American Journal of Primatology

RESEARCH ARTICLE

Translating Chimpanzee Personality to Humans: Investigating the Transportability of Chimpanzee-Derived Personality Scales to Humans

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There is a growing interest in the study of personality in chimpanzees with repeated findings of a similar structure of personality in apes to that found in humans. To date, however, the direct translational value of instruments used to assess chimpanzee personality to humans has yet to be explicitly tested. As such, in the current study we sought to determine the transportability of factor analytically-derived chimpanzee personality scales to humans in a large human sample ($N = 301$). Human informants reporting on target individuals they knew well completed chimpanzee-derived and human-derived measures of personality from the two most widely studied models of human personality: Big Five and Big Three. The correspondence between informant-reported chimpanzee- and human-derived personality scales was then investigated. Results indicated high convergence for corresponding scales across most chimpanzee- and human-derived personality scales. Findings from the current study provide evidence that chimpanzee-derived scales translate well to humans and operate quite similarly to the established human-derived personality scales in a human sample. This evidence of transportability lends support to the translational nature of chimpanzee personality research suggesting clear relevance of this growing literature to humans. Am. J. Primatol.

Key words: chimpanzees; personality; animal models; validity; translational research

INTRODUCTION

Within both the human and non-human primate literatures, research has converged on a relatively consistent five-factor structure of personality [Freeman & Gosling, 2010; John et al., 2008; McCrae & Costa, 2008; Weiss et al., 2007]. In humans, a large body of factor-analytic research consistently reveals five robust broad personality dimensions ["Big Five;" John et al., 2008] across languages and cultures: Neuroticism (e.g., general tendency to experience negative emotions and distress), Extraversion (e.g., energetic, approach-oriented), Openness (e.g., open-mindedness, originality), Agreeableness (e.g., prosocial tendency towards others), and Conscientiousness (e.g., impulse control abilities, attention to detail). Clark [2005] described another widely used model of personality whereby traits emerge through differentiation from three ("Big Three") largely innate biobehavioral temperament dimensions. Two of these dimensions are affective, namely, Negative and Positive Temperament, and the third dimension, Disinhibition (vs. Constraint), is a regulatory system that plays a role in the perception and interpretation of incoming stimuli [Clark & Watson, 2008; Tellegen, 1985]. Importantly, in both humans (for a review, see Markon, 2009) and chimpanzees [Latzman et al., 2014, 2015b], recent structural work has revealed hierarchical associations between Big Three traits and dimensions of the Big Five.

With regard to personality in chimpanzees, although the ultimate number of factors found across studies has varied, the existence of largely parallel dispositional traits among both human, and nonhuman primates is clear with a number of studies confirming the existence of comparable [e.g., Freeman et al., 2013; King and Figuerdo, 1997; King et al., 2008; Weiss et al., 2007], hierarchically organized [e.g.,

Contract grant sponsor: Brains and Behavior Seed Grant from Georgia State University; contract grant sponsor: NIH; contract grant numbers: HD-60563, MH92923.

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Received 1 September 2015; revised 4 December 2015; revision accepted 14 December 2015

DOI: 10.1002/ajp.22522
Published online XX Month Year in Wiley Online Library (wileyonlinelibrary.com).

Latzman et al., 2014, 2015b] dispositional traits in both humans and chimpanzees. The comparative nature and importance of the nonhuman primate literature is particularly clear for research with chimpanzees, because of their close genetic similarity to humans. Further, similar to humans [Bouchard, 2004], previous studies have shown that at least some portion of variability in chimpanzee personality is heritable and potentially linked to specific genetic polymorphisms [Hong et al., 2011; Hopkins et al., 2012; Latzman et al., 2014, 2015b; Weiss et al., 2000].

In addition to support for the replicability of a largely similar structure of personality in both chimpanzees and humans, personality traits have been found to evidence associations with a variety of important outcomes in both species. In chimpanzees, individual variation in personality has been found to be a predictor of a range of social behaviors (e.g., agonistic, affinitive) [Freeman et al., 2013; Massen & Koski, 2014; Pederson et al., 2005] and subjective well-being [Weiss et al., 2002, 2009]. Additionally, personality has been found to predict interest and willingness to participate in research tasks [Herrelko et al., 2012], success in problem-solving tasks [Hopper et al., 2014] as well as training success of blood glucose testing [Reamer et al., 2014]. Similarly, in humans, a large body of literature confirms the importance of these traits with respect to both psychological and physical health. For example, meta-analytic findings confirm the link between Conscientiousness and a variety of health-related behaviors, including diet and exercise, substance use behaviors, violence, risky sexual behaviors, among others [Bogg & Roberts, 2004]. Further, Neuroticism has repeatedly been shown to be the core personality trait associated with a wide range of psychopathology, most notably, anxiety and depression [Clark & Watson, 1991; for meta-analytic findings, see Kotov et al., 2010]. Finally, meta-analytic findings support low Agreeableness as a strong predictor of aggressive and antisocial behaviors [Miller & Lynam, 2001].

In an attempt to ensure comparability with the human personality literature, recent factor analytic research in a chimpanzee sample has led to the development of a comprehensive assessment instrument for measuring personality in chimpanzees [Freeman et al., 2013]. Importantly, in developing these scales, these authors explicitly considered both the large human literature as well as the relatively smaller literature on chimpanzee personality, potentially allowing for strong cross-species comparability. Specifically, results from principal components analyses provided strong evidence for a robust five-factor solution largely paralleling the Big Five model reliably found with human samples. Freeman et al. [2013] reported on a sixth factor (Methodical), however, this factor yielded poor predictive validity for expected behaviors. Although not included in the main analyses, for interested readers, bivariate analyses with this scale are included in the Supplemental Materials (Table SI). The remaining five factors that emerged were: Extraversion, Agreeableness, Reactivity/Undependability, Dominance, and Openness. Although not typically labeled as such in the Big Five model, Dominance appears to parallel reverse-keyed Neuroticism. Indeed, Dominance is reflected in low levels of fearfulness and timidity [Freeman et al., 2013; Latzman et al., 2015b]. Reactivity/Undependability, however, is a dimension not previously found to emerge in the Big Five model, consisting of items that have previously been found to load on Big Five Conscientiousness (e.g., impulsive, reverse-keyed), Agreeableness (e.g., deceptive, reverse-keyed), and Extraversion (e.g., calm, reverse-keyed) [Digman, 1990]. To date, however, the way in which personality scales developed in chimpanzees function in human samples relative to other traditional human-derived scales has yet to be explicitly investigated. Such an investigation would support the relevance of the human personality literature to chimpanzees as well as the relevance of the chimpanzee personality literature to humans.

Current Study

Although a burgeoning empirical literature supports the comparability of basic dispositional traits between chimpanzees and humans, suggesting an evolutionary-basis of personality, no study to date has explicitly tested the transportability of psychometric personality scales developed in chimpanzees to humans. As such, the translational value of the chimpanzee personality literature to humans is not unequivocal. The current study therefore aimed to explicitly evaluate the correspondence between personality scales developed in a chimpanzee sample [Freeman et al., 2013; hereafter "chimpanzee-derived" scales] and theoretically corresponding traditional human-derived scales in a human sample. With regard to chimpanzee personality trait links with the Big Five model in humans, as described above, we expected chimpanzee-derived Extraversion, Openness, and Agreeableness to link most strongly to their human-derived counterpart scales. Further, we expected chimpanzee Dominance to most strongly associate with low Neuroticism. Lastly, as Reactivity/Undependability consists of items that typically load on Conscientiousness, Agreeableness, and Extraversion in humans, we expected this scale to evidence negative associations with all three of these human-derived scales.

In addition to examining associations between chimpanzee-derived personality scales and human -derived Big Five scales, we also examined associations between chimpanzee-derived scales

and human-derived "Big Three" model scales. As mentioned above, the Big Three personality scales can be understood as higher-order dimensions under which the Big Five dimensions fall [Latzman et al., 2014; Markon et al., 2005]; Neuroticism, along with some components of low Agreeableness, combine to form Negative Temperament; Extraversion and Openness combine to form Positive Temperament; and low Agreeableness and low Conscientiousness combine to form Disinhibition. As such, we expected chimpanzee-derived Extraversion and Openness to link to human-derived Positive Temperament and chimpanzee-derived Dominance and to a lesser extent Agreeableness, to link to low human-derived Negative Temperament. Additionally, we expected chimpanzee-derived Reactivity/Undependability and, to a lesser extent Agreeableness, to link to human-derived Disinhibition positively and negatively, respectively.

METHODS

Participants

Participants consisted of 301 adults recruited through Amazon's Mechanical Turk (MTurk; www.mturk.com), an open online marketplace that provides access to participants for web-based data collection. Research indicates that studies conducted using MTurk produce results broadly similar to those yielded by traditional data collection methods [Buhrmester et al., 2011; Goodman et al., 2013]. Participants were asked to "report on an individual they know well" (e.g., spouse/partner, friend, family member) and were compensated monetarily for their participation. This approach was adopted because it is similar to the manner in which chimpanzee personality is determined (i.e., a caretaker or staff member rates the individual ape). The majority of were female (63.7%) and White (80.6%) whereas individuals on whom informants reported ($M_{age} = 36.99 \pm 14.42$) were about evenly split between males and females (52.5% males, 47.5% females), with 40.5% of targets being the informant's spouse/partner, 36.0% a friend, and 21.6% a family member. All study procedures were approved by the University's Institutional Review Board, and were in compliance with the American Society of Primatologists' Principles for the Ethical Treatment of Primates.

Measures

Chimpanzee personality inventory

Participants completed a slightly modified version of the chimpanzee personality inventory developed by Freeman et al. [2013]. As described above, this instrument consists of five replicable scales: Extraversion (e.g., Depressed [reversed], Solitary [reversed]; six items), Agreeableness (i.e., Protective, Considerate/Kind; two items), Reactivity/Undependability (e.g., Irritable, Temperamental/Moody; 15 items), Dominance (e.g., Fearful [reversed], Timid [reversed]; eight items), and Openness (e.g., Inquisitive/Curious; six items).

Additionally, in chimpanzees, these scales have been found to evidence strong convergent and discriminant validity with various observed behavior and has demonstrated strong criterion validity with other scales previously validated across several different studies [Freeman et al., 2013]. Further, reliability has been shown to be adequate both in terms of inter-rater reliability, as well as internal consistency, and factors have been found to demonstrate good external validity [Freeman et al., 2013; Hopper et al., 2014; Reamer et al., 2014]. Using this instrument in the current sample, informants rated target individuals on 40 of the 41 items from the original instrument on a Likert-type scale ranging from one ("least descriptive") to seven ("most descriptive"). The item "human-oriented" was not included in the computation of the Openness scale as it was thought not to be transportable for use with humans, leaving the modified Openness scale with five items. Further, examples of chimpanzee-specific behavior were excluded from item definitions. Informants therefore rated target individuals solely on the single adjective items. Internal consistencies (Cronbach's alphas) for the current sample were as follows: Extraversion = 0.64; Dominance = 0.66; Agreeableness = 0.66; Openness = 0.67; Reactivity/Undependability = 0.89.

Big five personality

Participants also rated target individuals using the informant-report version of the Big Five Inventory (BFI; John et al., 2008), a 44-item measure designed to assess the Big Five personality traits: neuroticism, extraversion, openness, agreeableness, and conscientiousness. Participants rated the extent to which various statements describe the target individual on a 5-point Likert-type scale ranging from Agree Strongly to Disagree Strongly. In the current sample, internal consistencies (Cronbach's alphas) were as follows: Extraversion = 0.83; Openness = 0.84; Agreeableness = 0.90; Conscientiousness = 0.90; Neuroticism = 0.90.

Big three personality

Finally, participants rated target individuals using an informant-report version of the General Temperament Survey ([GTS; Clark & Watson, 1990], a 90-item, True-False measure designed to assess the three broad-based dimensions of personality in the Big Three model: Negative Temperament, Positive Temperament, and Disinhibition. In addition to these three broad-based dimensions, the GTS also includes two Positive Temperament

subscales, Energy and Positive Affectivity, and two Disinhibition subscales, Carefree Orientation and Antisocial Behavior. In the current sample, internal consistencies (Cronbach's alphas) were as follows: Carefree Orientation = 0.81; Antisocial Behavior = 0.83; Positive Affectivity = 0.85; Energy = 0.86; Disinhibition = 0.91; Positive Temperament = 0.91; Negative Temperament = 0.94.

Analyses

Missing data were imputed at the item level using the expectation-maximization (EM) estimation; no participant was missing more than 5.75% of their data. Convergent and discriminant patterns of associations between the chimpanzee-developed personality scales and the traditional human scales were then evaluated in different ways. First, bivariate (zero-order) correlations among and between chimpanzee-developed scales and human-developed scales were computed. Differences between dependent correlations were compared using asymptotic Z-tests. Next, to evaluate correspondence between variance unique to each chimpanzee-developed scale and its human personality trait counterpart, regression models were performed in which scores on each of the human-developed scales were included as predictors with the five chimpanzee scales as the criterion. A parallel set of analyses were conducted for both Big Five scales and Big Three scales. Descriptive statistics in addition to inter- and intra-scale correlations among all scales are included in the Supplemental Materials (see Table SII).

RESULTS

Associations Between Chimp Personality Scales and Big Five Personality Scales

Bivariate correlations between chimpanzee-derived and human-derived Big Five personality scales are presented in Table I, Panel A. The strongest associations for three of the five chimpanzee-derived scales were with theoretically corresponding human-derived scales; chimpanzee-derived Openness, Agreeableness, and Dominance linked strongly to human-derived Openness ($r = 0.66$, $P < 0.001$), Agreeableness ($r = 0.69$, $P < 0.001$), and low Neuroticism ($r = -0.62$, $P < 0.001$), respectively. Further, associations between these corresponding chimpanzee-derived and human-derived scales were significantly different from associations with non-corresponding scales (all $Zs > |3.71|$, all $Ps < 0.001$). Chimpanzee-derived Extraversion linked most strongly to low human-derived Neuroticism ($r = -0.60$, $P < 0.001$), followed by Extraversion ($r = 0.56$, $P < 0.001$), with the latter yielding a slightly lower, albeit significantly different correlation than the former ($Z = -15.02$, $P < 0.001$). Moreover, the association between chimpanzee-derived Extraversion and human-derived Neuroticism was significantly larger than all other human-derived scales (all $Zs > -12.13$, all $Ps < 0.001$), whereas the association between counterpart Extraversion scales was only significantly larger than human-derived Openness ($Z = 2.91$, $P < 0.01$). Lastly, chimpanzee-derived Reactivity/Undependability linked most strongly to low human-derived Agreeableness ($r = -0.71$, $P < 0.001$), followed by Neuroticism ($r = 0.63$, $P < 0.001$) and low Conscientiousness ($r = -0.56$, $P < 0.001$), respectively; correlations were significantly different from one another and significantly stronger than associations between chimpanzee-derived Reactivity/Undependability and the remaining two human-derived scales (all $Zs \geq |3.62|$, all $Ps < 0.001$).

Within multivariate models, convergent associations with corresponding scales were clearly evident with the strongest unique predictive associations (i.e., beta coefficient magnitudes) between corresponding chimpanzee and human-derived personality scales (see Table II). Specifically, chimpanzee-derived Extraversion, Openness, Agreeableness, and Dominance were most strongly predicted by human-derived Extraversion ($\beta = .38$, $t = 9.12$ $P < .001$), Openness ($\beta = .48$, $t = 10.85$, $P < .001$), Agreeableness ($\beta = .61$, $t = 11.55$, $P < 0.001$), and low Neuroticism ($\beta = -0.59$, $t = -10.40$ $P < 0.001$), respectively. Additionally, chimpanzee-derived Reactivity/Undependability was most strongly predicted by low human-derived Agreeableness ($\beta = -0.53, t = -11.41, P < 0.001$), followed by low Conscientiousness ($\beta = -0.26$, $t = -5.67$, $P < 0.001$) and Neuroticism ($\beta = 0.24$, $t = 4.65$, $P < 0.001$).

Associations Between Chimpanzee-Derived Personality Scales and Human-Derived Big Three Scales

Bivariate correlations between chimpanzee-derived personality scales and human-derived Big Three personality scales and subscales also evidenced strong correspondence between chimpanzee- and human-derived scales (see Table I, Panel B). In particular, chimpanzee-derived Extraversion and Openness were most strongly associated with human-derived Positive Temperament and its subscales; the latter was most strongly associated with the Positive Affectivity subscale ($r = 0.51$, $P < 0.001$), whereas the former was most strongly associated with the broad Positive Temperament scale ($r = 0.67$, $P < 0.001$). Additionally, chimpanzee-derived Dominance was most strongly associated with low human-derived Negative Temperament ($r = -0.54$, $P < 0.001$). Contrary to expectations, chimpanzee-derived Agreeableness showed the strongest correlation with Positive Temperament ($r = 0.44$, $P < 0.001$), an association that was significantly stronger than associations with the other human-derived scales ($Zs = 8.92$ and 10.77, $Ps < 0.001$ for associations with Negative Temperament and Disinhibition,

TABLE I. Bivariate Correlations Between Chimpanzee-Derived and Human-Derived Measures of Personality

Panel A					
	Chimpanzee-derived personality scales				
Human-derived big five scales	Extraversion	Agreeableness	Reactivity/undependability	Dominance	Openness
Extraversion	0.56[a]	0.22	−0.09	0.54	0.40
Agreeableness	0.51	0.69[b]	−0.71[a,b]	0.23	0.47
Conscientiousness	0.49	0.47	−0.56[a]	0.43	0.48
Neuroticism	−0.60[b]	−0.44	0.63[a]	−0.62[b]	−0.42
Openness	0.39	0.42	−0.24	0.25	0.66[a,b]
Panel B					
Human-derived big three scales					
Negative temperament	−0.49	−0.34	0.59[a]	−0.54[b]	−0.33
Positive temperament	0.67[a,b]	0.44	−0.25	0.45	0.50
Energy	0.59[a]	0.32	−0.18	0.39	0.38
Positive affectivity	0.62[a]	0.46[b]	−0.24	0.42	0.51[b]
Disinhibition	−0.22	−0.42	0.64[a,b]	−0.09	−0.30
Carefree orientation	−0.24	−0.36	0.55[a]	−0.14	−0.34
Antisocial behavior	−0.18	−0.38	0.62[a]	−0.06	−0.18

$N = 301$.
[a]Highest correlation in row.[b]Highest correlation in column.
Correlations of $> |0.11|$ are significant, $P < 0.05$; $> |.15|$, $P < 0$ .01; $> |0.19|$, $P < 0.001$.

respectively). This strong association was particularly pronounced at the subscale level with the strongest association emerging between chimpanzee-derived Agreeableness and human-derived Positive Affectivity-($r = 0.46$, $P < 0.001$). Thus, with the exception of chimpanzee-derived Agreeableness, associations among corresponding scales were significantly stronger than associations with non-corresponding scales (all Zs $> |8.10|$, all ps $< .001$). Lastly, chimpanzee-derived Reactivity/Undependability was most strongly related to human-derived Disinhibition ($r = 0.64$, $P < 0.001$), followed by Negative Temperament ($r = .59$, $P < 0.001$) although the magnitude of these broad scale associations did not statistically differ ($Z = 1.12$, $P > 0.05$). These associations were, however, significantly higher than the association between chimpanzee-derived Reactivity/Undependability and human-derived Positive Temperament (Zs $= 11.80$ and 10.06, respectively, Ps < 0.001).

A largely consistent pattern of associations between chimpanzee-derived personality scales and human-derived Big Three scales and subscales was found at the multivariate level, with human-derived Big Three subscales emerging as more distinctively associated with corresponding chimpanzee-derived scales within the regression models. As shown in Table III Panel A, at the level of the broad personality dimensions, chimpanzee-derived Extraversion, Openness, and Agreeableness were all most strongly predicted by human-derived Positive Temperament (βs $= 0.57$, 0.44, and 0.35, ts $= 13.42$, 8.51, and 6.93, respectively, all Ps < 0.001). Additionally, Chimpanzee-derived Dominance was most strongly predicted by low human-derived Negative Temperament ($\beta = -0.50$, $t = -9.59$, $P < 0.001$). Finally, chimpanzee-derived Reactivity/Undependability was most strongly predicted by human-derived Disinhibition ($\beta = 0.48$, $t = 10.96$, $P < 0.001$), followed by Negative Temperament ($\beta = 0.38$, $t = 8.31$, $P < 0.001$). At the subscale level (Table III, Panel B), chimpanzee-derived Openness and Agreeableness were most strongly predicted by the Positive Affectivity subscale (βs $= 0.47$, 0.51, ts $= 6.65$, 7.45, respectively, all Ps < 0.001) and chimpanzee-derived Extraversion was predicted in similar magnitude by both Positive Temperament subscales (βs $= 0.31$ and 0.30, ts $= 5.30$ and 5.02, all Ps < 0.001 for Energy and Positive Affectivity subscales, respectively). Further, Reactivity/Undependability was most strongly associated with the Antisocial Behavior subscale ($\beta = 0.38$, $t = 7.04$, $P < 0.001$).

DISCUSSION

The current study provides important data on the translational nature of chimpanzee personality research to humans. Specifically, we collected data from human informants reporting on target individuals they knew well and evaluated the correspondence between informant-reports on chimpanzee-derived personality scales and counterpart human-derived personality scales from the two most widely-studied models of human personality (i.e., Big Five and Big Three). All told, similar to recent research examining psychopathology-relevant, caregiver-reported chimpanzee scales [e.g., Latzman et al., 2015a], results highlight the translational value of chimpanzee personality research to humans by

TABLE II. Multivariate Regression Analyses Predicting Chimpanzee-Derived Personality From Human-Derived Big Five Scales

Human-derived big five scales	Chimpanzee-derived personality scales														
	Extraversion			Agreeableness			Reactivity/undependability			Dominance			Openness		
	β	t	P	β	t	P	β	t	P	β	t	P	β	t	P
Extraversion	0.38[a,b]	9.12	<0.001	0.05	1.25	0.213	0.13	3.55	<0.001	0.37	8.72	<0.001	0.20	4.84	<0.001
Agreeableness	0.18	3.54	<0.001	0.61[a,b]	11.55	<0.001	−0.53[b]	−11.41	<0.001	−0.26	−5.00	<0.001	0.15	2.99	0.003
Conscientiousness	0.11	2.14	0.033	0.21	4.06	<0.001	−0.26[a]	−5.67	<0.001	0.08	1.49	0.136	0.18	3.61	<0.001
Neuroticism	−0.27	−4.83	<0.001	0.12	2.07	0.039	0.24	4.65	<0.001	−0.59[a,b]	−10.40	<0.001	0.02	0.27	0.785
Openness	0.08	1.80	0.073	0.12	2.52	0.012	0.13	3.28	0.001	0.03	0.78	0.438	0.48[a,b]	10.85	<0.001

$N = 301$.
[a]Highest association in row.
[b]Highest association in column.

establishing the criterion-related validity of chimpanzee-derived personality scales in a sample of humans.

Internal consistencies for the chimpanzee-derived personality scales as applied to human targets were slightly lower than most values previously reported in chimpanzee samples [Freeman et al., 2013], although still within acceptable to excellent range, ranging from 0.64 (6-item Extraversion scale) to 0.89 (15-item Reactivity/Undependability scale). Nonetheless, the Cronbach's alpha for chimpanzee-derived Agreeableness was notably higher than values reported in chimpanzee samples. Further supporting the transportability of these chimpanzee-derived personality scales to humans was the impressive pattern of convergent correlations between chimpanzee-derived scales and counterpart human-derived scales. Indeed, correlations between counterpart scales for the chimpanzee-derived and human-derived instruments (concurrent validity coefficients) were largely consistent with expectations. Further, evidence for discriminant validity was also found in that, in general, the chimpanzee-derived scales correlated to a lesser degree with non-corresponding human-derived scales. Contrary to expectations, though, chimpanzee Reactivity/Undependability was generally not associated with human-derived Extraversion/Positive Temperament; it was instead associated with human-derived Neuroticism/Negative Temperament. These latter findings may be a function of the negative valence of the majority of the Reactivity/Undependability items (e.g., Irritable, Temperamental/Moody) tapping emotional dysregulation content consistent with human-derived Neuroticism/Negative Temperament. Finally, contrary to expectations, although evidencing strong associations with human-derived Big Five Agreeableness, chimpanzee-derived Agreeableness evidenced the strongest association with Big Three Positive Temperament, potentially reflecting the prosocial nature of chimpanzee-derived Agreeableness items (i.e., Protective and Considerate/Kind).

Although results from the bivariate analyses suggest a relatively clear pattern of concurrent associations with counterpart scales, bivariate correlations were fairly large across scales, indicative of the overlapping nature of personality constructs, generally. Thus, multiple regression analyses using the human-derived personality scales as predictors of scores on each chimpanzee-derived personality scale, controlling for the shared variance among human-derived scales, were used to clarify the unique associations between these scales. Table IV summarizes these findings. For both human-derived Big Five and Big Three scales, counterpart human-derived scales contributed the strongest predictive associations to chimpanzee-derived scales, consistent with expectations. With regard to associations with human-derived Big Five scales, chimpanzee-derived Reactivity/Undependability showed a pattern of associations consistent with that seen at the

TABLE III. Multivariate Regression Analyses Predicting Chimpanzee-Derived Scales From Human-Derived Big Three Personality Scales

	Chimpanzee-Derived Personality Scales														
	Extraversion			Agreeableness			Reactivity/undependability			Dominance			Openness		
Panel A															
Human-derived big three scales	β	t	P	β	t	P	β	t	P	β	t	P	β	t	P
Negative temperament	−0.29	−6.22	<0.001	−0.09	−1.57	0.118	0.38	8.31	<0.001	−0.50[a,b]	−9.59	<0.001	−0.10	−1.77	0.078
Positive temperament	0.57[a,b]	13.42	<0.001	0.35b	6.93	<0.001	−0.03	−0.73	0.468	0.31	6.36	<0.001	0.44b	8.51	<0.001
Disinhibition	0.00	−0.07	0.940	−0.33	-6.21	<0.001	0.48[a,b]	10.96	<0.001	0.17	3.42	0.001	−0.19	−3.50	0.001
Panel B															
Human-derived big three subscales	β	t	P	β	t	P	β	t	P	β	t	P	β	t	P
Negative temperament	−0.29	−5.86	<0.001	−0.01	−0.16	0.876	0.33	6.97	<0.001	−0.53[a,b]	−9.65	<0.001	−0.07	−1.21	0.229
Energy	0.31[a,b]	5.30	<0.001	−0.10	−1.45	0.147	0.09	1.56	0.120	0.23	3.48	0.001	−0.03	−0.41	0.684
Positive affectivity	0.30	5.02	<.001	0.51[a,b]	7.45	<0.001	−0.15	−2.58	0.010	0.07	0.96	0.340	0.47b	6.65	<0.001
Carefree orientation	0.01	0.23	0.815	−0.09	−1.49	0.137	0.18	3.46	0.001	0.02	0.25	0.805	−0.25[a]	−3.88	<0.001
Antisocial behavior	−0.04	−0.69	0.491	−0.33	−5.17	<0.001	0.38[a,b]	7.04	<0.001	0.17	2.69	0.008	0.00	0.05	0.960

$N = 301$.
[a]Highest association in row.
[b]Highest association in column.

bivariate level; although showing strongest predictive associations with low human-derived Agreeableness and Conscientiousness, chimpanzee-derived Reactivity/Undependability showed an association with Neuroticism that was substantially stronger than the expected association with Extraversion.

With regard to associations with human-derived Big Three scales, chimpanzee-derived Agreeableness was, unexpectedly, most strongly predicted by human-derived Positive Temperament, rather than Negative Temperament or Disinhibition. In fact, no significant association was observed between human-derived Negative Temperament and chimpanzee-derived Agreeableness. This is consistent with findings at the bivariate level and may indicate that the relatively few items on this scale are tapping into more prosocial features. Chimpanzee-derived Reactivity/Undependability also showed a pattern of associations with Big Three scales that ran counter to expectations; although chimpanzee-derived Reactivity/Undependability was most strongly predicted by human-derived Disinhibition as expected, Negative Temperament also emerged as a significant predictor. This is consistent with the pattern of results with human-derived Neuroticism and reveals a consistent pattern of associations between chimpanzee-derived Reactivity/Undependability and scales tapping emotional dysregulation across human-derived measures. All told, results highlight the transportability of the chimpanzee-derived scales to humans, underscoring the translational nature of chimpanzee personality research not only with regard to the relevance of chimpanzee personality research to humans, but also the relevance of human personality research to non-human primates, in particular chimpanzees.

Limitations

The current study is not without limitations. First, we relied exclusively upon informant-report which may have artificially inflated observed relations between scales due to shared method variance. Additionally, while the majority of the chimpanzee personality literature has obtained ratings from multiple caregiver informants, we collected ratings from a single informant. It will thus be important for future research to include multiple raters and to investigate the inter-rater reliability of these ratings for human targets.

As many of the items included across scales were quite evaluative, and many of the participants were rating individuals they likely feel strongly about (i.e., spouse), in addition to potential inflation of associations as a result of data collected from a single informant, there is the possibility of responses bias (e.g., social desirability) resulting in spurious associations emerging. As a means of considering this concern, in a set of post-hoc analyses, we reran analyses after first accounting for potential response

TABLE IV. Summary of Concurrent Associations Between Chimpanzee-Derived and Human-Derived Personality Scales

Chimpanzee-derived scales	Human-derived big five	Human-derived big three
Extraversion	Extraversion, low neuroticism	Positive temperament
Agreeableness	Agreeableness	Positive temperament, low disinhibition
Reactivity/undependability	Low agreeableness, low conscientiousness, neuroticism	Disinhibition, negative temperament
Dominance	Low neuroticism, extraversion	Low negative temperament
Openness	Openness	Positive temperament

biases at an individual participant level. We did this by ipsatizing the data, a method that controls for individual response styles by standardizing participants' responses at the item level [e.g., McCrae et al., 2001; Soto et al., 2008; Ten Berge, 1999], before rerunning bivariate and multivariate analyses for comparison with our original results. With some minor exceptions, results across datasets were largely consistent at the bivariate level. Most notably, with regard to associations with human-derived Big Five scales, although chimpanzee-derived Openness was most strongly associated with its corresponding human-derived scale, ipsitized chimpanzee-derived Openness was most strongely associated with Agreeableness and Conscientiousness, followed by Openness (rs = 0.54, 0.53, and 0.51, respectively, all Ps < 0.001). Findings from regression analyses using the ipsatized dataset were also largely consistent with our original results, again with some notable exceptions. However, although most strongly associated with Positive Temperament ($\beta = 0.35$) followed by ($\beta = -0.33$) in our original results, ipsitized chimpanzee-derived Agreeableness was most clearly associated with Disinhibition ($\beta = -0.40$) with remaining associations relatively weak. Further, chimpanzee-derived Openness was surprisingly most strongly associated with low Disinhibition ($\beta = -0.33$, $t = -6.72$, $P < 0.001$), a finding that was not observed at the bivariate level in the ipsatized dataset or in our original results (see Supplemental Tables SIII, IV, and V for full results of these analyses). It is important to note that although promising, like many if not all approaches to accounting for response style biases, this approach is not without its own limitations [see Conway & Lance, 2010] and should be interpreted as such.

Additionally, given that the chimpanzee personality inventory used in the current study [Freeman et al., 2013] was developed in a chimpanzee sample with consideration of the human personality literature, many of the items on this measure, although not identical in nature, show substantial overlap with those on the human-derived personality measures, also potentially contributing to inflated correlations between scales. Nonetheless, our interest was not in the functioning of individual items but was instead in the associations between these chimpanzee-derived personality scales and traditional human-derived scales. Further, although marked by a number of important strengths [Buhrmester et al., 2011; Goodman et al., 2013], the use of an mTurk sample also may present some limitations including with regard to sample generalizability. However, there is evidence to suggest that mTurk samples may actually be more diverse and produce data that exceed in quality than other internet and traditionally derived samples [Buhrmester et al., 2011]. Additionally, the current study evaluated the transportability of a single, relatively new, chimpanzee personality assessment instrument. Importantly, there is a sizeable literature on chimpanzee personality using other instruments, most notably the Chimpanzee Personality Questionnaire [CPQ; King and Figueredo, 1997]. Although there is quite a bit of overlap between the CPQ and the chimpanzee personality inventory used here Freeman et al., 2013], future research is needed to confirm the extent to which the current findings generalize to other measures of chimpanzee personality. Further, future research would benefit from the incorporation of both human and chimpanzee samples, allowing for an investigation of the similarities and differences in personality expression, and associated behaviors across these two species.

Limitations notwithstanding, findings from the current study provide evidence that chimpanzee-derived scales operate quite similarly to the established human-derived personality scales in a human sample. This evidence of transportability lends support to the translational nature of chimpanzee personality research suggesting clear relevance of this growing literature to humans, which, suggests relevance of human personality literature to chimpanzees. This is particularly important in light of the large literature confirming the importance of personality with respect to both psychological and physical health.

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