Personality Traits and Owner-Dog Attachment in a Canadian Sample

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Much of the literature on owner-dog attachment and the influence of personality on the owner-dog relationship has originated in Europe, with few studies in North America. To address this imbalance, 29 owner-dog dyads from a Canadian population were tested in the Strange Situation Test (SST) and owners completed assessments of their own personalities (NEO-FFI-3), the personalities of their dogs (MCPQ-R), and their level of attachment to their dogs (DAQ). Attachment scores were comparable to those in previous research, and all owner-dog dyads were deemed to be securely attached. However, no predicted "matching" of seemingly analogous personality traits (e.g., human and dog Neuroticism) was found, and there was no relationship between dog personality and attachment behaviours during the SST. In contrast, owners with higher Extraversion scores initiated more contact with their dogs in the first reunion episode of the SST (following separation). Owners scoring low on Openness and/or Neuroticism had dogs with higher scores for Training Focus, suggesting that these dogs could more easily attend to a calm, stable owner. Owners who scored high in Openness had dogs with lower Amicability scores, possibly indicating more tolerance of a less desirable dog trait by such owners. Differences between the findings of this study and those conducted in Europe suggest that more emphasis should be given to the possible impact of cultural variation on the behaviours of and perceived relationships between owners and their dogs.

Keywords: owner-dog relationship, personality, attachment

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Attachment behaviors typically involve one individual seeking and maintaining close proximity to another (Bowlby, 1958; 1972). The 'attachment figure' is often used as a 'secure base' for exploration, providing social and emotional support that is important for handling stressful situations and new environments (Ainsworth, 1979, 1989). This attachment concept, which originally described the relationship between human infants and their mothers, is also evident in the behavior and

neurobiology of non-human species (e.g., Insel & Young, 2001; Remage-Healey, Adkins-Regan & Romero, 2003), as well as at least one type of interspecific relationship, i.e., that between humans and their pets. Pet-owner attachment has been examined from the standpoints of the owner, typically with questionnaires (e.g., Archer & Ireland, 2011; Bagley & Gonsman, 2005; Kurdek, 2009; Sable, 2013) and the pet, primarily dogs, *Canis familiaris*, using behavioral observations in specific testing situations (e.g., Gácsi, Topál, Miklósi, Dóka & Csányi, 2001; Mariti et al., 2013; Prato-Previde, Fallani & Valsecchi, 2006; Topál et al., 2005; Wanser & Udell, 2018).

Evaluation of Owner-Dog Attachment

Behaviors used to assess the attachment of a dog to the owner include a behavioral preference for the owner over other people, often measured by increased time spent in close proximity and greater attention (i.e., longer gaze durations) to the owner compared to others (e.g., Horn, Range & Huber, 2013; Kerepesi, Dóka & Miklósi, 2015; Mongillo, Bono, Regolin & Marinelli, 2010). Attachment is also evident in how dogs react to separation from the owner. Responses to owner separation include: vocalizations, active search for the owner, waiting by the door through which the owner left, and avoiding interaction with a caregiver 'substitute' or stranger (e.g., Prato-Previde et al., 2006; Scaglia et al., 2013). In addition, the occurrence of behaviors such as excessive self licking, defecation/urination, pacing, and destruction of property may indicate separation-related disorder (SRD, also called separation anxiety; Schwartz, 2003; Sherman, 2008). Although clear evidence for the role of attachment in SRD is still emerging (Parthasarathy & Crowell-Davis, 2006; van Rooy, Thompson, McGreevy & Wade, 2018), both dog personality (high Neuroticism) and owner attachment style (high attachment avoidance) may increase

the likelihood of SRD development (Konok et al., 2015).

The dog's manifestation of attachment to the owner has been evaluated most often with a variation on Ainsworth's Strange Situation (Ainsworth, 1969), a procedure developed to address attachment styles of young children towards their mothers (i.e., secure or insecure; Ainsworth & Bell, 1970). This test uses a novel and interesting environment (i.e., toys are typically present) into which the child (or dog) and caregiver enter for a brief period of time. A stranger is then introduced, the caregiver leaves for some period of time, and then eventually returns. The child (or dog's) behavior during these episodes of being together, separated, and reunited is observed and quantified. The canine version of the test, hereafter referred to as the Strange Situation Test (SST), assesses attachment-related behaviors that indicate the dog's preference for the owner vs. a stranger (relative time dog spends near or in contact with each), whether the owner is used as a secure base for exploration (frequency of approach to owner, proximity), and the dog's reaction to separation from the owner and subsequent reunion (Fallani, Prato-Previde, & Valsecchi, 2007; Gácsi et al., 2001; Mariti et al., 2013; Palestrini, Prato-Previde, Spiezio & Verga, 2005; Palmer & Custance, 2008; Prato-Previde, Custance, Spiezio & Sabatini, 2003; Rehn, Lindholm, Keeling & Forkman, 2014; Rehn, McGowan & Keeling, 2013; Schöberl et al., 2016; Siniscalchi, Stipo & Quaranta, 2013; Solomon, Beetz, Schöberl, Gee & Kotrschal, 2018; Topál et al., 2005; Topál, Miklósi, Csányi & Dóka, 1998).

Owner Personality, Dog Behavior, and Attachment

Owner personality likely plays an important role in how owners interact with the dog, on the dog's behavior, and on the dog-owner attachment relationship. These relationships have been documented in

various studies requiring different dog-owner interactive activities (e.g., Kis, Turcsán, Miklósi & Gásci, 2012; Kotrschal, Schöberl, Bauer, Thibeaut & Wedl, 2009; Payne, Bennett & McGreevy, 2015; Wedl, Schöberl, Bauer, Day & Kotrschal, 2010). Owners scoring high on Neuroticism and Openness used more physical and verbal commands when telling their dogs to sit, and had dogs that continued to sit for longer durations (Kis et al., 2012). Owners scoring high on Neuroticism were likely to report their dog as an important social support system (Kotrschal et al., 2009). Owners scoring high on Extraversion more often reported that they enjoyed activities with their dogs (Kis et al., 2012; Kotrschal et al., 2009). Potential physiological influences of owner personality traits on their dogs have also been reported; owners scoring high on Neuroticism and low on Conscientiousness had dogs with higher morning cortisol (a glucocorticoid hormone related to stress and arousal; Schöberl et al., 2012), and in a version of the SST, dogs with owners scoring high on Neuroticism, as well as those with owners scoring high on Agreeableness showed lower cortisol reactivity over the procedure (Schöberl et al., 2016). Also, owner personality traits, as well as dog traits, were related to the dog's behavior even when no interaction occurred between the dog and the owner, i.e., during a 'picture viewing' task that required owners to be inattentive to their dogs (Wedl et al., 2010). Owners who scored high in Neuroticism had dogs who spent more time close to them, while dogs who were considered "vocal and aggressive" showed less time in close proximity to their owners (Wedl et al., 2010). Furthermore, differences in how the owner viewed the dog, i.e., as a social supporter vs. a social partner or companion, were related to how often the dog approached the owner during the task, with dogs of owners who considered them a means of social support approaching the owner more

often (Wedl et al., 2010).

Recently, Solomon et al. (2018) further demonstrated that dog personality may influence the nature of the dog-owner attachment relationship. More active/excitable dogs, scoring higher in the personality trait Extraversion (via the owner-reported Monash Canine Personality Questionnaire-Revised, MCPQ-R; Ley, McGreevy & Bennett, 2009), were more likely to demonstrate behaviors during the SST that led to an attachment classification of "insecure". This attachment security classification, based on those reported for human infants (Ainsworth, Blehar, Waters & Wall, 1978), is given when the dog shows behaviors other than those deemed to indicate a secure bond to the owner. For example, while a securely attached dog will approach the owner upon reunion and then return to play or exploration, an insecurely attached dog may show resistance to owner proximity, or exaggerated attempts to engage in physical contact with the owner (Solomon et al., 2018; see also Wanser & Udell, 2018). It is important to note that the MCPQ-R (among other) canine personality assessments are, in fact, reported by owners; i.e., they reflect dog personality as *perceived* by owners. Certainly, while there is substantial evidence that owner and non-owner assessments of dog personality (including behavioural assays) correspond quite highly (e.g., Fratkin, Sinn, Patall, & Gosling, 2013; Posluns, Anderson, & Walsh, 2017), owner-based dog personality assessments may, to some degree, reflect the owners themselves.

Cultural Influences on Relationships among Owner-Dog Attachment and Personality?

Undoubtedly, dog-owner relationships must be influenced by both the personality traits of dogs and owners. Interestingly, there is some evidence that owners and their dogs show similar scores for certain personality traits and behavioral

preferences, a phenomenon known as "personality matching" (Curb, Abramson, Grice, & Kennison, 2013; Turcsàn, Range, Viranyi, Miklósi & Kubinyi, 2012). In fact, as owner-reported dog personality may partially reflect the owner's perceived similarity of the dog to themselves, the concept of owner-dog personality matching is consistent with the larger relationships literature showing that perceived, but not actual, similarity is an important predictor of liking an existing (human) partner (e.g., Montoya, Horton, & Kirchner, 2008). Turcsàn et al. (2012), using the Big Five Inventory (BFI) for owners and an amended owner-reported BFI for dogs, found that scores of owner-dog dyads were similar on at least four of the five main personality factors: Neuroticism, Extraversion, Conscientiousness and Agreeableness (similarities on Openness were found in only one analysis). Curb et al. (2013) discovered that owner satisfaction with their dog was higher when owners and dogs both scored similarly on sharing possessions, enjoyment of running outside, whether or not they engaged in destructive activity, and their ability to get along with others. Although attachment measures were not assessed specifically, higher owner satisfaction with the dog is likely correlated with greater attachment, at least from the owner's perspective.

Research on the "pet enhancement bias", i.e., whether people report that their pet is better than the average pet, has shown that owners who are highly attached to their pets and/or report higher similarity to their pets report a more pronounced bias towards them (El-Alayli et al., 2006). These effects may be mediated by *liking* the pet; owners who reported more similar traits to their pet also liked them more. Interestingly, El-Alayli et al. (2006) suggest that cultural differences could influence pet enhancement bias, as people from Western and Eastern cultures

differ in self-enhancement. To date, however, there has been no investigation of the possible effects of culture on the pet enhancement bias and, more generally, few studies directly exploring cultural impacts on dog-owner attachment relationships.

It is noteworthy that most behavioral studies investigating dog-owner attachment, either using the SST protocol or a similar objectively scored test, have been conducted in Europe. Two published North American studies either do not replicate results from similar studies conducted elsewhere in the world (i.e., Thielke, Rosenlicht, Saturn & Udell, 2017; effects of intranasal oxytocin on dog-owner attachment-related behaviors were dissimilar to those found in two Japanese studies), or are not directly comparable (i.e., Wanser & Udell, 2018; comparable SST method was used, but the study focused on animal-assisted activities which, to date, is unique in this literature). This raises some concerns regarding the generalizability of the nature of the dog-owner attachment relationship to other parts of the world, including Canada and the United States (US), since cross-cultural differences in attitudes towards pets (e.g., Serpell, 2017; Templer & Arikawa, 2011), and reasons for pet-keeping (e.g., Wan, Kubinyi, Miklósi & Champagne, 2009) are well known. Such differences may have profound influences on the actual or perceived attachment relationship formed between owners and dogs. For example, a cross-cultural comparison of German Shepherd owners in Hungary and the US revealed that, in addition to significant differences in some reported dog personality traits, 88% of American owners reported their purpose for having their dog as "pet/companion/family member", while only 26% of Hungarian owners did so (Wan et al., 2009). Furthermore, dog owners from Hungary and Germany reported significantly different incidences of dog SRD (33.1% vs.

18.4%, respectively; Konok et al., 2015). In this same survey, the dog personality trait "affectionate" appeared to relate differently to dog SRD in the two countries. Indeed, dog behaviors in the SST may differ on the basis of country; in one preliminary study, dogs spent more time near strangers following owner departure when the dog-owner pairs came from Hungary compared to Austria or Italy (Horn, Marshall-Pescini, Virányi, & Range, 2013). Even within the US, owner race/ethnicity appears to relate to the dog-owner relationship. In a questionnaire-based study, Hoffman, Chen, Serpell, and Jacobson (2013) showed that the impact of a dog personality trait (excitability) on the owner's reported attachment to the dog was significantly moderated by whether the owner was Caucasian/Non-Caucasian. Additional research in other countries, and among differing cultural groups within countries, will give us a more robust depiction of the factors that influence dog-owner attachment.

This study is the first to directly examine the relationships between personality and dog-owner attachment in the SST in a Canadian population. We evaluated the relationships among: owner and dog personality (personality matching), owner and dog personality traits and owner attachment scores, owner personality traits and both owner-and dog-initiated behaviors in the SST, and dog personality traits and dog behaviors, using standardized and validated personality assessments of owners (Neuroticism Extraversion Openness-Five Factor Inventory-3, NEO-FFI-3; Costa & McCrae, 1985) and dogs (MCPQ-R), an owner-based attachment questionnaire (Dog Attachment Questionnaire, DAQ, Archer & Ireland, 2011), and the SST. Although we felt that owners and dogs tested in Canada might show different outcome patterns relative to those found among European owner-dog dyads, we present our hypotheses as if they

would not, given the paucity of evidence on which to make alternate predictions. Based on the previous personality matching work, we predicted that dogs and owners would show similar scores for possibly analogous personality traits, such as Extraversion, Neuroticism, and Agreeableness/ Amicability. Owner personality traits were expected to correlate with attachment-related behaviors in the SST, both those initiated by dogs (e.g., seeking proximity to owner) and owners (e.g., owner-initiated touching of the dog). Similar to Wedl et al. (2010) we expected more neurotic owners would have dogs that stayed near them longer and would possibly initiate more physical contact with their dogs. Dog personality traits were expected to associate with the dog's behavior during the SST; e.g., more excitable dogs (high Extraversion) were predicted to spend less time near owners (see Solomon et al., 2018), and more neurotic dogs (high Neuroticism) more time near them. Dogs scoring higher in Neuroticism were expected to also avoid contact with the stranger during the SST, and to spend more time near the door after the owner leaves, as a means of re-gaining proximity. We also expected that higher owner attachment (DAQ) scores would correlate with more attachment-related behaviors from dogs during the SST, and possibly with dog personality traits, such as Amicability and Training Focus. We assessed owner and dog personality and behaviors, as well as attachment scores, for any differences between males and females (both dogs and humans). Since sex differences in DAQ scores are documented, with female owners scoring higher (Archer & Ireland, 2011), we expected to see this difference in our sample.

The behaviors displayed during the SST are reported briefly here, but more detail is provided in Ryan, Storey, Anderson & Walsh (2019). They can also be found in Ryan (2015, unpublished Masters thesis).

Method

Ethical approval

This study was carried out in accordance with Canada's Tri-Council Policy Statement: Ethical Conduct for Research Involving Humans (TCPS 2) and regulations of the Canadian Council on Animal Care (CCAC). Permits for this specific research project were issued under the auspices of Memorial University of Newfoundland's Interdisciplinary Committee on Ethics in Human Research (ICEHR #2012-320-SC) and Institutional Animal Care Committee (IACC protocol #12-01-CW). As per approved protocol in ethics permit ICEHR #2012-320-SC, written consent was obtained from participants (owners) prior to their participation in the study. Participant welfare was a priority, and this study used non-invasive behavioral observations, questionnaire data, and minimally invasive saliva sampling techniques. As described below, significant stress-related behaviors in dogs during behavioral testing were grounds for stopping the test.

Participants

Participants were recruited through a variety of social media (e.g., public posters, dog shows, and local classified ads such as www.kijiji.ca). Twenty-nine (29) volunteer owner-dog dyads completed the behavioral study; three recruited dyads did not complete the testing due to excessive apprehension (i.e., panting, trembling) in the dog during the SST. Owners were six males and 23 females, ranging from 20 to 71 years old (X ± SD, 40 ± 14.8 years). Twenty-one (72.4%) owners reported not having children.

There were 13 male and 16 female dogs, ranging from eight months to 14 years old (M ± SD, 6.0 ± 3.9 years). Five of the 29 dogs were sexually intact: one female (not in estrus) and four males. Dogs were of various breeds (i.e., mixed breed, N =9; beagle, N=5; Labrador retriever, N= 3; and N =1 for all of the following breeds, as reported by owners: Cavalier King Charles spaniel, rough collie, eurasier, German shepherd dog, golden doodle, Labrador husky, miniature golden doodle, Newfoundland, olde English bulldogge, pitbull terrier, Samoyed, Yorkshire terrier); all but one dog weighed more than 8 kg. All dogs were kept strictly for companionship purposes, i.e., there were no working or service dogs in this study. Most households (N =19, 66.0%) had one dog at the time of the study; the remaining owners kept multiple dogs (maximum of four dogs).

Prior to participation, dogs and owners were screened to ensure that they were free from endocrine disorders or pathologies and that the dog and owner had cohabitated for at least six months. None of the dogs had aggressive tendencies (according to owner reports) and all were familiar with travelling outside of their homes.

Recruitment and testing occurred between August 9th, 2012 and February 25th, 2013. Owners and dogs arrived at Memorial University of Newfoundland between 1300 and 1900h. Because saliva sampling was part of this study (results reported in Ryan et al., 2019), participants were asked to refrain from eating (especially dairy products) one hour before arrival, to refrain from drinking caffeine two hours before arrival and not to pet their dogs excessively on route to the study location, as these factors may influence salivary analyte results (e.g., Handlin et al., 2011).

Materials and Procedure

Study Location. Upon arrival, owners provided signed consent to the researcher. Two different study rooms were used because of the availability and seasonal use of office space on campus. Due to restrictions of locations to mount cameras in the first room, certain behaviors could not be coded with accuracy. Therefore, behavioral data for the Strange Situation Test (SST) were evaluated only for the 26 dyads that

were tested in the second (main) location.

The main study location was a 2.7m x 5.3m office, containing a desk, two chairs, a speakerphone, a basket of toys, a water bowl and a series of storage units (filing cabinets and book shelves). Additionally, to make the room easier to clean between participants, a thin rubber mat was secured on the floor. Four synchronous security cameras (LH114000 series, Lorex, Plainsfield, IL, USA) were set-up in the room at a variety of angles, so that most of the room was captured. The cameras were connected to a computer hard drive (upon which video files were stored) and a viewing monitor. As the video format produced by this system was .264, a series of file conversions were performed using Wondershare^{TM} (Surrey, BC, Canada) before the final .mp4 files were created. Cooling fans were also placed in the room to mask external ambient noise, and to prevent overheating.

Strange Situation Test Procedure. The SST basic protocol involves a dog experiencing a series of separation and reuniting events from her/his owner and exposure to a stranger (Table 1). Slight additional modifications included reducing the duration of the episodes and incorporating saliva sampling. One of four female strangers (20-30 years old) was used for each dog, chosen to ensure that the dog had no previous interactions with that person.

During the SST, 'there was a brief (30 sec) introductory period and seven 'episodes', each lasting approximately 3 min (Table 1). All episode changes and instructions were administered over a speakerphone and saliva sampling occurred at specific intervals throughout the, procedure. Ten minutes after dyads arrived, the researcher took baseline saliva samples from both owners and their dogs. Owners and dogs were then introduced to the room, the dog was unleashed, and owners were shown the locations of the speakerphone, toys, and water. Episode 1 began when the researcher left and owners were instructed to interact/play with their dog. During Episode 2, a stranger entered the room, sat down and engaged in conversation with the owner. Near the end of Episode 2 the owner left, while the stranger attempted to interact/play with the dog. Episode 3 was the first episode that the dog and stranger were alone. Strangers were instructed to attempt to interact/play with the dog and near the end of

Table 1. *Summary of the Strange Situation Test (SST). Each episode is outlined with respect to durations and events that occurred in the room.*

Event	Saliva Sample	Time	Description
Introduction		30 sec	Owner + dog + researcher enter room
Episode 1		3 min	Owner + dog
Episode 2		3 min	Stranger enters, greets owner + dog; owner exits at end of episode
Episode 3	Dog	3 min	Stranger + dog
Episode 4		3 min	Owner returns; Owner + dog
Episode 5		3 min	Owner leaves; Dog alone
Episode 6	Owner (outside room) + Dog	3 min	Stranger returns; Stranger + dog
Episode 7	Owner + Dog	3 min	Owner returns; Owner + dog

the episode took the dog's second saliva sample (8.5 min into the procedure). In Episode 4, the owner was instructed to enter the room and the stranger was asked to exit, while the owner interacted with their dog. For Episode 5, the dog was completely alone. During Episode 6, the stranger entered the room and took the dog's third saliva sample (15.5 min into the procedure), while the owner provided their second saliva sample outside of the room. After taking the sample, strangers attempted to interact/play with the dog. Episode 7 was the final episode; the stranger exited the room and the owner returned and was instructed to interact/play with their dog. At the end of Episode 7, the researcher took both the dog's and the owner's last saliva sample (21.5 min into the procedure).

Behavior. Videos converted to .mp4 files were watched using QuickTime Media Player 7 (Apple, Toronto, ON, Canada), synchronized with a behavioral coding program (logger.app; http://play.psych.mun .ca/_apps/log/; ©Avery Earle, Memorial University of Newfoundland). This coding program was synchronized with the video's time signature and allowed a one-letter code to be assigned to each behavior, providing a time stamp for when the behavior occurred. The resulting .txt data files were analyzed to extract durations and frequencies of the behaviors analyzed using Python code.

The behaviors coded included physical proximity, physical contact, body shaking and door scratching (Table 2). Proximity was assessed using the dog's travel pattern such that one state could change into another depending on the dog's position in the room (e.g., "near owner" could change to "near door"). Dogs were considered to be in close proximity to a person or object if they were within one distance of their own body length (snout to rear) from a person(s) or object(s). This method was preferred to choosing an arbitrary numerical value (e.g., 1

m), as the significance of proximity within 1 m would likely vary according to dog size.

Both the duration and frequency of coded behaviors were primarily acquired from the main camera that gave the most complete view of the room. Proximity to the door, however, was analyzed using the camera that exclusively monitored activity near the door. Physical proximity and physical contact behaviors were coded from the beginning of Episode 1 until the end of Episode 7 and were analyzed both as cumulative measures across all episodes and separately for each episode (since episodes reflect different changing situations to which the dog must respond and the same response across episodes is not necessarily expected; see Siniscalchi et al., 2013). During coding of physical contact, notes were made regarding who initiated contact and whether the contact was intentional, i.e., clear indication of movement goal (forward gaze, dog often coming to retrieve a toy) vs. unintentional, i.e., brushing a tail off the person's leg while sniffing a toy on the ground. Unintentional contact was excluded from the definition of physical contact (but was incorporated into the physical proximity measure).

Body shaking was defined as any one continuous bout of side-to-side movement starting at the head and extending down the body (as if the dog was drying off). Door scratching was counted each time the dog made contact using their paw with the door. A new bout was counted when contact was broken (i.e., all paws on the floor) and then resumed.

All duration values recorded for each attachment-related behavior were expressed as a proportion of time; that is, the duration spent performing the given behavior was divided by the total time available for that behavior to occur, e.g., the time required for saliva sampling was subtracted from the total duration of those episodes. The duration of the behavior was then divided by the 'total

interaction time', thereby producing a fair and accurate picture of the attachment behaviors.

Based on dog behavior, owner-dog attachment styles were assigned independently by two judges, as per Wanser & Udell (2019). These attachment styles describe owners and dogs as being either securely or insecurely attached. Further details can be found in Ryan et al. (2019).

Assessment Instruments. A series of supplemental questions, two standardized personality assessments, and a questionnaire on attachment were given to participants (see Appendix A). Supplemental questions required owners to report basic information

Table 2. *Ethogram of dog behaviors analyzed.*

Behavior	Definition

Physical proximity to:
    Owner
    Stranger
    Door
	Physical closeness, excluding actual contact, to any focal object/individual or combination of focal objects/individuals in space, while within the distance of the dog's own body length (snout to rear). Both frequencies and durations were measured. Each interval was based on the dog's position and could be ended by any state change.

Physical contact
    Owner
    Stranger
    Cannot see
	Contact occurring between a person and the dog, including petting (stroking), patting (hit lightly), jumping up on, sitting on, kissing, pawing, and extended touch (making physical contact using a toy or touching/pulling the dog's collar). The individual initiating the contact was recorded and frequency and duration were measured.
	
	Physical contact within the context of the saliva sample was not considered contact with stranger or researcher and extended touch by lifting a bowl for the dog to drink was excluded.

Body shaking	A side-to-side motion that begins at the head and extends down the body. This behavior mimics a typical wet dog dry-off routine, without the context of being wet.
Door scratching	A bout of physical contact made with the door such that continual touching was considered a single bout and if contact was broken (neither paw touching the door) the bout was ended. Under some circumstances when one paw fell and at the exact same time the other paw resumed position on the door, contact was said to be unbroken.

pertaining to their own health, their dog's health and general activities the dog and owner engaged in together. The majority of supplemental questions were not used for analysis, except for owner-reported separation anxiety in dogs, dog age, and how long the dog and owner had lived together. The standardized and validated assessments consisted of the Neuroticism Extraversion Openness-Five-Factor-Inventory-3 (NEO-FFI-3; Costa & McCrae, 1985), and the Monash Canine Personality Questionnaire Revised (MCPQ-R; Ley et al., 2009). These instruments were chosen, in part, due to their relatively short length and, hence, lower time commitment needed by study participants to complete them. In addition, both personality assessments are considered to have construct validity and reliability (NEO-FFI-3: McCrae & Costa, 2010; MCPQ-R: Ley et al., 2009). The final instrument was the Dog Attachment Questionnaire (DAQ; Archer & Ireland, 2011). This tool was selected because it was the only owner-based questionnaire to specifically and quantitatively evaluate the attachment relationship between owners and their dogs available to us at the start of the study. All participants in the study completed the MCPQ-R ($N = 29$) and the DAQ ($N = 29$), but not all participants completed the NEO-FFI-3 ($N = 25$, recovery rate of 86.2%).

NEO-FFI-3. The NEO-FFI-3 is a standardized assessment designed for adolescents and adults that uses a series of 60 statements, rated by the participant on a 5-point Likert scale. Each statement relates to one of the big five personality factors: Openness, Conscientiousness, Extraversion, Agreeableness and Neuroticism, with 12 test items per factor. The inventory yields an overall and adjusted (for age and sex) T-score profile of participants for each factor. T-scores less than 45 are considered low scores, those greater than 56 are considered high scores, and those between 45-55 are average. Briefly, high scores for Openness are associated with individuals described as creative, imaginative, and preferring variety, while low scorers on this trait are less interested in novelty, prefer routine, and tend to be more conventional. High scores for Conscientiousness are associated with the adjectives hardworking, goal-oriented, and responsible, while low scores are associated with the adjectives lazy, negligent, and imprecise. Individuals scoring high in Extraversion are talkative, active, and sociable, while those scoring lower are more controlled, independent, and quiet. High scorers on the trait Agreeableness are good-natured, trusting, and friendly, while low scorers are more suspicious, competitive, and irritable. Individuals scoring high on Neuroticism are often more anxious and emotionally labile, while those low on this trait are calm, self-controlled, and more emotionally stable.

This assessment was completed after the original SST at the participant's convenience using an online platform (PAR iConnect; Psychological Assessment Resources, Inc., Lutz, FL).

MCPQ-R. Ley and colleagues (2009) developed the MCPQ-R to identify adjectives, and consequently, condense these adjectives into related super categories for the purpose of describing individual differences in dogs (Ley, Bennett, & Coleman, 2008). The validated MCPQ-R asks owners to rate how well each of a series of 26 adjectives describes their dog on a 6-point Likert scale Based on factor analyses, each adjective belongs to one of five dimensions: Training Focus, Amicability, Neuroticism, Extraversion and Motivation. Each dimension score is based on the rating given to the adjectives belonging to that category divided by the number of adjectives for that category. Training Focus assesses how attentive, biddable, and obedient the dog appears to the owner. Amicability is a measure of friendliness and sociability.

Neuroticism incorporates ratings of nervousness, fearfulness, submissiveness, and timidity into a trait. Extraversion is primarily a measure of the dog's liveliness, excitability, and activity. Motivation describes how persevering, assertive, and determined the dog behaves.

DAQ. The DAQ requires owners to rate how much they agree with each of a series of 35 statements on a 5-point Likert scale. Statements were designed to gain information regarding the depth of the human-dog relationship. Some statements were positively scored such that strong agreement with those items conveyed a strong bond, whereas, other statements were negatively weighted such that strong agreement dismissed or scorned the importance of the relationship (e.g., "My dog is an important part of my life" versus "Having a dog means that you cannot do what you want to", respectively). Upon completion, each response is taken into account, added (or subtracted) together and averaged across all responses (DAQ score = total score/35). An overall average score of 3.0/5 or greater was considered to indicate moderate to high levels of attachment.

Statistical Analyses

All statistical analyses were carried out using IBM SPSS Statistics 20 (IBM, Armonk, NY, USA) or Jamovi 1.0.0.0 (www.jamovi.org). A series of normality tests (binomial and Kolmogorov-Smirnov tests) were performed to determine whether the data were normally distributed. Analyses comparing groups of individuals (e.g., proportion of time with owner vs. stranger) were performed using Independent Samples t-tests. As this work is primarily descriptive, we chose to examine zero-order correlations among personality and behavioral variables, and used Pearson r bivariate tests. No separate estimates of effect sizes are given as absolute values of r indicate effect magnitude. All significance probabilities reported are two-tailed, $p = 0.05$. Given the exploratory nature of these correlational relationships, Bonferroni corrections were not utilized as they were thought to be too restrictive (see Jaeger & Halliday 1998). Instead, we used the Benjamini-Hochberg procedure, which decreases the False Discovery Rate by controlling the permitted proportion of falsely rejected hypotheses (Benjamini & Hochberg, 1995). We assessed the statistical outcomes of multiple tests based on accepting a false positive rate of 10% and 20% (i.e. when we permitted 1 in 10 vs. 2 in 10 of the test outcomes to be false). For all but two results (identified later), the outcomes of the procedure for both rates were the same. The reported sample size deviates from the total number of participants ($N = 29$), as only 26 participants completed SST testing in the main room, and 25 participants completed the NEO-FFI-3.

Results

Attachment-related behaviors

In brief, behaviors observed during the SST indicated dogs were attached to their owners. For example, comparisons of episodes in which the dog was exclusively with the stranger (Episodes 3 and 6) to episodes exclusively with the owner (Episodes 4 and 7) showed that dogs spent proportionately less time in close proximity to the stranger compared to the owner (e.g., Episode 3 vs. 4: $M \pm$ SEM $= 0.135 \pm 0.023$ vs. 0.684 ± 0.040, $t_{25} = -14.91$, $p < 0.001$, $N = 26$; Episode 6 vs. 7: $M \pm$ SEM $= 0.131 \pm 0.026$ vs. 0.709 ± 0.038, $t_{25} = -15.47$, $p < 0.001$, $N = 26$). As well, during Episode 2, when the owner and stranger were both present, dogs spent more time near the owner than the stranger ($t_{25} = 2.60$, $p = 0.015$). Similarly, over the entire SST, dogs engaged in more physical contact bouts with their owner ($M \pm$ SEM $= 53.65 \pm 3.79$, $N = 26$) compared to the stranger ($M \pm$ SEM $= 22.92 \pm 2.29$, $N = 26$, $t_{25} = 8.32$, $p < 0.001$), and spent more time with the owners ($M \pm$ SEM $= 220.95 \pm 17.58$ sec, N

= 26) during these contact bouts ($M\pm$ SEM= 97.28± 10.18 sec, $N = 26$, $t_{25} = 4.42$, $p <$ 0.001).

All owner-dog dyads were classified as having a "secure attachment" style. Whether owners reported having multiple dogs or being a parent had no influence on owner-dog attachment behaviors. Complete SST behavioral results can be found in Ryan (2015) and in Ryan et al. (2019).

Owner Personality

NEO-FFI-3 T-scores (corrected for gender) for men ($N = 4$) and women ($N = 21$) were averaged for each of the five personality factors. The combined T-scores in all domains were either within or very close to the average range (45 – 55) for this test ($M\pm$ SEM): Neuroticism: 50.1± 2.39; Extraversion: 51.2± 2.09; Openness 55.8± 1.67; Agreeableness: 55.0± 2.16; Conscientiousness: 50.7± 2.24. The full range of T-scores from low to high was seen across participants in each domain.

Dog personality

The average MCPQ-R personality dimension scores for dogs obtained were ($M\pm$ SEM): Neuroticism: 51.9± 0.03%; Extraversion: 70.4 ± 0.03%; Amicability: 80.6± 0.03%; Motivation: 66.6± 0.03%; Training Focus: 72.1± 0.02%. There was an unexpected sex difference in Extraversion, as female dogs scored significantly higher than male dogs (77.1± 0.03% vs. 62.2± 0.05%,

respectively; $t_{27} = -2.49$, $p = 0.019$).

Sex differences in owner-perceived attachment (DAQ)

All owners obtained a score higher than 3, suggesting significant perceived attachment to their dogs. As reported in the literature, a sex difference was found in DAQ scores; women scored significantly higher than men: $M\pm$ SEM: 3.71± 0.054 vs. 3.30± 0.115; $t_{27} = -3.35$, $p = 0.002$, $N = 29$), even though there were only four male owners. The overall DAQ mean was nearly identical to that reported in the original paper, which had 163 participants (this study: 3.62± 0.057; Archer & Ireland, 2011: 3.61± 0.049).

Human and dog personality

Predicted links between human (NEO-FFI-3) and dog (MCPQ-R) personality scores for human Agreeableness and dog Amicability and for human and dog Neuroticism (Table 3) were not observed. However, scores for dog Training Focus were associated negatively with owner scores for Neuroticism ($r = -0.528$, $p = 0.007$, $N = 25$) and Openness ($r = -0.509$, $p = 0.009$, $N = 25$, Table 3). Additionally, owners scoring higher on Openness (i.e., more creative, prefers variety over routine) had dogs that scored lower on Amicability (i.e., less friendly; $r = -0.508$, $p = 0.010$, $N = 25$, Table 3). These results remained significant following the Benjamini-Hochberg procedure using a 10% False Discovery Rate.

Table 3. *Pearson correlations between dog (MCPQ-R) and owner (NEO-FFI-3) personality traits. MCPQ-R: Amicability, Extraversion, Motivation, Neuroticism and Training-focus (dogs); NEO-FFI-3: Agreeableness, Conscientiousness, Extraversion, Neuroticism and Openness (owners).*

	Amicability	Extraversion	Motivation	Neuroticism	Training Focus
Agreeableness	.033	-.010	.090	.137	.139
Conscientiousness	-.079	.141	-.002	.139	.399
Extraversion	.245	-.175	-.068	-.142	.393
Neuroticism	-.114	.013	.001	-.082	**-.528***
Openness	**-.508***	.421	.301	-.189	**-.509***

*Note. * indicates $p \leq 0.01$; significant following Benjamini-Hochberg procedure; N=25.*

Attachment scores, personality, and behavior

Human personality scores did not appear to be related to owner-perceived attachment (DAQ) scores, with the exception of Extraversion. Owners with higher DAQ scores tended to have higher Extraversion scores (NEO-FFI-3; $r = 0.443$, $p = 0.026$, $N = 25$). However, this result remained significant only when the 20% False Discovery Rate during the Benjamini-Hochberg procedure was used.

DAQ scores were not related to dog MCPQ-R scores, dog/owner behaviors during the SST, or whether owners reported either being parents or owning more than one dog.

Owner attachment-related behaviors and owner personality

One owner-initiated behavior was related to owner personality: owners scoring higher on Extraversion initiated more contact with their dog in Episode 4 (following the dog's first reunion with the owner during the SST) ($r = 0.433$, $p = 0.044$, $N = 22$).

Dog attachment-related behaviors and owner personality

No dog behaviours observed during the SST were significantly related to owner personality following correction for multiple comparisons.

Dog attachment-related behaviors and dog personality

Dogs with higher Amicability scores spent more time near the door during Episode 1 (the first episode dogs spent in the test room with their owners; $r = 0.583$, p $= 0.002$, $N = 26$). This result only remained significant, however, following the Benjamini-Hochberg procedure using a False Discovery Rate of 20%. No dog personality dimensions were related to the body shake or door scratching behaviors.

Discussion

In this Canadian sample, owner and dog personality traits were associated with few of the attachment-related behaviors measured during the SST. Nor did we find evidence for the "matching" of seemingly analogous personality traits between owners and dogs, although other (non-analogous) owner and dog traits were correlated. These results may serve to highlight important challenges in research investigating factors related to dog behaviour and dog-owner attachment. Indeed, here we offer a "first-pass" set of relationships that need to be further investigated in different populations and across different cultural contexts, in studies with adequate statistical power, as highlighted by recent discussions on the value of replication in scientific research (e.g., Simons, 2014).

All owners scored relatively highly on the questionnaire-based assessment of attachment to their dog (DAQ), with female owners reporting higher levels of attachment, as has been shown previously by Archer and Ireland (2011). However, contrary to expectations, the DAQ score did not correlate with any owner or dog behaviors observed during the SST. Furthermore, the only personality trait for owners that was related to the DAQ score was Extraversion. More extraverted owners reported greater levels of attachment to their dogs. In contrast, no dog personality dimension, as measured by the MCPQ-R, was related to the DAQ.

The lack of relationship between owner-reported attachment and any dog or owner behavior in the SST may be primarily due to the relatively restricted range of the DAQ scores; all owners showed attachment scores above the mid-point of the Likert scale (i.e., DAQ scores > 3). It is possible that SST behavioral differences would emerge among participants with lower scores, although it seems unlikely volunteers required to travel to a research setting with their dog for behavioral testing would have a lower-than-average attachment to the dog. The relationship between DAQ and Extraversion

scores for owners may suggest that outgoing owners engage in more shared activities with their dogs which may, in turn, alter or enhance the perceived strength/satisfaction of the owner-dog bond (as per Curb et al., 2013), and be reflected in DAQ scores. Alternatively, the relationship between DAQ scores and owner Extraversion may be a study artefact. Owners willing to participate in research with their dog are probably both relatively strongly attached to their dogs and relatively extraverted, thereby creating a correlation between the attachment score and owner personality trait that is indirect and not generalizable to the average dog owner (also see Turcsán et al., 2012). In fact, assessment of attachment styles among owner-dog dyads in our study showed no variation; all were classified as securely attached, which is not entirely representative of the pet-owning population, even those who agree to partake in research (e.g., Wanser & Udell, 2019). Other personality traits, such as higher Openness and Agreeableness also might characterize dog owners who volunteer themselves and/or their dogs for research, although this is speculative. However, our participants showed T-scores for both these traits that were at the high end of "average".

While there was no evidence that possibly analogous personality traits of dogs and their owners "matched" in this small sample, three relatively strong relationships were found. The dog MCPQ-R Training Focus trait was associated with lower scores for both owner Neuroticism and Openness. These two correlations may be indicative of how owners with such personality traits interact on a daily basis with their dog in terms of presenting consistent, calm communication and training routines. Owners who scored more highly on Openness, and, thereby, likely tolerate or enjoy novelty and unpredictability, tended to have dogs with traits that might be considered less desirable, i.e., lower friendliness (low

Amicability). One possible explanation for relationships between owner and dog personality traits could be that certain types of owners select certain types of dogs to live with, e.g., particular breeds, individual dog activity levels, and/or trainability. As all of the owners in our study reported a strong attachment to their dogs, it might also be the case that they have a higher than average tolerance level for less desirable traits in their dogs. It should be noted that a limitation of our study is the small sample size of owner-dog dyads (comparable, however, to other studies in this literature), and the fact that only medium-to-large sized dogs (i.e., 8 kg or greater) are represented. Relationships that owners may develop with toy-and small-sized dogs might differ slightly from those presented here, and would be worth investigating more closely.

Interestingly, no NEO-FFI-3 owner personality traits were related to any measured dog behavior during any SST episode. We predicted that owners scoring higher on Neuroticism would initiate more contact with their dogs and, based on Wedl et al. (2010), who also used the NEO-FFI-3 to assess owner personality (but did not use the SST), would have dogs that spent more time near them. In contrast to Wedl et al. (2010) and other studies, in which owner Neuroticism was related to dog-human behaviors during non-SST behavioral tasks (Kis et al., 2012; Kotrschal et al., 2009), these relationships were not found. In fact, the only NEO-FFI-3 personality trait that was linked to any behavior during the SST was Extraversion. More extraverted owners initiated more physical interaction with their dog during the episode in which the owner and dog reunited following the first separation (Episode 4). Although owner verbal output is not reported in this study, physical contact with the dog at and following reunion typically included verbal greetings and praise, and, hence would be

consistent with Kis et al. (2012), who reported that more extraverted owners used more verbal praise when performing a "sit and stay" task with their dog, which precluded physical contact.

The only dog personality trait related to dog-initiated behaviours during the SST was Amicability. Friendly dogs (high Amicability) spent less time near their owner, and more time near the door, during the first 3 minutes of the SST. This finding likely reflects the sociable nature of dogs scoring highly on this trait. Less time near owner and more time near the door in the first few minutes of being in the SST room may also reflect the dog seeking to interact with people on the other side of the door, given their relative novelty.

Contrary to predictions, no previously reported personality matches between human-dog dyads were replicated. Turscán et al. (2012) evaluated the personality of dog owners in Hungary and Austria using the Big Five Inventory (BFI) and an adapted version for dogs (Canine BFI; Gosling, Kwan, & John, 2003). They found significant correlations between owner and dog ratings for each of the Big Five traits, which are the same traits described by the NEO-FFI-3. The fact that, in the current study, we used a different dog personality assessment, the MCPQ-R, may account for our failure to obtain correlations among seemingly analogous personality traits (e.g., NEO-FFI-3 Agreeableness and MCPQ-R Amicability; NEO-FFI-3 Neuroticism and MCPQ-R Neuroticism, etc.). Although the human and dog personality traits in these assessments may appear similar, their constructs may be different enough to exclude the possibility of "matching" owners and dogs. Indeed, the MCPQ-R dimension Motivation is relatively dissimilar to any human personality trait, and may be unique to dogs (Ley et al., 2009). Interestingly, Turscán et al. (2012) also found that perceived personality matching was

greater in magnitude for owners and their dogs from Hungary compared to those from Austria. They concluded that cultural differences, such as dog keeping practices and factors affecting dog choice, should be considered when evaluating owner-dog personality and relationships. Furthermore, they also cautioned that their results should be interpreted in light of the fact that dog owners who volunteer for dog-related research are likely more interested in dog behavior than the average owner, a point with which we strongly concur.

Indeed, the self-selected nature of the dog owners who voluntarily participate in research studies designed to examine aspects of the dog-owner relationship may have a major impact on these studies' findings. As well, while there is not yet any compelling reason to assume that the cultural context will have large impacts on the basic canine behavioral repertoire, or the outcomes of tests designed to evaluate dog-owner attachment, such as the SST, it is very possible that culture can modify such behaviours. Contextual factors may influence variables related to dog-owner bonds, such as owner perception or expectations of dog behavior, which, in turn, could moderate the relationship between owner or dog personality and dog-owner attachment. In the human literature on cross-cultural patterns of attachment, it is well recognized that both universality and contextual determinants influence the attachment relationship between caregivers and children (Mesman, van Ijzendoorn, & Sagi-Schwartz, 2018), i.e., while there is undoubtedly a shared or universal process for the development of attachment among all humans, factors that include immediate contextual and cultural differences also play an important role in determining the final form of attachment relationships. With dogs, a US study showed that dog excitability was negatively associated with owner-reported attachment to

the dog, but only for Caucasian dog owners (Hoffman et al., 2013). Other studies that report on reasons for keeping dogs (e.g., Wan et al., 2009) and incidences of dog SRD and related canine personality factors (Konok et al., 2015) also point to between-country differences that are not yet well understood.

We would speculate that, in general, Canadian and US companion dog owners (at least those willing to participate in research) would share similarities in terms of their reported relationships to their dogs. Within North America, there are likely subtypes of dog-owner relationships. Such relationship types may be influenced by cultural ideas about dog breeds, the nature of responsible dog ownership (e.g., the need to spay/neuter), often promoted in the media, by veterinary professionals and others, and/or by exposure to pet product marketing (e.g., dog clothing and accessories). Not all dog owners in North America will be equally susceptible to these influences, given their heterogeneous cultural and ethnic backgrounds. However, if such owner-dog relationship types exist, they may also exist, but be less common outside of North America, since such relationships must develop within cultural contexts. Indeed, some of our failure to replicate prior findings may be due to the fact that much of the work on dog-owner attachment, and the influence of dog and owner personality, has been conducted by a few highly prolific canine research programs in Europe, where dog-owner relationships- although unlikely to be homogeneous within the continent- may, on average, be different from those in North America. This possibility raises intriguing opportunities for collaboration on cultural factors that may influence owner-dog relationships.

It appears that most studies on dog-owner attachment, including ours, do not report sufficient detail about participants, e.g., age, gender, ethnic/cultural background (although, in our study, it is likely that most participants would self-identify as Caucasian). As well, whether studies like ours use any statistical control for Type 1 error due to multiple independent comparisons (e.g., the Bonferonni correction or the Benjamini-Hochberg procedure) varies; not doing so can be justified on the grounds of controlling for an increase in Type 2 error (Jaeger & Halliday, 1998). However, these error risks must be balanced with the knowledge that failing to control for Type 1 error will likely result in some findings that are spurious, and will not be replicated. Our approach of implementing a False Discovery Rate to permit some assessment of which relationships might be most likely "real" might be advised for future exploratory research that is interested in evaluating many specific behaviors with other factors.

We cannot preclude the possibility that dogs from different countries also behave differently, either because of the differing nature of the interactions they experience with owners, and/or other inherent differences, e.g., within-breed genetic variation, country-specific genetic lineages (Parker et al., 2017), or lower rates of spay/neuter in some European countries compared to North America (Trevejo, Yang, & Lund, 2011; Diesel, Brodbelt, & Laurence, 2010, respectively). In order to better understand the true nature of the dog-owner attachment relationship, expanding research to additional non-European countries, including Canada and the US, should be a priority. Current "open science" initiatives, such as the Psychological Science Accelerator (Chartier, McCarthy, & Urry, 2018), designed to promote wide collaboration, could be useful vehicles for facilitating simultaneous and directly comparable studies in multiple countries. Furthermore, evaluating within-country similarities and differences among dog-owner attachment for various cultural or ethnic groups, including indigenous peoples

and first-generation immigrants, will give a more complete picture of the factors that impact dog and owner bonds. As well, to provide for future meta-analyses the opportunity to evaluate factors such as cultural background/ethnicity and owner gender, studies of dog-owner relationships should include as much detailed information about their study sample as possible.

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