Spring 2015

The Dog and Pony Show: A Critique of Human Animal Interaction Research

Sarah Jo Willcockson
Carroll College, Helena, MT

The Dog and Pony Show: A Critique of Human Animal Interaction Research

Sarah Jo Willcockson

Carroll College

SIGNATURE PAGE

This thesis for honors recognition has been approved for the

Department of Psychology.

Director — 5/1/15 Date

Reader — 5/1/15 Date

Reader — 5/4/15 Date

Dog and pony show: “an elaborate display or performance designed to attract people’s attention” –Oxford Dictionary of English Idioms

Contents

Abstract

The scientific evidence supporting certain foundational anthrozooligical assertions regarding the human-animal bond is inadequate to support the definitional human to nonhuman-animal bond phenomenon defined as—a unique, bilateral benefit derived from interspecies interaction that is not and cannot be garnered from interaction with conspecifics (Fine & Beck, 2010). Problems in human-animal interaction research are highlighted and analyzed, such as poor internal validity, lack of control groups, and various confounding variables. Further, the parameters of human-animal interaction research, such as the de facto limitation to animal-human models, is questioned and analyzed in order to offer avenues of human-animal interaction research that could reduce the number of confounding variables. The research alternative offered is the use of animal-animal models to test effects of conspecifics, specifically the effects of interspecies interaction versus intraspecies interaction. In order to view animal-animal models as a viable research alternative, it is first necessary to understand the degree to which humans and nonhuman animals are analogous. However, once understood, the possible introduction of animal-animal models could negate many of the confounds that detract from human-animal interaction research, such as non-randomized sampling and researcher expectations. Ultimately, this investigation raises questions about how and if research should continue to expostulate that animals can be used as proxy emotional models for both human-animal interaction research and as objects of anthropomorphism in therapeutic practice.

Introduction

The Human-Animal Bond (HAB) is the theoretical hypothesis that there is a unique, bilateral, positive impact from interspecies interaction between humans and non-human animals (Fine & Beck, 2010). Historically, the HAB began to gather its modern momentum when Boris Levinson, owner of a therapeutic practice, documented the unique progress his young clients made when in the presence of his pet dog (Levinson, 1969). Various other studies have added credence to the HAB in the following decades.

The human-to non-human animal bond (from herein out non-human animals will be referred to as animals) or HAB is a subset underneath the umbrella term of HAI—human-animal interaction. The terms HAI and HAB will both be used in a purposeful way in order to more carefully represent and discuss the literature and its impacts.

Currently, the HAB is the foundation for Animal-Assisted Activities (AAA), Animal-Assisted Interventions (AAI), Animal-Assisted Therapy (AAT), Equine-Facilitated Therapy (EFL), Animal-Assisted Canine Therapy (AACT), among other animal-facilitated behavior modification modalities. The HAB is also the root of the academic field of Anthrozoology—the study of human to non-human animal interactions. While consideration will be given to some of the many branches that have sprung from the concept of the HAB, first it is important to analyze the efficacy of the foundational claim of the HAB: a unique, bilateral benefit is derived from interspecies interaction that is not and cannot be garnered from interaction with conspecifics (Fine & Beck, 2010).

The claim that the HAB is a unique, bilateral positive impact from interspecies interaction between humans and non-human animals (Fine & Beck, 2010) is surmised from the many effects claimed by different HAB scholars. The studies surveyed in the first section of this paper are quoted throughout important HAB literature, necessitating an analysis of how- and if—each one supports all or any of the main tenants: bilateralism, positive impact (measurable and objective), impact from interspecies interaction, unique impact that is somehow different from the positive impact resulting from conspecific interaction.

As a roadmap for the paper, first the definition of therapy in regards to HAI will be discussed followed by a thorough analysis of confounds in HAI research design. Next, specific attention will be given to the lack of theoretical framework present in HAI research, the misrepresentative citations often seen throughout HAI literature, the conclusions of various meta-analyses done in the HAI field, and then a series of observations and arguments for research design solutions.

Definition of Therapy

Compounding upon the initial definitional claim of the human-animal bond, if HAB scholars wish to claim HAB as a foundation for therapeutic research (Parish-Plass, 2008; Jalongo, Astorino & Bomboy, 2004; VanFleet & Thompson, 2010; Weiss, 2009) then the HAB must withstand further scrutiny inherent in the definition of ‘therapy’.

An important distinction must be realized between a positive emotional response being experienced and the standards used for therapeutic practice. A client experiencing positive feelings is not sufficient evidence for a modality to be considered a viable therapeutic strategy—otherwise palm-reading, and crystals could be considered “therapy”

(Beck and Katcher, 1984; Kruger & Serpell, 2010). Because placebos inherently cause transient relief, transient relief cannot be considered therapy. If transient relief is allowed to be representative of therapy, the standards for therapeutic modalities plummet and therapy becomes placebic rituals. Therefore, the distinction between brief relief and therapy must be remembered when surveying case studies and anecdotes that purportedly support HAB research. These case studies and stories, as will be shown throughout the paper, consist of the majority of HAB literature. However, a client experiencing enjoyment from the presence of an animal is not indicative of a deeper psychological phenomenon (Kruger & Serpell, 2010, p 34). An example of this distinction applied to HAB literature is the prolific Friedmann (1995) cardiac study. This longitudinal study demonstrated a correlation between pet ownership and greater likelihood of living longer than a fellow, non-pet owner, cardiac patient with an equally serious cardiac ailment. Friedmann, when surveying the utility of his results, states that the data shows no evidence "…that [the] effects are responsible for more than transient or short-term improvements in physiological parameters, such as heart rate and blood pressure" (Friedmann, 1995). Apart from a few exceptional examples, the systemic absence of longitudinal studies that include follow-ups after therapy-trials further raise concern that research has not been sufficient to address or demonstrate a significant difference between a placebo and a viable therapeutic modality (Nagasawa, Kikusui, Onaka & Ohta, 2008; Odendaal & Meintjes, 2003).

In addition, very few studies compare HAB therapy modalities to placebo treatments (i.e. Yorke, Adams, & Coady, 2008 and many of the EAT studies cited in the theoretical framework section of this paper). If a therapy modality is not compared to a

placebo treatment—not just lack of treatment—then it does not deserve a reputation of being superior to a placebo.

Confounds in Current Research

While there has been significant progress in recent decades concerning HAB research (in the form of number of studies present) there is an inflated sense of certainty present in human-animal bond research. This false certainty is a result of an overuse of a few, credible studies while not acknowledging the prevalent limits of the research design and confounds present. These studies are used to back claims such as:

> "People who enjoy being with animals know the healing bond which can develop between humans and their pets. And though humans have innately known the therapeutic qualities of animals for centuries, it is only recently that Animal Assisted Therapy has been developed as a viable therapeutic method with its own theories, practices and research. Because the very presence of an animal is considered to be therapeutic…" (Weiss, 2009).

An individual, unaware of the problems with HAB research, would likely read that only to be impressed with a false certainty that HAB research is definitive and/or widely accepted in the academic community. Neither conclusion is true.

Research Design

This section will provide an overview of the research studies often cited as being foundational in HAI literature. They include: the Friedmann et al. research; Levinson (1969); Jenkins (1986); Nagasawa, Kikusui, Onaka, Ohta, (2009); Strong, Brown, Huyton, Coyle, (2002); and have the potential to be the more foundational research that has been conducted concerning Anthrozoology. They stand out in several ways. First,

they are all quantitative studies that stand apart from the more subjective case studies and anecdotes that often appear in HAB research. Second, these studies use physiological outcomes instead of emotional states as their measurement mechanisms. These objective measures guard against errors in interpretations that could be incurred from subjective, observational research. Moreover, it is important that HAB literature start being written for the HAB skeptic—not the already convinced HAB researcher seeking confirmation. These objective measures will be far more compelling to those not already predisposed to subscribe to HAB arguments. Many other research studies will be cited in order to clarify and provide contrast, however, these initial studies will provide the framework for this section and serve as examples of the critiques offered of HAB research.

A limit of human-animal interaction research is presence of effective control groups and controls for confounding variables. To exemplify this point, consider the first Friedmann studies—research largely agreed to be an important catalyst for current human-animal interaction momentum. Ninety-two cardiac patients were observed and followed in order to examine the relationship between pet-ownership and life-expectancy. This research yielded a correlation between pet ownership and greater likelihood of living longer than a fellow cardiac patient with an equitably severe cardiac ailment that did not own a pet (Friedmann et al., 1980). This correlation persisted when the study was replicated with a greater sample size (n = 369) several years later (Friedmann & Thomas, 1995). However, it is unlikely that these studies support the human-animal bond as defined for several reasons.

First, the variable of owning a pet is not the mechanism which grants longer life. If it were, owning a cat should have demonstrated equally positive benefits. Instead,

owning a cat was a negative predictor for survival. This may be the result of a confounding variable since those that owned cats were primarily women and there is a gender difference in expectancy of recovery from the cardiac ailments (Friedmann, Son, Tsai, 2010). However, at the very least it would indicate that the pet is not enough to counteract the bias against women and/or actively increasing longevity. Further, the physiologic profiles of pet owners were tested for significant differences, and a significant difference was found between just-dog owners and just-cat owners. This may indicate that the mechanism behind increased survival is physiologic state by itself or combined with having an object of attachment—be it human or otherwise. Social support in and of itself, such as that provided by a marital spouse, regardless of the quality of the marriage, has already been demonstrated to contribute to ease in recovery (Kulik & Mahler, 1989). The Friedmann studies are not indicative of a HAB as formally defined since the findings suggest that owning a pet provides an equitable amount of expedited recovery that having a spouse or cohabitation would also afford (Friedmann, Son, Tsai, 2010). If having an object of attachment is beneficial irrelevant of it being a heterospecifics or conspecific, it does not support the hypothesis that the human-animal bond is a phenomenon unique from an intraspecies attachment or forming an attachment to an inanimate object. In the Friedmann et al. (1993) study, it was shown those that had more positive attitudes toward dogs had mitigated jumps in blood pressure versus those with less positive attitudes (Friedmann et al., 2013). This supports the hypothesis that this research serves to confirm the impacts of attachment irrespective of what the object of attachment is.

Plus, the results of the Friedmann (1995) study are complex and should be oversimplified. They found there was "… no significant relation between pet ownership and 1-year survival… There was a significant relation between *dog* ownership and survival [*p = .044*]... The combination of physiologic and psychosocial variables and pet ownership was 95.74% accurate at predicting membership in a survival group." (Friedmann, 1995; p 1215) When Friedmann et al. continued to research, creating another study in 2013, they found a similar species difference in how pet (again, testing effects of object of attachment—*not* interspecies interaction versus intraspecies interaction) presence impacted systolic and diastolic blood pressure. Cat-owner interaction demonstrated lower diastolic BP (blood pressure) and higher systolic BP versus dog-owner interaction which demonstrated lower diastolic and systolic BP (Friedmann, 2013). This species difference does not support the hypothesis that there is a unique human-animal bond.

To further analyze critical research, in 1986, another study demonstrated a positive correlation between lower blood pressure and reading to/petting their respective dogs (n=20) (Jenkins, 1986). Yet, another quantitative study found a correlation between seizure alert dogs and decreased frequency of tonic-clonic seizures over a 24-week period (*P*= .038) (Strong et al, 2002). In further support of the HAB, Nagasawa et al. (2008) researched the correlation between urinary oxytocin concentrations and a dog owner gazing at his/her dog. The findings dictated that there was increased oxytocin after gazing at the respective pet dog and increasingly concentrated urinary oxytocin among those individuals who had better than average relationships with the pet—indicating that hormone release was indicative/ a function of attachment behavior. These research

projects are largely inspired based on the first published observation of Boris Levinson (1969). As a result, it would be inappropriate to have a discussion on HAB research without referencing that first, critical study.

First, Boris Levinson, while often credited with creating the impetus for all ensuing HAB pursuits, is often overlooked as being comprised *wholly* of anecdotes and case studies. Furthermore, even though Levinson's research is not definitive—which he admits, stating his observations were merely meant to facilitate further research—it is often used to justify the practical implementation of AAI when more scientifically rigorous research is absent (Kruger & Serpell, 2010).

The Jenkins (1986) study that concluded that petting a bonded dog could lower blood pressure in the owner also becomes less compelling once examined. First, when replicated with hypertensive individuals petting their respectively bonded dogs, there is no evidence of significant lowering of blood pressure. This more recent study not only had greater internal reliability-control, the protocol was petting an un-bonded dog, whereas in Jenkins it was reading aloud which alters heartrate- but had significantly more participants (n= 31 versus n= 20). Additionally, the replication study was testing the presence of an animal and not the presence of a *bonded* animal (Schelke, Trask, Wallace, Baun, Bergstrom, McCabe, 1991). Because attachment in and of itself is a separate variable from interspecies versus intraspecies interaction, the research design of exclusively using pre-bonded companion animals is a consistent confound in HAI research.

Yet another study found that it takes between five and twenty-four minutes, with an average time of fifteen minutes, for mean arterial blood pressure to drop after a

baseline has been established, meaning that the eleven and eighteen minute treatment conditions that Jenkins established would potentially not be reactive to the given treatment because of the lack of time to adjust to treatment/rest conditions (Odendaal & Meintjes, 2003). Rather, the participants' blood pressure measurement could reasonably be either in-flux or due to the previous condition of 'at rest'. While this may not be a confound that would cause a Type I error, it does mean that the research is not designed to accurately detect the effect of the variable being tested—in this case most likely attachment effects.

Furthermore, in the Jenkins study (1986) every participant was screened for a positively related relationship with the animal. The results found were as follows: lower systolic pressure ($P < .001$); lower diastolic pressure ($P< .01$); but heartrate was not significantly altered. The variable being tested is whether or not having an object of attachment present is decreasing blood pressure, not whether having an animal present is decreasing blood pressure. Claiming that this supports the HAB phenomena is analogous to stating that having friends prevents depression, so long as you like the friends that you have, and then claiming that simply having a friend is a complex phenomenon that wards against depression. In reality, as far as the reader can reasonably conclude, *attachment* is the measured variable and the likely mechanism used to produce the desired effects. It is not novel that attachment, the process of bonding, can improve affective state, quality of life, and the lowering of blood pressure, regardless of the object of the attachment. In order to indicate that the HAB is in any way a unique or novel phenomenon hinging on the fact that the non-human animal is the unique variable, one must have a control group comparing the effects of interacting with bonded conspecifics, or comparing the effects

of having un-bonded conspecifics present with the effects of un-bonded heterospecifics present

The same problem that exists with the Jenkins (1986) study also exists with the Nagasawa et al. (2008) study—the variable being examined is likely impacts of attachment rather than the impacts of interspecies interaction versus intraspecies interaction. The design of the experiment does not lend itself to being indicative of any underlying human-animal bond. First, the control group is allowed to interact with the bonded dog. The control-group participant is simply precluded from making direct eye-contact. This means that the variable being directly manipulated is not presence of the animal, but the impact of direct eye-contact with an animate creature (there was not a control group making direct eye-contact with a fellow human). This means that the study is hinging on the premise that making eye-contact is a unique attachment behavior that produces unique results separate from interaction sans eye-contact. Putting aside the fact that this seems a highly unsupportable premise on the human side—otherwise blind individuals should not be able to form the same kind of relationships as individuals with sight—throughout this study, it is presumed a dog's gaze is an attachment behavior, even stating "A dog's gaze can be considered as an attachment behavior that elevates the OT [oxytocin] levels of the owner" (Nagasawa et al., 2008, p 44). However, as acknowledged in the same study, a dog looking at the owner has been shown to be a function of seeking information from the human (Miklosi et al., 2003). Unless shown specifically otherwise, the presumptive claim that the dog is gazing at the owner because the dog is exhibiting an attachment behavior is unwarranted. In order for this claim to be even peripherally investigated, a control group with a stranger and an unfamiliar dog should have been

included in order to verify that eye-contact is made not only as an informative function, but also a bonding factor.

Plus the group sampled was recruited from dog training classes. This sample, it is safe to assume, is already pro-dog and attentive to their respective creatures. This group is likely already predisposed to have a positive bias towards the variable being investigated. If researchers try to generalize the HAB phenomenon to the general public, groups must be randomized as much as possible in order to avoid slanted results. In addition to poor external validity, this study is also an example of poor internal validity. There was no controlling for varying individual levels of oxytocin before the study, nor was there attention allotted to the timing of the experimental groups in order to account for cyclical rises in hormone release. More detailed analysis of errors in research design relating to neurophysiological measures will be addressed in the following sub-section.

Next, a similar study was conducted wherein eighteen adult participants (n= 18) were analyzed in order to demonstrate the decrease in cortisol, increases in plasma ß-endorphin, oxytocin, prolactin, phenyl-acetic acid, and dopamine as a result of interaction with a dog (Odendaal & Meintjes, 2003). Pre-test values were used as an internal control against the post-test values in order to mitigate the effects of individual variance between participants. The external control was reading a book during the treatment condition instead of interacting with the dog. The dogs used were either unfamiliar dogs—provided for the participants that did not own a dog—or dogs owned by the participants. This could be a potential confound, but also introduces the concept of the dog as the variable instead of effects of attachment to a particular canine. While significance was achieved across the board for every physiological variable, quiet book reading also produced

similar physiological changes. Interestingly, canine-interaction showed significantly greater differences than book reading in three areas: increase of ß-endorphin ($p< 0.01$), oxytocin ($p < 0.01$), and prolactin ($p < 0.01$)—note that cortisol decrease was not significantly different between dog interaction and book reading. (Odendaal & Meintjes, 2003)

This study (Odendaal & Meintjes, 2003) is of particular interest because, not only does it clarify the Jenkins (1986) and Nagasawa et al. (2009) studies, but also because it tests the animals in the equation. Dogs were not shown to have a significant decrease in cortisol as a result of interspecific interaction albeit their measurements did achieve significance in every other measurement in parallel with their human counterparts. These observations must be approached with caution since no control group for the dogs was implemented—their measurements were not taken before the experiment and there was no external control. However, in terms of support for the bilateral aspect of the HAB, the dogs were shown to have some, yet not equally significant, positive benefit from the interaction across species barrier (Odendaal & Meintjes, 2003).

Furthermore, the Strong et al., 2002, the last of the initial studies outlined at the beginning of the section, is also not enough to indicate the presence of a bilateral unique benefit from interspecies interaction. While the prospect of canine companions being able to mysteriously mitigate the effects of seizures is engaging, by the researchers own admittance, this study has a deplorably small sample size ($n= 10$), and includes one patient that did not experience any positive effects. To put into perspective how small sample sizes can create dangerous false positives, consider the tragedy of Thalidomide research. With three trials testing for toxicity, the third of which was a double-blind

controlled placebo study of n= 724, researchers still missed the devastating side-effects of birth deformities and neurological damage (Hackshaw, 2008). In addition, again by the researchers own admission, the positive effects of being able to predict the timing of the seizures and increase normal life activities—thereby increasing confidence—are not controlled for and are also possible explanations for increased positive affect of the seizure patients. This increased confidence could possibly function as a confounding variable that could decrease frequency of seizures (Strong et al., 2002).

These particular studies serve as microcosmic placeholders to exemplify many of the overarching problems often found in HAB research.

Neurophysiological Correlates

Among HAI research one neuropeptide, Oxytocin (OT), is often the focus of research attempting to establish objective measures of bonding and attachment (Miller, Kennedy, Devoe, Hickey, Nelson, & Kogan, 2009; Nagasawa et al., 2008; Odendaal & Meintjes, 2003). This neuropeptide has been dubbed the "love molecule" (Bartz, Zaki, Bolger, & Ochsner, 2011; Grillon, Krimsky, Charney, Vytal, Ernst & Cornwell, 2012) or the "moral molecule" (Grillon et al., 2012; Churchland & Winkielman, 2012) by popular psychology in order to simplify its effect. First, an analysis of the neuropeptide's measurement validity is discussed, followed by an overview of the accuracy of calling Oxytocin a "love molecule"/ using it as a measurement of bonding.

Measurement Validity

Oxytocin is a nine-amino acid peptide synthesized in the hypothalamus—specifically in the paraventricular (PVN) nucleus and the supraptic (SON) nucleus of the hypothalamus (Weisman, Zagoory-Sharon, Schneiderman, Godron, & Feldman, 2012).

The PVN and SON release OT into the cerebral spinal fluid (CSF) which account for some of the centrally produced OT (the spinal cord, bed nucleus of the stria terminalis [BNST] and anterior commissural nucleus function as central sources of OT as well). Brain regions affected by OT include: medial preoptic area (MPOA), the lateral septum, BNST, nucleus accumbens (NAcc), the amygdala, the hippocampus, the spinal cord, among others. Peripheral OT- OT located throughout the body in the circulatory system- is also produced by the thymus, heart, gastrointestinal tract, uterus, placenta, amnion, corpus luteum, testes, and uterus. The OT system is integrated with and co-regulated with the hypothalamic-pituitary-adrenal (HPA) axis. (Feldman, 2012; Heinrichs et al., 2009) The HPA axis is directly related with reaction to stress (Herman & Cullinan, 1997).

There is no current definitive evidence that peripheral measurements of Oxytocin- measurements taken from the blood/ urine- correlate with central production of Oxytocin in the brain under socio-physiological conditions in humans. Rather, it is suggested and assumed—not proven—that peripheral measurements correlate with central measures of OT. (Anders, Goodson, & Kingsbury, 2013; Churchland & Winkielman, 2012; Heinrichs, Dawans, & Domes, 2009) If OT easily passed through the blood brain barrier, the correlation between peripherally and centrally produced OT might not be as problematic of a claim. However, it is also unclear whether OT or Vasopressin (VP)—a hormone molecularly very similar to Oxytocin—is able to cross the blood brain barrier (BBB) (Anders et al., 2013; Churchland & Winkielman, 2012; Ott, Finlayson, Lehnert, Birte, Heinrichs, Born, & Hallschmid, 2013) and if some does pass through, it is only a marginal amount (Heinrichs et al., 2009). Both OT and VP are large hydrophilic molecules that cannot easily navigate the BBB, which means access to the brain through

the BBB, if occurring, is subject to narrow windows of time and specified pre-existing conditions such as a hypertensive state induced by exogenously produced VP in a supraphysiological dose (Churchland & Winkielman, 2012; McEwen, 2004; p 549). Because the BBB and blood-CSF barrier consist of lipid molecules, only lipophilic molecules pass easily sans transporters (McEwen, 2004; p 533). Research has shown that CSF levels of OT/VP are not representative of OT/VP peripheral measurements and they do not vary together in response to external stimuli unless both central and peripheral origins are simultaneously stimulated (Churchland & Winkielman, 2011; McEwen, 2004; p 544-545).

Next, it is known that endogenously produced hormones use circumventricular organs (CVO's) as an interface between the circulatory system and the brain because of their lack of BBB (McEwen, 2004; 535, 540). However, it is not clear how peripherally injected exogenous OT/VP could access the brain in amounts great enough to effect behavior. McEwen (2004) offers several scenarios but none are presented as realistic except the process of "transcytosis" but, given this is the process by which OT/VP access CSF, it could only be brain-blood communication because of a lack of evidence of the recycling process occurring on the abluminal side of the BBB. Thus, transcytosis does not explain how OT/VP accesses the brain when peripherally manipulated. (McEwen, 2004; p 551-552) Several explanations are offered for how OT/VP could cause behavioral changes *without* accessing the brain such as increase of blood-flow to the brain or activation of receptors of the central nervous system (CNS) (McEwen, 2004; p 553), but this would mean that the hormone under investigation is not directly responsible but that secondary effects of the hormone is the variable under question.

This problem is relevant to HAI research that strives to use Oxytocin as an objective measurement of anxiolytic effects of animal- or evidence of attachment- since the HAI researchers have exclusively used peripheral measurements taken from blood/urine. There is no currently published HAI research, to the writer's knowledge, investigating exogenously injected peripheral oxytocin and HAI impacts or the correlation between centrally and peripherally produced oxytocin in context with HAI research. While there is some research that indicates a possible correlation between plasma and CSF OT/AVP levels in response to maternal interaction and touch as well as studies that show strong correlation between plasma levels and behavior modification (Weisman, 2012), it is not definitive, lacks scientific explanation, and HAI research must be forthcoming in the shortcomings of its neurological measurements. If HAI research used animal-animal models, as will be suggested later in the paper, it could use microdialysis on primates—a relatively noninvasive process—in order to demonstrate comparable peripheral and central OT/AVP levels (Churchland & Winkielman, 2011) as a result of HAI interaction. This could be a way to advance both HAI research and AVP/OT research concurrently.

While the ignorance of oxytocinergic peripheral-to-central mechanism is still a problem, the following OT research will be analyzed without reference to lack of definitive physiological apparatus for the sake of argument.

Oxytocin Function versus Label

As stated earlier, OT has been termed the "love" molecule" (Bartz, 2012) or the "moral molecule" (Grillon et al., 2012; Churchland & Winkielman, 2012). These terms

are misrepresentative of modern OT research and have led to oversimplification that has directly harmed HAI progress.

For instance, Miller (2009) offers support of its use of OT as a bonding measurement between animals and humans by stating that it has been shown to decrease stress and facilitate bonding/socialization. In current research new aspects of OT have been demonstrated that directly contradict the premise used by HAI research. OT is demonstrated as *increasing* anxiety in response to an unpredictable threat via stimulation of BNST—a direct anxiogenic effect—among other effects such as increasing territoriality and aggression towards out-group members (Grillon et al., 2012). A recent literature review of OT showed that nearly fifty percent of OT prosocial experiments were non-significant, sixty percent of those findings were confounded by "situational or individual differences", and approximately twenty percent of overall OT social findings were significant for antisocial effects such as increased mistrust, out-group aggression, envy, and insecure attachments. This same paper found that increases in trust were only consistent if the individual was portrayed as trustworthy and, if portrayed thus or was a member of an out-group, higher levels of measurements of OT were associated with decreased cooperation and decreased trust. This was especially true of individuals with pre-existing attachment/trust issues. (Bartz et al., 2011) Similar results were found for individuals diagnosed with Borderline Personality Disorder (BPD) that exhibited decreased cooperation behavior, more punishing behavior, and less trusting behavior correlated with increased OT levels. The results were significant especially for those who had high avoidant behavior/ anxious attachment style versus low avoidant behavior/anxious attachment style. (Bartz et al., 2010) Yet another study found that

women that had undergone recent interpersonal harm and had high levels of OT were associated with greater anxiety after the relevant conflict and significantly decreased tendency to forgive (Tabak, Mccullough, Szeto, Mendez, & Mccabe, 2011). Neuroscientist Panksepp (2012) writes that there is no decisive evidence that oxytocin correlates with elevated positive mood (p 38) and that quail with cerebrally injected OT were shown to demonstrate behavior consistent with increased confidence but not necessarily happiness or bonding. In fact, the quail injected with OT were less distressed as being socially isolated. (Panksepp, 2012; p 39-41)

The working model of OT as simply a bonding molecule no longer makes sense in light of recent demonstrated effects. Other, more accurate models may include: OT as an emotional amplifier or amplifier of social salience (Anders et al., 2013; Bartz et al., 2010; Bartz et al., 2011), OT as a "confidence" booster/ inhibitor of fear (Panksepp, 2012; p 38-44; Tabak et al., 2010; Tops, Peer, Korf, Wijers, & Tucker, 2007), OT as a conditional anxiolytic/ suppressor of the HPA axis (Heinrichs et al., 2009; Ott et al., 2013; Tops et al., 2007), and OT as part of a philosophical system of bridging the "subjectivity gap" or functioning as a form relational proprioception (Feldman, 2012). Note that these models are not mutually exclusive and may dynamically relate to one another.

However, consider what these models mean for HAI research. First, because HAI research is being utilized as justification for therapeutic models, individuals are using animals as tools for theoretically increasing OT in patients with pre-existing trust conditions, dysfunctional attachment styles, and individuals experiencing interpersonal harms (e.g. Yorke, Adams, & Coady, 2008). As presented above, these are not the

personality types that experience positive impacts from higher levels of OT. Nagasawa et al. (2008), Odendaal and Meintjes (2003), and Miller (2009) all used healthy individuals for their OT studies, thereby spotlighting a systemic confound in HAI OT research. It has not yet been demonstrated what correlation exists in attempting to manually (exogenously) raise OT levels (with animals) and therapeutic affects for HAB patients with traumatic background or personality disorders.

Perhaps the varying OT models can shed light on discrepancies that have previously confounded HAI research such as the broad range of individuals' reactions to animals or inconsistent experimental results. Given the emotional amplification model, if individuals already had a liking for the relevant animal, it [the emotional amplification model] might expound upon/clarify the emotional amplifier aspect of OT. An analogous parallel may be the mechanism in which individuals with higher OT show increased cooperation and trusting behaviors only as long as the relevant individual is portrayed as trustworthy (Bartz et al., 2011). In other words, OT only had positive effects in social situations that were perceived positively. In this same way, OT may only have positive effects in interspecies interaction situations if the individual perceives the relevant animal positively. This could explain both the variance in how individuals react to animals and why HAI has yet to stumble on the dysfunctional functions of OT given animal interaction does raise levels of OT—it almost exclusively researches individuals already disposed with positive feelings towards the respective animals.

To take the analysis one step further, perhaps current HAI research has misaligned the causality chain. Instead of an animal acting as a unique stimulus causing an increase in oxytocin thereby increasing attachment behavior, perhaps pre-existing

higher oxytocin predisposed the individual to develop social affiliation more easily, affiliate with the relevant animal, seek the animal out which would further amplify the affinity for the animal, and then cause the individual to self-identify as pro-animal and become part of the perpetuation of the human-animal bond. This model acknowledges the possible function of OT as a bonding molecule in some circumstances while not precluding the acknowledgement of its other, equally important functions. Within this model, there is room for individuals that fear or dislike animals and develop those feelings over time and with frequent exposure. The previous "love" molecule model does not allow for these occurrences. Furthermore, this model would still cause possible increases in OT in some individuals in the presence of a bonded animal, explaining some current research results.

Finally, it is important that HAI researchers acknowledge the diverse functions of OT—from facilitating punishment behavior (Bartz et al., 2010) to inhibiting reward-driven food consumption (Ott et al., 2013)—in order to disinhibit HAI and OT research progress. It is because of the existing oversimplified belief that OT is something benign as a "love" molecule that experiments are perpetually designed to exclusively investigate the positive effects of OT, hindering tautological discovery (Anders et al, 2013; Bartz et al., 2011; Ott et al., 2013). If only positive effects are investigated, only positive effects will be discovered.

Lack of Theoretical Framework

AAT studies assign different psychological constructs to the effects depending on the psychological model used or supported. This is due to a lack of theoretical framework to serve as justification for AAT. Two of the most common frameworks used

are attachment theory—utilizing the biological need humans theoretically have for social attachment—and the intrinsic attributes of the animal—related to E.O. Wilson's theory of biophelia (the theory that mankind possesses an innate attraction for the natural world) (Kruger & Serpell, 2010). In short, one theory explains AAT using human nature; the other explains it [AAT] using human attraction to nature. To exemplify how the lack of theoretical framework occurs in AAT literature, one study quantified behavioral symptoms of recovery from physical trauma, the impetus theoretically being the relationship between horse and rider, with coding software that analyzed taped interviews of the trauma victims. Results, both anecdotal evidence from the interviewees and empirical evidence gathered via quantifying behavioral symptoms, indicated that a positive relationship with a horse accelerated recovery. The researchers postulated that horse-human contact produced the positive effects due to the animal offering social support (Yorke et al., 2008). Another study suggested that the effects, anecdotally recorded qualitative benefits in mitigating emotional disorder symptoms, of horse-human interaction are a result of the participants learning to be empathetic towards animals and cross-applying these learned concepts to human interactions (Ewing et al., 2007). Still another study asserts that the act of establishing a relationship with an intimidating and powerful animal builds self-confidence and feelings of empowerment. These feelings, the study suggests, should be accredited with any positive effects of horse-human interaction (Shultz et al., 2006). Yet still another study proposes that animals (specifically horses) provide an avenue for judgment-free communication which can help individuals practice difficult communication patterns and account for any positive social and interpersonal impacts (Kern et al., 2011). These examples demonstrate that, even if human-animal

interaction research studies had perfect efficacy, there is no consensus on the cause for any perceived effects.

However, these studies are nowhere near academically rigorous. Even those researchers known for being foundational to HAB research, such as Kruger, Serpell, Katcher, and Beck, acknowledge that studies have been problematic and rife with problems such as small, heterogeneous sample sizes, a lack of control groups, and an over-reliance on case studies and "pilot" investigation (Kruger & Serpell, 2010; Katcher & Beck, 2003). Further specific problems include: demand characteristics, bias of researchers, and lack of recording of possible long-term effects in order to differentiate the treatment from temporary relief, medications taken concurrently with treatment options, and unrepresentative participant samples.

Misrepresentative Citations

These problems are often overlooked and studies that do not withstand scientific rigor are frequently cited as definitive scientific findings. To demonstrate this argument, "Animal-Assisted Play Therapy: Canines as Co-Therapists" by Mary J. Thompson is an often cited article in the HAB community. It synthesizes and outlines the research supporting AACT as well as offers suggestions for individuals seeking to incorporate canines into play therapy (Thompson, 2009). The following statements are directly quoted from her article:

> "Research has shown that animals are significant in the overall development of children. Through animals, children learn about social interactions, boundaries, emotional reciprocity, and responsibility. Studies have shown that children who own pets have more empathy for others, higher self-esteem, and better social

> skills than other children (Jalongo, Astorino, & Bomboy, 2004). The child-animal bond is unlike any other relationship a child may have."
>
> "Thompson, Mustaine, and Weaver (2008) completed the first known controlled study of the use of canines in nondirective play therapy… Results of the study showed that the presence of the therapy dog, children in the study showed an improvement in mood and affect, an increased ability to engage in thematic play, and more readily established report."

These statements connote, if not explicitly communicate, that AACT is a grounded, researched, modality. While Thompson (2009) uses additional studies, these references consist of the nexus of her foundation and are thereby the ones investigated.

First, Jalongo, Astorino, and Bomboy (2004) is a series of anecdotes and observations from individuals working with children and animals. It could be viewed as a borderline deception to label it a "study", much less one that supports the claims that she uses it to support. While it is undeniably a valuable piece of literature for any individual seeking to use canines for therapeutic purposes, it should not be included in the HAB library of valuable, scientifically rigorous studies.

Next, Thompson (2009) supports her next statement by citing Thompson, Mustaine, and Weaver (2008). This is an unpublished doctoral dissertation that is not available for analysis. Perhaps it is scientifically rigorous—but it is unpublished and not available for comment.

As another example, Risë VanFleet and Tracia Faa-Thompson publish "The Case for Using Animal Assisted Play Therapy" in 2010.VanFleet and Thompson are both play therapists that incorporate animal-assisted therapy in their current practices—Family

Enhancement & Play Therapy Center (VanFleet) and Turn About Pegasus Programme (Thompson). Turn About Pegasus Programme also incorporates EAT and hypnotherapy. The paper admits that more research is needed to support the HAB, but they list several studies that "show promise" (p 15). These studies include "Equine Assisted Therapy and Theraplay" (Weiss, 2009), "Animal-Assisted Therapy with Children Suffering from Insecure Attachment Due to Abuse and Neglect: A Method to Lower the Risk of Intergenerational Transmission of Abuse?" (Parish-Plass, 2008), the Thompson (2009) study previously discussed, and the Nimer & Lundahl (2007) metanalysis.

Weiss (2009) states:

> "People who enjoy being with animals know the healing bond which can develop between humans and their pets. And though humans have innately known the therapeutic qualities of animals for centuries, it is only recently that Animal Assisted Therapy has been developed as a viable therapeutic method with its own theories, practices and research."

She approaches the HAB as an already proven theory, using Levinson as her support. Her research is comprised of descriptive accounts of sessions that she has conducted with clients over a period of 12 sessions which also use play therapy. One case study is described in great detail. While Weiss' insights and experience as a therapist are valuable and informative, qualitative accounts of clinical observations cannot substitute for hard evidence.

Parish-Plass (2008) is also a compilation of clinical examples that are used to support the use of animals in a therapeutic setting. Parish-Plass gives a valuable survey of literature and inspiring stories of individuals that have reportedly benefitted from

therapeutic animals. However, again, clinical observations are not sufficient for drawing conclusions.

Meta-Analyses

"Animal-Assisted Therapy: a Meta-Analysis (Report)" (Nimer & Lundahl, 2007) concluded that AAT did have positive, moderately strong effects on clients. However, the meta-analysis consisted of 37 studies out of the original 250 studies identified as relating to AAT. Of the studies, 119 met the criteria—criterion being 1.) reported on AAT, not AAA 2.) had an N of 5 or greater 3.) written in English 4.) Provided adequate data for computing upon reading. After coding, only 37 peer-reviewed sources and 12 dissertations actually met the criteria for academic rigor. Almost half of these studies did not have a control/ comparison group. Furthermore, these studies investigated AAT effects on issues from Autism-Spectrum Disorder, "medical difficulties", behavioral problems, and emotional problems. In addition, it used a range of species including dogs, dolphins, and horses. This, as the researchers admit, exposes them to the "comparing apples to oranges" critique sometimes associated with meta-analysis. While this meta-analysis inspires interest and reason for further investigation, it would be hard to take its conclusion as irrefutable while highlighting how few HAB related studies are academically viable.

Another, recent meta-analysis of Animal Assisted Activities/Therapies revealed that only 3% of relevant research studies conducted met criteria for scientific validity (Holmes et al., 2011). This is largely due to the unavoidable confounds introduced by the human elements of the experimentation such as "novelty effects; demand characteristics;

informant and experimenter bias; a lack of reliable and validated measures; and a lack of adequate control groups" (Marino & Lilienfield, 2007).

Fundamental Premise Taken for Granted

Among these many systemic research issues, one problem is both the most troubling and the potential solution to other highlighted confounds. Frequently, therapists explain the HAB mechanism as contingent on clients perceiving and mirroring animal emotions—exploiting anthropomorphisms made by the client (Ewing et al., 2007; Holmes et al., 2011; Schultz et al., 2006; VanFleet & Thompson, 2010; Weiss, 2009; etc.). Many studies perceive the ability of animals to feel emotion as a given, a premise that is so immutably true that it is above debate. However, the premise that non-human animals possess emotional capabilities is a highly contested issue. (The case for the emotional animal has many critiques to overcome. Further readings on the subject include Blumberg & Sokoloff [2003]). Before addressing the case for the "emotional animal", the implications should be enumerated.

If non-human animals (herein referred to as simply animals) are able to feel emotions and are susceptible to the same psychological factors as humans, then the HAB should be truly bilateral in the sense that the animal could be experiencing the same unique, positive, emotional benefit from interspecies interaction. It does not follow that there is any evidence to presuppose/dictate that humans must be one of the species involved in the equation. If humans were taken out of the experimental equation, it would open previously unexplored avenues of research that offer bypasses around many confounds introduced by the human element (e.g. concurrent medications, biased samples, demand characteristics, etc.). On a different vein, if it cannot be reasonably

concluded that animals experience emotion, the definitional aspect of bilateralism should be excluded from the HAB construct and anthropomorphisms should be viewed as an illegitimate form of therapy.

Case for the Emotional Animal

Before talking about specific emotions (e.g. anger, jealousy, envy, glee, contentment), it is important to establish whether animals are capable of the simplistic positive versus negative emotional state. Bateson and colleagues (2011) designed an experiment to establish the valence (positivity or negativity) of an animal's emotional (affective) state by measuring the pessimism/optimism of decisions in honey bees before and after being exposed to a naturally occurring, aversive stimulus. In three separate experiments, the results showed significant cognitive, pessimistic bias in the honeybees exposed to the aversive stimulus supporting the hypothesis that even insects are capable of positive versus negative affective states (Mendl, Paul, Chittka, 2011). Creatures simplistic as the planarian and crayfish exhibit preference for drugs also desired by humans, suggesting that other animals are able to value-encode substances based on emotional affect (Panksepp & Burgdorf, 2003). Furthermore, barring the emergence of more behavioral experiments, the burden of proof is shifting to the side claiming animals are emotionless. The same paper goes on to explain that, unless evolution caused the subcortical regions that govern basic emotion to become vestigial in mankind, humans and other mammals share the same basic emotional brain mechanisms. Not only does the former belief defy Occam's razor (since it requires humanity to evolutionarily diverge and create a whole new form of emotional neural circuitry), but it requires additional non-existent evidence. It is more reasonable to assert that mankind created additionally

complex emotions with the development of the frontal lobe region. In the acclaimed book, *The Archaeology of Mind* (Panksepp & Biven, 2012) Panksepp describes the seven basic emotions believed to be governed by the relevant subcortical region—seeking, rage, fear, lust, care, panic, and play.

Panksepp's seven basic emotions overlap with "basic emotions" postulated by researchers that have studied universal emotions in humans. Using universal facial expressions, facial expressions demonstrated by blind individuals, and ANS physiology, Paul Ekman reiterates findings that six basic emotions found in humans are: "happiness, fear, sadness, anger, and disgust combined with contempt" (Ekman, 1992). He continues to describe the findings of these emotions present in developing humans before emotional context is learned. This is a prime example in which phylogeny may recapitulate ontogeny. The parallels between the "basic emotions" of humans and the "basic emotions" of animals, found independently of one another, are intriguing yet not decisive proof that animals experience emotions analogous to human emotion.

Bonding Structure

Since the central emotion of interest, the emotion relevant to whether the HAB phenomenon is generalizable, is bonding/affection/ "nurturing", any physiological evidence for this particular emotion must be evaluated.

One measurable act that facilitates social interaction and bonding in humans is laughing. Neuroscientist Panksepp (2007) presents compelling evidence that this same mechanism ["laughter"] is present in rats, and thereby present in the mammalian brain. Among the five main studies concerning the correlation between rat laughter—50 K Hz "chirps"—and positive affective state/behavior, all five supported the hypothesis that the

correlation was strong enough to presume the connection something other than arbitrary happenstance (Panksepp, 2007; Panksepp & Burgdorf, 2003; Burgdorf & Panksepp, 2002; Portfors, 2007; Takahashi et al., 2010).

In addition to the studies supporting the hypothesis that 50-K Hz vocalizations in rats is linked to rat emotion and behavior, two other studies analyzed "laughter" in two other species, dogs and apes, shedding light on the possibility of laughter as an evolutionary consequence of social bonding (Leavens, 2009; Simonet et al., 2005).

Simply put, the evolutionary advantage of laughter is contingent on the relevant animal being a social species. Laughing aids in successfully soliciting play as well as producing positive affective responses from peers (Panksepp & Burgdorf, 2003; Portfors, 2007). The connection between the 50-K Hz vocalizations and social interaction is exhibited by the fact that vocalizations increase if the rat is "primed" with social isolation before being physically stimulated by the researcher. This suggests that "the response is regulated by social-need processes with the brain" (Panksepp & Burgdorf, 2003). Additionally, it was also shown in the same study that other forms of deprivation, such as food deprivation, were not effective in increasing frequency/ intensity of "laughter". In another instance, the connection between rat laughter and the corresponding play response from a conspecific indicated that the 50-K Hz chirp could be a powerful conspecific communication tool (Takahashi et al., 2010)

Social preferences were also guided by laughter. Individuals that "chirped" more (laughed/ 50-K Hz vocalizations) were preferred over individuals that rarely vocalized and researchers that elicited more chirps were preferred over researchers that simply petted the rodents (Panksepp & Burgdorf, 2003; Portfors, 2007). This could indicate that

an ultimate function of laughter is to gain social strength. Laughter may be an integral piece in maintaining both societal and emotional health since "play" behavior strengthens social bonds and facilitates the alleviation of stress, creating a more energetic and productive creature.

Regardless, this information helps solidify *why* it is evolutionarily advantageous, the ultimate explanation versus the proximate explanation, for animals to develop affective states associated with the play/nurturing systems. In many species isolation is correlated with increased risk of predation or exclusion from resources. In both human and nonhuman studies, isolation has been shown to increase sensitivity to potential threats as well as increase drive to establish societal status. Additionally, parallel physiological responses, including that of hypothalamic-pituitary-adrenal axis activation (associated with stress responses), to isolation were recorded in both humans and animals (Cacioppo, Hawlkey, Norman, & Berntson, 2011). Social relationships have been empirically demonstrated to be integral to normal development of behavior in several species including rats, primates, and marmosets. Stereotypies that begin as a result of isolation while young persist even after isolation with conspecifics is ended (Mellow, Galvao-Coelho, & Medeiros, 2014).

Generalizable Psychological Explanations

Ultimately, while it is difficult to say with certainty that humans and animals experience isolation in the same way, it is reasonable to assert that isolation creates detrimental effects on species other than humans. It would also be reasonable to assert that, as a function of avoiding the negative effects of isolation, members of animal species seek/need socialization. The attachment theory previously used to justify human

effects from HAB hinges on this exact premise, suggesting that if the attachment theory is correct, it is not unreasonable to establish need for investigation into whether or not the HAB theory is generalizable across species barriers.

The second theory that seeks to explain HAB in humans is biophelia—the innate love of nature that humanity experiences (Kruger & Serpell, 2010). The mechanism behind this theory is that humanity evolved within nature, relied upon nature for sustenance, and became evolutionarily bound to nature through the need to coexist with nature. Animals, perhaps even more so than humanity, experienced the same factors that humanity did—requiring nature for survival, ergo developing a psychological need for nature. Therefore, if biophelia becomes the preferred explanation of choice for the HAB phenomenon, biophelia, too, is applicable to animals.

Conclusion

It is clear the current HAI research is inadequate for the conclusion that there is bilateral, unique, long-term positive impact from interspecies interaction that cannot be achieved through interaction with conspecifics. One avenue for potential research is the investigation of emotions in animals, particularly the extent to which animal brain mechanisms are analogous to human brain mechanisms. This is important since it offers a way to negate confounds the human factor inextricably introduces into current HAB research.

Next, HAI research must venture out of its narrow use of neuroscience and acknowledge the limitations of tools such as oxytocin research. If HAI research began to use control groups that used anxiolytic drugs it could simultaneously establish if the bond is *more* than calming effects of attachment impacts and concurrently aid OT research in

teasing out the degree to which OT effects are dependent on its relationship with the HPA axis. Furthermore, control groups with anxiolytic drugs might help HAI studies differentiate themselves from experimental groups that are reading a book or pursuing other (non-therapeutic) avenues of relaxing. This may aid in establishing HAB modalities as traditional therapeutic practices and mitigate the argument that it is responsible for only the transience relief garnered from a placebo treatment.

Furthermore, too often the component of bilateralism is ignored in HAI research. If the idea of the human-animal bond is ever going to materialize as defined in this paper, key tenants have to be pursued and taught with equal weight. The fact that bilateralism is the component often neglected simply invites the anthropocentric critique on an academic field simultaneously extolling the value of animals and using them as a mean to an end.

Finally, a major stumbling block with HAI research is the lack of experimental designs that test the concept of a human-animal bond separate from the effects of conspecific or generalized attachment effects. If the tested variable is consistently attachment and not the effect of a unique human-animal bond then the research is destined to reveal the same effects demonstrated from conspecific attachment or strong attachment to inanimate objects. Numerous suggestions have been offered throughout this paper to mitigate the potential problem. When pursuing new experimental designs, that neuro-scientific hypothesis are not stop-gaps to be exploited and animal-animal models could negate many existing confounds.

In conclusion, those that critique HAB/HAI research and the scholastic field of Anthrozoology are neither baseless nor incorrect. It is clear that research has been rife with confounds and largely conducted to affirm researchers' expectations rather than

answer academic questions. The only way research improves and the HAB hypothesis is legitimized is by overcoming criticisms. Therefore, in order to facilitate progress, flaws must be highlighted and questions must be asked. The main criticism offered in this paper is the de-facto human-animal model limitation. The main solution offered is the use of the animal-animal model.

References

Anders, S. M., Goodson, J. L., & Kingsbury, M. A. (2013). Beyond "Oxytocin = Good": Neural Complexities and the Flipside of Social Bonds. *Archives of Sexual Behavior, 42*(7), 1115-1118. doi:10.1007/s10508-013-0134-9

Ayto, J. (2010). D. In *Oxford dictionary of English idioms*. Oxford: Oxford University Press.

Bartz, J., Simeon, D., Hamilton, H., Kim, S., Crystal, S., Braun, A., Vicens, V., Hollander, E. (2010). Oxytocin can hinder trust and cooperation in borderline personality disorder. *Social Cognitive and Affective Neuroscience, 6*(5), 556-563. doi:10.1093/scan/nsq085

Bartz, J. A., Zaki, J., Bolger, N., & Ochsner, K. N. (2011). Social effects of oxytocin in humans: Context and person matter. *Trends in Cognitive Sciences, 15*, 301-309. doi:10.1016/j.tics.2011.05.002

Bateson, M., Desire, S., Gartside, S., & Wright, G. (2011). Agitated Honeybees Exhibit Pessimistic Cognitive Biases. *Current Biology, 21*(12), 1070-1073. doi:10.1016/j.cub.2011.05.017

Beck, A. M., & Katcher, A. H. (1984). A New Look at Pet-Facilitated Therapy. *Journal of the American Veterinary Medical Association, 18*(4), 414-421. Retrieved February 4, 2015.

Blumberg, Mark S., and Greta Sokoloff. "Hard Heads and Open Minds: A Reply to Panksepp (2003)." *Psychological Review* 110.2 (2003): 389-94. Web. doi: 10.1037/0033-29X.110.2.389

Cacioppo, J. T., Hawkley, L. C., Norman, G. J., & Berntson, G. G. (2011). Social isolation. Annals of the New York Academy of Sciences, 1231(1), 17-22. doi:10.1111/j.1749-6632.2011.06028.x

Churchland, P. S., & Winkielman, P. (2012). Modulating social behavior with oxytocin: How does it work? What does it mean? *Hormones and Behavior, 61*(3), 392-399. doi:10.1016/j.yhbeh.2011.12.003

Dog-laughter: Recorded playback reduces stress related behavior in shelter dogs. (2005, July 31). *Proceedings of the 7th International Conference on Environmental Enrichment*.

Ekman, P. (1992). Are there basic emotions? *Psychological Review, 99*(3), 550-553. doi:10.1037//0033-295X.99.3.550

Ewing, C., MacDonald, P., Taylor, M. & Bowers, M. (2007). Equine-Facilitated Learning for Youths with Severe Emotional Disorders: A Quantitative and Qualitative Study. *Child and Youth Care Forum, 36*, 59-72.

Fine, A. H., A. Beck (2010). Understanding our kinship with animals: Input for Health Care Professionals Interested in the Human/Animal Bond., In A. H. Fine (Author), *Handbook on Animal-Assisted Therapy: Theoretical Foundations and Guidelines for Practice* (3rd ed., pp. 3-16). San Diego, California: Academic Press.

Friedmann, E., Kather, A. H., Lynch, J. J., & Thomas, S. A. (1980). Animal Companions and One-Year Survival of Patients after Discharge from a Coronary Care Unit. *Public Health Report, 95*, 307-312.

Friedmann, E., Son, H., & Tsai, C. (2010). The Animal/Human Bond: Health and Wellness. In A. H. Fine (Author), *Handbook on Animal-Assisted Therapy: Theoretical Foundations and Guidelines for Practice* (3rd ed., p. 89-90). San Diego, California: Academic Press.

Friedmann, E. & Thomas, S. A. (1995). Pet Ownership, Social Support, and One-Year Survival after Acute Myocardial Infarctiion in the Cardiac Arrythmia Suppression Trial (CAST). *American Journal of Cardiology, 76*, 1213- 1217.

Friedmann, Erika, Sue A. Thomas, Heesook Son, Deborah Chapa, and Sandra Mccune. "Pet's Presence and Owner's Blood Pressures during the Daily Lives of Pet Owners with Pre- to Mild Hypertension." *Anthrozoos: A Multidisciplinary Journal of The Interactions of People & Animals* 26.4 (2013): 535-50. Web. 13 Apr. 2015. doi: 10.2752/1753037 13X13795775536138.

Grillon, C., Krimsky, M., Charney, D. R., Vytal, K., Ernst, M., & Cornwell, B. (2012). Oxytocin Increases Anxiety to Unpredictable Threat. *Molecular Psychiatry, 18*(9), 958-960. doi:10.1038/mp.2012.156

Hackshaw, A. (2008). Small studies: Strengths and limitations [Editorial].*European Respiratory Journal, 32*(5). Retrieved February 2, 2015, doi: 10.1183/09031936.00136408

Heinrichs, M., Dawans, B. V., & Domes, G. (2009). Oxytocin, vasopressin, and human social behavior. *Frontiers in Neuroendocrinology, 30*(4), 548-557. doi:10.1016/j.yfrne.2009. 05.005

Herman, J. P., & Cullinan, W. E. (1997). Neurocircuitry of stress: Central control of the hypothalamo–pituitary–adrenocortical axis [Abstract].*Trends in Neurosciences, 20*(2), 78-84. doi:10.1016/S0166-2236(96)10069-2

Holmes, C., Goodwin, D., Redhead, E., & Goymour, K. (2011). The Benefits of Equine-Assisted Activities: An Exploratory Study. *Child & Adolescent Social Work Journal*,*29*, 110-122.

Jalongo, M. R., Astorino, T., & Bomboy, N. (2004). Canine Visitors: The Influence of Therapy Dogs on Young Children's Learning and Well-Being in Classrooms and Hospitals. *Early Childhood Education Journal*,*32*(1), 9-16. doi:10.1023/B:ECEJ.0000039638.60714.5f

Jenkins, J. L. (1986). Physiological Effects of Petting a Companion Animal. *Psychological Reports, 58*(1), 21-22. doi:10.2466/pr0.1986.58.1.21

Kern, J. K., Fletcher, C. L., Garver, C. R., Jyutika, K. M., Grannemann, B. D., Knox, K. R., Richardson, T. A., Trivedi, M. H. (2011). Prospective Trial Of Equine-Assisted Activities in Autism Spectrum Disorder. *Alternative Therapies Health Med., 17*, 14-20.

Kruger, K. A., MSW, & Serpell, J. A., PhD. (2010). Animal-Assisted Interventions In Mental Health: Definitions and Theoretical Foundations. In A. H. Fine (Author), *Handbook on Animal-Assisted Therapy* (3rd ed., p. 33). San Diego, California: Academic Press

Knutson, B., Burgdorf, J., & Panksepp, J. (2002). Ultrasonic vocalizations as indices of affective states in rats. *Psychological Bulletin, 128*(6), 961-977. doi: 10.1037/0033-2909.128.6.961

Kulik, J. A., & Mahler, H. I. (1989). Social support and recovery from surgery. *Health Psychology, 8*(2), 221-238. doi:10.1037//0278-6133.8.2.221

Levinson, B. (1969). *Pet-oriented Child Psychotherapy*. Springfield, IL: Charles C. Thomas.

Leavens, D. (2009). Animal communication: Laughter is the shortest distance between two apes. *Current Biology, 19*(13), 511-513. doi: 10.1016/j.cub.2009.05.007

Marino, L., Lilienfeld, S. O. (2007). Dolphin-Assisted Therapy: More Flawed Data and More Flawed Conclusions. *Anthrozoös, 16*, 147-159.

McEwen, B. B. (2004). Brain-Fluid Barriers: Relevance for Theoretical Controversies Regarding Vasopressin and Oxytocin Memory Research. *Advances in Pharmacology, 50*, 531-567. doi:10.1016/S1054-3589(04)50014-5

Mello L. E., Galvao-Coelho N., & Medeiros M. A. (2014). Social isolation disrupts hippocampal neurogenesis in young non-human primates. Frontiers in Neuroscience, 8 doi:10.3389/fnins.2014.00045

Mendl, M., Paul, E., & Chittka, L. (2011). Animal Behaviour: Emotion in Invertebrates? *Current Biology, 21*(12), R463-R465. doi:10.1016/j.cub.2011.05.028

Miller, S. C., Kennedy, C., Devoe, D., Hickey, M., Nelson, T., & Kogan, L. (2009). An Examination of Changes in Oxytocin Levels in Men and Women Before and After Interaction with a Bonded Dog [Abstract].*Anthrozoos: A Multidisciplinary Journal of The Interactions of People & Animals, 22*(1), 31-42. doi:10.2752/175303708X390455

Miklosi, A., Kubinyi, E., Topal, J., Gacsi, M., Viranyi, Z., & Csanyi, V. (2003). A Simple Reason for a Big Difference: Wolves do not Look Back at Humans, but Dogs Do. Curr. *Current Biology,* (13), 763-766. Retrieved February 3, 2015.

Nagasawa, M., Kikusui, T., Onaka, T., & Ohta, M. (2009). Dog's gaze at its owner increases owner's urinary oxytocin during social interaction. *Hormones and Behavior, 55*(3), 434-441. doi:10.1016/j.yhbeh.2008.12.002

Nimer, J., & Lundahl, B. (2007). Animal-Assisted Therapy: A Meta-Analysis. *Anthrozoos: A Multidisciplinary Journal of The Interactions of People & Animals, 20*(3), 225-238. doi:10.2752/089279307X224773

Odendaal, J., & Meintjes, R. (2003). Neurophysiological Correlates of Affiliative Behaviour between Humans and Dogs. *The Veterinary Journal, 165*(3), 296-301. doi:10.1016/S1090-0233(02)00237-X

Ott, V., Finlayson, G., Lehnert, H., Heitmann, B., Heinrichs, M., Born, J., & Hallschmid, M. (2013). Oxytocin Reduces Reward-Driven Food Intake in Humans. *Diabetes, 62*(10), 3418-3425. doi:10.2337/db13-0663

Panksepp, J. (2007). Neuroevolutionary sources of laughter and social joy: Modeling primal human laughter in laboratory rats. *Behavioral Brain Research, 182,* 231-244. doi: 10.1016/j.bbr.2007.02.015

Panksepp, J., & Biven, L. (2012). *The archaeology of mind: Neuroevolutionary origins of human emotions*. New York: W. W Norton.

Panskepp, J., & Burgdorf, J. (2003). "Laughing" rats and the evolutionary antecedents of human joy? *Physiology & Behavior, 79*, 533-547. doi: 10.1016/S0031-9384(03)00159-8

Portfors, C. (2007). Types and functions of ultrasonic vocalizations in laboratory rats and mice. *Journal of the American Association for Laboratory Animal Science, 46*(1), 28-34. Retrieved September 30, 2014.

Parish-Plass, N. (2008). Animal-Assisted Therapy with Children Suffering from Insecure Attachment Due to Abuse and Neglect: A Method to Lower the Risk of Intergenerational Transmission of Abuse? *Clin. Child Psychol Psychiatry, 13*(7). doi:10.1177/13591045070833

Rousseau, J., Masters, R. D., Masters, J. R., & Rousseau, J. (1964). *The First and Second Discourses*. New York: St. Martin's Press.

Rygula, R., Pluta, H., & Popik, P. (2012). Laughing rats are optimistic. *Plos One, 7*(12). doi: 10.1371/journal.pone.0014115

Schuelke, S. T., RN, MSN, Trask, B., RN, MSN, Wallace, C., RN, MSN, Baun, M. M., DNSc., Bergstrom, N., PhD., RN, & McCabe, B., PhD., RN. (1991). Physiological Effects of the Use of a Companion Animal Dog as a Cue to Relaxation in Diagnosed Hypertensives. In *The Latham Letter*. Alameda, California: The Latham Foundation.

Schultz, P., Remick-Barlow, G., & Robbins, L. (2006). Equine-Assisted Pychotherapy: A Mental Health Promotion/Intervention Modality for Children Who Have Experienced Intra-Family Violence. *Health & Social Care in the Community, 15*, 265-271.

Strong, V., Brown, S., Huyton, M., & Coyle, H. (2002). Effect of trained Seizure Alert Dogs ® on Frequency of Tonic–Clonic Seizures. *Seizure, 11*(6), 402-405. doi:10.1053/seiz.2001.0656

Tabak, B. A., Mccullough, M. E., Szeto, A., Mendez, A. J., & Mccabe, P. M. (2011). Oxytocin indexes relational distress following interpersonal harms in women. *Psychoneuroendocrinology, 36*(1), 115-122. doi:10.1016/j.psyneuen.2010.07. 004

Takahashi, N., Kashino, M., & Hironaka, N. (2010). Structure of rat ultrasonic vocalizations and its relevance to behavior. *Plos One, 5*(11), 1-7. doi: 10.1371/journal.pone.0014115

Thompson, M. J. (2009). Animal-Assisted Play Therapy: Canines as Co-Therapists. *Compelling Counseling Interventions,* 199-209. Retrieved February 3, 2015. Alexandria, VA: American Counseling Association.

Tops, M., Peer, J. M., Korf, J., Wijers, A. A., & Tucker, D. M. (2007). Anxiety, cortisol, and attachment predict plasma oxytocin. *Psychophysiology,44*(3), 444-449. doi:10.1111/j.1469-8986.2007.00510.x

VanFleet, R., & Faa-Thompson, T. (2010). The Case for Using Animal Assisted Play Therapy. *Bri. J. Play Therapy, 6*, 4-18. Retrieved February 4, 2015.

Weisman, O., Zagoory-Sharon, O., Schneiderman, I., Gordon, I., & Feldman, R. (2013). Plasma oxytocin distributions in a large cohort of women and men and their gender-specific associations with anxiety. *Psychoneuroendocrinology, 38*(5), 694-701. doi:10.1016/j.psyneuen.2012.08.011

Weiss, D. (n.d.) (2009). Equine Assisted Therapy and Theraplay. In E. Munns, Lanham MD, & J. Aronson (Authors), *Applications of Family and Group Theraplay* (pp. 225-233).

Yorke, J., Adams, C., & Coady, N. (2008). Therapeutic Value of Equine--Human Bonding in Recovery from Trauma. *Anthrozoos, 21*, 17-30.