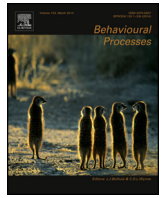




Contents lists available at [ScienceDirect](#)

Behavioural Processes

journal homepage: www.elsevier.com/locate/behavproc



Which personality dimensions do puppy tests measure? A systematic procedure for categorizing behavioral assays

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ARTICLE INFO

Article history:
Available online xxx

Keywords:
Animal personality
Measurement science
Expert-categorization
Standardized test
Domestic dog

ABSTRACT

With the recent increase in interest in personality in dogs, behavioral assays of their behavior have proliferated. There has been particularly strong interest in predicting adult behavior from puppy tests. As a result, researchers and practitioners seeking to measure personality in puppies are faced with a bewildering array of options and no clear guide as to what behavioral assays have been developed or which personality dimensions those assays measure effectively. To address this issue, we used an 'expert-categorization' procedure—a standardized method often used in the course of meta-analyses—to identify the subset of those assays consensually judged to measure major personality dimensions effectively. We used this procedure to identify all relevant puppy tests and to categorize them in terms of their ability to measure nine personality dimensions identified in previous research (activity, aggressiveness, boldness/self-assuredness, exploration, fearfulness/nervousness, reactivity, sociability, submissiveness, trainability/responsiveness). Specifically, we identified 264 assay subtests, derived from 47 studies, which were subjected to a standardized categorization procedure undertaken independently by six expert judges. These procedures yielded a set of behavioral tests judged to measure the nine dimensions effectively and also demonstrated a widely applicable method for developing and evaluating behavioral test batteries.

This article is part of a Special Issue entitled: Canine Behavior.

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1. Introduction

Recent decades have witnessed a strong and steady growth in research on personality or temperament in dogs (Fratkin et al., 2013; Jones and Gosling, 2005). This growth has been driven, in large part, by practical and applied questions about the extent to which the adult behavior of working or companion dogs can be predicted from their behavior as puppies (e.g., Bollen and Horowitz, 2008; Campbell, 1972; Duffy and Serpell, 2012; Goddard and Beilharz, 1985; Hackney 1986; King et al., 2012; Sinn et al., 2010; Svobodova et al., 2008; Wilsson and Sinn, 2012; Wilsson and Sundgren, 1998a). The behavioral tests (or "assays") have been developed across a wide array of theoretical, practical, and commercial contexts. Each of these contexts is associated with unique goals and perspectives on

measurement. Consequently, there has been a proliferation of behavioral assays, designed to assess a wide array of personality traits.

The creation of so many tests reflects the healthy state of canine science. However, researchers and practitioners wanting to measure personality in puppies are faced with a bewildering array of options and no clear guide as to what behavioral assays have been developed or which personality dimensions those assays measure. To address this issue, we used a systematic procedure to identify all relevant puppy tests and categorize them in terms of their ability to measure different personality traits. In doing so, we also provide a demonstration of the procedure, which can be adapted for use in other contexts (e.g., identifying behavioral assays for special populations).

1.1. How many personality dimensions?

With so many researchers from so many different disciplines interested in dogs, there is little agreement on the number of dimensions needed to characterize the full range of individual

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Table 1
Personality dimension framework used as the basis for the judges' categorizations of the behavioral assay subtests.

Source reviewed	Personality dimension	Representative descriptors for each personality dimension
Jones and Gosling (2005), Réale et al. (2007) and Ley et al. (2008) ^a	Activity	Locomotor activity, activity/inactivity, energy, hyperactivity, restlessness
Jones and Gosling (2005) and Réale et al. (2007)	Aggressiveness	Aggression, bite, agonistic reaction
Réale et al. (2007) and Ley et al. (2008)	Boldness/self-assuredness	Determination, tenaciousness, independence, opportunistic, tameness (tame/untamed), shyness (shy/not shy), behavior in response to any risky (but not new) situation
Réale et al. (2007)	Exploration	Exploratory, neophilia, curiosity, behavior in response to a new situation
Jones and Gosling (2005) and Ley et al. (2008)	Fearfulness/nervousness	General nervousness, flight, timidity, wariness, cautiousness, sensitivity
Jones and Gosling (2005)	Reactivity	Excitability, behavior problems
Jones and Gosling (2005), Réale et al. (2007) and Ley et al. (2008) ^b	Sociability	Affability, extraversion, playfulness, behavior in response to the presence or absence of conspecifics (excluding aggressive behavior)
Jones and Gosling (2005)	Submissiveness	Submission, dominance
Jones and Gosling (2005) and Ley et al. (2008)	Trainability/responsiveness	Obedience, distractibility, cooperation, reliability, trainability, intelligence, attentiveness, cleverness
N/A	Other dimension	Judge names other dimension not listed above
N/A	None of the above dimensions	Judge determines test does not seem to measure any of the above dimensions
N/A	Unable to determine	Judge unable to determine dimensions measured based upon information provided in the study description

^a Ley et al. (2008) 'extraversion' dimension descriptors overlap with 'activity'.

^b Ley et al. (2008) 'amicability' dimension descriptors overlap with 'sociability'.

differences in dog personality. For example, one model of canine personality specifies three broad underlying dimensions (Svartberg, 2005), but others have suggested 5 (Svartberg and Forkman, 2002), 6 (Svartberg et al., 2005) or as many as 11 (Duffy and Serpell, 2012; Serpell and Hsu, 2001; Hsu and Serpell, 2003). To empirically evaluate the points of convergence and divergence across the models, one review of the dog-personality literature collated all previous work on dog-personality structure, subjecting the constituent behaviors and traits to an expert-categorization procedure; these procedures identified seven broad dimensions of personality: activity, aggressiveness, fearfulness/nervousness, reactivity, sociability, submissiveness, and trainability/responsiveness (Jones and Gosling, 2005). In addition, Réale et al. (2007) developed a five-dimension model that includes two dimensions—boldness/self-assuredness and exploration—not fully captured by the seven (Jones and Gosling, 2005) categories. Combining the seven dimensions identified by Jones and Gosling (2005) with the two additional dimensions identified by Réale et al. (2007) yields a framework (Table 1) that is both parsimonious and covers all the major dimensions of personality (e.g., Hsu and Serpell, 2003; Ley et al., 2008; Mirkó et al., 2012; Svartberg and Forkman, 2002).

1.2. Expert-categorization procedure

The research on dog personality also reveals considerable disagreement over terminology, with some researchers using similar terms to describe different behaviors and other researchers using different terms to describe similar behaviors (i.e., jingle/jangle fallacies: Carter et al., 2013; Gosling, 2001). Consequently, it is often unclear what the behavioral assays used in dog studies actually measure. To address this issue, a systematic procedure is needed for determining which personality dimensions are expressed in the various behavioral assays. One promising approach involves the use of the 'expert-categorization' procedures typically used in the course of quantitative meta-analyses (Barrick and Mount, 1991; Fratkin et al., 2013; Lipsey and Wilson, 1996; Rosenthal, 1991), in which subject-matter experts independently sort

items into categories and their categorizations are subsequently aggregated statistically. The advantage of this approach is that it can guard against the idiosyncratic biases of any one individual that result from variation in type and breadth of experience among individuals. This method uses a panel of expert judges (i.e., individuals with substantial experience working with behavioral research and the species or taxon of interest) who independently categorize items according to a personality dimension framework. The items sorted are removed from their theoretical context (e.g., the assay purportedly measuring sociability is not labeled as such when it is categorized), allowing the expert judges to focus on the content whilst blind to the original designation of the item.

1.3. Review and categorization of behavioral assays

The aim of the present review is to identify the full range of behavioral assays used in previous research and demonstrate the use of an 'expert-categorization' procedure—often used in the course of meta-analyses—to identify the subset of those assays that measure major personality dimensions. In light of the applied angle of much of the research done on dogs, many canine-personality research studies focus on predicting adult behavior using puppy tests (Fratkin et al., 2013). Our goal was to identify assays that are applicable across a wide range of contexts. Therefore, our analysis focused on assays evaluating behavioral traits of puppies (i.e., dogs less than 12 months of age) for the purposes of characterizing personality.

This aim was achieved in two phases. The first phase accomplished a literature review and identified, for categorization purposes, the discrete behavior assay subtests described in each selected publication. The second phase demonstrated the use of standardized meta-analytic 'expert-categorization' methods to determine which personality dimensions are measured by behavioral assays. We used the results of our categorization procedures to provide insights regarding behavioral assays that are likely to be useful for measuring personality in future research.

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