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Personality in the behaviour of great apes: temporal stability, cross-situational consistency and coherence in response

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Using a multidisciplinary approach, the present study complements ethological behaviour measurements with basic theoretical concepts, methods and approaches of the personality psychological trait paradigm. Its adoptability and usefulness for animal studies are tested exemplarily on a sample of 20 zoo-housed great apes (five of each of the following species): bonobos, *Pan paniscus*; chimpanzees, *Pan troglodytes verus*; gorillas, *Gorilla gorilla gorilla*; and orang-utans, *Pongo pygmaeus abelii*. Data on 76 single trait-relevant behaviours were recorded in a series of 14 laboratory-based situations and in two different group situations. Data collection was repeated completely after a break of 2 weeks within a 50-day period. All behaviour records were sufficiently reliable. Individual- and variable-oriented analyses showed high/substantial temporal stability on different levels of aggregation. Distinctive and stable individual situational and response profiles clarified the importance of situations and of multiple trait-relevant behaviours. The present study calls for a closer collaboration between behavioural biologists and personality psychologists to tap the full potential of animal personality research.

Keywords: behaviour prediction; bonobo; bottom-up approach; chimpanzee; gorilla; individual differences; orang-utan; personality; traits

Measuring temporally stable variants of normal behaviour (i.e. personality: Funder 2004; Nettle 2006) is becoming increasingly a matter of interest to scientific studies in domestic and wild animals. Given the dimensionality of personality variation, traits are discussed within evolutionary frameworks as ecologically adaptive trade-offs of different fitness costs and benefits (Tooby & Cosmides 1990; Buss 1991; Dall et al. 2004). Therefore, personality investigations in animals can broaden our understanding of the evolutionary origins of interindividual variation in behaviour in human and nonhuman animals.

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The study of stable individual differences in the empirical structure of quantitative behavioural measures entails a number of methodological difficulties that are caused by fluctuations in manifest behaviour. As already stated by Donald O. Hebb in the 1940s, finding 'meaningful order and consistency' in 'endless series of specific acts' (Hebb 1946, page 88, 1949) that are stable enough to permit predictions of the individual's future behaviour is rather challenging. Therefore, ethological methods of measuring behaviour have to be complemented with theories, methods and statistics specifically designed for the analysis of stable individual differences developed in human personality psychology (Gosling 2001; Gosling et al. 2003; Sih et al. 2004; Nettle 2006). The present paper shows how methods and theories from neighbouring disciplines can complement each other successfully in a study on personality differences in great apes.

Among many rather different theoretical approaches to personality, the psychological trait paradigm is the most appropriate for research on animal personality. The trait

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paradigm assumes that individuals display stability and consistency in their behaviour across time and situations, and that they differ from each other in the pattern of traits that constitute their personality (Stern 1911; Allport 1937; Funder 2004). Unlike many other conceptualizations of personality, the trait paradigm focuses primarily on measuring and cataloguing lasting behavioural tendencies without assuming cognitive components that may be uniquely human, or specifying the relative contributions of nature or nurture, or their interaction over the course of life.

Personality traits are meant to be latent dimensional variables along which individuals differ from one another in the degree to which they possess a particular trait. They are distinct from states that are, in contrast, externally caused and only temporary (Funder 2004). Temporal stability is the crucial criterion to infer traits from interindividual differences, and personality from individual trait profiles. Traits, furthermore, create stable relations between situations and the responses of an individual across time. However, a situation may have a different impact on different individuals. This results in a low cross-situational consistency of behaviour, yet situational profiles that are stable across time and distinctive between individuals (Funder & Colvin 1991, Mischel et al. 2002). Similarly, a situation can induce a specific behaviour in one kind of individual, and a different behaviour in another, which results in a low coherence between responses within a situation and stable individual response profiles (Asendorpf 1988).

A systematic approach to personality should, therefore, include a variety of trait-related situations and behaviours that are collected repetitively. In fact, the problem of fluctuations in manifest behaviour can only be solved with sufficient aggregation of behaviour scores on a given trait dimension across several trait-relevant situations, or across several observations within the same situation if (and only if) the scores are sufficiently consistent across situations or time (Epstein 1979, 1980; Asendorpf 1988, 1992; Mischel et al. 2002).

In nonhuman primate studies, the trait paradigm has only rarely been applied explicitly despite its suitability and usefulness (e.g. Rouff et al. 2005). For example, many studies lack the important criterion of establishing temporal stability (for exceptions see Hebb 1949; Stevenson-Hinde et al. 1980; Suomi et al. 1996). Temporal stability is, however, implicated in studies reporting on the high heritability of interindividual differences (e.g. Weiss et al. 2000). To date, situational or response profiles have not been investigated in nonhuman primates, although they are crucial for tackling methodological problems derived from cross-situational consistency and coherence in response.

The present empirical study applies the trait paradigm's theory and methods to a personality study on a sample of zoo-housed great apes. A number of trait constructs were selected bottom-up from the species' behavioural repertoires (Uher 2005). They were operationalized in a large number of trait-related behaviours in a variety of situations. Behavioural data were then subjected to analyses of temporal stability, cross-situational consistency and coherence in response.

METHODS

Subjects

Twenty great apes housed in the Wolfgang Köhler Primate Research Center (WKPRC) in the Leipzig Zoo, Germany, participated in this study from January to March 2005. We included five adolescent or adult bonobos, *Pan paniscus*; chimpanzees, *Pan troglodytes verus*; gorillas, *Gorilla gorilla gorilla*; and orang-utans, *Pongo pygmaeus abelii*. Subjects ranged in age from 7 to 31 years, with a median of 16 years (see Table 1). Data on all apes were collected for the observations; in the behavioural tests four subjects in each species could be tested. The subjects were housed in social groups consisting of 5–18 animals in spacious, naturally designed indoor (230–430 m^2) and outdoor enclosures (1680–4000 m^2), and in special testing rooms, each with a number of interlinked cages (each 5.1–7.3 m^2). The subjects were mostly tested individually and always treated in accordance with ethical principles of noninvasive research; testing was stopped if the subjects showed acute signs of distress (e.g. diarrhoea), which happened just once throughout data collection. During the period of testing, all apes received their complete daily diet consisting of various fresh fruits, vegetables, leaves, cereals, eggs and meat, and were never deprived of food or water at any time.

Design

Trait-related behaviour was recorded in a variety of situations, each narrowly defined by situational features. The specificity of some situations allowed measuring just

Table 1. Species, sex, age and rearing history of the subjects

Species	Subject	Name	Sex	Age (years)	Rearing history
Bonobo	B-Jo	Joey	M	22	Nursery
	B-Ku	Kuno	M	8	Nursery
	B-Li	Limbuko	M	9	Nursery
	B-Ul*	Ulindi	F	11	Mother
	B-Ya	Yasa	F	7	Mother
Chimpanzee	C-Do*	Dorien	F	24	Nursery
	C-Fd	Frodo	M	11	Mother
	C-Fk	Fraukje	F	28	Nursery
	C-Ro	Robert	M	29	Nursery
	C-Sa	Sandra	F	11	Mother
Gorilla	G-Be	Bebe	F	25	Mother/peer
	G-Go*	Gorgo	M	23	Nursery
	G-Nd	Ndiki	F	27	Mother/peer
	G-Ru	Ruby	F	7	Mother
	G-Vi	Viringika	F	9	Mother/peer
Orang-utan	O-Bi*	Bimbo	M	24	Nursery
	O-Dk	Dokana	F	16	Mother
	O-Du	Dunja	F	31	Nursery
	O-Pd	Padana	F	7	Mother
	O-Pi	Pini	F	16	Mother

F: female, M: male.
*Subjects dropped from data collection in the series of behavioural tests.