

BRIEF REPORT

Personality Structure in Wild Eastern Chimpanzees (*Pan troglodytes schweinfurthii*)

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A study of wild chimpanzees using a brief questionnaire identified four factors that only weakly resembled those identified in zoo- and laboratory-housed samples. To test whether the failure to recover these factors was attributable to the small number of questionnaire items sampled in that study, the present study obtained ratings on 40 chimpanzees in Budongo Park, Uganda on the 54-item Hominoid Personality Questionnaire. Exploratory factor analysis using a matrix-free likelihood method for extracting factors obtained four personality factors—Dominance, Disagreeableness, Openness, and Extraversion—from 46 items that passed reliability screening. These factors resembled, but were not identical to, personality factors found in earlier samples of chimpanzees in human care. These findings are consistent with the notion that a universal structure of chimpanzee personality exists and that there may be some variation across habitats and populations.

Keywords: Big Five, field study, five-factor model, primate, traits

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Studies of humans find that five broad factors are sufficient to summarize a large number of lower-level traits (see Digman, 1990, for a review). This personality “structure” has been found across multiple cultures (McCrae et al., 2005), and it is the product of genetic correlations between the lower-level traits (e.g., McCrae et al., 2001).

There is evidence that a common set of personality factors summarizes lower-level traits in chimpanzees (*Pan troglodytes*), a species with whom we share a recent common ancestor (Glazko & Nei, 2003). Nine ratings-based studies subjected lower-level traits to principal components analysis or to exploratory factor analysis (Dutton, 2008; Freeman et al., 2013; King & Figueredo, 1997; King et al., 2005; Martin, 2005; Murray, 1995; Úbeda & Llorente, 2015; Weiss et al., 2007). Although the results varied across studies, six factors—Dominance, Extraversion, Conscientiousness, Agreeableness, Neuroticism, and Openness—

were found in at least three data sets based on trait ratings (see Table 1). Similar factors also emerged when traits were measured using behavioral observations (Freeman et al., 2013; Koski, 2011; Massen et al., 2013; van Hooff, 1970). These results are consistent with a personality structure that is universal to chimpanzees and that personality structures are species-specific adaptations (Weiss, 2018).

The chimpanzee subjects in these studies lived in zoological parks, research centers, or sanctuaries. To test whether similar personality factors also emerge in wild chimpanzees, Weiss et al. (2017) obtained ratings on a brief Swahili-language version of the Hominoid Personality Questionnaire (HPQ; Weiss, 2017) from long-term research assistants at Gombe National Park, Tanzania. Exploratory factor analysis of 19 items that were sufficiently reliable yielded factors labeled Dominance, Extraversion, Openness, and Agreeableness, but these factors only faintly resembled those found in the other studies, and

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 The data are available at <https://osf.io/etsqa/>.

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Table 1
Findings From Trait Rating Studies of Chimpanzee Personality

Source	Factor					
	Dom	Ext	Con	Agr	Neu	Opn
Murray (1995)	Y	Y	Y			
King and Figueredo (1997)	Y	Y	Y	Y	Y	Y
King et al. (2005)	Y	Y	Y	Y	U	
Martin (2005) ^a	Y	Y	Y	Y		Y
Weiss et al. (2007)	Y	Y	Y	Y		
Dutton (2008)	Y	Y		Y	Y	Y
Weiss et al. (2009)	Y	Y	Y	Y	U	U
Freeman et al. (2013) ^b	Y	Y	Y	Y		Y
Úbeda and Llorente (2015)						
Table 1	Y	Y			Y ^c	
Table 2 ^d	Y	Y ^e	U	U		U

Note. Cells left blank if the factor was not found in a study. Dom = Dominance; Ext = Extraversion; Con = Conscientiousness; Agr = Agreeableness; Neu = Neuroticism; Opn = Openness; Y = factor found; U = whether the factor was found is uncertain.

^a Martin extracted six factors, but the only loading on the sixth was the item protective. ^b Freeman et al. extracted an additional factor, methodical, but it was identified by just two unique loadings. In addition, correlations between the methodical and the other domain scales revealed that the methodical factor was not an independent construct. ^c This factor loaded was defined primarily by items related to Neuroticism but also on items related to low Agreeableness. Úbeda and Llorente thus labeled this factor neuropsychoticism. ^d Because one factor was a blend of Conscientiousness and Agreeableness ("Consc-Agreeableness") and the other was a blend of Conscientiousness and Openness ("Consc-Openness"), their findings with respect to the presence of Conscientiousness, Agreeableness, and Openness, they were described as uncertain. ^e Items that loaded on the factor labeled "Extraversion" in this analysis included items associated with Agreeableness (e.g., trustful and helpful).

only Dominance and Extraversion were defined by more than two items (see Table 2 in Weiss et al., 2017).

These results from Weiss et al.'s study of chimpanzees at Gombe raised the possibility that the set of factors identified in the previous studies was not a species universal and that it existed only among chimpanzees in human care. Correlations among behaviors in samples under human care may be modified, for example, by experiences related to being in regular contact with humans and/or to routines related to animal husbandry or care procedures. This explanation, however, does not explain why the personality factors found in the existing samples that differed in both how often they were in contact with humans and the degree to which their days were structured were largely the same. Likewise, it does not explain why different structures are found in captive samples of closely related species (e.g., bonobos; Weiss et al., 2015).

An alternative explanation to why similar personality factors did not emerge in the Gombe chimpanzees was that Weiss et al. (2017) obtained ratings on a brief version of the HPQ, and so there were too few items to represent each of the six factors, that is, the factors were underdetermined (MacCallum et al., 1999). King et al.'s (2005) findings supported this possibility. In that study, which used a sufficiently long questionnaire, Dominance, Extraversion, Conscientiousness, and Agreeableness, and possible evidence for Neuroticism and Openness were found in chimpanzees living in multiple zoos in the United States, one zoo in Australia, and in chimpanzees living at the Habitat Ecologique et Liberté des Primates sanctuary or at Conkouati Douli National Park (the release site), both in the Republic of the Congo (Congo Brazzaville).

The present study tested the extent to which the six personality factors identified in previous studies of chimpanzees can be found in wild Eastern chimpanzees living in the Budongo Forest. Raters completed the full (54 item) version of the HPQ, and so the number of excluded items would have to be very high to adversely affect the degree to which factors are overdetermined (MacCallum et al., 1999).

Method

Subjects

Data were collected on as many chimpanzees as possible (20 male and 20 female). The ages of the chimpanzees ranged from 13 to 52 years ($M = 26.5$, $SD = 9.34$). The males ranged in age from 13 to 38 years ($M = 24.0$, $SD = 7.42$). Ten males belonged to the Waibira community and ranged in age from 15 to 38 years ($M = 25.8$, $SD = 8.66$). The other 10 males belonged to the Sonso community and ranged in age from 13 to 32 years ($M = 22.2$, $SD = 5.83$). The females ranged in age from 14 to 52 years ($M = 29.0$, $SD = 10.53$). Ten females belonged to the Waibira community and ranged in age from 14 to 52 years ($M = 29.0$, $SD = 10.53$). The other 10 females belonged to the Sonso community and ranged in age from 18 to 52 years ($M = 35.7$, $SD = 9.60$).

Ratings

Prior to being rated, the members of the Sonso community had been observed for approximately 22 years and the members of the Waibira community had been observed for approximately 4 years. Raters included a U.K.-based researcher and six local research assistants. Raters were required to have at least 6 months of experience and to be comfortable reading and writing in English. Raters had between 6 months and 20 years of full-time experience working with the communities in which they rated chimpanzees.

Ratings were made on the 54-item HPQ. Items consisted of a trait, for example, "fearful," and one to three sentences (clarifying definitions) that framed the trait in terms of chimpanzee behavior. For the item fearful, the clarifying definition was "Subject reacts excessively to real or imagined threats by displaying behaviors such as screaming, grimacing, running away or other signs of anxiety or distress." The HPQ asks raters to make judgments based on their "own understanding of the trait guided by the clarifying definition" and to assign each trait a score from 1 (*displays either total absence or negligible amounts of the trait*) to 7 (*displays extremely large amounts of the trait*). The HPQ also instructs the raters to not discuss their ratings. For this study, the raters were administered a form of the English-language HPQ in which the clarifying definitions referred to "the environment" instead of "the enclosure."

Statistical Analyses

Data transformations and analyses were conducted using Version 4.3.2 of R (R Core Team, 2023). The ratings of one chimpanzee in the Sonso community by two raters were excluded because none of the items were completed. The ratings of a second chimpanzee in the Sonso community by another two raters were also excluded. In one case, the rater did not complete any items. In the other, following convention (e.g., Morton et al., 2013), the ratings were excluded because more than one-sixth (10 or more) of the items were missing.

Table 2
Factor Loading Matrix for the Four-Factor Structure

Item	Factor					h^2
	Assigned	Dominance	Disagreeableness	Openness	Extraversion	
Fearful	D–	–0.96	–0.17	–0.05	–0.04	0.96
Dependent/follower	D–	–0.95	–0.20	0.19	–0.07	0.98
Stable	N–	0.92	–0.21	0.17	–0.05	0.93
Independent	D+	0.90	0.33	0.00	–0.10	0.93
Cool	N–	0.89	–0.40	0.13	–0.01	0.98
Submissive	D–	–0.87	–0.37	0.26	–0.17	1.00
Timid	D–	–0.87	–0.38	0.12	–0.14	0.93
Vulnerable	D–	–0.87	–0.38	0.23	–0.16	0.97
Anxious	D–	–0.84	0.29	–0.29	–0.01	0.88
Manipulative	D+	0.83	0.32	0.07	0.38	0.95
Persistent	D+	0.83	0.45	0.11	0.19	0.94
Intelligent	D+	0.83	–0.33	0.23	0.13	0.86
Thoughtless	C–	–0.79	0.01	0.32	0.24	0.79
Decisive	D+	0.79	–0.31	–0.42	0.15	0.92
Clumsy	C–	–0.78	0.20	0.07	–0.14	0.67
Individualistic	E–	0.74	0.35	0.36	–0.02	0.80
Dominant	D+	0.74	0.52	–0.31	0.29	0.99
Distractible	C–	–0.69	0.47	0.24	–0.04	0.74
Erratic	C–	–0.67	0.26	–0.18	0.55	0.84
Sociable	E+	0.66	–0.27	0.10	0.42	0.70
Excitable	N+	–0.66	–0.08	–0.24	0.34	0.62
Aggressive	C–	0.66	0.57	–0.27	0.40	1.00
Protective	A+	0.66	–0.24	–0.65	–0.08	0.92
Defiant	C–	0.65	0.60	–0.37	0.18	0.95
Gentle	A+	–0.02	–0.98	–0.08	0.04	0.97
Irritable	C–	0.03	0.97	0.07	0.17	0.98
Jealous	C–	0.20	0.93	0.06	0.26	0.98
Affectionate	E+	–0.13	–0.92	–0.29	–0.01	0.96
Sensitive	A+	–0.20	–0.90	–0.20	0.21	0.94
Friendly	E+	0.24	–0.90	0.10	0.30	0.97
Stingy/greedy	D+	0.19	0.89	0.01	0.29	0.92
Bullying	D+	0.36	0.84	–0.07	0.36	0.97
Autistic	N+	0.04	0.82	0.41	0.06	0.85
Disorganized	C–	–0.59	0.75	0.11	–0.03	0.92
Cautious	D–	–0.25	–0.71	–0.59	0.11	0.94
Helpful	A+	0.36	–0.71	–0.43	0.31	0.91
Impulsive	C–	–0.45	0.59	0.24	0.42	0.79
Reckless	C–	–0.20	0.56	0.32	0.35	0.58
Imitative	E+	–0.37	0.56	0.49	0.08	0.69
Inquisitive	O+	0.03	0.16	0.94	–0.18	0.94
Curious	O+	0.12	0.13	0.83	0.36	0.85
Predictable	C+	0.27	–0.47	–0.75	–0.19	0.89
Innovative	O+	0.18	0.14	0.73	0.18	0.62
Playful	E+	–0.05	–0.53	0.54	–0.11	0.59
Active	E+	0.47	–0.12	0.11	0.76	0.83
Solitary	E–	–0.08	–0.25	–0.25	–0.69	0.60
Sum of squares		16.96	13.57	5.99	3.44	
Proportion of variance		0.37	0.29	0.13	0.07	

Note. Factors rotated using the varimax procedure. Loadings $\geq |0.4|$ are indicated in boldface. The column labeled “Assigned” indicates the relationship of items to factors as designated in Table II in Weiss et al. (2009). h^2 = item communalities; – = Negative loading; + = Positive loading; D = Dominance; E = Extraversion; C = Conscientiousness; A = Agreeableness; N = Neuroticism; O = Openness.

After exclusions, each chimpanzee was rated by two to six raters ($M = 3.88$, $SD = 1.95$) for a total of 155 ratings. The U.K.-based researcher rated all members of both communities, one field assistant rated all members of the Waibira community, another field assistant rated all members of the Sonso community, three other field assistants rated 19 members of the Sonso community, and the sixth field assistant rated 18 members of the Sonso community. Of these ratings, 23 out of a possible 8,370 (0.27%) responses (155 HPQs each with 54 items) were missing for

unknown reasons. All 12 affected chimpanzees were members of the Sonso community: nine were not rated on one item by one rater; one was not rated on one item by two raters; two, including one of those missing data on a single item, were not rated on two items, each; and one was not rated on nine items by one rater. Because the amount of missing data was small, in each case, following established practice (Weiss, 2017), a missing response for an item was replaced with the mean of responses to that item.

A custom R function written by Mark James Adams was used to compute interrater reliability coefficients in which raters are treated as fixed effects (Shrout & Fleiss, 1979). The terms in the analysis of variance included the main effects of subject identity (target), the main effects of rater identity (rater), and the Target $\times$ Rater interaction (error). The between-target mean square and the error mean square were then used to compute two forms of intraclass correlation coefficients (ICCs): ICC(3,1) represents the reliability of ratings from any single rater and ICC(3, k) represents the reliability of mean ratings based on k raters (Shrout & Fleiss, 1979). Following established practice (Weiss, 2017), items were removed if their reliability was less than or equal to 0.

The fad function from the fad package (V 0.9-1; Dutta & Dai, 2022) was used to extract factors from the correlation matrix of reliable items. The fad function uses a novel profile likelihood method to extract factors when the number of variables exceeds the number of subjects (Dai et al., 2020). Following Dai et al. (2020), the number of factors was determined by comparing Bayesian Information Criteria (BIC; Schwarz, 1978) from solutions with different numbers of factors. For this study, the minimum number of factors was set equal to 0 and the maximum number was that which yielded the item-to-factor ratio closest to 20:3. For example, if 40 items met the reliability criterion, the maximum number of factors was set to six. The 20:3 ratio was chosen because a simulation study found that it led to stable solutions even with small sample sizes (see Table 1 and Figure 1 in MacCallum et al., 1999). After extracting the solution corresponding to the lowest BIC, the resulting factor loading matrix was rotated using the varimax procedure. Loadings were defined as salient if they were greater than or equal to 0.4. The results were then inspected. If fewer than two items had their highest salient loading on one of the factors, the solution was rejected and the solution that had the next lowest BIC was examined. This step was repeated until each factor was represented by two or more salient loadings.

To compute interrater reliabilities of the factors, unit-weighted factor scores (Gorsuch, 1983) were computed by assigning each loading on a factor a weight of 0, 1, or -1 . Weights of 1 were assigned to loadings that were salient, positive, and the highest in absolute value. Weights of -1 were assigned to loading that were salient, negative, and the highest in absolute value. A weight of 0 was assigned to all other loadings. Ratings from each rater of each chimpanzee were multiplied by these weights and summed. ICC(3,1) and ICC(3, k) for each unit-weighted factor score were computed in the same manner as for items.

To obtain internal consistency reliabilities, after taking the mean of each item for each subject, items were assigned to factors if unit weights were 1 or -1 . The α function from the psych package (V 2.3.9; Revelle, 2023) was used to compute Cronbach's α s and their 95% confidence intervals (CIs) for each factor. These CIs were based on 1,000 resamples of the data.

Transparency and Openness Statement

Data, code, and materials are available at the Open Science Foundation (Weiss, 2025). The article cites all statistical packages and libraries used to conduct analyses. The kableExtra (V 1.4.0; Zhu, 2024) package was used to help create tables. The article reports how the sample size was obtained, all data exclusions and substitutions, and all measures used in the study. The data were not manipulated. Neither the study design nor the analyses were preregistered.

Results

ICC(3,1) and ICC(3, k) estimates for the items are in Table S1 in the online supplemental materials. Forty-six items had ICC(3,1) estimates ranging from .01 to .48 ($M = 0.15$, $SD = 0.12$). The comparable ICC(3, k) estimates ranged from .02 to .78 ($M = 0.37$, $SD = 0.20$). The items lazy, depressed, unperceptive, quitting, sympathetic, conventional, unemotional, and inventive had reliabilities equal to or below zero, and thus were excluded from further analyses.

The lowest BIC was obtained with seven factors. The seven-factor solution was rejected because one factor was defined by a single loading (see Table S2 in the online supplemental materials). The six- and five-factor solutions were rejected for similar reasons (see Tables S3 and S4 in the online supplemental materials). All factors from a four-factor solution, which accounted for 86.8% of the variance, were defined by at least two unique loadings (see Table 2). The first factor (Dominance) described the degree to which chimpanzees were assertive, conscientiousness, and emotionally stable versus submissive, unconscientious, and emotionally unstable. The second factor (Disagreeableness) described the degree to which chimpanzees were disagreeable, antagonistic, and selfish versus agreeable, peaceful, and altruistic. The third factor (Openness) described the degree to which an individual is exploratory, investigative, and tries new things. The fourth factor (Extraversion) was narrow and related to activity and gregariousness, both of which are lower-order facets of Extraversion (Costa & McCrae, 1995).

ICC(3,1) estimates for Dominance, Disagreeableness, Openness, and Extraversion were .63, .23, .35, and .33, respectively. The ICC(3, k) estimates for these factors were .87, .53, .68, and .66. The Cronbach's α s were .93 (95% CI = [.88, .96]), .91 (95% CI = [.86, .94]), .73 (95% CI = [.45, .84]), and .31 (95% CI = [.33, .70]), respectively, for these factors.

Discussion

Four factors—Dominance, Disagreeableness, Openness, and Extraversion—found in the present sample of wild Eastern chimpanzees resembled factors found in studies of chimpanzees living in human care (Dutton, 2008; Freeman et al., 2013; King & Figueredo, 1997; King et al., 2005; Koski, 2011; Martin, 2005; Massen et al., 2013; Murray, 1995; Úbeda & Llorente, 2015; van Hooff, 1970; Weiss et al., 2007, 2009). The present findings, therefore, indicate that the use of a brief questionnaire contributed to the inability to find a similar structure in chimpanzees living in Gombe National Park (Weiss et al., 2017). These results echo and amplify warnings voiced in the human personality literature about the use of brief personality questionnaires (Chapman, 2014; Chapman & Elliot, 2019; Weiss & Costa, 2014).

There were differences between the factors found in this and in studies of chimpanzees in human care: Conscientiousness and Neuroticism were absent; items associated with Conscientiousness (e.g., Weiss et al., 2009) loaded on Dominance or Disagreeableness; several items associated with Extraversion (e.g., Weiss et al., 2009) loaded either on Dominance, Disagreeableness, or Openness; and contrary to previous findings (e.g., Weiss et al., 2009), Dominance rather than Agreeableness loaded on protective. Moreover, the interrater reliabilities of factors were lower than those found in the previous studies of chimpanzees (e.g., King &

Figueredo, 1997), although they were higher than those found in Gombe chimpanzees (Weiss et al., 2017).

The absence of Conscientiousness and Neuroticism in the present sample could not have been related to deficient item content: 12 of the 14 Conscientiousness items and all four Neuroticism items were included in the analyses. One possible explanation is that there were not enough observable differences in traits related to Conscientiousness and/or Neuroticism that could be discerned during focal follows. This problem may be particularly acute for Neuroticism and Conscientiousness as behaviors related to these factors may be less overt than behaviors related to Dominance, Disagreeableness, Openness, and Extraversion. This situation differs from that at zoos, research centers, and some sanctuaries, where staff are constantly exposed to and/or interact with chimpanzees as part of daily animal husbandry. In other words, staff at these facilities may be more likely to witness rare but significant behaviors (Stevenson-Hinde & Hinde, 2011) and/or discern subtle individual differences. Another possible explanation is that some or all of these differences are products of localized selection or genetic drift. These findings may also reflect a limitation of the present study, that is, the small sample size.

The results from this study highlight the need for a large-scale study of personality in wild chimpanzees. Such a study would bring us closer to identifying a universal chimpanzee personality structure or identifying environmental conditions (e.g., food abundance and infectious diseases) or social conditions (e.g., population size and kinship structure) that led to the evolution of differences in personality structure across populations. These and other studies will therefore improve our understanding of the personalities of chimpanzees in the wild and in human care, better understand chimpanzees as individuals and as a species, and offer a glimpse into the character of the common ancestor that we share with chimpanzees.

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