Status of Instrument Development in the Field of Human-Animal Interactions & Bonds: Ten Years On

Lauren Samet | ORCID: 0000-0003-3325-6056
Canine Behaviour & Research Department, Dogs Trust,
London, United Kingdom
lauren.samet@dogstrust.org.uk

Helen Vaterlaws-Whiteside | ORCID: 0000-0001-5168-1131
Canine Behaviour & Research Department, Dogs Trust,
London, United Kingdom
hmvaterlaws-whiteside@outlook.com

Melissa Upjohn
Canine Behaviour & Research Department, Dogs Trust,
London, United Kingdom
Corresponding author
melissa.upjohn@dogstrust.org.uk

Rachel Casey | ORCID: 0000-0002-6559-9531
Canine Behaviour & Research Department, Dogs Trust,
London, United Kingdom
rachel.casey@dogstrust.org.uk

Abstract

The multidisciplinary nature of human-(nonhuman) animal interactions (HAI), and global interest in HAI development, has led to an explosion of research in recent years justifying the need to update previous reviews in the subject area. This paper reports the results of a systematic literature review focusing on measures of HAI created in the ten-year period since previous reviews ended (2008). Thirty new HAI questionnaires were identified using two sets of search terms. Results indicated that reliability and validity testing were still not standard within tool creation. Companion animal HAI remained dominant in the instrument field; however, there was continued research

into exotic animal HAI and the initiation of research into therapy and assistance animal HAI. Refinement of terminology and consistent use of definitions could facilitate researchers from various disciplines being able to locate relevant research in future. Similar review updates are recommended for attitudes to animal tools.

Keywords

human-animal interaction – measurement – survey instruments – tools

Human-(non-human) animal interaction (HAI) is a term used to describe an occasion where an animal and human influence each other, for example, communicate with or react to one another (Bokkers, 2006). HAIs can lie anywhere within the spectrum of positive to negative, purposeful to accidental, a one-off or routine, and does not necessarily need to be perceived equally by both parties (Bokkers, 2006).

Previous HAI tool (questionnaire) reviews include Anderson's (2007) *Assessing the Human-Animal Bond: A Compendium of Actual Measures,* and Wilson and Netting's (2012) "The Status of Instrument Development in the Human-Animal Interaction Field," which included Anderson's (2007) work. Wilson and Netting's (2012) systematic literature review documented the existence of 140 instruments up to the year 2009 and is a valuable paper for anyone wishing to begin research and tool design in this subject area.

Findings from Wilson and Netting's (2012) review on what characterizes a good HAI tool are useful for creating better tools. For example, practical HAI tools should have a name and allow access to them for use elsewhere. This sounds obvious but is not always met in tool design. For example, Kurdek (2009) cited the sources that questions were adapted from, but a name and a copy of the final scale and wording used was not provided. It is also likely that some questionnaires are simply not designed as tools for repeated use and therefore are not named further than their descriptions (e.g., Arahori et al., 2017; Pongrácz & Szapu, 2018). Not having access to these basic features limits a tool's development and opportunity for citation and use elsewhere because of the difficulty in finding and using them. Other common features of successful HAI instruments include the identification of their context for use; rarely are questionnaires able to be applied universally without some of the question meanings being lost in translation, which can invalidate data being collected.

Defining context for use allows a tool's construct validity to be maintained (i.e., the degree to which a test measures what it claims, or purports, to be measuring) (Belshaw et al., 2015). Other types of validity testing recommended to

ensure tools are accurate in what they measure include content validity, face validity, and criterion validity (Cronbach & Meehl, 1955). To avoid biasing users, wording in tools should also aim to avoid conjecture or anthropomorphism – unless these factors are under investigation.

Reliability testing is equally important to carry out as it reports the consistency of a measure. Different types exist (e.g., internal consistency, test-retest reliability, and inter- and intra-rater reliability), and it depends on what data are being collected as to which tests are best suited for purpose. (A 2015 paper by Belshaw et al. provided a useful summary of these tests and their importance.) Both validity and reliability testing are advised in tool design to allow authors and others viewing the results to evaluate the quality of data that a questionnaire can collect.

The aim of this systematic literature review was to explore how many new tools had been created in the ten-year period since Wilson and Netting's (2012) review ended (end of 2008) and provide an appendix of new tools in continuation on from the one they presented. It is hoped that providing this information on new tools' forms, functions, validity/reliability evidence, and popularity of use will allow other researchers to easily identify which tools are most efficient for purpose, and which may need development in future work. Due to the large number of tools in existence, regular review of the subject area also allows valuable work to be tracked, traced, and not lost in the ever-increasing field of HAI research.

Methods

To achieve continuity with Wilson and Netting's (2012) work, we used their methods to identify and review HAI tools developed in this field since 2009. However, following completion of the review, three additional tools not captured using Wilson and Netting's (2012) search terms were identified through hand searches in papers. A second systematic literature review was therefore conducted using an updated set of search terms to reflect the changes and advances in the field, in the hope of capturing all new instruments created between 2009 and 2018. Here we present the results of both stages of the systematic review and the instruments identified within the process.

Literature was systematically reviewed according to PRISMA guidelines (Moher et al., 2009). An initial review was conducted using Wilson and Netting's (2012) methodology as a baseline, which had built upon Anderson's (2007) methods. The suitability of search phrases used in the original review were tested using the National Library of Medicine (NLM) PubMed database with Medical Subject Headings (MeSH) terminology. The search term

"Bonding, Human-Pet" (Wilson & Netting, 2012), continued to be a preferred term in the MeSH database over "Animal-Human Bond*" (and "Companion animal," "Human-Pet Bonding," and "Pet-Human Bonding"), meaning it was more likely to be used as a label to identify an article's content theme. The search terms "Animal, Domestic AND Human*," "Object relation AND domestic animal*," and "Animal-assisted therap*" were also preferred terms within the MeSH database in 2019; the latter therefore replacing "Pet Therapy" which was previously used in the Wilson and Netting (2012) review. The databases and journals searched are described in Table 1, alongside the qualifying criteria for a paper's (HAI tool's) eligibility.

TABLE 1   The nine qualifying criteria for screening records during the systematic literature review

Qualifying Criteria for Screening	Justification for Use
1 Published between 01/01/2009 and 01/01/2019.	To allow for an update of the previous review completed up to 31/12/2008.
2 Identified in: Databases: Science Direct, Google Scholar, EThOS and OpenGrey PUBMED, Scopus, ProQuest, PsychINFO, PsychArticles, HABRIcentral, and OpenGrey; or Journals: *Anthrozoös*, *Society & Animals*, and the *Journal of Applied Animal Welfare Science* (JAAWS); or within citation lists of any qualifying papers (backwards from reference lists, and forwards from citing papers). These databases allow review of peer reviewed publications and post graduate research theses, sources considered most reputable for research findings.	Databases commonly used in systematic literature reviews (e.g., Google Scholar, Science Direct) alongside databases specializing in HAI research (e.g., HABRIcentral).
3 Written or translated in English.	Lack of funding for translation services. Only impacted one record which contained a pilot HAI / attitude survey (see Table 2).
4 Tool focuses on human subjects (rather than related to measuring non-human animal behavior).	To review HAI questionnaires only, as per Wilson and Netting (2012).

TABLE 1   The nine qualifying criteria for screening records (*cont.*)

Qualifying Criteria for Screening	Justification for Use
5 Tool measures a specific HAI, i.e., one which had or did exist, rather than general attitude towards non-human animals.	As per Anderson (2007). To ensure that tools reviewed were HAI specific (i.e., focused on "interaction") and not focused on other factors that might only influence HAI.
6 Based on or adapted from empirical data collection.	To avoid use of biased research. As is standard in scientific reviews and as per Wilson and Netting (2012).
7 At least partly based on quantitative methods for data collection (i.e., tools relying solely on qualitative methods or using only semi-structured or observational approaches were excluded).	To specifically review HAI tools as per Wilson and Netting (2012).
8 Was named as an assessment tool and did not just include a one-off question/s on HAI.	To specifically review HAI tools as per Wilson and Netting (2012).
9 Tool is either completely original or contains sections measuring HAI that were original or had originality i.e., had been reworded / adapted using questions from several other surveys (e.g., was not just using sections derived directly from pre-existing surveys).	All original tools should be picked up via the systematic review of literature. Therefore, including studies which incorporated non-original tool/question use would not generate any new data in terms of HAI tools in existence.

We decided to conduct an additional systematic literature review after three peer-reviewed papers were identified which were not found in the original review. The suitability of search phrases was trialed to ensure they captured these additional records and to ensure they reflected recent step changes in approaches to terminology. Search phrases used were: "human-pet" or "companion animal" or "pet-human" or "human-animal" or "pet owner," alongside "bond*" or "interact*" or "relation*" or "attach*".

Ethical Approval

Research was given ethical approval by Dogs Trust Ethical Review Board – ERB007.

Results

Unconventionally, it was decided to use both sets of results in the review as each revealed original HAI tools that the other did not. (The first search based on Wilson and Netting's [2012] search terms identified 12 tools that the second search terms did not, while the second search revealed six tools that the first did not.) Thirty original tools were identified using both systematic literature review search methods (Appendix 1[1]). The number of records identified by both methods at various stages of the systematic literature review are summated and shown in Figure 1. Appendix 1 lists all the original questionnaires identified during both searches, alongside what they measured, information on their structure, details of validity and reliability testing (if present), and the original source in which they were published. Table 2 shows the five records for which full access was unavailable due to a paywall, language barrier, and/or failure to obtain via contacting authors or institutions privately.

The 30 HAI questionnaires identified ranged in purpose from measuring human-animal attachment (and attachment types), relationships, bonds, compatibility, parenting styles, empathy, social support, interaction types, willingness to makes sacrifices, and willingness for self-disclosure with a companion animal. The majority of questionnaires (22) were targeted at companion animal species, eight of which focused on dogs, and three on cats. Two questionnaires focused on horses, which may or may not be counted as companion animals, however, since, in the context of these HAI studies (Dinges, 2015; Sloan-Brown, 2013), they were categorized as therapy animals. Only one of the tools designed for dog HAI measurement was specifically focused on service dogs (Fratkin, 2015), but this was examining relationships between puppy-raisers and guide dogs-in-training, so was not strictly looking at working relationships.

Some of the questionnaires explored companion animals as "safe havens" (Kurdek, 2009) or as providing some sort of emotional support in the context of a companion animal rather than a service animal (e.g., for assistance or therapy). Six questionnaires focused on zoo animals' relationships with keepers, all of which were designed for use with multiple animal species. One

---

1   Appendix 1 is freely available on the external website ResearchGate: https://rb.gy/8oakn7.
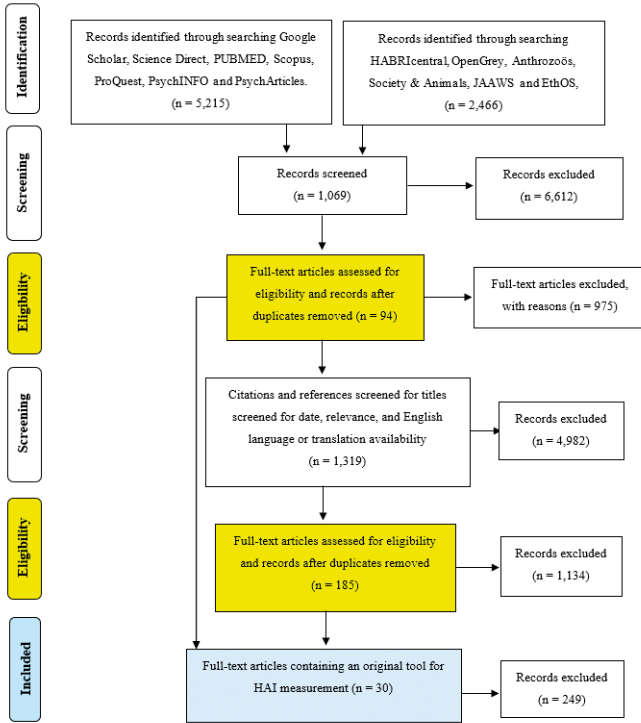
FIGURE 1   Total records identified through the systematic review
using two separate sets of search terms
Note: The first set of terms was based on Wilson and
Netting's (2012) review and included "Bonding, Human-
Pet," "Animal, Domestic AND Humans," "Animal-assisted
therapy," and "Object relation AND domestic animal";
the second set being "human-pet" or "companion
animal" or "pet-human" or "human-animal" or "pet
owner", alongside "bond*" or "interact*" or "relation*" or
"attach*." The records identified were then screened for
eligibility using criteria in Table 1.

questionnaire was designed for generic HAI measurement and was presumably for use in any species.

Of the 30 papers containing the tools identified, 19 reported internal consistency reliability testing; the most common test being Cronbach's alpha, which was employed 15 times. Principal component analysis (PCA) was also commonly reported (12 studies) often alongside Cronbach's alpha (in 9 studies). Only four papers mentioned test-retest reliability measures alongside tests for internal consistency. Eleven papers mentioned no form of reliability testing.

TABLE 2   Systematic literature review records for which full access was unavailable*

Record	Source	Relevant Notes
Murrow (2013).	ProQuest.	Abstract mentions use of behavioral tests and the Devereux Student Strengths Assessment (DESSA), indication that it is unlikely to include an original HAI tool.
Salgırlı, Emre, Beşgül, Öztürk, and Sagmanlıgıl (2012).	*Ankara Üniversitesi Veteriner Fakültesi Dergisi*	Published in Turkish (available here: http://vetjournal.ankara.edu.tr/en/download/article-file/698429). English abstract suggests the pilot questionnaire is based around dog guardian knowledge and attitude towards their dog/s.
Michalopoulos (2017).	ProQuest	Abstract states data were collected utilizing an online self-report survey and indicates attachment style exploration; however, details of the survey questions were not provided.
Siess (2018).	ProQuest	Abstract indicates survey includes questions on the amount of comfort participants receive from their companion animals. Unclear whether it is Zasloff's CCAS (1996) used or an original tool.
Bulgakova, Burgos, Calvo, Bowen, and Fatjó (2017).	HABRICentral (Conference Proceedings)	From Proceedings of the 11th International Veterinary Behaviour Meeting, 14–16th September 2017, Samorin, Slovakia. Abstracts unavailable.

Note: *Unavailable due to a paywall, use of non-English language, or failure to obtain access privately via contacting authors.

Twenty papers mentioned no form of validity testing other than face validity based on similarity to a previous tool, or content validity based on literature review and expert consultation (it was assumed most questionnaires had some type of face or content validity, when based on or informed by previous research or established tools purporting to measure similar constructs). The most popular form of validity testing was convergent validity testing (used in 6 of the 10 papers that validity tested) and was often used alongside construct validity testing. However, some appeared to use this terminology interchangeably with criterion testing. Use of exploratory factor analysis (5/10),

confirmatory factor analysis (2/10) and divergent validity testing (2/10) were also cited in the studies. Eight studies used a form of both reliability and validity testing (other than face validity).

The Companion Animal Bonding Scale (CABS; Poresky et al., 1987), Lexington Attachment Scale (LAPS; Johnson et al., 1992), Comfort from Companion Animals Scale (CCAS; Zasloff, 1996), Companion Animal Semantic Differential (CASD; Poresky et al., 1988), and Pet Attachment Questionnaire (PAQ; Zilcha-Mano et al., 2011) were cited as comparative tools used when criterion testing appeared. The eight tools that used both validity (other than face or content) and reliability testing in their design were: a) the Assessment of Dog Owners' Behaviours & Experiences – Version 1 (ADOBE-1) scale; b) Behaviours Indicative of Attachment with Pets Scale (BIAPS); c) Emotional and Supportive Attachment to Companion Animals Scale (ESACA); d) Horse Bonding Scale (HBS); e) Human-Animal Interaction Scale (HAIS); f) Pet Dogs as Attachment Figures & Safe Havens in Young Adults Questionnaire; g) Relationship Questionnaire; and h) The Short Attachment to Pets Scale (SAPS) for children and young people (see Appendix 1 for full details).

Nine of the 30 tools had been published in *Anthrozoös*, while others were published in journals on topics ranging from behavior and veterinary science, child development, personality, and zoo biology. There were also five tools that were developed by post-graduate student research and published with open access online as doctoral or MSc theses. Five of the 30 tools identified in the reviews had been used in subsequent peer reviewed, published studies.

Discussion

The context for many of the most recent HAI measures comes from companion animals (including horses but mainly dogs and cats) and zoo animals, for which research into keeper bonds with animals is growing. It is of note that within this review, few tools were designed for HAI measurement in service, assistance, or working animal-human dyads, outside of equine therapy and puppy-raisers for guide dogs-in-training. It is debatable whether zookeepers training animals for displays can be counted as working partnerships because training is often considered part of an enrichment program within the animal's husbandry routines (Melfi, 2013).

Due to the size and scope of this field and the range of roles working animals play in modern society (e.g., detection, assistance, therapy, herding, hunting) the lack of focused exploration that has taken place thus far is surprising and lends itself well as an important topic for future research to address. The

same can be said for species-specific tools; companion animals appear to be well represented in tools but the variety of species that can be categorized as a modern companion animal or "pet" is no longer restricted to just mammals. Companion animals may include birds, fish, and reptiles alongside less domesticated mammalian species that may also be classed as exotic (e.g., sugar gliders and chinchillas). These species may need tailored questionnaires that have been validated and reliability tested for that species to ensure they are meeting their intended purpose. It is surprising that questionnaires for rabbit-based HAIs have not yet been explored considering that they are the UK's third-most popular mammalian companion animal (Pet Food Manufacturing Association, 2019). Exploration of less traditional or less common species-specific HAIs could allow greater learning on what animal attributes create a bond or relationship by identifying more of those species that do not do so as readily (which may be why they have not yet been studied).

The use of reliable and valid measures of HAI is of utmost importance in questionnaire design (Grinnel, 1997). Face, content, criterion, and construct validity are important in development (Grinnel, 1997; Wilson & Netting, 2012). The majority of questionnaires found in this review obtained a logical sample of questions from the abundance of potential items via good judgement and a strong knowledge of the field (a form of content validity) and measured what they purported to from the perception of both the designers and the respondents (face validity). However, the incorporation of criterion validity and construct validity was less common.

Assessment of construct validity could theoretically prove difficult because HAIs are complex, two-way, multi-factorial, and often contextual events, and to assess the meaningfulness of this from a single questionnaire can be problematic. This is further complicated by the variation in terms and definitions used to describe HAIs. For example, many tools stating they measure the human-animal bond (HAB) tended to focus on human-centric questions. However, without questions representing the animal's investment in said HAB, there is risk of only measuring human attachment (attachment being unidirectional and therefore different to a bond). Terminology and definitions within HAI do not always make this distinction in these relationships clear. For example, Johnson et al. (1992) defined a HAB as "an emotional attachment between an owner and their pet" (p. 160) and therefore risked the loss of construct validity. A single set of universal terms and definitions are yet to be agreed upon but would be highly valuable in future tool design and HAI research.

Payne et al. (2015) recognized the often-overlooked animal representation within HAB tool questions. They suggested tools that were able to tease apart the underpinnings of an HAI could increase the understanding of the animals'

perspective of the associated human. This may involve the use of new questions that objectively address how an animal behaves or responds to a person in different HAI situations. This is important when studying HAI due to the associated implications for animals' welfare and wellbeing in their relationships with humans. If HAI focus is solely on the human experience, then it is failing to engage with the animal half of the interaction.

Questionnaire designers need to be sensitive to cultural differences and terminology use that may compromise the validity and reliability of a HAI questionnaire for universal use. The same could be said for the use of one HAI questionnaire across different species, or the same species used for different purposes. Validity and reliability testing, and improving tools to increase their validity/reliability, could assist instrument inclusivity if designed and tested for widespread use across cultures, across species, and across industries. Repeat tool testing in new research or for new populations should be commonplace and encouraged by peer reviewers to ensure data quality remains high. This tended to fall by the wayside in some of the tools reviewed here if previously validity/reliability tests had been carried out.

Validity and reliability testing took different forms but were still not consistently used for new tools created since the start of 2009, even after Wilson and Netting (2012) highlighting this issue nearly a decade earlier. Part of the reason for this may be time constraints and a researcher's need for a "quick and dirty" analysis of a research topic. In these cases, it would be advised – where possible – not to reinvent the wheel, but to use a previously established questionnaire instead. There is still further scope for increased reliability and validity testing in the design and use of new HAI tools, which should continue to be implemented to ensure strong data. Many tools relied too heavily on face and content validity over construct and criterion validity testing. Similarly, although internal consistency measures were included in over 50% of new tools, inter- and intra-rater measures were lacking. Language used was important; occasionally the terminology chosen, or explanations of reliability/validity testing, led to difficulty in determining which type of validity or reliability characteristics were being tested. For example, criterion validity was occasionally classed as construct validity, possibly due to criterion-related validity being the examination of whether a tool behaves as per the theory of its construct. To confuse matters further, criterion validity was sometimes referred to as concurrent validity (Cronbach & Meehl, 1955), demonstrating the minefield of this subject area.

Only five of the 30 HAI tools identified had been used in further peer-reviewed studies. These tended to be by original authors who continued the tool's development to refine, validate, or evolve it further. This finding, alongside anecdotal

observation, suggested that many modern HAI studies still turn to classic HAI tools (e.g., the Lexington Attachment to Pets Scale). However, this highlights the need for the continued validity and reliability testing of these original tools over time as cultures and terminology evolve within the same population. New terms, for example, "fur baby" (see Greenebaum, 2004), are being coined, in part reflecting the cultural shift in the importance of some people's relationships with their companion animals. For instance, in November 2009, the UK's internet search interest for the phrase "fur baby" was one-fourth as popular as in November 2017, when the term reached peak popularity according to Google Trends (2019). This illustrates how tools may become outdated if not kept up to date in phrasing and language use. Continued review and development of established tools is vital as the number of different HAI approaches increases (Wilson & Netting, 2012). Equally, there is also risk of those not cited regularly becoming lost in the field, despite potentially harboring promising ideas for question content and fresh approaches to construct design.

This review highlighted that many HAI scales were not created or used in isolation but in conjunction with other scales and questionnaires to ascertain human-animal attachment levels or emotional investment levels. These included the Animal Empathy Scale (Paul, 2000), the Rusbult Investment Model (Rusbult et al., 1998), the Network of Relationships Inventory (NRI; Furman & Burmheister, 2009), Attachment Style Questionnaire (ASQ; Feeney et al., 1994), the Stuffed Animal Attachment Questionnaire (Cromer & Freyd, 2004), the Multi-Dimensional Support Scale (MDSS; Winefield et al., 1992), and the Observation Coding Tool for Human-Animal Interaction Research (OHAIRE; Guérin et al., 2018). Personality tests including the NEO-5 factor Inventory (Costa & McCrae, 2009), Inventory of Parent and Peer Attachment (IPPA; Armsden & Greenberg, 1987), and the Dog Big Five Inventory (Konok et al., 2015) were also used. Some of these co-measures were used to help validate HAI tool findings, while some allowed further insight into reasoning behind the findings from the HAI questionnaires.

Limitations

Any tools published after the 1st of January 2019 were not included in the search criteria. Searches were limited to records that met criteria stated in Table 1 (based upon Anderson [2007] and Wilson and Netting's [2012] original reviews). Due to the number of search results generated, it was necessary to have a strict eligibility criterion and search strategy. Budget constraints meant that sources such as postgraduate student theses, which required payment to access (n = 3), were not included in the review. The five tools for which access

could not be gained are shown in Table 2. Information from their abstracts suggested that the majority were unlikely to include novel tools, but this cannot be confirmed for certain without viewing the records in their entirety.

The range of search terms needed to identify relevant papers in this review highlighted the variation in terminology and methodology in instruments that measure HAI. Greater consistency in terminology may enable the separation of HAI measures into subcategories rather than grouping them all together, which could benefit future reviews and save time.

In this paper, different search terms were used across databases and journal sources to ensure identification of the maximum number of papers. As illustrated by finding different papers across two searches, it currently remains difficult to identify all relevant resources using one set of search terms. As Wilson and Netting (2012) observed, it remains challenging to determine which papers included a HAI measurement questionnaire from the title or abstract, without detailed evaluation of papers. Better definition of terms, rationale, populations, and context for questionnaire use by authors could help researchers identify appropriate resources more easily.

Other available indirect measures of HAI (realized and unrealized; for example, human empathy scales, personality traits, compassion, humaneness, and anthropomorphism measures) may also be worthy of separate review for consideration in new instrument designs. Searches we employed here picked up on some of the attitude assessment tools available, including the Emotion Reporting Questionnaire (ERQ) and Emotional Behaviour Questionnaires (EBQ; Konok et al., 2015); the Brief Measures of the Animal Attitude Scale (ASS-10 and AAS-5; Herzog et al., 2015), and the Coleman Dog Attitude Scale (CDAS; Coleman et al., 2016), and identified some records of qualitative measures of HAI assessment too. Anderson (2007) estimated that 40 percent of human-animal studies were focused on attitudes towards animals, including large literature reviews of animal attitude scales (Herzog & Dorr, 2000; Wilson & Netting, 2012). For this reason, Anderson (2007) did not include these types of tools in his review and nor did we here, highlighting a difference in our continued review from that of Wilson and Netting's (2012). However, we feel this amount of literature warrants separate review and recommend that a future review focuses specifically on measures of attitude toward animals using a tailored set of search terms for this purpose.

The screening criteria selected placed focus on novel and original tools (see Table 1, Criteria 9); however, this meant some named tools such as the Pet Attachment and Life-Impact Questionnaire (PALS; DeMarni et al., 2013), the Pet Perks Survey (Word, 2012), and Mueller's (2014) study, which consisted

of questions from a number of other HAI surveys, were not included in this review even though they were cited as tools in their own right elsewhere (e.g., Volsche & Gray [2016] cited PALS).

Conclusion

The HAI measurement field continues to expand into new territories and across animal industries. The increase in the number of studies examining HAI since the end of 2008 demonstrates the continued research appetite for better and new measures of HAI; especially in those fields for which tools are lacking (e.g., assistance and therapy animals). The shift in terminology used across various industries, and across and within various species over time, poses a challenge for future HAI reviews but also underlines the necessity for regular field reviews to assist future research. The inconsistent use of terminology and definitions of key terms (Hosey & Melfi, 2014; Wilson & Netting, 2012) can also threaten face and construct validity when questionnaires are used in different contexts. As the HAI field continues to develop, it could be helpful to achieve consensus on types or subcategories of interactions, and the factors which may influence them. Finally, appropriate and continued validity and reliability testing is essential in future research and tool use, even when reusing previously validated questionnaires, or parts of them. We recognize that many questionnaires are developed to gather data for a specific purpose in specific circumstances and not all are expected to go on and be used as failproof tools. However, refining HAI tool development in this way could help with the evolution and efficiency of new approaches in HAI investigation.

Conflicts of Interest

In accordance with Taylor & Francis policy and my ethical obligation as a researcher, I can report there are no conflicts of interest relating to this study.

References

American Veterinary Medical Association (2019). *Human-animal bond*. Retrieved October 19, 2019, from https://www.avma.org/KB/Resources/Reference/human -animal-bond/Pages/Human-Animal-Bond-AVMA.aspx.

Anderson, D. (2007). *Assessing the human-animal bond: A compendium of actual measures*. Purdue University Press.

Angle, R. L. (1994). *Utilization of the pet bonding scale to examine the relation between the human/companion animal bond and self-esteem in preadolescence* (Publication No. 9507546) [Doctoral thesis, University of Houston, Texas]. ProQuest Dissertations Publishing. https://search.proquest.com/docview/304122004.

Aragunde-Kohl, U., Gómez-Galán, J., Lázaro-Pérez, C., & Martínez-López, J. Á. (2020). Interaction and emotional connection with pets: A descriptive analysis from Puerto Rico. *Animals, 10*(*11*)*, 2136*. http://doi.org/10.3390/ani10112136.

Arahori, M., Kuroshima, H., Hori, Y., Takagi, S., Chijiiwa, H., & Fujita, K. (2017). Owners' view of their pets' emotions, intellect, and mutual relationship: cats and dogs compared. *Behavioural Processes*, *141*, 316–321. https://doi.org/10.1016/j.beproc.2017.02.007.

Armsden, G. C., & Greenberg, M. T. (1987). The inventory of parent and peer attachment: relationships to well-being in adolescence. *Journal of Youth and Adolescence, 16*(5), 427–454. https://link.springer.com/article/10.1007/BF02202939.

Bartlett, M. S. (1950). Tests of significance in factor analysis. *British Journal of Statistical Psychology*, *3*(2), 77–85. https://doi.org/10.1111/j.2044-8317.1950.tb00285.x.

Bayne, K. (2002). Development of the human-research animal bond and its impact on animal well-being. *Institute for Laboratory Animal Research Journal*, *43*(1), 4–9. https://doi.org/10.1093/ilar.43.1.4.

Beck, A. M. (1999). Companion animals and their companions: Sharing a strategy for survival. *Bulletin Science, Technology & Society, 19*(4), 281–285. https://doi.org/10.1177/027046769901900404.

Belshaw, Z., Asher, L., Harvey, N. D., & Dean, R. S. (2015). Quality of life assessment in domestic dogs: An evidence-based rapid review. *The Veterinary Journal, 206*(2), 203–212. https://doi.org/10.1016/j.tvjl.2015.07.016.

Bokkers, E. A. (2006). Effects of interactions between humans and domesticated animals. In: J. Hassink, & M. van Dijk (Eds.), *Farming for health* (pp. 31–41). Springer. https://doi.org/10.1007/1-4020-4541-7_3.

Bowlby, J. (1969). *Attachment and loss: Volume 1, Attachment*. The Hogarth Press and the Institute of Psycho-Analysis.

Bowlby, J. (1977). The making and breaking of affectional bonds: 1. Aetiology and psychopathology in the light of attachment theory. *The British Journal of Psychiatry, 130*, 201–210. https://doi.org/10.1192/bjp.130.3.201.

Boyce, P. & Parker, G. (1989). Development of a scale to measure interpersonal sensitivity. *Australian and New Zealand Journal of Psychiatry, 23*, 341–351. https://doi.org/10.3109/00048678909068294.

Boyraz, G., & Bricker, M. E. (2011). Pet loss and grief: An integrative perspective. In C. Blazina, G. Boyraz, & D. Shen-Miller (Eds.), *The psychology of the human-animal bond: A resource for clinicians and researchers* (pp. 383–401). Springer Science. https://doi.org/10.1007/978-1-4419-9761-6_22.

Brennan, K. A., Clark, C. L., & Shaver, P. R. (1998). Self-report measurement of adult attachment: An integrative overview. In J. A. Simpson & W. S. Rholes (Eds.), *Attachment theory and close relationships* (pp. 46–76). Guilford Press. https://psycnet.apa.org/record/1997-36873-002?source=post_page.

Brown, S. E. (2007). Companion animals as self-objects. *Anthrozoös*, *20*(4), 329–343. https://doi.org/10.2752/089279307X245654.

Brown, O. K., & Symons, D. K. (2016). "My pet has passed": Relations of adult attachment styles and current feelings of grief and trauma after the event. *Death Studies*, *40*(4), 247–255. http://doi.org/10.1080/07481187.2015.1128499.

Bulgakova, N., Burgos, S., Calvo, P., Bowen, J., Fatjó, J. (2017, September 14–16). Relationship among cat-owner bond, cat behavior problems and cat environment conditions: a study with 1553 Spanish cat owners. *Proceedings of the 11th International Veterinary Behaviour Meeting*, Samorin, Slovakia. http://dx.doi.org/10.1079/9781786394583.0000.

Claxton, A. M. (2011). The potential of the human-animal relationship as an environmental enrichment for the welfare of zoo-housed animals. *Applied Animal Behaviour Science*, *133*(1–2), 1–10. https://doi.org/10.1016/j.applanim.2011.03.002.

Coleman, J. A., Green, B., Garthe, R. C., Worthington Jr, E. L., Barker, S. B., & Ingram, K. M. (2016). The Coleman dog attitude scale (C-DAS): Development, refinement, validation, and reliability. *Applied Animal Behaviour Science*, *176*, 77–86. https://doi.org/10.1016/j.applanim.2016.01.003.

Collins, N. L., & Read, S. J. (1990). Adult attachment, working models, and relationship quality in dating couples. *Journal of Personality and Social Psychology*, *58*(4), 644–663. https://doi.org/10.1037/0022-3514.58.4.644.

Costa, P. T. & Jr, McCrae, R. R. (2009). The five-factor model and the NEO inventories. In J. N. Butcher (Ed.), *Oxford handbook of personality assessment* (pp. 299–322). Oxford University Press. https://doi.org/10.1093/oxfordhb/9780195366877.013.0016.

Cromer, L. D., & Freyd, J. J. (2004, February 12–16). *Stuffed animals, pets, and dissociation* [Poster presentation]. American Association for the Advancement of Science Annual Conference, Seattle, WA.

Cronbach, L. J., & Meehl, P. E. (1955). Construct validity in psychological tests. *Psychological Bulletin, 52*(4), 281.

DeMarni Cromer, L., & Barlow, M. R. (2013). Factors and convergent validity of the pet attachment and life impact scale (PALS)". *Human-Animal Interaction Bulletin, 1*(2), 34–56. https://scholarworks.boisestate.edu/psych_facpubs/190/.

Doherty, N. A., & Feeney, J. A. (2004). The composition of attachment networks throughout the adult years. *Personal Relationships*, *11*, 469–488. https://doi.org/10.1111/j.1475-6811.2004.00093.x.

Feeney, J. A., Noller, P., & Hanrahan, M. (1994). Assessing adult attachment. In M. B. Sperling & W. H. Berman (Eds.), *Attachment in adults: Clinical and developmental perspectives* (pp. 128–152). Guilford Press. https://psycnet.apa.org/record/1994-98431-004.

Field, N. P., Orsini, L., Gavish, R., & Packman, W. (2009). Role of attachment in response to pet loss. *Death Studies*, *33*(4), 334–355. https://www.tandfonline.com/doi/abs/10.1080/07481180802705783.

Fine, A. H., & Beck, A. M. (2015). Understanding our kinship with animals: Input for health care professionals interested in the human-animal bond. In A., H., Fine (Ed.), *Handbook on animal-assisted therapy: Foundations and guidelines for animal-assisted interventions* (4th ed., pp. 3–10). Elsevier Academic Press. https://doi.org/10.1016/B978-0-12-801292-5.00001-8.

Fournier, A. K., Berry, T. D., Letson, E., & Chanen, R. (2016). The human-animal interaction scale: Development and evaluation. *Anthrozoös*, *29*(3), 455–467. https://doi.org/10.1080/08927936.2016.1181372.

Furman, W. & Buhrmester, D. (2009). Methods and measures: The network of relationships inventory: Behavioral systems version. *International Journal of Behavioral Development*, *33*, 470–478. https://doi.org/10.1177/0165025409342634.

Google Trends (2019). *Search term: Fur baby* (*United Kingdom*). Retrieved December 20, 2019, from https://trends.google.com/trends/explore?date=2009-01-01%202019-12-20&geo=GB&q=fur%20baby.

Greenebaum, J. (2004). It's a dog's life: Elevating status from pet to "fur baby" at yappy hour. *Society & Animals*, *12*(2), 117–135. https://doi.org/10.1163/1568530041446544.

Grinnell, R. M. (1997). *Social work research and evaluation* (3rd ed.). F. E. Peacock Publishers Inc. https://scholarworks.wmich.edu/books/306.

Guérin, N. A., (2017). *Psychometrics properties and use of a behavioral observation coding tool for human-animal interaction research* (Publication No. 10608361) [Master's thesis, Purdue University, Australia]. Purdue e-Pubs. https://docs.lib.purdue.edu/dissertations/AAI10608361/.

Guérin, N. A., Gabriels, R. L., Germone, M. M., Schuck, S. E. B., Traynor, A., Thomas, K. M., McKenzie, S. J., Slaughter, V., & O'Haire, M. E. (2018). Reliability and validity assessment of the observation of human-animal interaction for research (OHAIRE) behavior coding tool. *Frontiers in Veterinary Science*, *5*, 268. https://doi.org/10.3389/fvets.2018.00268.

Harb, G. C., Heimberg, R. G., Fresco, D. M., Schneier, F. R. & Leibowitz, M. R. (2002). The psychometric properties of the interpersonal sensitivity measure in social anxiety disorder. *Behaviour Research and Therapy, 40*, 961–979. https://doi.org/10.1016/S0005-7967(01)00125-5.

Hartmann, M., & Walter, H. (2009). Konnen (Heim) Tiere die Funktion eines Selbstobjekts ubernehmen? *Self psychology: European Journal for Psychoanalytical Therapy and Research, 38*, 365–388. https://habricentral.org/resources/23961.

Hawkins, R., & Williams, J. (2017). Childhood attachment to pets: Associations between pet attachment, attitudes to animals, compassion, and humane behaviour. *International Journal of Environmental Research and Public Health*, *14*(5), 490. 10.3390/ijerph14050490.

Hawkins, R. D., & Williams, J. M. (2016). Children's beliefs about animal minds (Child-BAM): Associations with positive and negative child-animal interactions. *Anthrozoös*, *29*(3), 503–519. https://doi.org/10.1080/08927936.2016.1189749.

Hemsworth, P. H. (2003). Human-animal interactions in livestock production. *Applied Animal Behaviour Science*, *81*, 185–198. https://doi.org/10.1016/S0168-1591(02)00280-0.

Herzog, H., & Dorr, L. (2000). Electronically available surveys of attitudes toward animals. *Society & Animals*, *8*(2), 183–190. https://doi.org/10.1163/156853000511078.

Herzog, H., Grayson, S., & McCord, D. (2015). Brief measures of the animal attitude scale. *Anthrozoös*, *28*(1), 145–152. https://doi.org/10.2752/089279315X14129350721894.

Hinde, R. A. (1976). On describing relationships. *Journal of Child Psychology and Psychiatry*, *17*(1), 1–19. https://doi.org/10.1111/j.1469-7610.1976.tb00370.x.

Hosey, G. (2008). A preliminary model of human-animal relationships in the zoo. *Applied Animal Behaviour Science*, *109*(2–4), 105–127. https://doi.org/10.1016/j.applanim.2007.04.013.

Hosey, G. & Melfi, V. (2014). Human-animal interactions, relationships and bonds: a review and analysis of the literature. *International Journal of Comparative Psychology*, *27*(1), 117–142. https://psycnet.apa.org/record/2014-07616-008.

Hsu, Y., & Serpell, J. A. (2003). Development and validation of a questionnaire for measuring behavior and temperament traits in pet dogs. *Journal of the American Veterinary Medical Association*, *223*(9), 1293–1300. https://doi.org/10.2460/javma.2003.223.1293.

John, O. P., & Srivastava, S. (1999). The Big Five Trait taxonomy: History, measurement, and theoretical perspectives. In L. A. Pervin & O. P. John (Eds.), *Handbook of personality: Theory and research* (pp. 102–138). Guilford Press. http://t.personality-project.org/revelle/syllabi/classreadings/john.pdf.

Johnson, T. P., Garrity, T. F., & Stallones, L., (1992). Psychometric evaluation of the Lexington Attachment to Pets Scale (LAPS). *Anthrozoös*, *5*(3), 160–175. https://doi.org/10.2752/089279392787011395.

Kim, J. O., & Mueller, C. W. (1978). Factor analysis: Statistical methods and practical issues. In E. Uslaner (Ed.), *Series: Quantitative applications in the social sciences* (pp. 7–82). Sage Publications. https://dx.doi.org/10.4135/9781412984256.n7.

Aragunde-Kohl, U., Gómez-Galán, J., Lázaro-Pérez, C., & Martínez-López, J. Á. (2020). Interaction and emotional connection with pets: A descriptive analysis from Puerto Rico. *Animals*, *10*(11), 2136. https://doi.org/10.3390/ani10112136.

Konok, V., Kosztolányi, A., Rainer, W., Mutschler, B., Halsband, U., & Miklósi, Á. (2015). Influence of owners' attachment style and personality on their dogs' (*Canis familiaris*) separation-related disorder. *PLoS One*, *10*(2), e0118375. https://doi.org/10.1371/journal.pone.0118375.

Langston, S. C. (2014). *Understanding and quantifying the roles of perceived social support, pet attachment, and adult attachment in adult pet owners' sense of well-being* (2376/5158) [Doctoral thesis, Washington State University]. WSU Research Exchange. http://hdl.handle.net/2376/5158.

Massie, H. N. & Campbell, B. K. (1983). The Massie-Campbell scale of mother-infant attachment indicators during stress. In J. Call, E. Galenson, & R. Tyson (Eds.), *Frontiers of infant psychiatry* (pp. 394–412). Basic Books. https://doi.org/10.1007/s10826-013-9728-z.

Meehan, M., Massavelli, B., & Pachana, N. (2017). Using attachment theory and social support theory to examine and measure pets as sources of social support and attachment figures. *Anthrozoös*, *30*(2), 273–289. https://doi.org/10.1080/08927936.2017.1311050.

Mehrabian, A., & Epstein, N. (1972). A measure of emotional empathy. *Journal of Personality*, *40*(4), 525–543. https://doi.org/10.1111/j.1467-6494.1972.tb00078.x.

Melfi, V. (2013). Is training zoo animals enriching? *Applied Animal Behaviour Science*, *147*(3–4), 299–305. https://doi.org/10.1016/j.applanim.2013.04.011.

Michalopoulos, K. (2017). *Dog ownership, attachment and overall wellbeing among young adults* (Publication No. 10157424) [Doctoral thesis, Alliant International University]. ProQuest Dissertations Publishing.

Moher, D., Liberati, A., Tetzlaff, J., Altman, D. G., The PRISMA Group (2009). Preferred reporting items for systematic reviews and meta-analyses: The PRISMA statement. *PLoS Medicine 6*(7), e1000097. https://doi.org/10.1371/journal.pmed.1000097.

Mueller, M. (2014). The relationship between types of human-animal interaction and attitudes about animals: An exploratory study. *Anthrozoös 27*(2), 295–308. https://doi:10.2752/175303714X13903827487728.

Muldoon, J. C., Williams, J. M., & Currie, C. (2019). Differences in boys' and girls' attachment to pets in early-mid adolescence. *Journal of Applied Developmental Psychology*, *62*, 50–58. https://doi.org/10.1016/j.appdev.2018.12.002.

Murrow, B. L. (2013). *A quantitative exploration into the effects of the human and animal connection* (Publication No. 3597045) [Doctoral dissertation, Pacifica Graduate Institute]. ProQuest Dissertations Publishing. https://www.proquest.com/docview/1449406471.

Noonan, E. (2008). People and pets. *Psychodynamic Practice*, *14*(4), 395–407. https://doi.org/10.1080/14753630802492722.

O'Haire, M. E., Bibbo, J., Mueller, M. K., Ng, Z. Y., Buechner-Maxwell, V. A., & Hoffman, C. F. (2018). Overview of centers and institutes for human-animal interaction in the United States. *Human-Animal Interaction Bulletin*, *6*, 3–22. https://vet.purdue.edu/chab/ohaire/files/documents/HAI_2018_HAIB_OHaire2.pdf.

Paul, E. S. (2000). Empathy with animals and with humans: Are they linked? *Anthrozoös*, *13*(4), 194–202. https://doi.org/10.2752/089279300786999699.

Paul, E. S., & Serpell, A. (1993). Childhood pet keeping and humane attitudes in young adulthood. *Animal Welfare*, *2*, 321–337. https://www.researchgate.net/publication/233633883_Childhood_Pet_Keeping_and_Humane_Attitudes_in_Young_Adulthood.

Payne, E., Bennett, P. C., & McGreevy, P. D. (2015). Current perspectives on attachment and bonding in the dog – human dyad. *Psychology Research and Behavior Management*, *8*, 71–79. https://doi.org/10.2147/PRBM.S74972.

People's Dispensary for Sick Animals (2011). PDSA *Animal Wellbeing* (PAW) *report* (*2011*). Retrieved November 13, 2019, from http://www.pdsa.org.uk/pet-health-advice/pdsa -animal-wellbeing-report.

Pet Food Manufacturing Association (2019). *Pet population 2019.* Retrieved December 12, 2019, from https://www.pfma.org.uk/pet-population-2019.

Plutchik, R. (1980). *Emotion: A psychoevolutionary synthesis*. Harper & Row.

Plutchik, R., & Kellerman, H. (1974). *Manual of the emotions profile index*. Western Psychological Services.

Poresky, R. H., Hendrix, C., Mosier, J. E., & Samuelson, M. L. (1987). The companion animal bonding scale: Internal reliability and construct validity. *Psychological Reports*, *60*(3), 743–746. https://doi.org/10.2466/pr0.1987.60.3.743.

Poresky, R. H., Hendrix, C., Mosier, J. E., & Samuelson, M. L. (1988). The companion animal semantic differential: Long and short form reliability and validity. *Educational and Psychological Measurement*, *48*(1), 255–260. https://doi.org/10.1177/00131644 8804800131.

Robinson, C. C., Mandleco, B., Olsen, S. F., & Hart, C. H. (1995). Authoritative, authoritarian, and permissive parenting practices: Development of a new measure. *Psychological Reports*, *77*(3), 819–830. https://doi.org/10.2466/pr0.1995.77.3.819.

Rusbult, C. E., Martz, J. M., & Agnew, C. R. (1998). The investment model scale: Measuring commitment level, satisfaction level, quality of alternatives, and investment size. *Personal Relationships*, *5*(4), 357–387. https://doi.org/10.1111/j.1475-6811.1998.tb00177.x.

Ryan, R. M., La Guardia, J. G., Solky-Butzel, J., Chirkov, V., & Kim, Y. (2005). On the interpersonal regulation of emotions: Emotional reliance across gender, relationships, and cultures. *Personal Relationships*, *12*, 145–163. https://doi.org/10.1111/j.1350-4126 .2005.00106.x.

Salgırlı, Y., Emre, B., Beşgül, K., Öztürk, H., Sagmanlıgıl, V. (2012). A pilot study on assessment of dog owners' attitude towards their dogs. *Ankara Üniversitesi Veteriner Fakültesi Dergisi, 59*(1), 11–15. http://DOI:10.1501/Vetfak_0000002494.

Schuman, H., & Presser, S. (1996). *Questions and answers in attitude surveys: Experiments on question form, wording, and context*. Sage Publications.

Siess, S. (2018). *Optimistic bias, bondedness to companion animals, and satisfaction with providers: Predictors of treatment decisions for companion animals with severe cardiac disease* (Publication No. 10823237). [Doctoral dissertation, State University of New York at Stony Brook], ProQuest Dissertations Publishing. https://search.proquest .com/openview/a4a2d0bf76dcc2cd20bec56c4f42c089/1?pq-origsite=gscholar&cbl =18750&diss=y.

Serpell, J. A. (1996). Evidence for an association between pet behaviour and owner attachment levels. *Applied Animal Behaviour Science 47*, 49–60. https://doi.org /10.1016/0168-1591(95)01010-6.

Snell, W. E., Miller, R. S., & Belk, S. S. (1988). Development of the emotional self-disclosure scale. *Sex Roles, 18*(1–2), 59–73. https://doi.org/10.1007%2FBF00288017.

Society for Companion Animal Studies (2019). *Human-animal bond*. Retrieved October 8, 2019, from http://www.scas.org.uk/human-animal-bond/.

Tannenbaum, J. (1995). *Veterinary ethics: Animal welfare, client relations, competition and collegiality* (2nd ed.). Mosby.

Trigg, J., Thompson, K., Smith, B., & Bennett, P. (2019). Archetyping relationships with companion animals to understand disaster risk-taking propensity. *Journal of Risk Research, 22*(4), 475–496. https://doi.org/10.1080/13669877.2017.1405458.

Thorn, P., Howell, T. J., Brown, C., & Bennett, P. C. (2015). The canine cuteness effect: Owner-perceived cuteness as a predictor of human-dog relationship quality. *Anthrozoös, 28*(4), 569–585. https://doi.org/10.1080/08927936.2015.1069992.

Volsche, S., & Gray, P. (2016). "Dog moms" use authoritative parenting styles. *Human-Animal Interaction Bulletin, 4*, 1–16. https://www.researchgate.net/publica tion/307631961_Dog_Moms_Use_Authoritative_Parenting_Styles.

Wilson, C. & Netting, F. (2012). The status of instrument development in the human-animal interaction field. *Anthrozoös, 25*(1), s11–s55. https://doi.org/10.2752 /175303712X13353430376977.

Wolf, E. S. (1988). *Treating the self: Elements of clinical self-psychology*. Guilford Press.

Word, J. L. (2012). *Pet Perks: An Examination and Analysis of the Relationship Between Companion Animals and the Development of Empathy*. [Unpublished thesis, Texas State University]. Texas State University. https://digital.library.txstate.edu/handle /10877/4475.

Zasloff, R. L. (1996). Measuring attachment to companion animals: A dog is not a cat is not a bird. *Applied Animal Behaviour Science, 47*(1–2), 43–48. https://doi.org/10 .1016/0168-1591(95)01009-2.

Zilcha-Mano, S., Mikulincer, M., & Shaver, P. R. (2011). An attachment perspective on human-pet relationships: Conceptualization and assessment of pet attachment orientations. *Journal of Research in Personality, 45*(4), 345–357. https://doi.org/10 .1016/j.jrp.2011.04.001.

Zilcha-Mano, S., Mikulincer, M., & Shaver, P. R. (2012). Pets as safe havens and secure bases: The moderating role of pet attachment orientations. *Journal of Research in Personality, 46*(5), 571–580. https://doi.org/10.1016/j.jrp.2012.06.005.