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Original Article

# Personality in Sanctuary-Housed Chimpanzees: A Comparative Approach of Psychobiological and Penta-Factorial Human Models

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**Abstract:** We evaluate a sanctuary chimpanzee sample ($N$ = 11) using two adapted human assessment instruments: the Five-Factor Model (FFM) and Eysenck's Psychoticism-Extraversion-Neuroticism (PEN) model. The former has been widely used in studies of animal personality, whereas the latter has never been used to assess chimpanzees. We asked familiar keepers and scientists ($N$ = 28) to rate 38 (FFM) and 12 (PEN) personality items. The personality surveys showed reliability in all of the items for both instruments. These were then analyzed in a principal component analysis and a regularized exploratory factor analysis, which revealed four and three components, respectively. The results indicate that both questionnaires show a clear factor structure, with characteristic factors not just for the species, but also for the sample type. However, due to its brevity, the PEN may be more suitable for assessing personality in a sanctuary, where employees do not have much time to devote to the evaluation process. In summary, both models are sensitive enough to evaluate the personality of a group of chimpanzees housed in a sanctuary.

**Keywords:** chimpanzees, personality, five-factor model, Eysenck, sanctuary

## Introduction

In the most complete study to date, Gosling (2001) identified 187 personality studies conducted with 64 different animal species. The studies ranged from mollusks or arthropods, to amphibians, reptiles, birds, and fish, but the majority of studies (84%) were carried out with mammals (29% of which were primates). The results of these studies indicate that inter-individual behavioral differences grant adaptive and fitness advantages to these species (Dall, Houston, and McNamara, 2004; Dingemanse and Wolf, 2010; Smith and Blumstein, 2008; Wolf and Weissing, 2010). This does not necessarily mean that the

personalities of phylogenetically distant species are homologous to human personalities. However, the similarities found among human and non-human primates could be explained as evolutionary conserved features (Weiss, Inoue-Murayama, King, Adams, and Matsuzawa, 2012). The conservation of behavioral dispositions across species suggests that processes of balancing selection (environmental heterogeneity, negative frequency-dependent selection, and migration) that have been implicated in the evolution of human personality (Penke, Denissen, and Miller, 2007) have also maintained variation in chimpanzee personality.

The instruments used for the assessment of personality have varied over the years (Briffa and Weiss, 2010). Most of the non-human animal (Gosling, 2001) and primate (Freeman, Gosling, and Schapiro, 2011) studies have employed some type of coding, but the rating method has been the most widely used with chimpanzees (Freeman and Gosling, 2010). In the rating method, keepers, researchers, or volunteers who are familiar with the animals are responsible for evaluating the personality of the individuals, usually using Likert scale adjectives lists (Vazire and Gosling, 2004). Considering that many of these animals are in captive conditions (such as zoos, sanctuaries or laboratories), an assessment tool is needed that will aid in the rapid and effective assessment of personality by employees of these centers, who do not have much time to undertake assessments. The ultimate goal is to find practical applications in the field of animal management, welfare, wellbeing, and health.

Our research employs a "top-down" rating assessment (Freeman et al., 2013; Uher, 2008) with two of the major models used to study human personality: the Five-Factor Model (FFM) (Goldberg, 1990) and Eysenck's Psychoticism-Extraversion-Neuroticism model (PEN) (Eysenck and Eysenck, 1964). The first is a hierarchical model with five bipolar factors: Neuroticism, Extraversion, Agreeableness, Conscientiousness, and Openness to Experience (Goldberg, 1990; McCrae and Costa, 1999). This model suggests that human personality is classified into these five dimensions (John and Srivastava, 1999). The model (1) has demonstrated high reliability and predictive ability in humans, describing most individual differences in personality (Digman, 1990); (2) has revealed a genetic basis for these traits (Bouchard and Loehlin, 2001); and (3) is widely applicable to different situations and cultures (McCrae and Terracciano, 2005). Therefore, it describes traits that are most likely biologically based and that may exist in some of our primate relatives. This model has been one of the most widely used to organize and integrate the studies of animal personalities in general, and primates in particular (Freeman and Gosling, 2010). Using the FFM as a framework, some studies have determined the most common personality dimensions in primates (King and Figueredo, 1997; Konečná, Weiss, Lhota, and Wallner, 2012; Lilienfeld, Gershon, Duke, Marino, and de Waal, 1999; Morton et al., 2013; Weiss et al., 2009; Weiss, King, and Perkins, 2006). It has been concluded that most of the traits studied in animals essentially correspond to the first three dimensions of the model, whereas the Conscientiousness factor seems to be restricted to chimpanzees (Gosling, 2001; Gosling and John, 1999; Gosling and Vazire, 2002). Although the five factors of the model are proposed as temperament dimensions, the first three could be regarded as more "basic" traits—i.e., dimensions associated more with emotional reactivity and individual physiological processes. The first two dimensions of the FFM coincide with those postulated by Eysenck (Eysenck and Eysenck, 1963), who later added a third factor called "Psychoticism" (Eysenck and Eysenck, 1964). Curiously, the Eysenck model (PEN)

has not been applied previously in chimpanzees, despite the fact that it has an empirical psychobiological base. Eysenck used it only in rhesus monkeys (Chamove, Eysenck, and Harlow, 1972). So, given the success that researchers have had in adapting the Five-Factor Model for use with non-human species, we wanted to examine whether the PEN could be employed with non-human species as well in order to gain a better understanding of their personalities. As with other top-down models applied in animals (e.g., Emotions Profile Index [EPI]: Buirski, Kellerman, Plutchik, Weininger, and Buirski, 1973; Interpersonal Circumplex: Zeigler-Hill and Highfill, 2010), it is essential to test the usefulness and consistency of the method in chimpanzees. In any case, determining whether all or some of the factors in the Psychoticism-Extraversion-Neuroticism model or the Five-Factor Model are expressed in chimpanzees could be very important for the understanding of human behavior from a phylogenetic perspective.

The primary objective of this study was to evaluate the factor structure of personality in a group of sanctuary chimpanzees employing the top-down method (Freeman et al., 2013) of two of the main models used in humans: the Five-Factor Model (FFM) and the Psychoticism-Extraversion-Neuroticism model (PEN). We have evaluated the usefulness of the PEN and have attempted to determine which of the two theoretical personality models proposed is best suited to assess personality in chimpanzees housed in a sanctuary—i.e., in animals previously used for entertainment and as pets, which is unlike most studies conducted with laboratory and zoo chimpanzees (Brittain and Corr, 2009; Freeman and Gosling, 2010; King, Weiss, and Farmer, 2005). Additionally, unlike other sanctuary samples, because these animals have been previously used for commercial purposes or as pets, they may provide interesting data when compared to other types of samples (King et al., 2005; Weiss, King, and Hopkins, 2007). Although their living conditions have likely improved, it is important to consider that these animals may have misaligned personality patterns and possibly even mental disorders (Bradshaw, Capaldo, Lindner, and Grow, 2008; Ferdowsian et al., 2011, 2012; Lilienfeld et al., 1999; Martin, 2005) due to traumatic captive conditions prior to their arrival at the primate rescue center.

## Materials and Methods

### *Study site and sample*

Since 2000, the Fundació Mona (FM) (Girona, north-eastern Spain, 41°54'N, 2º49'E) has been dedicated to the rescue, recovery, rehabilitation, re-socialization, and sheltering of primates that have been exploited or abused. FM seeks to provide these primates with the best captive conditions through naturalized environments and stable social groups in order to help the animals develop patterns of behavior common to their species, thus promoting their welfare. Two females and nine males with a mean age of 22.90 years (*SD* = 13.43) were included in the study sample. The sample included individuals from early adolescence to old age. We conducted this research in accordance with all national and institutional guidelines for the care and management of primates established by FM.

### *Raters*

The questionnaires were evaluated by 28 raters (25% men and 75% women) who knew all of the chimpanzees for at least 6 months and who fell into one of three different

profiles: researchers (50%), keepers (43%), and volunteers (7%). All of the raters evaluated all subjects with both questionnaires. Raters were instructed to base their judgments on their general impressions of the chimpanzees, not on frequency estimates of past behaviors. The instructions also warned the evaluators to avoid discussing their ratings with other raters. Raters were classified into three categories according to the length of time they had known their study subjects: those who knew the sample for less than 1 year (35%), for between 1 and 3 years (27%), and for more than 3 years (38%).

*Questionnaires*

The Eysenck questionnaire (PEN) was created based on a previous study (Totusaus and Llorente, 2011) and consists of a total of 12 adjectives rated on a 7-point Likert scale. Each adjective has an antonym, and according to the degree to which the adjective described the chimpanzee, the evaluation came closer to one pole or the other. Meanwhile, the FFM questionnaire was based on a questionnaire previously used by King and Figueredo (1997), which was based on Goldberg's study (1990) in humans. In our case, two of the adjectives that were used by King and Figueredo ("submissive" and "independent") were eliminated because the adjectives "dominant" and "dependent" included in the list represented the same trait. In addition, three other adjectives were not included in this study: "clumsy," "autistic," and "manipulative." The first two were eliminated because they were not represented in any factor in the study by King and Figueredo (1997), and the third was discarded because it received low scores in the same study. Thus, the total number of adjectives used in the FFM questionnaire in our study was 38, with a rating scale of 1 to 7. As in Eysenck's questionnaire, in the FFM questionnaire, we decided to use the synonym-antonym evaluation, so the antonyms were deduced from the adjectives used in the King and Figueredo (1997) study. In some cases, additional adjectives were included for both poles in order to clarify the definition of the trait.

*Inter-rater reliability of items*

The reliability of the 28 raters was assessed for each item using two intraclass correlation coefficients (ICC) (Shrout and Fliess, 1979). The first ICC (3, 1) indicates the reliability of the scores for a single evaluator. The second ICC (3, k) indicates the reliability for the mean scores of the evaluators (in our case, based on an average of 28 raters per chimpanzee).

*Data reduction: PCA and REFA for both models*

To determine the personality trait domains, we first transformed our data into *z*-scores using a principal-components analysis (PCA) to identify the dimensions underlying the mean ratings. To determine the number of factor components to extract (only the factors that exceeded the 95$^{th}$ percentile of the values derived from random matrices were extracted), we examined the scree plot and used parallel analysis (Horn, 1965; O'Connor, 2000). After determining the number of components, we subjected those components to an orthogonal (varimax) and oblique (promax) rotation. For the purpose of interpreting and scoring factors, we defined absolute loadings greater than or equal to 0.50 as salient. The component scores were unit-weighted, thus the *z*-scores of items with salient primary loadings were assigned weights of +1 or -1, depending on the direction of the loading. Items with nonsalient loadings were assigned weights of 0. Unit-weighted scores are more

generalizable across studies and are highly correlated with differentially weighted scores (Gorsuch, 1983). Moreover, due to the small sample, we used regularized exploratory factor analysis (REFA), a new technique specifically designed to derive factors when the sample size is very small (Jung and Lee, 2011; Jung and Takane, 2008). For this analysis we used quartimax rotation and specified unweighted least squares for factor extraction.

## Results

*Inter-rater reliability of items*

The ICCs for the single (3, 1) and average (3, k) ratings were generally strong and there were no unreliable coefficients equal to or less than zero to eliminate from the analysis, indicating that raters tended to agree in their judgments about the personality traits of the chimpanzees. In the case of the PEN, the ICC (3, 1) coefficients ranged from .20 (cruel) to .54 (active), with a mean reliability of .37. The ICC (3, k) coefficients ranged between .87 (cruel) and .97 (active) with a mean reliability of .94.

In the case of the FFM, the ICC (3, 1) coefficients ranged from .09 (laborious) to .60 (active), with a mean reliability of .35, while the ICC (3, k) coefficients ranged between .74 (laborious) and .97 (active), with a mean reliability of .92.

*Data reduction: PCA and REFA results for the PEN model*

Visual inspection of the scree plot for the 11 mean ratings suggested three components to extract, and a parallel analysis of the 11 mean ratings also suggested three components. Because no differences were found between the two methods, we decided not to use orthogonal Procrustes rotation (McCrae, Zonderman, Costa, Bond, and Paunonen, 1996). The three components identified by the abovementioned instruments were extracted using PCA. The components were subjected to varimax rotation (K.M.O = 0.792) so as to obtain an interpretable orthogonal structure. The three components based on the 11 mean ratings accounted for 64.91% of variance. We were more restrictive than prior studies (e.g., Konečná et al., 2008, 2012; Weiss, Adams, and Johnson, 2011), defining ≥|.5| loadings as salient (see Table 1). We extracted three factors from the 11 mean ratings using REFA and subjected these factors to a quartimax rotation. As REFA loadings are shrunk toward zero (Jung and Lee, 2011), they are more conservative than loadings obtained via PCA. We also defined ≥|.5| loadings as salient. The dimensions extracted by REFA and those extracted by PCA were highly comparable (see Table 1). With little exception, none of the extractions led to differences in how the dimensions were interpreted.

The first factor loaded positively on the items "spontaneous," "active," "social," and "creative," and negatively on the item "sad." We therefore labeled this factor Extraversion. The second factor is characterized by the adjectives "aggressive," "anxious," "impulsive," "cruel," and "bad-tempered," which reflect a Neuroticism factor with a Psychoticism component. We labeled this Neuropsychoticism. Finally, the third factor loaded the adjective "dominance," so it was labeled Dominance.

From the three components extracted, the promax rotation produced quite weak correlations, with a mean absolute intercorrelation value of .17 (see Table 2).

**Table 1**. Factor loadings obtained according to the PEN model

| | Principal Component Analysis | | | Regularized Exploratory Factor Analysis | | |
|---|---|---|---|---|---|---|
| | Factor 1 | Factor 2 | Factor 3 | Factor 1 | Factor 2 | Factor 3 |
| Spontaneous | **.79** | .01 | .25 | **.79** | .02 | .08 |
| Active | **.78** | .06 | .30 | **.80** | .07 | .11 |
| Sad | **-.78** | .25 | -.13 | **-.76** | .23 | .03 |
| Social | **.70** | -.12 | .31 | **.71** | -.10 | .12 |
| Creative | **.57** | .10 | -.27 | .37 | .06 | -.10 |
| Aggressive | .06 | **.85** | .17 | .08 | **.82** | .12 |
| Anxious | -.00 | **.78** | -.16 | -.06 | **.69** | -.08 |
| Impulsive | .47 | **.70** | .05 | .43 | **.65** | -.03 |
| Cruel | -.22 | **.66** | -.09 | -.22 | **.56** | -.04 |
| Bad tempered | -.50 | **.66** | .08 | -.46 | **.61** | .13 |
| Dominant | .07 | .10 | **.88** | .23 | .07 | **.97** |
| Fearful | -.36 | .12 | **-.68** | -.46 | .11 | -.38 |

**Table 2.** Factor intercorrelation matrix for the PEN model

| Factor | Extraversion | Neuropsychoticism | Dominance |
|---|---|---|---|
| Extraversion | - | | |
| Neuropsychoticism | -.11 | - | |
| Dominance | .32 | -.07 | - |

*Data reduction: PCA and REFA results for the Five Factor Model*

Visual inspection of the scree plot for the 11 mean ratings suggested four components, as did the parallel analysis of the 11 mean ratings. We therefore decided to continue with the PCA without applying orthogonal Procrustes rotation. After determining that there were four components to extract, these components were extracted using PCA and were subjected to varimax rotation (K.M.O. = 0.915) so as to obtain an interpretable orthogonal structure. The four components accounted for 60.67% of variance based on the 11 mean ratings. We therefore determined loadings of ≥|.5| as salient (see Table 3). We extracted four factors from the 11 mean ratings using REFA and subjected these factors to a quartimax rotation. As REFA loadings are shrunk toward zero (Jung and Lee, 2011), they are more conservative than loadings obtained via PCA. We also defined loadings of ≥|.5| as salient. The dimensions extracted by REFA and those extracted by PCA were highly comparable (see Table 4). There were some exceptions, although none led to differences in how the dimensions were interpreted.

The first factor positively loaded on items such as "sociable," "playful," "gregarious," "friendly," "bold," "affectionate," "cheerful," "active," and "sympathetic," among others. We thus labeled this factor Extraversion. The second factor loaded on items related to "not defiant," "peaceable," "patient," "not bullying," "patient," "reflexive," and "generous," among others. We therefore labeled this factor Conscientiousness with a component of Agreeableness. The third factor loads the items "fearful," "submissive," "emotional," and "dependent." We thus labeled this component Dominance (although it has a component of Neuroticism). Finally, on the fourth factor we found the items "laborious," "intelligent," "inventive," "organized," and "constant," making it a factor of Conscientiousness with a component of Openness to Experience.

**Table 3.** Factor loadings obtained according to the FFM

| | Principal Component Analysis | | | | Regularized Exploratory Factor Analysis | | | |
|---|---|---|---|---|---|---|---|---|
| | Factor 1 | Factor 2 | Factor 3 | Factor 4 | Factor 1 | Factor 2 | Factor 3 | Factor 4 |
| Sociable | **.86** | -.12 | .11 | .04 | **.87** | -.07 | .04 | -.05 |
| Friendly | **.84** | .19 | -.04 | -.05 | **.83** | .23 | -.12 | -.03 |
| Affectionate | **.83** | .15 | -.11 | .02 | **.81** | .18 | -.18 | -.05 |
| Cheerful | **.81** | -.11 | .19 | .07 | **.83** | -.07 | .13 | -.01 |
| Playful | **.78** | -.31 | -.13 | .07 | **.78** | -.29 | -.18 | -.00 |
| Gregarious | **.77** | -.22 | .15 | .04 | **.79** | -.17 | .09 | -.04 |
| Sympathetic | **.75** | .31 | -.04 | .00 | **.72** | .35 | -.12 | -.07 |
| Active | **.73** | -.40 | .13 | .14 | **.77** | -.36 | .09 | .06 |
| Bold | **.70** | -.30 | .33 | .07 | **.74** | -.25 | .29 | -.01 |
| Sensitive | **.68** | .28 | -.15 | .16 | **.66** | .30 | -.21 | .10 |
| Inquisitive | **.67** | -.26 | -.00 | -.32 | **.71** | -.23 | -.04 | .25 |
| Gentle | **.63** | .46 | -.04 | .05 | **.61** | .48 | -.11 | -.00 |
| Trustful | **.62** | .07 | .46 | -.11 | **.64** | .12 | .40 | -.19 |
| Helpful | **.59** | .26 | .11 | .25 | **.61** | .30 | .05 | .19 |
| Not decisive | -.45 | .23 | -.40 | -.40 | **-.53** | .18 | -.39 | -.34 |
| Imitative | .41 | -.15 | -.32 | .23 | .41 | -.15 | -.34 | .20 |
| Protective | .40 | .37 | .24 | .30 | .43 | .40 | .19 | .26 |
| Not defiant | -.16 | **.80** | -.19 | -.12 | -.23 | **.78** | -.21 | -.09 |
| Peaceable | .16 | **.80** | -.00 | -.15 | .11 | **.80** | -.06 | -.17 |
| Patient | .12 | **.77** | .10 | -.10 | .08 | **.78** | .05 | -.12 |
| Not bullying | -.14 | **.73** | -.14 | -.13 | -.20 | **.71** | -.17 | -.11 |
| Responsible | -.27 | **.70** | -.04 | .21 | -.28 | **.68** | -.04 | .24 |
| Predictable | .11 | **.69** | .15 | .29 | .12 | **.70** | .11 | .27 |
| Impulsive | .47 | **-.69** | -.10 | -.02 | .49 | **-.67** | -.11 | -.07 |
| Calm | .17 | **.62** | .49 | -.22 | .16 | **.66** | .43 | -.26 |
| Generous | .36 | **.61** | -.04 | -.02 | .32 | **.62** | -.10 | -.05 |
| Prudent | -.40 | **.61** | -.01 | .13 | -.41 | **.59** | -.01 | .17 |
| Constant | .03 | **.61** | .32 | .37 | .07 | **.63** | .30 | .35 |
| Stable | .30 | **.58** | **.53** | .03 | .31 | **.62** | .47 | -.02 |
| Fearful | .37 | -.09 | **.71** | .26 | .45 | -.04 | **.69** | .20 |
| Dominant | .17 | -.27 | **.67** | .30 | .26 | -.22 | **.68** | .26 |
| Emotional | -.17 | .37 | **.60** | .10 | -.13 | .40 | **.60** | .09 |
| Dependent | -.28 | .06 | **.57** | .13 | -.22 | .08 | **.60** | .14 |
| Laborious | .36 | .01 | .18 | **.58** | .43 | .04 | .17 | **.53** |
| Intelligent | .23 | -.10 | .23 | **.58** | .31 | -,07 | .23 | **.54** |
| Inventive | .28 | -.22 | -.04 | **.57** | .34 | -,21 | -.04 | **.54** |
| Organized | -.16 | .43 | ,21 | **.56** | -.11 | ,44 | .22 | **.56** |
| Constant | -.09 | .13 | ,02 | **.55** | -.04 | ,13 | .05 | **.55** |

From the four factors extracted, the promax rotation produced relatively weak correlations, evidencing discriminant validity, with a mean absolute value intercorrelation of .15 (see Table 4).

**Table 4.** Factor intercorrelation matrix for the FFM

| Factor | Extraversion | Consc-Agreeableness | Dominance | Consc-Openness |
|---|---|---|---|---|
| Extraversion | - | | | |
| Consc-Agreeableness | -.12 | - | | |
| Dominance | .35 | .05 | - | |
| Consc-Openness | .13 | .02 | .25 | - |

## Discussion

This study revealed some very interesting results. First of all, the sample of sanctuary-housed chimpanzees presents a clear personality structure, developed with three factors for the PEN model and four factors for the FFM, with acceptable standards of inter-observer reliability and validity. Secondly, it has been demonstrated that the PEN model can be used to measure the personality of chimpanzees in a sanctuary. The use of the PEN yielded an idiosyncratic factor for chimpanzees related to dominance, and a characteristic compound factor of Neuroticism and Psychoticism. With the FFM, Conscientiousness was combined with the Agreeableness and Openness factors, and the Dominance factor was very close to Neuroticism. Finally, the results obtained with both methods in a sanctuary chimpanzee sample are similar to those obtained in humans.

The constructive validity for the data obtained in this study is expressed from the convergent and discriminant validity of the factors (Campbell and Fiske, 1959). Convergent validity can be estimated using the magnitudes of the item loadings onto the factors to which they are assigned. Regarding the 12 items evaluated for the PEN model, all of them loaded with values superior to .50 in the PCA, but two of them ("fearful" and "creative") did not load in the REFA. In relation to the 38 items evaluated for the FFM, two of them did not have salient loading on any of the factors, even though the ICC values were not low. In any case, the overall pattern of factor loadings revealed good evidence of convergent validity. On the other hand, discriminant validity has been demonstrated with the factorial independence shown by the low intercorrelation values when an oblique factor solution was obtained (i.e., approaching .50), and although there was a moderate interfactor correlation for each theory (.32 [PEN] and .35 [FFM]), it is important to remember that human studies (Borkenau and Ostendorf, 1990; Costa Jr., McCrae, and Dye, 1991; Grazlano and Ward, 1992) typically show at least two or three moderately high interfactor correlations.

It was not difficult to identify factors for both models, as most of them are similar to those found in humans (see Table 5). Nevertheless, there are some distinctive features. With the PEN model we found a peculiar factor that includes aspects of neuroticism and aspects of psychoticism, which we labeled Neuropsychoticism. The PEN model also yielded a factor related to dominance. Although this cannot be compared with humans due to the idiosyncrasy of this factor for chimpanzees, the two adjectives loaded in our study for the PCA (see Table 1) are the same as those in the study by King and Figueredo (1997) loaded under the factor that they called "Dominance" (see Table 5). For this reason, and in

spite of the fact that the REFA (see Table 1) loads just one of these adjectives (the differences found between PCA and REFA are probably due to the small sample), we also decided to call the third factor "Dominance." In fact, many authors have emphasized the importance of intraspecific dominance in chimpanzee personality (de Waal, 1989; Freeman and Gosling, 2010; King and Figueredo, 1997). The factor of dominance was found by King and Figueredo (1997) with the FFM and maintained in later studies (see Freeman and Gosling, 2010, for a review). This factor (with the Extraversion factor) is one of the most commonly identified in chimpanzees and gets the highest levels of inter-rater reliability and the strongest validity coefficients in primates (Freeman and Gosling, 2010). With the FFM, we found a factor of Dominance that was very close to the Neuroticism factor (see Table 5), but we decided to call it Dominance because of the reasons given above. Also with the FFM, the factors of Agreeableness and Openness to Experience were found to have a component of Conscientiousness. This can be explained by the fact that although all the other factors are generally found in animals, (Gosling, 2001; Gosling and Vazire, 2002), Conscientiousness seems to be restricted to chimpanzees (Gosling and John, 1999). So, this factor may have become part of the above factors in the specific case of sanctuary chimpanzees. For these reasons, we decided to call the factors: Conscien-Agreeableness and Conscien-Openness, respectively.

**Table 5.** Personality structure obtained in this study (according to REFA) for chimpanzees using the PEN model (compared to humans [Eysenck and Eysenck, 1964][1]) and the FFM (compared to humans [Goldberg, 1990] and a previous study with chimpanzees [King and Figueredo, 1997][2])

| Psychoticism-Extraversion-Neuroticism Model | | |
|---|---|---|
| | Humans | Chimpanzees |
| | E. and E. 1964[1] | This study |
| Spontaneous | Extraversion | Extraversion |
| Active | Extraversion | Extraversion |
| Sad | Neuroticism | Extraversion |
| Social | Extraversion | Extraversion |
| Creative | Extraversion | -- |
| Aggressive | Psychoticism | Neuropsychoticism |
| Anxious | Neuroticism | Neuropsychoticism |
| Impulsive | Psychoticism | Neuropsychoticism |
| Cruel | Psychoticism | Neuropsychoticism |
| Bad tempered | Neuroticism | Neuropsychoticism |
| Dominant | Extraversion | Dominance |
| Fearful | Neuroticism | -- |

| | Five Factor Model | | |
|---|---|---|---|
| | Humans | Chimpanzees | |
| | Goldberg, 1990 | This study | K. and F. 1997[2] |
| Sociable | Extraversion | Extraversion | Extraversion |
| Friendly | Agreeableness | Extraversion | Extraversion |
| Affectionate | Agreeableness | Extraversion | Extraversion |
| Cheerful | Extraversion | Extraversion | Extraversion |
| Playful | Extraversion | Extraversion | Extraversion |
| Gregarious | Extraversion | Extraversion | Extraversion |
| Sympathetic | Agreeableness | Extraversion | Agreeableness |
| Active | Extraversion | Extraversion | Extraversion |
| Bold | Extraversion | Extraversion | Dominance |
| Sensitive | Agreeableness | Extraversion | Agreeableness |
| Inquisitive | Openness | Extraversion | Openness |
| Gentle | Agreeableness | Extraversion | Agreeableness |
| Trustful | Neuroticism | Extraversion | Conscientiousness |
| Helpful | Agreeableness | Extraversion | Agreeableness |
| Not decisive | Conscientiousness | Extraversion | Dominance |
| Imitative | Openness | -- | Extraversion |
| Protective | Conscientiousness | -- | Conscientiousness |
| Not defiant | Agreeableness | Conscien-Agreeableness | Conscientiousness |
| Peaceable | Agreeableness | Conscien-Agreeableness | Dominance/Conscientiousness |
| Patient | Agreeableness | Conscien-Agreeableness | Conscientiousness |
| Not bullying | Agreeableness | Conscien-Agreeableness | Dominance |
| Responsible | Conscientiousness | Conscien-Agreeableness | Conscientiousness |
| Predictable | Conscientiousness | Conscien-Agreeableness | Conscientiousness |
| Impulsive | Extraversion | Conscien-Agreeableness [(-)] | Conscientiousness |
| Calm | Neuroticism | Conscien-Agreeableness | Neuroticism[)] |
| Generous | Agreeableness | Conscien-Agreeableness | Dominance |
| Prudent | Conscientiousness | Conscien-Agreeableness | Conscientiousness |
| Constant | Conscientiousness | Conscien-Agreeableness | Conscientiousness |
| Stable | Neuroticism | Conscien-Agreeableness | Neuroticism |
| Fearful | Neuroticism | Dominance | Dominance |
| Dominant | Neuroticism | Dominance | Dominance |
| Emotional | Neuroticism | Dominance | Neuroticism |
| Dependent | Neuroticism | Dominance | Dominance |
| Laborious | Openness | Conscien-Openness | Extraversion |
| Intelligent | Openness | Conscien-Openness | Dominance |
| Inventive | Openness | Conscien-Openness | Openness |
| Organized | Conscientiousness | Conscien-Openness | Conscientiousness |
| Constant | Conscientiousness | Conscien-Openness | Conscientiousness |

The reason for the differences found between our results and studies on humans and previous studies with chimpanzees (King and Figueredo, 1997) could be the idiosyncrasy not only of the species, but also of the sample type. For example, the adjectives "friendly" and "affectionate" in humans have connotations of warmth with conspecifics. These are related to the Agreeableness factor in humans (Goldberg, 1990), whereas our study in chimpanzees and King and Figueredo's (1997) studies with the FFM load in the Extraversion factor. For that reason, the top-down methodology could be controversial because it can include features that are not important or that do not include relevant aspects of the personality in the studied species. On the other hand, in relation to differences due to the sample type, the differences found between Western and non-Western cultures in human FMM studies could be considered (Church and Katigbak, 1989; Narayanan, Menon, and Levine, 1995; Yang and Bond, 1990), but the differences found in chimpanzees associated with sample type (King et al., 2005; Weiss et al., 2007) are more relevant. As we compared our results with a zoological sample, we have to take into account that the sample analyzed in this study is housed in a sanctuary with naturalized enclosures and no exposure to visitors, so the only source of stress is the readjustment of groups. Moreover, the subjects analyzed in this study had been hosted in this center since a mean age of 8.63 years (at the time of the study). So, we could say that they are showing personality patterns more similar to wild members of the species than a zoological sample, although due to the scarcity of studies in this area, a comparison cannot be made. A zoological sample, compared with sanctuary chimpanzees, exhibits more aberrant behaviors and fewer species-typical behaviors (Wobber and Hare, 2011).

In answer to the question of which model is better to assess the personality of sanctuary chimpanzees, we have found that both models are equally valid because both highly coincide with the results obtained for humans and have high levels of total variance and mean reliability for the ICCs. However, it is important to emphasize the brevity of the PEN model in comparison with the FFM. Because of its shorter length, we believe that this type of assessment would be useful in sanctuaries, where the workers cannot devote much time to evaluating the personality of the subjects.

In conclusion, our research demonstrates the validity of the application of both of the human personality models studied in related species such as chimpanzees, indicating that the similarities may possibly be explained as evolutionarily conserved traits. However, we want to highlight that these measures concern chimpanzees housed in a sanctuary. In future research, this type of study should be replicated and extended to include other subjects housed in rescue centers, with large sample sizes, similar to those used in other studies. These considerations could be very important in order to increase the ecological validity of this study and to gain further insight into chimpanzee personalities and their implications for the management and welfare of these rehabilitated animals in sanctuaries.

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