Behaviour Differences in Companion Dogs in Response to Unfamiliar Conspecific Contact and Personality Measurements

by

© Julie A. Posluns

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Abstract

The measurement of behaviour and personality can provide valuable information about the individual characteristics of dogs, provided these measurement tools are standardized. In the case of behaviour, an exhaustive list of the domestic dog's behaviour units has yet to be described. In the case of personality, there is little consensus on the structure of canine personality. I aimed to characterize the individual differences of dogs in the context of unfamiliar conspecific contact. I recorded the behaviour of pairs of dogs in two interactions to examine the effect of familiarity, sex and sex of partner on activity budgets and behaviours of each of the focal dogs. The owner and the dog's walker completed two questionnaires prior to the dog-dog meetings: the Monash Canine Personality Questionnaire-Revised (MCPQ-R) and the Dog Personality Questionnaire (DPQ). Overall, the data showed that behaviour changed as familiarity increased. This change was influenced by sex, as mixed sex pairs spent more time in close proximity to one another while simultaneously near a human than did other pairs, but only in the first meeting. As well, male pet dogs spent more time overall near people during meetings with an unfamiliar dog, and may use humans to facilitate conspecific contact or minimize potential threat. The two personality assessments were examined for correspondence in structure and for consensus among dog walkers and dog owners. Correspondences between the assessments suggest we are honing in on the structure of canine personality, but personality assessment reliability should be reported and the dog-related experience of personality raters, as well as the context in which they observe the dogs they are rating, should be taken into account. Reliability appears to increase when assessments include separate components for canine-directed aggression, e.g., towards people vs. towards animals. Further research on the factors that influence dog-dog social interactions, such

as individual differences in personality traits, sex, and familiarity, may lead to improved canine welfare.

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Chapter 1: Introduction and Co-Authorship Statement

1.1 Introduction

Individuals within a population of animals consistently vary from one another in their behavioural responses to stimuli and the challenges they face (MacKay & Haskell, 2015). This variability is even greater in domestic dogs: due to human influence via artificial selection, there are hundreds of breeds of domestic dogs with extreme physical and behavioural diversity (e.g., Parker, Dreger, Rimbault, Davis, Mullen, Carpintero-Ramirez & Ostrander, 2017; Wayne & vonHoldt, 2012). Historically, this phenotypic diversity translated into the ability of breeds to excel at various roles, for example, as guard dogs (e.g., German shepherds and rottweilers) and hunting dogs (e.g., German short-haired pointers) (Serpell & Duffy, 2014). Yet today as dogs are more commonly embedded in city life, qualities that may have once been desired specializations are not equally valued in the urban environment. In addition, dogs that fulfill applied roles, as guide, service, and scent detection dogs, need to be selected for their ability as suitable working partners. Understanding the variables that help to predict a dog's behaviour is important, then, for both practical and animal welfare reasons; the ability to reliably and validly assess individual differences can help ensure that each dog is placed in an environment which matches its attributes.

Characterizing individual dogs via behavioural tests is widely used by canine practitioners (e.g., shelter programs, Lucidi, Bernabò, Panunzi, Villa, & Mattioli, 2005; Mornement, Coleman, Toukhsati, & Bennett, 2014; military dogs, Haverbeke, Smet, Depiereux, Giffroy, & Diederich, 2009; guide dogs for the blind, Duffy & Serpell, 2012). The aim of these tests is to evaluate the dog in order to predict their future behaviour and personality. It is now widely accepted that

personality, or consistent individual differences in behaviour, can be measured in many animals, including dogs (Gosling & John, 1999; Gosling, Kwan, & John, 2003). Yet despite the wide-scale use of tools to measure both behaviour and personality in dogs, the reliability and validity of these assessments have not yet been adequately described (Rayment, De Groef, Peters, & Marston, 2015). Specifically, criticisms of current test protocols include a lack of clear terminology regarding the behaviours tested (Overall, 2014) and a lack of consistency in levels of dog-related experience for those administering the tests (Rayment, Peters, Marston, & De Groef, 2016). As well, little consideration has been given to the role of certain dog characteristics (e.g., breed, age, sex) on standardizing tests (Diederich & Giffroy, 2006).

This lack of test standardization can have a profound impact in a shelter environment where the consequences of a dog failing an assessment due to aggression may lead to euthanasia (Mornement et al., 2014). Even in the face of such irreversible outcomes, the predictive validity of shelter assessments has not been demonstrated (Mornement, Coleman, Toukhsati, & Bennett, 2015). This may be due, in part, to the challenges of characterizing socially complex animals like dogs, that have both inter- and intra-specific interactions. Domestic dogs can be observed interacting with conspecifics in various contexts, such as on walks, in dog parks, and in multi-dog households. These interactions can often be investigative in nature (i.e., sniffing), but can also be playful or aggressive (Westgarth, Christley, Pinchbeck, Gaskell, Dawson, & Bradshaw, 2010). Although some assessments that evaluate shelter dogs have factors that distinguish between dog-directed and human-directed behaviours, (e.g., anxiety-sociability towards dogs, Palma, Barillari, Natoli, Dufour, Fantini, Palme, & Viggiano, 2005; aggression towards other animals, Jones, 2008), these assessments may need to be further nuanced. For example, in the

case of dog-directed aggression, aggression may be directed at specific dogs (e.g., a specific size, breed, or sex), or may occur either only with household dogs or towards unfamiliar dogs (Orihel, 2006). To date, with few exceptions (e.g., Bradshaw & Lea, 1992; Ottenheimer Carrier, Cyr, Anderson, & Walsh, 2013), close examination of the variables that might influence dog-dog contact, and, indeed, detailed descriptions of the behaviours that occur between dogs during social interactions, have been largely ignored by researchers. As opportunities for contact among unfamiliar pet dogs is increasing with the growing popularity of dog parks (e.g., Urbanik & Morgan, 2013), scientifically-sound ways of characterizing the behaviours involved in conspecific social contact should be an important focus of canine research. Such work would not only provide a valid index of conspecific social behaviour, but it might allow insights into practical issues, such as dog-directed aggression.

Measuring Behaviour and Personality

Researchers and professionals working with dogs (and other animals) assess behaviour with two main methods: 1) behavioural coding in which dogs are scored for narrowly-defined behaviours according to a predetermined ethogram (see Martin & Bateson, 2007), and 2) questionnaire-based tools in which dogs are rated on a Likert scale as to how well a specified trait characterizes the target dog (e.g., Ley, Bennett, & Coleman, 2008; Mirkó, Kubinyi, Gácsi, & Miklósi, 2012).

In the case of behaviour coding, observers may examine subtle behaviours, such as the change in the angle of a dog's tail position when exposed to different stimuli (e.g., Quaranta, Siniscalchi, & Vallortigara, 2007), or more overt behaviours, for example, the frequency of play

bows within a dyadic play session (Byosiere, Espinosa, & Smuts, 2016). Investigators consider this type of measurement to be largely unbiased because it is based on direct observation (Gosling, 2001). However, systematic examination of behaviour can be challenging because it can be difficult to determine which behaviours are relevant to particular research questions and how to examine them in a biologically meaningful way (Fugazza & Miklósi, 2014; Overall, 2014). While cataloging behaviour continues to be an important tool in understanding the domestic dog's behavioural repertoire, many investigators are not interested in small, specific behaviour units but instead are concerned with an individual dog's general disposition, or personality.

Canine personality can be assessed for dogs with behaviour ratings, in which respondents are asked to rate their dog's actions (e.g. "Dog likes to chase bicycles, joggers, and skateboarders"), or how well adjective descriptors (e.g., "friendly") apply to the dog, using a Likert scale. Because responses to these questionnaires appear to be subjective, this approach may be considered less reliable than behaviour coding (Mirkó, Dóka, & Miklósi, 2013). Yet, extensive research on animal personality suggests that this is not the case. For example, combined ratings of multiple observers can overcome the potential challenges caused by one rater's perception (Gosling, 2001). In a meta-analysis on the consistency of canine personality ratings, Fratkin, Sinn, Patall and Gosling (2013) showed that there were no differences in consistency between behavioural ratings and behavioural coding.

Despite the knowledge that questionnaire-based assessment can be effective in characterizing the individual differences in dogs, the reliability and validity of many such

assessments have not been adequately described (Rayment et al., 2016). For one thing, multiple researchers have proposed different dog personality assessments in which both the number and the content of the personality components (i.e., personality traits or dimensions) vary (e.g., Ley, Bennett, & Coleman, 2009; Mirkó et al., 2012; Svartberg & Forkman, 2002). As well, in many studies, the reliability of the test is not reported (Gartner, 2015). Furthermore, in studies where reliability is reported, there may not have been any attempt to control for or to examine the different levels of dog-related experience that raters may have, which could create rater biases (Rayment et al., 2015). Finally, it is likely that studies using ratings to assess dog personality should take into account whether the context in which the rater observes the dog influences their assessments. To date, consideration of context is not common, even though personality assessments may be performed in contexts such as animal shelters, which are known to be particularly stressful and traumatic environments for dogs (Shiverdecker, Schiml, & Hennessy, 2013). Without standardization of personality assessment tools, the broad applicability of these tests is limited.

Examining behavioural assessments in conjunction with questionnaire-based assessments has become a popular approach to investigate dog behaviour. For example, Konok, Dóka, and Miklósi (2011) coded separation anxiety behaviours to validate owner's responses to a questionnaire about their dogs' separation-related behavior. In many shelters dogs are administered test batteries where they are rated for their response to specific stimuli (Dowling-Guyer, Marder, & D'Arpino, 2011; Mornement et al., 2014). To determine whether these evaluations are accurate in predicting the behaviour of the dog, investigators examine the correspondence between the results and an owner's post-adoption personality survey (Marder,

Shabelansky, Patronek, Dowling-Guyer, & Segurson D'Arpino, 2013; Mornement et al., 2015). Combining personality questionnaires and measurements of behavior has great potential to strengthen both measurement tools. However, the usefulness of this methodology relies on the accurate description of the behaviours in question and a reliable and valid personality assessment. To date, canine ethological studies which meet these criteria are sorely needed.

Conspecific Contact

One area of dog research that has received little systematic measurement is conspecific interactions among pet dogs. When multiple dogs interact, the safety of the dogs and their handlers is a primary concern. Our current understanding of social relationships between groups of pet dogs is lacking, with many of the assumptions regarding social communication and behaviour continuing to rely on an outdated wolf model (Fatjó, Feddersen-Petersen, Ruiz De La Torre, Amat, Mets, Braus, & Manteca, 2007; McGreevy, Starling, Branson, Cobb, & Calnon, 2012)

Domestic dogs diverged from an ancestor shared with modern grey wolves between an estimated 9000 and 34 000 years ago (Freedman et al., 2014). Although some dog behaviour patterns may be derived from wolves, domestication has caused dogs to diverge considerably from the lupine form (Bradshaw, Blackwell, & Casey, 2016) both behaviorally and physically. Given such substantial divergence between the two species, the wolf and the domestic dog both deserve to be examined in their own right. In the case of the dog, selective breeding and husbandry practices have modified the species even further, to the point where many signals of canine communication may be compromised. For example, docked tails cannot wag, and hackles

can no longer be raised in some breeds (McGreevy & Nicholas, 1999). It has been suggested that the more dogs deviate from the lupine form, the more affected are their signaling structures (Goodwin, Bradshaw, & Wickens, 1997), although additional research in this area is sorely needed.

Although dog-dog relationships have not received sufficient research attention, there is one area that provides an excellent framework to build upon; the study of dog-dog play. Bekoff (1972, 1974) outlined the signals dogs used to communicate a playful intent (e.g., play bow), which became a framework for a dog play ethogram. The development of a comprehensive ethogram of dog play behaviours has advanced the study of the nuances of dog play (e.g., cooperation and competition, Bauer & Smuts, 2007; the function of play bows, Byosiere et al., 2016; the function of rollovers, Norman, Pellis, Barrett, & Henzi, 2015; partner preferences, Ward, Bauer, & Smuts, 2008). Furthermore, Horowitz (2009) was able to demonstrate that dogs have sophisticated abilities in play and demonstrate a 'rudimentary theory of mind'. These advanced cognitive abilities are arguably necessary to communicate complex terms of the relationship to minimize the risk of injury or misunderstanding (Bekoff, 2014).

In addition to play, another area that may require dogs to have sophisticated communication skills is that of unfamiliar dog-dog contact. When two adult dogs first encounter one another they likely do not know what behaviour to expect of the other individual. This could create an environment in which dogs are anxious and vigilant, although individual differences likely play a role (Mariti, Papi, Ducci, Sighieri, Martelli, & Gazzano, 2010; Pullen, Merrill, & Bradshaw, 2013). In fact, for many species, interaction with unfamiliar conspecifics puts them at risk of altercation, and stable relationships only develop over time, with increasing familiarity

(e.g., goats, Patt, Gygax, Wechsler, Hillmann, Palmec, & Keil, 2013; hamsters, Delbarco-Trillo & Johnston, 2011; sows, Arey & Edwards, 1998). In wolves, unfamiliar conspecific interactions can be fatal (Mech, 1993). Despite the possibility that conspecific contact may lead to conflict or agonistic interactions, unfamiliar dogs meet daily at dog parks. In the few empirical studies that have been carried out in dog parks, the rates of aggression are very low among dogs interacting in these parks (Howse, 2016; Ottenheimer Carrier et al., 2013; Shyan, Fortune & King, 2003). This low rate of aggression may be due, in part, to selection by owners of the dogs that get brought to the park; i.e., owners may not take their dogs to dog parks if they have experienced negative or agonistic interactions, or if they know their dog to be aggressive towards others. It has been documented that unfamiliar dogs have more conflict interactions than familiar dogs (Cools, Van Hout, & Nelissen, 2008), and that the first few minutes of an interaction between dogs may be more important for unfamiliar compared to familiar dogs (Pullen et al., 2013). Thus, much like dog-dog play, first encounters between unfamiliar dogs may require sophisticated communication to negotiate the terms of the relationship and prevent any misunderstandings. Although first encounters between unfamiliar dogs should be rich in communication and behaviour, they have been rarely studied.

Overview of this work

This thesis is: 1) a comprehensive investigation of the interactions of unfamiliar dogs during brief meetings in a neutral territory, and 2) a study of the convergence and correspondence between two widely-use canine personality tools. In Chapter 2, I examine how dogs initially respond to unfamiliar conspecific contact, and how these behaviours change in a

second interaction held one week later. Thus, the effect of familiarity (which has increased between the first and second meeting), as well as the influence of the sex of the interacting dog pairs, is analyzed.

Chapter 3 is a slightly modified version of a manuscript that has been published in *Applied Animal Behaviour Science* (Posluns, Anderson, & Walsh, 2017; modifications include additional discussion of the human personality literature, based on the suggestions of a supervisory committee member). In it, I examine the correspondence between two emerging canine personality questionnaires: The Monash Canine Personality Questionnaire – Revised (MCPQ-R; Ley et al, 2009) and the Dog Personality Questionnaire (DPQ; Jones, 2008). I compare these assessments using: 1) the convergence between components (i.e., derived personality dimensions and traits) of the assessments, and 2) the inter-rater reliability of two respondents (the dog's owner and the dog's walker) for each assessment. These assessments are examined for common structure as correspondences among personality factors would provide empirical support that they validly represent aspects of canine personality. While both questionnaires have similar components, one fundamental difference between them is that in the MCPQ-R, only one component measures a dog's tendency toward friendliness/aggression. In contrast, the DPQ devotes two components to characterize individual differences in friendliness/aggression; separate components characterize a dog's response to people and animals. The practical implications of these differences when evaluating dogs in applied settings, such as a shelter environment, which can have important welfare consequences, are discussed. I also discuss how variation in dog handling experience/education, as well as the context in which each evaluator experiences the dog, may affect the personality ratings obtained.

While it has taken four decades to unravel the nuances of play, the study of how dogs respond to unfamiliar conspecific contact and how they may communicate to reduce conflict is just beginning. Results of this study may inform management of dogs, including how to manage first-time unfamiliar conspecific introductions. As well, understanding dog-dog interactions may help prevent dogs being relinquished to shelters; inter-dog aggression can be a huge source of distress for owners, and is one of the common reasons dogs end up in the shelter environment (Orihel & Fraser, 2008). Prevention of dog-directed aggression is important for the safety of people and dogs. Empirical systematic research on dog-dog interactions can help identify the "typical" patterns of dyadic interactions and behaviours among unfamiliar dogs that either indicate or counter-indicate the likelihood of aggression. Overall, this thesis research will demonstrate how behavioural measurements and personality ratings can be utilized to assess individual characteristics of domestic dogs in the context of unfamiliar conspecific contact. Knowledge of these characteristics may allow owners, as well as professional dog caregivers and handlers, to better manage the social interactions of individual dogs.

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1.3 Co-Authorship Statement

This research study was carried out under the supervision of Dr. Carolyn Walsh of the Canine Research Unit, Department of Psychology, Memorial University of Newfoundland. Under her guidance, with the additional input of my Supervisory Committee member Dr. Rita Anderson, I developed the research questions and methodology used for this project, which are described in detail in Chapter 2 and 3 of the thesis. Procedural designs were also presented to my third committee member, Dr. Aimée Suprenant, Department of Psychology, Memorial University of Newfoundland, who provided feedback and suggestions. I collected all video footage. I either collected the saliva samples, or instructed assistants on their collection. Salimetrics (State College, PA, U.S.A) completed hormonal assays (e.g., cortisol), which are not included in this thesis, but will be reported on in a future publication. All of the participants were recruited by me and all questions or concerns regarding this research project were directed to me. Both Chapter 2 and Chapter 3 contain data that I exclusively analyzed and reports that I have written, with edits and suggestions provided by my supervisor and committee members. Because of their collaboration including materials required for data collection and intellectual contributions, Dr. Carolyn Walsh and Dr. Rita Anderson are co-authors of manuscripts arising from chapters in this thesis.

Chapter 2: The Behavioural Responses of Urban Companion Dogs to Unfamiliar Conspecific Contact

2.1 Abstract

Little is known about how individual dogs respond to initial contact with unfamiliar dogs. This study examined the interactions of 30 pairs of unfamiliar spayed and neutered companion dogs, 20 same-sexed (10 male and 10 female) and 10 mixed-sex pairs in two 5-min greeting sessions scheduled one week apart. Observations of untethered dog-dog encounters were made in a neutral yard with each dog's handler present. For each dyad, the effects of familiarity (Week 1 vs. Week 2) and pair type (male-male, male-female, female-female) on the activity budget were examined. As well, for each focal dog, the effects of familiarity (Week 1 vs. Week 2), sex, and partner's sex on time spent alone with a human, latency to initiate contact, body sniffing, and time spent following were examined. The occurrences of threat behaviours, play, urine investigation, and countermarking were also observed. An increase in latency to initiate contact and a decrease in sniffing and following behaviour from Week 1 to Week 2 suggest that, after their initial encounter, dogs recognized a conspecific as more familiar. Approaches toward partners primarily involved complete suspension of eye contact. Mixed-sex pairs spent more time in close proximity to one another while near a human during the Week 1 session, compared to same-sex pairs. This finding, along with the finding that male dogs spent proportionately more time alone next to a human in both weeks compared to females, suggests that humans are important in interactions between unfamiliar dogs possibly as facilitators of contact between them, or as intervenors in any potential conflict. Conspecific encounters were primarily uneventful; only a small fraction of pairs engaged in play, and very few dogs displayed agonistic

behaviour in either session. The behaviour patterns of these socialized companion dogs suggest that first encounters are important in the development of familiarity between dogs, and surprisingly little time is spent interacting with an unfamiliar conspecific during initial brief meetings.

2.2 Introduction

The domestic dog (*Canis familiaris)* has been integrated into the human social environment for possibly more than 100,000 years (Vilà et al., 1997). Living with humans has greatly influenced the social lives of domestic dogs and it has been argued that, unlike wolves *(Canis lupus)*, the companion dog's primary communicative partners are humans, not conspecifics (Miklósi, Topal, & Csányi, 2004). Therefore, research on the dog's social communication system has tended to focus on heterospecific relationships (e.g., reviewed in Reid, 2009), while patterns of dog-dog communication have received surprisingly little empirical attention (*c.f.* Goodwin, Bradshaw, & Wickens, 1997; Kerswell, Bennett, Butler, & Hemsworth, 2009; Kerswell, Butler, Bennett, & Hemsworth, 2010). Although humans direct the social lives of household dogs in urban environments, the advent of dog parks and dog daycare facilities has increased the opportunity for conspecific contact, creating a practical demand to understand social relationships between dogs, how they develop, and the factors that influence the types of relationships that may be formed. Recent empirical research has addressed some aspects of canine social behaviour. For example, the presence of dominance relationships in companion dogs were recently investigated in a dog daycare (Trisko & Smuts, 2015) and in a dog kennel (van der Borg, Schilder, Vinke, & de Vries, 2015). Although dynamics of dog-dog play have been examined (e.g., Bekoff, 1974, 1995; Horowitz, 2009; Norman, Pellis, Barrett, & Henzi, 2015; Smuts, 2014), other aspects of canine sociality continue to be derived from an outdated wolf model of social communication (e.g., Bradshaw & Nott, 1995; Kerswell et al., 2010; Rugaas, 2006), despite the fact that extensive selection associated with domestication has led to

considerable morphological and behavioural differences (e.g., Kerswell et al., 2009, 2010; Mehrkam & Wynne, 2014; Stone, McGreevy, Starling, & Forkman, 2016).

Descriptive ethological studies of dogs are important for identifying biologically-meaningful behaviours, and the use of a comprehensive canine ethogram to do so is necessary (Overall, 2014). One area of research in need of further observational attention involves the interactions between unfamiliar dogs. Little is known about what behaviours are important when unfamiliar dogs interact, and how those behaviours change as familiarity increases. Although there are documented cases in which unacquainted wolves have contact (e.g., at breeding, Stahler, Smith, & Landis, 2002), interactions outside the pack are rare and often fatal (Mech, 1994). In contrast, companion dogs are exposed to unfamiliar dogs of all shapes, sizes, and breeds while on leashed walks and in unleashed dog parks. Although dog park interactions are primarily positive (Ottenheimer Carrier, Cyr, Anderson, & Walsh, 2013; Shyan, Fortune, & King, 2003), partner familiarity appears to increase social interaction (Capra, Barnard, & Valsecchi, 2011). In unfamiliar dog interactions, the first few minutes may be a critical period to gather information about the unfamiliar conspecific: Pullen, Merrill, and Bradshaw (2013) showed that after this time period unfamiliar dogs spent less time in close proximity to one another than did familiar dogs. As well, conflicts are more common among unfamiliar than familiar dogs and unfamiliar dogs show fewer post-conflict reconciliations (i.e., exchanges of friendly behaviour shortly after an aggressive interaction) than do familiar pairs (Cools, Van Hout, & Nelissen, 2008). Aggression towards unfamiliar dogs is a serious concern of owners who visit veterinary behaviourists (Haug, 2008). In a study of direct observations of social

interactions, all the dogs that displayed aggressive encounters were either unfamiliar or had low familiarity with their partner (Capra et al., 2011).

When two dogs first meet, visual communication may involve changes in tail position (Quaranta, Siniscalchi, & Vallortigara, 2007), ear positions, and facial expressions. A dog's tail may be an indicator of an emotional or dispositional state such as friendliness or fear (Leaver & Reimchen, 2008; Siniscalchi, Lusito, Vallortigara, & Quaranta, 2013). The current framework for a dog's visual communication system (reviewed by Bradshaw & Nott, 1995) has been largely based on the signals performed by wolves interacting within their pack (Goodwin et al., 1997), which may be accurate for dogs that have maintained a lupine-like appearance. However, as a result of artificial selection, many breeds deviate morphologically from the lupine form. Consequently, their signalling abilities may be limited (McGreevy & Nicholas, 1999; Scott, 2013). Despite the potential loss of signalling repertoire, research suggests that more physically modified breeds are surprisingly not more susceptible to negative conspecific interactions than their less modified counterparts (Goodwin et al., 1997). However, because visual communication may no longer be reliable, it is possible that dogs rely on other non-visual communication modalities (Goodwin et al., 1997; Kerswell et al., 2009).

Dogs have a suite of visual signals they can use to manage conflicts (Gazzano, Mariti, Papi, Falaschi, Foti, & Ducci, 2010). These behaviours are functionally defined as 'calming signals' in the popular dog literature (Rugaas, 2006). Several of these behaviours relate to the absence of visual attention (e.g., looking elsewhere, turning away, lowering the head to the ground). Suspending eye contact momentarily (also termed 'averting gaze', e.g., Gácsi, Vas,

Topál, & Miklósi, 2013) can be traced to the wolf social communication, where this signal has been hypothesized to prevent the escalation of aggression in the presence of a socially more dominant conspecific (Fox, 1969; Fox 1971 cited in Gácsi et al., 2013). Dogs may use a looking away signal to possibly avoid contact when presented with an unfamiliar conspecific (Fox, 1969; Bradshaw & Nott, 1995). A preliminary study on so-called "calming signals" in domestic dogs demonstrated that the frequency of signals, particularly 'looking else', was higher when conspecifics were unfamiliar (Mariti, Papi, Ducci, Sighieri, Martelli, & Gazzano, 2010). Thus, when meeting an unfamiliar dog, the movement of the head may serve an important communicative function.

Olfactory inspection is a major communication channel in dog social interaction and may be especially important if visual signals are compromised (Goodwin et al., 1997). The anal sac of dogs provides individual identification (Natynczuk, Bradshaw, & Mcdonald, 1989), which is likely to be important for recognition (Bekoff, 2001). Patterns of investigating a dog's front regions (e.g., mouth and ears) and their rear parts (e.g., anogenital region) may be a function of sex and/or reproductive ability (Dunbar, 1977). For example, in a study of interactions between unfamiliar conspecifics meeting while on leash walks, frequencies of anogenital investigations were higher in males than females (Bradshaw & Lea, 1992). As well, dogs may gain olfactory information about an unfamiliar dog, such as their social status, by investigating conspecific urine (Lisberg & Snowdon, 2011). Despite its obvious importance, the role of olfaction in dog-dog communication has yet to be thoroughly investigated (e.g., Kerswell et al., 2009).

Another challenge within the limited reports of dog-dog interactions are the various dog populations being studied (e.g., free ranging suburban dogs, Bonanni, Valsecchi, & Natoli, 2010; group-housed domestic dogs, Pullen et al., 2013, and van der Borg et al., 2015; urban companion dogs or 'family dogs', Řezáč, Viziová, Dobešová, Havlíček, & Pospíšilová, 2011; Ottenheimer Carrier et al., 2013). Additionally, studies of urban companion dogs involve dogs that may vary in their castration status. For example, populations of urban companion dogs studied in dog daycare scenario are typically neutered/spayed (e.g., Trisko & Smuts, 2015), whereas studies that focus on dogs in dog parks (Shyan et al., 2003) and shelters (Orihel & Fraser, 2008) typically include dogs that may either be spayed/neutered or intact. It is likely that castration status influences the social interactions of dogs (Roll & Unshelm, 1997), but little attention has been given to this possibility.

In the present study I examine the untethered interactions of neutered/spayed unfamiliar companion dogs. In a neutral yard, each dog was exposed to a single unfamiliar conspecific in two 5-min greeting sessions spaced one week apart. To allow for sufficient exposure to one another, in Week 1 dog pairs spent an additional 15 minutes walking together on-leash in the neighbourhood. To test the effects of sex and sex of partner, three types of dog pairs were created (male pairs, mixed-sex pairs, and female pairs). I examined the effect of familiarity (Week 1 vs. Week 2) on the activity budgets of pairs, contact latency, the occurrence of body-sniffing, and following behaviour, as well as the approach style of individual dogs upon making visual contact with a conspecific. Threat behaviour (lunges and charges), play behaviour (play slap and play bows), urine investigation and countermarking were characterized descriptively.

As familiarity increases, I expected to see differences in the responses of dogs to conspecifics from their first to second meeting. More specifically, I predicted that dogs would recognize the conspecific as (relatively more) familiar in Week 2 and would spend less time investigating and interacting with the partner. As suggested by Pullen et al. (2013), once the partner is no longer novel, investigating the environment may be prioritized. Latency to initiate contact was expected to be greater in Week 1 than in Week 2, since presumably when dogs become more familiar or comfortable with the conspecific, contact latency should decrease. As unfamiliar dogs may be more cautious in their interactions and display more signals that may function to diffuse potential conflict (e.g., Mariti et al., 2010), I expected dogs to demonstrate the absence of visual attention to the conspecific, hence I looked at the approach style. Although the majority of dogs observed interacting in dog parks showed at least one play behaviour (Ottenheimer Carrier et al., 2013), and dogs continue to play throughout their adult life (Bradshaw, Pullen, & Rooney, 2015), play tends to occur more frequently in younger dogs (Bekoff, 1974; Hall, 1998 as cited in Bradshaw et al., 2015), and lasts longer between familiar dogs (Bradshaw et al., 2015). Since my sample was composed of unfamiliar adult dogs, I did not expect to observe many playful interactions within dog pairs. Because dogs were primarily recruited from dog walking companies and were therefore, well-socialized and experienced in meeting unfamiliar dogs, I expected to see very little agonistic behaviour. As well, because all dogs were neutered/spayed, I expected minimal sex effects on behaviours.

2.3 Methods

2.3.1 Subjects

Sixty companion dogs (spayed females, N=30; neutered males, N=30) of various breeds (16 purebreds and 44 mixed breeds; Appendix B) were recruited via word of mouth from various dog walking companies and other local dog owners in Toronto, Canada. Subject ages ranged from 11 months to 11 years (4.30 ± 2.62 yrs; mean ± SD; the ages of four dogs were not reported). Dogs with a history of aggression towards other dogs or had experienced an altercation that caused another dog to require veterinary attention were excluded from the study. Age, breed, weight and socialization history were gathered from owner reports. Owners also provided additional information, including personality assessments, that are reported elsewhere (Chapter 3; Posluns, Anderson, & Walsh, 2017). The research was approved by the Interdisciplinary Committee on Ethics in Human Research (ICEHR Ref No. 20140006-SC) and the Animal Care Committee (IACC Ref No. 12-01-CW).

2.3.2 Study Site

Study trials were carried out at a residential, fully enclosed grassy yard (15.1 x 5.2 metres) in Toronto, Ontario, Canada. The yard had two points of entry on opposite ends from one another and aside from several waste bins along the edge of the house and one large tree, the yard was an open lawn (Fig. 2.1). The yard was unfamiliar to all dogs, except for two dogs that had briefly entered the yard to access the house, approximately two weeks before the Week 1 trial.

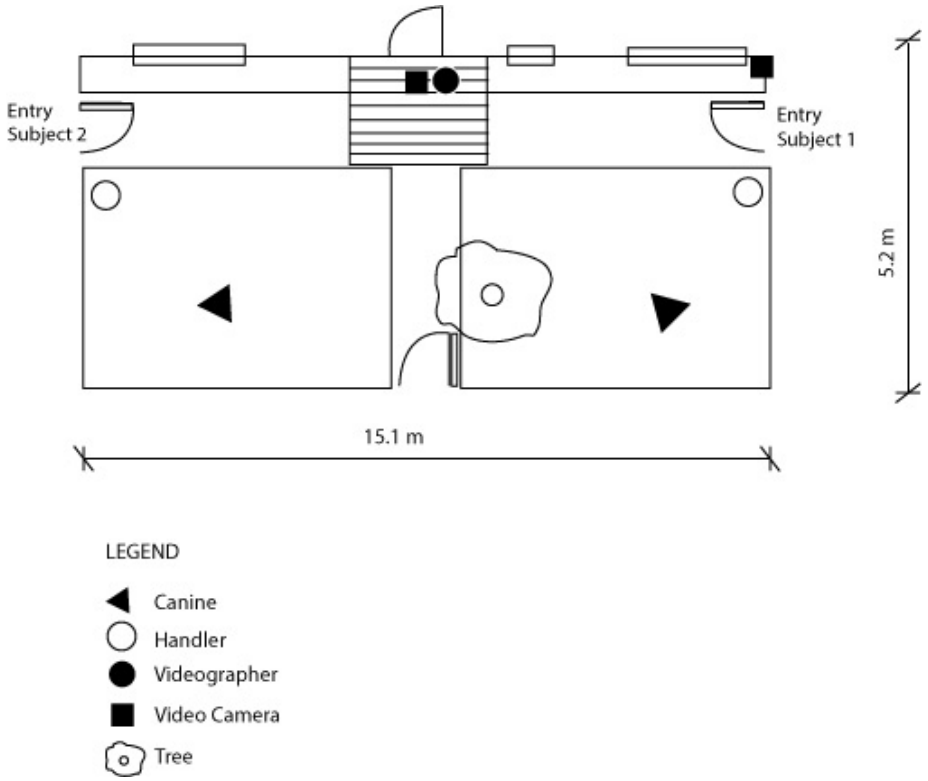

Figure 2.1 Map of study site

2.3.3 Procedure

Two 5-min meetings, separated by one week, between 30 pairs of unfamiliar dogs were observed between May-August 2013. Unfamiliar dyad pairs were created based on sex (10 male-male; 10 female-male; 10 female-female) and size (no pair had more than a 7 kg weight difference). Pairs were assigned such that they had no prior contact. In both Week 1 and Week 2, meetings were carried out between the hours of 3-5 pm. There were no procedural differences between the two meetings. At their scheduled time, dogs arrived at the study site with their

owner or familiar handler (i.e., dog walker). Each dog was directed to stand at a separate entry point to prevent visual contact with the other dog prior to entering the yard. At the onset of the session, the dogs were simultaneously untethered and entered the yard (note that daily walking equipment such as harnesses and collars, which were typically left on when dogs were untethered, e.g., at the dog park, were not removed). To prevent any escape attempts from the yard, the humans entered the yard and were instructed to stand at the gate they had entered through and to ignore the dogs. Thus, three humans were present during each meeting: two handlers and the researcher who filmed the interaction; all dogs were familiar with one of the two handlers and some dogs had met the researcher previously. At the end of the first 5-min session, handlers were instructed to leash their dogs and pairs were walked together on-leash around the neighbourhood for 15 minutes. No effort was made to clean the study site between trials, unless dogs defecated, in which case the feces were picked up. It is assumed that there was a gradual accumulation of new scents in the yard, much as there would be in a dog park or other public setting.

2.3.4 Video-recording

A stationary camera (Panasonic HC-V510) was positioned on a platform in the southwest corner of the yard. Except for a blind spot by the west gate and southwest corner, the stationary camera provided a view of the whole yard. Close-up interactions were filmed with a hand-held camera (Sony Handycam DCR-SR60). The video files were saved in .mp4 format and behavioural events were recorded during video playback via an event recorder (Logger.app © A. Earle, Memorial University).

2.3.5 Time Budgets and Behavioural Coding

The general activity and behaviours of each dog in the yard were coded from video recordings. For frequency behaviours, all occurrence sampling was used; that is, each occurrence of the behaviour was recorded from the continuous recording of the dogs. For all other behaviours, total durations were measured (Martin, Bateson, & Bateson, 2007).

2.3.5.1 Activity Budgets – Individuals

To determine the individual activity budgets of each dog in the 5-min sessions, the proportion of time the focal dog spent in four mutually exclusive states was calculated. Fig 2.2 illustrates the four possible activity states.

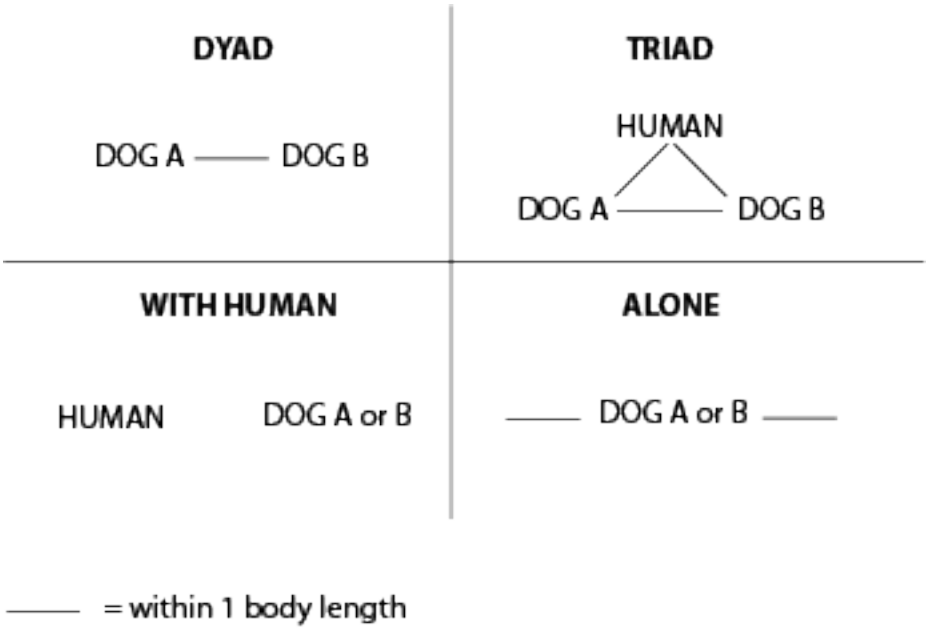

Figure 2.2 Four activity states of dogs in greeting sessions: Dyad, Triad, With Human, Alone.

Dogs were coded as being in a dyadic state (Dyad) if they were within one body length of the conspecific and greater than one body length from any human. Dogs were recorded as being in a With Human state if they were within one body length of a human and greater than one body length away from a conspecific. When dogs were within one body length of both a human and a conspecific, they were recorded as being in a triadic state (Triad). If focal dogs were not within one body length of either a dog or a human, they were recorded as being Alone. I selected the focal dog's body length as a measurement tool as it has been previously used to quantify conspecific interaction in dogs (e.g., Pullen et al., 2013). In some cases, due to either visual obstruction by humans or dogs, or insufficient video resolution, the total (visual) sampling time for individual dogs was less than the allotted 5 min. Thus, independent scores for each dog's activity budget were created by dividing the observed time in each state by the total sampling time. Time budgets were converted to percentages and total duration was used to calculate the percentages.

2.3.5.2 Activity Budgets – Pairs

Although each dog had independent scores for each of the four activity states, partners' scores in the dyadic and triadic states were highly correlated (Dyad: Week 1, $r(29)=0.92$, Week 2, $r(29)= 0.89$; Triad: Week 1, $r(29)=0.93$, Week 2, $r(29)=0.76$), and were averaged to create composite pair scores. A third state, Away from Conspecific, that specified when the dog was not near (i.e., not within one body length) the other dog was created by combining the proportion of time dogs spent in the With Human state and the Alone state. Because this state was identical

for partners (Away from Conspecific: Week 1, r(29)=1.00, Week 2, r(29)= 1.00) partner scores were averaged to create a pair score. Thus, each pair's time budget was divided into the following three exhaustive and mutually exclusive states: Dyad, Triad and Away from Conspecific (combined Alone and With Human). Time budgets were converted to percentages and total duration was used to calculate the percentages.

2.3.5.3 Latency to Initiate Contact

I examined the time elapsed, in seconds, from when the focal dog had visual contact with the conspecific (defined as head oriented toward the conspecific) until there was little visible separation between any body part of the focal dog and the partner. Dogs that did not initiate contact were given a latency of 300 s, the total length of the trial. Note that since each pair member was treated as a focal dog, the latency to initiate contact can differ between pair members. All behavioural variables coded from the videos are defined in an ethogram (Table 2.1).

2.3.5.4 Approach Style

I coded the approach style of individual dogs by observing the focal dog's head position in relation to the partner until there was no visible separation between the focal dog's snout and the partner. This measurement characterizes the level of visual attention dogs had with their partner before contact. A dog that moved directly towards the conspecific without changing his/her head or body position was coded as having a Direct Approach. Dogs were coded as Looking Away if they turned their heads less than 90° (estimated) from the conspecific, or lowered their head to the ground before they approached the conspecific. Although in these cases

the dog's gaze was averted, the 270° peripheral vision of dogs likely allows the dog to continue to receive visual communication from the conspecific (Fuller & Fox, 1969, as cited in Horowitz, 2009). Dogs were coded as Turned Away if their heads were oriented more than 90° degrees (estimated) away from the conspecific. This included dogs that socially interacted with a human, or turned to investigate something in the yard or along the fence, before they made contact with the conspecific. When dogs were in this Turned Away state, visual contact with the other dog was completely suspended.

2.3.5.5 Sniffing Behaviour

The Sniffing Front score was the total amount of time (measured in seconds) in the 5-min trial during which there was little visible separation between the focal dog's snout and the front parts (face, ear, shoulder, front leg(s)) of the conspecific. The Sniffing Rear score was the total amount of time in the 5-min trial during which there was little visible separation between the focal dog's snout from the rear parts (anus, inguinal area, hind leg(s)) of the conspecific. Total Sniffing refers to the combined Front Sniffing and Rear Sniffing scores.

2.3.5.6 Following Behaviour

The Following score was the total amount of time dogs spent following the conspecific partner. Dogs were coded as Following if they moved behind a locomoting (e.g., walking, running) conspecific, maintaining a distance of less than 2 body lengths, while not overtaking the other dog.

2.3.6 Inter-rater Reliability

To assess the inter-rater reliability of the coded behaviours, a second independent observer coded a subset of the temporal measurements (Dyad, Following, Latency to Contact, Sniffing Rear), and a subset of the frequency measurements (Play Bow, Play Slap, Lunge, Charge, Countermarking, and Urine Investigation) for 12 (20% of all videos) randomly-selected focal dogs. As the data were continuous, intra-class correlations (ICCs) were calculated for each category to assess inter-rater reliability (Rousson, Gasser, & Seifert, 2002). Measurements of both time in Dyad and Latency to Initiate Contact revealed perfect agreement between observers (ICC=1.0). Sniffing Rear and Following were also highly correlated between observers (Sniffing Rear: ICC=0.95, Following: ICC=0.85). Possibly due to the rarity of the frequency behaviours coded there was absolute agreement between the raters for Play Slap, Play Bow, Lunge, Charge, Urine Investigation, and Countermarking (ICC = 1.00).

Table 2.1 Ethogram of behavioural variables coded in the interactions of unfamiliar conspecifics. Play signal and visual attention definitions are modified from Horowitz (2009)

Behaviour	Description
Latency to Initiate Contact	Time elapsed, in seconds, from when the focal dog had visual contact with the conspecific (head oriented in the direction of the conspecific) until there was little visible separation between any body part of the focal dog and the conspecific.
Sniffing Front	Time, in seconds, during which there was little visible separation between the focal dog's snout and the front parts [face, ear, shoulder, front leg(s)] of the conspecific.
Sniffing Rear	Time, in seconds, during which there was little visible separation between the focal dog's snout and the rear parts [anus, inguinal area, hind leg(s)] of the conspecific.
Total Sniffing	Combined time, in seconds, of Sniffing Front and Sniffing Rear.
Following	Time, in seconds, during which the focal dog followed a moving (walking, running, etc.) conspecific within two body lengths and was in line with the leader, while not overtaking the leader.
Visual Attention	When the dogs' head and body were forward-facing and directed toward the conspecific.
Direct Approach	Once visual attention with the conspecific occurred, the focal dog's head and body position were oriented towards the conspecific until contact was made. The dog could either be standing or moving towards the conspecific.
Looking Away	Once visual attention with the conspecific occurred, the focal dog made at least one occurrence where its head turned sidewise (less than 90°) and/or was lowered to the ground before contact was made with the conspecific. Although the gaze was averted, the focal dog should still be able to maintain peripheral vision with the conspecific (Fuller & Fox, 1969, cited in Horowitz, 2009).
Turned Away	Once visual attention with the conspecific occurred, the focal dog turned its head away more than 90° from the conspecific before contact was made with the conspecific. Visual attention of the conspecific was suspended.
Play Bow	Body position in which the forelimbs were down; hind legs raised; tail erect or wagging.
Play Slap	Usually a simultaneous slap of ground with two forelimbs, occurring in the play bow position.
Lunge	A sudden angular leap towards conspecific.
Charge	A running approach made towards the receiver from more than two body lengths away.
Counter-marking	Urinating on (or near) the same spot previously urinated on by a dog during the same observation period.
Urine Investigation	Snout placed in close proximity to area where conspecific recently urinated.

2.4 Statistical Analyses and Results

Analysis of a dog's behavior when interacting with a partner in a dyad requires concurrent consideration of the partner's behavior (Kenny & Judd, 1986). For example, the degree to which Dog A investigates Dog B may influence how much Dog B investigates Dog A. This mutual influence violates the assumption of independence between observations required for many common analytical tools, including the analysis of variance (Kenny & Judd, 1986). Further, our subjects were measured at two time points (Week 1 and Week 2). Because the pair's Week 1 greeting values will likely be related to the pair's values for the Week 2 greeting, these repeated measurements also violate the assumption of independence. Linear mixed models (LMMs) are often used to account for issues of non-independence by adding random effects, or variables that vary within hierarchical groups (e.g., pairs of dogs), to fixed effects (Bolker, Brooks, Clark, Geange, Poulsen, Stevens, & White, 2009; Kenny, Kashy, & Cook, 2006; Winter, 2013). For data that are clustered in pairs, scores at the individual level are analyzed once the dependence of observations within the pairs has been accounted for (Hedeker, 2003; Hedeker & Gibbons, 1994). When there are multiple responses per subject, LMMs also take into account the within subject variation (Lindstrom & Bates, 1990).

Because activity budget states were reported as percentages of total time, analysis of this variable violates the assumption of homoscedasticity and normality; residuals of percentages are not normally distributed. To address this violation, follow-up analyses were run using the actual times and the results were almost identical. I report the results from the analysis of the percentages. Continuous data that were not normally distributed were log-transformed. Unless,

otherwise specified, visual inspection of residual plots did not reveal any obvious deviations from homoscedasticity or normality.

All LMMs were calculated using the lme4 package (Bates, 2010) in R 3.1.0 (R Development Core Team, 2006). Following the method described by Winter (2013), likelihood ratio tests were used to compare the two models. Model 1 (the full model) included the fixed effect or interaction in question and Model 2 (the reduced model) excluded the fixed effect or interaction in question. For example, to investigate the fixed effect Week on a behaviour, I included it in the full model with two other fixed effects (e.g., Sex and Partner's Sex); the reduced model included both Sex and Partner's sex but not the fixed effect of Week. If the difference between the likelihood ratios of these two models was significant, I concluded that the fixed effect of Week was significant (Winter, 2013; Levy, 2014). Likelihood ratio tests were conducted to examine whether the fixed effect removed in the reduced model was statistically significant, as p-values are not automatically generated from mixed models in R. Chi-square statistics are generated because the -2log-likelihood ratio (-2llr) of the two models being compared approximates a Chi-square distribution (Wilks, 1938). To calculate the effect sizes for the mixed models, I used the R package Mumin (Bartoń, 2015). R^2 values are reported for significant effects as an estimator of effect size. Alpha level was set *a priori* at 0.05. Means ± standard error of the mean (SE) are reported in the text for results not displayed graphically.

2.4.1 Multilevel modelling at the level of the individual

When two partners' scores differed from one another, I analyzed the subject at the individual level nested within the pair. I used this approach for the variables With Human,

Latency to Initiate Contact, Sniffing (Front, Rear, Total), and Following. For these outcome variables, models were fit to assess the relationships between Sex, Week, Partner and an interaction of these variables. For these models, two random effects (subjects nested in pairs) were included. For all relationships, additional post-hoc models were fit to tease apart effects attributable to interactions from main effects.

2.4.1.1 Results

With Human. For both weeks, male dogs spent a larger percentage of time in the With Human state than did females (females, n=30, Week 1: 30.10 ± 4.00%, Week 2: 23.03 ± 2.96%; males, n=30, Week 1: 47.41 ± 4.56%, Week 2: 44.83 ± 4.69%, $\chi^2(2) = 15.67$; $R^2 = 0.13$, $p < 0.001$). There was no significant effect of Week, Partner's Sex, nor interaction of these variables.

Latency to Initiate Contact. Latency to initiate contact significantly increased from Week 1 to Week 2 by approximately 22 seconds (Week 1: 56.9 ± 13.0 sec, Week 2: 79.3 ± 13.3 sec; $\chi^2(1) = 11.48$; $R^2 = 0.09$, $p < 0.001$). There was no effect of Sex, Partner's Sex or an interaction of these variables. There were four pairs (of 30), referred to as 'non-greeters', in which neither individual initiated contact in Week 1. Of those, three pairs made contact in Week 2. Six of the dogs that made contact with their partner in Week 1 did not initiate contact in Week 2. Because all dogs that did not initiate contact were given latency scores of 300 sec, the analyses were re-run with only those dogs that contacted the other dog in both Weeks 1 and 2. In this analysis, latencies increased from Week 1 to Week 2 by 29 sec and the pattern of results was the same, i.e., increased in Week 2 (Week 1: 16.1 ± 4.3 sec, Week 2: 45.5 ± 9.1 sec; $\chi^2(1) = 17.86$; $R^2 = 0.18$, $p < 0.001$). Again, there was no effect of Sex, Partner's Sex, or interaction of these

variables. Most dogs made contact within the first minute of the interaction (Week 1: 78%, Week 2: 67%).

Sniffing (Front, Rear, Total). Fifty dogs (83%) engaged in sniffing in Week 1. The five pairs of dogs that did not sniff in Week 1 were removed from the analysis. LMMs revealed a significant Partner's Sex X Week interaction on the duration of Sniffing Front (Fig. 2.3). Dogs with female partners spent more time Sniffing Front in Week 1 than Week 2, while there was no significant change in Sniffing Front for dogs with male partners ($\chi^2(2) = 11.62$; $R^2 = 0.16$, $p = 0.02$, Fig. 2.3).

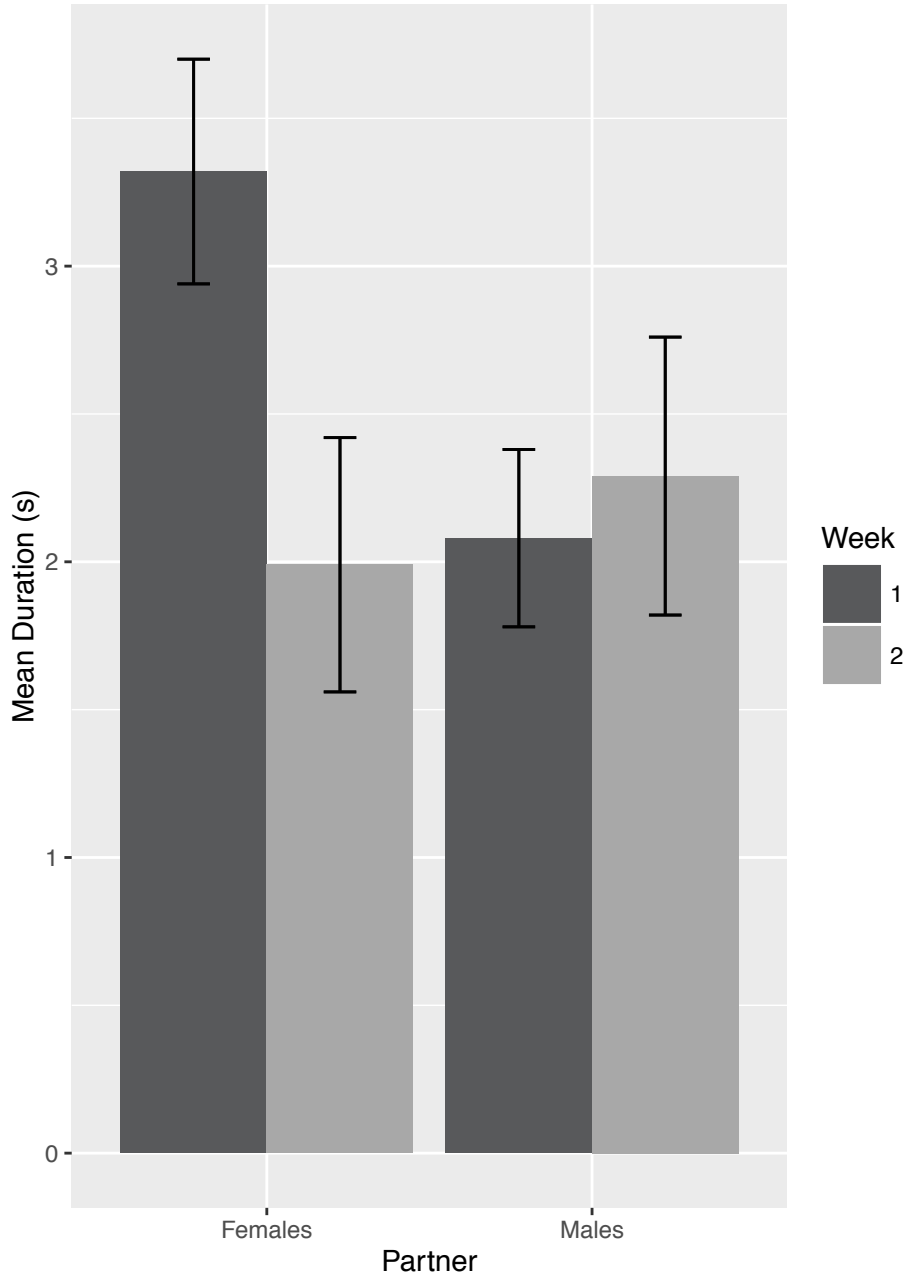

Figure 2.3 The effect of Partner Sex and Week on Sniffing Front duration (mean seconds ± SE) for individual dogs. Dogs with female partners spent significantly more time Sniffing Front in Week 1 than in Week 2.

Sniffing Rear significantly decreased from Week 1 to Week 2 ($\chi^2(1) = 5.03$, $R^2 = 0.05$, $p = 0.02$, Week1= 4.87 ± 0.54 sec, Week 2 = 3.69 ± 0.54 sec), and was not affected by Sex, Sex of Partner or the interaction of these variables. The overall time dogs spent sniffing (Total sniffing) significantly decreased from Week 1 to Week 2 (Week 1 = 7.62 ± 0.55 sec, Week 2 = 5.81 ± 0.77 sec; $\chi^2(1) = 7.18$; $R^2 = 0.07$, $p < 0.01$).

Following. Thirty-four dogs (57%) spent some time following their partner in Week 1. Eighteen dogs (30%) spent some time following their partner in Week 2. Duration of following decreased significantly from Week 1 to Week 2 (Week 1 = 2.52 ± 0.48 sec, Week 2 = 1.42 ± 0.42 sec, $\chi^2(1) = 8.64$; $R^2 = 0.07$, $p = 0.003$). There was no significant effect of Partner, Sex or interaction of these variables on time spent following.

2.4.2 Multilevel modeling at the level of the pair

When scores of within-pair variables have minimum variation, one option is to run an analysis using a pair score; i.e., a score created by taking an average of the two pair members. I used this approach for the variables Dyad, Triad, and Away from Conspecific. LMMs were used, with Week, Pair Type (male-male, male-female, and female-female), and a Week X Pair Type interaction as independent variables; the activity budgets, modeled at the pair level (Dyad, Triad, Away from Conspecific), were the dependent measures. Dog Pair was entered as a random effect. I used a random intercept for the random effect but assumed a fixed slope.

2.4.2.1 Results

Dyad. Overall, pairs spent approximately 10% of the session in the Dyad (Week 1: 10.3 ± 1.7%, Week 2: 8.8 ± 1.4%). There was no effect of Pair Type, Week, or the interaction of Pair Type X Week.

Triad. Overall, pairs spent approximately 8% of the session in the Triad. The mixed-sex pairs spent a larger percent of time in the Triad than other pair types, but only in the first week (significant interaction of Pair Type X Week; $\chi 2$ (2) = 12.73; $R^2 = 0.32$, p = 0.002; Fig. 2.4).

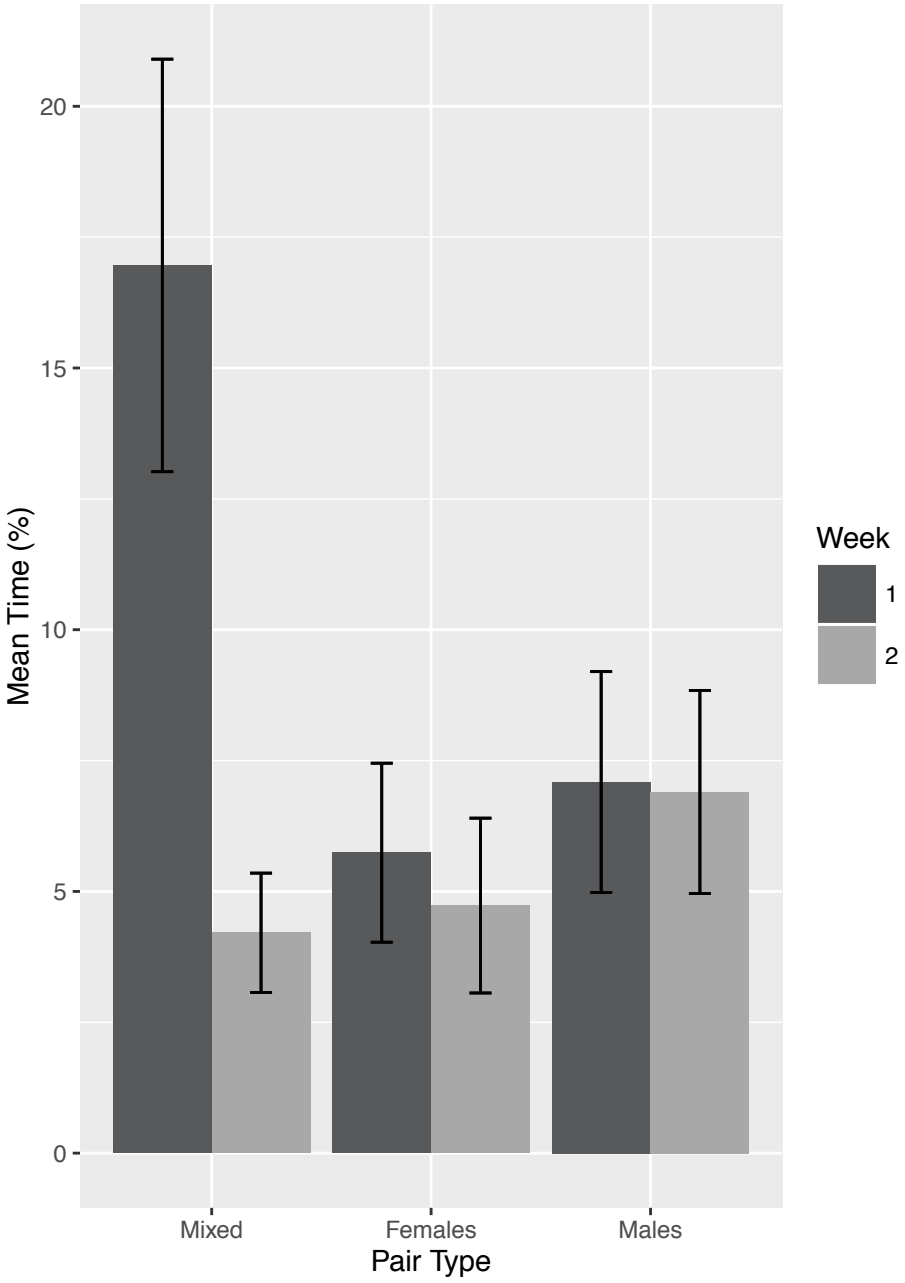

Figure 2.4 Mean percentage (± SE) of 5 min sessions that dog pairs (N=30) spent in the Triad state in Weeks 1 and 2. Mixed sex pairs spent more time in a Triad than other pair types, but only in Week 1.

Away from Conspecific. Pairs spent the largest proportion of time in the Away from Conspecific state. Time in this state significantly increased from Week 1 to Week 2 (Week 1: 79.8 ± 2.6%, Week 2: 86.0 ± 1.9%; $\chi 2$ (1) = 6.16, R^2 =0.1, p = 0.01). There was no effect of Pair Type, or an interaction between Week and Pair Type.

2.4.3 Social Influence: Correlations between Partners' Scores in the With Human State, Latency to Initiate Contact, and Sniffing

Correlation coefficients can be used as indices of social influence (Salvy, Jarrin, Paluch, Irfan, & Pliner, 2007). To assess level of social influence among partners for the With Human state, latency to contact, duration of sniffing (Front, Rear and Total) and duration of following, I calculated the relationship between the partner's behavioural measurements (percentage score) using correlation coefficients. When the members of the group were distinguishable by sex (e.g., mixed-sex pairs), Pearson correlation was used unless the data were not normally distributed, in which case Spearman's R was used. When the pair members were not distinguishable (e.g., same-sex partners), intraclass correlation coefficients (ICCs) were used (as recommended by Griffin & Gonzalez, 1995; Shrout & Fleiss, 1979). Statistically significant differences between the correlation coefficients of the different pair types were compared from Week 1 to Week 2 using the Fisher r-to-z transformation.

2.4.3.1 Results

The correlation coefficients for the With Human state, Latency to Initiate Contact, and Sniffing (Front, Rear, Total) behaviours are shown in Table 2.2.

With Human. The individual scores of partners for time spent in the With Human state correlated significantly in Week 1 for the mixed-sex pairs and the male pairs. The scores of dogs in male pairs were also significantly correlated in Week 2. Female pairs appeared to behave more independently than other pairs, as each partner's percentage of time for the With Human state were not correlated in either Week 1 or Week 2. The correlations between mixed-sex pairs' scores for the With Human state significantly changed from Week 1 to Week 2 ($z = 2.01$, $p = 0.04$), such that partners had moderate correlations in Week 1, but none in Week 2.

Latency to Initiate Contact. Latency to initiate contact scores were significantly correlated among all pair types in Week 1. For all pairs in Week 2, latency to initiate contact correlations decreased significantly. While scores of both female pairs and mixed-sexed pairs remained significantly correlated in Week 2, the correlation between male pairs' scores was no longer significant.

Sniffing. Sniffing Front was significantly correlated between partners for all pair types in Week 1 and Week 2. However, scores for Sniffing Rear were significantly correlated for only the male pairs in Week 1; female and mixed-sex pairs did not show this relationship. Mutual Sniffing Rear decreased significantly from Week 1 to Week 2 for male pairs and no pair types had correlated Sniffing Rear behaviour in Week 2. In Week 1, Total Sniffing was significantly correlated for both types of same-sex pairs. In Week 2, only partners of the mixed-sex pairs had significantly correlated Total Sniffing scores.

Table 2.2 Correlations between partners' activity states and behaviours by Pair type and Week.

	Week	Male Pairs (n=10) [a]	Female Pairs (n=10) [a]	Mixed Sex Pairs (n=10)
With Human	Week 1	0.68**	0.41	0.68** [b]
	Week 2	0.52*	0.09	0.14 [b1]
Latency to Initiate Contact	Week 1	1.00**	0.99**	0.98** [b]
	Week 2	0.18 [1]	0.47* [1]	0.66** [b1]
Sniffing Front	Week 1	0.71**	0.84**	0.84** [b]
	Week 2	0.87**	0.70**	0.74** [c]
Sniffing Rear	Week 1	0.55*	-0.09	0.17 [b]
	Week 2	-0.10 [1]	0.14	0.34 [b]
Total Sniffing	Week 1	0.69**	0.48*	0.24 [b]
	Week 2	0.37	0.42	0.57* [b]

* = $p<0.05$; ** = $p<0.001$.
[a]Intraclass correlation
[b]Pearson's r
[c]Spearman's rank-order correlation

1 Represents a significant difference in the correlation coefficients of Week 1 and Week 2 using the Fisher r-to-z transformation.

2.4.4 Behavioural Descriptions: Contact Initiations, Approach Styles, Play, Agonistic Behaviour, Urine Investigation and Countermarking

2.4.4.1 Contact Initiations

Dogs were recorded as either making first contact to the front parts [face, ear, shoulder, front leg(s)] or the rear parts [anus, inguinal area, hind leg(s)] of the conspecific. Z-scores were

used to determine if there was a significant difference between the number of contact initiations that were snout-to-snout versus snout-to rear. Of the 52 dogs that made contact in Week 1, the first point of contact for 44 (85%) was snout-to-snout, leaving 8 dogs (15%) with snout-to-rear first contact in Week 1. Of the 52 dogs that made contact in Week 2, 38 (73%) met snout-to-snout with 14 (27%) meeting snout-to-rear. For both weeks, the probability of snout-to-snout as a first point of contact was significantly higher than snout-to-rear (Week 1, $z = 14.14$, $p < 0.001$; Week 2, $z = 7.472$, $p < 0.001$).

2.4.4.2 Approach Style

A small proportion of dogs demonstrated a Direct Approach to the conspecific in both weeks (Week 1: n = 9; 15%, Week 2: n = 11, 18%). The Looking Away style of approach was observed in 25% (n =15) of dogs in Week 1 and 17% (n= 10) in the Week 2. The majority of dogs in both Week 1 (n = 36, 60%) and in Week 2 (n = 39, 65%) demonstrated a Turned Away style of approach. This approach style was typically observed in dogs that greeted a human or turned to examine something in the yard. For these dogs, complete visual contact with the conspecific was suspended for at least a few moments prior to contact.

2.4.4.3. Play Behaviour

Notably, few dog pairs engaged in playful interactions. Only three pairs (10%) played in Week 1 and three pairs (10%) played in Week 2, one of which had played in Week 1. Three other dogs presented at least one instance of a play bow or a play slap that was not reciprocated in Week 1. One dog in Week 2 presented a play signal that was not reciprocated.

2.4.4.4 Agonistic Behaviour

Five dogs (8.3%) presented one or more agonistic behaviours (a lunge or a charge) in Week 1. Only one dog that behaved agonistically in Week 1 did so again in Week 2. No other dogs behaved agonistically in Week 2.

2.4.4.5. Urine Investigation and Countermarking

More dogs urinated in the yard during the second session than in the first one (Week 1: 65%, 21 males, 18 females; Week 2: 80%, 22 males, 26 females). In Week 1, 15 dogs (38%) investigated their partner's urine; more males investigated their partner's urine than did females (11 males, 4 females). In Week 2, 25 dogs (52%) investigated their partner's urine (12 males, 13 females). In Week 1, five dogs (3%) countermarked their partner's urine; all were males with male partners. In Week 2, eight dogs (19%) countermarked their partner's urine, two of which were females countermarking their female partner's urine. No individuals in mixed pairs countermarked their partner's urine in either Week 1 or Week 2.

2.5 Discussion

Familiarity between 30 pairs of unfamiliar pet dogs was manipulated by creating two brief meetings between the pairs, who were matched by size (within 7 kg), and sex, such that there were 10 male-male, 10 female-female, and 10 male-female pairs. The 5-min meetings took place one week apart in the same neutral location, with the first meeting followed by both dogs being walked on-leash together in the neighborhood to increase their familiarity with one another. Even though this single brief meeting was a relatively weak manipulation of familiarity, there were nonetheless significant changes in some behaviours between Weeks 1 and 2, all with

small-to-medium effect sizes: latency to initiate contact (increased in Week 2), sniffing (rear and total, decreased in Week 2), following behaviour (decreased in Week 2), and time spent further than one body length from the conspecific (increased in Week 2). Thus, in general, following a single meeting, dogs appeared to decrease their proximity-seeking and investigative behaviours towards each other, which would be predicted if initial meetings between unfamiliar dogs serve mainly an investigative function.

In addition, the sex of each focal dog and the sex of the partner influenced some specific behaviours even though all dogs had been spayed/neutered. Specifically, male dogs spent more time near humans and away from conspecifics (i.e., in the With Human state), and dogs with female partners spent more time sniffing fronts during the initial meeting only. Furthermore, in the initial meeting, dogs in mixed pairs spent the most time in the Triad state, i.e., within one body length of both a human and the other dog. The effect sizes of these sex-related effects and interactions were all medium-to-large, indicating that the sex of unfamiliar dogs may exert relatively important influences on some behaviours, particularly those that involve people. Note that, in this study, the handler present at the meetings did not interact with or engage the dogs. Thus, this may be a conservative test of the influence of sex on behaviours that occur with or near people during initial meetings of unfamiliar dogs.

Familiarity

Interestingly, familiarity seemed to have little effect on behaviours shown during the initial approaches of dogs towards each other. During both meetings, the majority of dogs approached one another indirectly by either turning their head to ‘look away’ or by turning both

their head and body, to first investigate something in the yard or to approach a human before they approached the other dog. Fewer than 20% of the dogs in each week made a direct approach towards the conspecific. Although dogs may have used a looking away signal to avoid eye contact with a conspecific, it is possible that, in this environment with competing distractions, investigating the unfamiliar conspecific was not a priority and dogs simply prioritized investigating other stimuli. Once contact was made, interactions typically involved inspection of the head and anogenital regions; these behavioural components of first interactions have previously been documented (Bradshaw & Lea, 1992, Řezáč et al., 2011). Latency to initiate contact times suggest that for most dogs the close contact was a priority; the vast majority of dogs made contact within in the first minute in both weeks. However, the total durations of actual pair interactions were short; of the total 5 min session dogs spent, on average, approximately 30 sec (10% of session length) within close contact (i.e., within one body length of each other). After this initial period of interaction very few dyadic behaviours were observed. Indeed, Pullen et al. (2013) also found that after an initial interaction period unfamiliar dogs explored the environment independently. In this study, few pairs (5 of 30 pairs) engaged in play and very few dogs (5 of 60 dogs) demonstrated any agonistic behavior.

Latency to initiate contact increased from Week 1 to Week 2, possibly suggesting that the novelty of the conspecific had declined by the second session. Again, this could be due to priority being given to investigating the environment. Although the yard should have been less novel to the dogs at Week 2, the accumulated scents from other tested dogs would be novel. Latency to initiate contact scores were strongly correlated for all pair types in the first week. These correlation coefficients were all were significantly smaller in the second week, suggesting

that partners may have been less influenced by one another's contact initiations in the second week. In fact, 10% of dogs that made contact with their partner in Week 1 did not make any contact with their partner in Week 2. Sniffing scores also demonstrated that dogs responded differently to their more familiar partners in Week 2; total amounts of time spent sniffing decreased in the second session. Similarly, time spent following another dog, which may facilitate gathering information about a conspecific, decreased from Week 1 to Week 2. Taken together, these changes in behaviour from Week 1 to Week 2 may suggest that dogs recognized each other from further away and no longer needed close contact for individual identification.

Dogs may have relied on olfactory and visual information to recognize a conspecific. In a study of both on-leash and off-leash dog interactions in public places, Řezáč et al. (2011) found that 25% of interacting individuals did not engage in any sniffing behaviour. With their powerful ability to detect odours at low concentrations (Gadbois & Reeve, 2014; Lorenzo, Wan, Harper, Hsu, Chow, Rose, & Furton, 2003) it is possible that dogs don't need close contact for individual identification, even after a single interaction. In Week 2, morphological characteristics such as the dog's body size and fur colour may also have assisted dogs in their ability to perceive the partner as familiar. Autier-Dérian, Deputte, Chalvet-Monfray, Coulon, and Mounier (2013) demonstrated that domestic dogs, when presented with images of many animal species can visually discriminate between them. Considering the vast morphological variation in dog breeds, this certainly suggests that dogs have sophisticated cognitive abilities in discrimination and categorization, two processes that may help dogs recognize a familiar conspecific.

There are several potential explanations for why some dogs did not make contact with their partner. They could be responding to a prior negative experience of meeting a similar unfamiliar dog. Trisko, Sandel and Smuts (2016) suggest that non-interactive relationships between dogs (a relationship with no affiliation) may be based on mutual avoidance, perhaps due to asymmetrical social ranks (i.e., one dog may be dominant over the other). Bradshaw and Lea (1992) suggest that the process of garnering information during a sniffing interaction may be a mild form of dominance and some dogs may be uncomfortable with another dog's sniffing behaviour. Partner preferences may explain the reduced contact in Week 2. Řezáč et al. (2011) found that sniffing behaviour was observed more often when small dogs encountered one another than when small dogs encountered large dogs. Although my pairs were created to have matching weight, other factors such as age, energy level, and breed may also explain why dogs spent less time in close contact with one another during the second meeting.

Sex

In Week 1, mixed-sex pairs spent more time in close proximity to one another in the presence of a human (Triad) than did same sex pairs. If dogs were motivated to approach the same human, it may be that the mixed sex pairs were less fearful, or more tolerant of being close to one another, than were same sex pairs. In a study of a group of dogs at a daycare facility, Trisko and Smuts (2015) found that aggression was more frequent in same-sex than mixed sex pairs. Aggression between dogs around humans may also be caused by dogs perceiving humans as a potential resource. For example, humans at dog parks often dispense treats, toys and attention. It may be that it is less risky for mixed sex pairs to compete for the same resource than same sex pairs. Although the relationship between sex of pairs and resource guarding has not

been well studied, Jacobs, Coe, Pearl, and Niel (2017) demonstrated that dogs who expressed resource guarding in the presence of other dogs were more likely to be male and neutered. The proportion of time that mixed sex pairs spent simultaneously near a human and the other dog decreased in Week 2, possibly suggesting that either the novelty of the humans had declined by Week 2 and/or the dogs learned that the humans were not a valued resource, as they did not interact with the dogs.

Across both weeks males spent more time in the With Human state (near a human without the other dog nearby) than females did, and correlations in both Weeks 1 and 2 suggest that individuals in male pairs influenced one another to be in this state. Previous research demonstrates that of all unfamiliar dog-dog interactions outside the home, males are at the highest risk of having conflicts with other males (Borchelt, 1983; Fatjo, Amat, Mariotti, de la Torre, & Manteca, 2007; Sherman, Reisner, Taliaferro, & Houpt, 1996). Thus, it is possible that males in male-male pairs stand close to a human and not near the other dog as a strategy to avoid possible negative conspecific interaction or conflict. Although none of the dogs in this study were intact, it is worth noting that there is some evidence that intact males fight more than castrated males (Borchelt, 1983; Hopkins, Schubert, & Hart, 1976) and are also more likely to be targets of aggression (Roll & Unshelm, 1997).

In contrast to the results of Bradshaw and Lea (1992), there was no preferential sniffing by males of the rear parts of their partners. However, unlike many of the dogs in Bradshaw and Lea's (1992) study, all of the dogs in the current study were sexually altered, which may have influenced these results. I did observe preferential sniffing of front parts by dogs with female partners, but only in Week 1. Front sniffing was correlated for members of all pair types in both

weeks; although a dog sniffing another dog's front parts dog did not guarantee mutual investigation, it predisposes the partner to be in a position to also investigate the initiator's front parts. In contrast, rear sniffing can often occur while one dog investigates a partner who is not oriented towards him/her. Rear sniffing scores were correlated only for the male pairs and only in Week 1, which suggests mutual rear sniffing may be a characteristic of first encounters between male dogs.

While there was no difference between sexes for frequency of urination it appears that in the second week the incidence of urination for females increased. Countermarking may be competitive; both male and female dogs exclusively countermarked dogs of the same sex. It is thought that scent-marking behavior has an important function when unfamiliar dogs meet which may include sexual and individual identity (Doty & Dunbar, 1974) and denoting territories and masking the odors of other dogs (Simpson, 1997 as cited in Řezáč et al., 2011). Interestingly, Lisberg and Snowdon (2011) demonstrated that gonadectomized dogs countermark intrasexually similarly to intact dogs. Although all the dogs in this study were neutered and spayed, these results parallel their findings.

The human effect

In environments where there are many social interactions between companion dogs, humans play an important role in intervening to prevent altercations (e.g., dog park: Shyan et al., 2003; Walsh, Howse, Green, Butler, & Anderson, 2011; dog daycare facilities: Trisko & Smuts, 2015). Although in this study handlers were instructed to not interact with the dogs, and they did not do so, their presence in the yard appeared to affect many of the dogs' behavioural

interactions. However, disentangling the interaction of the human presence and the sex of the dog (and sex of pairs) is beyond the scope of this thesis; I did not record how much time each dog spent with each different human in the yard. However, it is clear that in this study humans are important in the interactions of unfamiliar dogs, and they may serve a number of purposes. For example, as mentioned above, it is possible that humans were perceived by the dogs as a valued resource and dogs in the Triad state may have been vying for the attention of the same human. It is also possible that humans were facilitators of conspecific contact (particularly for mixed sex pairs in Week 1). As well, for male pairs in both weeks, humans may have provided a secure base for the dogs, i.e., a means to avoid conflict (e.g., dogs may have learned from experience that being close to a human reduces the potential of dog-dog conflict, which is likely a greater risk for male pairs (Sherman et al., 1996). Further analysis of the time budgets of the individual dogs and dog pairs can help clarify the roles of humans and possibly provide further insight into the motivations of the dogs, i.e., whether they were more motivated to interact with their conspecific partner, the humans present, or both conspecific and humans simultaneously.

The low incidence of play

Interestingly, there was a much lower incidence of play among the dog pairs than might be expected from studies of social interactions of dogs in dog park settings (e.g., Howse, 2016; Ottenheimer Carrier et al., 2013). Because play is affected by the familiarity of partners (Mitchell & Thompson, 1991b as cited in Rooney, Bradshaw, & Robinson, 2000), it is possible the two encounters in my study were not sufficient to form a social bond that would foster play. Another factor that may explain the low incidence of play is the age of the dog sample; the mean

age was over 4 years old and only one dog was under 1 year old. Petak (2013) reported that in behavioural observations of 12 shelter dogs between the ages of 6 and 12 years, playful behaviour was rarely observed. Řezáč et al. (2011) reported that puppies played with one another more than twice as often as adults. While adult dogs do continue to play throughout their lives (Bradshaw et al., 2015), play typically decreases as species age (Hall, 1998 as cited in Bradshaw et al., 2015). As well, it has been reported that dog-human play decreases with age (Rooney et al., 2000), and older dogs play less than younger dogs at dog parks (Ottenheimer Carrier et al., 2013). Howse (2016) found that dog density influenced the occurrence of some behavioural interactions in the dog park (e.g., the rate of anogenital and head sniffing was higher when there were more than four dogs). This suggests that multiple dog interactions, such as those in dog park settings, may influence dogs to be more confident and playful. However, even in a group of highly social dogs (e.g., dogs that attend dog daycares) approximately half of the dyads showed no interaction besides occasional sniffing (Trisko & Smuts, 2015). These non-interactive relationships suggest that partner preferences may play an important role in dog-dog interactions. Trisko et al. (2016) found that in a dog daycare facility sex was an important variable in partner preferences; mixed-sex dyads were more likely to affiliate than other dyads. Clearly, there are many other variables that may influence social compatibility in adult dogs (e.g., size, personality, energy level, castration status, etc.) that should be further investigated. It is also worth noting that because the humans in this study were specifically instructed not to engage with the dogs, there may have been a degree of artificiality that could have discouraged the dogs from socially interacting.

Conclusion

As familiarity of neutered socialized companion dogs increases, dogs react differently to their conspecifics by demonstrating less proximity-seeking and investigative behaviours. The role of sex and familiarity in social companionability, as well as other variables that may influence dog-dog interactions (e.g., age, castration status, personality, etc.), still need to be further clarified. Humans appear to have an important role in unfamiliar dog-dog interactions. Whether dogs are using humans skillfully, i.e., to mitigate the potential conflict or to facilitate conspecific social interaction, should also be further investigated. In daycares and dog parks it is common for human involvement to reduce conflict interactions, and dogs may learn that humans can act as secure bases in a potentially threatening environment. The lack of agonistic interactions demonstrates the exceptional skills unfamiliar dogs display at navigating initial interactions. Because of the heightened possibility for conflict between unfamiliar dogs, and the possible need for sophisticated communication to avoid conflict, the interactions of unfamiliar dogs present an excellent opportunity to further the research on canine social cognitive capacities.

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CHAPTER 3: COMPARING TWO CANINE PERSONALITY ASSESSMENTS: CONVERGENCE OF THE MCPQ-R AND DPQ AND CONSENSUS BETWEEN DOG OWNERS AND DOG WALKERS

3.1 Abstract

Despite the number of emerging questionnaire-based canine personality assessments, there is still no consensus on the content and number of broad personality dimensions in domestic dogs. In the current study, I compared two canine personality questionnaires: The Monash Canine Personality Questionnaire-Revised (MCPQ-R) and the Dog Personality Questionnaire (DPQ) to further clarify the structure of canine personality. To determine how the components of each assessment aligned with one another, target dogs (n=60) were rated by two knowledgeable informants, the dog's owner (n=60) and the dog's walker (n=10), and their ratings were examined according to the following criteria: 1) convergence between MCPQ-R dimensions and DPQ factors, measured by correlations among seemingly analogous personality traits, and 2) consensus of ratings between owners and walkers, measured by inter-rater reliability of the pairs. For both owners and walkers, there were significant positive correlations between seemingly analogous personality traits: Neuroticism (MCPQ-R) and Fearfulness (DPQ), Extraversion (MCPQ-R) and Activity/Excitability (DPQ), and Training Focus (MCPQ-R) and Responsiveness to Training (DPQ). Amicability (MCPQ-R) and both Aggression factors (towards People and towards Animals, DPQ) were significantly negatively correlated, as was Amicability (MCPQ-R) and Fearfulness (DPQ). Significant inter-rater reliability was observed for the MCPQ-R dimensions of Neuroticism, Extraversion and Amicability, as well as the DPQ factors Fearfulness, Aggression towards People, and Aggression towards Animals. Motivation

(MCPQ-R) showed no consensus among raters, and was not well-supported as a high level trait in this study. Further research should 1) determine whether separating Aggression into two separate measures improves the validity of a canine personality instrument, and 2) if low inter-rater reliability for the MCPQ-R dimensions Training Focus and Motivation and the DPQ factors Responsiveness to Training and Activity/Excitability is a result of differences among raters in dog-related experience and/or the context in which the dog is typically observed. Further standardization of canine personality assessment tools and recognition of the factors that influence rater assessments are critical to the application of canine personality evaluation in real-world contexts, such as shelter re-homing and selection of working dogs.

3.2 Introduction

Canine personality research has expanded over the last decade with several theoretical and applied goals (Fratkin, Sinn, Patall, & Gosling, 2013; Miklósi, Turcsán, & Kubinyi, 2014; Rayment, De Groef, Peters, & Marston, 2015). From a theoretical perspective, researchers are interested in the association between personality traits and a diverse array of variables; specifically, social relationships (Ákos, Beck, Nagy, Vicsek, & Kubinyi, 2014), owner and dog demographics (Kubinyi, Turcsán, & Miklósi, 2009), hormonal profiles and social behaviour (Ottenheimer Carrier, Cyr, Anderson, & Walsh, 2013), and observable behavioural tendencies in pet dogs (Rayment, Peters, Marston, & Groef, 2016). From a practical perspective, establishing a relationship between individual differences in current and future dog behaviour is important for several applied processes: selecting puppies for working dog programs such as police dogs (Slabbert & Odendaal, 1999) and guide dogs (Asher et al., 2013; Serpell & Hsu, 2001); understanding why dogs are relinquished to shelters (Segurson, Serpell, & Hart, 2005); and how

to best facilitate dog placements with prospective owners (Duffy, Kruger, & Serpell, 2014; Haverbeke, Pluijmakers, & Diederich, 2015; Mornement, Coleman, Toukhsati, & Bennett, 2015).

Researchers have derived canine personality dimensions from a number of assessment methods (see Fratkin et al., 2013; Gartner, 2015; Rayment et al., 2015 for reviews). A recent focus of interest is the questionnaire-based assessment, in which knowledgeable informants rate dogs on broad traits. In these questionnaires, a respondent is asked to indicate the degree to which a series of personality traits characterize the dog being assessed on a Likert scale. These trait ratings are then combined to create personality constructs. Known as the *personality-judgment approach* (Funder, 1999 cited in Gosling, Kwan, & John, 2003), this methodology has been long used for measuring human personality (Funder, 1995; Funder, 2012; Funder & West, 1993). Gosling et al. (2003) extended the personality-judgment approach to dogs by demonstrating that knowledgeable informants can use trait ratings to describe personality in dogs with the same standards of accuracy achieved in the human personality literature.

Most personality theorists agree that the Five-Factor Model of personality (FFM) is a comprehensive model of human personality traits (Costa & McCrae, 1992, Digman, 1990). Instruments that measure the FFM rate humans on five constructs labeled Extraversion, Openness, Conscientiousness, Neuroticism, and Agreeableness. In the case of canine personality, however, there is still no consensus on what dimensions reflect individual variation in dogs. To illustrate this inconsistency across the literature, Gosling et al. (2003) modified a version of the FFM for dogs and scored dogs on a four-dimensional model with constructs labeled Energy, Affection, Emotional Reactivity, and Intelligence. Kubinyi et al. (2009) also adapted a human

personality inventory for dog behaviour that yielded four dimensions: Calmness, Trainability, Dog Sociability, and Boldness. Mirkó, Kubinyi, Gácsi, and Miklósi (2012) created a different questionnaire and derived four dimensions: Stranger-directed Sociability, Activity, Aggressiveness, and Trainability. Although it appears the traits identified in these studies overlap, no consensus has been reached regarding the number and the content of canine personality dimensions.

Another challenge of these multiple emerging canine personality questionnaires is the lack of comparable reports on the reliability of these assessments (Gartner, 2015; Jones & Gosling, 2005; Rayment et al., 2015). One acceptable method to assess reliability is to calculate the inter-rater reliability of questionnaires administered from two or more knowledgeable informants (e.g., Ley, McGreevy, & Bennett, 2009b; Stolarova, Wolf, Rinker, & Brielmann, 2014). In a review of pet personality research, Gartner (2015) found that only 10 canine personality studies published after 2005 reported numerical inter-rater reliability; of these, many used variable methodologies. In the human personality research, correlations between two individuals rating one person they know well typically range between 0.30-0.65, with 0.3 as a suggested minimum barrier for reliability (McCrae, 1982).

Of the canine personality studies that report inter-rater reliability, similar levels to the human personality research have been achieved. For example, Gosling et al. (2003) measured the inter-rater reliability of peers and owners to assess dogs on a modified version of the FFM and found consensus correlations of approximately 0.60. Gartner (2015) found the sample weighted mean correlation coefficient for inter-rater reliability measures across six studies of canine

personality research was 0.68. Although these results demonstrate the canine personality can be measured reliably, little is known about which parameters influence inter-rater reliability levels. In many cases, canine personality questionnaires are administered to individuals with little regard for the different levels of dog-related experience (Rayment et al., 2016). In summary, it is unclear whether or not questionnaires are reliable when there is a mixed group of raters.

In the current study, two canine personality scales were compared using methodologies from human personality research to further clarify the structure of canine personality. The first aim of this study was to examine the convergence of scales (also called factors or dimensions) from two canine personality assessments using two data sources – owner ratings and dog walker ratings. If personality scales are similar, i.e., the dimensions measure the same or similar personality constructs, strong correlations should be observed among them (McCrae & Costa, 1987; Zuckerman, Kuhlman, Joireman, Teta, & Kraft, 1993). The second aim was to examine the inter-rater reliability of two observers, an owner and a knowledgeable acquaintance of the dog (i.e., a dog walker) for each personality questionnaire. If each assessment is a reliable representation of canine personality, ratings between the two knowledgeable informants should align (Gosling et al., 2003). In human research, teacher- and parent-ratings are often used as a quality criterion for measurements of children's skills and behaviour (e.g. Sollie, Larsson, & Morch, 2012; Stolarova et al., 2014).

This study addresses an important practical research question, i.e., whether a screening questionnaire for canine personality designed to be answered by owners also can be employed by other canine caregivers, particularly those that have experience observing dog behaviour. As

well, this research is particularly important for ethical and welfare reasons; shelters often use behavioural assessments to aid in matching dogs with prospective homes. Questionnaire-based assessments are often given to the new owner to establish the degree to which the behavioural tendencies identified by a shelter assessment of the dog translate into the behaviour of the dog in the adoptive home (Rayment et al., 2016). Any lack of correspondence between the behavioural test battery and the owner's survey responses calls into question the predictive validity of the assessment method (Mornement et al., 2015). Because the consequences of a poor behavioral assessment in a shelter setting may result in euthanasia (Mornement et al., 2015), there is a genuine urgency to standardize these assessment tools and recognize the parameters that affect reliability (inter-rater and re-test) and validity (ability to predict real-world outcomes). Before correspondence between behavioural traits in battery tests and broader personality traits in domestic dogs can be established there should consensus on the systematic description of high order personality traits.

3.3 Methods

3.3.1 Subjects

Dog owners (n=60), who were clients of dog walking companies in Toronto, Ontario, Canada were recruited as volunteers for the present study. The target dogs (n=60, one dog per owner) were well-socialized pet dogs and had no serious behavioural issues. Dog ages ranged from 11.5 months to 11 years (4.3 ± 2.62 years; mean ± SD; three of the dog ages were reported as unknown). Male and female dogs were equally represented in the sample; all the dogs of both sexes were spayed or neutered. There were 17 purebreds and a large number of mixed breeds

(72%), including various poodle crosses (n=18, see Appendix A). Forty-three (72%) of the subjects had participated in some form of pet obedience training, the remaining 17 (28%) had no formal training. Fifty-one of the dogs lived in single-dog households and nine dogs lived in a multi-dog household. Of the owner respondents recruited, there were 16 males (17%) and 44 females (73%). The participating owners had owned their dog for an average of 3.94 years (range 10 months – 11 years). Only one dog was owned for less than a year due to the fact that at the time of the study she was just under one-year-old. Of the 60 dogs recruited, 48 had a dog walker who provided the same two personality assessments as the owner. A total of 10 dog walkers participated in the study (9 females, 1 male). Four of the 10 walkers were certified professional dog trainers that also walked dogs professionally. The other six walkers had worked as professionals in the dog walking industry for over two years and were colleagues of the first author. To participate in the study, walkers must have walked the dog(s) they evaluated a minimum of 15 times over a period of no less than 3 weeks. Dog walks typically consisted of walking each dog as part of a larger dog group, and visiting local dog parks. Of the 10 walkers, three provided assessments on only one dog each. Seven walkers were the primary walker for more than one participating dog, and, thus, provided multiple dog evaluations: one provided assessments for 13 dogs; one for nine dogs; one for six dogs; two for five dogs; one for four dogs; and one for three dogs.

3.3.2 Administering the Test

Both owners and walkers were hand-delivered a package that contained two separate canine personality questionnaires. Owners were also given an additional form with several other

questions about the dog's age, sex and training history. The order of assessments was counterbalanced among respondents, i.e., half of the respondents were asked to complete the MCPQ-R first. The research was approved by Memorial University of Newfoundland's Interdisciplinary Committee on Ethics in Human Research (ICEHR Ref No. 20140006-SC) and the Animal Care Committee (IACC Ref No. 12-01-CW). Dog owners who agreed to participate signed a consent form and provided basic information about the dog, including name, age, sex, breed, and spay/neuter status. Dog walkers were given one month to fill out the questionnaires and were given no instructions as to the order in which they should complete the questionnaires or how many they should complete at any given time.

3.3.3 The Questionnaires

The Monash Canine Personality Questionnaire – Revised (MCPQ-R) is a 26-item, adjective-based questionnaire that rates individual dogs on five dimensions: Extraversion, Neuroticism, Amicability, Training Focus and Motivation (Ley, Bennett, & Coleman, 2008). Respondents rate their dogs on a 6-point scale from 1 (really does not describe my dog) to 6 (really describes my dog). For example, the assessor is asked to rate the dog on the adjective, 'friendly', with a higher score indicating more expression of the trait. The Dog Personality Questionnaire (DPQ) is presented in either a 45-item (short form) or 75-item (long form) format and rates dogs on five factors: Activity/Excitability, Responsiveness to Training, Aggression towards People, Aggression towards Animals, and Fearfulness. Each of the factors of the DPQ is comprised of a number of facets, which are more specific sub-categories purported to reflect aspects of each personality factor (Jones, 2008). For example, Activity/Excitability is comprised

of four facets: Excitability, Playfulness, Active Engagement and Companionability. Statements are either adjective-based (e.g., “Dog is boisterous”) or more context-specific (e.g., “Dog behaves fearfully during visits to the veterinarian”). Respondents are asked to rate the dogs on a 7-point scale, indicating how well they agree with the statement, from 1 (disagree strongly) to 7 (agree strongly). For each trait, a higher score reflects greater expression of that trait. For example, a dog whose rater “strongly agreed” that a dog was “dominant over other dogs” would receive a score of “7”; dogs who do not exhibit this behavior would receive a “1” (“strongly disagree”). DPQ long-form items were coded into traits in accordance with Jones (2008) and the DPQ scoring key. Most items were summed into factors in their original form; however, a small number of items were reverse-coded prior to factor creation in accordance with scoring instructions. I used the longer form to maximize the amount of data collected as the personality assessments were being used for additional research. Table 3.1 lists the five personality dimensions of the MCPQ-R and the five factors (and associated facets) of the DPQ.

Table 3.1 Factors and facets of the Dog Personality Questionnaire (DPQ and dimensions of the Monash Canine Personality Questionnaire – Revised (MCPQ-R)

DPQ					
Factors	Fearfulness	Aggression towards People	Activity/ Excitability	Aggression towards Animals	Responsiveness to Training
Facets					
	Fear of People	General Aggression	Excitability	Aggression towards Dogs	Trainability
	Nonsocial Fear	Situational Aggression	Playfulness	Prey Drive	Controllability
	Fear of Dogs		Active Engagement	Dominance over Other Dogs	
	Fear of Handling		Companionability		
MCPQ-R					
Dimensions	Neuroticism	Amicability	Extraversion	Motivation	Training Focus

Both assessments have been tested for reliability (Jones, 2008; Ley et al., 2009b) and validity (Jones, 2008; Ley, Bennett, & Coleman, 2009a). Both are currently being used in hypothesis-driven empirical work and have received corroborative support from such research (e.g., MCPQ-R, Ottenheimer Carrier et al, 2013; Walker, 2014; Schöberl, Beetz, Solomon, Wedl, Gee, & Kotrschal, 2016; DPQ, Ákos et al., 2014).

To compare the two canine personality assessments, the ratings for the items from each of the five scales were summed, divided by the maximum score possible for the scale and converted to a percentage, thereby creating a unit-weighted scale score for each personality subscale (Jones, 2008; Ley et al., 2009a). In the case of the DPQ, narrower facets within each factor were first summed before calculating the factor scores. Six of the questionnaires (5%) were incomplete due to a single unanswered question, and there was one questionnaire with two

answers missing. In these cases, I calculated the percentage for that subscale based on the adjusted maximum possible points. In this sample, the mean percentages for the five personality dimensions for the MCPQ-R (owner and walker; Table 3.2) were comparable to those obtained by Ley et al. (2009a). Descriptive statistics for the DPQ were unavailable to compare with our DPQ ratings (Table 3.3).

Table 3.2 Means, standard deviation, and ranges for the five Monash Canine Personality Questionnaire-Revised (MCPQ-R) personality dimensions measured by owner (O) ratings (N=60) and dog walker (W) ratings (N=48).

MCPQ-R Dimension	Rater	Mean % (S.D.)	Range %
Amicability	O	81.1 (14.2)	40.0-100.0
	W	75.3 (13.8)	48.3- 100.0
Neuroticism	O	46.3 (16.9)	16.7-87.5
	W	45.8 (18.7)	16.7-83.3
Extraversion	O	65.6 (13.9)	33.3-94.4
	W	68.8 (21.0)	25.0-100.0
Training Focus	O	79.8 (12.9)	50.0-100.0
	W	79.5 (11.8)	50.0-97.2
Motivation	O	63.7 (15.9)	23.3-93.3
	W	68.5 (19.1)	20.0-100.0

Table 3.3
Means, standard deviation, and ranges for the five Dog Personality Questionnaire (DPQ) personality factors measured by owner (O) ratings (N=60) and dog walker (W) ratings (N=48).

DPQ Dimension	Rater	Mean % (S.D.)	Range %
Aggression towards People	O	29.6 (13.9)	14.3-74.3
	W	38.5 (15.0)	14.3-67.1
Aggression towards Animals	O	41.9 (12.3)	21.0-73.3
	W	41.1 (11.3)	20.0-65.7
Fearfulness	O	43.6 (13.6)	21.4-80.0
	W	43.9 (11.6)	15.0-67.9
Activity/Excitability	O	74.2 (9.5)	33.6-90.0
	W	68.3 (13.1)	38.6-93.6
Responsiveness to Training	O	75.6 (12.3)	44.3-97.1
	W	68.0 (11.3)	45.7-88.6

3.4 Statistical Analyses and Results

All analyses were conducted using the statistical package R, version 3.0.2 (R Core Team 2014).

3.4.1 Statistical Analyses

Descriptive statistics, including means, standard deviations, frequency and cross-tabulations were used to examine raw data. Histograms were used to investigate the distribution of ratings. Since seven walkers were the primary handler for more than one dog and, thus, provided more than one assessment, non-parametric median comparison tests (Dinno, 2015; Dunn, 1964) were used to determine whether there was evidence of consistent between-walker variation that could have led to bias in walker rating. Dunn median tests were used to assess whether within-walker variation impacted ratings for each domain. For example, the median of

Extraversion (MCPQ-R) for all dogs rated by walker 10 were compared to the median ratings from each walker who rated multiple dogs (e.g., walkers 1-9). Because three walkers rated between one and three dogs, a median test was not appropriate and these walkers were pooled and classified as a single walker for this analysis. Median comparison tests were calculated using R package 'dunn.test' (Dinno, 2016), using Bonferroni corrections for multiple comparisons. No significant differences emerged. This finding suggests that walkers consistently rated dogs, regardless of the number of dogs they were assigned to rate.

The convergence between the five dimensions of the MCPQ-R and the five factors of the DPQ for both groups of raters was examined using correlations. When divergences were found between the expected correspondences, further relationships between the facets of DPQ and the dimensions of the MCPQ-R were analyzed. Pearson's r was used to calculate correlations with normally distributed data and Spearman's rho was used to calculate correlations with non-normally distributed data. Fisher r-to-z transformation was used to calculate a value of z that was applied to assess whether the correlation coefficients of the two respondents (owner vs. walker) differed significantly (as per Stolarova et al., 2014).

The extent to which owners and walkers agreed on the attribution of traits to the same dog was examined through intra-class correlation coefficient (ICC). To determine the reliability of one rater I used single measures ICC. To determine the reliability of multiple raters I used average measures ICC. ICC values were calculated using R package 'ICC' (Wolak, Fairbairn, & Paulsen, 2012). As a standard of comparison for consensus correlations, I used guidelines from both human and dog personality research (McCrae & Costa, 1987; Jones & Gosling, 2005,

respectively); scores greater than 0.60 reflect high inter-rater reliability, scores between 0.30-0.60 reflect moderate inter-rater reliability, and scores below 0.30 raise questions concerning the ability of the raters to assess the personality factor accurately or even the validity of the factor being assessed.

3.4.2 Aim 1: Convergence Between the Five Dimensions of the MCPQ-R and the Five Factors of the DPQ

3.4.2.1 Results

For 21 (84%) of the 25 possible relationships between MCPQ-R dimensions and DPQ factors, owners and walkers showed the same patterns (i.e., statistically significant relationships either existed between the constructs or did not, Table 3.4).

Table 3.4
Pearson's r or Spearman's rank-order correlations among MCPQ-R dimensions and DPQ factors for owner (O; N=60) and dog walker (W; N=48).

	DPQ									
MCPQ-R	Aggression towards People		Aggression towards Animals		Fearfulness		Activity/ Excitability		Responsiveness to Training	
Rater	O	W	O	W	O	W	O	W	O	W
Amicability	**-0.60*** **	**-0.59*** **	**-0.46*** **	**-0.48** **	**-0.34** **	**-0.39** **	0.06	0.20	0.24	**0.37** **
Neuroticism	0.15	0.00	-0.15	-0.12	**0.63*** **	**0.72*** **	-0.18	-0.19	0.14	0.14
Extraversion	0.17	0.07	0.01	0.15	0.00	-0.14	**0.41** **	**0.73*** **[1]	**-0.37** **	**-0.38** **
Training Focus	-0.08	-0.08	-0.04	**-0.29** *	0.10	0.02	0.19	0.08	**0.65*** **	**0.72*** **
Motivation	0.18	**0.33** *	**0.32** *	**0.50*** **	-0.08	0.28	0.14	**0.56*** **[1]	**-0.35** **	**-0.43** **

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$
[1] Represents a significant correlation coefficient of the two respondents (owner vs. walker) using the Fisher r-to-z transformation.
Values in bold indicate significant correlations.

For both owners and walkers, there was a strong negative relationship between Amicability (MCPQ-R) and Aggression towards People (DPQ), and a slightly weaker but substantial negative relationship between Amicability (MCPQ-R) and Aggression towards Animals (DPQ). Neuroticism (MCPQ-R) and Fearfulness (DPQ) also aligned. Similarly, Extraversion (MCPQ-R) scores were positively correlated with the analogous construct Activity/Excitability (DPQ) scores for both owners ($r = 0.41$, $p < 0.01$) and walkers ($r = 0.73$, $p < 0.001$); however, this relationship was significantly stronger for walkers ($z = -2.47$, $p < 0.05$). Training Focus (MCPQ-R) and Responsiveness to Training (DPQ) were also substantially correlated for both raters. Also

noteworthy are correlations among non-analogous traits: Amicability (MCPQ-R) was moderately negatively correlated with Fearfulness (DPQ) for both rater groups, and Extraversion (MCPQ-R) scores for both groups of respondents were negatively correlated with Responsiveness to Training (DPQ). For both rater groups Motivation (MCPQ-R) also showed a negative relationship with Responsiveness to Training (DPQ), and a positive relationship with Aggression towards Animals (DPQ). For the walkers only, however, Motivation was strongly correlated with Activity/Excitability (DPQ; $r = 0.56$, $p < 0.001$); the correlation coefficient differed significantly between owners ($r = 0.14$, $p > 0.05$) and walkers ($z = -2.47$, $p < 0.05$). Although the correlations were not significantly different between the rater groups, there were three other cases in which MCPQ-R and DPQ ratings were significantly correlated. There was a significant positive correlation between Motivation and Aggression towards People for the walkers but not for the owners. For the walkers, but not the owners, Amicability (MCPQ-R) significantly correlated positively with Responsiveness to Training (DPQ). Finally, for the walkers, Training Focus (MCPQ-R) was significantly negatively correlated with Aggression towards Animals (DPQ). Thus, for all dimensions/factors predicted to be analogous between the MCPQ-R and DPQ, the correlation coefficients for both groups of raters were statistically significant. Four correlations (16% of total) in which owners and walkers did not show the same pattern of relationships were all for non-analogous traits. In these cases, walker ratings of a MCPQ-R dimension and DPQ factor significantly correlated, but owner ratings did not.

To further clarify the pattern of divergence in ratings of owners and walkers for relationships of the MCPQ- R dimensions Motivation and Extraversion with the Activity/Excitability (DPQ) factor, I examined the relationship of these dimensions to each

Activity/Excitability facet (Activity, Playfulness, Active Engagement, and Companionability). For owners, Extraversion correlated with only the Excitability facet of the Activity/Excitability factor (Table 3.5).

Table 3.5
Pearson's r or Spearman's rank-order correlations between two MCPQ-R dimensions (Extraversion and Motivation) and the DPQ facets of the Activity/Excitability factor for owner (O, N=60) and dog walker ratings (W, N=48)

	DPQ Facets of Activity/Excitability							
MCPQ-R	Excitability		Playfulness		Active Engagement		Companionability	
Rater	O	W	O	W	O	W	O	W
Extraversion	**0.63*** **	**0.79*** **	0.22	**0.55*** **[1]**	0.14	**0.61*** **[1]**	-0.04	0.13
Motivation	**0.29***	**0.59*** **	-0.10	**0.47*** **[1]**	**0.40****	**0.47*** **	-0.19	-0.15

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$
[1] Represents a significant correlation coefficient of the two respondents (owner vs. walker) using the Fisher r-to-z transformation.
Values in bold indicate significant correlations.

For the walkers, Extraversion correlated with Excitability, as well as both the Playfulness and Active Engagement facets of the Activity/Excitability factor. For the owners, Motivation was significantly correlated with two Activity/Excitability facets, Excitability and Active Engagement. For the walkers, both these DPQ facets, as well as the facet of Playfulness correlated strongly with Motivation.

3.4.3 Aim 2: Consensus Between Owners and Walkers for the MCPQ-R and DPQ

3.4.3.1 Results

The ICC was used to measure the inter-rater reliability between construct scores of the two informant ratings (Table 3.6).

Table 3.6
Intraclass correlation coefficient (ICC) for inter-rater reliability between dog owner (O) and dog walker (W) ratings (N=48); 95% confidence intervals in parentheses.

MCPQ-R Dimensions	Single Measures ICC(1,1) (95% confidence interval)	Average Measures ICC(1,k) (95% confidence interval)
Amicability	**0.33 (0.06-0.56)****	**0.50 (0.1-0.72)****
Neuroticism	**0.54 (0.34-0.71)*****	**0.70 (0.47-0.83)*****
Extraversion	**0.39 (0.12-0.60)****	**0.56 (0.21-0.75)****
Training Focus	0.23 (-0.06-0.48)	0.37 (-0.12-0.65)
Motivation	0.07 (-0.21-0.35)	0.14 (-0.53-0.52)
Mean	0.31	0.45
DPQ Factors		
Aggression towards People	**0.42 (0.16-0.63)****	**0.59 (0.27-0.77)****
Aggression towards Animals	**0.53 (0.29-0.70)*****	**0.69 (0.45-0.83)*****
Fearfulness	**0.54 (0.34-0.71)*****	**0.70 (0.47-0.83)*****
Activity/Excitability	0.21 (-0.08-0.46)	0.34 (-0.17-0.63)
Responsiveness to Training	0.23 (-0.06-0.48)	0.37 (-0.12-0.65)
Mean	0.39	0.54

*$p < 0.05$, **$p < 0.01$, ***$p < 0.001$

For the MCPQ-R, Neuroticism, Extraversion and Amicability all had single measures ICC values above 0.30, a barrier that is used when measuring convergent correlations in the human personality realm (McCrae & Weiss, 2010). Values for MCPQ-R Training Focus and Motivation dimensions were below the 0.30 cut-off. Average measures ICC values paralleled the single measures ICC with Neuroticism showing the highest consensus; moderate consensus was reached for Amicability, Extraversion and Training Focus. Motivation was the only dimension with an average measures ICC below 0.30. For both single measures and average measures ICC, Neuroticism, Extraversion and Amicability were considered statistically significant, as 95%

confidence intervals (CIs) do not include 0. The mean single measures and average measures ICC scores for all MCPQ-R dimensions were 0.31 and 0.45, respectively.

Single measures ICC values (all above 0.42) showed the reliability of a single informant's scores compared favourably to previous animal research for the DPQ factors of Fearfulness, Aggression towards Animals, and Aggression towards People (Table 3.6). Responsiveness to Training and Activity/Excitability were both lower than 0.30. Average measures ICC scores show the same pattern, but scores were higher and always exceeded 0.30. For both single measures and average measures ICC, only Fearfulness, Aggression to Animals, and Aggression to People were considered statistically significant (95% CIs do not include 0). The mean single measures and average measures ICC scores for all the factors of the DPQ were 0.39 and 0.54, respectively.

To explore why owners and walkers did not reach consensus for the DPQ Activity/Excitability factor (ICC=0.21), despite doing so for the apparently analogous dimension of Extraversion in the MCPQ-R, I examined the inter-rater reliability for each of its facets (Excitability, Playfulness, Active Engagement, Companionability). Of the four facets of the Activity/Excitability factor, owners and walkers had significant ICCs only for Playfulness (Table 3.7).

Table 3.7

Intraclass correlation co-efficients (ICC) for inter-rater reliability for dog owner (O) and dog walker (W) for the facets of the DPQ Activity/Excitability factor; N=48.

DPQ Activity Facets	Single Measures ICC(1,1) (95% confidence interval)	Average Measures ICC(1,k) (95% confidence interval)
Excitability	0.21 (-0.07-0.47)	0.35 (-0.15-0.64)
Playfulness	**0.41 (0.15-0.62)****	**0.59 (0.26-0.77)****
Active Engagement	0.03 (-0.25-0.31)	0.06 (-0.68-0.47)
Companionability	0.09 (-0.19-0.36)	0.17 (-0.48-0.53)

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Values in bold indicate significant correlations.

Discussion

While both the MCPQ-R and DPQ are promising candidates for models of canine personality, our results demonstrate considerable empirical overlap between them. Strong convergence between the assessments provide support that these scales are measuring analogous underlying canine personality constructs: Neuroticism (MCPQ-R) and Fearfulness (DPQ), Extraversion (MCPQ-R) and Activity/Excitability (DPQ), Training Focus (MCPQ-R) and Responsiveness to Training (DPQ), and Amicability (MCPQ-R) and Aggression (both towards People and Animals; DPQ). Although previous literature suggests that Motivation (MCPQ-R) should be related to Extraversion (Ley et al., 2009a; Rayment et al., 2016), our owner assessments do not demonstrate the expected correspondence between Motivation and Activity/Excitability. Inter-rater reliability between dog owners and walkers was significant for three MCPQ-R dimensions (Amicability, Neuroticism, and Extraversion) and three DPQ factors (Aggression towards People, Aggression towards Animals, and Fearfulness). Inter-rater reliability for Motivation was weak, and Motivation converged with several DPQ factors,

dependent on the rater (owner vs. walker). Thus, support for Motivation as a high order personality dimension is limited. As well, although the DPQ is presented as five factors, Aggression towards Humans and Aggression towards Animals could be easily combined to support a four-factor model. However, our results suggest inter-rater reliability scores may be stronger when these two components are separated. Activity/Excitability (DPQ) and both personality dimensions related to trainability (Training Focus (MCPQ-R), Responsiveness to Training (DPQ) were more sensitive to the rater differences than were the other components.

3.4.4 Convergence of Assessments by Observers

All seemingly analogous constructs, Neuroticism (MCPQ-R) and Fearfulness (DPQ), Extraversion (MCPQ-R) and Activity/Excitability (DPQ), Training Focus (MCPQ-R) and Responsiveness to Training (DPQ), strongly converged for both owners and walkers. Similarly, as expected, the two DPQ Aggression constructs (Aggression towards People and Aggression towards Animals) converged strongly with Amicability (MCPQ-R) for both groups of respondents. The results lend support that these broad traits are important components in the structure of canine personality.

Some convergent correlations between non-analogous constructs arose for both owners and walkers. Not surprising, Amicability (MCPQ-R) correlated negatively with Fearfulness (DPQ), which is consistent with Goodloe and Borchelt (1998) who identified one (of 22) personality factor that combined both fear and avoidance of strangers, and Rayment et al. (2016) who found Amicability correlated with factors related to social fear. Unexpectedly, the Motivation and Extraversion dimensions of the MCPQ-R correlated negatively with

Responsiveness to Training (DPQ). In contrast, Svartberg and Forkman (2002) found that both active and confident behavior (termed boldness) increases a dog's trainability, although these relationships were found in a sample of working dogs which may behave differently than pet dogs. In a study of pet dogs, Kubinyi et al. (2009) found that the most important variable related to the trainability of the dog is the experience the dog had in professional training. Further analysis of trained versus untrained dogs can help clarify these relationships. Motivation (MCPQ-R) correlated with Aggression towards Animals, which is consistent with Svartberg and Forkman (2002) who reported that a dog's level of confidence was related to dominance aggression. Ley et al. (2008) characterizes MCPQ-R 'Motivation' as a tendency towards competitive aggression and social confidence in dogs, which includes traits such as perseverance, and assertiveness.

Although strong relationships between Extraversion (MCPQ-R) and Activity/Excitability (DPQ) were found for both respondents, the relationship between the walker scores was substantially stronger than was the relationship between owner scores. This was a result of stronger correlations between the walkers Extraversion (MCPQ-R) dimension and the DPQ facets; for the walkers, Extraversion correlated with the Excitability, Playfulness, and Active Engagement facets, whereas, for the owners, Extraversion only correlated with the Excitability facet. The walkers may have rated dogs more consistently across instruments because they only considered the dog in one context (i.e., on group walks and at the dog park), whereas owners rated their dog based on knowledge of the dog's behaviour across several contexts (i.e., home, the dog park, interactions with different family members, etc.). For example, the DPQ asks respondents to rate the following statement: 'Dog gets bored in play quickly'. Similarly, in the

MCPQ-R, the respondent is asked to rate the dog on the adjective 'restless'. Because the walker will likely rate the dog on how restless he/she is only in a single context, e.g., at the dog park, the two ratings may be more likely to converge. As well, as experienced handlers, dog walkers are likely adept at recognizing play, and other behaviours related to being active and engaged. It may be that the experiences of observing dog behaviour affected the ratings for this personality component. Certainly, the development of expertise specific to the observation of socially relevant dog body language has been suggested by the differential brain activity of dog experts compared to non-experts in a task requiring participants to observe interacting dogs (Kujala, Kujala, Carlson, & Hari, 2012).

Of 25 comparisons between MCPQ-R dimensions and DPQ factors, there were four instances in which a DPQ factor and MCPQ-R dimension correlated significantly for walkers but not owners. The strong positive correlation that emerged in the walker assessments for Motivation and Activity/Excitability is well supported (Ley et al., 2009a; Rayment et al., 2016), and may be due to the walkers observing the dogs in contexts where they behave socially (e.g., dog parks). Also noteworthy, Motivation (MCPQ-R) correlated with Aggression to People for the walkers but not the owners. Rayment et al. (2016) was surprised to find no correlation of Motivation with an owner-directed aggression trait found in the Canine Behavioural Assessment and Research Questionnaire (CBARQ, Hsu & Serpell, 2003) and suggested this relationship may only emerge in very specific contexts. Also unclear are the other diverging correlations between rater groups: for walker ratings only, there was both a weak negative relationship between Training Focus (MCPQ-R) and Aggression towards Animals (DPQ), and a positive relationship between Amicability (MCPQ-R) and Responsiveness to Training (DPQ).

3.4.5 Consensus Between Owners and Walkers

Dog owners and walkers showed the strongest inter-rater reliability scores for Neuroticism (MCPQ-R), Fearfulness (DPQ), and Aggression to Animals (DPQ), suggesting, perhaps, that behaviours indicating these personality traits/dimensions are easily evaluated by both owners and non-owners. Indeed, it is possible that in the social context (dog parks) in which the walkers interact with the dogs, dogs would be quite likely to express behaviours that indicate fear or timidity (e.g., hunched posture, tail tuck; Ottenheimer Carrier et al., 2013), or behaviours that indicate the opposite end of the dimension continuum (e.g., boldness).

Although the inter-rater reliability scores for Amicability (MCPQ-R) were statistically significant, consensus between owners and walkers was greater for the DPQ in which aggression is separated into the two measures Aggression towards People and Aggression towards Animals. Such a difference in the level of consensus suggests that different raters are likely to agree more strongly when questions are more specific about the target of a dog's interactions (e.g., "dog behaves aggressively toward dogs"). In fact, when administering the MCPQ-R to owners, it was not unusual for them to ask questions such as whether the adjective "friendly" referred to behaviour towards other dogs, or towards humans. During the DPQ instrument design process, Jones (2008) found strong correlations between the aggression constructs, suggesting that a four-factor model (with only one aggression construct) was possible. However, because one of the primary goals of the DPQ was to develop the DPQ as a practical assessment tool (e.g., to screen shelter dogs for the suitability as companions), it was ultimately decided that the five-factor model, where aggressive interactions with humans and other animals are measured separately,

would increase the practicality of the tool. Other dog personality theorists have also explored the importance of both inter- and intra-species relations in characterizing dog personality (e.g., Kubinyi et al., 2009). Gosling et al. (2003) argued the most important aspect of any canine personality inventory is its validity. Further analysis of instrument validity, or ability to predict future behaviour, can clarify the benefit of subdividing the aggression construct. For example, does knowledge of a dog's targets of aggression increase re-homing success? Both aggression towards people or other animals are two of the leading causes of shelter relinquishment (Salman, Hutchison, Ruch-Gallie, Kogan, New, Kass, & Scarlett, 2000). Despite the potential applicability of subdividing aggression, subsuming the two scales into one broader construct might be more suitable for hypothesis-based research.

Interestingly, significant inter-rater reliability was not reached for Activity/Excitability (DPQ) by either owners or walkers, but was reached for the seemingly analogous construct Extraversion (MCPQ-R). One possible explanation might reflect differences between the two tests. The MCPQ-R requires raters to rate the dog on six adjectives for the dimension of Extraversion, while the DPQ requires them to evaluate 20 statements targeting four different facets of the factor of Activity/Excitability. In fact, dog owners and walkers had substantial consensus for only one facet of this DPQ factor, Playfulness. Given the different contexts in which owners and walkers interact with the dog, they may have different opportunities to observe the behaviours underlying the other facets of Excitability, Companionability, and Active Engagement. For instance, owners may have more experience with behaviors related to Companionability (in the home), while walkers might be better able to assess Playfulness and Active Engagement (in dog parks with other dogs).

Owners and walkers did not have strong inter-rater reliability for their ratings of Training Focus (MCPQ-R) and Responsiveness to Training (DPQ). This may reflect a lack of experience of the dog walkers with the dogs in a training context, as dog walks and park visits typically do not involve formal training. There is also a possibility that a dog's responsiveness to training might vary based on the handler (owner vs. walker); for example, Goodloe and Borchelt (1998) argued that dogs exhibit different behaviour patterns towards various family members.

Of all personality dimensions/factors, Motivation (MCPQ-R) had the lowest inter-rater reliability score, and was the only construct with an average measures ICC that did not exceed 0.3, our "cut-off" for reliability. As consensus estimates are one form of accuracy criteria for examining personality assessment methods, these results suggest that Motivation may not represent a meaningful first-order canine personality construct. However, Ley et al. (2009b) found significant consensus for Motivation (and all other dimensions) between the two adult members of the household in which the dog lived (i.e., co-owners). Indeed, comparing all of our owner-walker ICC values for the MCPQ-R to those reported in Ley et al. (2009b), it is obvious that consensus among owners and non-owners (i.e., walkers) is substantially lower than it is among co-owners. In our study, no statistically significant consensus was reached for either Motivation or Training Focus, suggesting that rater variability was most sensitive to these personality dimensions.

Overall, the DPQ achieved a slightly higher average mean consensus estimate of inter-rater reliability than the MCPQ-R (0.54 vs. 0.45, respectively), as one might expect given the more specific type of questions. However, the difference between average consensus estimates

for the instruments most likely reflected the very low inter-rater reliability scores for the MCPQ-R dimension of Motivation.

For both instruments, the mean average consensus inter-rater reliability is lower than previously reported for dog personality assessments (typically over 0.60; see Gartner, 2015; Gosling et al., 2003). However, in order to provide accurate comparison, more reports are necessary and statistical methodologies need to be streamlined. The consensus between self-reports and observer reports was examined by McCrae and Weiss (2010) for human personality assessments. There were several variables that affected the degree of self-other agreement including the level of acquaintance of the rater and target individual, i.e., spouse, roommate, friend, etc., and the amount of exposure the rater had with the target individual (e.g., two weeks vs. five years) (McCrae & Weiss, 2010). In terms of the level of acquaintance, the quality of the relationship affected self-observer agreement; spouse ratings agreed with self-reports more highly than did ratings of other less well-acquainted informants such as peers (McCrae, 1994). Less is known regarding the effects of exposure time on a rater's assessment. For example, when college roommate's assessments were matched with self-reports at two time points from the start of their relationship (two weeks and fifteen weeks), the median self-other agreement scores rose from .27 to .43 across the five personality trait scales (Kurtz & Sherker, 2003). However, Goma-I-Freixanet, Wismeijer, and Valero (2005) demonstrated that in the case of self-reports compared to spouse reports, the degree of consensus was not related to years spent living together.

For dogs, the nature of the relationship with their assessor (i.e., dog walker vs. owner) and the effect of the rater's exposure time to the target dog have not been systematically studied.

For example, Gosling et al. (2003) calculated inter-rater reliability of owners and their peers in assessing the personality of dogs, but did not mention the quality of the relationship between the (non-owner) peer and target dog. Not surprising, whether or not the rater resided in the home with the dog may have impacted the ratings. Ley et al. (2009b) tested the inter-rater reliability of the MCPQ-R with two people who shared the home with the dog and found high reliability scores (all over 0.60) for each of the personality dimensions. In contrast, Jones (2008) tested the inter-rater reliability of the DPQ with raters that were not required to live with the assessed dog and found inter-rater reliability scores lower than those previously reported, although details of the quality of the rater-dog relationship were not described.

In terms of exposure time, Walker (2014) required foster owners to have spent a minimum of 1.5 hours each day over the course of two weeks with the dog prior to assessment. In the current study, we required that a minimum of 15 walks within three weeks of walking the dog qualified a dog walker as an assessor of the dog's personality. Horn, Range, and Huber (2013) argued that when considering how a dog behaves towards a familiar person may be less about their exposure time to that person and more so about the nature of their relationship, for example, by being involved in joint activities and feeding. Our results highlight the possibility that lack of rater agreement may also be a function of owners and dog walkers observing the dogs in different environments. This is important not only for rater agreement but also for the validity of the assessments. After low validity was reported for standardized assessments of shelter dogs, Mornement et al. (2015) suggested dogs should be measured in long-term foster homes. Research in the human personality realm suggests that when measuring human personality, the effects of persons, situations, and person X situation interactions need to be

considered (Geiser, Litson, Bishop, Keller, Burns, Servera, & Shiffman, 2015). For example, the relationship between context and observer ratings has been explored in the employment context where customers and supervisors' ratings of sales representatives predict sales performance (Mount, Barrick, & Strauss, 1994). In the case of dogs, further research could explore if the ratings of dogs at the dog park predict their future behaviour at the dog park, or if ratings in foster homes predict their success once they are adopted.

3.5 Conclusions

Both the MCPQ-R and the DPQ have been put forth as potential candidates for the structure of canine personality. The considerable alignment between the two assessments suggests that we are narrowing in on the general trait taxonomy of canine personality. Correspondence between the two instruments suggests: 1) Neuroticism (MCPQ-R) and Fearfulness (DPQ) are essentially identical, as are Training Focus (MCPQ-R) and Responsiveness to Training (DPQ), and Extraversion (MCPQ-R) and Activity/Excitability (DPQ); 2) Although Amicability (MCPQ-R) and both Aggression towards People and Animals are on opposite ends of the continuum, the strong negative relationship between these measures supports that they measure the same construct. 3) Motivation is not well represented as a first-order personality factor and further investigation is warranted; 4) Subsuming the two separate Aggression constructs (DPQ) into one broad dimension may be supported for hypothesis-driven research, while maintaining two separate constructs may be warranted for more practical assessment purposes (e.g., shelter re-homing); 5) Mean consensus and differing patterns of convergence scores among different rater groups highlight that both the MCPQ-R and DPQ are sensitive to the different contexts from which assessors base their evaluation of the dog (e.g., dog

park/social setting vs. home) and/or the dog-handling experience of the raters. Further research should clarify how the demographics of raters, including the nature and length of their relationship to the dog, and their professional dog handling experience affect the reliability and validity of canine personality assessment tools. This is critical for instances in which dog personality assessments may have direct consequences for individual dog welfare, e.g., decisions around shelter re-homing/placement/euthanasia, or selection of working dogs.

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Appendix A

Demographic information for study dogs

			Number of dogs
Sex	Male		30 (50%)
	Female		30 (50%)
Castration Status	Male		30 (100%)
	Female		30 (100%)
Purebred	Yes		17 (28%)
	No		43 (72%)
Size	Small	Up to 12 kg	10 (17%)
	Medium	13-26 kg	29 (48%)
	Large	27 kg and up	21 (35%)
Age	1 – 2 years		18 (30%)
	3-4 years		17 (28%)
	5-6 years		11 (18%)
	7+ years		14 (23%)
Total Number of dogs			**60**

Appendix B

Breeds of purebred study dogs (n =16). All other dogs (n= 44) were mixed breeds.

Breed	**Number of dogs represented by breed**
Boxer	1
Corgi	1
Golden Retriever	3
Labrador Retriever	2
Portuguese Water Dog	1
Pug	1
Rhodesian Ridgeback	1
Samoyed	1
Shetland Sheepdog	1
Siberian Husky	1
Standard Poodle	1
Standard Schnauzer	1
Vizsla	1
Total	**16**

CHAPTER 4: GENERAL DISCUSSION AND CONCLUDING REMARKS

4.1 Introduction

The development of measurement tools to assist in the management of dogs is a key priority for canine practitioners. In particular, the appropriate matching of dogs to applied positions, and screening shelter dogs for rehoming are both important agendas that rely on standardized tools to predict future behaviour. When it comes to measuring the social interactions of dogs, little is known, in particular, about what characterizes individual dogs' interactions with an unfamiliar conspecific. This thesis detailed the behavioural interactions between unfamiliar companion dogs in the early stages of meeting and how factors such as sex of the interacting dogs and increased familiarity influences social behaviour. Knowledge of such factors may lead to empirically-based practices that could enhance or safeguard dog welfare in situations where unfamiliar dogs meet (e.g., dog daycares, dog parks). As well, I investigated the convergence and inter-rater reliability of two canine personality assessments that are often used to describe and predict how individual dogs respond in many contexts, including that of unfamiliar conspecific contact. Here, I highlight the main results from the preceding chapters and make suggestions regarding the implications of these findings.

4.2 The Responses of Dogs to Unfamiliar Conspecific Contact

4.2.1 Not all conspecific contact may be equally valuable

In the current research, both the familiarity of the dog and the sex of the pairs interacting were relevant variables in relation to conspecific contact. Behaviours between dogs changed subtly between first and second meetings, e.g., the initial interactions primarily involved sniffing,

which significantly decreased in Week 2. This pattern presumably emerged because less olfactory information was needed or was salient after the initial meeting. Although it only occurred in Week 1, the observation that mixed sex pairs spent more time together than other pairs is supported in other literature. Research on familiar dog interactions suggests that mixed sex dyads have the greatest and male dyads the least affiliation (e.g., Bauer & Smuts 2007; Trisko, Sandel, & Smuts 2016); however, data are relatively scarce.

Pullen, Merrill and Bradshaw (2013) found that following an initial interaction, unfamiliar dogs explored independently; indeed, this pattern was observed in the current work. Although dogs spent little time in close proximity to one another (approximately 10% of the total session length), it is unknown whether further opportunities for interaction would have increased affiliation, e.g., once the novelty of the environment wore off. However, based on the results of Trisko et al. (2016), it should not be surprising when dog pairs don't affiliate; even in a group of highly social dogs in a daycare environment, over half of the dogs showed no affiliation with one another. This result suggests that partner preferences may play an important role in dog-dog interactions. For example, Ward, Bauer, and Smuts (2008) argued that certain breeds of dogs may show social skills based on artificial selection; sled dogs that need to work in close proximity to one another should have more tolerance for conspecifics than breeds such as terriers that were selected to work alone. In summary, a number of variables may affect the value of conspecific contact (i.e., age, breed, familiarity, etc.). Because many owners bring their dogs to dog parks to allow them to freely socialize with other conspecifics, the roles of these variables should be further clarified.

4.2.2 Humans Have an Important Role in Unfamiliar Conspecific Contact

Despite the efforts of the handlers to ignore the dogs during the sessions, it was clear that humans had an effect on the behavioural responses of dogs to unfamiliar conspecific contact. It is worth mentioning that removing humans from the study site would not likely solve the issue of human influence on dog behaviour, as dogs likely would be looking for their handlers and be potentially stressed by being 'abandoned.' The desire for dogs to gain access to people was also noted by Pullen et al. (2013), who observed that some dogs would attempt to escape the study site for human contact. At the dog park, owners do interrupt dog-dog behaviours that they deem unsuitable (Walsh, Howse, Green, Butler, & Anderson, 2011). Similarly, at daycares, supervisors interrupt possible outbreaks of aggression, and redirect the dogs using pieces of food (Trisko & Smuts, 2015). Thus, it is not surprising that dogs in this study may have valued close proximity to a human, although the role of humans remains unclear. It is possible that for some dogs, humans are being perceived as a valuable resource and some pairs are more affected by the potential for resource guarding of a human than others. Alternatively, being close to a human may have facilitated conspecific contact (particularly for the mixed sex pairs in Week 1). It is also possible that humans are being used as intervenors in potential conflicts, as suggested by the highly correlated With Human behaviour of the dogs in male pairs, which may indicate that the presence of an unfamiliar male conspecific induces some anxiety in their male partner.

If the presence of an unfamiliar conspecific induces stress or anxiety in the other dog, it would be predicted that those dogs that remained close to a human would also demonstrate higher levels of cortisol. To determine if exposure to an unfamiliar conspecific induced a stress response, salivary cortisol, a stress-related hormone, was measured for the dogs in this study, but

is not reported in this thesis. These analyses are underway and will be reported separately. Ottenheimer Carrier, Cyr, Anderson and Walsh (2013) investigated the relationship between dog social behaviour and cortisol in the dog park, and found that dogs which displayed a hunched posture, a behaviour indicative of stress, also showed high levels of cortisol.

4.2.3 Socialized Dogs Displayed Few Agonistic Behaviours When Meeting an Unfamiliar Conspecific

It is possible the lack of agonistic behaviours (i.e., lunges or charges) observed between unfamiliar dogs may have been a result of the dogs selected for the study, who were all well-socialized. Similarly, Trisko and Smuts (2015) observed very few agonistic behaviours in a daycare environment; a setting that should have a high proportion of very social dogs. In this study, it is possible dogs used subtler signals such as 'looking away' to communicate with other dogs. However, the function of this behaviour was hard to document since there were other novel stimuli in the study site that could have influenced the direction of a dog's gaze. Thus, it was unclear whether dogs rarely approached one another directly because they were using a strategy to diffuse conflict or because they were more drawn to the other competing distractions (i.e., humans). Firnkes, Bartels, Bidoli and Erhard (2017) demonstrated that breaking eye contact is an appeasement signal dogs used in the presence of a threat from a human. Because studies of dog-dog communication can not only inform us how to better manage conspecific contact but also inform dog-human interactions, further clarifying the signals that dogs display in a threatening situation would be of great value.

4.3 The Structure of Canine Personality

4.3.1 Using Personality Assessments to Assess Unfamiliar Conspecific Contact

One of the challenges in the canine personality realm is that initially many assessments were modelled after the human Five Factor Model (FFM) (e.g., Gosling, Kwan & John, 2003; Kubinyi, Turcsán, & Miklósi, 2009). Because there was no need to distinguish between inter-and intra-specific aggression for human personality ratings, these assessments naturally lacked this type of discrimination (Mirkó, Kubinyi, Gácsi, & Miklósi, 2012). More researchers are recognizing the importance of characterizing individual differences in response to unfamiliar conspecific contact in personality and behavioural assessments. For example, Hsu and Sun (2010) added several new items to the C-BARQ, a survey designed to measure behaviour and temperament in dogs. These items focused on characterizing dogs' aggressive and fearful responses when interacting with unfamiliar dogs. Certainly, when comparing the DPQ and MCPQ-R in the same context, as was done in the current study, the DPQ, with two components devoted to aggression (Aggression towards People and Aggression towards Animals), helps to clarify the dog's target of aggression, which would be valuable knowledge in the shelter environment. Aggression is the main reason dogs are returned to shelters (Wells & Hepper, 2000). There is real danger if aggressive dogs are not classified properly and enter society (Bollen & Horowitz, 2008). Furthermore, shelters face liability issues if they adopt out an aggressive dog (Orihel & Fraser, 2008). Although both the MCPQ-R and the DPQ appear to be good representations of canine personality, the practical application of both assessments need to be considered further.

4.3.2 Variables That Affect Reliability in Personality Assessments

Rayment, Peters, Marston and De Groef (2016) recently highlighted that differences in rater experience can cause biases in reliability of personality assessments. While the dog walkers' likely greater overall dog handling experience compared to that of the dog owners in this study may explain the divergences between the walker and owner ratings, it is possible that the context in which the dog was observed also affected ratings. In the case of the training components in both assessments (MCPQ-R: Training Focus; DPQ: Responsiveness to Training) large divergences among ratings of owners and walkers were found. It could be argued that not seeing dogs in a training context (i.e., at obedience class or training school) would impact opinions of the walkers compared to the owners. Similarly, if walkers observe the dogs in the dog park more often than owners, they may have a different idea of the dog's sociability than the owners, possibly explaining the divergences in the Excitability/Activity (DPQ) factor. There are data to support that a dog's behaviour can change based on the context in which it is observed. For example, Marder, Shabelansky, Patronek, Dowling-Guyer, and D'Arpino (2015) investigated resource guarding in a shelter environment. They found that in approximately 50% of cases where the dogs demonstrated resource guarding behaviours in the shelter, these behaviours did not transfer into the home. For this reason, it is recommended that shelter dogs be rated in foster homes, which may provide a context more similar to their future environment (Mornement, Coleman, Toukhsati, & Bennett, 2015).

4.4 Implications

If the goal of dog parks or daycare is to provide exercise and enrichment for dogs, it is important for both owners and practitioners to understand the different variables that may affect a dog's experience in these environments. For example, if familiarity affects conspecific contact and unfamiliar dogs potentially cause stress or anxiety (Pullen et al., 2013), dogs that visit the dog park infrequently would be at a disadvantage because they haven't had the opportunity to become familiar with the other dogs or the physical environment. Indeed, cortisol levels in dogs after 20 minutes in a dog park was higher in dogs who were infrequent visitors, suggesting that they may have been more stressed or experienced a greater arousal response to the novelty of the park (Ottenheimer Carrier et al., 2013). One recommendation may be that if dog owners intend to use dog parks for exercise and socialization, then dogs should be frequent visitors so that they have the opportunity to develop familiarity with the other dogs. As well, if dogs show that they may not tolerate some other dogs (i.e., puppies or males) likely to be in a dog park, owners should consider alternative activities, such as setting up playdates or walks with more socially compatible conspecifics that can still provide the benefit of socialization.

Ottenheimer Carrier et al. (2013) suggested that the most reliable indicator of fear or stress in the dog park may be hunched posture, which correlated with cortisol levels. Similarly, with further research, we may be able to determine if standing by a human is an example of a behavioural marker for fear or anxiety during exposure to unfamiliar conspecifics. Behaviours that can be honest indicators of a dog's well-being in specific environments or contexts are of value and further work should aim to provide empirical support for such indicators of emotional state.

Because euthanasia is a common outcome when dogs fail shelter behavioural assessments (Mornement, Coleman, Toukhsati, & Bennett, 2014), standardizing such assessments urgently needed. Dogs that are aggressive to humans are returned to the shelter at a higher rater than dog-aggressive dogs (Wells & Hepper, 2000), further suggesting that the distinction between the two types of aggression should be made by any canine personality assessments that would be used in such an applied setting. This distinction can help address the differing needs of such dogs and help with the education of owners on how to specifically manage potential problem behaviours.

Understanding unfamiliar conspecific contact can also inform training methodologies. For example, trainers may encourage owners to desensitize and counter-condition dogs to the approach of stimulus dogs (Orihel & Fraser, 2008). However, if olfactory information is important to overcoming the challenge of meeting an unfamiliar conspecific, creating a safe scenario in which an unfamiliar dog can sniff the unfamiliar dog may help speed up the process of building familiarity and overcoming anxiety or reactivity.

4.5 Concluding Remarks

The goal of any canine personality or behavioural assessment is to predict the future behaviour of the dog being tested. This study highlights that in the case of unfamiliar conspecific contact, both of these assessment methods need to be refined. The domestic dog's behaviour units relevant to first interactions with unfamiliar dogs have yet to be described in the literature. In the case of personality, there is a need for further consensus on the structure of canine personality, including characterizing a dog's level of aggression. As opportunities for conspecific contact appear to be growing for urban pet dogs, understanding the factors that affect dog-dog

interactions are extremely valuable to ensuring safety when unfamiliar dogs meet. As well, correspondence between behaviour and personality, in the context of dog-dog contact, is particularly important in the shelter environment, where behavioural assessments need to accurately prepare future owners on how to handle their dog's behavioural issues. It is my hope that this research can be applied to inform practitioners of the variables that should be considered when assessing unfamiliar dog-dog contact, as well as how to help owners tailor unfamiliar conspecific contact to benefit their own pet dogs.

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