Universidade Federal de Juiz de Fora
Pós-Graduação em Ciências Biológicas
Mestrado em Comportamento e Biologia Animal

Isadora de Castro Travnik

AVALIAÇÃO QUALITATIVA DO COMPORTAMENTO COMO INDICADOR DO TEMPERAMENTO EM GATOS DOMÉSTICOS (*Felis silvestris catus*)

Juiz de Fora
2020

Isadora de Castro Travnik

AVALIAÇÃO QUALITATIVA DO COMPORTAMENTO COMO INDICADOR DO TEMPERAMENTO EM GATOS DOMÉSTICOS (*Felis silvestris catus*)

Dissertação apresentada ao Instituto de Ciências Biológicas, Programa de Pós-Graduação em Comportamento e Biologia Animal da Universidade Federal de Juiz de Fora, como requisito para obtenção do grau de Mestre.

Orientadora: Profa. Dra. Aline Cristina Sant'Anna

Juiz de Fora

2020

Ficha catalográfica elaborada através do programa de geração
automática da Biblioteca Universitária da UFJF,
com os dados fornecidos pelo(a) autor(a)

Travnik, Isadora de Castro.
Avaliação Qualitativa do Comportamento como indicador do temperamento em gatos domésticos (Felis silvestris catus) / Isadora de Castro Travnik. -- 2020.
69 f. : il.

Orientadora: Aline Cristina Sant'Anna
Dissertação (mestrado acadêmico) - Universidade Federal de Juiz de Fora, Instituto de Ciências Biológicas. Programa de Pós-Graduação em Ciências Biológicas: Comportamento Animal, 2020.

1. Personalidade. 2. Bem-estar animal. 3. Gatos de abrigo. 4. Animais de companhia. I. Sant'Anna, Aline Cristina, orient. II. Título.

Isadora de Castro Travnik

AVALIAÇÃO QUALITATIVA DO COMPORTAMENTO COMO INDICADOR DO TEMPERAMENTO EM GATOS DOMÉSTICOS (*Felis silvestris catus*)

Dissertação apresentada ao Instituto de Ciências Biológicas, Programa de Pós-Graduação em Comportamento e Biologia Animal da Universidade Federal de Juiz de Fora, como requisito para obtenção do grau de Mestre.

Aprovada em: 17 de fevereiro de 2020.

BANCA EXAMINADORA:

Prof. Dr. Mateus José Rodrigues Paranhos da Costa

Prof. Dr. Giovanne Ambrosio Ferreira

Profa. Dra. Aline Cristina Sant'Anna (orientadora)

Juiz de Fora

2020

AGRADECIMENTOS

Agradeço a diversas pessoas que me motivaram e apoiaram nesses dois anos de mestrado.

Primeiramente a minha orientadora professora Aline, que sempre acreditou e abraçou as minhas ideias, sendo empática em diversos momentos, incentivando o meu crescimento e me dando oportunidades de aprender e me desenvolver como profissional.

A todos do grupo NEBEA, por cada conversa, apoio e amizade. Por se mostrarem comprometidos a participarem das etapas da pesquisa dedicando o seu tempo e concentração.

A todas as pessoas queridas, Carlos, Letícia, Mariana e em especial ao Felipe, externas ao laboratório, que se dedicaram nessa empreitada e participaram da pesquisa.

Meus sinceros agradecimentos a Marilu, por abrir as portas e ceder o espaço onde foi realizado o estudo. Uma mulher de coração enorme e muito amor em suas ações.

Aos professores da Pós-Graduação por cada ensinamento e conselhos. Ensinar é um ato altruísta. Gostaria de, algum dia, ser para alguém aquilo que vocês foram para mim.

As secretárias, Daiane e Marlu que sempre se manifestaram para auxiliar, instruir e prestar esclarecimentos.

A minha família, aos meu pais Cecília e Albert por todo amor, apoio e encorajamento. Ao meu irmão Mathias, aos meus primos, em especial ao Carlos, por estar sempre disposto a ouvir, uma ou duas vezes, as dificuldades e vitórias conquistados por todas as etapas. E ao meu tio José, por dedicar longas horas na transcrição destes capítulos. A todos vocês o meu amor.

A banca examinadora da qualificação e da defesa, por todas as considerações valiosas em melhora desse manuscrito.

Ao órgão financiador de pesquisas CAPES, pela concessão da bolsa de estudos, a Universidade Federal de Juiz de Fora e ao Programa da Pós-Graduação por todo o suporte.

A Deus.

RESUMO

A Avaliação Qualitativa do Comportamento (QBA) é um método baseado na observação da linguagem corporal dos animais através de descritores, em substituição ao uso de categorias comportamentais isoladas. Como a QBA é um método sujeito à interpretação pelos avaliadores, é necessário avaliar a sua consistência a fim de possibilitar seu uso como indicador de temperamento em animais. O objetivo deste estudo foi avaliar a validade e confiabilidade inter-observador da QBA como um indicador do temperamento de gatos domésticos. Foram aplicados quatro testes comportamentais a 42 gatos mantidos em abrigo: pessoa desconhecida (UP); novo objeto (NO); reação a co-específico (CO) e oferta de alimento (FO). Os testes foram filmados e avaliados usando um etograma que incluía categorias comportamentais discretas e por um escore de três categorias criado para cada um dos testes, gerando informações quantitativas sobre as dimensões do temperamento. Aos vídeos também foi aplicada a QBA por 19 avaliadores de diferentes perfis (i: com experiência em avaliação do comportamento animal; ii: sem experiência; iii: tutores de gatos; iv: não tutores; e v: todos os observadores). Os 20 descritores utilizados foram pontuados em uma escala analógica visual (ativo, carinhoso, agressivo, agitado, atento, alerta, calmo, confiante, curioso, medroso, amigável, indiferente, nervoso, relaxado, sociável, estressado, desconfiado, tenso, vocal e pidão). Os dados quantitativos e da QBA foram analisados por meio de Análise de Componentes Principais. Um dos observadores foi designado como ‘ouro’ por possuir experiência com a QBA, e sua análise foi comparada com os resultados extraídos dos testes de modo quantitativo, por análise de variância e correlação de Spearman. Para obter a confiabilidade entre os observadores foi utilizada o coeficiente de concordância de Kendall (W). Os componentes principais (PC) encontrados, considerados como dimensões principais do temperamento dos gatos, a partir dos testes comportamentais foram 'amigabilidade' (PC1-UP), 'neofobia' (PC1-NO), 'antecipação' (PC1-FO), 'sociabilidade' (PC1-CR), 'indiferença' (PC2-UP, PC3-NO, PC3-FO) e 'tolerância' (PC3-UP, PC2-NO, PC2-FO, PC2-CR). Enquanto por meio da QBA encontramos as dimensões 'calma' (PC1-QBA), 'agitação' (PC2-QBA) e 'ousadia' (PC3-QBA), que identificavam quatro perfis de gatos: calmo/agitado, calmo/quieto, medroso/agressivo e medroso/fujão. Os primeiros PC obtidos para cada teste foram significativamente correlacionados com o PC1-QBA (calma) e o PC3-QBA (ousadia) foi correlacionado com o escore que representava comportamentos agressivos no teste UP. Essa correlação mostra que o observador ‘ouro’ foi capaz de captar os aspectos evidenciados pela dimensão principal dos testes comportamentais e os comportamentos agressivos expressos

apenas pelo escore, validando o QBA como método de identificação do temperamento de gatos domésticos. A confiabilidade das dimensões para os 19 observadores mostrou concordância ‘alta’ em PC1 (0,71) e ‘baixas’ em PC2 (0,21) e PC3 (0,29). Desse modo, a QBA foi considerada uma ferramenta válida e prática para identificar e diferenciar temperamentos de gatos, assim como confiável para a dimensão ‘calma’. As dimensões encontradas, consideradas válidas e confiáveis, são traços importantes do temperamento dos gatos, possuindo boas aplicações em ambientes práticos de abrigos, podendo ser usados como base para estabelecer processos adotivos mais efetivos e estratégias de manejo para os gatos domésticos mantidos em abrigos.

Palavras chave: Bem-estar animal. Animais de companhia. Personalidade. Gatos de abrigo.

ABSTRACT

The Qualitative Behavior Assessment (QBA) is a method that builds the observation of animals' body language through descriptors, instead of focusing on isolated behavioral categories. As the QBA is a method subject to the evaluator's interpretation, it is necessary to evaluate the consistency between evaluators in order to enable its use as an indicator of temperament in animals. Thus, the aim of this study was to assess the validity and inter-observer reliability of QBA as an indication of cats' temperament. Four behavioral tests were applied to 42 shelter cats: unfamiliar person (UP); novel object (NO); co-specific reaction (CO) and food offering (FO). The tests were filmed and assessed using an ethogram that included discrete behavioral categories and by a score of three categories created for each of the tests, generating quantitative information on the existing temperament dimensions. The videos were also assessed using the QBA method by 19 assessors of different profiles (i: experienced in animal behavior assessment; ii: inexperienced; iii: cat owners; iv: no-owners; v: all observers). The 20 descriptors used were scored in visual analog scales (active, affectionate, aggressive, agitated, attentive, alert, calm, confident, curious, fearful, friendly, indifferent, nervous, relaxed, sociable, stressed, suspicious, tense, vocal and greedy). The quantitative and QBA data were analyzed using Principal Component Analysis. One of the observers was designated as 'gold' because he already had experience with QBA, and its analysis was compared with the results extracted from the behavioral tests, by analysis of variance and Spearman's rank correlation. Kendall's coefficient of concordance (W) was used to obtain inter-observer reliability. The Principal Components (PC) found, considered as the main dimensions of cats temperament, by using coding method were 'fearfulness' (PC1-UP), 'neophobic' (PC1-NO), 'anticipation' (PC1-FO), 'sociability' (PC1-CR), 'indifference' (PC2-UP, PC3-NO, PC3-FO) and 'tolerance' (PC3-UP, PC2-NO, PC2-FO, PC2-CR). While by using QBA we found the dimensions 'calmness' (PC1-QBA), 'restless' (PC2-QBA) and 'aggressiveness' (PC3-QBA), which identified four cat profiles: calm/active, calm/quiet, fearful/aggressive and fearful/flighty. The first PC obtained for each test were significantly correlated with the PC1-QBA (calmness) and PC3-QBA (aggressiveness) was correlated with the score that represented aggressive behaviors in th UP test. This correlations showing that 'gold' observer captured aspects evidenced by the first dimension of all behavioral tests and the aggressive behaviors expressed only by the score, validating the QBA as a method of identifying the temperament of domestic cats. The reliability of the dimensions for the 19 observers showed 'high' agreement on PC1 (0.71) and 'low' for PC2 (0.21) and PC3 (0.29). Thus, the QBA was considered a valid and feasible tool for

identifying and differentiating cat temperaments, as well as reliable for a ‘calmness’ dimension. The dimensions found, regarded as valid and reliable, are important traits of cats temperament, being promising in practical shelter environments as a basis for establishment of effective adoptive processes and management strategies to domestic cats kept in shelters.

Keywords: Animal Welfare. Companionship animals. Personality. Shelter cats.

LISTA DE FIGURAS

LISTA DE TABELAS

CAPÍTULO 1

CAPÍTULO 2

LISTA DE ABREVIATURAS E SIGLAS

CO	Co-specific reaction
FD	Flight distance
NO	Novel object
NSA	Near security area
OF	Food offering
PC	Principal Component
PC1	First Principal Component
PC2	Second Principal Component
PC3	Third Principal Component
PCA	Principal Components Analysis
QBA	Qualitative Behavior Assessment
UP	Unfamiliar person

SUMÁRIO

CAPÍTULO 1

REVISÃO DA LITERATURA

Temperamento

O temperamento é definido como as variações individuais no comportamento, consistentes ao longo de um determinado período de tempo e em diferentes contextos (Briffa e Weiss, 2010; Stamps e Groothuis, 2010; Hudson et al., 2015). Onde 'contextos' refere-se a quaisquer estímulos externos presentes no momento da expressão comportamental (Stamps e Groothuis, 2010). Outros termos como personalidade, estilos de enfrentamento e síndrome comportamental também vêm sendo utilizados, suas definições são variáveis, apresentando sutis diferenciações (Gartner e Weiss, 2013). Por isso, nesse estudo o termo temperamento será utilizado como sinônimo dos demais termos. O comportamento dos animais em diferentes situações nos mostra uma gama de traços comportamentais ou dimensões, e estes, por sua vez, nos auxiliam na percepção da sua individualidade (Mendl e Harcout, 2000). O temperamento é fortemente expresso quando os animais são colocados sob novas situações (Réale et al., 2007), deste modo, quantificar as reações a novos estímulos são bons meios de se reconhecer os distintos perfis de temperamento em animais (Feaver et al., 1986; Siegford et al., 2003). Os perfis de temperamento se formam através da interação entre genética e ambiente, principalmente na infância, onde seu temperamento ainda está em construção (Curley e Branchi, 2013). Este é considerado um componente adaptativo com potencial evolutivo, uma vez que, sua flexibilização e plasticidade é modulada pela genética (Briffa e Weiss, 2010).

Os trabalhos com temperamento em animais não humanos começaram a despertar interesses desde a década de 30 (Gartner, 2015). Os primatas foram os primeiros sujeitos de estudos dessa natureza (Crawford, 1938), decorrente da sua proximidade filogenética com humanos (Freeman e Gosling, 2010). Tais abordagens logo se ampliaram, passando a ser desenvolvidos estudos com animais de fazenda (Fordyce et al., 1982) e animais de companhia, como cães (Humphrey, 1934) e gatos (Feaver et al., 1986). A grande variação de termos e metodologias, no entanto, vem sendo um problema na análise comparativa dos trabalhos sobre temperamento (Gartner e Weiss, 2013). Highfill et al. (2010) classificaram dois tipos de metodologias para se avaliar ao temperamento dos animais. A primeira delas é denominada 'codificação' (do inglês *coding)*, onde categorias comportamentais são registradas e

quantificadas através de um etograma. Esse registro pode ocorrer tanto em testes controlados, onde os animais lidam com um estímulo específico, quanto no ambiente natural do animal em seu ambiente e hábitos cotidianos (Highfill et al., 2010). A segunda é a 'classificação' (do inglês *rating)*, caracterizada por descrever os estados emocionais e a linguagem corporal dos animais com o uso de descritores, através da percepção de observadores. Podemos encontrar na literatura trabalhos com temperamento utilizando metodologias qualitativas, ou de classificação (Bennet et al., 2017; Ha e Ha, 2017), quantitativas, ou codificação (Feaver et al., 1986; Guenther et al., 2014), e ainda encontramos alguns onde é utilizada uma associação dos dois tipos de métodos (Highfill et al., 2010; Sant'Anna e Paranhos da Costa, 2013).

Métodos baseados em codificação do comportamento

A codificação consiste do registro descritivo dos atos dos animais. Na codificação, existem diversas formas de registrar os dados comportamentais, por isso quando utilizado, o método deve ser escolhido baseado no objetivo, espécie e número de animais (Azevedo et al., 2018). O registro pode ocorrer de modo contínuo, onde os comportamentos dos animais são coletados durante todo o tempo de observação, registrando todas as ocorrências comportamentais; ou por rota de coleta no tempo, onde são selecionados intervalos de tempo periódicos (Martin e Bateson, 1993). O registro por coleta no tempo é menos preciso e nem todas as informações são preservadas, no entanto, ela é uma maneira de condensar as informações e registrar simultaneamente um maior número de categorias diferentes (Martin e Bateson, 1993). Também existem quatro formas de se registrar as amostras, também conhecidas como rotas de amostragem, segundo Martin e Bateson (1993), que são ad libitum, focal, varredura e amostragem do comportamento. A amostragem ad libitum consiste em uma amostragem não sistematizada, onde o observador anota o que lhe parece relevante no momento. Esse método, no entanto, é facilmente influenciado por comportamentos mais perceptíveis e evidentes. A amostragem focal consiste em observar um indivíduo ou pequeno grupo de animais por todo um determinado tempo, registrando todas as categorias do seu comportamento. A amostragem por varredura consiste em intervalos regulares de tempo onde o comportamento dos animais é registrado rapidamente naquele instante, esse método possibilita a análise de diferentes indivíduos ao mesmo tempo. O método por amostragem do comportamento consiste no registro por ocorrência de um comportamento específico de interesse, onde um grupo de animais é observado. Esse método é utilizado comumente quando

busca-se estudar comportamentos que não ocorrem com tanta frequência (como disputas e cópulas), sendo esses comportamentos frequentemente perdidos na amostragem focal ou por varredura (Martin e Bateson, 2000).

Encontramos na literatura exemplos de trabalhos com gato com o uso dessa abordagem como os de Feaver et al. (1986), no qual os autores utilizaram dados obtidos através do registro de comportamentos (e.g. cheirar, olhar, brincar, comer, dormir, entre outros) para identificar as diferenças individuais dos gatos. Foram analisados 14 gatos domésticos adultos, onde cada grupo de gatos foi avaliado por, pelo menos, 25 horas. Após esse tempo, os gatos foram pontuados através do método de classificação e identificados os perfis de temperamento (alerta, sociável e estável - do inglês *equable*). Os componentes dos perfis foram correlacionados com cada um dos comportamentos registrados nas observações, encontrando por exemplo correlações entre o item agressividade e os comportamentos olhar, bater e perseguir (Feaver et al., 1986). Outro trabalho que demonstra a aplicação de métodos de codificação para avaliar o temperamento de gatos domésticos é o de Fukimoto et al. (2019); nesse estudo uma lista de possíveis comportamentos foi pré-definida e nela, cada comportamento possuía uma nota variável, notas positivas para comportamentos afiliativos e negativas para comportamentos aversivos. Com esses dados Fukimoto et al. (2019) encontraram as dimensões agradabilidade, capacidade receptiva (do inglês *openness*) e extroversão.

Métodos baseados em classificação do comportamento

O uso de abordagens classificatórias, ou qualitativas, na avaliação do comportamento vem ganhando mais espaço nas últimas décadas, a partir dos desenvolvimentos de Wemelsfelder et al. (2001) a qual introduziu a ideia da observação do 'animal como um todo' ao invés de partes isoladas ou comportamentos isolados. Os autores defendem que a observação do animal no seu ambiente em um contexto mais amplo é capaz de revelar informações que, talvez, os métodos quantitativos não conseguissem avaliar de forma integrativa, além de captar flutuações comportamentais mais sutis e difíceis de serem mensuradas nos testes quantitativos. Desta forma, eles desenvolveram uma metodologia denominada Avaliação Qualitativa do Comportamento (do inglês *Qualitative Behavior Assessment*, QBA) a qual permite identificar, através de uma gama de descritores, a intensidade da expressão de diversos estados mentais ou características comportamentais de um dado animal, em determinado momento, permitindo

inferir sobre o nível de bem-estar em que esse animal se encontra (Wemelsfelder, 2007). Se pensarmos no conceito de temperamento, tal método pode ser vantajoso por permitir uma avaliação integrativa de diversos traços ou dimensões do temperamento. Assim é possível observar o animal em diversos contextos e obteremos um indicativo das diversas dimensões que compõem o seu temperamento. Os descritores nesta metodologia são quantificados em escalas analógicas visuais pelos observadores e, posteriormente, os dados são submetidos a métodos estatísticos multivariados que permitem integrar as informações com base nos diversos descritores. Esse método avaliativo demonstrou ser válido e não ser apenas uma percepção subjetiva não confiável (Wemelsfelder e Lawrence, 2001; Wemelsfelder, 2007; Walker et al., 2010; Fleming et al., 2013; Sant'Anna e Paranhos da Costa, 2013).

Para animais de companhia, encontramos quatro trabalhos de QBA realizado com cães (Walker et al., 2010; Arena et al., 2017; Walker et al., 2016; Arena et al., 2019). Walker et al. (2010) trabalharam com 10 cães de trabalho da raça Beagle, em atividade na alfândega do Aeroporto Internacional de Auckland (Nova Zelândia), e 18 observadores não treinados, para avaliar a expressão dos cães em um teste de interação com uma pessoa desconhecida, já que a interação entre ambos é crucial para a manutenção de altos níveis de bem-estar animal (Walker et al., 2010). Na literatura científica, a maioria dos trabalhos desenvolvidos com essa metodologia se resume a animais de fazenda (Stockman et al., 2012; Sant'Anna e Paranhos da Costa, 2013; Góis et al., 2016). Apesar disso, a mesma pode ser uma ferramenta promissora para avaliação do comportamento também para animais de companhia, uma vez que a proximidade do avaliador com o sujeito do estudo pode resultar em uma familiaridade maior com estes animais do que com determinadas espécies de fazenda (como por exemplo as aves comerciais) e com isso causar um aumento da sua eficácia.

Gatos domésticos e obstáculos enfrentados nos abrigos

O gato doméstico, *Felis silvestris catus* (Linnaeu, 1758), é o felino mais conhecido da atualidade. Sua domesticação começou a mais de nove mil anos (Broom e Fraser, 2010) com uma possível associação mutualística decorrente do início do processo de armazenamento de grãos na agricultura e, consequentemente, aumento da densidade de roedores nas áreas periantrópicas. Os gatos nesse contexto predavam os roedores que se aproximavam dos agrupamentos humanos agindo como agente de controle natural, enquanto o ser humano

oferecia para estes abrigo e alimento (Driscoll et al., 2007). Hoje distribuídos por quase todo o globo, os gatos apresentam uma ampla flexibilidade comportamental, podendo se habituar a diferentes ambientes e situações.

A população de gatos em estado domiciliado no mundo chega a cerca de 271,9 milhões, sendo que 22,1 milhões se encontram no Brasil (IBGE, 2013). Quanto a animais de abrigos, estima-se que nos Estados Unidos 3,2 milhões de gatos sejam alojados anualmente, sendo que destes, aproximadamente 26,9% são eutanaziados, 50% encontram um novo lar, enquanto os demais permanecem no abrigo ou têm outros destinos (ASPCA, 2018). Para o Brasil encontramos dificuldades para acessar o número total de animais alojados em abrigos, sejam estes públicos ou privados. Nos abrigos os gatos enfrentam diversos problemas de bem-estar correlacionados com o estresse (McCobb et al., 2005). Os cuidadores têm uma obrigação ética de fornecer um ambiente habitacional apropriado que promova o bem-estar dos gatos (Stella et al., 2014). No entanto, na prática, as instituições encontram grandes dificuldades. Os espaços disponibilizados para manter os animais cativos tendem a ser reduzidos, tanto em tamanho, quanto em qualidade do ambiente. Animais adultos tendem a permanecer por mais tempo nas instituições e acabam desenvolvendo problemas comportamentais e fisiológicos. Esses problemas estão ligados diretamente a elevação dos níveis de estresse devido a estratégias de manejo, acomodações e socialização feitas de maneira inadequada, que levam muitas vezes a eutanásia dos animais (Gourkow e Fraser, 2006). Essa situação está diretamente ligada ao grande número de animais nos abrigos. Os casos de abandono e retorno contribuem para o aumento desses números e envolvem não apenas questões práticas, como também questões éticas.

As pessoas vêem seus animais de estimação cumprindo papéis importantes em suas vidas. Desse modo, adoções mal sucedidas podem causar grande sentimento de tristeza nos adotantes, suprimindo o desejo de incorporar um animal de companhia a sua residência e família (Shore, 2005). Os casos de abandonos e retornos aos abrigos podem resultar de inúmeros fatores, dentre eles a mudança de residência, descoberta ou desenvolvimento de alergias por algum dos membros da família e comportamentos indesejáveis do gato como, problemas sociais com os animais já residentes do lar e com crianças, fuga, hiperatividade, timidez, comportamentos destrutivos e agressividade (Casey et al., 2009; Salman et al., 2000; Shore, 2005). Casey et al. (2009) demonstraram que, dentre os animais que foram devolvidos para os abrigos, 38% retornaram com a justificativa de apresentarem problemas comportamentais. Dentre estes problemas, 44% foram referentes a agressão direcionadas a

outros gatos ou a pessoas. A falta de compreensão de seus tutores sobre aspectos comportamentais de seus gatos acaba prejudicando a formação do vínculo afetivo, assim como as expectativas formuladas em cima do relacionamento com seu novo animal de companhia. Como ilustra Shore (2005) " (...) as pessoas que retornam com os animais para o abrigo, neste estudo, não conceituaram a adoção como o início de um relacionamento que levará tempo para se estabilizar e/ou como algo que pode ser melhorado".

Gato doméstico e temperamento

Em gatos o temperamento pode não estar totalmente desenvolvido antes dos quatro meses de vida (Lowe e Bradshaw, 2001). Diversos estudos desenvolvidos com gatos buscaram entender as variações dos traços de temperamento a partir de diversas variáveis como, efeito paterno (Turner et al., 1986), lateralidade (McDowell et al., 2016), coloração da pelagem, raças (Mendl e Harcout, 2000), sexo e castração, idade (Bennett et al., 2017) e manejo na infância (Lowe e Bradshaw, 2001). O primeiro trabalho publicado sobre a personalidade dos gatos domésticos foi realizado por Feaver et al. (1986), estes produziram três escores de personalidade para cada gato, a saber, alerta, sociável e estável - do inglês *equable*. Onde, o escore alerta era definido por reações de atividade e curiosidade e o escore sociável era definido por maiores reações de sociabilidade e menores reações de medo, hostilidade e tensão (Feaver et al., 1986). Outro trabalho realizado com gatos aplicou um questionário a 416 tutores e identificou através de 29 descritores, seis dimensões de temperamento (lúdico, nervosismo, amabilidade, dominância, exigência, intolerância), que representavam 56,08% da variância dos dados (Bennett et al., 2017). Algumas associações de características do animal também foram correlacionadas com traços do temperamento, como a idade correlacionada a uma maior atividade de brincadeira (Bennett et al., 2017) e pelagem alaranjada em gatos machos com maior grau de agressividade (Mendl e Harcout, 2000).

No entanto, os estudos sobre temperamento em gatos ainda são escassos sendo seus impactos negligenciados ao longo do tempo. Os trabalhos de temperamento com animais de companhia envolvem, em sua grande maioria, os cães (Gartner, 2015), provavelmente por estes serem utilizados como animais de trabalho e precisarem atender a algumas exigências comportamentais durante suas atividades, ou até mesmo por seu maior tempo de domesticação e proximidade com o ser humano. Em uma revisão de literatura realizada por Gartner (2015)

foi reportado que 95 dos trabalhos encontrados foram realizados com cães, enquanto apenas 24 foram realizados com os gatos domésticos. Quando produzidos com gatos, os trabalhos não necessariamente foram realizados para definir e encontrar os perfis de temperamento, mas sim para estudar traços específicos de temperamento nestes animais, tais como sociabilidade, agressividade e dominância (Gartner e Weiss, 2013).

Além das características físicas (como idade e tamanho do pelo) o temperamento também é um dos fatores que influencia no processo adotivo dos gatos domésticos e na relação humano-animal (Evans et al., 2019; Gourkow e Fraser, 2006; Sinn, 2016). Traços do temperamento como medo e timidez são apontadas como motivo para a devolução de animais anteriormente adotados (Casey et al., 2009; Shore, 2005). Por outro lado, gatos com alta 'agradabilidade/amabilidade' e baixo 'neuroticismo' geram maior satisfação para seus tutores (Bennett et al., 2017; Evans et al., 2019). No momento da adoção, outro importante traço do temperamento a ser considerado é a sociabilidade. Tutores demonstram que comportamentos de brincadeira, simpatia e de aproximção foram os principais motivadores no momento da sua escolha (Sinn, 2016). Nesse contexto, se faz necessário que as instituições proporcionem oportunidades para que os adotantes possam interagir com os gatos do abrigo, assim como se faz evidente a importância de se trabalhar a sociabilidade dos animais (Sinn, 2016).

Portanto, a identificação dos perfis de temperamento dos gatos se torna uma ferramenta fundamental para definir estratégias de manejo, reduzir traços de temperamento prejudiciais para a relação humano-animal, como medo e agressividade, através de processos de habituação e condicionamento, além da educação e concientização dos tutores. A concientização e educação dos tutores aumenta o sucesso das adoções por meio do desenvolvimento de expectativas mais realistas do comportamento dos gatos, o que melhora a relação tutor-gato e reduz o número de retornos e abandono (Shore, 2005; Weiss et al., 2015). Enquanto definir estratégias de manejo adequadas ao temperamento de cada animal atua para melhorar o bem-estar dos indivíduos alojados em abrigos, o que por si só, já é um resultado positivo, que repercute diretamente no número das adoções (Gourkow e Fraser, 2006). De Rivera et al. (2017), por exemplo, mostram que animais mais medrosos apresentam maiores períodos de inatividade e permanecem, significativamente, menos tempo próximo dos humanos. Essa informação pode implicar na adequação dos alojamentos para os animais medrosos. Nestes espaços podem ser disponibilizados um número maior de áreas de descanso e principalmente de esconderijos que proporcionem a estes animais a sensação de segurança, já que eles preferem monitorar suas áreas de locais elevados (Rochlitz, 2000).

Desse modo, a realização de trabalhos mais completos sobre o temperamento de gatos é importante para que se melhorar a relação gato-tutor, através do desenvolvimento de expectativas mais realistas do comportamento do seu gato, e com isso, reduzir o número de casos de abandono. Além disso, um melhor embasamento do processo de adoção nos abrigos pode aumentar o sucesso desse processo e diminuir o número de retornos, ou possível soltura do animal para as ruas. Para Weiss et al. (2015) gatos e tutores devem ser compatíveis para evitar esses retornos. A identificação dos perfis de gatos também é importante para reconhecer os perfis mais suscetíveis a problemas comportamentais para que se possa proceder o adestramento visando minimizar as expressões de comportamentos indesejáveis, viabilizando o processo adotivo e melhorando o bem-estar do indivíduo e a relação gato-tutor. Ainda segundo Weiss et al. (2015), gatos com níveis de sociabilidade mais baixos podem não ser colocados para a adoção e ficarem mais tempo no abrigo para intervenção comportamental. Assim, o presente estudo visa testar uma metodologia válida, viável e confiável para a avaliação do temperamento de gatos, através da Avaliação Qualitativa do Comportamento (QBA).

Referências

ARENA, L.; WEMELSFELDER, F.; MESSORI, S.; FERRI, N.; BARNARD, S. Application of Free Choice Profiling to assess the emotional state of dogs housed in shelter environments. **Applied Animal Behaviour Science,** v. 195, p. 72-79, 2017.

ARENA, L.; WEMELSFELDER, F.; MESSORI, S.; FERRI, N.; BARNARD, S. Development of a fixed list of descriptors for the qualitative behavioural assessment of shelter dogs. **BioRxiv** 545020.

ASPCA Pet Statistics. Disponível em: https://www.aspca.org/animal-homelessness/shelter-intake-and-surrender/pet-statistics. 2018. Acessado em: 16 November 2019.

AZEVEDO, C.S.; BARÇANTE, L.; PALHARES, C.T. **Comportamento Animal: uma Introdução aos Métodos e à Ecologia Comportamental**. 1ª Edição. Curitiba: Appris, v. 1, p. 220, 2018.

BENNETT, P.C.; RUTTER, N.J.; WOODHEAD, J.K.; HOWELL, T.J. Assessment of domestic cat personality, as perceived by 416 owners, suggests six dimensions. **Behavioural Processes**, v. 141, p. 273-283, 2017.

BRIFFA, M.; WEISS, A. Animal personality. **Current Biology,** v. 20, n. 21, p. R912-R914, 2010.

BROOM, D.M.; FRASER, A.F. Bem-estar de gatos. In: **Comportamento e Bem-estar de Animais Domésticos**. 4ª Edição. São Paulo - Manole. p. 323-328, 2010.

CASEY, R.A.; VANDENBUSSCHE, S.; BRADSHAW, J.W.S.; ROBERTS, M.A. Reasons for relinquishment and return of domestic cats (Felis silvestris catus) to rescue shelters in the UK. **Anthrozoös**, v. 22, n. 4, p. 347-358, 2009.

CRAWFORD, M.P. A behavior rating scale for young chimpanzees. **Journal of Comparative Psychology**, v. 26, n. 1, p. 79, 1938.

CURLEY, J.P.; BRANCHI, I. Ontogeny of stable individual differences: genes, environment, and epigenetic mechanisms. In: Carere, C.; Maestripieri, D. **Animal Personalities - Behavior, Physiology, and Evolution**. The University of Chicago Press. p. 279-316, 2013.

DE RIVERA, C.; LEY, J.; MILGRAM, B.; LANDSBERG, G. Development of a laboratory model to assess fear and anxiety in cats. **Jounal of Feline Medicine Surgery**, v. 19, n. 6, p. 586-593, 2017.

DRISCOLL, C.A.; RAYMOND, M.M.; ROCA, A.L.; HUPE, K.; JOHNSON, W.E.; GEFFEN, E.; HARLEY, E.; DELIBES, M.; PONTIER, D.; KITCHENER, A.C.; YAMAGUCHI, N.; O'BRIEN, S.J.; MACDONALD, D. The near eastern origin of cat domestication. **Sciencexpress**, p.1-10, 2007.

EVANS, R.; LYONS, M.; BREWER, G.; TUCCI, S.J.P.; DIFFERENCES, I. The purrfect match: The influence of personality on owner satisfaction with their domestic cat (Felis silvestris catus). **Personality and Individual Differences**, v. 138, p. 252-256, 2019.

FEAVER, J.; MENDL, M.; BATESON, P.J. A method for rating the individual distinctiveness of domestic cats. **Animal Behaviour**, v. 34, n. 4, p. 1016-1025, 1986.

FLEMING, P.A.; PAISLEY, C.L.; BARNES, A.L.; WEMELSFELDER, F. Application of Qualitative Behavioural Assessment to horses during an endurance ride. **Applied Animal Behaviour Science**, v. 144, n. 1-2, p. 80-88, 2013.

FORDYCE, G.; GODDARD, M.; SEIFERT, G. The measurement of temperament in cattle and the effect of experience and genotype. **Proceedings of the Australian Society of Animal Production**, v. 14, n. 3, p. 329-32, 1982.

FREEMAN, H.D.; GOSLING, S.D. Personality in nonhuman primates: a review and evaluation of past research. **American Journal of Primatology**, v. 72, n. 8, p. 653-671, 2010.

FUKIMOTO, N.; HOWAT-RODRIGUES, A.B.; MENDONÇA-FURTADO, O.J.A.A.B.S. Modified Meet your Match® Feline-alityTM validity assessment: An exploratory factor analysis of a sample of domestic cats in a Brazilian shelter. **Applied Animal Behaviour Science**, v. 215, p. 61-67, 2019.

GARTNER, M.C. Pet personality: A review. **Journal Personality Individual Differences**, v. 75, p. 102-113, 2015. ISSN 0191-8869.

GARTNER, M.C.; WEISS, A. Personality in felids: a review. **Applied Animal Behaviour Science**, v. 144, n. 1-2, p. 1-13, 2013.

GÓIS, K.C.R.; CEBALLOS, M.C.; SANT'ANNA, A.C.; PARANHOS DA COSTA, M.J.R. Using an observer rating method to assess the effects of rotational stocking method on beef cattle temperament over time. **Revista Brasileira de Zootecnia**, v. 45, n. 9, p. 501-508, 2016.

GOURKOW, N.; FRASER, D. The effect of housing and handling practices on the welfare, behaviour and selection of domestic cats (Felis sylvestris catus) by adopters in an animal shelter. v. 15, p. 371-377. 2006.

GUENTHER, A.; BRUST, V.; DERSEN, M.; TRILLMICH, F. Learning and personality types are related in cavies (Cavia aperea). **Jounal of Comparative Psychology**, v. 128, n. 1, p. 74, 2014.

HA, D.; HA, J. A subjective domestic cat (Felis silvestris catus) temperament assessment results in six independent dimensions. **Behavioural Processes**, v. 141, p. 351-356, 2017.

HIGHFILL, L.; HANBURY, D.; KRISTIANSEN, R.; KUCZAJ, S.; WATSON, S. Rating vs. coding in animal personality research. **Zoo Biology**, v. 29, n. 4, p. 509-516, 2010.

HUDSON, R.; RANGASSAMY, M.; SALDANA, A.; BANSZEGI, O.; RODEL, H.G. Stable individual differences in separation calls during early development in cats and mice. **Frontiers in Zoology**, v. 12, p. 12, 2015.

HUMPHREY, E.S. "Mental Tests" for shepherd dogs an attempted classification and evaluation of the various traits that go to make up "Temperament" in the german shepherd dog. **Journal of Heredity**, v. 25, n. 4, p. 129-136, 1934.

INSTITUTO BRASILEIRO DE GEOGRAFIA E ESTATÍSTICA (IBGE). População de animais de estimação no Brasil – 2013. Elaborado por: Abinpet. 2013.

LOWE, S. E.; BRADSHAW, J. W. Ontogeny of individuality in the domestic cat in the home environment. **Animal Behaviour**, v. 61, n. 1, p. 231-237, 2001.

MARTIN, P.; BATESON, P. **Measuring Behaviour: an Introductory Guide**. 2ª Cambridge: Cambridge University Press, p. 222, 1993.

MCCOBB, E. C.; PATRONEK, G.J.; MARDER, A.; DINNAGE, J.D.; STONE, M.S. Assessment of stress levels among cats in four animal shelters. **Journal of the American Veterinary Medical Association**, v. 226, n. 4, p. 548-555, 2005.

MCDOWELL, L.J.; WELLS, D.L.; HEPPER, P.G.; DEMPSTER, M. Lateral Bias and Temperament in the Domestic Cat (Felis silvestris). **Journal of Comparative Psychology**, v. 130, n. 4, p. 313-320, 2016.

MENDL, M.; HARCOURT, R. Individuality in the domestic cat: origins, development and stability. In: Turner, D.C. & Bateson, P. **The Domestic Cat: The Biology of its Behavior**. v. 2, p.179-190, 2000.

RÉALE, D.; READER, S.M.; SOL, D.; MCDOUGALL, P.T.; DINGEMANSE, N.J. Integrating animal temperament within ecology and evolution. **Biological Reviews**, v. 82, n. 2, p. 291-318, 2007.

ROCHLITZ, I. 2000. Feline welfare issues. In: Turner, D. C.; Bateson, P. (eds.) **The Domestic Cat: The Biology of its Behaviour**. Cambridge University Press, Cambridge pp. 207-226.

SALMAN, M.D.; HUTCHISON, J.; RUCH-GALLIE, R.; KOGAN, L.; NEW JR, J.C.; KASS, P.H.; SCARLETT, J.M. Behavioral reasons for relinquishment of dogs and cats to 12 shelters. **Journal of Applied Animal Welfare Science**, v. 3, n. 2, p. 93-106, 2000.

SANT'ANNA, A.C.; PARANHOS DA COSTA, M.J. Validity and feasibility of qualitative behavior assessment for the evaluation of Nellore cattle temperament. **Livestock Science**, v. 157, n. 1, p. 254-262, 2013.

SHORE, E.R. Returning a recently adopted companion animal: adopters' reasons for and reactions to the failed adoption experience. **Journal of Applied Animal Welfare Science**, v. 8, n. 3, p. 187-198, 2005.

SIEGFORD, J.M.; WALSHAW, S.O.; BRUNNER, P.; ZANELLA, A.J. Validation of a temperament test for domestic cats. **Anthrozoos**, v. 16, n. 4, p. 332-351, 2003.

SINN, L. Factors affecting the selection of cats by adopters. **Journal of Veterinary Behavior**, v. 14, p. 5-9, 2016.

STAMPS, J.; GROOTHUIS, T.G.G. The development of animal personality: relevance, concepts and perspectives. v. 85, n. 2, p. 301-325, 2010.

STELLA, J.; CRONEY, C.; BUFFINGTON, T. Environmental factors that affect the behavior and welfare of domestic cats (Felis silvestris catus) housed in cages. **Applied Animal Behaviour Science,** v. 160, p. 94-105, 2014.

STOCKMAN, C. A.; MCGILCHRIST, P.; COLLINS, T.; BARNES, A.L.; MILLER, D.; WICKHAM, S.L.; GREENWOOD, P.L.; CAFE, L.M.; BLACHE, D.; WEMELSFELDER, F. Qualitative Behavioural Assessment of Angus steers during pre-slaughter handling and relationship with temperament and physiological responses. **Applied Animal Behaviour Science**, v. 142, n. 3-4, p. 125-133, 2012.

TURNER, D.C.; FEAVER, J.; MENDL, M.; BATESON, P. Variation in domestic cat behaviour towards humans: A paternal effect. **Animal Behaviour**, 1986.

WALKER, J.K.; DALE, A.R.; D'EARTH, R.B.; WEMELSFELDER, F. Qualitative Behaviour Assessment of dogs in the shelter and home environment and relationship with quantitative behaviour assessment and physiological responses. **Applied Animal Behaviour Science,** v. 184, p. 97-108, 2016.

WALKER, J.; DALE, A.; WARAN, N.; CLARKE, N.; FARNWORTH, M.; WEMELSFELDER, F. The assessment of emotional expression in dogs using a Free Choice Profiling methodology. **Animal Welfare**, v. 19, n. 1, p. 75-84, 2010.

WEISS, E.; GRAMANN, S.; DRAIN, N.; DOLAN, E.; SLATER, M. Modification of the Feline-Ality™ Assessment and the Ability to Predict Adopted Cats' Behaviors in Their New Homes. **Animals**, v. 5, n. 1, p. 71-88, 2015.

WEMELSFELDER, F. How animals communicate quality of life: the qualitative assessment of behaviour. **Animal Welfare -** Potter bar then Wheathampstead, v. 16, p. 25, 2007.

WEMELSFELDER, F.; HUNTER, T.E.; MENDL, M.T.; LAWRENCE, A.B. Assessing the 'whole animal': a free choice profiling approach. **Animal Behaviour**, v. 62, n. 2, p. 209-220, 2001.

WEMELSFELDER, F.; LAWRENCE, A.B. Qualitative assessment of animal behaviour as an on-farm welfare-monitoring tool. **Acta Agriculturae Scandinavica, Section A-Animal Science**, v. 51, n. S30, p. 21-25, 2001.

Nota do autor: visando publicação, os capítulos 2 e 3 obedecem a norma de citação do periódico *Animal Welfare*. Enquanto o capítulo 1 obedece às normas da ABNT.

CAPÍTULO 2

DO YOU SEE THE SAME CAT THAT I SEE? VALIDITY OF QUALITATIVE BEHAVIOR ASSESSMENT AS A TEMPERAMENT INDICATOR IN DOMESTIC CATS

Validity of QBA as cat's temperament indicator

Isadora de Castro Travnik[A,B], Aline Cristina Sant'Anna[B]

[A] Programa de Pós-Graduação em Comportamento e Biologia Animal, Instituto de Ciências Biológicas, Universidade Federal de Juiz de Fora, 36.036-330, Juiz de Fora, Minas Gerais, Brazil.
[B] Núcleo de Estudos em Etologia e Bem-estar Animal. Departamento de Zoologia, Instituto de Ciências Biológicas, Universidade Federal de Juiz de Fora, 36.036-330, Juiz de Fora, Minas Gerais, Brazil.

ABSTRACT: The aim of this study was to assess the validity of Qualitative Behavior Assessment (QBA) as an indicator of cat's temperament. If valid it could be used to establish adoptive processes and handling strategies for domestic cats kept in shelters. Four behavioral tests were applied: unfamiliar person (UP); novel object (NO); co-specific reaction (CO) and food offering (FO) tests. Tests were filmed and assessed using an ethogram that included discrete 25 behavioral categories, generating quantitative information (i.e. coding) on the existing temperament dimensions. The videos were also assessed by another observer using the QBA method, based on a list of 20 adjectives rated in visual analog scales (rating method). Data was analyzed using Principal Component Analysis. Analysis of variance and Spearman's rank correlation were used to relate the three principal components (PC) of QBA with the temperament dimensions obtained with the coding methods. The principal temperament dimensions found with the coding method were 'fearfulness' (PC1-UP), 'neophobic' (PC1-NO), 'anticipation' (PC1-FO), 'sociability' (PC1-CR), 'indifference' (PC2-UP, PC3-NO, PC3-FO) and 'tolerance' (PC3-UP, PC2-NO, PC2-FO, PC2-CR). The QBA allowed us to identify four animal profiles, calm/active, calm/quiet, fearful/aggressive and fearful/flighty based on three dimensions: 'calmness' (PC1-QBA), 'restless' (PC2-QBA) and 'aggressiveness' (PC3-QBA). The first PC obtained for each test using coding method were correlated with the PC1-QBA, suggesting that the QBA revealed the behavioral variation of the sampled cats. Thus, the QBA was a valid tool to identify and differentiate cat temperaments.

Keywords: Feline welfare, Co-specific reaction test, Food offering test, Novel object test, Personality, Unfamiliar person test.

INTRODUCTION

Temperament is defined as the individual variations of behavior consistent along a period of time and/or in different contexts, also known as animal personality (Réale *et al* 2007; Briffa & Weiss 2010; Stamps & Groothuis 2010; Hudson *et al* 2015). Animals' behavioral responses in different contexts show several behavioral dimensions which, together, enable the perception of their individuality (Mendl & Harcourt 2000). Temperament is strongly expressed when animals are placed under new situations (Réale *et al* 2007), thus, quantifying reactions to new stimulus is a good means to recognize the distinctive temperament profiles (Feaver *et al* 1986; Siegford *et al* 2003). The great variation of terms and methodologies used for identify temperament dimensions in companion animals brings on challenges to comparative analysis of existing papers (Gartner & Weiss 2013). Highfill *et al* (2010) classify two types of methodologies used to assess animal temperament: *i*) *rating methods*, characterized by the use of observers perceptions to describe the emotional states of animals through descriptors; *ii) coding*, characterized by the record of animal behavior in natural environments or in experimental settings (such as standardized tests) quantifying discrete behavioral categories through an ethogram (Highfill *et al* 2010).

The use of qualitative approaches to assess behavior has been gaining more ground with the developments by Wemelsfelder *et al* (2001), who have introduced the idea of integrative assessment of '*whole animal*' instead of considering isolated behavioral elements. According to those authors, the qualitative observation of animal can gather various information and subtle behavioral fluctuations that, perhaps, the quantitative methods could not assess (Wemelsfelder *et al* 2001). Thus, they has developed the Q*ualitative Behavior Assessment* (QBA), a type of rating methods that enable the assessment of animals' body language and their interactions with the environment at a certain moment, allowing to infer on their mental states and behavioral characteristics (Wemelsfelder 2007). Considering the temperament concept, the QBA method can be advantageous because it allows an integrative assessment of many temperament dimensions in a single measure. Thus, the animals could be observed in several contexts and different temperament dimensions could be assessed simultaneously. The QBA has been considered valid as an indicator of animal welfare (Wemelsfelder & Lawrence 2001; Walker *et al* 2010; Fleming *et al* 2013), and has been also used as an indicator of temperament in few previous studies (Sant'Anna & Paranhos da Costa 2013; Góis *et al* 2016).

With respect to the situation of domestic cats in shelters, there is a great deal of difficulties to access general data in several countries. In shelters, cats face a lot of welfare problems related to stress (McCobb *et al* 2005). Adult animals tend to stay longer in shelters and may develop behavioral and physiological problems related to stress generated by handling, accommodation and socialization, which may result in their euthanasia, raising several ethical concerns (Gourkow & Fraser 2006). This situation is directly linked to cases of returned and abandonment that may be the result of many factors including the owners' lack of comprehension about behavioral aspects of their companion animals, including the animal temperament (Shore 2005). Temperament is also a factor that influence in the adoptive process of cats (Gourkow & Fraser 2006). Therefore, the identification of their profiles becomes a fundamental tool to set up handling strategies focusing on cats' individuality. Improvement of handling strategies would increase the number of adoptions through the increase of cats' welfare (Gourkow & Fraser 2006). The identification of cats' temperament profiles would also increases the adoption success through the development of more realistic expectations of the behavior of each individual cat, what would improve the cat-owner relationship and reduce the number of returns and abandonment (Shore 2005; Weiss *et al* 2015).

Temperament studies with pets involve mostly dogs (Gartner 2015). Regarding the studies about QBA in pets, we have found only four published papers performed with dogs (Walker *et al* 2010; Arena *et al* 2017; Walker *et al* 2016; Arena *et al* 2019). In the scientific literature most of the studies developed with QBA are focused on farm animals (Stockman *et al* 2012; Góis *et al* 2016) and at our best knowledge no works have been done with domestic cats. In spite of that, it can be a promising tool to assess the behavior of pets, since the closeness of humans with companionship animals can lead to better ability to perceive and record the companion animals' body language. The QBA is also indicated for application in practical environments where resource and time are limited (Sant'Anna & Paranhos da Costa 2013; Góis *et al* 2016). Thus, the aim of this study was to assess the validity of QBA as an indicator of cats' temperament that allows the identification of temperament profiles in domestic cats.

MATERIALS AND METHODS

This study was conducted with animals in a private shelter after being approved by the Animal Ethics Committee - Federal University of Juiz de Fora/MG, Brazil *(Protocol n.*

051/2018). Forty-two adult mixed breeds short hair cats were used, 22 females and 20 males, all of them castrated and showing no clinical signs of diseases. The animals were housed in eight pens, ranging from 2 to 9 cats each with 55 m^2, on average. The space availability ranged from 3.35 m^2 to 43.5 m^2 per animal, with access to a courtyard fenced with wire mesh. The indoor environment of the pens had shelves at different heights, plastic bed covered with newspapers, sand boxes and feeding areas. The free-range area was partially covered, providing natural ventilation, visual contact among the adjacent pens and many physical environmental enrichment items.

The cats had access to dry cat food and water *ad libitum* and were kept in stable groups (living together for more than three years) considering their familiarity and origin. The cats' temperament assessment was accomplished in two phases, the first one was a trail in which behavioral tests were applied, followed by the behavioral recording using coding (quantitative analyses using an ethogram) and rating (Qualitative Behavior Assessment).

Coding methods

Four standardized tests were performed to assess the temperament of the animals (Table 1): i) unfamiliar person (UP) test (adapted from McDowell *et al* 2016), to assess the animals' sociability, in seven phases with raising levels of stimulus; ii) novel object (NO) test (adapted from Durr & Smith 1997), to assess the neophobic or neophiliac responses of the cats. For this purpose, a train-shaped toy that could emit light and sound was used, trying to reach a balance between a very frightening object and a neutral or uninteresting one (Durr & Smith 1997); iii) co-specific reaction (CR) test used to infer the sociability with an unknown cat. In order to avoid the risks of aggression against the co-specific and to reduce the possibility that subtle variations in the behavior of the co-specific at the moment of the test affected the behavioral responses by the target animals, a taxidermized cat was used; iv) food offering (FO) test was carried out to assess the cats' behavior and level of excitability when wet cat food was offered to them by an unfamiliar human (Table 1). In any of the tests, in cases the animal showed behaviors indicative of panic (e.g. jump over the walls, attempts to scape by the wire mesh) the procedure was interrupted.

Table 1. Description of procedures performed in each temperament tests in the respective phases. Unfamiliar person test was adapted from McDowell *et al* (2016) and novel object test was adapted from Durr and Smith (1997). In any of these phases in cases the animal showed behaviors indicative of panic the procedure was interrupted.

Test/Phase	Description
Unfamiliar person test	
Phase 1	An unknown person entered the pen, went to one of its ends, got down and stood still for 1 min.
Phase 2	During 1 min the animal was called by the unknown person.
Phase 3	Flight distance test: a person started moving from the opposite end relative to the cat position in the pen, approaching it, straight and calmly, within its visual field. Reached for it and tried to touch it. Procedure was repeated for three times, considered the average distance (in cm) in the analyses. Leather gloves were used for security reasons.
Phase 4	The animals were stroked in the head and back, in this order, for 1 min.
Phase 5	The tester tried to hold the animal and put it in his chest, tried three times.
Phase 6	The animals were stroked in the head and back, in this order, for 1 min. After that, the cat was left on the ground.
Phase 7	The tester held the tail of the animal firmly, holding it for 3 s.
Novel object test	
Phase 1	A toy with sound and light as a stimulus was positioned in the center of the room for 1 min.
Phase 2	The toy was turned on for 1 min more.
Co-specific reaction test	
Phase 1	A taxidermized cat was positioned in the center of the pen during 3 min.
Food offering test	
Phase 1	A person standing in the center of the pen held a food pot (wet cat food), during 3 min.
Phase 2	The food was offered to each animal individually.

The UP and NO tests were performed sequentially, during four consecutive days, whereas the CR was performed one week later and FO test was done 27 days after the two first tests. All tests were performed in the area where the animals lived (home pens). The UP and NO tests were performed with cats kept individually in one of their home pen divisions (indoor or in the courtyard area), with 12 m^2 on average (min. area of 4 m^2 and max. of 27 m^2). On the other hand, the CR and FO tests were applied to animals kept in their pen groups, allowing them to access the whole pen.

The cats' behavioral reactions in each test were also quantified using behavioral based predefined visual scores, varying from low behavioral reactivity to high behavioral reactivity (Table 2). All tests were filmed and the videos were used to record the behavior of each animal through continuous and focal sampling methods (Martin & Bateson 1993). The ethogram used (Table 3) was adapted from Feaver *et al* (1986), the categories characterized as events were quantified in frequency and the categories of states in duration.

Table 2. Scores of behavioral reactivity used in each of the behavioral tests.

Tests	Description		
	Low	**Intermediate**	**High**
Unfamiliar person	Did not show any reaction of withdrawal or aggression.	Withdrew and did not allow approach.	Showed aggressive reactions in any phase of test.
Novel object	Touched the object.	Did not touch the object and did not show any flight reaction.	Did not touch and showed flight reactions.
Co-specific reaction	Approached 1 m or less to the taxidermized cat.	Remained in the test area, but did not approach the taxidermized cat.	Not visible during the whole test.
Food offering	Approached the observer and accepted food at the first attempt.	Did not accept food at the first attempt, but accepted it at the subsequent trials; or did not accept food and did not show flight reaction.	Did not accept food and showed aggressive or flight reactions during the food offering attempts.

Table 3. Ethogram used for coding records of the behavioral tests (adapted from Feaver *et al* 1986). Where: NO = novel object, FO = food offering and CR = co-specific reaction tests.

Behavioral categories	Description
Locomotion	Walk, run or jump (in s).
Stay still	Remains in the same place, with the four feet touching the ground (in s).
Lay down	Lower region of body touching the ground (in s).
Seated	Back feet on the ground and the front ones stretched (in s).
Standing	Back and front feet stretched (in s).
Tail up	Tail positioned above the level of the animal when standing or off the ground when seated or laying down (in s).
Tail down	Tail positioned parallel to or below the level of the animal when standing; and close to the ground, but far from its body, when seated or laying down (in s).
Tail tucked	Tail positioned between the legs towards the belly when standing; and close to the ground, but near or under the body, when seated or laying down (in s).
Near security area	The cat remains near the exits or hideout (in s).
Grooming	Licks or bites itself, scratches or rubs its paw above the head (in s).
Look	Observes, functional definition perceived through movement of head towards the test object (in s).
Sniff	Investigates with movements of nose or snout (in s).
Down ear posture	Both ears positioned horizontal or backward (in s).
Drink	Takes water (in s).
Tolerance Phase 4 (p6) Phase 6 (p4)	Time (in s) during which the animal allowed physical touch in UP test at phase 4 and phase 6.
Latency NO Phase 1 (p1) Phase 2 (p2)	Time (in s) between the beginning of stimulus and the first occurrence of behavior of touching the object at phase 1 and phase 2. Animals that got away were penalized with 10 s.
Latency CR	Time (in s) in which the animal delayed to be 1 m away from the taxidermized cat.
Test duration	Duration (in s) of test NO.
Closer	Time (in s) in which the cat stayed within 1 m from the test object in tests CR and OF.

(continuation)

Out of sight	Time (in s) during which the animal was not visible.
Approach	Move so as to shorten the distance from the test object (in frequency).
Vocalization	Mew (in frequency).
Rub	Rub the head, the body or the tail on objects or on the observer (in frequency).
Flight distance	Distance (in cm) that a cat allows a non-familiar person to approach before expressing the first withdraw or attack response (hiss or kick) or defensive behaviors (down ear posture, muscle tension, freezing).
Allowed to be caught	Measurements (in scores) of behavioral reaction at the moment of trying to hold the cat in the arms (on the lap). 1. Accepted to stay in one's arms (lap) at the first attempt; 2. Accepted to stay in one's arms (lap) at the second attempt; 3. Accepted to stay in one's arms (lap) at the third attempt; 4. Did not accept to stay in one's arms (lap)

Rating method - Qualitative Behavior Assessment

The footages of the four temperament tests of each cat were merged into a single video of 12 min, on average, per animal. The videos were showed to an observer with prior experience in the application of the QBA and with more than ten years of experience with cats (a cat owner). The order of the tests footages in each video was randomized, as well as the order of video presentations to the assessor, to reduce the influence of test order and pens. The behavioral expression of the cats was assessed using 20 adjectives ('active', 'affectionate', 'aggressive', 'agitated', 'attentive', 'alert', 'calm', 'confident', 'curious', 'fearful', 'friendly', 'indifferent', 'nervous', 'relaxed', 'sociable', 'stressed', 'suspicious', 'tense', 'vocal' and 'greedy'). The adjectives were chosen based on the scientific literature (Góis *et al* 2016; Ha & Ha 2017; Litchfield *et al* 2017; Wemelsfelder *et al* 2001), trying to keep a balance between positive and negative expressions of behavior (Sant'Anna & Paranhos da Costa 2013). The descriptors were quantified in 126 mm visual analog scales, with markings more to the left indicating the smallest expression of that characteristic and markings more to the right indicating the greatest expression of the characteristic, on a continuous scale. Then the distance, in mm, from the left extremity to the assessor's mark was obtained as the score for each adjective.

Data analyses

For the coding method, four *Principal Components Analyses (PCA)* were performed to the ethogram data (one for each behavioral test). Behavioral categories that occurred in less than 20% of the animals were removed from the behavioral coding analyses (Kasbaoui *et al* 2016). The PCA is a method that combines all of the variables in a data matrix to identify

associations among them and, based on the results, generates indexes that are the principal components describing the variations found in the dataset (Manly 2008). The principal components with eigenvalues above 1 were retained as the main dimensions of cats' temperament. Variables with loadings above 0.6 were considered as the higher contributors to the temperament dimensions. The scores received for each animal in these axes (or dimensions) were defined as their temperaments. Cats with scores between -1 and 1 in a given dimension were considered animals with 'medium temperament' in that dimension. In this study, a 'medium temperament' is the profile expressed by most of the individuals of a population in a specific dimension, and which does not show expressive (discriminatory) and/or consistent responses in a certain dimension.

The same procedure was them applied to the QBA data, for which a PCA was applied to a matrix of animals (42 rows) and adjectives (20 columns). The principal components obtained were considered as the main temperament dimensions according to the QBA. We tested for the confounding effects of pen group and sex for the QBA data, using analysis of variance. Since we did not find significant effects in the temperament dimensions of QBA ($P > 0.05$), these variables were not included in the further analyses.

For assessing the relationships between the coding data generated by each behavioral test with the QBA, Spearman's rank correlation coefficients were used. In order to relate the predefined scores of each behavioral test with the QBA dimensions, analyses of variance were used, including the temperament dimension (PC) as dependent variable and each reactivity score as independent variable. Means were compared using post-hoc Tukey test. For all analyses $P < 0.05$ were regarded for significance.

RESULTS

Characterization of cats' temperament based on the coding method

First the predefined reactivity scores were applied to the general reactions of the animals in each test. In the test UP, 18 cats were scored as 'low' and 16 were scored as 'intermediate'. In the tests NO and CR most of the animals were scored as 'intermediate' (n = 28 and 20 respectively). In its turn, for the test of FO, most of the cats were scored as 'low' (n = 20). In all of the tests the score 'high' had the lower frequencies (from 7 to 9 cats) (Figure 1).

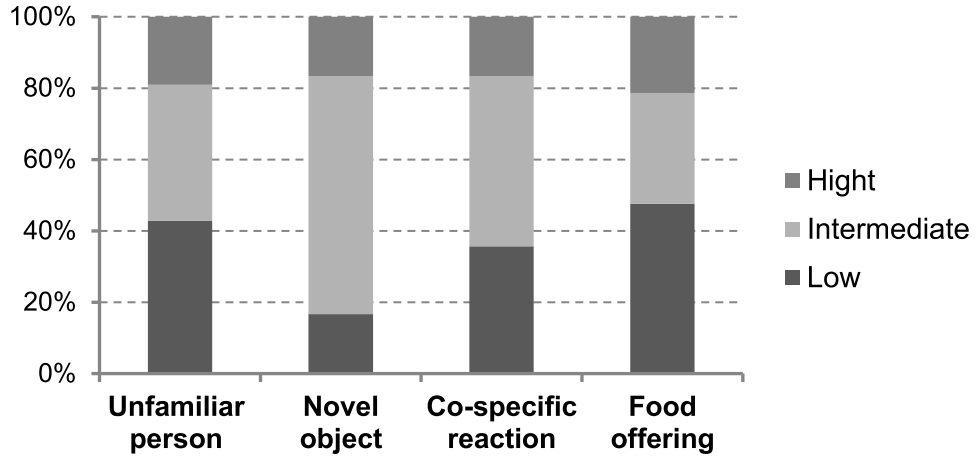

Figure 1. Distributions of the reactivity scores in the four temperament tests (N = 42).

The Principal Components Analysis of unfamiliar person (UP) test showed three principal components (PC) as main dimensions of cats' temperament (Figure 2a, b). The PC1-UP explained 45.40% of the variation in the dataset and presented higher positive loadings for the variables 'stay still' (0.90), 'lay down' (0.84), 'tail tucked' (0.80) and 'allowed to be caught' (0.79); as well as higher negative loadings for the variables 'standing' (-0.94), 'approach' (-0.92), 'locomotion' (-0.90), 'rub' (-0.85), 'tolerance-p6' (-0.72), 'tail up' (-0.70) and 'tolerance-p4' (-0.66), characterizing the 'fearfulness' dimension. The PC2-UP explained 12.94% of the variation in the dataset and presented higher negative loadings for the variables: 'seated' (-0.80) and 'tail down' (-0.78), characterizing the dimension 'indifference'. The PC3-UP explained 9.91% of the variation in the dataset and the 'flight distance' (-0.74) was the variable with high loading, characterizing the 'tolerance' dimension.

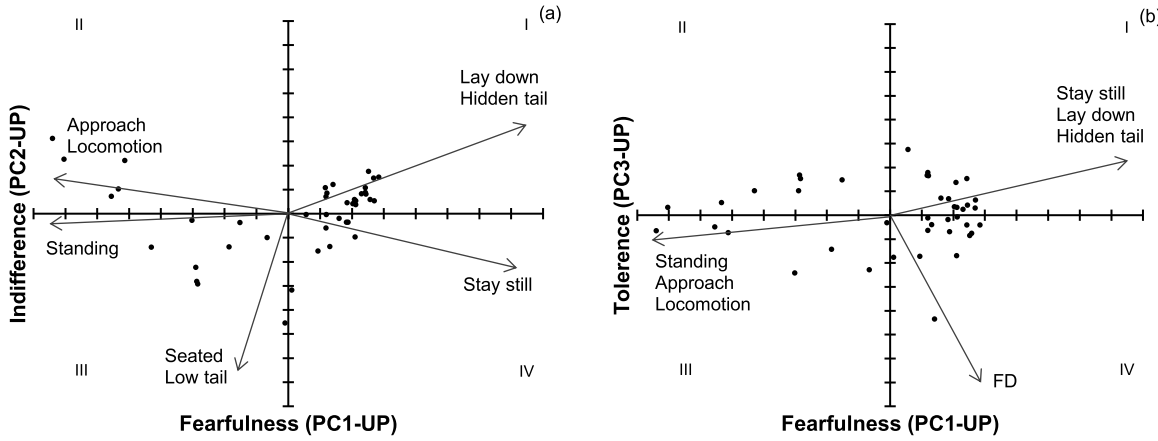

Figure 2. Plot of cats in the temperament dimensions extracted in the unfamiliar person (UP) test (N = 42). Where, FD = flight distance. Numbers from I to IV represent the quadrants.

In the novel object (NO) test three principal components were found as main dimensions of cats' temperament (Figure 3a, b). The PC1-NO explained 29.99% of the dataset variation and showed the following variables with positive loadings 'standing'(0.78), 'approach' (0.78), 'locomotion' (0.76), 'tail down' (0.73) and 'sniff' (0.60); and negative loadings for 'lay down' (-0.73), 'latency-p1' (-0.71) and 'tail tucked' (-0.64), characterizing the dimension 'neophilic'. The PC2-NO explained 26.54% of the dataset variation showing positive loading for 'latency-p2' (0.92); and three variables with high negative loadings 'test duration' (-0.97), 'stay still' (-0.96) and 'look' (-0.64), characterizing the dimension 'tolerance'. The PC3-NO explained 11.59% of the dataset variation with high loadings for 'grooming' (0.79) and 'seated' (0.66), characterizing the dimension 'indifference'.

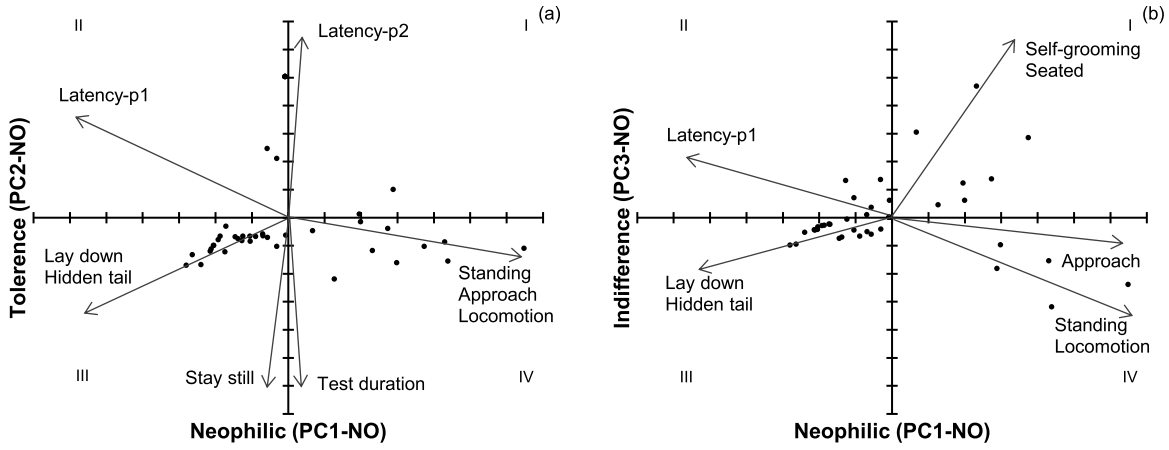

Figure 3. Plot of cats in the temperament dimensions extracted in the novel object (NO) test (N = 42). Numbers from I to IV represent the quadrants.

In the co-specific reaction (CR) two principal components were obtained as main dimensions of temperament (Figure 4). The PC1-CR explained 52.24% of the data set variation and had positive loadings for 'closer' (0.92), 'standing' (0.90), 'tail down' (0.89), 'locomotion' (0.87), 'approach' (0.83) and 'sniff' (0.80); and negative loadings for 'latency' (-0.91), 'near security area' (-0.82), 'lay down' (-0.74), 'tail tucked' (-0.67), characterizing the dimension 'sociability'. The PC2-CR explained 24.27% of the dataset variation through the variable with positive loading 'out of sight' (0.96) and negative loadings for 'stay still' (-0.90), 'look' (-0.65), 'lay down' (-0.63), 'tail tucked' (-0.60) characterizing the dimension 'tolerance'.

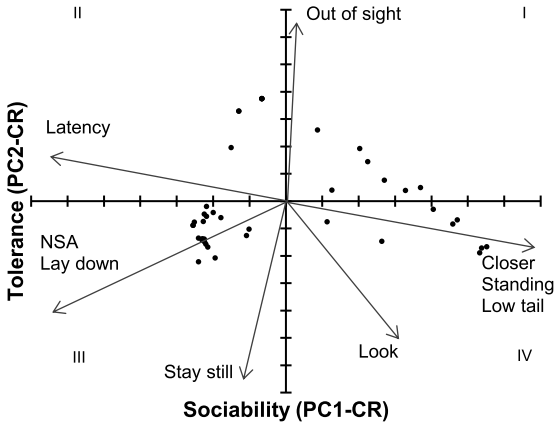

Figure 4. Plot of cats in the temperament dimensions extracted in the co-specific reaction (CR) test (N = 42). Where, NSA = near security area. Numbers from I to IV represent the quadrants.

In the food offering (FO) three main components were obtained as the main dimensions of cats' temperament (Figure 5a, b). The PC1-FO explained 40.62% of the dataset variation and showed higher positive loadings for 'standing' (0.90), 'locomotion' (0.86), 'approach' (0.81), 'tail up' (0.80), 'closer' (0.73); and higher negative loadings for 'tail tucked' (-0.85), 'latency' (-0.84), 'lay down' (-0.83) and 'near security area' (-0.69), characterizing the dimension 'anticipation'. The PC2-FO explained 17.10% of the dataset variation and showed higher positive loading for 'stay still' (0.82), 'look' (0.66) and 'out of sight' (-0.94), characterizing the dimension 'tolerance'. The PC3-FO explained 10.84% of the dataset variation and showed higher positive loadings for the variables: 'seated' (0.78) and 'tail down' (0.62), characterizing the dimension 'indifference'.

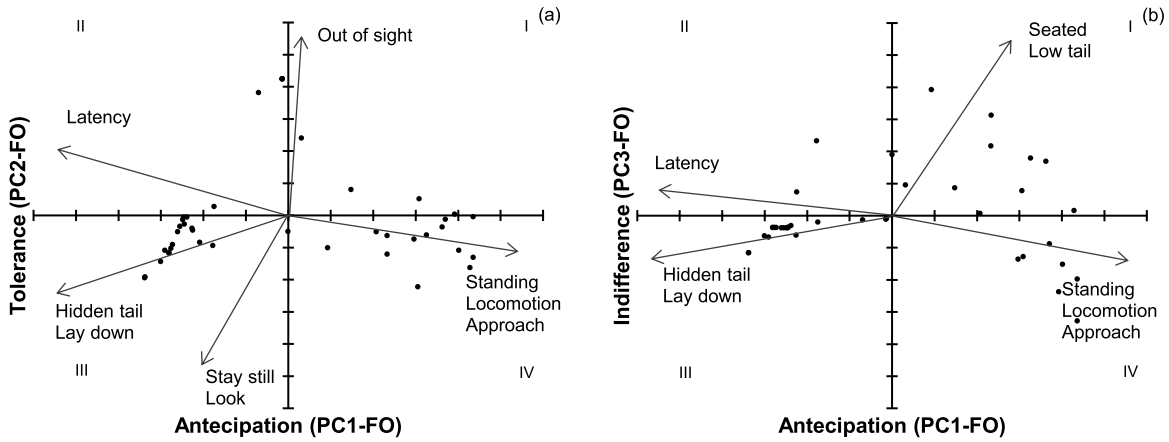

Figure 5. Plot of cats in the temperament dimensions extracted in the food offering (FO) test (N = 42). Numbers from I to IV represent the quadrants.

The correlation among the principal components of the quantitative tests was then calculated. The first components of all tests were significantly correlated with one another ($P < 0.05$, Table 4), revealing that the cats considered more friendly in the unfamiliar person test (had lower scores in PC1-UP) were also the more neophilic in the novel object test (higher scores in PC1-NO), sociable in the co-specific reaction test (higher scores in PC1-CO) and more able to anticipate the positive reward in the food offering test (higher scores in PC1-FO) (Table 4).

Table 4. Spearman's rank correlation coefficients between the main temperament dimensions obtained in the four behavioral tests by using coding method. *** P-values < 0.001, ** P-values < 0.01. Where: UP = unfamiliar person, NO = novel object, CR = co-specific reaction and OF = food offering tests.

Temperament dimensions (PC1)	Fearfulness UP	Neophilic NO	Sociability CR	Anticipation OF
Fearfulness UP	-	-0.644***	-0.424**	-0.493***
Neophilic NO	-0.644***	-	0.457**	0.572***
Sociability CR	-0.424**	0.457**	-	0.532***
Anticipation OF	-0.493***	0.572***	0.532***	-

Characterization of cats' temperament based on Qualitative Behavior Assessment (QBA)

The Principal Component Analysis of QBA showed three principal components as main dimensions of cats' temperament (Figure 6a, b). The PC1-QBA explained 54.59% of the dataset variations and showed higher positive loadings for the descriptors 'calm' (0.97), 'relaxed' (0.95), 'friendly' (0.85), 'confident' (0.79), 'greedy' (0.82), 'affectionate' (0.77), 'curious' (0.68), 'active' (0,65); and higher negative loadings for 'tense', 'fearful' (-0.93, both), 'alert' (-0.89), 'stressed' (-0.81), 'nervous' (-0.77) and 'attentive' (-0.66), characterizing the dimension 'calmness'. The PC2-QBA explained 12.69% of the dataset variation and showed high positive loadings for the descriptors 'indifferent' (0.64), 'agitated' (-0.72) and 'active' (-0.61), reflexing the dimension 'restless'. The PC3-QBA explained 9.35% of the dataset variation and the descriptors 'aggressive' (0.71) and 'suspicious' (-0.60) had high loadings characterizing the dimension 'aggressiveness'.

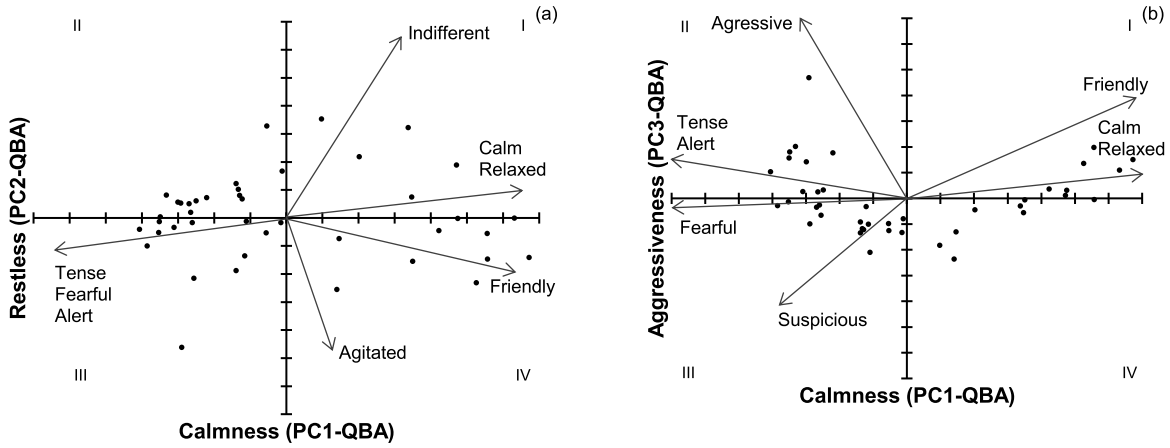

Figure 6. Plot of cats in the dimensions extracted by using the Qualitative Behavior Assessment (N = 42). Numbers from I to IV represent the quadrants.

Correlation between coding and rating (QBA) methods

All four temperament scores were related with PC1 of QBA (dimension 'calmness') ($P < 0.05$ for all, ANOVA). They did not show significant relationship with PC2 ('restless') ($P > 0.05$, ANOVA), whereas the score UP was the only one related ($P < 0.05$, ANOVA) with PC3 ('aggressiveness') (Table 5).

Table 5. Means (± standard deviation) of the QBA temperament dimensions as a function of the reactivity scores obtained in the four temperament tests. Values in parentheses are the number of animals. Where: UP = unfamiliar person, NO = novel object, CR = co-specific reaction and OF = food offering tests.

	Score-UP		Score-NO	Score-CR	Score-OF
	Calmness (PC1-QBA)	**Aggressiveness (PC3-QBA)**	**Calmness (PC1-QBA)**	**Calmness (PC1-QBA)**	**Calmness (PC1-QBA)**
Low	3.02 ± 2.75[a] (18)	-0.07 ± 1.20[c] (18)	3.94 ± 2.26[a] (7)	3.03 ± 2.70[a] (15)	2.57 ± 2.91[a] (20)
Intermediate	-1.89 ± 1.14[b] (16)	-0.86 ± 0.59[b] (16)	-0.29 ± 3.00[b] (16)	-1.27 ± 2.43[b] (20)	-2.17 ± 1.56[b] (13)
High	-3.03 ± 0.85[b] (8)	1.56 ± 1.49[a] (8)	-2.78 ±1.23[b] (8)	-2.88 ± 0.92[b] (7)	-2.57 ± 0.83[b] (9)

[a-c] Different letters in the column represent significant difference of means ($P < 0.05$; ANOVA Procedure).

We used the Spearman's rank correlation coefficient to evaluate the associations between the main dimensions obtained in QBA with those ones obtained in coding method applied to the four tests. The QBA dimensions 'calmness' and 'restless' were significantly correlated ($P < 0.05$) with all PC1 of coding method (Table 6). These results indicate that cats identified by the observer as calmer and more indifferent were the animals more friendliness, neophilic, sociable and anticipatory based on the coding method.

Table 6. Significant Spearman's rank correlation coefficients found between QBA dimensions (rows) and the dimensions obtained by using coding method applied to behavioral tests (columns). *** P-values < 0.001, ** P-values < 0.01, * P-values < 0.05.

Temperament dimensions	Fearfulness (PC1-UP)	Tolerance to human (PC3-UP)	Neophilic (PC1-NO)	Sociability (PC1-CR)	Anticipation (PC1-FO)
Calmness (PC1-QBA)	-0.681***	0.307*	0.533***	0.470**	0.695***
Restless (PC2-QBA)	0.308*	0.263	-0.319*	-0.309*	-0.399**

DISCUSSION

In the present study we have found five principal dimensions of cats' temperament based on the coding method, fearfulness, tolerance, neophilic, sociability anticipation and indifference. The first principal components of each test (i.e. the dimensions fearfulness, neophilic, sociability and anticipation) revealed behaviors linked to calmness - fear and to the primary stiles of responses to each stimulus presented. The qualitative behavior assessment enabled identifying three main dimensions of cats' temperament, that are calmness, restless and aggressiveness. The first principal components of all behavioral tests and QBA were correlated with one another, demonstrating that even animals in different situations behave in similar way and keep a behavioral consistency defined as temperament (Briffa & Weiss 2010; Stamps & Groothuis 2010; Hudson *et al* 2015).

Friendly animals had low scores in the unfamiliar person test, being calmer and characterized as not perceiving the unknown person as aversive, whereas the fearful animals perceived the tester as frightening (showing higher scores in PC1-UP). Moreover, divergent behavioral reactions were observed within each of these extremes. There were two clear stiles of 'calm animals' the ones who could perceive the unknown person as a positive (Figure 2a, quadrant II) and the others which showed low values of tolerance to approach and contact (Figure 2b, quadrant III) but remained calm during the test, i.e. without evident fear/flight reactions (Figure 2a, quadrant III). The fearful animals, in turn, did not spread in PC2-UP, since most of them were grouped as 'medium temperament' in the dimension 'indifference' (i.e. scored between -1 and 1). Regarding the tolerance to approach and contact by an unknown person, the fearful animals showed two profiles, i.e. they behaved actively running away (Figure 2b, quadrant IV), or they allowed approach and contact but displaying freezing reaction

(Figure 2b, quadrant I). The tolerance to be touched or the running away actions demonstrated by fearful cats, most probably occurred due to the passive or defensive strategies resulting in submissive or flight responses, respectively (Carlstead *et al* 1993). Several previous studies were carried out with behavioral tests for assessment of cats' responses to humans and measured their levels of sociability and aggression (Mertens 1991; Siegford *et al* 2003; McDowell *et al* 2016; de Rivera *et al* 2017). In one of these studies, McDowell *et al* (2016) identified two main dimensions, 'neuroticism' and 'impulsiveness'. The neuroticism expressed aggression in one extreme and positive/docile behaviors in the other. Is worth noting that their animals showed aggressive responses to humans (McDowell *et al* 2016), what did not happen in the present study. In our study, the aggressive behaviors occurred in less than 20% of the cats and thus, the variables were not included in the PCA of UP test, what could characterize a shortcoming of the coding method.

In the novel object test, neophilic animals were considered more positively engaged with the novel object, whereas the neophobic ones showed aversive reactions towards it. Similar to the unknown person test, there were also two stiles of neophilic animals, the ones being more active and interacting with the novel object (Figure 2d, quadrant IV) and the others acting with indifference (remained still in the presence of the object) (Figure 2d, quadrant I). Boissy *et al* (2007) state that exploration is intimately affected by fear and that investigative processes only occur when no further needs have to be addressed, what may express positive welfare. Again, the neophobic animals remained with a medium temperament in the dimension 'indifferent', what was revealed by their concentration close to zero in the PC2-NO. The dimension 'tolerance' discriminated cats that remained during the whole test, to those ones who did not tolerate the second phase and flight away (Figure 2c, quadrants I and II). There were cats which showed panic reactions during the test session, resulting that their trials were interrupted, leading them to be considered as neophobic and also discriminated in the 'tolerance' dimension as intolerant (with lower values in PC3-NO).

The co-specific reaction test demonstrated two temperament dimensions, enabling to discriminate the more sociable and investigative animals in relation to the taxidermized cat (Figure 2e, quadrant IV) from the uninterested ones (Figure 2e, quadrant I). It was also possible to discriminate uninterested animals that remained visible (Figure 2e, quadrant II) and those which were not visible during the test (Figure 2e, quadrant II). Once this test was carried out in group, with cats allowed to access to the whole pen, the animals were free to either approach or not the taxidermized cat. In spite of not being possible to infer the motivations of the animals

to get out of the test area, it would be reasonable to infer that cats which came nearby the taxidermized cat were strengthener of interest. In the co-specific reaction test the most interactive animals tended to show tail down, different from the friendly cats' in the test of reactions to unfamiliar person, which tended to display tail up when interacting positively with the observer. It was previously described that tail down is related to mental states of relaxation, whereas tail up is described as associated with affiliative components of positive relationships with both humans or other familiar animals (Bradshaw & Cameron-Beaumont 2000). The differences in cats' behavior between the two tests (unfamiliar person and unknown cat) show that the dimensions defined here as 'fearfulness' towards unfamiliar person and 'sociability' towards the unknown cat were in fact different traits.

In the food offering test the anticipative animals were characterized by the capability to anticipate situations that were potentially positive for them, whereas the non-anticipative animals had more latency to react and less responsivity to the attractive food. Anticipatory behaviors are expressed through changes in behavioral patterns, directed towards an object or situation perceived as positive, before obtaining it (Boissy *et al* 2007). This ability to anticipate something good has positive valence and indicates good mental states (Boissy *et al* 2007). The dimension 'tolerance', as in the co-specific reaction test, discriminated animals that did not remain visible during the whole test. In dimension 'indifference', the anticipatory animals acted with distinct behaviors, reacting in a more relaxed way (Figure 2g, quadrant I), otherwise approaching and trying to get the food in an active way (Figure 2g, quadrant IV). Most of the animals with lower degree of anticipation had a medium temperament relative to indifference.

The predefined visual scores characterized animals as low, intermediate and high reactivity, being useful to represent the general responsivity of the animals in each test. By comparing the cats' responses to the unfamiliar person and the food offering tests we could notice differences in cats' responses, in spite of an unfamiliar human be involved in both procedures. The aggressive and flight responses (score high) were much more frequent in UP (57.14%) in than in FO test (21.43%), evincing how the food could be perceived as a positive stimulus for these animals. We could also observe differences in the cats' responses between the co-specific and novel object tests, whereby the animals showed higher behavioral reactivity (score high) to the taxidermized cat than to the novel object, suggesting that they were perceived as two distinct things, having different motivations to interact with them.

In the Qualitative Behavior Assessment (QBA) the first dimension discriminated calm (in right side of graph, Figure 3a) and fearful cats (in left side of graph, Figure 3a). The calm animals could be differentiated in two profiles according to their levels of engagement with the stimulus tested, since they were perceived by the observer as more active and interactive (Figure 3a, quadrant IV) or more passive and quieter (Figure 3a, quadrant I). Most of the fearful animals remained in the range of medium temperament in PC2-QBA (dimension 'restless'), as they were scored in the quantitative tests. However, for QBA some of the fearful were regarded as extreme ones, by flighting away, in the 'restless' dimension (Figure 3a, quadrant III), whereas the others reacted aggressively towards the stimulus, being regarded as extremes for the 'aggressiveness' dimension (Figure 3b, quadrant II). The fearful cats were characterized as 'tense', 'fearful', 'alert', 'stressed', 'nervous' and 'attentive', this result is in agreement with literature, where alert and attention behaviors are usually used as fear measures (Boissy *et al* 2007). Thus, four profiles of cats' temperament could be identified by using QBA, calm/active (Figure 3a, quadrant IV), calm/quiet (Figure 3a, quadrant I), fearful/flighty (Figure 3a, quadrant III) and fearful/aggressive (Figure 3b, quadrant II). The dimension 'aggressiveness' demonstrates how the animals react to potentially stressful situations, in a passive (shy) or active (bold) way (Koolhaas *et al* 2010), what is extremely important when considering animals that will be exposed to close contact with people, as pets are. Calm and bold animals could be active and friendly, whereas fearful and bold ones present an aggressive behavior. Therefore, it is necessary interpret the axis 'calmness' along with the axis 'aggressiveness' so that we do not end up erroneously grouping the friendly and active animals with the aggressive ones (Figure 3b, right side).

Few previous studies identified the personalities of cats through qualitative rating methods. These, in turn, used questionnaires filled up by the cat owners. Litchfield *et al* (2017) characterized 2.802 cats using 52 descriptors and found five dimensions characterized as 'neuroticism', 'extroversion', 'dominance', 'impulsiveness' and 'agreeableness' (Litchfield *et al* 2017). In its turn, Ha and Ha (2017) analyzed 251 animals using 18 descriptors and identified others five dimensions named as 'social', 'active', 'human non-social', human aggressive' and 'intense' (Ha & Ha 2017). In spite of the distinct names of dimensions, they have a certain relation with the dimensions found in the present study by using QBA. Litchfield *et al* (2017) defined 'neuroticism' with higher loadings for 'insecure', 'anxious', 'fearful of people', 'shy' and 'suspicious', and defined 'agreeableness' with strong loadings for 'affectionate', 'friendly to people' and 'gentle'. If we analyze the two dimensions of Litchfield *et al* (2017), we can find

similarities with the dimension of ‘calmness’ of QBA in our study, that was also related with the first three dimensions of Ha and Ha (2017). In addition, the dimension ‘human aggressive’ described by Ha and Ha (2017) showed high loadings for ‘aggressive’ and ‘hostile-people’, characteristics strongly expressed in our dimension ‘aggressiveness’. In general, our results corroborate with some dimensions described in the literature and the greater number of dimensions found in these previous studies could perhaps be influenced by the larger sample size, what is possible in researches using questionnaire surveys.

A recent study conducted with shelter cats in Brazil aimed to apply a methodology that seeks to gather cats that have similar personalities to their owners, the Meet your Match® Feline-ality™ (Fukimoto *et al* 2019). In this study the authors found, through an 11-phase test, three dimensions of cats’ temperament: ‘agreeableness’, ‘openness’ and ‘extraversion’ (Fukimoto *et al* 2019). However, the variables were analyzed in scores assigned to a set of behaviors (from negative to positive values). The dimension ‘agreeableness’ showed high loadings for the phases ‘open hand’, ‘stroking’, ‘call and approach’ and ‘introduction to novel room’. The dimension ‘openness’ showed high loadings for the phases ‘introduction to novel room’, ‘body posture’ and ‘social response when door is opened’. While the dimension ‘extraversion’ showed high loadings for the phases ‘play’, ‘sensitivity’, ‘hug’ and ‘greeting approach’. The loadings represented tests and not behaviors, thus it was difficult to compare these dimensions with those of the present study, but the dimensions found in Fukimoto *et al* (2019) demonstrated behaviors that indicate similarity to our ‘fearfulness’ and ‘calmness’ dimension.

In the current study, all of the reactivity scores were related with the dimension ‘calmness’ of the QBA ($P < 0.0001$) demonstrating that this rating method allows us to identify whether the cats were more calm or fearful. Animals that received scores 'low' were understood as calmers (higher scores in PC1-QBA) whereas animals that received scores 'intermediate' and 'high' were considered more fearful, and did not differ among each other. There was also a correlation of reactivity score in the unknown person with the dimension of ‘aggressiveness’ of the QBA ($P < 0.0001$), which was the only coding variable that discriminated aggressive behaviors. Animals classified as ‘high’ had higher means in the aggressiveness dimension, followed by the ‘intermediate’ and the ‘low’ ones. Considering these groupings and the dimension 'aggressiveness' found in the QBA, we may consider that in shelter animals used for the present study prevailed the defensive aggressiveness (Reisner *et al* 1994).

The QBA dimension ‘calmness’ was correlated with all of the PC1 based on the coding method, revealing that the assessor could synthesize the cats’ body language in a single scale, that gathered information from their reactions in all four tests. These results corroborate the data of Walker *et al* (2016) who showed correlations with dimensions of the QBA with quantitative behavior in shelter dogs. In the present study, the QBA correlation coefficients were higher with the UP and OF tests. In both tests, the dimensions ‘fearfulness’ and ‘anticipation’ were also related with the dimension ‘restless’ of QBA, indicating that the assessor tends to better discriminate cats’ reactions in tests involving human-animal relationships. This result could be, in parts, explained by the greater familiarity with the behavior of the cats in this situation, whereby human beings take part of the interactions.

It is important to note that the QBA enabled to gather behavioral expressions that were excluded from the coding method analyses (discrete behaviors) because of low occurrence in the sample. For example, the behaviors expressing aggression towards human (e.g. licks, nibbled, hisses and kicks), that in the QBA could appear in the scores of the cats for the descriptor aggressive. Thus, we may infer that rare or infrequent responses with relevance for the characterization of temperament variation in a sample are not lost by using QBA. Despite of its integrative and flexible approach, the QBA has some limitations regarding feasibility that must be acknowledged. To judge how the QBA results are related in practice, an interpretation by an expert ethologist is indicated (Fleming *et al* 2016). This method also does not eliminate the need of an experimentation phase (i.e. the standardized behavioral tests), considering that the animals must be analyzed in several situations and be exposed to different stimuli to express their behavioral individual differences in responses to potentially pleasant or stressful situations. It may imply some difficulties in its application during management routines of shelters. A possible solution for this scenario would be the application of QBA by a person familiar to the animals. Since it is carried out according to the perception of people, it is necessary to develop studies involving inter and intra-observer reliability for QBA, although it had been regarded reliable in other contexts (Wemelsfelder & Lawrence 2001). It is worth analyzing whether the profiles of the assessors influence the temperament assessments and which are the best profiles of assessors for the application of this method.

Animal welfare implications

The identification of temperament profiles of shelter cats, trough valid and practical methods, such as QBA, can be an additional tool to improve the management practices of these

institutions. Both management in the shelter and the allocation of cats eligible to adoption to the proper owners would be favored by the temperament assessment. For instance, the allocation of cats to collective pens have to take into account their temperaments. The provision of enrichment items could also consider the individuality of the target cats. Fearful animals' benefits from the provision of elevated areas, such as shelves, hiding sites and security areas, while friendly cats could gain more benefits from human contacts and play activities (Rochlitz 2000).

Identifying the stiles of temperament that better match with owners' preferences and profiles could also improve human-animal relationships, raising the chances of successful adoptions. Fearful animals are less attractive to adopters, whereas the most desirable behavioral profiles are the friendly, sociable and relaxed ones (Gourkow & Fraser 2006). One of the biggest risks towards the development of post-adoption attachment between owner and their pets is the unreal expectations established by the owners. Thus, it is fundamental to inform and advise the adopter about the temperament of the animal chosen (Weiss *et al* 2015). Thus, according to the profiles found in this study by using QBA, we can infer that calm/active animals could be directed to people with willingness to interact, play and stimulate positive activities for these animals. Calm/quiet cats could be more adequate to families with children and elderly people, since they are less active and easier to care, with lower risks of accidents. Animals in fearful/flighty and fearful/aggressive extremes are animals that may need behavioral interventions previously to adoption to increase their tolerance to human contacts, thus improving the cats' welfare and owners' safety. Fearful/aggressive cats could also be adopted by people with a higher level of knowledge about cats' behavior, who could understand their particularities and provide adequate care and environment, with lower degree of tactile interactions, provision of escape routes and security areas for the cat. The proper allocations of cats to owners could be favored by the use of QBA as temperament indicator, reducing the number of returns and abandonments to shelter and helping to assist in the ethical awareness of future owners.

CONCLUSION

The Qualitative Behavior Assessment is a valid tool to identify and discriminate temperaments profiles of the sampled cats and, thus, could be used in shelters as a methodology

more practical than the quantitative coding approaches. The QBA allows to identify temperament profiles, such as 'calm/active', 'calm/quiet', 'fearful/flighty', 'fearful/aggressive', by which shelter managers could categorize animals with potential to be adopted without further complications and others who would need behavioral interventions, as training strategies. Cats with difficult temperaments could also be adopted by owners who are aware of and willing to handle their particular behavioral needs. The QBA should also be valid for temperament assessment of cats in other contexts, such as domiciliated animals, or even to other companionship species. For these purposes, the adjectives list proposed in this study must be updated in order to include behavioral characteristics more appropriate to the context and / or species in question.

ACKNOWLEDGEMENTS

We would like to thank the staff of the private cat shelter who collaborated with the data collection, especially to Maria José Ribeiro Toledo for authorize and support the study. We also thank the undergraduate and graduate students of NEBEA - UFJF for their collaboration with data collection. This study is part of the master's thesis of the first author prepared to the Graduate Program in Behavior and Animal Biology of the Universidad Federal de Juiz de Fora (UFJF), Brazil. This study was financed in part by the Coordenação de Aperfeiçoamento de Pessoal de Nível Superior – Brasil (CAPES) – Finance Code 001.

REFERENCES

Arena L, Wemelsfelder F, Messori S, Ferri N and Barnard S 2017 Application of Free Choice Profiling to assess the emotional state of dogs housed in shelter environments. *Applied Animal Behaviour Science* **195**:72-79

Arena L, Wemelsfelder F, Messori S, Ferri N and Barnard S 2019 Development of a fixed list of descriptors for the qualitative behavioural assessment of shelter dogs. *bioRxiv* 545020

Boissy A, Manteuffel G, Jensen MB, Moe RO, Spruijt B, Keeling LJ, Winck-ler C, Forkman B, Dimitrov I, Langbein J, Bakken M, Veissier I, Aubert A and Bakken M 2007 Assessment of positive emotions in animals to improve their welfare. *Physiology & behavior* **92**(3):375-397

Bradshaw J and Cameron-Beaumont C 2000 The signaling repertoire of the domestic cat and its undomesticated relatives. In: Turner DC and Bateson P (eds) *The domestic cat: the biology of its behaviour.* Cambridge University Press, Cambridge pp 68-93

Briffa M and Weiss A 2010 Animal personality. *Current Biology* **20**:R912-R914

Carlstead K, Brown JL and Strawn W 1993 Behavioral and physiological correlates of stress in laboratory cats. *Applied Animal Behaviour Science* **38**:143-158

de Rivera C, Ley J, Milgram B and Landsber, G 2017 Development of a laboratory model to assess fear and anxiety in cats. *Jounal of feline medicine surgery* **19**:586-593

Durr R and Smith C 1997 Individual differences and their relation to social structure in domestic cats. *Journal of Comparative Psychology* **111**:412

Feaver J, Mendl M and Bateson PJ 1986 A method for rating the individual distinctiveness of domestic cats. *Animal Behaviour* **34**:1016-1025

Fleming PA, Clarke T, Wickham SL, Stockman CA, Barne L, Collins T and Miller DW 2016 The contribution of qualitative behavioural assessment to appraisal of livestock welfare. *Animal Production Science* **56**:1569-1578

Fleming PA, Paisley CL, Barnes AL and Wemelsfelder F 2013 Application of Qualitative Behavioural Assessment to horses during an endurance ride. *Applied Animal Behaviour Science* **144**:80-88

Fukimoto N, Howat-Rodrigues AB and Mendonça-Furtado OJAABS 2019 Modified Meet your Match® Feline-ality TM validity assessment: An exploratory factor analysis of a sample of domestic cats in a Brazilian shelter. *Applied Animal Behaviour Science* **215**:61-67

Gartner MC 2015 Pet personality: A review. *Journal Personality Individual Differences* **75**:102-113

Gartner MC and Weiss A 2013 Personality in felids: a review. *Applied Animal Behaviour Science* **144**:1-13

Góis KCR, Ceballos MC, Sant'Anna AC and Paranhos da Costa MJR 2016 Using an observer rating method to assess the effects of rotational stocking method on beef cattle temperament over time. *Revista Brasileira de Zootecnia* **45**:501-508

Gourkow N and Fraser D 2006 The effect of housing and handling practices on the welfare, behaviour and selection of domestic cats (*Felis sylvestris catus*) by adopters in an animal shelter **15**:371-377

Ha D and Ha J 2017 A subjective domestic cat (*Felis silvestris catus*) temperament assessment results in six independent dimensions. *Behavioural Processes* **141**:351-356

Highfill L, Hanbury D, Kristiansen R, Kuczaj S and Watson S 2010 Rating vs. coding in animal personality research. *Zoo Biology* **29**:509-516

Hudson R, Rangassamy M, Saldana A, Banszegi O and Rodel HG 2015 Stable individual differences in separation calls during early development in cats and mice. *Frontiers in Zoology* **12**:12

Kasbaoui N, Cooper J, Mills DS and Burman O 2016 Effects of long-term exposure to an electronic containment system on the behaviour and welfare of domestic cats. *Plos One* **11**:e0162073

Koolhaas JM, de Boer SF, Coppens CM and Buwalda B 2010 Neuroendocrinology of coping styles: Towards understanding the biology of individual variation. *Frontiers in Neuroendocrinology* **31**:307-321

Litchfield CA, Quinton G, Tindle H, Chiera B, Kikillus KH and Roetman P 2017 The 'Feline Five': An exploration of personality in pet cats (Felis catus). *Plos One* **12**:e0183455

Manly JFM 2008 *Métodos estatísticos multivariados: uma introdução.* 3ª ed. Porto Alegre: Bookman

Martin P and Bateson P 1993 *Measuring behaviour: an introductory guide.* 2ª ed. Cambridge University Press: Cambridge

McCobb EC, Patronek GJ, Marder A, Dinnage JD and Stone MS 2005 Assessment of stress levels among cats in four animal shelters. *Journal of the American Veterinary Medical Association* **226**:548-555

McDowell LJ, Wells DL, Hepper PG and Dempster M 2016 Lateral Bias and Temperament in the Domestic Cat (Felis silvestris). *Journal of Comparative Psychology* **130**:313-320

Mertens C 1991 Human-cat interactions in the home setting. *Anthrozoos* **4**:214-231

Mendl M and Harcourt R 2000 Individuality in the domestic cat: origins, development and stability. In: Turner DC and Bateson P (eds) *The domestic cat: The biology of its behaviour.* Cambridge University Press, Cambridge pp 179-190

Reisner IR, Houpt KA, Erb HN and Quimby FW 1994 Friendliness to humans and defensive aggression in cats: The influence of handling and paternity. *Physiology & Behavior* **55**(6):1119-1124

Réale D, Reader SM, Sol D, McDougall PT and Dingemanse NJ 2007 Integrating animal temperament within ecology and evolution. *Biological reviews* **82**:291-318

Rochlitz I 2000 Feline welfare issues. In: Turner DC and Bateson P (eds.) *The domestic dat: The biology of its behaviour.* Cambridge University Press, Cambridge pp 207-226

Sant'Anna AC and Paranhos da Costa MJ 2013 Validity and feasibility of qualitative behavior assessment for the evaluation of Nellore cattle temperament. *Livestock Science* **157**:254-262

Shore ER 2005 Returning a recently adopted companion animal: adopters' reasons for and reactions to the failed adoption experience. *Journal of Applied Animal Welfare Science* **8**(3):187-198

Siegford JM, Walshaw SO, Brunner P and Zanella AJ 2003 Validation of a temperament test for domestic cats. *Anthrozoos* **16**:332-351

Stamps J, Groothuis TGG 2010 The development of animal personality: relevance, concepts and perspectives. *Biological Reviews* **85**:301-325

Stockman CA, McGilchrist P, Collins T, Barnes AL, Miller D, Wickham SL, Greenwood PL, Cafe LM, Blache D and Wemelsfelder F 2012 Qualitative Behavioural Assessment of Angus steers during pre-slaughter handling and relationship with temperament and physiological responses. *Applied Animal Behaviour Science* **142**:125-133

Walker JK, Dale AR, D'Eath RB and Wemelsfelder F 2016 Qualitative Behaviour Assessment of dogs in the shelter and home environment and relationship with quantitative behaviour assessment and physiological responses. *Applied Animal Behaviour Science* **184**:97-108

Walker JK, Dale AR, Waran N, Clarke N, Farnworth M and Wemelsfelder F 2010 The assessment of emotional expression in dogs using a Free Choice Profiling methodology. *Animal Welfare* **19**:75-84

Weiss E, Gramann S, Drain N, Dolan E and Slater M 2015 Modification of the Feline-Ality™ Assessment and the Ability to Predict Adopted Cats' Behaviors in Their New Homes. *Animals* **5**:71-88

Wemelsfelder F 2007 How animals communicate quality of life: the qualitative assessment of behaviour. *Animal Welfare* **16**:25

Wemelsfelder F, Hunter TE, Mendl MT and Lawrence AB 2001 Assessing the 'whole animal': a free choice profiling approach. *Animal Behaviour* **62**:209-220

Wemelsfelder F and Lawrence AB 2001 Qualitative assessment of animal behaviour as an on-farm welfare-monitoring tool. *Acta Agriculturae Scandinavica, Section A - Animal Science* **51**:21-25

CAPÍTULO 3

DO YOU SEE THE SAME CAT THAT I SEE? 2. INTER-OBSERVER RELIABILITY FOR QUALITATIVE BEHAVIOR ASSESSMENT AS TEMPERAMENT INDICATOR IN DOMESTIC CATS

Isadora de Castro Travnik[A,B], Daiana de Souza Machado[A,B], Aline Cristina Sant'Anna[B]

[A] Programa de Pós-Graduação em Comportamento e Biologia Animal, Instituto de Ciências Biológicas, Universidade Federal de Juiz de Fora, 36.036-330, Juiz de Fora, Minas Gerais, Brazil.
[B] Núcleo de Estudos em Etologia e Bem-estar Animal. Departamento de Zoologia, Instituto de Ciências Biológicas, Universidade Federal de Juiz de Fora, 36.036-330, Juiz de Fora, Minas Gerais, Brazil.

ABSTRACT: As the Qualitative Behavior Assessment (QBA) is a method subjected to the assessor's interpretation, it is necessary to evaluate the consistency among assessors for different species and contexts so that we can use it as an indicator of animal temperaments. The aim of this study was to assess the inter-observer reliability of QBA as temperament indicator of domestic cats. First, four behavioral tests were applied to produce videos of cats behavioral responses to different stimuli. The QBA was applied by 19 observers with divergent profiles of contact with cats and experience in behavioral assessment. Five observer groups were defined, two of them related to experience level (experienced *vs*. inexperienced, n = 8 each); two related to the degree of contact (cat owners *vs*. no-owners, n = 9 each); and total (n = 19). Forty-two 12-minutes videos were assessed, composed by footages of four behavioral tests: unfamiliar person; novel object; co-specific reaction and food offering tests. By using principal component analysis (PC) we found three principal dimensions of cats temperament, 'calmness' (PC1), 'restless' (PC2) e 'aggressiveness' (PC3). According to Kendall's coefficient of concordance, inter-observer reliability for the 19 observers was high in PC1 (W = 0.71) and low for PC2 (W = 0.21) and PC3 (W = 0.29). In spite of the low concordance among all observers in PC3, the individual concordances with the gold observer ranged from moderate (> 0.4) to high (> 0.7). As to the groups 'experience' and 'ownership' the PC1 and PC3 means showed no significant differences. When the reliabilities for each of the descriptors were assessed in an isolated manner, the coefficients were predominantly low (> 0.4) and moderate (> 0.7). We concluded that, although each observer had a different comparative scale to score each adjective, the general view of the cats' temperament was consistent in the first dimension. All the observers could identify variations in the cats' temperaments and their behaviors expressed in the

principal temperament dimensions, ‘calmness’, with good concordances, what did not occur for the QBA descriptors in an isolated manner.

Key-words: Companionship animals, Personality, Rating method, Shelter cats, Welfare.

INTRODUCTION

The use of rating methods for assessing animal behaviors has been increasing in recent years, through the development of Qualitative Behavior Assessment (QBA) (Wemelsfelder *et al* 2001). The QBA is a method that allows us to assess the behavioral expression of animals with subtle variations, as well as their behavior and patterns of interaction with the environment, instead of analyzing discrete and isolated categories of behavior (Wemelsfelder & Lawrence 2001). Thus, it is possible to identify behavioral variations that are difficult to be identified in coding methods (Wemelsfelder *et al* 2001). Additionally, behaviors presented by one or few animals, which would be disregarded in usual statistical analyses, can be taken into consideration. The QBA is based on the use of descriptors to quantify positive or negative mental states, on visual analog scales. The QBA can be applied in two ways, from the Free Choice Profile (FCP), in which an observer uses descriptors chosen by him/her at the moment of the assessment or the Fixed-List (FL), in which the observer uses a list of predefined descriptors (Bokkers *et al* 2012; Phythian *et al* 2013; Diaz-Lundahl *et al* 2019). The latter method has regarded as valid, mainly for studies with more practical purposes (Arena *et al* 2019).

To date, most of the QBA studies were developed with farm animals, using it as an indicator of animal welfare (Wemelsfelder & Lawrence 2001; Stockman *et al* 2012; Fleming *et al* 2013; Arena *et al* 2017) or animal temperament (Sant’Anna & Paranhos da Costa 2013; Góis *et al* 2016). In spite of focusing on farm animals, the QBA can be a promising tool for assessing the behavior of companionship animals too. Considering that such animals have undergone a co-evolution process with human beings, what resulted in a behavioral modulation that improved the communication between humans and animals (Bradshaw & Cameron-Beaumont 2000; Miklósi *et al* 2000). However, up to now this methodology has been applied only to dogs (Walker *et al* 2016; Arena *et al* 2017; Arena *et al* 2019). No previous papers using QBA has been found in the scientific literature for assessing cats’ behavior.

The assessment of consistency among assessors for different species and contexts is an important step so that new methodologies may be widely used (Kaler 2009). Previous studies focusing on the analyses of intra- and inter-observer reliabilities of QBA showed divergent results (Clarke *et al* 2016; Bokkers *et al* 2012; Phythian *et al* 2013; Diaz-Lundahl *et al* 2019). Bokkers *et al* (2012) assessed reliabilities for QBA by using eight experienced and ten inexperienced observers and found that the degrees of concordance varied among the descriptors and dimensions, leading the authors to conclude that the QBA presents reliabilities apparently insufficient to be considered a tool to access the welfare of dairy cattle (Bokkers *et al* 2012). Other works, however, showed more promising values of reliability, ranging from high (0.7 - 0.9) to very high coefficients (0.9 - 1.0) of correlation among trained observers (Phythian *et al* 2013; Diaz-Lundahl *et al* 2019). These were considered able to identify, with good reliabilities, the general level of welfare of sheeps (Phythian *et al* 2013; Diaz-Lundahl *et al* 2019). Similar data have been found in a study with dogs, whereby 25 observers presented a high inter-observer reliability for different groups of observers (Clarke *et al* 2016).

Studies about temperament of companionship animals involve mostly dogs (Gartner 2015). For cats, there are few papers, most of them focusing on identifying the principal dimensions of temperament and, among these studies, there is a great variation of methods used, making their comparison difficult (Gartner & Weiss 2013; Finka *et al* 2019). Identifying the principal dimensions of cats' temperament through a reliable and feasible methodology could be useful, for instance, for organizations that care of abandoned animals in shelters (Fukimoto *et al* 2019). The information gathered from assessment of temperaments in shelters could be used to develop best practices of cats' management, housing adequacy and awareness of possible owners who intend to adopt shelter animals (Gourkow & Fraser 2006; Weiss *et al* 2015; Fukimoto *et al* 2019).

The familiarity of human beings with companionship animals can lead to better interpretations of their mental states. In this scenario, it is necessary to identify the adequate profiles of observers to perform a QBA in cats. Therefore, this study aims at to assess the inter-observer reliability by using the Qualitative Behavior Assessment with observers having different experience and profiles of contact with cats.

MATERIALS AND METHODS

The study has been approved by the Animal Ethics Committee at the Federal University of Juiz de Fora, MG, Brazil, (protocol n. 051/2018). Forty-two adult animals living in stable shelters were assessed, 22 of them being females and 20 males. All of the individuals were shorthair, castrated and having no apparent signals of diseases. The total area of the shelter, where the cats had been housed was approximately 472 m², each pen measuring 59 m² on average. The animals had been distributed in eight pens (2 to 9 animals per pen), where each of them had a free-range and an indoor area (area per animal: 3.35 to 43.50 m²). The indoor environment of the pens had shelves at different heights, plastic bed covered with newspapers, sand boxes, feeding areas and water source. The free-range area was partially covered, fenced with wire mesh providing natural ventilation and visual contact among the pens, and several physical structures used to enrich the environment. The cats had food and water supply *ad libitum* and lived in stable groups (living together for more than three years). There were two analysis stages: (i) Four behavioral tests to produce videos; (ii) Application of *Qualitative Behavior Assessment* (QBA) to 19 observers.

Behavioral tests for videos production

Four standard tests were applied in order to produce videos (Table 7): (i) Unfamiliar person (UP) test (modified from McDowell *et al* 2016), with the aim of assessing the cats' reaction in front of human beings in seven stages, with growing levels of stimulus (contact with the tester); (ii) Novel object (NO) test (adapted from Durr & Smith 1997), the aim of which was to assess how the animal behaves in front of a novel, if they are neophobic or neophiliac. To this end, we chose a toy train that emitted light and sound when switched on. The toy was chosen seeking a balance among characteristics that could be interpreted as very frightening or uninteresting (Durr & Smith 1997); (iii) Co-specific reaction (CR) test, used to assess the sociability with other unknown cats. We opted to use a taxidermized cat to reduce the effect of individual variations of co-specific on the target animal to avoid possible risks and low level of welfare to the co-specific tester; (iv) Food offering (FO) test, performed to assess the animal's reaction and excitability to a moist food offering as a positive stimulus (Table 7). The UP and NO tests were performed sequentially and individually during four days. The CR and FO tests were performed in pen groups, one week and 27 days, respectively, after the first two tests. In case the animal showed behaviors indicating panic or behaviors that could jeopardize its bodily integrity, the tests were terminated.

Table 7. Description of procedures performed in each temperament tests in the respective phases. Unfamiliar person test was adapted from McDowell *et al* (2016) and novel object test was adapted from Durr and Smith (1997). In any of these phases in cases the animal showed behaviors indicative of panic the procedure was interrupted

Test/Phase	Description
Unfamiliar person test	
Phase 1	An unknown person entered the pen, went to one of its ends, got down and stood still for 1 min.
Phase 2	During 1 min the animal was called by the unknown person.
Phase 3	Flight distance test: a person started moving from the opposite end relative to the cat position in the pen, approaching it, straight and calmly, within its visual field. Reached for it and tried to touch it. Procedure was repeated for three times, considered the average distance (in cm) in the analyses. Leather gloves were used for security reasons.
Phase 4	The animals were stroked in the head and back, in this order, for 1 min.
Phase 5	The tester tried to hold the animal and put it in his chest, tried three times.
Phase 6	The animals were stroked in the head and back, in this order, for 1 min. After that, the cat was left on the ground.
Phase 7	The tester held the tail of the animal firmly, holding it for 3 s.
Novel object test	
Phase 1	A toy with sound and movement stimulus was positioned in the center of the room for 1 min.
Phase 2	The toy was turned on for 1 min more.
Co-specific reaction test	
Phase 1	A taxidermized cat was positioned in the center of the pen during 3 min.
Food offering test	
Phase 1	A person standing in the center of the pen held a food pot (wet cat food), during 3 min.
Phase 2	The food was offered to each animal individually.

The cats' behaviors were recorded using a Canon VixiHf R800 video camera and a Go Pro Hero 5 attached to the tester's head. The videos of each animal were watched by the researcher and edited. The editions included: (i) clipping each test with their respective times as defined on table 7; (ii) joining the four tests randomly sequenced in the 42 videos; (iii) excluding the tester's voice that could influence the observers at the moment of the QBA analysis; (iv) visual indication with arrow on cats to be assessed in group tests, when more than one animal appeared on the test. The time of each video was approximately 12 minutes, totalizing 503.35 minutes of recordings.

Qualitative Behavior Assessment (QBA)

The cats' behavioral expressions were assessed using 20 descriptors ('active', 'affectionate', 'aggressive', 'agitated', 'attentive', 'alert', 'calm', 'confident', 'curious', 'fearful', 'friendly', 'indifferent', 'nervous', 'relaxed', 'sociable', 'stressed', 'suspicious', 'tense', 'vocal' and 'greedy'). The descriptors were chosen based on the scientific literature (Góis *et al* 2016; Ha & Ha 2017; Litchfield *et al* 2017; Wemelsfelder *et al* 2001), trying to keep

a balance between positive and negative expressions of behavior (Sant'Anna & Paranhos da Costa 2013). The descriptors were quantified on 126 mm visual analog scales, with the extreme lefthand indicating the smallest expression of characteristic and the extreme righthand ones indicating the greatest expression of characteristic. The scales were measured with a ruler on a continuous scale (in mm). During all the sessions the observers were instructed not to communicate with one another when the tests were performed in group sessions. Intervals of 20 minutes minimum occurred after each hour of analysis, and could not exceed 12 videos a day.

Observers

The videos were presented to 19 observers aging from 18 to 37 years. The observers were grouped as follows: four veterinary medicine students; seven biological sciences students; three postgraduate students in animal biology and behavior; a researcher of animal behavior; and four people who are studying or studied Human Sciences (linguistics, history, journalism and psychology) at college. From this group five others were formed, two of them related with level of experience, (i) experienced: people with experience on behavioral analysis (n = 8 observers); (ii) inexperienced: people with no experience on behavioral analysis (n = 8); and two related to the degree of contact with cats, (iii) cat owners: people who had already been owners of cats (n = 9); (iv) no-owners: people who had never been owners of cats (n = 9); (v) all observers (n = 19). One of the observers was defined as 'gold' since he had 15 years of experience in behavioral observation and had been owner of cats for more than 10 years, in addition to applied the Qualitative Behavior Assessment to different species of domestic animals. The other observers were trained by performing the QBA by using five videos. Three of them showed isolated tests with cervids (unknown person or novel test) and two of them focused on cats, from pilot recordings performed previously with animals that were not part of the study. The trainings took place during 3 hours, consisting of a brief introduction to the method and an explanation of the meanings of each descriptor, followed by the marking of QBA for each one of the five videos and a subsequent discussion about the meaning of each descriptor. The aim of the training was to contribute for a better concordance among the observers (Grosso *et al* 2016).

Data analyses

The temperament dimensions were extracted from the 19 observers by using principal component analysis (Manly 2008). The principal components with eigenvalues > 1 were retained as the main dimensions of cats' temperament. Descriptors with loadings above 0.6 were retained as main contributions to the dimensions found. The scores of the animals in the three first principal components (PC) were transformed in QBA scores ranging from 0 to 100.

The inter-observer reliability was calculated using Kendall's coefficients of concordance (W). Firstly, there was an assessment of concordances of each individual observer with the gold one for the main dimensions of temperament (PC1 to PC3) and for the 20 isolated descriptors. Then, the Kendall's coefficients were calculated for each group (experienced, inexperienced, owners and no-owners) and for all of the observers. In order to interpret the *W*, the classification proposed by Martin & Bateson (2007) was used, as follows: slight concordance (0.0 - 0.2); low (0.2 - 0.4); moderate (0.4 - 0.7); high (0.7 - 0.9) and very high (0.9 - 1.0).

In order to compare the QBA measurements performed by the groups of experience and ownership, mixed models for longitudinal data were fitted using PROC MIXED of SAS. Models included the QBA descriptors (active, affectionate, aggressive, agitated, attentive, alert, calm, confident, curious, fearful, friendly, indifferent, nervous, relaxed, sociable, stressed, suspicious, tense, vocal and greedy) and the principal components (PC1, PC2, PC3) as dependent variable, in addition to the fixed effect of the groups experience (experienced *vs.* inexperienced), ownership (owners *vs.* no-owners) and their interactions. The random effect of animal (SUBJECT) was considered as a repeated measure within observer.

RESULTS

Characterization of cat temperaments

The Principal Components Analysis enabled to identify four principal components (PC) of temperament of cats analyzed by the 19 observers by using QBA. The fourth component (PC4) only presented the variable 'indifferent' with loading above (0.6), what was considered insufficient to express an interpretable dimension of cat temperament. Thus, the first three components retained and, together, explained 66.93% of the variation in the dataset, being

interpreted as the principal dimensions of cats' temperament (Table 8). The PC1 explained 43.29% of the dataset variation, showing high positive loadings for 'friendly', 'relaxed', 'affectionate', 'confident', 'curious', 'calm', 'greedy' and 'sociable', and negative loadings for 'tense', 'stressed', 'fearful', 'suspicious' and 'nervous'; being characterized as dimension 'calmness'. The PC2 explained 17.13% of dataset variation and presented only descriptors with high negative loadings: 'attentive', 'agitated', 'alert' and 'active', reflecting the dimension 'restless'. The PC3 explained 6.51% of variation and presented only the variable 'aggressive' with high positive loading, what may interpreted as the dimension 'aggressiveness'.

Table 8. Loadings of each descriptor used in the QBA, for the three main principal components (PC) generated in the Principal Component Analysis. Values above 0.6 are highlighted in bold type.

Descriptors	Calmness (PC1)	Restless (PC2)	Aggressiveness (PC3)
Active	0.58	**-0.60**	-0.24
Aggressive	-0.40	-0.10	**0.83**
Calm	**0.73**	0.25	0.05
Affectionate	**0.82**	-0.30	0.10
Tense	**-0.85**	-0.38	-0.04
Relaxed	**0.84**	0.16	0.09
Indifferent	-0.05	0.32	0.18
Curious	**0.74**	-0.46	0.01
Alert	-0.57	**-0.61**	-0.05
Nervous	**-0.66**	-0.37	0.40
Confident	**0.75**	-0.26	0.34
Vocal	0.40	-0.40	0.12
Attentive	-0.24	**-0.67**	0.07
Greedy	**0.67**	-0.47	0.02
Sociable	**0.62**	-0.40	0.07
Stressed	**-0.79**	-0.36	0.16
Fearful	**-0.77**	-0.28	-0.28
Friendly	**0.85**	-0.26	0.08
Agitated	0.21	**-0.64**	-0.29
Suspicious	**-0.77**	-0.38	-0.06
Eigenvalue	8.66	3.43	1.30

Inter-observer reliability among all observers

To verify the reliability of temperament dimensions between of each observer and the observer defined as 'gold', the Kendall's coefficients of concordance were used. All the 18 observers analyzed presented high concordance (> 0.70) with the gold in PC1 (Table 9). In PC2, one observer presented high concordance, 16 showed moderate concordance and one low concordance. In PC3, eight observers presented high concordance and ten had moderate concordance (Table 9).

When the reliabilities of the group 'all observers' were assessed for temperament dimensions, they presented high Kendall's coefficient in PC1 (W = 0.71), whereas PC2 and

PC3 presented low coefficients (W = 0.21 and 0.29, respectively) (Table 10). For each of the descriptors, the Kendall's coefficients (W) were predominantly low (13 descriptors), with four slight concordance and three moderate concordances (Table 10).

Table 9. Kendall's coefficient of concordance between each observer and the gold one in the three principal components (PC) found in cats (N = 42). Values higher than 0.7 are highlighted in bold type.

Observer	Group		Calmness (PC1)	Restless (PC2)	Aggressiveness (PC3)
	Experience	Ownership			
1 (Gold)	Experienced	Owner	-	-	-
2	Experienced	Owner	**0.93**	0.38	**0.74**
3	Experienced	Owner	**0.88**	0.60	0.49
4	-	Owner	**0.86**	0.48	0.68
5	Experienced	Owner	**0.84**	0.61	0.53
6	Inexperienced	Owner	**0.75**	0.61	0.65
7	Experienced	No-owner	**0.76**	0.66	**0.75**
8	Experienced	No-owner	**0.76**	**0.70**	0.63
9	-	No-owner	**0.80**	0.52	0.62
10	-	No-owner	**0.82**	0.60	**0.78**
11	Experienced	No-owner	**0.86**	0.68	**0.76**
12	Experienced	No-owner	**0.89**	0.53	0.67
13	Inexperienced	Owner	**0.84**	0.68	**0.75**
14	Inexperienced	-	**0.89**	0.58	**0.89**
15	Inexperienced	No-owner	**0.85**	0.46	**0.75**
16	Inexperienced	Owner	**0.86**	0.49	**0.79**
17	Inexperienced	Owner	**0.86**	0.41	0.68
18	Inexperienced	No-owner	**0.85**	0.41	0.52
19	Inexperienced	No-owner	**0.85**	0.62	0.58

Inter-observer reliability for the groups based on experience and ownership

To verify the reliability of temperament dimensions and of each descriptor as a function of the groups, the Kendall's coefficients of concordance (W) were also used. In all four groups, the PC1 coefficients were high. For PC2 and PC3 the coefficients of concordance were moderate, with the exception of PC2 for the group 'owners' that presented slight concordance (Table 10).

Regarding the reliability for each of the descriptors, the observers of the group 'experienced' presented low (9 descriptors), slight (4) and moderate (7) coefficients. In turn, for the group 'inexperienced', the coefficients were predominantly moderate (14), and the remaining ones were low (6). As to the Kendall's coefficients (W) for the group 'owners', the values were mostly moderate (10) and low (9) with the adjective 'indifferent' being the only one with slight concordance. In the group 'no-owners' the coefficients were mostly low (14) and moderate (4), with the descriptors 'indifferent' and 'attentive' being the only ones with slight concordance (Table 10).

Table 10. Kendall's coefficients of concordance (W) and means (± SE) by observers' profile groups when assessing 42 shelter cats on videos (experienced vs. inexperienced and owners vs. no-owners).

Descriptors	Experience				Ownership				All observers n = 19	
	Experienced n = 8		Inexperienced n = 8		Owners n = 9		No-owners n = 9			
	Mean (± SE)	W	Mean (± SE)	W	Mean (± SE)	W	Mean (± SE)	W	Mean (± SD)	W
Active	**31.77** (±1.41)	0.27	**37.99** (±1.87)	0.43	36.56 (±1.58)	0.45	33.20 (±1.73)	0.25	34.10 (±1.69)	0.31
Aggressive	12.56 (±1.11)	0.32	15.66 (±1.46)	0.47	14.86 (±1.24)	0.39	13.36 (±1.36)	0.30	13.77 (±1.68)	0.32
Calm	**41.35** (±1.62)	0.36	**50.64** (±2.14)	0.44	**41.48** (±1.81)	0.33	**50.51** (±1.99)	0.35	44.65 (±1.69)	0.32
Affectionate	20.95 (±1.61)	0.44	23.48 (±2.13)	0.68	23.12 (±1.80)	0.49	21.30 (±1.97)	0.54	21.90 (±1.69)	0.50
Tense	49.09 (±1.69)	0.35	54.10 (±2.24)	0.52	**57.40** (±1.89)	0.48	**45.80** (±2.07)	0.31	51.04 (±1.70)	0.36
Relaxed	**38.52** (±1.71)	0.43	**44.84** (±2.27)	0.49	**37.41** (±1.92)	0.45	**45.95** (±2.10)	0.39	40.72 (±1.70)	0.39
Indifferent	**32.36** (±1.32)	0.13	**43.82** (±1.75)	0.24	**31.69** (±1.48)	0.14	**44.50** (±1.62)	0.16	36.14 (±1.69)	0.11
Curious	**20.36** (±1.31)	0.29	**28.33** (±1.74)	0.57	**27.79** (±1.47)	0.44	**20.89** (±1.61)	0.31	23.41 (±1.69)	0.36
Alert	**54.75** (±1.50)	0.22	**61.81** (±1.99)	0.30	**63.15** (±1.68)	0.26	**53.41** (±1.84)	0.20	57.35 (±1.69)	0.18
Nervous	32.13 (±1.48)	0.30	30.86 (±1.95)	0.43	**37.42** (±1.65)	0.37	**25.57** (±1.81)	0.30	32.05 (±1.69)	0.30
Confident	**26.07** (±1.43)	0.42	**31.29** (±1.89)	0.38	27.10 (±1.60)	0.44	30.26 (±1.75)	0.29	27.83 (±1.69)	0.34
Vocal	14.16 (±0.97)	0.36	16.19 (±1.29)	0.38	15.43 (±1.09)	0.35	14.92 (±1.19)	0.30	14.91 (±1.68)	0.29
Attentive	**61.93** (±1.24)	0.09	**69.85** (±1.64)	0.24	**72.73** (±1.39)	0.20	**59.05** (±1.52)	0.13	65.06 (±1.68)	0.09
Greedy	17.97 (±1.33)	0.30	19.10 (±1.76)	0.43	**21.32** (±1.49)	0.42	**15.75** (±1.63)	0.32	18.53 (±1.69)	0.34
Sociable	32.36 (±1.56)	0.40	30.20 (±2.06)	0.42	**35.25** (±1.74)	0.37	**27.32** (±1.91)	0.41	31.81 (±1.69)	0.37
Stressed	41.30 (±1.70)	0.40	46.22 (±2.25)	0.49	45.71 (±1.90)	0.46	41.82 (±2.08)	0.41	42.94 (±1.70)	0.40
Fearful	57.02 (±1.75)	0.42	57.09 (±2.32)	0.48	59.21 (±1.96)	0.43	54.90 (±2.15)	0.39	56.83 (±1.70)	0.36
Friendly	27.56 (±1.67)	0.53	29.76 (±2.21)	0.62	28.69 (±1.87)	0.60	28.63 (±2.05)	0.54	28.32 (±1.70)	0.54
Agitated	**25.33** (±1.41)	0.17	**40.28** (±1.86)	0.29	31.91 (±1.57)	0.20	33.70 (±1.72)	0.20	30.65 (±1.69)	0.16
Suspicious	**55.00** (±1.62)	0.14	**63.64** (±2.14)	0.46	**62.29** (±1.81)	0.31	**56.35** (±1.98)	0.21	58.14 (±1.69)	0.24
PC1	38.56 (±1.05)	0.71	39.55 (±1.38)	0.75	37.77 (±1.17)	0.71	40.34 (±1.28)	0.74	38.92 (±1.68)	0.71
PC2	**56.25** (±0.73)	0.27	**51.63** (±0.96)	0.31	**50.43** (±0.81)	0.17	**57.45** (±0.89)	0.34	54.47 (±1.67)	0.21
PC3	35.96 (±0.64)	0.37	36.94 (±0.85)	0.35	36.75 (±0.72)	0.30	36.16 (±0.79)	0.32	36.38 (±1.67)	0.29

The significantly different means are in bold type, where $P < 0.05$.

Through analyses of variance for longitudinal data, differences in the scores of each descriptor and the dimensions (PC1, PC2 and PC3) as a function of the groups of experience (experienced *vs.* inexperienced) and ownership (owners *vs.* no-owners) were assessed. For

temperament dimensions, only PC2 was significantly different between the groups of observers experienced *vs.* inexperienced ($F_{1,794} = 14.67$, $P \leq 0.001$), and the groups owners *vs*. no-owners ($F_{1,794} = 33.83$, $P \leq 0.001$). The groups of experience also differed for the following descriptors: 'active' ($F_{1,794} = 7.03$, $P = 0.008$), 'calm' ($F_{1,794} = 11.93$, $P = 0.001$), 'relaxed' ($F_{1,794} = 4.94$, $P = 0.027$), 'indifferent' ($F_{1,794} = 27.18$, $P \leq 0.001$), 'curious' ($F_{1,794} = 13.37$, $P \leq 0.001$), 'alert' ($F_{1,794} = 8.03$, $P = 0.005$), 'confident' ($F_{1,794} = 4.85$, $P = 0.028$), 'attentive' ($F_{1,794} = 14.75$, $P \leq 0.001$), 'agitated' ($F_{1,794} = 41.09$, $P \leq 0.001$) and 'suspicious' ($F_{1,794} = 10.41$, $P = 0.001$) (Table 10). As to the groups of ownership, the differing descriptors were 'calm' ($F_{1,794} = 11.29$, $P = 0.001$), 'tense' ($F_{1,794} = 17.06$, $P \leq 0.001$), 'relaxed' ($F_{1,794} = 9.02$, $P = 0.003$), 'indifferent' ($F_{1,794} = 33.98$, $P \leq 0.001$), 'curious' ($F_{1,794} = 10.04$, $P = 0.002$), 'alert' ($F_{1,794} = 15.28$, $P \leq 0.001$), 'nervous' ($F_{1,794} = 23.43$, $P \leq 0.001$), 'attentive' ($F_{1,794} = 44.02$, $P \leq 0.001$), 'greedy' ($F_{1,794} = 6.39$, $P = 0.012$), 'sociable' ($F_{1,794} = 9.42$, $P = 0.002$) and 'suspicious' ($F_{1,794} = 4.90$, $P = 0.027$) (Table 10).

For some descriptors there was significant interactions between ownership and experience where, in general, the group with experience and no-owners differed from the remaining ones, showing significantly lower means in the descriptors: 'tense' ($F_{1,794} = 7.76$, $P = 0.006$), 'alert' ($F_{1,794} = 15.42$, $P = <0.001$), 'attentive' ($F_{1,794} = 7.65$, $P = 0.006$), 'stressed' ($F_{1,794} = 14.32$, $P \leq 0.001$), 'fearful' ($F_{1,794} = 17.75$, $P \leq 0.001$), 'agitated' ($F_{1,794} = 5.13$, $P = 0.024$) and 'suspicious' ($F_{1,794} = 7.62$, $P = 0.006$). As to PC2, the results were inverted, the group experienced and no-owners presented PC2 values higher, showing the significant interaction of the two profiles in this dimension ($F_{1,794} = 11.75$, $P \leq 0.001$).

DISCUSSION

For any behavioral measuring tool, one of the most important characteristics to make it a good method is the reliability when performed by different assessors (Kaler 2009). Thus, our work aimed at analyzing the reliability of inter-observer responses of 19 observers for the Qualitative Behavior Assessment, with a fixed-list of 20 descriptors applied to 42 domestic cats. Through the Principal Component Analysis (PCA) we obtained three principal dimensions of cats temperament ('calmness', 'restless' and 'aggressiveness'). The Kendall's coefficient of concordance (W) for all observers was high for the dimension 'calmness' (PC1) and low for the dimensions 'restless' and 'aggressiveness' (PC2 and PC3). Despite the low concordance in

PC3, the individual concordances with the gold observer showed moderate (> 0.4) to high concordances (> 0.7). For the descriptors in an isolated manner, considering the five groups of ‘experience’, ‘ownership’ and ‘all observers’, the Kendal's coefficients showed that in 11% of cases the descriptors were considered slight, in 51% were considered low and in 38% were considered moderate. As to the groups ‘experience’ and ‘ownership’, in turn, the means of PC1 and PC3 did not show significant differences. Thus, each observer varied in the score for each descriptor in an isolated manner, but not in the general view about the animals’ temperaments.

The first factor extracted from PCA, characterized as ‘calmness’, had higher values for cats regarded as ‘friendly’, ‘relaxed’, ‘affectionate’, ‘confident’, ‘curious’, ‘calm’, ‘greedy’ and ‘sociable’, and lower values for cats regarded as more ’tense’, ‘stressed’, ‘fearful’, ‘nervous’ and ‘suspicious’. Thus, through this dimension, the cats could be distinguished on the basis of the degree and style of responses (positive or aversive) due to all the different stimuli used in the tests. These results are similar to PC2 found in the study by Arena *et al* (2019) who performed it using a QBA with dogs, whereby descriptors describing behavioral extremes were ‘comfortable’ and ‘relaxed’ at one side and ‘anxious’, ‘nervous’ and ‘stressed’ at the other. Our results are in agreement with another study performing QBA for sheep, in which Diaz-Lundahl *et al* (2019) had their PC1 descriptors with high loadings for the positive extreme, that is, ‘calm’, ‘content’, ‘relaxed’ and ‘friendly’, and negative values for ‘uneasy’, ‘vigilant’ and ‘fearful’. Both studies showed descriptors with semantic meanings positive and negative similar to the ones found in this study. All of them distinguished the animals defined as calmers from the most fearful ones. The dimension ‘restless’ (PC2) consisted of the descriptors ‘attentive’, ‘agitated’, ‘alert’ and ‘active’. Similarly a study on personality and interactions among domestic cats and owners (Wedl *et al* 2011), whereby principal component (PC1) was named ‘active’, consisted of the descriptors ‘curious’, ‘active’, ‘playful’, ‘excitable’ and ‘vigilant’. In general, both the PC1 of Wedl *et al* (2011) and the PC2 ‘restless’ of the current study demonstrate behaviors that indicate the more agitation and attention to stimuli. In its turn, the dimension of PC3 was characterized by the adjective ‘aggressive’, differently from the results reported by Arena *et al* (2019), performed with dogs, where this descriptor showed no high loading in any dimension found. The variation found in the results by Arena *et al* (2019) relative to the present study may be due to distinctions in the unfamiliar person tests. The lack of invasiveness of the tester may have not been able to induce aggressive conducts, differently from the test performed in this study. Another factor that may have influenced is that, by using dogs that were in the kennels for a long period of time, more docile dogs may have been selected.

When we analyzed the concordances of each observer with the gold one using the Kendall's coefficient of concordance (W) we noticed high and very high concordances among the observers in PC1. These results show that the observers, independently from having cats, or experience in the behavioral area or having never known QBA, are able to identify calm and fearful animals. By analyzing the Kendall's coefficients (W) for the dimension 'calmness' (PC1) in the group 'all observers' and for the remaining groups concerning to experience and ownership, we noticed a high concordance that confirms previous findings in the literature (Phythian *et al* 2013; Diaz-Lundahl *et al* 2019). These results demonstrate that all the selected profiles in this study could discriminate the dimension 'calmness'. Bokkers *et al* (2012), in turn, found slight-concordance values for PC1 after the first application of QBA by 8 experienced observers. In further analysis, after the observers applied the QBA for some time in practical environment, the values increased to low in the group experienced and to moderate in the group inexperienced (Bokkers *et al* 2012). These results, however, occurred in non-standard videos, supplied by a worker. The authors, thus, made their own videos and made new analysis of these videos. The observers increased their coefficients to moderate concordance. By demonstrating how much the videos can influence the interpretation of behaviors, from Bokkers *et al* (2012), we can infer that the high values of concordance in the present study for PC1 can be due to standardization of the situations exposed to the observers, and also to the individual analysis of each animal instead of analyzing groups. Another factor that may have influenced for high values of concordance is that the dimension PC1, expressed by the animals represented 43.29% of behavior variability, expressing the most general reaction of the animal during the tests in two behavioral extremes. In Arena *et al* work (2019), the PC1 value was moderate (0.61). This dimension, in turn, explained 28.3% of behavioral variations and presented descriptors with high positive loadings only. On the other hand, their PC2 explained 25.9% of variation, but had both positive and negative loadings, along the relaxed and stressed extremes and had high coefficient of concordance (0.80) (Arena *et al* 2019).

The concordances in the dimension 'restless' (PC2) of each observer with the gold one was high for only one observer and the other 16 presented moderate concordances. So, we can infer that in this parameter the degrees of experience and ownership exerted no influence. As for the dimension 'calmness' (PC1), we can observe a reduction in the concordance values. These results can suggest that the dimension 'restless' is subtler and presents greater problems of interpretation by observers. Kendall's coefficients of concordance (W), when we analyze the group 'all observers' and each group of experience and ownership, come up to reaffirm this idea.

The dimension ‘restless’ (PC2) showed low concordance for most groups, what indicated a clear fall in PC1 and PC2 coefficients. These results are opposite to the ones found by Phythian *et al* (2013), where the PC2 values were very close to the PC1 values. Both dimensions presented extremes of high positive and negative loadings. The observers analyzed the animals on one-minute videos, and aimed assessing sheep welfare (Phythian *et al* 2013). This short time of video can limit the number of behaviors expressed and their variations in the course of distinct situations (necessary to differentiate temperaments) and, therefore, might improve concordances, by reducing the influence of interpretations (Phythian *et al* 2013). The greatest complexity of responses from cats presented in the 12 minutes of video can have been one of the factors that reduced the concordance of less expressive dimensions.

As to the dimension 'aggressiveness' (PC3), when we compare each observer with the gold observer, we noticed that 44.4% of them (8) were able to interpret this dimension with high concordance and 55.6% with moderate concordance. This improvement in concordance in relation to the dimension ‘restless’ (PC2) can probably be linked to more conspicuous behaviors, which are the aggressive conducts, more easily identified through subjective assessments of cats’ body language (hissing, slaps, bites). In spite of PC3 getting better concordance values between the gold *vs.* each observer when compared to PC2, the PC3 showed low concordances agreement to PC2 when we analyzed the five groups and overall. In PC1 we can clearly identify two opposite expressions, positive and negative. This duality strengthens the conceptual view for observers to score the animals when analyzing them (Arena *et al* 2019). PC2 and PC3 dimensions, contrary to PC1, have descriptors of high loadings for one behavioral extreme only. This characteristic can explain partially the low concordance among the observers. Another possible factor is that each observer might have interpreted differently the importance of aggressive behaviors that perhaps have been expressed in other dimensions.

As to the group 'all observer', the Kendall's coefficients (W) for each descriptor were predominantly low, with four descriptors slight and three moderate. Such results were inferior to the ones reported in the literature. In these previous studies the coefficients of concordance were predominantly moderate (Arena *et al* 2019; Clarke *et al* 2016). Arena *et al* (2019), for instance, used 20 descriptors to perform the QBA and presented 16 descriptors with moderate concordances, 3 with high and one low concordance. However, lower values were already expected in the present study, since the videos used presented a much broader context of each animal, in a variety of situations (different tests). In this context the observers had to balance the different reactions of different tests in just one scale. Assessing the animals in different

situations increases the possibility of finding a broader behavioral repertoire and identifying the individual patterns that determine temperament dimensions. Both previously mentioned studies had shorter videos (1 min and 1.5 min) in which the reduced time could limit the behaviors presented, what might have raised the reliabilities in behavioral assessments (Clarke *et al* 2016; Arena *et al* 2019).

When the reliabilities were analyzed according to the profiles of the observers, we could identify that, for the group 'experienced', the Kendall's coefficients (W) were mostly low to moderate, with slight for four descriptors. Whereas, for the group 'inexperienced', the coefficients were predominantly moderate, with six descriptors with low value. As to the Kendall's coefficients (W) for the group 'owners', the values were moderate for 10 descriptors, low for nine and slight for the adjective 'indifferent'. Whereas the group 'no-owners' presented 14 low coefficients, four moderate and slight for the descriptors 'indifferent' and 'attentive'. Bokkers *et al* (2012), in turn, had a higher number of descriptors classified as moderate and presented a considerable increase in the second series of videos, indicating that the standardization of videos and familiarity with QBA can generate a significant improvement in observers' concordance concerning the isolated descriptors.

In order to compare the agreement as a function of the groups experienced *vs.* inexperienced and owner *vs.* no-owner for the principal dimensions and for each descriptor mixed models for longitudinal data are used. Among the three dimensions found, the only with significant differences between both groups of experience and for the groups ownership was the dimension 'restless' (PC2). This result reinforce to what extent this dimension presented distinct interpretations and insufficient reliability ratings.

The average scores of isolated descriptors for the groups experienced *vs.* inexperienced and owners *vs.* no-owners were significantly different for, respectively, 50% and 55% of descriptors. This result may have occurred due to individual measurement differences between observers, what is in agreement with the study developed by Arena *et al* (2019) who found different means of descriptors among the observers when applying the QBA to analyze the welfare of shelter dogs. The comparison among experience group demonstrated that a significant difference between groups was due to lower scores by the group experienced. In the comparison between ownership, the descriptors 'calm', 'relaxed' and 'indifferent' were scored with lower means by the owners and the descriptors 'tense', curious', 'alert', 'nervous', 'attentive', 'greedy', 'sociable' and 'suspicious' were scored higher by owners. Similar results

came out in Bokkers *et al* (2012), where by descriptors like ‘relaxed’, ‘calm’, ‘indifferent’, ‘bored’, ‘apathetic’ and ‘distressed’ were also rated by the experienced observers with lower scores. However, the authors formed two groups based on their contact with the animals vs. no contact and no experience with behavioral analysis, what makes it difficult to identify the causal factor of the differences found. Among the descriptors that showed significant differences in the means, ‘calm’, ‘relaxed’, indifferent’, ‘curious’, ‘alert’, ‘attentive’ and ‘suspicious’ were the seven descriptors that differed for the comparison of both groups of experience and for the groups ownership. For some of these descriptors, including ‘calm’, ‘relaxed’ and ‘indifferent’, these results may be explained by the lack of activity behaviors, that are usually more difficult to be distinguished (Konok *et al* 2015). For the others, the difficulty to measure them might be due to the behavioral complexity that a given adjective presents. Thus, each observer may have had a different perception according to his/her life experience and conceptions. Descriptors that are characterized by discrete behaviors such as vocalization, hissing or human contact may be easier to be interpreted. As we can observe from the results of the present study, the descriptors ‘aggressive’, ‘affectionate’, ‘vocal’ and ‘friendly’ showed equal means for of the groups performed. Yet, ‘stressed’ and ‘fearful’ were also descriptors that did not differ significantly in the analysis of groups. These results may have occurred because these descriptors represent negative mental states expressed through very conspicuous behavioral extremes (leaps, flight response, bristling of hair, freezing, ear contraction, among others).

Some descriptors showed a significant influence of interaction between ‘experience’ and ‘ownership’ groups. For these descriptors, ‘experienced’ and ‘no-owners’ showed lower means than the other groups. These values may be an indication that experience added to a possible feeling of responsibility and the lack of contact with the animals resulted in absence of behavioral references to evaluate cats. This condition may had lead them to act with caution at the moment of marking the descriptors, rating them with lower values. From what we could observe, the disagreement of among observers over the marking of isolated descriptors did not alter the general analysis of behavior, considering that the general picture of the animals are a comparative analyses, as it was also reported by Diaz-Lundahl *et al* (2019).

Although the observers had been able to identify the behavioral extremes, it is important to highlight that they showed no high concordance in descriptors individually. In practice, these results imply that any observer profile may be used for analyzing the temperaments of cats, but all cats in question should be analyzed. As the analysis is performed by comparison, it would not be correct to compare two assessments of different cats done by distinct observers. For

future studies it is advisable to check the intra-observer reliability and whether, in a practical environment, managers and keepers are able to perform the QBA to characterize the temperaments of cats.

CONCLUSION

We concluded that all observers were able to identify the dimensions 'calmness' and 'aggressiveness' with good reliabilities, enabling a practical application in shelters. We believe that keepers and workers too, using the QBA, will possibly manage to extract temperament traces. Identifying these traits in shelter cats can impact positively on their welfare, given that these animals would benefit from more adequate handling practices directed towards each kind of temperament. Besides, the QBA can be used to help in the adoption process, indicating the cats with the most adequate profiles for each owner, thus improving the human-animal interaction.

ACKNOWLEDGMENTS

The authors wish to thank the shelter team, especially Maria José Toledo for making their facility available to carry out the present research. We also to thank the 19 observers who donated their time and participated with great dedication. This study is part of the master's thesis of the first author prepared to the Graduate Program in Behavior and Animal Biology of the Universidade Federal de Juiz de Fora (UFJF), Brazil. This study was financed in part by the Coordenação de Aperfeiçoamento de Pessoal de Nível Superior – Brasil (CAPES) – Finance Code 001.

REFERENCES

Arena L, Wemelsfelder F, Messori S, Ferri N, and Barnard S 2017 Application of Free Choice Profiling to assess the emotional state of dogs housed in shelter environments. *Applied Animal Behaviour Science* **195:** 72-79.

Arena L, Wemelsfelder F, Messori S, Ferri N, and Barnard SJB 2019 Development of a fixed list of descriptors for the qualitative behavioural assessment of shelter dogs. *bioRxiv***:** 545020.

Bokkers E, de Vries M, Antonissen I, and de Boer I 2012 Inter-and intra-observer reliability of experienced and inexperienced observers for the Qualitative Behaviour Assessment in dairy cattle. *Animal Welfare* **21:** 307-318.

Bradshaw J, and Cameron-Beaumont C 2000 The signalling repertoire of the domestic cat and its undomesticated relatives *The domestic cat: the biology of its behaviour* p. 68-93.

Clarke T, Pluske JR, and Fleming PAJAABS 2016 Are observer ratings influenced by prescription? A comparison of free choice profiling and fixed list methods of qualitative behavioural assessment. *Applied Animal Behaviour Science* **177:** 77-83.

Diaz-Lundahl S, Hellestveit S, Stubsjøen SM, J Phythian C, Oppermann Moe R, and Muri KJA 2019 Intra-and Inter-Observer Reliability of Qualitative Behaviour Assessments of Housed Sheep in Norway. *Animals* **9:** 569.

Durr R, and Smith C 1997 Individual differences and their relation to social structure in domestic cats. *Journal of Comparative Psychology* **111:** 412.

Finka LR, Ward J, Farnworth MJ, and Mills DSJPo 2019 Owner personality and the wellbeing of their cats share parallels with the parent-child relationship. *Plos One* **14:** e0211862.

Fleming PA, Paisley CL, Barnes AL, and Wemelsfelder F 2013 Application of Qualitative Behavioural Assessment to horses during an endurance ride. *Applied Animal Behaviour Science* **144:** 80-88.

Fukimoto N, Howat-Rodrigues AB, and Mendonça-Furtado OJAABS 2019 Modified Meet your Match® Feline-alityTM validity assessment: An exploratory factor analysis of a sample of domestic cats in a Brazilian shelter. *Applied Animal Behaviour Science* **215:** 61-67.

Gartner MC 2015 Pet personality: A review. *Journal Personality Individual Differences* **75:** 102-113.

Gartner MC, and Weiss A 2013 Personality in felids: a review. *Applied Animal Behaviour Science* **144:** 1-13.

Góis KCR, Ceballos MC, Sant'Anna AC, and Paranhos da Costa MJR 2016 Using an observer rating method to assess the effects of rotational stocking method on beef cattle temperament over time. *Revista Brasileira de Zootecnia* **45:** 501-508.

Gourkow N, and Fraser D 2006 The effect of housing and handling practices on the welfare, behaviour and selection of domestic cats (Felis sylvestris catus) by adopters in an animal shelter. **15**: 371-377.

Grosso L, Battini M, Wemelsfelder F, Barbieri S, Minero M, Dalla Costa E, and Mattiello SJAABS 2016 On-farm Qualitative Behaviour Assessment of dairy goats in different housing conditions. *Applied Animal Behaviour Science* **180:** 51-57.

Ha D, and Ha J 2017 A subjective domestic cat (Felis silvestris catus) temperament assessment results in six independent dimensions. *Behavioural Processes* **141:** 351-356.

Kaler J, Wassink GJ, and Green LE 2009 The inter- and intra-observer reliability of a locomotion scoring scale for sheep. *The Veterinary Journal* **180:** 189-194.

Konok V, Nagy K, and Miklósi ÁJAABS 2015 How do humans represent the emotions of dogs? The resemblance between the human representation of the canine and the human affective space. *Applied Animal Behaviour Science* **162:** 37-46.

Litchfield CA, Quinton G, Tindle H, Chiera B, Kikillus KH, and Roetman P 2017 The 'Feline Five': An exploration of personality in pet cats (Felis catus). *Plos One* **12:** e0183455.

Manly JFM 2008 *Métodos estatísticos multivariados: uma introdução*. 3ª Edição. Porto Alegre: Bookman

Martin P, and Bateson P 2007 *Measuring behaviour: an introductory guide*. 3ª Edição. Cambridge University Press: Cambridge, UK. 176.

McDowell LJ, Wells DL, Hepper PG, and Dempster M 2016 Lateral Bias and Temperament in the Domestic Cat (Felis silvestris). *Journal of Comparative Psychology* **130:** 313-320.

Miklósi A, Polgárdi R, Topál J, and Csányi V 2000 Intentional behaviour in dog-human communication: an experimental analysis of "showing" behaviour in the dog. *Animal Cognition* **3:** 159-166.

Phythian C, Michalopoulou E, Duncan J, and Wemelsfelder F 2013 Inter-observer reliability of Qualitative Behavioural Assessments of sheep. *Applied Animal Behaviour Science* **144:** 73-79.

Sant'Anna AC, and Paranhos da Costa MJ 2013 Validity and feasibility of qualitative behavior assessment for the evaluation of Nellore cattle temperament. *Livestock Science* **157:** 254-262.

Stockman CA, McGilchrist P, Collins T, Barnes AL, Miller D, Wickham SL, Greenwood PL, Cafe LM, Blache D, and Wemelsfelder F 2012 Qualitative Behavioural Assessment of Angus steers during pre-slaughter handling and relationship with temperament and physiological responses. *Applied Animal Behaviour Science* **142:** 125-133.

Walker JK, Dale AR, D'Eath RB, and Wemelsfelder F 2016 Qualitative Behaviour Assessment of dogs in the shelter and home environment and relationship with quantitative

behaviour assessment and physiological responses. *Applied Animal Behaviour Science* **184:** 97-108.

Wedl M, Bauer B, Gracey D, Grabmayer C, Spielauer E, Day J, and Kotrschal K 2011 Factors influencing the temporal patterns of dyadic behaviours and interactions between domestic cats and their owners. *Behavioural Processes* **86:** 58-67.

Weiss E, Gramann S, Drain N, Dolan E, and Slater M 2015 Modification of the Feline-Ality™ Assessment and the Ability to Predict Adopted Cats' Behaviors in Their New Homes. *Animals* **5:** 71-88.

Wemelsfelder F, Hunter TE, Mendl MT, and Lawrence AB 2001 Assessing the 'whole animal': a free choice profiling approach. *Animal Behaviour* **62:** 209-220.

Wemelsfelder F, and Lawrence AB 2001 Qualitative assessment of animal behaviour as an on-farm welfare-monitoring tool. *Acta Agriculturae Scandinavica, Section A-Animal Science* **51:** 21-25.