weiss et al., 2007], five items were added to the questionnaire for a study of orangutan personality to increase representation of the positive and negative poles of these domains [see Weiss et al., 2006 for details]. In a second revision, we added the items *thoughtless*, *distractible*, and *quitting* to assess the low pole of Conscientiousness and the items *individualistic*, *innovative*, and *unperceptive* to assess the positive and negative poles of Openness. These items had been adapted from adjectives in an existing questionnaire [Table 4, McCrae & Costa, 1985].

Each item was rated on a 7-point Likert scale in which 1 indicated *Displays either total absence or negligible amounts of the trait* and 7 indicated *Displays extremely large amounts of the trait*. The HPQ instructed raters to base ratings on overall impressions and not on estimated frequencies of particular behaviors, and to avoid discussing their ratings with other raters.

There were missing data. For one chimpanzee, two raters did not answer one item (*quitting*) and one of these raters also did not answer the item *bullying*. In addition, one rater did not rate two chimpanzees on the item *aggressive* and another rater did not answer the item *distractible*. Consistent with the approach described for the NEO-PI-R [Costa & McCrae, 1992], a score of 4 was substituted for these missing values.

Subjective Well-Being Questionnaire

The subjective well-being questionnaire was identical to a four item questionnaire used to assess orangutan subjective well-being [Weiss et al., 2006] that had been adopted from a similar questionnaire used to rate chimpanzee subjective well-being [King & Landau, 2003]. Each item asked about a particular aspect of subjective well-being that has been described in the human literature: The first asked raters to assess the balance of positive vs. negative moods in the target chimpanzee; the second asked raters to indicate how pleasurable and satisfying social interactions were for the target chimpanzee; the third asked raters to indicate how successful the chimpanzee was at achieving its own set of personal goals; and the fourth asked how happy the rater would be if he or she were the target chimpanzee for a week. Each question was answered using a 7-point Likert scale in which 1 indicated *Displays either total absence or negligible amounts of the trait or state* and 7 indicated *Displays extremely large amounts of the trait or state*.

There were also missing data for this questionnaire. One rater did not rate one chimpanzee and a second rater did not rate three chimpanzees. In addition, one rater did not rate eight chimpanzees on the item about the balance of moods and the item concerning pleasure derived from social interactions. In the latter two cases, where partial data were available, we again substituted a 4 for the missing responses.

Questionnaire translation

The HPQ and subjective well-being questionnaire were translated into Japanese by Miho Inoue-Murayama. To insure the equivalence of the English and Japanese questionnaires, a native English speaker with extensive experience in Japanese then back-translated the questionnaires from Japanese into English. Inconsistencies were corrected and rechecked by back-translation.

Raters and Ratings

Raters were employed at zoos, research institutes, or the sanctuary. As in prior studies [e.g., King & Figueredo, 1997], raters were not trained to rate chimpanzees. However, we requested that only raters who had been working with chimpanzees at their facility for at least two years complete the ratings.

Forty-six raters completed the HPQ for the 146 chimpanzees. Across the 467 ratings, period of acquaintance ranged from 1.0 to 40.9 years ($M = 4.9$; SD = 4.7). Forty-four raters completed subjective well-being questionnaires for 146 chimpanzees. Ratings were made between 3 days prior and 284 days after ($M = 106$ days) HPQ ratings. Because of personnel changes, 27 subjective well-being ratings, representing 9 chimpanzees, were not made by the same individual who rated the chimpanzees on the HPQ. These new raters had approximately four months of experience with these

chimpanzees. Thus, across the 456 subjective well-being ratings, period of acquaintance ranged from 0.3 to 40.9 years ($M = 4.6$; SD = 4.7).

RESULTS

Interrater Reliabilities of HPQ and Subjective Well-Being Items

We estimated interrater reliabilities using two types of intraclass correlations: ICC(3,1) that indicates reliabilities of individual raters and ICC(3,k) that indicates reliabilities of scores based on the mean of k raters [Shrout & Fleiss, 1979]. To compute ICCs we calculated mean squares for chimpanzee(location) and the Rater × Chimpanzee(Location) interaction using a general linear model with Type III sums of squares [PROC GLM; SAS Institute, 1999]. Locations were the ten institutions contributing data.

We calculated interrater reliabilities of the 54 HPQ items in the 146 chimpanzees rated by at least two observers. The mean number of raters per chimpanzee was 3.20 and the mean number of chimpanzees rated by each rater was 10.15. The reliabilities of individual ratings ranged from 0.02 (*unemotional*) to 0.58 (*dominant*). The mean and median reliabilities of individual ratings were 0.28 and 0.30, respectively. The reliabilities of mean ratings ranged from 0.06 (*unemotional*) to 0.82 (*dominant*). The mean and median reliabilities of mean ratings were 0.54 and 0.58, respectively.

We used a paired samples t-test to assess whether there were mean-level differences in the interrater reliabilities of individual ratings of the original 43 items between ratings on the 100 chimpanzees in the original study [King & Figueredo, 1997] and ratings on the present sample. The mean interrater reliability across items for ratings of chimpanzees in the original study ($M = 0.32$) did not substantially differ from that of this study ($M = 0.30$). To examine whether the rank order of interrater reliabilities between these samples differed we calculated the correlation between item reliabilities in the two samples. The correlation was high, $r = 0.78$, $P < .0001$, suggesting that the rank order of interrater reliabilities across items was mostly preserved between samples.

We calculated the interrater reliabilities of the four subjective well-being items in the 146 chimpanzees rated by at least two observers. The mean number of raters per chimpanzee was 3.20 and the mean number of chimpanzees rated by each rater was 10.36. Interrater reliabilities of individual ratings for the items were 0.46 (pleasure derived from social interactions), 0.48 (success in achieving goals), 0.49 (how happy a rater would be if they were the chimpanzee), and 0.51 (balance of positive and negative moods). The interrater reliabilities of mean ratings for the same items were 0.73, 0.74, 0.75, and 0.77, respectively.

The mean interrater reliability of individual ratings for these items in this study was 0.48. Thus, it did not substantially differ from the mean interrater reliability of the same items in King and Landau's [2003] study of 128 chimpanzees rated in the US and Australia ($M = 0.47$).

Principal Components Analyses

Personality

We performed a principal components analysis (PCA) with varimax rotation on the mean ratings across judges for the 43 original items. To determine the number of components to extract, we used parallel analysis [Horn, 1965; O'Connor, 2000], which indicated that eigenvalues of the first six components (8.28, 7.26, 4.62, 4.13, 2.93, and 2.41) exceeded the 95th percentile of eigenvalues expected by chance. We therefore extracted six components accounting for 68.92% of the variance.

To compare these components to King and Figueredo's [1997] factors, we used orthogonal targeted Procrustes rotation [McCrae et al., 1996]. This technique rotates a matrix of loadings from one sample to a target matrix of loadings from a different sample and indicates the degree of congruence between samples based on loadings for each item, each factor, and the entire structure. Congruence coefficients ≥ 0.90 strongly indicate replicability, although a simulation study indicated that the more liberal criteria of congruences ≥ 0.85 were acceptable [Haven & ten Berge, 1977]. Procrustes rotation also insured that the structure derived from the Japanese sample would be maximally similar to that of the original sample thereby facilitating interpretation of components. Salient loadings were defined as absolute loadings ≥ 0.40.

Table I shows the results of rotating loadings of the 43 original items in the present sample to the loadings of the same 43 items in the original sample of 100 chimpanzees [King & Figueredo, 1997]. The congruence coefficient for the overall component structure was 0.85, thus showing that the overall pattern of loadings was consistent with the loadings of the same items in American zoo chimpanzees. Based on similarities of the salient loadings to the first four factors in the original sample and the high congruences, we labelled these components D_{CH}, E_{CH}, C_{CH}, A_{CH}, respectively. Although the congruence coefficients for the remaining two components were less than 0.85, the pattern of salient loadings were similar to the original N_{CH} and O_{CH} factors, leading us to assign them the same names.

To compute domain scores that would include the additional adjectives we followed a three-step procedure. First, we generated unit-weighted domain scores based on the original factor definitions using the original 43 adjectives [see Table 1 in King

TABLE I. Structure of Chimpanzees in Japan Rotated to Structure from King and Figueredo (1997)

	Factor						
Item	D_{CH}	E_{CH}	C_{CH}[a]	A_{CH}	N_{CH}[a]	O_{CH}	Item Cong.
Dominant	**0.82**	0.04	−0.30	0.02	0.18	−0.15	0.94
Submissive	**−0.78**	−0.13	−0.01	0.23	−0.16	0.28	0.89
Dependent	**−0.68**	0.20	−0.15	0.06	−0.22	−0.01	0.95
Independent	**0.43**	−0.29	−0.21	−0.10	−0.31	0.17	0.80
Fearful	−0.39	−0.04	0.05	−0.03	**0.74**	0.19	0.72
Decisive	**0.55**	−0.08	−0.01	0.36	−0.20	**0.45**	0.78
Timid	**−0.59**	**−0.41**	**−0.40**	0.04	−0.03	0.07	0.66
Cautious	−0.25	−0.30	0.29	0.22	−0.04	**0.51**	0.72
Intelligent	**0.47**	0.14	−0.01	**0.54**	−0.07	**0.46**	0.93
Persistent	**0.56**	0.29	−0.28	0.15	−0.03	0.35	0.98
Bullying	**0.57**	−0.12	**−0.59**	−0.19	0.03	−0.05	0.96
Stingy	**0.52**	−0.14	**−0.46**	−0.19	0.10	0.07	0.87
Solitary	−0.26	**−0.77**	−0.08	−0.05	−0.14	0.23	0.94
Lazy	−0.15	**−0.71**	−0.05	0.22	−0.34	−0.28	0.91
Active	−0.01	**0.71**	**−0.43**	−0.07	−0.04	0.26	0.97
Playful	−0.07	**0.71**	−0.19	0.04	0.03	**0.50**	0.88
Sociable	−0.04	**0.63**	0.08	**0.58**	0.02	−0.06	0.94
Depressed	**−0.42**	**−0.44**	−0.03	−0.13	**0.53**	0.18	0.70
Friendly	−0.42	0.22	0.32	**0.56**	−0.25	−0.06	0.77
Affectionate	−0.04	0.38	0.05	**0.72**	0.16	−0.08	0.86
Imitative	−0.36	**0.44**	−0.26	0.17	**−0.40**	0.28	0.88
Impulsive	−0.08	−0.25	**−0.72**	−0.02	0.27	0.12	0.85
Defiant	**0.55**	−0.01	**−0.69**	−0.14	−0.11	0.00	0.96
Reckless	−0.12	0.08	**−0.76**	−0.17	−0.17	−0.15	0.86
Erratic	−0.32	−0.18	−0.28	−0.06	**0.66**	0.10	0.65
Irritable	0.34	−0.24	**−0.68**	−0.12	0.25	0.05	0.95
Predictable	0.19	**−0.44**	0.23	0.31	−0.27	−0.07	0.77
Aggressive	**0.59**	0.01	**−0.68**	−0.13	0.04	−0.03	0.96
Jealous	0.33	0.06	**−0.68**	−0.04	0.07	0.11	0.88
Disorganized	**−0.40**	−0.14	**−0.71**	0.10	−0.19	−0.13	0.80
Sympathetic	0.09	0.30	0.19	**0.81**	0.12	−0.20	0.86
Helpful	0.29	0.28	0.02	**0.74**	0.11	−0.18	0.77
Sensitive	0.28	0.00	0.04	**0.63**	−0.10	**0.41**	0.80
Protective	−0.03	0.12	−0.02	**0.69**	−0.21	−0.04	0.84
Gentle	−0.23	0.13	0.37	**0.74**	−0.14	−0.10	0.91
Stable	0.28	0.05	**0.40**	0.28	**−0.44**	0.09	0.92
Excitable	0.00	−0.32	**−0.63**	0.11	**0.41**	0.00	0.81
Unemotional	−0.12	−0.33	−0.04	**0.41**	**−0.62**	−0.22	0.74
Inventive	−0.06	**0.48**	−0.13	0.14	−0.18	**0.69**	0.92
Inquisitive	0.03	**0.48**	−0.11	0.11	−0.03	**0.72**	0.97
Manipulative[b]	**0.66**	0.04	−0.38	0.25	0.02	0.10	0.87
Clumsy[b]	−0.23	−0.40	**−0.52**	0.10	**−0.50**	−0.17	0.76
Autistic[b]	−0.28	−0.18	−0.20	0.10	**0.57**	0.05	0.66
Factor Cong.	0.89	0.91	0.89	0.89	0.69	0.71	0.85

[a]Loadings have been reflected.
[b]Items not included in the factor analysis presented in King and Figueredo (1997). D_{CH} = Dominance; E_{CH} = Extraversion; C_{CH} = Conscientiousness; A_{CH} = Agreeableness; N_{CH} = Neuroticism; O_{CH} = Openness; Item Cong. = Item Congruence Coefficient; Factor Cong. = Factor Congruence Coefficient. Absolute loadings ≥ 0.40 are indicated in boldface.

& Figueredo, 1997] by summing scores for traits that had salient loadings after they had been multiplied by +1 or −1 depending on the direction of the loading. Items with nonsalient loadings were assigned a weight of 0. Thus, the score for any individual was the weighted average of that individual's scores on all traits defining the domain. Unit-weighted scores are desirable because they are highly correlated with differentially weighted scores and likely to be more generalizable across samples [Gorsuch, 1983, p 269]. Second, we conducted 11 general linear models analyses with Type III sums of squares [PROC GLM; SAS Institute, 1999]. In each model, one of the new items was the dependent variable and the six personality domain scores served as predictor variables. We assigned the new item to

the domain that explained most of the item's variance. This procedure indicated that *vulnerable*, $sR^2 = 0.34$, $P < .0001$, and *anxious*, $sR^2 = 0.24$, $P < .0001$ were negatively related to D_{CH}; *individualistic* was negatively related to E_{CH}, $sR^2 = 0.25$, $P < .0001$; *thoughtless*, $sR^2 = 0.27$, $P < .0001$, *distractible*, $sR^2 = 0.28$, $P < .0001$, *unperceptive*, $sR^2 = 0.21$, $P < .0001$, and *quitting*, $sR^2 = 0.26$, $P < .0001$ were negatively related to C_{CH}; *conventional* was positively related to A_{CH}, $sR^2 = 0.16$, $P < .0001$; *cool* was negatively related to N_{CH}, $sR^2 = 0.28$, $P < .0001$; and *curious*, $sR^2 = 0.31$, $P < .0001$, as well as *innovative*, $sR^2 = 0.43$, $P < .0001$ were positively related to O_{CH}. Third, although the items, *clumsy*, *manipulative*, and *autistic* were either not reliable or did not have salient loadings in the original study [King & Figueredo, 1997], this was not the case for the Japanese sample. Therefore, these items were assigned to the domains onto which they loaded viz. C_{CH}, D_{CH}, and N_{CH}, respectively. The domain assignments of the new items were used to define new unit-weighted domain scores (see Table II) that were converted into *T*-scores ($M = 50$, SD = 10). The domain mean and standard deviation used to calculate *T*-scores of each chimpanzee were the overall mean and standard deviation of all 146 chimpanzees in the sample.

Subjective well-being

A PCA of the subjective well-being items indicated that only the first component had an eigenvalue greater than 1.00 (3.55). This factor accounted for 88.87% of the variance. Loadings on the four items ranged from 0.92 to 0.95. We therefore created a unit-weighted domain score based on the mean of all four subjective well-being items (each with a weight of +1) and converted it into a *T*-score.

Interrater Reliabilities and Internal Consistencies of Domain Scores

Interrater reliabilities of individual raters were 0.63, 0.56, 0.32, 0.48, 0.38, 0.51, and 0.58 for D_{CH}, E_{CH}, C_{CH}, A_{CH}, N_{CH}, O_{CH}, and subjective well-being, respectively. Interrater reliabilities for mean ratings were 0.85, 0.80, 0.60, 0.75, 0.66, 0.77, and 0.81 for D_{CH}, E_{CH}, C_{CH}, A_{CH}, N_{CH}, O_{CH}, and subjective well-being, respectively. The internal consistencies (Cronbach's αs) were 0.86, 0.81, 0.86, 0.84, 0.70, 0.92, and 0.96 for D_{CH}, E_{CH}, C_{CH}, A_{CH}, N_{CH}, O_{CH}, and subjective well-being, respectively.

Personality Correlations with Subjective Well-Being

Subjective well-being was negatively correlated with N_{CH} and positively correlated with D_{CH}, E_{CH}, A_{CH}, and O_{CH} (see Table III). With the exception that success in achieving goals was not correlated with O_{CH}, correlations between the personality domains and each of the subjective well-being items mirrored the relationships between personality domains and the composite subjective well-being score.

TABLE II. Definitions Used to Generate Unit-Weighted Domain Scores

	Loading	
Domain	Positive	Negative
Dominance	Dominant	Submissive
	Independent	Dependent
	Decisive	Fearful
	Intelligent	Timid
	Persistent	Cautious
	Bullying	Vulnerable
	Stingy	Anxious
	Manipulative	
Extraversion	Active	Solitary
	Playful	Lazy
	Social	Individualistic
	Friendly	Depressed
	Affectionate	
	Imitative	
Conscientiousness	Predictable	Impulsive
		Defiant
		Reckless
		Erratic
		Irritable
		Aggressive
		Jealous
		Disorganized
		Thoughtless
		Distractible
		Unperceptive
		Quitting
		Clumsy
Agreeableness	Sympathetic	
	Helpful	
	Sensitive	
	Protective	
	Gentle	
	Conventional	
Neuroticism	Excitable	Stable
	Autistic	Cool
Openness	Inquisitive	
	Inventive	
	Curious	
	Innovative	

Effects of Sex and Age Differences on Personality and Subjective Well-Being

For all six personality domains and subjective well-being we tested for the effects of habitat type (zoo, research institute, or sanctuary), sex, age (as a continuous variable), and the Sex × Age interaction using a general linear model with Type III sums of squares [PROC GLM; SAS Institute, 1999]. Because domain scores are *T*-scores and the sex variable was dummy coded (0 = females; 1 = males), the unstandardized regression coefficients (*b* values) were

TABLE III. Correlations Between Personality Domains and Subjective Well-Being

	Subjective well-being				
Domain	Moods	Social	Goals	Be Chimp	Total
Dominance	0.39****	0.46****	0.63****	0.43****	0.50****
Extraversion	0.51****	0.52****	0.34****	0.47****	0.49****
Conscientiousness	0.12	0.07	−0.01	0.08	0.07
Agreeableness	0.24**	0.21**	0.18*	0.19*	0.22**
Neuroticism	−0.37****	−0.30***	−0.33****	−0.35****	−0.36****
Openness	0.22**	0.23**	0.13	0.23**	0.22**

* = $P<.05$, ** = $P<.01$, *** = $P<.001$, **** = $P<.0001$.

interpretable. For sex effects, one-tenth of the *b*-score for sex effects will be equal to the difference in standard deviation units between males and females. For age effects, one-tenth of the *b*-score will be equal to the difference in standard deviation units associated with each year of age.

There was a significant habitat effect on C_{CH}, $\eta_p^2 = 0.13$, $F_{2,140} = 10.53$, $P<.0001$. Post hoc Scheffe's tests revealed that C_{CH} was significantly higher in zoos than in the sanctuary ($M_{diff} = 6.92$, 95% CI = 2.84–11.01) or research institutes ($M_{diff} = 10.20$; 95% CI = 4.28–16.11). Habitat type was also a significant predictor of N_{CH}, $\eta_p^2 = 0.17$, $F_{2,140} = 14.05$, $P<.0001$. Post hoc Scheffe's tests revealed that that N_{CH} was significantly higher in research institutes ($M_{diff} = 9.72$, 95% CI = 4.04–15.39) and in zoos ($M_{diff} = 7.84$, 95% CI = 3.64–12.04) than in the sanctuary.

There was no significant difference between males and females in any of the six domains or subjective well-being. However, there were two statistically nonsignificant trends suggesting that males had higher D_{CH} ($b = 7.12$, $\eta_p^2 = 0.02$, $F_{1,140} = 3.35$, $P = .0694$) and lower C_{CH} ($b = -6.12$, $\eta_p^2 = 0.02$, $F_{1,140} = 2.78$, $P = .0974$) scores than females. Older chimpanzees had significantly higher D_{CH} ($b = 0.23$, $\eta_p^2 = 0.05$, $F_{1,140} = 6.75$, $P = .0104$), lower E_{CH} ($b = -0.46$, $\eta_p^2 = 0.18$, $F_{1,140} = 30.13$, $P<.0001$), and lower O_{CH} ($b = -0.45$, $\eta_p^2 = 0.16$, $F_{1,140} = 27.28$, $P<.0001$) scores than younger chimpanzees (see Fig. 1). None of the Sex × Age interactions were significant (all Ps > .5038).

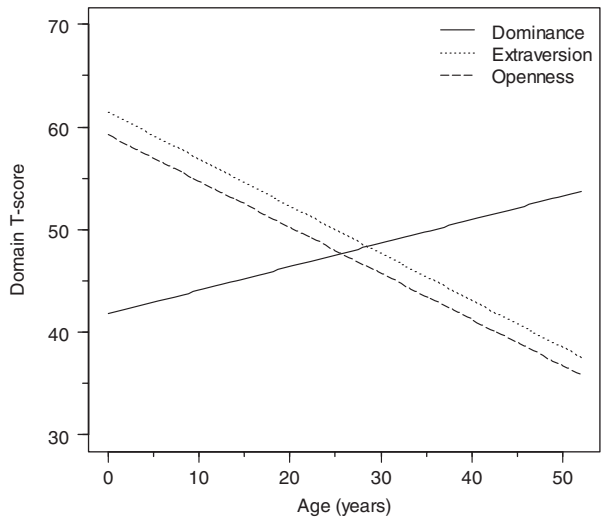

Fig. 1. Regression lines for cross-sectional age effects on Dominance, Extraversion and Openness.

DISCUSSION

Ratings on 54 adjectival personality descriptors and four subjective well-being items of chimpanzees housed in Japan were consistent across raters. Comparison of the interrater reliabilities of 43 adjectival personality descriptors in the present sample to those in a sample of chimpanzees in the US revealed no substantive cross-cultural differences in overall interrater reliability or in the rank order of interrater reliabilities across items. Similarly, there were no substantive differences between the means of the interrater reliabilities of the four subjective well-being items in this study and those in a study of personality and the subjective well-being in chimpanzees housed in the US and Australia [King & Landau, 2003].

These results are indicative of cross-cultural consistency in the meaning and intelligibility of the descriptor adjectives and their clarifying sentences as well as the subjective well-being indicators. The present results are the first evidence that cross-cultural effects on personality ratings do not constitute a serious problem in the subjective assessment of animal personality.

Historical and cultural variables may predispose Japanese raters to be more comfortable ascribing human-like personality characteristics to nonhuman animals. Thus, one might expect higher interrater reliabilities or a different rank ordering of item or factor reliabilities in Japan. The results did not support either of these predictions. In fact, Japanese ratings of chimpanzees were more consistent with American ratings of zoo chimpanzees than the latter were with American ratings of chimpanzees within Yerkes National Primate Research Institute. [Weiss et al., 2007]. These findings are evidence that

interrater reliabilities of ratings are based more on the nature of the items and chimpanzees than they are on the specific language or culture of the raters.

A PCA of personality descriptors shared between the present Japanese sample and the sample in the US indicated six components. An orthogonal targeted Procrustes rotation was used to compare these components to the six factors reported in a sample of chimpanzees in American zoos. This analysis revealed that D_{CH}, E_{CH}, C_{CH}, and A_{CH} replicated in the Japanese sample, whereas N_{CH} and O_{CH} did not. The same pattern of factor replicability occurred previously in comparisons of two independent samples of zoo-housed chimpanzees [Weiss et al., 2007, p 1269], zoo-housed chimpanzees with chimpanzees living in an African sanctuary in a naturalistic habitat and rated mainly with a French language questionnaire [King et al., 2005], and zoo-housed chimpanzees with laboratory-housed chimpanzees [Weiss et al., 2007]. Combined, these findings suggest that the failure of N_{CH} and O_{CH} to generalize from American to Japanese samples is most likely attributable to the small number of items defining N_{CH} and O_{CH}, and almost certainly is not a result of cultural or language differences between the US and Japan. Instead, the consistent pattern of Procrustes rotation results attests to the stability of chimpanzee factor structure across a remarkably diverse set of human cultures and physical settings.

One might suggest that similar personality domains may arise from the raters' preexisting expectations about correlations among the items on the questionnaires, i.e. the problem of implicit personality theories [Borkenau, 1992]. However, if implicit personality theories exerted strong effects on personality structure, the prediction would follow that the chimpanzee personality structure based on ratings from Japanese raters brought up in a culture that is highly accepting of anthropomorphism should be more human-like than the personality structure based on ratings from the US. The comparison of personality structure in this sample to that originally described by King and Figueredo [1997] led to results similar to those in two prior studies [King et al., 2005; Weiss et al., 2007]. Thus, cultural differences between raters had no important effect on correlations among personality traits.

As in prior findings in chimpanzees at American and Australian zoos [King & Landau, 2003] and in orangutans [Weiss et al., 2006], PCA on the four subjective well-being items revealed a single component. These results thus indicate a cross-cultural and cross-species generality of a single subjective well-being dimension within the context of the four items used in this study.

Chimpanzees' subjective well-being scores were negatively correlated with N_{CH}, but positively correlated with D_{CH}, E_{CH}, A_{CH}, and O_{CH}. Correlations between the individual subjective well-being items and the personality domains revealed a mostly similar pattern of results.

A previous study of chimpanzees also found that subjective well-being was positively associated with D_{CH} and E_{CH}; however, this study also found a positive association between subjective well-being and C_{CH} [King & Landau, 2003]. In fact, the Japanese data replicated human findings with respect to personality domains and subjective well-being [DeNeve & Cooper, 1998; Steel et al., 2008] more closely than King and Landau's [2003] earlier study. Although this finding may reflect implicit beliefs of the raters, it may have also resulted from the use of augmented personality domain scores or the fact that, unlike King and Landau's study, raters were not asked to use an ''anchoring'' procedure to assign subjective well-being ratings. A recent study of orangutan personality and subjective well-being, which also did not use an ''anchoring'' procedure [Weiss et al., 2006], supports the latter interpretation because correlations between subjective well-being and personality were similar to those in this study. Thus, overall the present findings on personality and subjective well-being parallel the present findings on personality, viz. invariance across culture and language differences of the raters.

Statistically nonsignificant trends suggested that males had higher D_{CH} and lower C_{CH} scores than females. These effects were small, but similar in direction to significant personality sex differences found in humans [McCrae et al., 2005] and chimpanzees in US and Australian zoos [King et al., 2008]. There were significant age effects; older chimpanzees were higher in D_{CH}, and considerably lower E_{CH} and O_{CH} scores than younger chimpanzees. The size of the age differences for D_{CH} and O_{CH} were comparable in size and direction to age differences found among chimpanzees in US and Australian zoos [King et al., 2008]. However, although the direction of the age effects on E_{CH} were in the same direction as those among chimpanzees in US and Australian zoos [King et al., 2008], the effect size was greater among chimpanzees in the US and Australia than among chimpanzees in Japan. Although this difference may reflect a cross-cultural difference, it is more likely that this difference arose because of the greater proportion of very young chimpanzees in the sample of chimpanzees in the US and Australian zoos (31.7%) than in the sample of chimpanzees in Japan (11.0%).

The subjective well-being of chimpanzees in Japan did not differ among chimpanzees in zoos, research centers, and a sanctuary. However, the chimpanzees housed in the sanctuary had the lowest N_{CH} scores, which may reflect the fact that most chimpanzees living in the sanctuary were in large groups. Moreover, the low C_{CH} and high N_{CH} scores of chimpanzees in the research institutes likely does

not reflect the influences of being research subjects as research at both institutes is noninvasive and participation by the chimpanzees is voluntary. As such, these differences may reflect differences in the relationships between the rater and the target at research institutes and how that influences the perception of the chimpanzees' personality.

Just as it is possible that chimpanzee personality structure arose from expected correlations among the adjectival descriptors [Borkenau, 1992], it is also possible that sex and age differences also reflect expectations. However, again, if this effect were present, one would expect different results when ratings are made by raters socialized in a different culture. With respect to sex and age differences, there is no convincing evidence that the culture of the raters influenced ratings.

Overall these findings suggest that personality ratings of chimpanzees in Japan resemble those of chimpanzees in the US and humans despite several potentially important cultural differences. These findings have practical implications, namely they suggest that ratings made with a Japanese translation of the HPQ and subjective well-being questionnaires yield results similar to those with English versions of the same questionnaires. Having similar measures that assess mostly stable behavioral, cognitive, and affective dispositions can facilitate exchange of information among zoos about the individual personalities of their charges. In particular, this may be an useful tool in making decisions about transferring chimpanzees or sharing information about how the needs of individuals with particular personality dispositions have been met. Finally, personality profiles can be used to improve communication to the public about the individuality of the chimpanzees. Similarly, a standardized measure of chimpanzee well-being or happiness also has possible practical implications. Combined with other measures, this common metric could be used to evaluate the success of enrichment programs or to compare different zoos. The result of these comparisons could lead to a better understanding of the sorts of programs and environments that foster chimpanzee happiness.

Humans and chimpanzees diverged as recently as 4 million years ago [Hobolth et al., 2007] and share approximately 98.8% of their genome in common [Chimpanzee Sequencing and Analysis Consortium, 2005]. Not surprisingly, researchers have often found that this close kinship is reflected in behavioral similarities, such as the capacity for culture [Whiten et al., 1999].

Previous findings of similar personality domains in chimpanzees and other nonhuman animals should not be surprising given the phylogenetic continuity of species. However, critics continue to raise alarm calls about the dangers of implicit personality theories guided, quite possibly, by anthropomorphism. We conducted several strong tests for the presence of such rater effects by examining ratings made by members of a different culture. In common with cross-cultural studies of human personality [McCrae et al., 2005], these results indicate that cultural differences likely had, if any, very little impact on the perception of chimpanzee personality. Future research may focus on statistically separating out rater and animal effects or how the personalities of raters influence ratings. However, we believe that this study strongly advances the argument that personality similarities between chimpanzees and humans do not lie in the eye of the beholder, but in the genes, brains, behavior, and souls that we inherited from our common ancestor.

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