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PLAY BEHAVIOUR OF THE DOMESTIC DOG *Canis familiaris,* AND ITS EFFECTS UPON THE DOG-HUMAN RELATIONSHIP

by

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ABSTRACT

FACULTY OF SCIENCE

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PLAY BEHAVIOUR OF THE DOMESTIC DOG Canis familiaris, AND ITS EFFECTS UPON THE DOG-HUMAN RELATIONSHIP

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Dog-human play is a widespread example of the otherwise rare phenomenon of interspecific play behaviour. In the popular literature on dog behaviour there are numerous untested claims that games significantly affect dog-human relationships.

Dog-human play was characterised as distinct from dog-dog play. Focal sampling of 402 dog walkers and a survey of 2585 dog owners revealed that dogs housed in multi-dog households played as frequently as did dogs in single-dog households, indicating that interspecific play is unlikely to be a substitute for intraspecific play. An experimental study of Labrador Retrievers showed that, when playing with another dog, dogs were more motivated to compete for possession of an object, but, when playing with a human, interaction was more important.

'Object-oriented play', defined as play involving two individuals responding to each other but centring around an object, was shown to differ structurally from both social and object play. Two experimental studies of Labrador Retrievers showed that people can increase dogs' interest in a toy via their presence and by a protocol of rewards.

The effects of different game types upon dog-human relationships were examined experimentally. A study of 30 Labrador Retrievers showed that repeated playing of some game types can affect dog-human relationships, but it detected no differences between dogs which won and lost at Tug-of-war, contrary to claims in the popular literature. A further study using 14 Golden Retrievers detected an increase in 'Obedient attentiveness' towards an experimenter after play and also an increase in 'Demandingness'. However, whether dogs won or lost at Tug-of-war only affected their 'Playful attention seeking' scores; after winning they scored higher than after losing.

When playing with their dogs, dog owners were observed to use a wide variety of play signals of varying effectiveness. Two of these signals, 'Bow' and 'Lunge', were shown experimentally to instigate play between dog and person, and their efficiency was increased when they were accompanied by play vocalisations.

The social consequences of the outcome of dog-human games were studied by allowing one dog (the spectator) to observe structured games between a second dog and a person. The spectator behaved differently towards each of the players depending upon whether it had observed the dog or the human win. The presence of human-dog play signals also altered the behaviour of the spectator towards the winner and the loser.

Correlations between the quality of dog-owner relationships and the types of games played were examined in 50 dog-owner partnerships in their own homes. Dogs which played Rough-and-tumble exhibited more 'Non-specific attention seeking' and less 'Separation-related behaviour'. Breed strongly affected 'Amenability'. Dogs which played Tug-of-war scored higher for 'Confident interactivity', but whether they won or lost had no effect. However, dogs which were reported to regularly initiate play with their owner scored lower for Amenability, were reported to be more dominant and were more likely to exhibit owner-directed aggression.

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who took great pride in my academic achievements

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"Observed play is aesthetically eloquent.
It fascinates the senses and entertains the mind."

(Fagen 1984, p.159)

Chapter 1

Introduction



"Do not ask me to give a definition of play"

(Lorenz 1956, p.633)

1.1 Rationale

Play is one of the most enigmatic and debated behavioural complexes (Rasa 1984). Decades of research have produced a wealth of descriptive data which sharply contrasts with the poverty of scientific knowledge (Beach 1945). Thompson (1998, p.183) attributes this to a "lack of precisely worded falsifiable hypotheses" and a "tendency for certain ideas to become generally accepted despite a lack of supporting data". Literature about the domestic dog can be similarly described. It is vast, but suffers from a deficiency of empirical hypothesis testing and an abundance of unsubstantiated claims which have, in some cases, been raised to theorem. In this thesis I challenge several common assumptions documented in both the general play research and the popular dog literature.

1.1.1 Why study dog behaviour?

1.1.1.1 The domestic dog

The domestic dog (*Canis familiaris* Linnaeus*)* is believed to have descended primarily from the grey wolf, *Canis lupus* (Clutton-Brock 1995; Vilà *et al.* 1997). Archaeological findings indicate domestication took place 12-15,000 years ago (Davis and Valla 1979), but recent mitochondrial DNA evidence suggests that divergence of the dog from the wolf may have occurred as long as 135,000 years ago (Vilà *et al.* 1997). This discrepancy is yet to be resolved.

Since domestication, dogs have lived in close association with people and fulfilled a variety of roles in human society. Historically they were a source of food (Serpell 1995), a means of transportation, and a focus for religious worship (Serpell 1996), roles which remain important in some cultures today. Dogs are also trained to guard people and livestock, to hunt, to work in the military, police and Customs services, and more

recently to aid people with a range of physical disabilities. But, as well as these utilitarian roles, dogs play an important function as companions to humans.

1.1.1.2 The dog as a companion animal

The first evidence of dogs being kept for companionship comes from a 12,000 year old Palaeolithic tomb in North Israel, where the remains of a human were found buried with the hand placed upon the shoulder of a puppy (Davis and Valla 1979). Chinese emperors (Serpell 1996), Greek and Roman nobles (Robinson 1995) and Medieval European aristocracy (Serpell and Paul 1994) were all keen pet-keepers. Today dog-ownership is widespread across many classes and cultures, and is particularly common in Western societies. The UK dog population exceeds 7.3 million, living in 26% of households (Anon. 1995) and the vast majority of these dogs are kept as companions (Robinson 1995).

Within this role, a dog can bring great pleasure to its owner, and studies have also attributed dog-ownership with a range of further benefits both physical (see Freidmann 1995) and psycho-social (see Hart 1995a). Interacting with a dog has been claimed to reduce blood pressure and anxiety and dog owners exhibit higher survival rates following coronary care than do non-owners (Freidmann 1995). Dogs have been identified as part of the social support system for families (Bryant 1985) and as a social lubricant for old people (Rogers *et al.* 1993) helping to relieve loneliness.

1.1.1.3 The dog-human relationship

The potential benefits of dog ownership are great, but they depend upon the formation of a successful relationship between dog and owner. Frequently people acquire a dog whose behaviour does not meet their expectations or fit in with their lifestyle, and whilst some owners tolerate sub-optimal relationships, many do not and their dogs are surrendered or even euthanased. In the UK, behavioural problems are amongst the most common reasons for owners abandoning their dogs (Podberscek 1997) and, in the USA, an

estimated 7.5-9 million dogs per year are euthanased because of unacceptable behaviour (Anderson and Foster 1988). This constitutes a significant welfare concern.

To maximise the benefits obtainable, and reduce the number of partnerships ending tragically, we need to understand the dynamics of the dog-human relationship. This can only be achieved via detailed knowledge of the behaviour of both dog and human partners and how they affect one another.

1.1.1.4 Current knowledge

Growing interest in human-animal bonds in Western societies is reflected in an increase in popularity of pet behavioural counselling. Counsellors help to correct many behavioural problems and improve countless dog-human relationships per year, and their ideas are widely published in the popular literature (*e.g.* Rogerson 1992; Abrantes 1997; Appleby 1997). Although the practices they advocate are usually successful, the theory and principles on which they are based are often unsubstantiated. Therapies generally involve numerous simultaneous changes of the owner's behaviour towards their dog. Thus any subsequent effects on the dog's behaviour cannot be attributed to one particular cause, and ineffective treatments may often remain unidentified. This leads to the perpetuation of many unproven ideas which can even have detrimental effects. For example O'Farrell (1992) suggests that Rough-and-tumble play between dog and owner should be avoided as it may lead to aggression. In Chapters 5 and 8, I find no support for this claim, but conversely show that Rough-and-tumble can provide substantial benefits for the dog-human relationship.

Scientific study of the dog-human relationship is essential. Pre-existing assumptions must be challenged and the effects of specific factors upon dog-human relationships empirically assessed. Although such research has become increasingly popular over the last 15 years (*e.g.* Robinson 1995; Serpell 1995), it remains in its infancy. Detailed studies of all types of dog-human interactions are required and amongst these is the study of play.

1.1.2 Why study play behaviour?

1.1.2.1 The importance of play

It is 101 years since the first published discussion of play behaviour (Groos 1898), and the subject has subsequently received much attention from biologists, psychologists and sociologists. The majority of this has been in the form of theoretical debate attempting to find a universal definition of play (*e.g.* Beach 1945; Loizos 1966), and to identify its evolutionary function (see Smith 1982 and Caro 1988) - a search which has hampered objective research and yielded no conclusive answers. In recent years play biologists have turned their attentions to empirical studies, both observational (*e.g.* American black bear, *Ursus americanus*: Henry and Herrero 1974; dwarf mongoose, *Helogale undulata rufula:* Rasa 1984) and experimental (*e.g.* squirrel monkey, *Saimiri sciureus*: Biben 1989; laboratory rats, *Rattus norvegicus:* Hole 1991) and the field has continued to thrive.

Today the importance of play behaviour is widely acknowledged amongst scientists and educationalists. Play levels are inversely proportional to cortisol levels in squirrel monkeys (Biben 1996) and so can be used as an indicator of good welfare conditions (*e.g.* Carpenter 1964; Jensen *et al.* 1998) and social recovery (Harlow and Suomi 1971). Environmentally induced brain growth in rats has been attributed to play (Ferchmin *et al.* 1980) and insufficient and abnormal play are distinguishing features in the childhood of drunk drivers and mass murderers (Brown 1998). These findings all show that play is an essential component of normal social development.

1.1.2.2 What is play?

Play behaviour is ubiquitous throughout mammals (Suomi 1982) and is also reported in birds (*e.g.* Heinrich and Smolker 1998) and reptiles (Burghardt *et al.* 1996). Humans find it easy to recognise play in other animals and inter-observer correlation is high (Mears and Harlow 1975; Rasa 1984). However, derivation of a universal definition has proven extremely difficult (Fagen 1981; Martin and Caro 1985) as is encapsulated by Konrad Lorenz (1956, p.633) "*Do not ask me to give a definition of play*".

Some maintain that play is an artificial category (Loizos 1966; Lazar and Beckhorn 1974), inappropriate to animals which do not "work". However, the ease with which play is identified, suggests this dismissal is inappropriate (Bekoff 1972) and both functional (*e.g.* Fagen 1984) and structural (*e.g.* Henry and Herrero 1974) definitions have been proposed. Although the structural perspective is more objective, no single definition has proved satisfactory for all species at all life stages.

In my opinion, play can only be adequately defined as activities which display some or all of the following structural features:

a) actions from various contexts incorporated within the same sequence (Miller 1975; Bekoff and Byers 1981),

b) motor patterns which appear exaggerated and more variable in orientation than their non-playful counterparts (Loizos 1967; Henry and Herrero 1974; Jolly 1985; Martin and Caro 1985),

c) motor patterns which are repeated more frequently than during non-play sequences (Loizos 1967),

d) motor acts which appear incomplete compared to non-playful behaviour (Henry and Herrero 1974; Miller 1975),

e) precedence by a "play signal", unique to the play context (Bateson 1955; Hill and Bekoff 1977; Fedderson-Peterson 1991),

f) absence or rare occurrence of behaviours associated with threat and submission (Blurton Jones 1967; Bekoff 1972; Symons 1978),

g) appearance of being "pleasurable" to the participants (Brownlee 1954; Bertrand 1969, Bekoff 1974; Henry 1986).

Play behaviour is diverse and can be directed at different targets. It is traditionally classified into three categories (Bekoff and Byers 1981; Smith 1982):

object play - involving the manipulation of inanimate things,

locomotor play - consisting of running and rotational body movement,

social play - when two or more individuals respond to each other's actions.

The validity of this categorisation will be challenged later (1.2.1).

1.1.2.3 The function of play

A study of play behaviour remains incomplete without some reference to its most distinguishing feature - its apparent lack of function. So I now briefly review the debate surrounding this.

Definitions of play often allude to an "apparent lack of purpose" (*e.g.* Bekoff and Byers 1981, p.301; Martin and Caro 1985, p.64). However, the laws of natural selection state that for a behaviour to persist there must be positive (or neutral) survival value associated with its performance. There are obvious costs incurred by a playing individual: increased energy expenditure (Fagen and George 1977); decreased time available for other essential activities (Bernstein 1980); increased conspicuousness to predators (Harcourt 1991); decreased vigilance and increased risk of injury (Byers 1977; Symons 1978). Play must also provide benefits (immediate or delayed) which outweigh these costs, and identification of these benefits has fuelled much debate and research (see review by Smith 1982). The most popular hypotheses fall into four categories:

1) Physical training

Play improves the fitness and develops the physical skills of the player (Brownlee 1954; Smith 1982). Supporting evidence includes: play constitutes most of the exercise budget of ponies, *Equus caballus* (Fagen and George 1977); Siberian ibex, *Capra ibex sibirica* choose to play on sloped rather than flat surfaces (Byers 1977).

2) Learning social skills

A variety of social skills are hypothesised to be improved by play:

a) Fighting skills - Correlations have been noted between competition levels and play levels both between species (Smith 1982) and between sexes (Symons 1978; Boulton 1996). These correlations have been proposed as evidence that play functions in the development of fighting skills, but social isolates still exhibit these skills (Cairns 1972) so play cannot be the sole mechanism determining their ontogeny.

b) Predatory skills - Predatory motor actions are predominant in carnivore play (West 1974) and inter-sex comparisons reveal that the most frequent hunters often spend more time in play (*e.g.* lions, *Panthera leo*: Schaller 1972). Experimental studies show that in some species *e.g.* the domestic cat, *Felis silvestris catus* (Caro 1980), hunting ability is increased by play opportunities, whilst in other species such as coyotes, *Canis latrans* it is not (Vincent and Bekoff 1978).

c) ***Social bonding*** - Play increases social cohesion between individuals (West 1974; Bekoff 1977a; Baldwin 1982; Vanderschuren *et al.* 1995). Evidence includes observations that individuals which play together often remain together (Blurton Jones 1967; Humphreys and Smith 1987; Fry 1990; Hole 1991) and temporal correlations between times of maximum play and bonding *(e.g.* Wilson and Kleiman 1974; Mech 1975).

d) Social rank acquisition - Play allows individuals to assess their relative strengths (Thompson 1998) and thus determine their dominance relationships (Carpenter 1964; Poirier and Smith 1974). Correlations between social status and characteristics of play behaviour are the main source of support for this idea. For example in the rat, *Rattus norvegicus,* habitual play partners develop asymmetries in play (consistent winners and losers) at the time dominance relationships emerge (Panksepp 1981; Pellis and Pellis 1991). This idea also predicts same-sex play partners will be preferred in species with single-sex hierarchies, which is borne out in humans (Clark *et al.* 1969; Fry 1990) and squirrel monkeys (Biben 1986)

e) Social communication- Play provides an opportunity to learn intraspecific communication skills (Poirier and Smith 1974; Vanderschuren *et al.* 1995). This idea is based on observations that rhesus macaques, *Macaca mulatta,* denied of suitable play partners are unable to inhibit aggression (Suomi 1979) or to react appropriately to facial expressions (Miller *et al.* 1967).

3) Cognitive and sensorimotor training

a) Facilitation of cortical development - Suomi (1982) offered the explanation that play facilitates cortical growth. The period of maximal Purkinje fibre synapse formation and muscle fibre development (see Byers 1998 for review) is temporally coincidental

with maximal play levels. Stimulation provided by enriched environments can lead to increased dendritical branching which is proposed to be a result of play (Ferchmin *et al.* 1980).

b) Increased cognitive and innovative abilities - This idea is often suggested with reference to primates (Fedigen 1972). Play allows animals to probe the environment and the feedback they receive leads to modification of their behaviour (Smith 1982) and enhanced ability to cope with extremes (Jolly 1985). Behaviours such as tool-use by chimpanzees, *Pan troglodytes* may have originated in play.

4) Affective quality

One reason for the perpetuation of play may be simply because it is "fun" (Bekoff 1972; Fagen 1981; Lewis 1982; Jolly 1985). A playing individual is likely to be well-nourished (Baldwin and Baldwin 1976; Sommer and Mendoza-Grandos 1995), thus play levels may function in the assessment of a prospective mate's fitness. Individuals that play may be inherently more attractive leading to accentuation of playfulness in successive generations (Fagen 1992).

The debate surrounding the function of play has been lively and long-lived, but remains inconclusive. I suggest this is the result of a theoretical flaw. Research has focussed on identifying a **single ultimate cause of play,** by which I mean, a benefit not obtainable in the absence of play and sufficient to outweigh the costs of play in *all* species at *all* life-stages. There is no reason to assume this exists.

There is evidence that the costs of play in some species are relatively small (Martin and Caro 1985; Caro 1995). Play levels are also labile; they are modified in response to environmental conditions. For example squirrel monkeys' play decreases to 1% of normal levels when food is scarce (Baldwin and Baldwin 1976) and langur monkeys, *Presbytis entellus* experience similar decreases when habitat quality is poor (Sommer and Mendoza-Grandos 1995). The flexibility of play levels means that the cost need never be significant and the fitness benefits obtained may be correspondingly variable (Fraser and Duncan 1998). Thus it is likely that play behaviour functions, not as an essential

ingredient for a single benefit (Vanderberg 1982; Martin and Caro 1985), but provides a range of marginal benefits, dependent upon species (Bekoff 1982), life stage and environmental conditions (Beach 1945). Play may thus be described as a "flexible non-specific back-up system" (Vanderberg 1982) whose benefits outweigh its costs in some favourable conditions.

1.1.2.4 Hypothesised functions can be real effects

Although ostensibly misguided, the search for a single function of play has produced very valuable results. Research, whilst failing to identify an ultimate cause of play behaviour, has provided compelling evidence for a range of proximate effects in a variety of species. The evidence for several of these effects is discussed in detail within this thesis.

1.1.3 Play behaviour of the domestic dog

Dogs exhibit high levels of play behaviour in comparison to other species, including their ancestor the wolf (Aldis 1975). Most mammalian species play frequently as youngsters, but levels decline dramatically with maturation (Byers 1998). However, for the domestic dog, play continues to be an important part of the social repertoire throughout adulthood. This is partly a result of captivity, where less time is devoted to essential activities such as foraging and predator avoidance, so more time is available for play (Burghardt 1988). However, it is likely that play has also been accentuated by artificial selection by humans. For many years people have, to a great extent, controlled dogs' reproductive opportunities, selecting breeding animals with characteristics which they find appealing. A predisposition to play is likely to have been one such characteristic (Mech 1970).

Although artificial selection makes the domestic dog an unsuitable subject for studying the evolution of play, there are numerous features which make it an ideal experimental subject for researching proximate effects. Perpetuation of play into adulthood means longitudinal studies of the effects of play can be easily interpreted as they are not

confounded by maturation. Also, domestic animals are less sensitive to stress induced by captivity and handling. This is crucial since play levels are decreased by stress (M^{c}Cune 1992; Biben 1996). Combined with their high readiness to play, these factors make dog play research efficient and easy to perform.

1.1.4 Dog-human play behaviour

1.1.4.1 What is dog-human play?

Most discussions and definitions of social play refer exclusively to intraspecific play. Martin and Caro (1985, p.65) for example, define social play as "play directed towards a conspecific". However, play can occur between members of different species. Fagen (1981) listed 23 species pairs reported to play together, but Caro and Alawi (1985) state that most were single cases or anecdotal. The only detailed study of interspecific play in wild animals is between two species of hyrax *(Procavia johnstoni* and *Heterohyrax brucei;* Caro and Alawi 1985).

Contrastingly, interspecific play between dogs and humans is extremely common (Russell 1936), and is claimed to occupy up to 44% of the interaction time between a dog and owner (J. Angus cited in Hart 1995b). With 7.3 million dogs in the UK, this probably makes playing with a dog a more popular leisure activity than playing football (Mugford 1980). Surprisingly, although there are several descriptive studies of dog-human play (*e.g.* Russell 1936; Aldis 1975), there are very few empirical studies examining "the role of play and how it influences the dog's behaviour in other contexts" (Nott 1992, p.76). This thesis aims to reddress the balance.

1.1.4.2 The value of dog-human play research

In addition to their importance for understanding the dog-human relationship, studies of dog-human play can be used to investigate more general mechanistic principles. This use was pioneered by Mitchell and Thompson (1993) who studied the effect of familiarity on the rarity of deception. Dog-human play is an ideal model for such studies as domestic

dogs are good subjects (as outlined above) and the human element provides control of experimental conditions.

Numerous experiments have attempted to manipulate intraspecific play opportunities, in a variety of species, but they have generally employed social isolation (*e.g.* Caro 1980). Their findings are therefore confounded by a global depression of all social behaviour (Bekoff 1976; Fagen 1981; Biben 1989). Studies using drugged partners have attempted to overcome this problem (Einon *et al.* 1978), but, in my opinion, unsatisfactorily due to the likelihood of side-effects detectable by the un-drugged partner. In contrast, studies of dog-human play can easily be controlled. The human partner can manipulate play opportunities whilst maintaining normal levels of social interaction. Dog-human play is therefore an ideal candidate for the study of many general aspects of play as I demonstrate when investigating the role of play signals (Chapter 7).

I have outlined the need for, and the rationale behind this project. I will now introduce some of the main concepts and three General Hypotheses central to this thesis.

1.2 Unique features of dog-human play

1.2.1 Object-oriented play

Play is traditionally categorised into three types - object, solitary and social (see 1.1.2.2). The evidence for this classification is that the three play types show different developmental profiles (Barrett and Bateson 1978; Gomendio 1988), predominate in different species (Happold 1976), and appear to have different motivational bases (Pellis 1991). There has been a movement to consider the three types separately (*e.g.* Gomendio 1988). But recently this has been challenged and the legitimacy of the three-way classification questioned (Thompson 1998), and I examine the relevance of these categories to dog-human play.

Many species intersperse different types of play within a single bout (*e.g.* black bear: Burghardt 1998; sable antelope, *Hippotragus niger*: Thompson 1998). There are also numerous cases of play which defy simple classification as they show elements of two or more types (Biben 1982; 1983). A striking example of this occurs when dogs and humans play together. Their games usually incorporate an object and so could be classified as object play, but they involve two individuals responding to each other's actions and so could also be classified as social play. I refer to this as "**object-oriented play**".

Although documented in a range of species (*e.g.* bottle-nosed dolphins, *Tursiops truncatus*: Alpers 1965; gorillas, *Gorilla gorilla*: Carpenter 1964 and ravens, *Corvus corax*: Heinrich and Smolker 1998), object-oriented play has not been the subject of empirical scientific investigation. It has previously been categorised as both social play (Aldis 1975) and as object play (Robinson 1992) but the possibility that it is homogeneous with neither has never been explored.

In Chapter 4, I present investigations examining the structure of dog-human object-oriented play. I compare it to both object and social play in order to assess the relative importance of the object and the human play partner.

1.2.2 Is dog-human play different to dog-dog play?

There is an extensive collection of popular literature aimed at explaining the interactions which occur between domestic dogs and humans (*e.g.* Rogerson 1992; Abrantes 1997; Appleby 1997). Many of the ideas advanced are based on ethological concepts relating to intraspecific social behaviour of the dog, and often refer to the behaviour of the ancestor, the wolf. There is one extremely common assumption; that dogs behave towards people as though they were conspecifics which have been incorporated within their hierarchy (*e.g.* Blackshaw 1985). It is consequently assumed that dog-human interactions have the same implications as their dog-dog counterparts. This opinion is summed up by Hediger (1965, p.295) who states that "there is no doubt about the fact that the dog considers its human master as a socially superior member of its own species - as a member of its pack". This assertion is unjustified given the absence of empirical data on this subject. Extrapolation from dog-dog behaviour to the dog-human context occurs with reference to all aspects of social behaviour, and is particularly common when discussing play.

There are claims that dog-human and dog-dog play are both motivationally (Whitney 1989; Rogerson 1992) and structurally (Mitchell and Thompson 1991a) homogeneous. In Chapter 3, I challenge these ideas and present empirical studies comparing both motivation and structure of dog-dog and dog-human play.

1.2.3 General Hypothesis 1

The experiments outlined in 1.2.1 and 1.2.2 form the first section of this thesis (Chapters 3 and 4). They all examine object-oriented dog-human play, comparing it to object play, social play and intraspecific dog play. Collectively they test the first general hypothesis that

"dog-human object-oriented play is a distinct category of play".

1.3 The effects of play on the dog-human relationship

1.3.1 Important dimensions of the dog-human relationship

The hypothesised functions of play (1.1.2.3) have been shown to be proximate effects in some species. Since play is an important interaction between dog and owner, its effects could have significant consequences for their relationship. Two of the proposed functions of play are particularly relevant. Social bonding (or attachment) and dominance are commonly acknowledged as important dimensions of a dog-human relationship (Mugford 1985), and both are claimed to be determined during play (*e.g.* Poirier and Smith 1974). However, both terms are controversial and often imprecisely used. This section briefly introduces dominance and attachment, reviewing their relevance to the dog-human context and defining their meanings as used throughout this thesis.

1.3.2 What is dominance?

1.3.2.1 An inconsistently used term

Since its initial application to pecking orders in fowl (Schjelderup-Ebbe 1922), the concept of dominance has been widely used to explain the social organisation of group-living animals. However, there has been little consistency in its use and a review by Drews (1993) outlines 13 different definitions of the term "dominance". Inconsistencies include whether dominance is an attribute of a dyad or an individual; whether it is context specific or general and whether it can be measured empirically or is merely a theoretical construct.

There is a tendency when referring to such a controversial and poorly defined concept, to invent a novel term, which can be easily defined. This has the advantage of short-term clarity, but does not benefit the scientific field in the long-term, as a multiplicity of terms

evolve which refer to essentially the same concept. I avoid this temptation, and continue to discuss dominance, but define precisely to what I refer. To formulate my definition I examine the research on canids.

1.3.2.2 Dominance in canid societies

Lockwood (1979) pointed out that almost all theoretical treatments of wolf (and I suggest, also dog) social behaviour involve the notion of dominance, yet it had never undergone rigorous validation. A critical reassessment of the construct of dominance followed, involving empirical studies of both wolf (Lockwood 1979; MacDonald 1987; van Hooff and Wensing 1987) and dog (Wright 1980) social behaviour. Although the consensus was that dominance is a useful term, I feel its use is only legitimate if the following factors are taken into consideration:

1) Assessments of dominance traditionally involved two animals being placed in a pen with a single bone and their rankings were based on possession of the bone (James 1949; Scott and Fuller 1965; Fox 1972; MacDonald 1987). Although *en masse* these tests produced consistent results, they did not equate with social dominance as assessed in other contexts (Wright 1980).
2) Subordinate animals can be "situationally dominant" without upsetting the "formal dominance" (van Hooff and Wensing 1987, p.248). Thus, assessment of dominance requires observation of many contexts and the whole spectrum of behaviour needs to be considered (Lockwood 1979).
3) Dominance and agonism are independent factors in wolf societies (Lockwood 1979). The frequency of aggressive threats is not a reliable indicator of dominance (van Hooff and Wensing 1987) although asymmetries in the direction of aggression do reflect social dominance (Lockwood 1979).
4) Dominance is a useful construct only when describing relationships. On an individual level it is more appropriate to refer to assertiveness and expansion tendencies (van Hooff and Wensing 1987).

5) Postures are a reliable indicator of dominance status (van Hoof and Wensing 1987).

6) Dominance relationships are maintained via both dominance confirmation and subordinance acknowledgement, (van Hooff and Wensing 1987) so indicators of both need to be considered in dominance assessment.

I conclude that dominance is an attribute of a dyadic relationship characterised by a consistent net outcome in favour of one of the members (Drews 1993), which is affected by resource and contextual specificity. But, is dominance relevant to the dog-human context?

1.3.2.3 The relevance of dominance to dog-human relationships

Many of the proposed definitions of dominance (Drews 1993) are inappropriate to relationships between members of different species, for example asymmetries in reproductive success and aggression levels (Wilson 1975). However, definitions in terms of "priority of access to resources" are applicable and have previously been used to describe interspecific relations between sympatric species such as songbirds (Morse 1974; Gautheraux 1978).

In Western cultures it is generally assumed that an owner can control the behaviour of their dog and assert priority of access to resources. Most dog owners aspire to this situation and the legal system is orientated towards it. Additionally, disputes over priority of access can result in owner-directed aggression (Overall 1997). Thus, dominance is a very important dimension of a dog-human relationship which I define as: ***"a tendency of one member of a dyad to assert itself over priority of access to resources"***.

1.3.2.4 The relationship between play and dominance

Many play theorists claim that dominance relationships are established during play (*e.g.* Altmann 1962; Carpenter 1964; Poirier and Smith 1974). This idea is often applied to dog-human relationships and pet behavioural counsellors state that dogs which are frequently allowed to win games, such as Tug-of-war, increase in dominance status relative to their owners (O'Farrell 1992; Rogerson 1992). However, dominance relationships have been shown to vary dependent upon the context and the resource under dispute (van Hooff and Wensing 1987). I therefore challenge the assumption that dominance relationships within play are generalised to other contexts, and in Chapters 5 and 8 present studies which test this empirically.

1.3.3 What is attachment?

1.3.3.1 An inconsistently used term

The term "attachment" is generally inferred to mean an emotional bond between two individuals. However, it is surrounded by theoretical and terminological difficulties. The terms bonding and attachment are often used interchangeably. But, bond implies a two way process or mutual attachment (Scott 1992) and so I refer to attachment as the one-way process, by which an individual becomes attached to an object or another animal. There have also been discrepancies in the use of attachment as a construct or motivator of the "attachment behaviours" from which it is inferred (Gubernick 1981). Some believe the intensities of the behaviours can be used as a measure of the strength of the attachment (*e.g.* Scott 1971), whilst others do not (Ainsworth 1973). I make no attempt to implicate the underlying mechanism or function of attachment, but use it to describe "dimension(s)[1] of a dyadic relationship, characterised by specificity, and preferential responding". Attachment can thus be demonstrated by several operational criteria (Gubernick 1981):

1) Preference for one individual (the presumed attachment figure) over another,
2) Seeking and maintenance of proximity to that figure,
3) Response to brief and extended periods of separation from the presumed attachment figure,
4) Response to reunion with the presumed attachment figure,
5) Use of the attachment figure as a secure base from which to explore the world.

1.3.3.2 The relevance of attachment to dog-human relationships

Prerequisites for attachment have been well researched (see Cairns 1966) and the only essential ingredient identified is prolonged proximity (Scott 1963). An animal can become attached to an inanimate object or to a conspecific, and in the case of domestic animals, to a member of another species. Cohabitation leads to interspecific attachments between sheep and goats (Hersher *et al.* 1963), lambs and dogs (Cairns and Johnson

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[1] Attachment is described as multi-dimensional by Cairns (1972).

1965) and monkeys and dogs (Mason and Kenney 1974) and the phenomena of dogs becoming attached to humans is well documented *(e.g.* Scott 1963; Scott and Fuller 1965; Fox and Stelzner 1967).

Attachment is an important element of a dog-owner relationship. Most owners find moderate levels of attachment behaviour such as effusive greetings, approaches to be petted and attempts to remain in proximity, very endearing. However, in excess these behaviours are undesirable and "overattachment" has been implicated in the development of separation-related problems (M°Cune *et al.* 1995). These problems include destruction, vocalisation and soiling when the dog is separated from, or denied access to, its attachment figure (Borcheldt and Voith 1982; M°Pherson 1998). Separation-related problems are the second most common behavioural problem, representing up to 39% (Borcheldt 1983) of the cases presented at behavioural clinics. Therefore, an understanding of the factors which affect the attachment process is essential.

1.3.3.3 The relationship between play and attachment

Although proximity is the only primary condition necessary for the formation of an attachment, there are other factors which facilitate the process. These include high levels of physical contact (Cairns 1966) and arousal (Scott 1962). Play often involves both these and may thus speed up the attachment process between the players. Intraspecific play is implicated in the process of social bonding (*e.g.* Poirier and Smith 1974; West 1974), although a deterministic role has never been proven. The hypothesis that play between dogs and owners affects attachment dimensions of their relationship is tested in Chapters 5 and 8 of this thesis.

1.3.4 General Hypothesis 2

Evidence supporting social effects of intraspecific play (including both dominance and attachment effects) comes primarily from correlations between features of play behaviour and dimensions of the players' relationship. Correlations are not evidence of cause and effect. In this thesis I present several experimental studies aimed to assess whether dog-human relationships are affected by the quantity and quality of play. I concentrate on attachment and dominance dimensions of the relationship testing the General Hypothesis that

"play between dogs and people has consequences outside the game".

1.4 Play signals

1.4.1 Intraspecific play signals

I have questioned whether play has significant effects on other dimensions of dog-human relationships. If not, it follows that dogs must be able to distinguish interactions which occur within the context of play from those which do not. But, how do they make this distinction? During intraspecific play the play "mood" is maintained via play signals. These are unambiguous actions such as the canid play bow (Bekoff 1974; Fox *et al.* 1976), which function in both the solicitation (Bekoff 1974; 1975) and maintenance (Bekoff 1975; 1995) of social play interactions.

1.4.2 Do interspecific play signals exist?

I hypothesise that play signalling also occurs interspecifically - between humans and dogs. The human performs actions which communicate the playful context of the interaction to their dog. The nature of these signals remains until now unstudied.

I suggest that interspecific play signals modify the effects of interactions on dog-owner relationships, especially dominance-related effects. By defining the context as playful, play signals ensure that the outcomes of interactions are context-specific and do not have generalised effects on other dimensions of the dog-human relationship.

1.4.3 General Hypothesis 3

In Chapters 6 and 7, I present studies examining the nature and effects of human-dog play signals. They are all aimed at testing the third General Hypothesis:

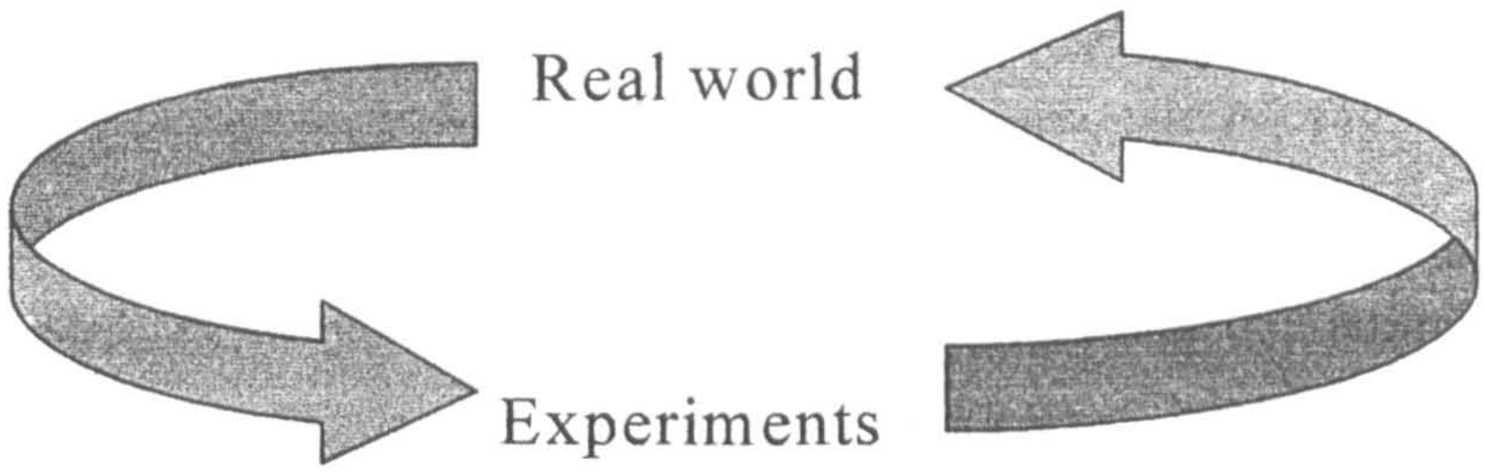
"dogs are able to distinguish between play and non-play interactions".

1.5 The approach

1.5.1 An applied study

I aim to make this an applied thesis, whose findings have applications within the dog-owning community. To ensure this I have taken a cyclical approach (Figure 1.1).

Figure 1.1 An applied study



I commenced my work with a questionnaire study of dog-owners which was used to gather information about natural play routines and generate specific hypotheses. I next tested these ideas experimentally, before finally returning to the dog-owning community to confirm the relevance of my findings and ideas.

1.5.2 Experimental studies

1.5.2.1 Choice of breeds

Selective breeding for specific traits has resulted in breeds which vary considerably in temperament (Hart and Hart 1985; Bradshaw *et al.* 1996). So when studying dog behaviour, one is faced with the problem of which breed to choose as experimental subjects. In this thesis I present a questionnaire survey (Chapter 2) and a correlational

study of dog-owner relationships (Chapter 8), which use volunteer dog-owners and thus include a wide range of breeds. However, for experimental work I concentrated on two breeds .

The Labrador Retriever was used for the majority of experiments. It was selected for a number of reasons:

a) It is currently the most popular dog breed in the UK (Pedigree Masterfoods survey 1997 and Kennel Club UK Registration data 1997),
b) It is a particularly playful breed (Bradshaw *et al.* 1996),
c) It is prone to behavioural problems, especially separation-related problems (Mugford 1995),
d) It is frequently chosen as a family pet, so knowledge which could improve relationships with people is particularly important.

The effects of games were also examined using a second breed, the Golden Retriever. This is also a playful family pet, and was rated fourth in the top ten registered breeds in 1997 (Kennel Club UK Registration data 1997). It too is susceptible to behavioural problems, but unlike the Labrador Retriever it shows a high incidence of owner-directed aggression (Mugford 1995). Since aggression and attachment-related problems represent two of the most common behavioural problems (Holmes 1988; Serpell and Jagoe 1995), this was an ideal choice of breeds.

1.5.2.2 The Waltham Centre for Pet Nutrition

Nine of the ten experimental studies presented in this thesis were carried out at the Waltham Centre for Pet Nutrition (WCPN), Waltham-on-the-wolds. Leicestershire, UK. Waltham is the research division of the Mars Petcare group of companies, and the industrial CASE sponsor of this project. Since 1965 Waltham have maintained colonies of dogs and cats at their research centre, WCPN. These are used primarily for nutritional and behavioural studies. There are currently 268 dogs belonging to 18 breeds and including 121 Labrador Retrievers. These are housed, mainly in pairs, in 9.5m^2 pens,

consisting of indoor and outdoor areas. All of the dogs receive daily exercise and contact with people and other dogs. Their housing and daily routines were designed, as far as possible, to mimic a "domestic, home-like ambience" (Loveridge 1998, p.101), thus making their study more applicable to domestic pets. Further details of housing and husbandry are described in Appendix 1.

1.6 Thesis aims and chapter outlines

This thesis coalesces the results of a multiple approach study of the play behaviour of the domestic dog. It includes pure and applied investigations assuming both correlational and experimental approaches. The primary aim is to use rigorous scientific techniques in order to gain a better understanding of play between humans and dogs, and the effects that play can exert upon their relationship. The studies are linked by three General Hypotheses:

1: *"dog-human object-oriented play is a distinct category of play"*

2: *"play between dogs and people has consequences outside the game"*

3: *"dogs are able to distinguish between play and non-play interactions"*

The thesis is divided into nine chapters:

Chapter 2 serves as an introduction to the project. It examines the play which naturally[2] occurs between dogs and their owners. A questionnaire survey provides information on usual play routines and video-taped dog-owner play sessions are used to derive an ethogram and a vocabulary for describing dog-human play behaviour.

In Chapters 3 and 4, General Hypothesis 1 is tested by experimental studies of the structure of object-oriented dog-human play. In Chapter 3, comparisons are made with dog-dog object-oriented play and, in Chapter 4, comparisons with dog-human social play and with object play.

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2 It may be argued that the term "natural" is inappropriate when referring to a domestic animal. However, I use it merely to describe behaviour which takes place spontaneously in a non-experimental situation.

The latter part of the thesis takes an applied perspective, testing General Hypothesis 2. In Chapter 5, I describe two longitudinal experiments. Both examine the effects of different play regimes upon developing relationships between dogs and humans. The first experiment uses Labrador Retrievers and explores a range of game types. The second experiment uses Golden Retrievers as subjects and looks specifically at Tug-of-war games.

Chapters 6 and 7 concentrate upon human-dog play signals. Firstly, I examine the play signals used by dog-owners and their effectiveness at initiating play (Chapter 6). I then present two experiments investigating their role in defining the playful context of a game (Chapter 7). These take a novel approach, using social learning as a window on play signalling. Collectively these two chapters test General Hypothesis 3.

Chapter 8 is the final results chapter and describes a home-based study of fifty dog-owner partnerships. It explores correlations between aspects of dog-owner play behaviour and measurable dimensions of their relationships.

A general discussion of the main findings and applications of this study is presented in Chapter 9. Here I summarise my results and consider the extent to which the initial hypotheses have been proven. I also discuss the wider implications of my findings.

Chapter 2

The starting point: the dog-owning community



"Play between species is not common. The outstanding exception is the play between man and his pets"

(Beach 1945, p.526)

2.1 Aims

This thesis examines play between domestic dogs and humans. It is an applied study and aims to investigate hypotheses which are relevant to the general dog-owning community. The home is the environment of the domestic dog, and the setting of most interspecific play, so this is where the study begins. Initial examination of the dog-owning population serves several functions:

a) The existing literature contains little information on the way people play with their dogs. Data collected here are used to develop methodologies, thereby ensuring the relevance of subsequent experiments to the domestic setting.

b) Observations of home-based play are used to develop descriptive techniques which are later applied in the experimental setting.

c) Tentative findings within the home environment are used to formulate precise hypotheses for further experimental testing.

d) Statistics calculated from dog-owners' reports facilitate interpretation of experimental results.

e) Subsequent work (Chapters 3-8) examines dog-human play from mainly a canine perspective, so this chapter provides an opportunity to examine owners' opinions and motives.

f) Dog-human play is essentially a home-based activity, so the study is set in context from the outset.

After an initial examination of the dog-human play literature (2.2), this chapter falls into two sections. In the first I aim to gain an overview of the play that takes place between dogs and their owners (2.3) and in the second I establish a vocabulary for use when describing dog-human play (2.4).

2.2 Background

There are very few studies specifically examining dog-human play, but during generalised work on the dog-human relationship some data has been accumulated. I now briefly review this, examining the extent to which dog-human play has already been studied and outlining the gaps in our current knowledge which are pursued within this chapter.

2.2.1 Who plays?

Although it has been claimed that as much as 44% of the interaction time between dog and owner is in the form of play (J. Angus cited in Hart 1995b), there are few published data on the incidence of dog-human play. In a telephone survey in the USA, Stallones *et al.* (1988) found that 94% of elderly dog owners "often played" with their dogs. When 259 Swedish dog owners were presented with a range of statements, 80% agreed that their dog gave them an "outlet for playfulness" (Adell-Bath *et al.*1979). Messent (1983) observed 44 people walking their dogs and saw 36% of dog walks to incorporate play, with owners playing an average of 3.5 games per walk. Games were more common with medium sized dogs (7.7 per owner per walk), than with large dogs (2.4 per owner per walk), and were not observed with small dogs, but these differences were not statistically significant.

These studies all suggest that play is a common dog-human activity. There appears to be a difference between the incidence in the home and on walks which may have important methodological implications and needs to be considered further.

2.2.2 What sort of play occurs?

The composition, or types of dog-human play occurring are not well documented. Descriptive studies mention dogs playing Chase, Fetch, Rough-and-tumble and Tug-of-war (*e.g.* Aldis 1975; for definitions of game types see Appendix 2). Smith (1983) observed ten dog-owning families, during their usual routines, for 20-30 hours. In addition to the four game types mentioned above, she identified Keep-away, but gave no indication of the relative frequencies of each game. Messent (1983) stated that 50% of games played on walks were Fetch.

Mitchell and Thompson (1991b) looked specifically at the composition of dog-human play. They noted that familiar and unfamiliar partnerships played differently, but their descriptions are in terms of "projects"[1] and all observations were under experimental conditions. These factors make it difficult to draw conclusions about naturally occurring play and highlight the importance of developing well defined descriptive techniques at the outset of a study.

I suggest that play composition varies with location. For example, although Fetch is very common on walks (Messent 1983), it may be less frequent in the home. This hypothesis requires investigation.

In Chapter 1 (1.2.1), I introduced the concept of object-oriented play. Previous studies, although not making this distinction, have concentrated on object-oriented play, paying very little attention to games which do not involve a toy. So, just how common is non-object play? I hypothesise that it is more frequent in the home setting, but this also requires testing.

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[1] "Projects" are defined as "sequences of actions that are repeated in order to calibrate an organism's control over these actions or the actions of the play partner" (Mitchell and Thompson, 1991a, p.189)

2.2.3 Why play?

The cause of intraspecific play has been a popular topic of debate (see 1.1.2.3), but has focussed mainly upon ultimate causation (Hall 1998). Proximate causes are also important - what motivates dogs and owners to play together? Dog owners readily agree that they express their own playful tendencies via playing with their dog (Adell-Bath *et al.* 1979) so human playfulness may be one reason for dog-human play. The non-competitive qualities of pet-oriented play have also been proposed to provide recreation for humans (Messent and Serpell 1981). But, as yet no-one has systematically asked dog owners why they choose to play.

Also, what motivates dogs to play with people? It is claimed that dogs play due to a deficiency in dog-dog play (refer to 1.2.2). However, this has not been explored experimentally.

There are postulated benefits for both play partners. For people, playing with pets is claimed to provide recreation and Mugford (1980) suggests that with decreasing family sizes, pet-oriented play may serve an important role in the normal social development of single and first born children. Additionally, the dog may benefit from playing with its owner. Behavioural counsellors advocate play as a means of stimulating and training a dog (*e.g.* Rogerson 1992). The potential benefits are diverse and owners' opinions may prove useful in their identification.

2.2.4 When does play take place?

I have discussed the general reasons for dog-human play occurring, but on a shorter time-scale, what determines the timing of individual play sessions? I suggest that interspecific play signals are important in the initiation of play (1.4.2). Smith (1983) failed to identify any signals consistently used to instigate dog-human play. Owners may be able to provide information on actions which fulfil this function.

Smith (1983) also noted that both dog and human are able to initiate and terminate play, but gave no indication of the relative frequency of each. Patterns of play initiation and termination have been seen to correlate to dominance dimensions of relationships in several species (*e.g.* coyotes, *Canis latrans*: Bekoff 1977; Bekoff and Byers 1981; rats, *Rattus norvegicus*: Pellis and Pellis 1992; squirrel monkeys, *Saimiri sciureus*: Biben 1998). Instigation patterns are also deemed to be important for dog-human relationships (*e.g.* Askew 1996), but no supporting data currently exist.

2.2.5 What are the effects of play?

Specific game types are alleged to have effects on both dominance and attachment dimensions of dog-human relationships (1.3). These claims are based mainly on hear-say and individual case studies. There are no quantitative data from the general dog-owning population to link features of games to the behavioural traits they are postulated to affect.

2.2.6 Summary

There are obvious gaps in our knowledge of dog-owner play behaviour. There exists a wealth of unsubstantiated claims and a sparsity of data. Therefore, my initial aim was to collect more data relevant to the points I have identified. To do so, I conducted a questionnaire survey of the dog-owning population.

2.3 Surveying the dog-owning community

2.3.1 Objectives

The questionnaire focussed upon the identified gaps in previous work and had the following objectives:

a) to sample the games owners commonly play with their dogs, in their own homes and on walks, and to investigate the objects used in those games,

b) to explore the occurrence of non-object games,

c) to test the hypothesis that the games played in the home differ from those played on walks, especially in terms of the amount of non-object play occurring,

d) to investigate owners' ideas of the value of interspecific play to themselves and to their dog and perceived indicators of high quality play sessions,

e) to determine which partner (dog or person) controls the timing of play sessions,

f) to identify actions which owners perceive as play signals,

g) to investigate possible relationships between the games played and quantifiable aspects of the dog-human relationship, such as attachment and aggression,

h) to assess whether there is a relationship between the frequency of dog-human play and the incidence of dog-dog play.

2.3.2 Method

I designed a questionnaire which aimed to achieve each of the objectives outlined above. It was piloted using colleagues, and any ambiguous questions were refined or eliminated. The final version included 30 questions of which many were open-ended. The questionnaire is presented as Appendix 3. It was distributed to dog owners in and around Southampton, U.K. Questionaries were left in the waiting rooms of five local veterinary surgeries and a dog club for people to voluntarily pick up. Only single-dog owners were recruited as this reduced the number of confounding variables. A total of 110 completed questionnaires was returned. Respondents were 81% women and 19% men. Of these, 9% were aged <18 years, 39% were 25-50, 36% were 40-60, 12% were 60+; 4% refused to give their age. The dog sample was 48% female and 52% male; 54% of the males and 85% of the females were neutered. The dogs ranged in age from 4 months to 17 years (mean=6.2 ± 0.4 years).The responses to the questionnaire were used to compile descriptive statistics and to carry out preliminary hypothesis testing.

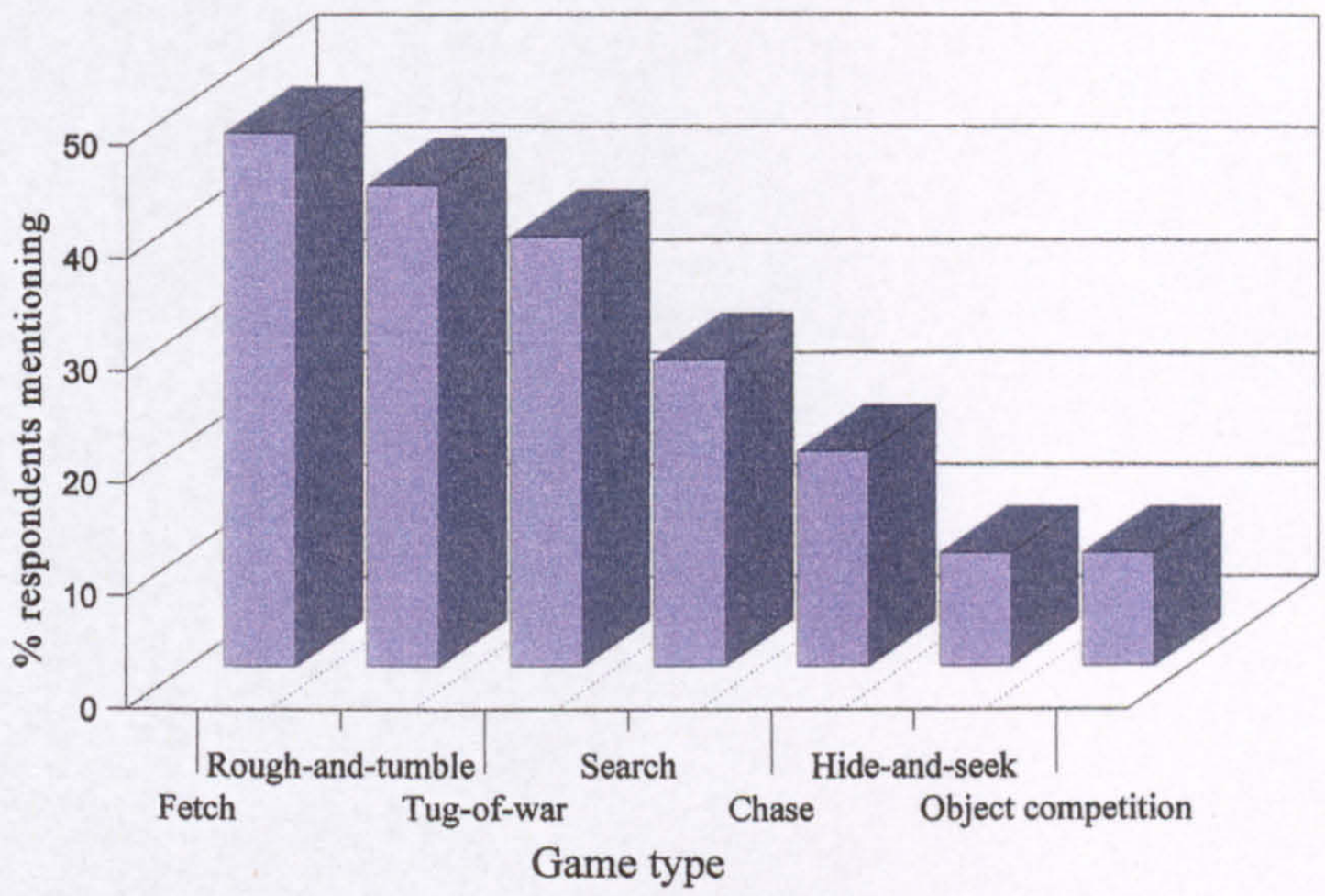
2.3.3 Results

Responses to questions relating to each objective are presented and discussed in turn, and their implications for future work outlined. Discussion of relevant theories is kept to a minimum as these are covered in depth in subsequent chapters.

2.3.3.1 Games played

The games played indoors and on walks were examined separately. Nearly all respondents (97%) reported playing with their dogs indoors. The frequencies ranged from once every four weeks to 56 times a week with a mean of 8.2 (±0.69) times per week. The most commonly reported game type was Fetch (47%), followed by Rough-and-tumble (43%) and Tug-of-war (38%; Figure 2.1). Of those who played indoors, 91% used objects in their games. The most common toy was a ball (53% of indoor players), but other popular choices included edible items (30%), squeaky toys (28%), tug toys (22%) and clothes (17%).

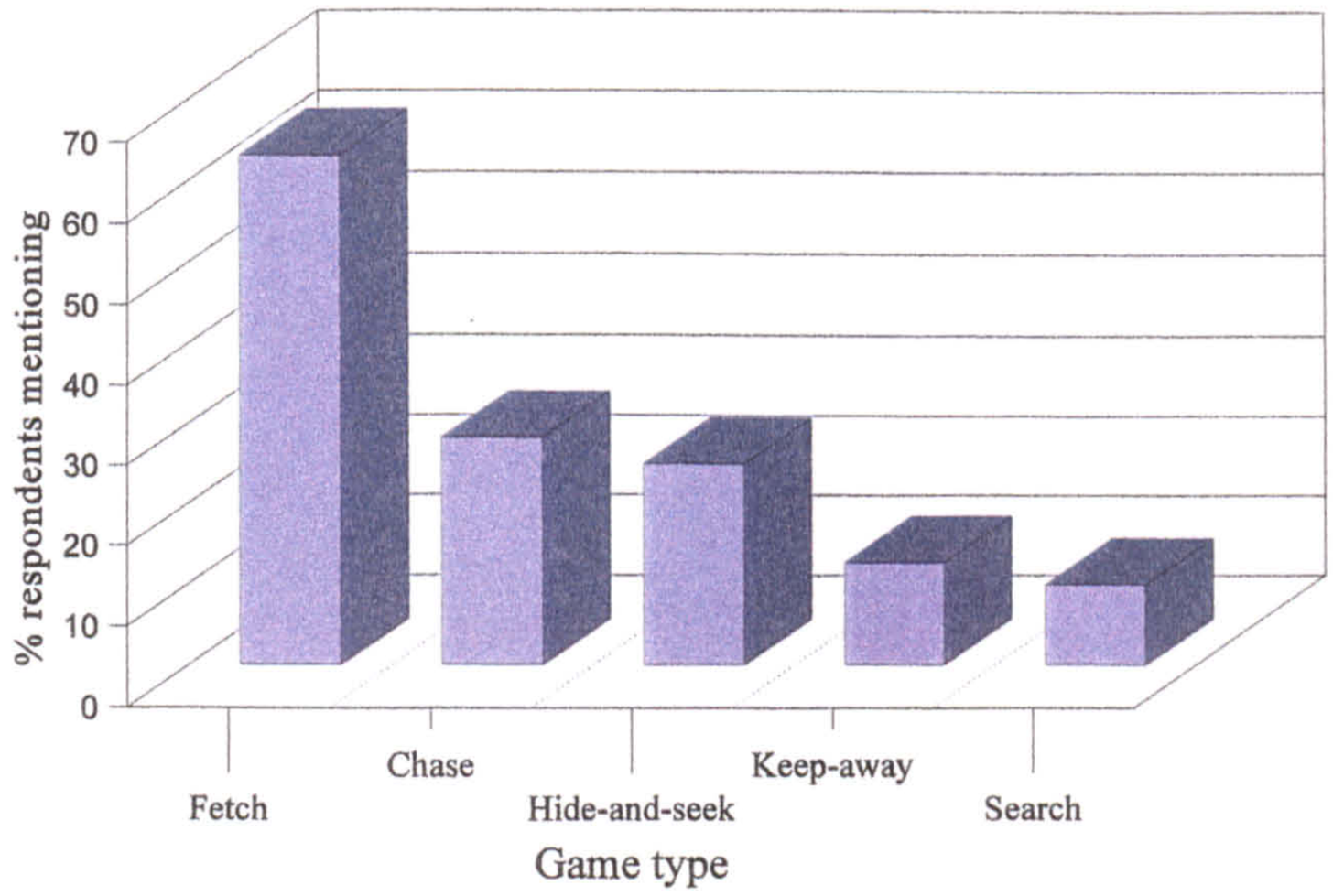
Figure 2.1 Games owners reported to play indoors with their dogs



Percentages are calculated using the whole sample of 110 respondents. All games listed by ≥10% of owners are shown. See Appendix 2 for definitions of game types.

Of the respondents, 88% reported playing on walks and of those 96% used objects. Fetch was the most frequent game (63%; Figure 2.2) and the most popular play objects were sticks (73% of the owners who played on walks) and balls (41%).

Figure 2.2 Games owners reported to play on walks with their dogs



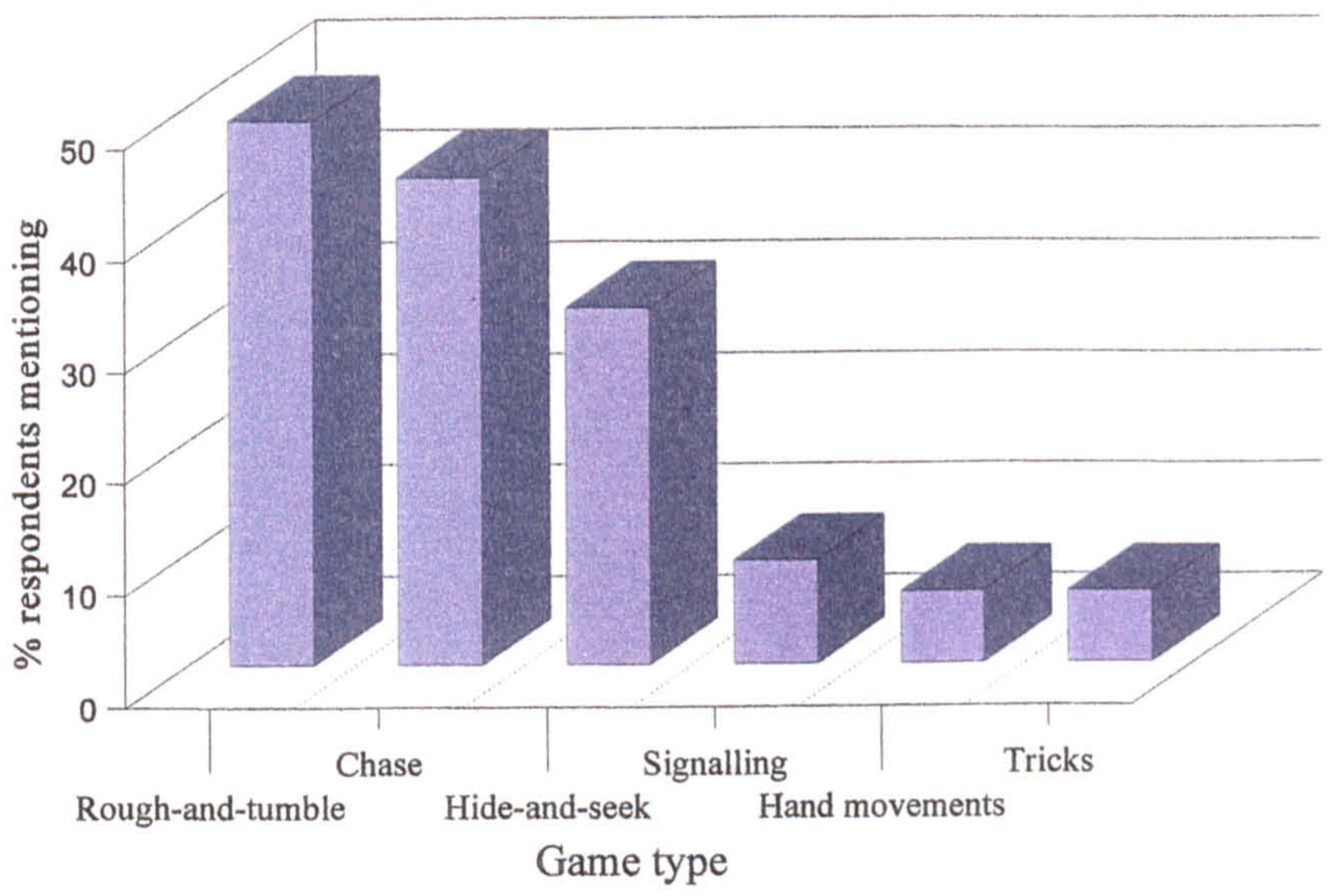
Percentages are calculated using the whole sample of 110 respondents. All games listed by ≥10% of owners are shown.

Discussion Subsequent experimental work focusses upon the games which this questionnaire identified to be the most common. For example, investigations of the effects of play on the dog-human relationship (5.3) examined three of the most common game types - Fetch, Tug-of-war and Rough-and-tumble.

2.3.3.2 Non-object play

When asked specifically whether they ever played games which did not involve an object, 83% of owners said that they did. The most popular game type was Rough-and-tumble which was played by 49% of partnerships (Figure 2.3).

Figure 2.3 Non-object games owners reported to play with their dogs



Percentages are calculated using the whole sample of 110 respondents. All games reported by ≥two owners are shown. See Appendix 2 for definitions of game types.

Discussion Previous literature on dog-human play has neglected non-object play, but this survey suggests that it is very common. Non-object games are therefore considered further in this (2.3.3.3) and later chapters (4, 5 and 6).

2.3.3.3 Differences between dog-owner play occurring in the home and on walks

There was no correlation between the reported frequency of play in the home and the likelihood that play would occur on a walk (Spearman Rank Correlation test[2] ; *Rho*=-0.14, *d.f.*=109, *p*=1).

[2] Spearman Rank Correlation Coefficient is a nonparametric measure of correlation between two ordinal variables. For all of the cases, the values of each of the variables are ranked from smallest to largest, and the Pearson correlation coefficient is computed on the ranks (see Fowler *et al.* 1998).

The most popular games on a walk were different from those in the home (see Figures 2.1 and 2.2). Contingency tests[3] confirmed that the difference was significant (χ^2=118, *d.f.*=11, p<0.0001). Progressive elimination of the most skewed ratios, and repetitive analysis revealed that significance was a result of differences in occurrence rates of six types of play: Rough-and-tumble, Object competition, Hand movements, Tug-of-war and Search were played more frequently in the home, whereas Keep-away was more popular on walks.

Owners who played non-object games were asked where the games took place and 80% reported them to occur in the home, whilst only 45% played non-object games on a walk (χ^2=13.9, *d.f.*=1, p<0.001).

Discussion These results support the initial hypothesis that there are differences between the games played in the home and on a walk in terms of both frequency and types of play. Dog-human play can therefore be described as contextually specific. Previous studies which have concentrated on play on walks (*e.g.* Messent 1983) are unlikely to be representative of all dog-owner play. This is an important concern in the design and interpretation of future work, especially surveys. Furthermore, non-object play is particularly affected by location, which suggests that this play type may warrant separate classification. This is examined further in Chapter 4.3.

2.3.3.4 Benefits of play

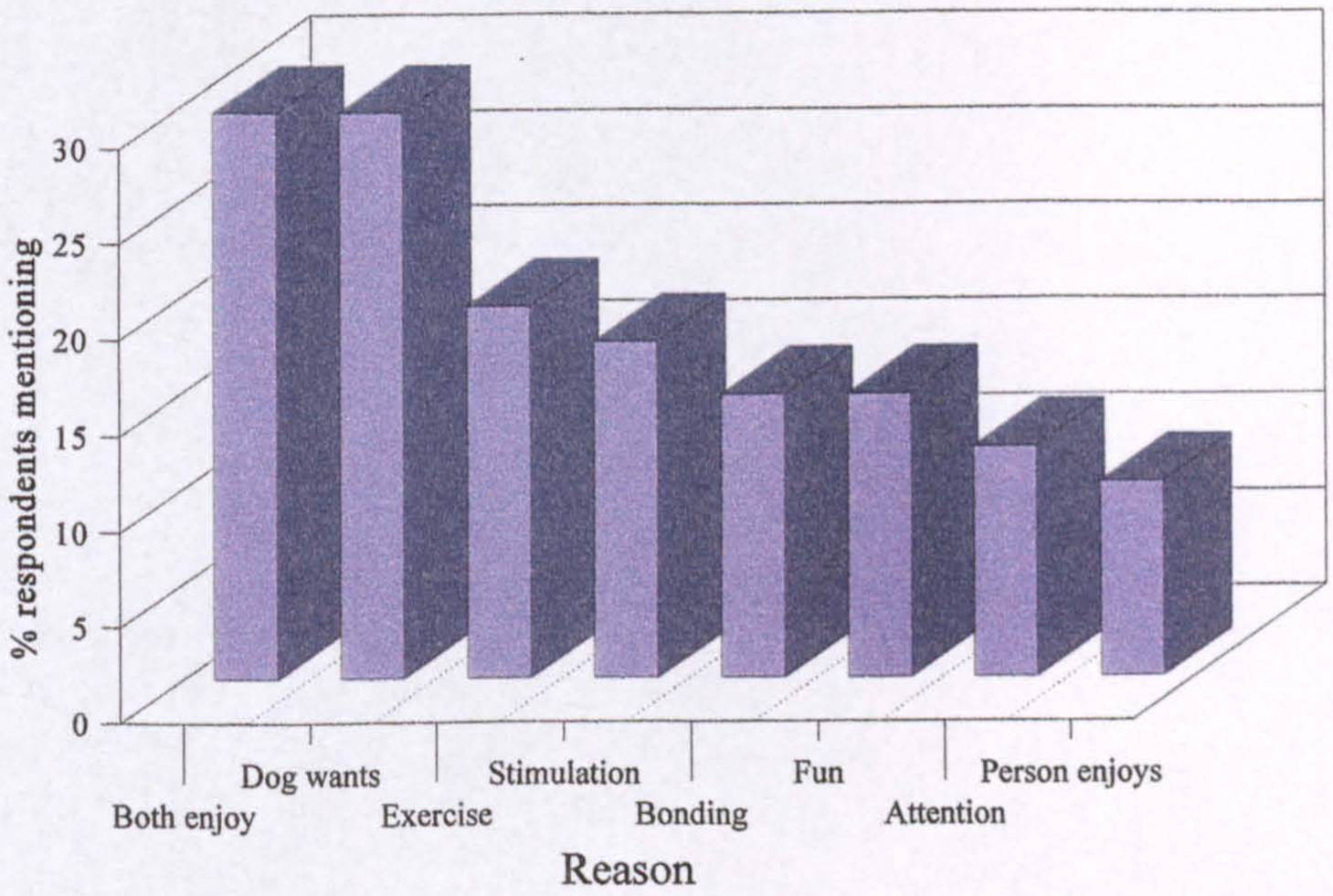
Owners were asked the main reasons why they played with their dogs (Figure 2.4). Enjoyment for both partners (30%) and "the dog wanting to play" (29%) were the most

---

3 A Contingency test is used on data which consists of frequencies in several discrete categories. It computes a chi-square value which indicates the significance of the difference between two independent groups. It tests the null hypothesis that the relative frequency with which group members fall into several categories is the same between groups (see Fowler *et. al* 1998).

common answers. Responses to this question were spontaneous, before the owners were prompted to think specifically of each of the partners concerned.

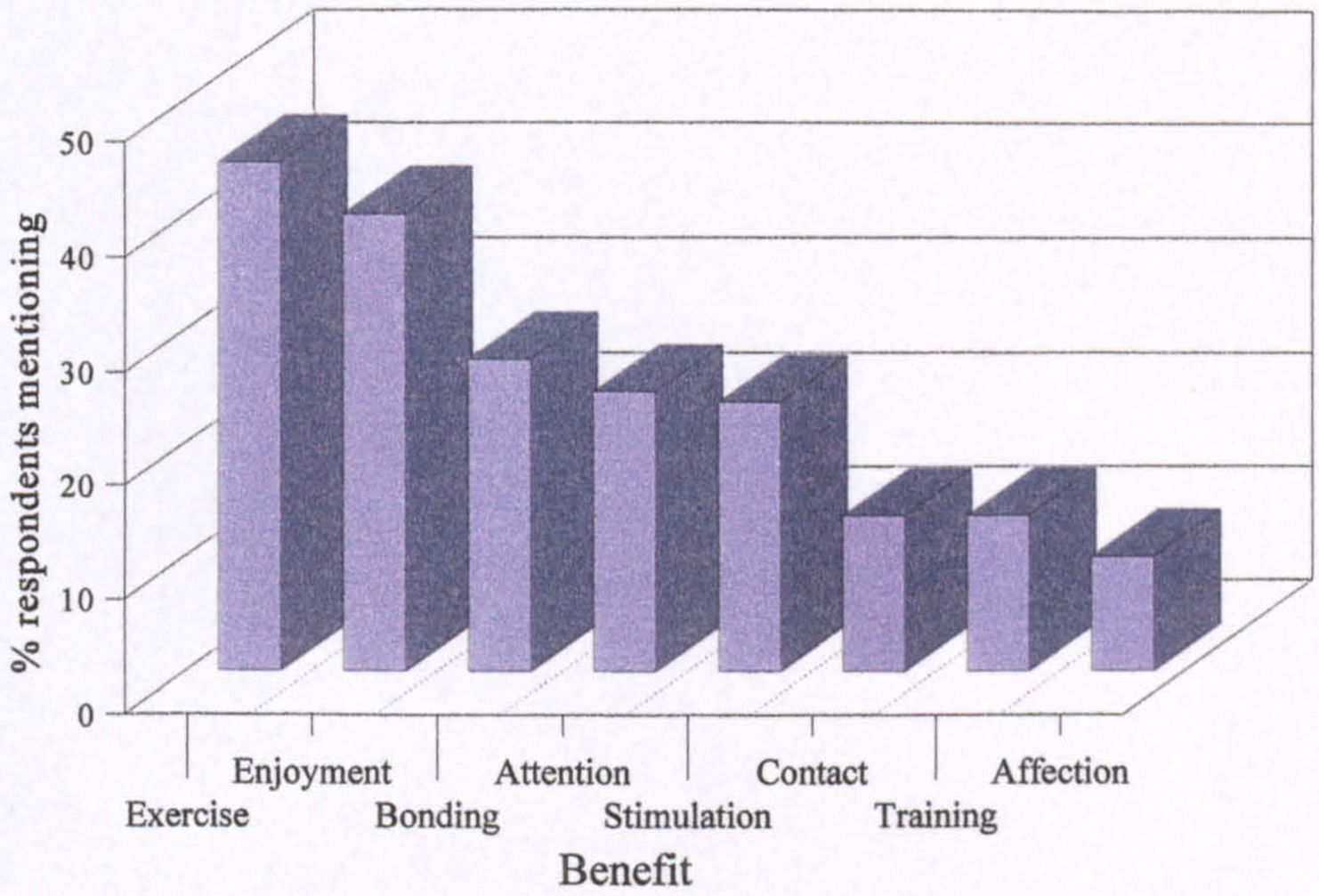
Figure 2.4 Main reasons owners stated for playing with their dogs



Two owners did not answer this question so percentages are calculated using 108 respondents.
All reasons mentioned by ≥10% of owners are shown.

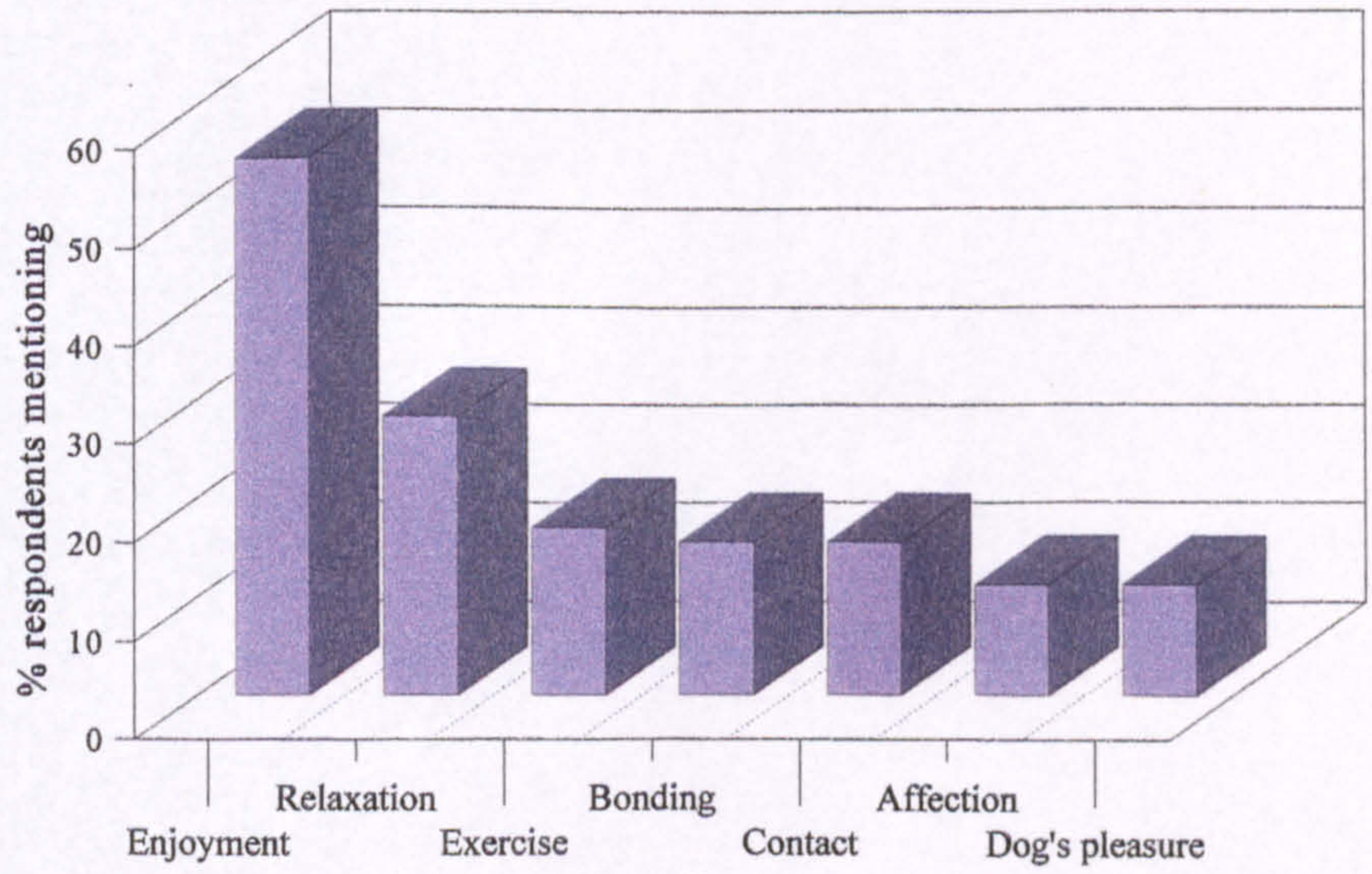
Subsequently, the owners listed the benefits they perceived their dog to obtain through play. Most owners (98%) acknowledged some benefit to their dog and the most common answer was exercise (45%; Figure 2.5), but enjoyment was more often reported as the most important benefit (40% mentioned and 25% listed as the most important benefit). The majority of owners (93%) also perceived themselves to benefit from playing. Many owners thought that enjoyment was their main benefit (55% mentioned and 35% listed as the most important benefit), but relaxation (28%) and exercise (17%) were also popular responses (Figure 2.6).

Figure 2.5 Benefits owners believe their dogs obtain via dog-human play



Percentages are calculated using the whole sample of 110 respondents.
All benefits mentioned by ≥10% of respondents are shown.

Figure 2.6 Benefits owners believe they obtain via playing with their dogs

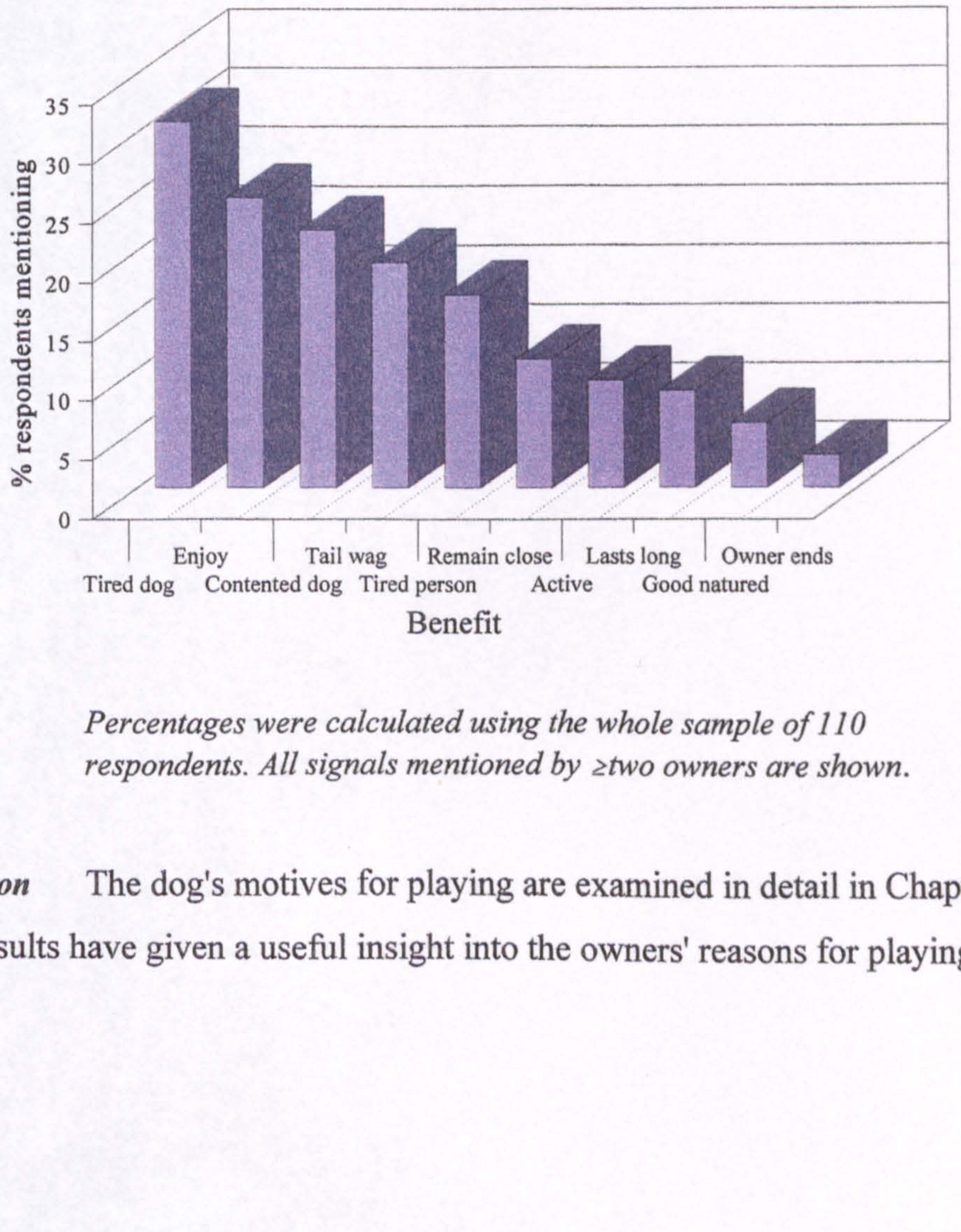


Percentages are calculated using the whole sample of 110 respondents.
All benefits mentioned by ≥10% of respondents are shown.

I next compared the main reasons the owner gave for playing, with the benefits they believed to be obtained by the two partners. Each owner was classified according to whether their main reason for playing included dog benefits, owner benefits or both. Nearly a third of owners (31%) stated their main reason to play as being most similar to the benefits they apportioned to their dog, whilst 20% gave answers more resembling their own benefits. So, more dog owners played for dog-centred reasons than reported playing mainly for their own benefit.

A similar trend was apparent when questioning the owners about signs they perceived to be indicative of a good play session (Figure 2.7). Most owners (69%) gave answers which involved factors solely including the dog, whilst only 1% of answers considered only the owner.

Figure 2.7 *Characteristics owners believe to be indicative of good dog-human play sessions*



Percentages were calculated using the whole sample of 110 respondents. All signals mentioned by ≥two owners are shown.

Discussion The dog's motives for playing are examined in detail in Chapter 4, but these results have given a useful insight into the owners' reasons for playing. Although

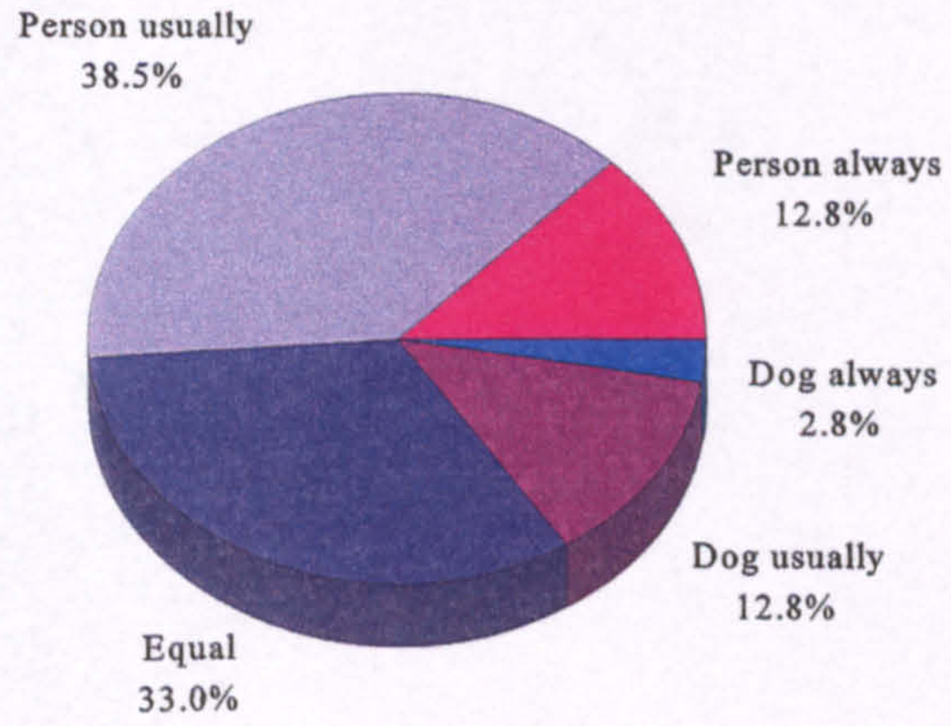
most owners play primarily for their dog's benefit, it is interesting that 93% also believe themselves to benefit. Relaxation and exercise were commonly stated advantages. Current health advice (especially regarding heart disease prevention) rates both of these highly, suggesting that dog-human play may be of considerable value to people. Play with animals has previously been hypothesised to be important for single children (Mugford 1980), but these results suggest that benefits may be more widespread. Further discussion of the effects of dog-human play on people is beyond the scope of this thesis, but it is an area worthy of further investigation.

I have also shown some of the benefits which owners think play can provide their dog. In Chapters 5 and 8, I examine the effects of play upon the dog-human relationship and determine whether several of these ideas are substantiated. Owners also suggested a range of possible indicators of high quality play sessions (Figure 2.7) and these suggestions are utilised when developing indices of play (2.4).

2.3.3.5 Control of play

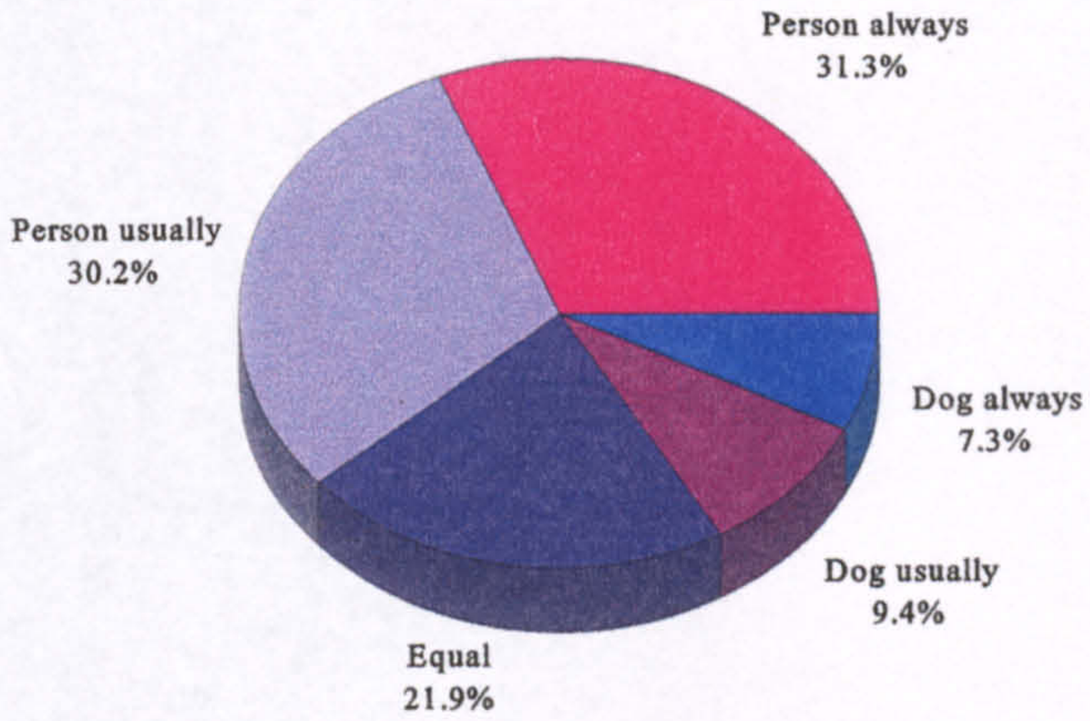
Owners were asked about the timing of play between themselves and their dog. The start of a play session was reported, in 51% of cases, to be usually (or always) determined by the person (Figure 2.8), whilst 16% reported most initiations by the dog.

Figure 2.8 Partner reported to usually initiate dog-human play sessions



One respondent failed to answer this question so percentages are calculated using 109 respondents.

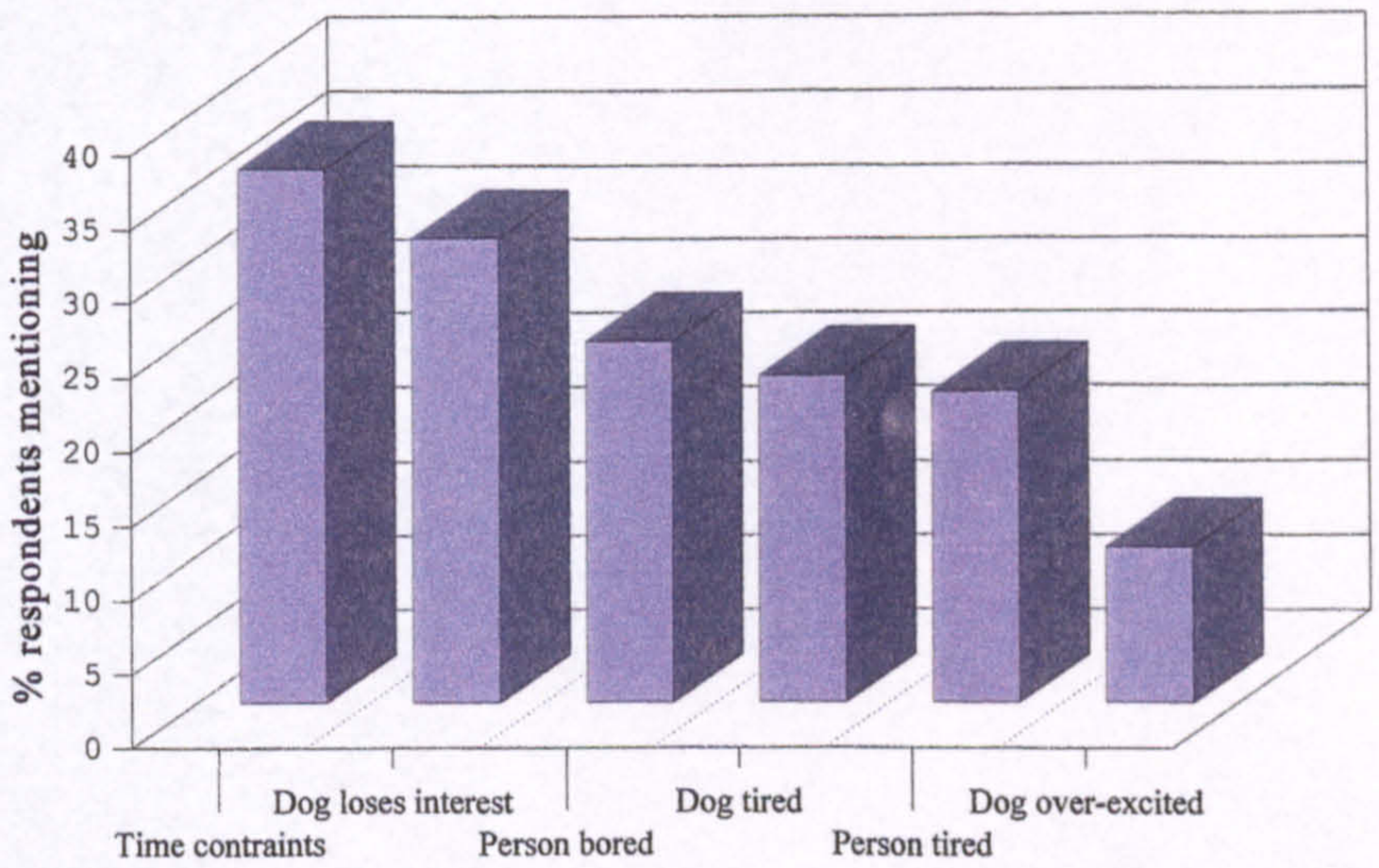
Figure 2.9 Partner reported to usually terminate dog-human play sessions



Fourteen respondents failed to answer this question so percentages are calculated using 96 respondents.

In the majority of cases termination of the play session was controlled by the person (Figure 2.9); 61% of owners claimed that they usually or always ended play sessions whilst only 17% of dogs usually determined the end of play. The most common causes of play session termination were time constraints on the owner (36%) and loss of interest by the dog (31%; Figure 2.10).

Figure 2.10 Most common reasons reported for termination of play sessions



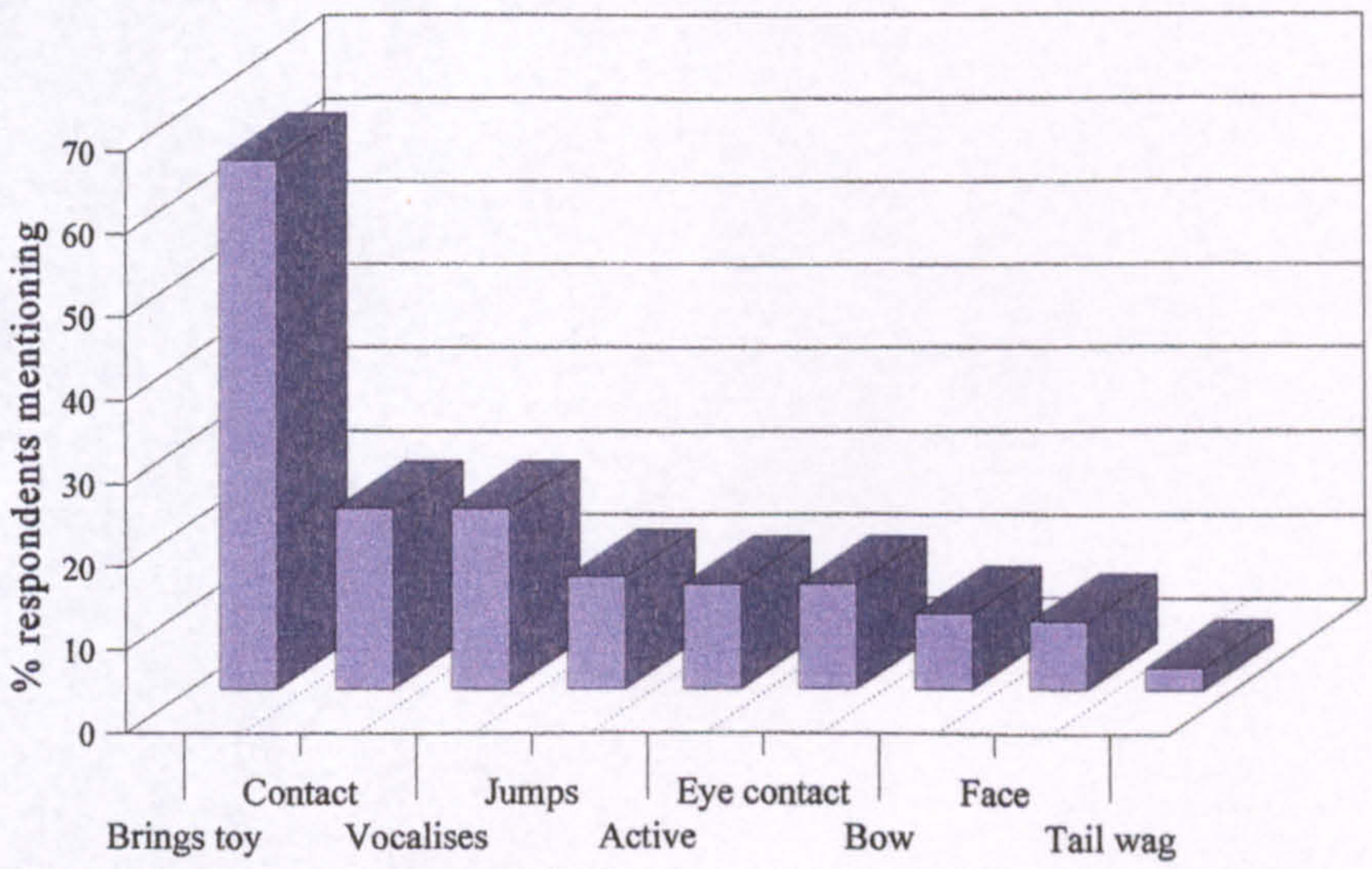
Twenty four respondents failed to answer this question so percentages are calculated using 86 respondents.
All reasons reported by ≥two respondents are shown.

Discussion Although the timing of play sessions is mainly controlled by owners, many dogs do initiate and terminate a proportion of play sessions. Control of interactions, including play, is a factor which is claimed to affect the dog-human relationship (*e.g.* O'Farrell 1992; Rogerson 1992). Possible effects are considered and tested in Chapters 5 and 8. It is however, important to consider that owners' reports may not correspond to what actually occurs. Although only 17% of owners reported their dogs to usually end play sessions, 31% stated "loss of interest" by the dog, as the most common reason to stop playing. This is an obvious discrepancy. I therefore use objective observations as well as owners' subjective reports in my subsequent studies of dog-owner relationships (Chapter 8).

2.3.3.6 Interspecific play signals

There were a number of dog behaviour patterns which were interpreted by the owner as signalling the dog's intention to play (Figure 2.11). Nine different behaviours were consistently reported by three or more owners. The most commonly reported signal was delivery of a toy (64%).

Figure 2.11 Behaviours owners perceived to be dog-human play signals



Percentages are calculated using the whole sample of 110 respondents. All signals reported by ≥two respondents are shown.

Discussion Owners were consistent in the actions which they interpreted as play solicitations: dog-human play signals. However, since owners also initiate play sessions (Figure 2.8), they must be able to communicate their intention to play to their dog. Human-dog play signals are currently undocumented and form the basis of Chapters 6 and 7.

2.3.3.7 Correlations between the games played and dimensions of the dog-human relationship

Preliminary exploration of links between dominance and attachment related behaviours and play was carried out.

Dominance Over a quarter of owners (28%) reported their dogs to display aggression towards them. Aggression can be dominance-related (Overall 1997) so to explore the link between games and dominance, the incidence of aggression was compared between players and non-players of specific games. The five most common game types (Fetch, Rough-and-tumble, Tug-of-war, Hide-and-seek and Chase) were examined in turn. The sample was divided into two classes: those dog-owner partnerships which engaged in the game type and those which did not. Contingency tests explored differences in the reported incidence of aggression between the two groups of dogs. This was a preliminary study, designed to explore trends for later experimental testing. I therefore discuss all results significant at the 10% level.

There was a trend for a higher incidence of aggression in dogs which played Tug-of-war games; 31% of players were described as aggressive, compared to 17% of the dogs that did not play Tug-of-war (χ^2=3.03, *d.f.*=1, p=0.08). There was no significant difference in the incidence of aggression between players and non-players for any of the other game types.

Attachment The frequency of play was tested for correlation to reported attachment levels using Spearman Rank Correlation test. Owners reported the frequency of indoor

play and non-object play as absolute frequencies. They also reported the likelihood that play would occur on a walk, but this was on a scale of 1-5 (5 meaning that play occurred on every walk and 0 meaning that it never occurred). Correlations were calculated using each of these indices of play frequency. Mann Whitney U tests[4] explored differences in the attachment ratings of the players and non-players of each of the five common game types.

There was no significant correlation between the frequencies of either non-object or indoor play and attachment ratings. These two play categories were stated in absolute frequencies, however play on walks, which was reported as likelihood of occurrence, (on a five point scale), was positively correlated (Spearman Rank Correlation test; Rho=0.33, $d.f.$=109, p<0.001) to attachment rating. This result may be a consequence of skewed usage of the rating scales by the owners.

Players of Hide-and-seek were reported as less attached by their owners than were non-players (4.4±0.1 vs. 4.5±0.1, U=1140, p=0.09). This was also the case with players of Rough-and-tumble (4.4±0.1 vs. 4.6±0.1, U=1108, p=0.09). Fetch players, conversely, were perceived as more attached than non-players (4.6±0.1 vs. 4.2±0.2, U=691, p=0.03), although the non-players category was quite small (20.6%).

It is also interesting to note that owners who mentioned bonding as a reason to play or a benefit obtainable from it, were more likely to play Rough-and-tumble (67% vs. 46%; χ^2=4.9, $d.f.$=1, p=0.03).

---

4 Mann-Whitney U is a nonparametric test which determines whether two independent samples are from the same population. It requires at least an ordinal level of measurement. U is calculated by the number of times a value in the first group precedes a value in the second group, when values are sorted in ascending order. p< 0.05 indicates that the samples are from different populations (see Fowler *et al.* 1998).

Discussion There is a suggestion of increased aggression in players of Tug-of-war, which is significant at the 10% level. This is tentative evidence to support a link between the playing of Tug-of-war and increased dominance.

There is no evidence that attachment of dog to person is affected by the frequency of play. The data does, however, support the idea that different game types have differential effects upon attachment. Owners' subjective reports suggest that dogs playing Fetch are more attached to their owners (although the sample is biased in favour of players). In contrast, dogs that play Hide-and-seek and those that play Rough-and-tumble are perceived as less attached. Both of these are non-object games, so games without objects may exert a different effect upon the dog-human relationship than do object-oriented games such as Fetch. This idea is pursued in Chapters, 4, 5, and 8.

These findings can only be interpreted as correlations between games played and dimensions of the dog-owner relationship. They do not necessarily imply cause and effect. It is equally plausible that the games played by dog and owner are a reflection of their existing relationship, rather than affecting their relationship, as is generally assumed. Experimental work is needed to test the possible effects of games further, and this is presented in Chapters 5 and 8.

2.3.3.8 Is there a relationship between the frequency of dog-owner play and the incidence of dog-dog play?

Owners reported both the frequency with which they played with their dog, and the likelihood that the dog would play with other dogs in a walk situation. There was a positive correlation between the two variables (Rho=0.24, $d.f.$=97, p=0.02); dogs which played more frequently with their owners were also slightly more likely to play with other dogs.

Discussion It is often claimed that the frequency of dog-human play is decreased by dog-dog play (*e.g.* Whitney 1989). The results of this survey oppose these claims, providing no evidence of a trade-off between dog-dog and dog-human play. Further investigations into this idea are presented in Chapter 3.

2.3.4 Concluding comments

This questionnaire has examined naturally occurring play, in the dog-owning community. It has highlighted several key areas which form the basis of subsequent chapters. Specific findings outlined here are discussed in the light of the literature and experimental findings in later chapters.

2.4 Developing a vocabulary for dog-human play

I have developed hypotheses about dog-human play and have collected data showing their relevance to the dog-owning community. In subsequent chapters I test the hypotheses experimentally. However, there exists no established vocabulary for describing dog-human play, nor quantitative techniques for measuring playful interactions. In this section I present an ethogram and subjective rating scales for quantifying play, both derived from observations of the dog-owning community.

2.4.1 Qualitative descriptions

2.4.1.1 Introduction

The first step in any behavioural work is the derivation of an ethogram (Bekoff 1972). Dog-human play involves two species and so the ethogram must incorporate the behaviours exhibited by each. Since I have previously identified non-object play as potentially different to object-oriented play (2.3.3.3), I studied both sorts of games whilst preparing the ethogram.

2.4.1.2 Method

A total of 21 of the questionnaire respondents (5 men, 16 women) were recruited to be video-taped playing with their dogs (13 males, 8 females; mean age=6±0.6 years). All were adult single-dog owners who volunteered via the reply slip on the questionnaire (see Appendix 3). Filming took place in the person's own home to minimise disruption to the normal play routine. Recording of play was in two stages. The first involved no objects and the second was object-oriented. There was no randomisation of session order as some dogs might have fixated on the object once it had been introduced and subsequent non-object play would have been impossible. Firstly the owner was asked to play freely

with their dog for five minutes, without any objects. They were urged to play as naturally as possible, to try to keep the dog involved and to avoid interactions with additional people. This was filmed using a video camera (Philips Explorer VKR6850), held by the experimenter (myself; female aged 23 years). Dog and owner were then given approximately five minutes rest.

A second five minute play session was then filmed. This incorporated the free use of objects as selected by the owner. Other instructions were the same as for the first session. Any partnership which did not adhere to the instructions was rejected from subsequent analysis. Eighteen dog-owner partnerships remained for which five minute sessions of both object and non-object play had been successfully recorded.

These 36 sessions were used to compile an ethogram which described all observed behavioural patterns of both the dog and human play partners. This is presented as Appendix 4.

2.4.2 Quantitative descriptions

Preliminary observations during focal sampling revealed substantial differences in the intensity of individual dog-human play sessions. Such variations may prove important when examining the effects of play and it would be useful to be able to quantify them. I propose that play sessions can be described in terms of three variables; Dog involvement, Human involvement, and Interactivity, each subjectively rated on a five point scale. Before adopting these measures for use in subsequent work, I tested their validity. This process involved three stages:

2.4.2.1 Inter-observer comparisons

The first stage was to examine inter-judge reliability at subjectively assessing each variable.

Method

Twelve independent assessors each watched twelve video-taped dog-human play sessions. The assessors were six males and six females. All were educated to at least BSc. degree standard in biology or psychology, were currently involved in scientific research, had owned a dog and considered themselves familiar with dog behaviour. The sessions were a sample of the object-oriented sessions described in Section 2.4.1. Each showed a different dog-human partnership playing for five minutes. The sessions were selected on the basis of those showing the widest range of game types. In addition, two further videos, thought to represent the extremes in terms of Dog involvement and Interactivity, were chosen as practice sessions.

Each assessor watched the practice sessions and then the other twelve play sessions in an order determined by a 12 x 12 Graeco Latin Square design (Cochran and Cox 1957). They were instructed to watch each video to completion, gaining an overall impression of the session, then to rate it for each of the variables; Dog involvement, Human involvement and Interactivity. To achieve a common standard of interpretation, the terms were defined:

Dog involvement - how involved or committed the dog was to playing,

Human involvement - how involved or committed the owner was to playing,

Interactivity - the degree of interactivity or reciprocity between the players, *i.e.* how well the partners were responding to one another.

Assessors were instructed to rate each variable on a scale of 1-5 and were encouraged to utilise the complete range of the scale. However, to allow for differences in use of the scale, each assessor's scores were ranked (each variable independently) prior to analysis. The twelve ranked scores for each variable, were then tested for inter-judge concordance using Kendall's test[6].

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6 Kendall's test is a nonparametric test of the hypothesis that several related samples are from the same population and is used to measures the agreement of raters. Each case is a judge or rater and each variable is an item or person being judged, in this case a play session. For each variable, the

Results

Table 2.1 Inter-judge concordance in assessment of subjective variables during object-oriented play sessions

Variable	χ^2	Kendall's W	*d.f.*	*p*
Dog involvement	83.12	0.63	11	<0.0001
Human involvement	71.19	0.54	11	<0.0001
Interactivity	77.75	0.59	11	<0.0001

The coefficients of concordance were highly significant (p<0.0001; Table 2.1) for each of the three variables. I therefore conclude that the inter-judge ranking of Dog involvement, Human involvement and Interactivity are not independent. The twelve observers were applying similar standards whilst scoring the play sessions. It is therefore justified to utilise the mean scores (for each variable) as "standards" or variables in later analysis and to adopt these variables as a reliable method for quantifying play sessions.

2.4.2.2 Correlations between subjective ratings and objective variables

Having established that inter-judge concordance was high, I next investigated the cues from which the assessors were consistently judging these variables. To do this I tested the correlation between the assessors' subjective scores and a range of objectively measured behavioural variables for the same sessions.

Method

This investigation used the same video-taped play sessions as the inter-observer concordance test (2.4.2.1). For each session, twelve behavioural variables were measured. These included variables which owners had reported to be signs of good quality play sessions (2.3.3.4; Figure 2.7) and additional variables which I hypothesised may be important. All objective variables tested are listed in Table 2.2.

---

sum of ranks is computed. Kendall's W is a coefficient of concordance which ranges between 0 (no agreement) and 1 (complete agreement; see Siegel and Castellan 1988).

Table 2.2 Behavioural variables tested for correlation to subjective play indices

Variable	Description	Source
Contact duration	Time for which the partners are in physical contact (s)	✢
Tail wag frequency	Number of tail wags performed by the dog	*
Bow frequency	Number of play bows performed by the dog	✢
Rear frequency	Number of rears performed by the dog	✢
Resting duration	Time for which the dog is inactive (s)	*
Play duration	Time for which the dog is engaged in play behaviour (as defined in 1.1.2.2)	*
Human vocalisation frequency	Number of vocalisations by the human, plus number of hand claps	✢
Dog vocalisation frequency	Number of vocalisations by the dog	✢
Time facing	Time dog spends orientated towards person (s)	✢
Dog possession frequency	Number of times dog possesses object	✢
Human possession frequency	Number of times human possesses object	✢
Shared possession frequency	Number of times both partners possess object simultaneously	✢

** listed as a sign of a good session by owners (2.3.3.4); ✢ hypothesised by myself; s- seconds*

All variables were calculated per minute over the five minute session. In addition a further variable "index of possession imbalance" was calculated. This was calculated using the equation:

(object possession duration of partner 1) / (object possession duration of partner 2)

where partner 1 is designated as the partner with the longest possession duration. Thus, the higher the score for this variable, the bigger the difference in possession duration between the two players.

The mean assessment rating (for the twelve judges) for each subjective variable, was tested for correlation to each of the behavioural variables using Spearman Rank Correlation tests.

Results

Mean assessment ratings showed significant correlations ($p<0.05$) to a number of behavioural variables (Table 2.3).

Table 2.3 Significant correlations between the mean scores for subjective variables and measured behavioural variables during object-oriented play sessions

Subjective variable	Behavioural variable	Spearman's *Rho*	*d.f.*	*p*
Dog involvement	Play duration	0.65	11	0.02
Human involvement	Contact duration	0.81	11	0.001
	Index of possession imbalance	-0.71	11	0.01
	Time facing	0.73	11	0.009
Interactivity	Shared possession frequency	0.77	11	0.003
	Human vocalisation frequency	0.65	11	0.002

Discussion

The twelve observers were consistent when rating the three subjective play variables and their mean ratings for each variable were significantly correlated to some of the behavioural variables. This suggests that observers were using objective criteria to derive their subjective scores. It is possible that the criteria used by the observers were not those measured in this experiment, but that both the observers' ratings and the measured objective variables were correlated to further variables not measured here. If this is the case, however, it does not affect how useful the subjective variables are. This is because:

a) scores for the subjective variables were consistent across observers,

b) subjective scores had an objective basis, and

c) subjective scoring is much quicker than quantification of behaviour and can take place in real time without the need for filming.

Therefore, I conclude that use of the subjective variables in subsequent studies is legitimate.

2.4.2.3 My own score comparison

The majority of subsequent experiments are subjectively rated by myself. It was therefore important that my scoring of these variables was consistent with those of other judges, and so I tested this.

Method

I rated each of the play sessions in the same way as the other judges (see 2.4.2.1). I did this prior to analysis of any of the data and before I measured the objective variables. A Spearman Rank Correlation test was performed between the mean inter-judge scores for each play session and my own independent rating. This was repeated for each of the three variables.

Results

Table 2.4 *Correlations between my own and mean inter-judge scores for subjective variables during object oriented play sessions*

Variable	Spearman's *Rho*	*d.f.*	*p*
Dog involvement	0.81	11	0.001
Human involvement	0.90	11	<0.0001
Interactivity	0.74	11	0.006

My own ratings were significantly correlated *(Rho*>0.7[7]) to the mean scores of the other judges, for each of the three variables. I therefore conclude that I was applying essentially the same standards in scoring as were the other judges and on this basis I decided to use this subjective rating technique in subsequent work.

[7] *Rho*>0.7 is a suitable acceptance level as it signifies that 50% of the variance in one set of scores (*i.e.* my ratings) is accounted for statistically by the other set of scores. (*i.e* the mean inter-judge score; Martin and Bateson 1993)

2.5 Concluding comments

In this chapter I have examined naturally occurring dog-human play. I have developed a number of hypotheses and descriptive techniques. I now utilise these further within the experimental setting.

Chapter 3

A comparison of dog-dog and dog-human play behaviour[1]





"There is no doubt that the dog considers its human master as a socially superior member of its own species"

(Hediger 1965, p.295)

1

The contents of this chapter have been accepted for publication as: Rooney, N.J,. Bradshaw, J.W.S and Robinson, I.H. A comparison of dog-dog and dog-human play behaviour. *Applied Animal Behaviour Science.*

3.1 Introduction

In the popular literature, it is often assumed that a single conceptual framework can be applied to both dog-dog and dog-human interactions; dogs behave towards humans as though they were conspecifics which have been incorporated within their hierarchy (see 1.2.2). Such generalisation is widespread when referring to play, and dog-human play is commonly believed to be homogeneous with dog-dog play. Assumptions of homogeneity take two forms.

3.1.1 Assumption 1: Dog-human and dog-dog play are motivationally homogeneous

Firstly, it is claimed that dog-human play can serve as compensation for a deficiency in dog-dog play. Authors state that "when no other dog is available then the owner can fill the need of being a playmate" (Whitney 1989, p.98), "if deprived of the opportunity to play with other dogs, they have no other choice but to direct play behaviour towards humans" (Askew 1996, p.171) and "a dog that lives with another dog will usually play more games with that dog than with its owner" (Rogerson 1992, p.55). These authors suggest that opportunities for intraspecific play reduce the performance of interspecific play, thereby implying the two are motivationally homogeneous, but I know of no data to support this claim.

My questionnaire survey revealed a positive correlation between the frequency of dog-owner play and the likelihood that a dog would play with other dogs (see 2.3.3.7) . This contradicts the idea of a trade-off between the two play types. Empirical study is evidently required.

3.1.2 Assumption 2: Dog-human and dog-dog play are structurally homogeneous

Secondly, there are assertions about the structure of play. Aldis (1975) states that dog-human play is composed of the same behavioural patterns as dog-dog play. Mitchell and Thompson (1991a) compared their own observations of dog-human play to others' (*e.g.* Aldis 1975) of dog-dog play. They noted the performance of only two additional "projects"[1] by dogs when playing with humans (one of which was in response to a person pretending to throw a ball, which a dog would not be capable of doing). On this basis they describe the two play types as similar. However, the observation that similar actions occur when dogs play with other dogs and with humans is not evidence that the structure is the same, since identical actions can be combined in different ways to fulfil different functions. There exists no quantitative data comparing the structure of dog-dog and dog-human play.

3.1.3 Objectives

In this chapter I challenge these unsubstantiated assertions. I test the null hypothesis that dog-human and dog-dog play are homogeneous categories. To do so I examine both quantity and quality of play.

I present two investigations which test the claim that dogs living with other dogs play less frequently with their owner than dogs that live alone. The first investigation (3.2) involved focal sampling in dog walking areas and compared the incidence of play in one and multi-dog partnerships. In the second (3.3), I incorporated questions within a national survey of dog owners, and examined reported dog-human play frequencies for single and multiple-housed dogs. The initial hypothesis predicts a higher incidence of interspecific play in single-housed dogs.

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1 "Projects" are defined as "sequences of actions that are repeated in order to calibrate an organism's control over these actions or the actions of the play partner" (Mitchell and Thompson 1991a, p.189)

I then tested the null hypothesis that the structure of dog-dog and dog-human play are the same, even when the actions compared are restricted to those occurring in intraspecific play. In an experimental study of twelve Labrador Retrievers (3.4), I compared both the composition and the competitiveness of intra- and interspecific object-oriented play.

All investigations within this chapter (along with those in Chapter 4) are aimed at exploring General Hypothesis 1, that:

"dog-human object-oriented play is a distinct category of play".

3.2 Focal sampling

3.2.1 Introduction

This study tests the hypothesis that dog-dog and dog-human play are motivationally homogeneous. If this is true, I predict that dogs which are housed in pairs are less likely to play with their owners than dogs housed singly. This prediction was tested via focal sampling of owners walking their dogs.

3.2.2 Methods

3.2.2.1 Procedure

During the period October 1995 - January 1996, 25 visits were made to five popular dog walking locations in the south of England: Southampton Common (OS grid reference- SU415145), Mayflower Park, Southampton (SU416112); Grandpont Nature Reserve, Oxford (SP527042); Shotover Park, Oxford (SP569061); University Parks, Oxford (SP514074). A total of 16 hours of observations was made. Repeat visits to the same site occurred at different times of day to minimise multiple recordings of the same subjects. During observations, the experimenter (myself; female, aged 23 years) was accompanied by a dog and attempted to remain unnoticed.

3.2.2.2 Data recording

I recorded each person visibly walking a dog, who remained in view for 30 seconds or more. Groups of dog walkers were only included if walker-dog partnerships could easily be identified. I assumed that dogs being walked alone were also housed alone, and multiple dogs being walked by one person belonged to the same household. For each partnership I recorded:

a) number of dogs being walked, classified as one or multiple,

b) sex of person,

c) size of dog, on a 3-point scale: small (*e.g.* toy poodle, King Charles Spaniel, medium (*e.g.* Border Collie, Cocker Spaniel) or large (*e.g.* Labrador Retriever, German Shepherd Dog),

d) whether they played together whilst in view.

I was particularly interested in the effect of the number of dogs upon the incidence of dog-owner play, but the other independent variables were recorded to allow examination of possible interactive effects.

3.2.2.3 Statistical analysis

Log-linear analysis[2] was used to compare the characteristics of those partnerships which played to those which did not. Using partnerships as the observational unit meant that only one dog within each partnership was represented, thus maintaining independence of the data. The independent variables tested were: number of dogs, sex of walker, size of dog and play presence (present or absent). Backwards selections were carried out, once using all the two-way interaction terms, and once using all the three-way interactions. The final models were examined and any significant effects ($p<0.05$), which included the term "play presence" were examined further via contingency tests (refer to 2.3.3.3 for description of technique).

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2 Log-linear models are used to analyse contingency tables with three or more dimensions. The dependent variable is the number of cases (frequency) in a cell of the crosstabulation, and the explanatory variables are factors and covariates. The procedure can be used to test null hypotheses that there are no interactions between variables upon the observed frequencies, or hypotheses of partial and conditional independence.

3.2.3 Results

A total of 402 dog-owner partnerships were recorded of which 311 comprised single dogs (owners: 165 female, 146 male) and 91 multiple dogs (owners: 58 female, 33 male). Play was observed in 51 of the partnerships; 17.8% of one-dog partnerships and 17.6% of multiple-dog partnerships. Log-linear analysis using two-way interactions produced a final model with two significant effects. The only variable which interacted with play presence was size of dog (χ^2=8.9, *d.f.*=2, p=0.01). Subsequent contingency tests showed that medium-sized dogs were more likely to play than were large or small dogs (χ^2=10.6, *d.f.*=2, p<0.005; Table 3.1).

Table 3.1 *Percentage of owners of different sized dogs observed to play during focal sampling*

Size of dog	N	Percentage observed to play
Small	105	6.7
Medium	191	18.3
Large	106	8.6

The model, using three-way interactions, showed a significant interaction between dog size, dog number and play presence (χ^2=8.7, *d.f.*=2, p=0.01). Contingency tests showed that dog number only had a significant effect in the case of small dogs, with multiple-dog partnerships being more likely to play than single-dog partnerships (16% vs. 3%; χ^2=4.4, *d.f.*=1, p<0.05; Table 3.2).

Table 3.2 *Small dogs - percentage of single and multiple dog owners observed to play with their dogs during focal sampling*

Number of dogs	N	Percentage observed to play
One	74	2.7
Multiple	31	16.1

3.2.4 Discussion

3.2.4.1 Evidence against motivational homogeneity

The results do not support the hypothesis that dogs in multi-dog households are less likely to play with their owner than dogs that live in single-dog households. During dog walks, number of dogs did not significantly affect the overall incidence of play, whilst the size of the dog did. For small dogs, a dog within a multi-dog partnership was more likely to play with their owner than was a single-dog, further contradicting the initial hypothesis.

3.2.4.2 The role of the owner

In this study I have compared the presence of play between samples. However, play occurrence is not determined exclusively by the dog. Owners also assume a role, and it may be argued that multiple-dog owners are keener dog enthusiasts and therefore more likely to instigate play. But the dog must be receptive for play to take place and these observations suggest that there is no reduction in the willingness to play shown by multiple-housed as compared to singly-housed dogs.

3.2.4.3 The effect of dog size

I found that medium-sized dogs were more likely to play with their owners than were large or small dogs. A similar trend was observed by Messent (1983; see 2.2.1) when following London dog owners walking their dogs. This size effect could be a result of breed characteristics - medium-sized breeds have been selected for specific purposes and may be innately more playful. However, many particularly playful breeds (*e.g.* Labrador Retriever; Bradshaw *et al.* 1996) are large and so this explanation is unconvincing. I suggest that the difference is due to ownership style. Owners who acquire a medium-sized dog may do so for different reasons than do those owners acquiring large and small dogs. The observed difference in play incidence may thus be a result of owners' attitudes and not characteristics of their dogs.

3.2.4.4 Concluding comments

These results suggest that the initial hypothesis is incorrect. Dogs which are multiple-housed are no less likely to play with their owner than are singly housed dogs. Focal sampling had the advantage that it allowed non-intrusive examination of the incidence of play without reliance on owners' subjective reports, but it only examined play in one context; a walk. I have previously shown that dog-owner play is context specific (2.3.3.3). I therefore carried out a further study to confirm the current findings. It used different methodology (surveying owners), looked at frequency of play (instead of point sampling occurrence) and involved a very large sample size.

3.3 Dog owner survey

3.3.1 Introduction

The results of focal sampling do not support the hypothesis that dog-dog and dog-human play are motivationally homogeneous. This survey of dog-owners was carried out to explore the hypothesis further.

3.3.2 Methods

3.3.2.1 Procedure

I designed questions which were incorporated within an interview-based door-to-door survey of dog owners conducted by Pedigree Masterfoods (Melton Mowbray, UK). The survey was of 2585 dog-owners, distributed throughout mainland UK. Two thousand and seven owned one dog and 578 owned more than one dog. An owner was defined as "a person who lived in a household with a dog and regularly purchased the dog food". Respondents were almost exclusively female. This produced a biased sample, but in the previous study (3.2) the effect of sex of owner on play occurrence was not significant and so is probably not a great limitation. Each respondent was asked a range of questions about ownership style and pet food choice, but data were also collected on the number of dogs owned, their ages and sizes. One of the questions had six components which related to play behaviour. Respondents owning multiple dogs were instructed to answer with reference to the one they had owned for longest (the focal dog). Each owner was asked to rate the approximate frequency with which they played each of six sorts of games with their dog. The six types were those which the questionnaire (2.3.3.1) had identified as the most common: Fetch, Tug-of-war, Chase, Hide-and-seek and Rough-and-tumble, and an

additional category of "other games". For each game, the owner rated the frequency of playing as: 0- never; 1-occasionally; 2-approximately weekly; 3-several times a week; 4-approximately daily; or 5-several times a day.

3.3.2.2 Play indices

Two indices of play frequency were compiled. Play index 1 represented the maximum score (1-5) which the respondent gave for any of the six game types. Play index 2 was calculated by adding the scores for each game type, giving a total which ranged from 0 to 30. The two indices are not independent, but both were retained as index 1 has the advantage of simplicity, whilst index 2 is a more accurate measure of overall frequency and diversity of play.

3.3.2.3 Statistical analysis

I performed two-way Analysis of Variance[3] (ANOVA) to examine the effect of independent variables upon the dependent variable play frequency (as measured using each of the play indices). The model included the independent variables dog number (one or multiple), and size of dog - small, medium or large (as this was seen, in Study 3.2, to affect play incidence). The multiple-dog owners answered the play questions with reference to their longest owned dog which led to a difference in age distribution; singly-housed dogs were significantly younger than multiple housed dogs in multiple dogs (7.94±0.07 vs. 9.20±0.11; Contingency test; χ^2=84.9, *d.f.*=11, p<0.001). Dog age was therefore included as a covariate within the model. ANOVA was performed twice, once using each of the play indices.

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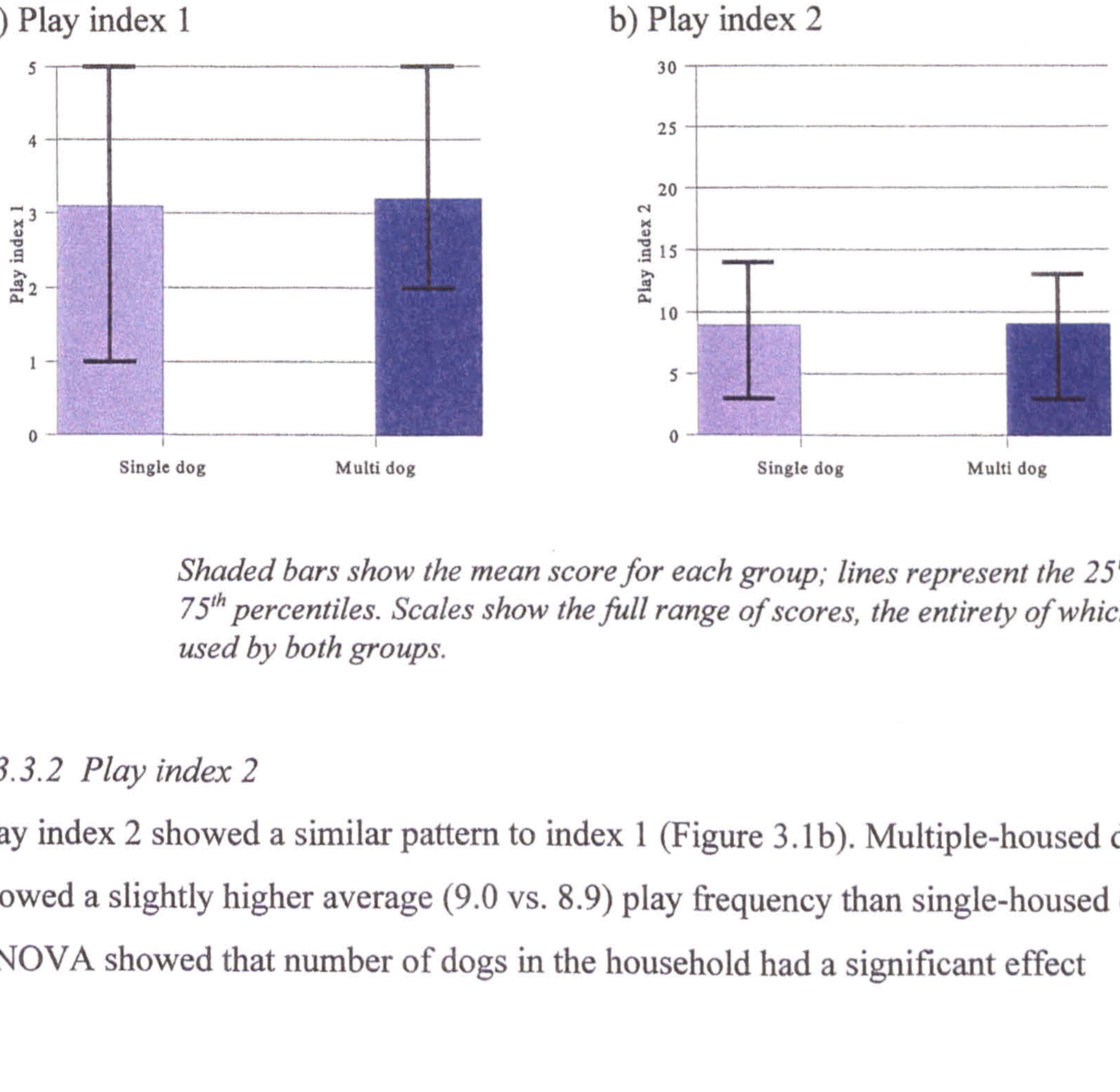
[3] Analysis of variance (ANOVA) is a procedure used to examine the effect of independent variables (in the case of two-way ANOVA two independent variables) upon a single dependent variable. The independent variables divide the population into groups. ANOVA tests null hypotheses about the main effects of independent variables. It can also be used to investigate interactions between the independent variables.

3.3.3 Results

3.3.3.1 Play index 1

ANOVA showed that the number of dogs in the household significantly affected the frequency of dog-owner play ($F_{(1,2545)}$=43.6, p<0.001). Mean frequencies were very similar for both dog number groups but slightly higher frequencies were reported by the owners of multiple dogs than single dogs (3.2 vs. 3.1; Figure 3.1a). The covariate dog age exerted a highly significant effect upon the incidence of play ($F_{(1,2545)}$=639.4, p<0.001), with frequency of play decreasing with age of dog. Neither the main effect of dog size ($F_{(2,2545)}$=5.1, p=0.43), nor the interaction of dog size and number of dogs ($F_{(2,2545)}$=5.4, p=0.42), had a significant effect.

Figure 3.1 Play frequencies of dogs in single (N=2007) and multi-dog (N=578) households



Shaded bars show the mean score for each group; lines represent the 25th and 75th percentiles. Scales show the full range of scores, the entirety of which was used by both groups.

3.3.3.2 Play index 2

Play index 2 showed a similar pattern to index 1 (Figure 3.1b). Multiple-housed dogs showed a slightly higher average (9.0 vs. 8.9) play frequency than single-housed dogs. ANOVA showed that number of dogs in the household had a significant effect

($F_{(1,2545)}$=5.6, p=0.02), but the magnitude of the effect was much less than that of age ($F_{(1,2545)}$=257, p<0.001). As with index 1, size of dog exerted no significant main effect ($F_{(2,2545)}$=0.39, p=0.68), and no interactive effect with number of dogs ($F_{(2,2545)}$=1.8, p=0.16).

3.3.4 Discussion

3.3.4.1 Effect of dog number on play frequency

These results confirm the findings of Study 3.2. Dogs that live in single-dog households do not exhibit more play with their owners than dogs that live with other dogs. In fact, these results show the frequency of play between a dog and owner is slightly higher in multiple-dog than in single-dog households. However, examination of the F ratios reveals that the effect of dog number, although significant (due to the very large sample size), is much smaller than the effect of dog age. It is not surprising that age plays a major role in determining the frequency of dog-human play - this is also the case in intraspecific play of many species (Byers 1998).

3.3.4.2 Comparing the findings of the survey with the focal sampling results

The results of the survey (3.3) are not identical to those of focal sampling (3.2). During focal sampling there was no significant difference in play incidence between one and multiple-dog partnerships. Conversely, the survey showed dogs in multi-dog households played slightly more often than those in single-dog households. This difference is possibly a consequence of the difference in sample size, which is considerably larger in Study 3.3, giving greater statistical power. Also, in Study 3.2, I observed an interaction between dog size and number not seen in Study 3.3 which may be a result of sampling technique, as play behaviour on walks differs from that in the home (2.3.3.3). However, both studies show that single dogs play with their owners no more often than multiple-housed dogs, under normal domestic conditions.

3.3.4.3 Comparison with other species

This result is in contrast to observations of domestic cats, *Felis silvestris catus* (Mertens 1991; Bradshaw and Smart 1993). Singly-housed cats played with their owners more often than pair-housed cats. This may reflect a species-specific difference, or may be due to ownership style; cat and dog owners choosing whether to obtain one or several pets may base their decisions on different reasons.

3.3.4.4 Concluding comments

For the dog, it appears that opportunities to engage in intraspecific play afforded by living with other dogs do not satiate the motivation to engage in interspecific play. To explore this concept further, experimental studies are necessary, manipulating intraspecific play levels and examining the effects on interspecific play. Manipulation of play opportunities without changing general social contact levels is problematic (see 1.1.4.2) and raises welfare considerations. To further investigate the inter-/ intraspecific distinction I therefore examined the composition of play.

3.4 Comparison of the structure of dog-dog and dog-human play

3.4.1 Introduction

Focal sampling and a survey of dog owners suggest that dog-dog and dog-human play are not motivationally homogeneous. I now present an experiment designed to test whether they are structurally homogeneous.

3.4.2 Methods

3.4.2.1 Subjects

The subjects were twelve adult Labrador Retrievers. There were three males and nine females, ranging in age from 6.5 to 62.5 months (mean=23.5 months). They were housed singly or in pairs at the Waltham Centre for Pet Nutrition, UK and used primarily for nutrition trials (1.5.2.2; for further details of housing and husbandry see Appendix 1). All received daily contact with other dogs and people.

3.4.2.2 Design

The experiment followed a within-subjects, repeated measures design.

3.4.2.3 Procedure

Each subject was trialled four times on four different days (within a period of one week). Play behaviour varies with time of day (Pellis 1991) so each subject was trialled at the same time, in each condition. Sessions were in a large grass paddock (approximately 120m^2), familiar to all the dogs. They were filmed from an adjacent paddock using a hand-held video camera (Philips Explorer VKR6850). Each session followed the same format. The dog was released in the paddock with its play partner (dog or human dependent upon condition) and allowed to acclimatise for two minutes. A "Ragger" toy

(Petlove Ltd: a 30 cm long piece of rope knotted at each end which can simultaneously be held by two animals) was then thrown into the paddock by the camera operator. The partners played freely for three minutes. This constituted Phase 1. A second Ragger was then thrown into the paddock and Phase 2 began. This phase was designed specifically to examine the level of competition. It continued for a maximum of three minutes, but was terminated if the focal dog lost interest in the object, or possessed it for an uninterrupted period of 30 seconds.

In the first two sessions the play partner was a dog, in the next two, a person.
Play behaviour is affected by the familiarity of partners (Mitchell and Thompson 1991b; Appendix 5) so for each focal dog, human and dog partners were selected which showed a similar degree of familiarity. The dog partner was either the dog routinely housed with the focal dog, or a regular companion during communal exercise periods, and was matched in age and sex as these factors are known to increase play (Biben 1998; Thompson 1998). Where practical, a different partner was used for each of the two dog-dog sessions, but in eight cases this was not possible due to logistic problems such as one of the dogs being in oestrus or lack of familiarity. Restricted dog numbers meant that play partners were also experimental subjects. The human partner was a member of the dog-care staff, who had regular contact with the dog (at least twice a week). Staff were familiar with different dogs, so three people (1 male, 2 females) were used and all were unaware of the hypotheses of the experiment.

To compare behaviours in specific situations it was necessary to present subjects with similar stimuli during interspecific and intraspecific sessions. Preliminary observations of intraspecific play were carried out and a set of guidelines for the human players compiled. They were each briefed prior to each session and were encouraged to:

a) produce no motor actions that a dog was not capable of *e.g.* throw the toy or raise it above the dog's head,
b) keep the focal dog playing,
c) include all possible permutations of an object competition game.

3.4.2.4 Behavioural measures

To minimise subjectivity, no attempt was made to distinguish exploration from play. Play was defined structurally, as any object-oriented activity comprising of the eleven activities listed in Table 3.3. Videoed sessions were analysed using the Observer data recording package (Noldus Information Technology b.v.). Each dog took part in two intraspecific sessions, but to maintain independence they were the focal animal in one and served as the play partner in the other. Phases 1 and 2 were examined separately. Ten of the sessions were randomly selected. These were observed twice and intra-observer reliability concordance calculated using the Observer package. Concordance between equivalent five-second sample intervals was 84% during Phase 1 and 76% during Phase 2.

Table 3.3 Definitions of object-oriented play activities

Play activity	Description
Chase object	dog moves in same direction as a moving object, which is usually held by play partner
Watch object	dog orientates towards and pays close attention to object, tracking object's movement with its eyes
Tug object	dog pulls longitudinally on object which is simultaneously held by partner
Shake object	dog moves head from side to side whilst holding object which is usually simultaneously held by partner
Chew object	dog places object in its mouth repeatedly opening and closing its jaws around it
Hold object	dog maintains possession of object
Run chased	dog moves away from partner whilst holding object and being pursued by partner
Run ignored	dog moves away from partner whilst holding object and not being pursued by partner
Show object	dog approaches partner carrying object and then withdraws, maintaining possession
Mutual run	dog moves in same direction as partner whilst both simultaneously hold the object (no tugging is apparent)
Run tugging	dog runs in same direction as partner whilst simultaneously holding the object, and competing to gain sole possession

During Phase 1, I examined general play structure. All variables were measured over the three minute period. I measured the duration of each play activity (Table 3.3) and seven other variables as defined in Table 3.4.

Table 3.4 Behavioural variables measured during Phase 1 (one object)

Variable name	Description
Interest duration	Total time for which dog shows interest in the object; comprising the 11 object-oriented activities (Table 3.3)
Competition frequency	number of times dog holds object simultaneously with partner whilst attempting to gain sole possession, via tug or shake
Show object frequency	number of times dog approaches partner carrying object and then withdraws still holding toy
Presentation frequency	number of times dog approaches partner while holding object and surrenders it without contest
Win frequency	number of competitions in which dog maintains possession of object
Proportion give-up	proportion of competitions in which dog appears to surrender possession of object
Proportion time shake	proportion of time spent in competition (as defined in competition frequency variable) during which dog moves head from side to side whilst holding object between teeth

The length of Phase 2 was variable, therefore variables were expressed as rates per minute, calculated over the interest duration (as defined in Table 3.4). There were six general variables measured during the whole phase (Table 3.5). In Phase 2 the focal dog now had the option to either possess its own object or to compete for its partner's. So, to assess the motivation to do each, whilst allowing for differences in the partner's behaviour, additional measurements were taken whenever two situations occurred - when the focal dog competed for an object, and when it possessed an object. The variables measured are listed in Table 3.6.

Table 3.5 Behavioural variables measured throughout whole of Phase 2

Variable	Description
Interest duration	as defined in Table 3.4
Competition frequency	as defined in Table 3.4
Proportion win	proportion of total competitions following which focal dog maintains possession of the object
Duration both object interest	time focal dog shows interest in both objects
Duration same object interest	time focal dog shows interest in same object as its partner

Table 3.6 Specific behavioural variables measured during Phase 2
a) whenever focal dog competed for same object as their play partner,
b) whenever focal dog possessed object

Variable	Description
a) Competing for object	
Mean win time	Mean duration of competitions following which focal dog maintains possession of object
Mean lose time	Mean duration of competitions following which focal dog loses possession of object
Maximum competition	Maximum duration of a single competition for an object
Proportion interest loss	Proportion of competitions ended by focal dog losing interest in object
Proportion deflection	Proportion of competitions ended by focal dog deviating to other object
b) Possessing object	
Mean competition start latency	Mean time before focal dog approaches partner and initiates a competition
Mean interest loss latency	Mean time before focal dog loses interest in both objects
Proportion interest loss	Proportion of possessions ended by focal dog losing interest in both objects
Proportion competition start	Proportion of possessions ended by focal dog approaching partner and initiating competition
Maximum possession	Maximum duration of a bout of sole possession

3.4.2.5 Statistical analysis

All variables showed dependence between means and variances, and were therefore transformed. Duration, frequency and latency variables were transformed using log(x+1) and proportional variables via arcsin($\sqrt{x}$). I explored the effect of partner type (condition) on the composition of interested time to see whether the eleven object-oriented activities were differentially affected. I used a Repeated Measures Multi-factor ANOVA[4] (SPSS-PC v7.0 - also used for all subsequent analysis) and examined the interaction between condition and activity. A significant interaction would suggest that the activities were affected differently. All remaining variables were analysed using Repeated Measures two-way ANOVAs. For each factor, *F*-ratios were calculated using the corresponding between-subjects mean square as the error term.

3.4.3 Results

3.4.3.1 Phase 1

Partner type had different effects upon the eleven play activities ($F_{(10,110)}$=2.8, p<0.001). Five of the activities differed significantly between the human and dog conditions (Table 3.7). The focal dog spent significantly more time performing chase object, watch object, tug object, run chased and show object when playing with a person than another dog. The other six play activities did not differ significantly.

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4 For description of ANOVA refer to page 3.10. Multi-factor ANOVAs are used to examine the effect of more than two independent variables upon a single dependent variable. Repeated Measures provides analysis of variance when the same measurement is made several times on each subject (see Dytham 1999).

Table 3.7 Play activities significantly affected by partner type during Phase 1

Play activity	Mean (± S.E.) duration with human partner (s)	Mean (± S.E.) duration with dog partner (s)	$F_{(1,11)}$	p
Chase object	18.7 ± 3.8	5.7 ± 3.3	11.2	<0.01
Watch object	6.1 ± 2.3	3.3 ± 1.4	6.8	<0.05
Tug object	72.6 ± 7.5	34.1 ± 11.3	8.8	<0.05
Run chased	15.1 ± 2.6	4.8 ± 1.5	18.8	<0.01
Show object	12.1 ± 2.4	6.7 ± 1.6	17.6	<0.01

The total interest duration ($F_{(1,11)}$=2.4, p<0.1) was not significantly affected by partner type, but several of the other behavioural variables were (Table 3.8). Dogs displayed higher competition, show object and presentation frequencies and higher give-up proportions when playing with a person than when playing with another dog. However, the proportion of competition time spent shaking the toy was higher when the play partner was a dog (significant only at p<0.1).

Table 3.8 Behavioural variables significantly affected by partner type (p<0.1) during Phase 1

Behavioural variable	Mean (± S.E.) human partner	Mean (± S.E.) dog partner	$F_{(1,11)}$	p
Competition frequency	3.40 ± 0.28	1.39 ± 0.39	16.5	<0.005
Show object frequency	1.65 ± 0.27	0.44 ± 0.19	20.3	<0.005
Presentation frequency	0.79 ± 0.17	0.04 ± 0.03	19.1	<0.005
Proportion give-up	0.28 ± 0.10	0.0 ± 0.0	6.5	<0.05
Proportion time shake	0.01 ± 0.01	0.13 ± 0.07	3.3	<0.1

All frequencies are expressed as rates per minute

3.4.3.2 Phase 2

During Phase 2, three of the variables were significantly affected by partner type (Table 3.9). When playing with a person, dogs exhibited higher competition frequencies and longer durations of both object interest. The maximum single object possession duration was longer during intraspecific trials than during dog-human trials.

Table 3.9 Behavioural variables significantly affected by play partner type ($p<0.1$) during Phase 2

Behavioural variable	Mean (± S.E.) human partner	Mean (± S.E.) dog partner	*F*	*d.f.*	*p*
Competition frequency	4.32 ± 1.24	1.39 ± 0.17	11.2	1,10	<0.01
Duration both object interest (s)	15.30 ± 3.06	5.37 ± 3.61	6.4	1,11	<0.05
Mean competition start latency (s)	7.50 ± 0.77	30.91 ± 8.52	5.3	1,7	<0.1
Proportion competition start	0.62 ± 0.08	0.40 ± 0.13	4.7	1,10	<0.1
Maximum possession (s)	21.01 ±0.03	0.40 ± 0.06	5.5	1,10	<0.05

Abbreviations: d.f.-degrees of freedom; these are variable due to the absence of some behavioural patterns in some subjects. Frequency and duration variables are expressed per minute, calculated over the interest duration.

3.4.4 Discussion

3.4.4.1 Are dog-dog and dog-human play structurally homogeneous?

I have shown that although the total interest in the object did not vary when the focal dog played with a person or another dog, other aspects of their behaviour did. I therefore reject the null hypothesis and conclude that intra - and interspecific play are not homogeneous in structure.

The composition of play was different. During dog-human play activities such as show object, tug, chase and run chased figured more prominently. These are all interactive activities whilst more solitary activities such as chew and hold object, were not significantly affected by partner type.

3.4.4.2 Intraspecific play is more competitive

During Phase 1, dogs engaged in more competitions when playing with a human. They more frequently showed and presented the toy to a person than to a dog. These differences suggest that the dogs were keener to instigate play with a person. During interspecific play, a larger proportion of competitions were ended by the dog giving up, but during dog-dog play, more of the competition time was spent shaking the object (significant only at $p<0.1$). Lateral shaking is generally thought to indicate more vigorous competition than tugging (Rogerson pers. comm.) and so these two differences suggest that winning possession of the object was more important during intraspecific play.

In Phase 2, I observed more competitions and longer durations of interest in both objects during interspecific play. However, maximum possession durations were longer during dog-dog play. When playing with a person, a dog was more likely and quicker (although significant only at $p<0.1$) to leave the object it possessed and start competing with its partner. I suggest these findings indicate that, during intraspecific play, dogs are more strongly motivated to possess the object and are thus more competitive. Contrastingly, during interspecific play, interactions with the person are of greater importance.

3.4.4.3 The link between hunting behaviour and object play

These differences can be interpreted by considering hunting behaviour. Biben (1982) performed a cross-species comparison of the hunting behaviour and object play of carnivores. She found that the more cooperative the hunting behaviour of a species, the more sharing and less competition that occurred during their object play. For example there is much sharing during the play of the group-hunting bush dogs, *Speothos venaticus*, whilst solitary crab-eating foxes, *Cerdocyon thous* compete for and defend objects. Domestic dogs often defend food items from conspecifics (Scott and Fuller 1965), feral dogs seldom hunt cooperatively (Nesbitt 1975; Boitani *et al.* 1995; Macdonald and Carr 1995) and dingos (*Canis familiaris dingo*) mainly hunt alone (Corbett and Newsome 1975). According to Biben's (1982) ideas I would expect

intraspecific dog play to be competitive, with little sharing of play items. This appears to be the case in the present study.

Dogs hunt interspecifically with humans. For hundreds of years domestic dogs (especially retrieving breeds) have been selected to hunt with humans. They share and even surrender their prey to people. If hunting behaviour and play are under similar motivation, as Biben (1982), and Hall and Bradshaw (1998) suggest for other species, I would expect dog-human play to involve more sharing and to be less competitive than dog-dog play. My results support these predictions.

3.4.4.4 Limitations of this study

The subjects all belong to a single population of Labrador Retrievers and I can not assume that these findings will be universal, since breeds of dog vary widely in their behaviour (Hart and Hart 1985; Bradshaw *et al.* 1996). Labradors have been selected for their ability to retrieve and it would be interesting to compare play behaviour in breeds which have been selected for different purposes. Subjects were observed playing with familiar dogs and people, with which they had stable relationships. Repetition using unfamiliar or young animals may give different results.

3.5 General discussion

3.5.1 Are dog-dog and dog-human play homogeneous?

I have shown that having many opportunities to engage in intraspecific play does not reduce the performance of interspecific play by dogs, as has previously been claimed (Whitney 1989; Rogerson 1992; Askew 1996). This suggests that, under normal conditions, the motivation to play with humans is not satisfied by dog-dog play. I have also shown that the structure of dog-human object-oriented play is different to its dog-dog counterpart; specifically the relative motivations to possess an object and to interact with the partner differ. I suggest that, taken together, these findings indicate that the two categories are not homogeneous.

3.5.2 Implications of these results for the dog-human relationship

There are several possible implications of this dichotomy. Dog-human games are frequently claimed to have effects upon the relationship between the players (1.3). Consistently allowing a dog to win games is alleged to result in the dog perceiving itself as stronger than its owner, leading to subsequent conflict and behavioural problems (McBride 1995). This idea is based on extrapolation of intraspecific behaviours, particularly those of the wolf. Winning possession of toys is described as simulating the winning of the battle for the best meat at the end of a pack hunt (Appleby 1997, p.182), which can have consequences for the social hierarchy. This idea assumes that play is a contest and the goal is to possess the toy. Although this was the case during dog-dog play, I saw no evidence for it during dog-human play. Since dogs react differently to human and dog play partners, I see no reason to assume that the consequences of dog-human games are the same as dog-dog games. Decreased competitiveness may mean that the outcome of dog-human games is less likely to affect the players' relationship and this is tested in Chapter 5.

3.5.3 Anthropomorphism?

Hediger (1964, p.166) claims that the "humanizing [anthropomorphising] tendency of man corresponds to the animalizing tendency of animals". I have shown that dogs do not "animalize" when playing, but react differently to human and canine partners. Whether other elements of dog social behaviour are homogeneous when interacting with conspecifics and humans remains to be seen. But one wonders whether the notion that animals have an "animalizing tendency" is not itself a result of anthropomorphism. I suggest that in future we should b careful when extrapolating from dog-dog interactions to the dog-human context.

3.5.4 Concluding comments

These findings support General Hypothesis 1. In comparison to its dog-dog counterpart

"dog-human object-oriented play is a distinct category of play".

In the next chapter I continue to research this hypothesis by comparing dog-human object-oriented play to further categories of play.

Chapter 4

Object-oriented play



"It is a pretty sight to see one of them push back a lady's skirt with his paw to find her foot and then pounce upon it eagerly never biting to hurt her "

(Groos 1898, p.134)

4.1 Introduction

Play is typically categorised into three distinct types; locomotor, social and object (Bekoff and Byers 1981; 1.1.2.2). Much of the play between dogs and people cannot be classified according to this system. Most dog-human games are "object-oriented"- although focussing upon an object they are social in context (1.2.1). In my questionnaire survey (2.3) all 110 respondents reported playing object-oriented games with their dogs and 98% of the games observed during focal sampling (3.2) were of this type. Since object-oriented play shows elements of both social and object play, how the dog perceives the person's role is not clear. At the simplest level the human may be animating the toy during object play or, at the most complex, the dog may be engaging in social play, the object serving merely as a common focus. In the previous chapter (3.4), I observed that the relative importance of partner and object differs in dog-human and dog-dog games. In this chapter I concentrate on dog-human object-oriented play and investigate the relative importance of the human and the object to the dog.

4.1.1 Background

Object-oriented play is not specific to the domestic dog (Aldis 1975; Hubrecht 1995), but is reported in a range of other species. Bottle-nosed dolphins, *Tursiops truncatus* have been observed playing communally with a feather (Alpers 1965) and brown bears, *Ursus arctos* socially playing with a fish (Fagen 1996). Object-oriented play has also been reported in oriental small-clawed otters, *Aonyx cinerea* (Pellis 1991), gorillas, *Gorilla gorilla* (Carpenter 1964) and giant pandas, *Ailuropoda melanoleuca* (Wilson and Kleiman 1974), but this play type is not limited to mammals. There are claims that a Nile soft-shelled turtle, *Trionyx triunguis* engaged in tug-of-war with its keeper (Burghardt 1998) and ravens, *Corvus corax* have been seen playing communally with a variety of

objects (Heinrich and Smolker 1998). The highest reported incidence, however, is in canids. Wolves, *Canis lupus* engage in object-oriented play (Mech 1970; Loeven 1996) and Biben (1983) recorded 48% of object play to be social in context in maned wolves, *Chrysocyon brachyurus,* 16% in crab-eating foxes, *Cerdocyon thous*, and 77% in bush dogs, *Speothos venaticus*.

There is no consensus as to how object-oriented play should be categorised. Robinson (1992) with reference to domestic cats, *Felis silvestris catus* defined object play as "play involving an object whether social or solitary", thus making object-oriented games object play. In support of this idea Biben (1982) observed most object-oriented sequences by crab-eating foxes to begin with one partner playing with an object and attracting the other player, but the object remained the focus. Contrastingly, Aldis (1975), when watching dogs, noted that social play often continued once the object was dropped. He concluded that object-oriented play bears only a superficial resemblance to object play, the object having no intrinsic value and the most important interactions being between the players. These differences of opinion may reflect interspecific variation, or may be the result of subjective judgments and a lack of empirical data. Clark *et al.* (1969, p.215) when describing the play behaviour of nursery school children made a valid point by highlighting the difficulty in knowing "if the activity or the sociability are primary".

Object-oriented play shows similarities and differences to both object and social play. I hypothesise that it is homogeneous with neither, but represents a distinct form of play.

4.1.2 Objectives

In this chapter I investigate the General Hypothesis 1:

"dog-human object-oriented play is a distinct category of play".

I use an experimental approach and examine the structure of object-oriented play. A series of four experiments are presented which aim to:

a) determine whether object-oriented play is distinct from social play,

b) determine whether object-oriented play is distinct from object play,

c) explore the role of the person during object-oriented play.

4.1.3 Chapter outline

The chapter is divided into four parts (4.2 - 4.5), each describing a separate experiment. Experiment 4.2 used a mixed-breed sample and examined play in dog-owner partnerships. The remaining experiments (4.3 - 4.5) were carried out at the Waltham Centre for Pet Nutrition and used Labrador Retrievers as subjects.

The first experiment (4.2) compared object-oriented play to social play to ascertain the importance of the object. I hypothesise that object-oriented play is distinct from non-object play, the null hypothesis being that object-oriented play is indistinguishable from social play and the object has no role.

The second experiment (4.3) compared object-oriented play to object play. I hypothesise that the person plays an integral role in object-oriented play and so investigate the null hypothesis that object-oriented play is indistinct from object play, the human having no role.

The third (4.4) and fourth (4.5) experiments build on the results of the first two and explore further the role of the person. The hypotheses they test will be introduced in detail later (4.3). Firstly, I hypothesise that humans can influence dogs' object play via presence, without participating in the game. Experiment 4.4 therefore examines the effect of human presence on object play. Secondly, I hypothesise that play with objects can be shaped by reinforcement. Experiment 4.5 tests this by rewarding subjects for playing with an object and comparing their subsequent play levels to a control group.

4.2 Is object-oriented play distinct from social play?

4.2.1 Introduction

There is one school of thought that object-oriented play should be classified as social play (*e.g.* Smith 1982). I hypothesise that in the case of dog-human play, the differences between social (non-object) and object-oriented play are great enough to warrant their separate classification. I have already shown that object-oriented games are very common both in the home and on walks (91% and 96% of owners respectively; see 2.3.3.1). Non-object games, however, are more frequent in the home than on a walk (80% vs. 45% of owners; χ^2=13.9, *d.f.*=1, p<0.001; see 2.3.3.3). There is a distinction in the context in which object-oriented and non-object play occur, but are there further differences which justify their separate categorisation? To answer this, I performed an experiment which compared the structure of non-object and object-oriented play. I examined the behaviour of human and dog during play sessions that incorporated an object and those which did not.

4.2.2 Method

4.2.2.1 Design

The experiment followed a within-subjects design

4.2.2.2 Subjects

I used the same videoed play sessions as were used to compile the ethogram (2.4.1) and for the inter-observer comparisons (2.4.2). The subjects were 18 dog-owner partnerships. For full details of recruitment of subjects and filming of sessions refer to Chapter 2.

4.2.2.3 Procedure

Each partnership was filmed in two, five minute play sessions - one object-oriented and one non-object (social).

4.2.2.4 Behavioural measures

From the videoed sessions, nine variables describing the behaviour of the dog and person were recorded. These are listed and defined in Table 2.2 in Chapter 2 (variables 10-12 were omitted as they are specific to object-oriented play).

4.2.2.5 Statistical analysis

Wilcoxon Signed-Rank tests[1] were used to compare each variable in the object-oriented and non-object sessions. A significant z value ($p<0.05$) indicated that the variable differed significantly between session types.

4.2.3 Results

Wilcoxon Signed-Rank tests revealed significant differences between object-oriented and non-object sessions in three of the measured variables: duration of contact, time-facing human, and human vocalisation frequency (Table 4.1). All variables were higher in non-object sessions than they were in object-oriented sessions.

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[1] Wilcoxon's Signed-Rank test is a nonparametric procedure which tests if two variables have the same distribution making no assumptions about the shapes of their distributions. It takes into account information about the magnitude of differences within pairs and gives more weight to pairs that show large differences than to pairs that show small differences. The test statistic (z) is based on the ranks of the absolute values of the differences between the two variables (see Fowler *et al.* 1998).

Table 4.1 Variables which differed significantly between non-object and object-oriented play sessions

Variable	Median for non-object sessions	Median for object-oriented sessions	Wilcoxon z value	*n*	*p*
Contact duration (s)	27.6	1.3	-3.72	18	<0.001
Time-facing human (s)	47.5	44.7	-2.37	18	<0.05
Human vocalisation frequency	22.6	15.3	-2.06	17	<0.05

4.2.4 Discussion

4.2.4.1 Evidence against homogeneity

Dog-human object-oriented play does differ structurally from social play. During social play there is more contact between players, dogs face their partner for longer and the human vocalises more frequently. I therefore reject the null hypothesis and conclude that object-oriented dog-human play is not homogeneous with social play.

4.2.4.2 Communication potential

The variables which differ are particularly relevant. They all represent opportunities for communication between players. During social play there is more potential for physical, visual and auditory communication between dog and person. I later examine the learning which occurs (Appendix 5) during play and the effects of games on the dog-human relationship (Chapter 5). It is possible that differences in the potential for communication lead to differences in the amount of learning which takes place. This may in turn produce differential effects of play upon the dog-human relationship. I therefore conclude that non-object and object-oriented play should be regarded as distinct categories of play and, when examining learning (Appendix 5) and effects of play (Chapter 5), I examine each category separately.

4.2.4.3 Important variables

It is interesting to note that the variables which differ between non-object and object-oriented play are those which were found to correlate with assessors' subjective ratings during object-oriented play sessions (Table 2.2 in 2.4.2.2). Contact durations correlated to subjective ratings for Human involvement, whilst values for time-facing human and human vocalisation frequencies correlated with Interactivity scores. These differences suggest that, if the judges had been asked to rate non-object sessions and had remained consistent, they would have rated the non-object sessions higher than the object-oriented sessions for both Human involvement and Interactivity. This could be interpreted in one of two ways: either non-object play results in more Human involvement and Interactivity than does object-oriented play, or the judges when rating the object-oriented play sessions, were applying social play standards. Either way, the two play types differ in ostensibly important ways.

4.3 Is object-oriented play distinct from object play?

4.3.1 Introduction

I have established that dog-human object-oriented play is distinct in structure from social play. I now investigate the possibility that object-oriented play is simply object play performed in a social context. People believe that they are "playing" with their dog, but the dog may be playing with the object (the person's presence being irrelevant). If so, I would expect a dog's play behaviour with an object to be unchanged by the participation of a person; object-oriented play would be indistinguishable from object play. This is the null hypothesis tested here.

This experiment examined dogs' play behaviour with an object in the absence and when held by a person (object-oriented play). I designed a toy which could be played with similarly when held by a person and by a mechanical structure. Dogs were presented with the toy in both conditions and their behaviour compared to assess whether the person's involvement in the game had an effect.

4.3.2 Method

4.3.2.1 Design

The experiment followed a within-subjects design

4.3.2.2 Subjects

The subjects were 14 Labrador Retrievers. There were four males and ten females ranging in age from 9 to 62 months (mean=21 months). They were all housed in pairs at the Waltham Centre for Pet Nutrition (see 1.5.2.2 and Appendix 1). All had daily contact with people and dogs, and had regular access to a variety of toys.

4.3.2.3 Apparatus

Trials were conducted in an approximately square, outdoor concrete exercise area measuring 80m^2. Near the centre of this area there was a metal T shaped frame. The upright bar was 1.7m high and set in concrete. The horizontal bar was free to rotate. An "Exelpet" plastic toy (Pedigree ™) was firmly attached to the end of a 1m length of rope. On the opposite end of the rope there was a metal clip. During object-held trials this clip was attached to the arm of the metal frame (Figure 4.1), whilst in human-held trials it was held by the experimenter (myself; female, aged 23 years; Figure 4.2). In both cases the toy was suspended 50cm above the ground. The subjects had previously encountered the T-bar with a rope attached, but never with a suspended toy.

Figure 4.1 *Apparatus during object-held trials*



Figure 4.2 *Apparatus during human-held trials*



4.3.2.4 Procedure

Each dog was trialled four times, on consecutive days. The order of subjects remained identical to ensure that each dog was tested at the same time of day and that distraction due to olfactory cues remained approximately constant between trials. They were presented with each of the two conditions, object-held and human-held, twice. Half of the dogs received the human-held condition first and half the object-held first. Conditions

were subsequently alternated. All trials were filmed using a video camera (Philips Explorer VKR6850) mounted on a tripod in an adjacent pen.

Each session followed the same protocol. The dog was led from its kennel and placed in the experimental enclosure. The T-frame was present, but without the attached rope. A two minute acclimatisation period followed. The dog was then placed in a holding pen, adjacent to, but out of view of the experimental enclosure whilst the rope (with toy attached) was positioned. In object-held trials the rope was clipped onto the T-frame and pushed to start its rotation. In human-held trials the experimenter held the rope and rotated it in a manner mimicking the movement of the T-frame.

The dog was then released into the experimental enclosure, which contained a rotating toy held by either a T-frame or a person. In the human-held trials, the experimenter did not interact with the dog; they held the rope firmly, maintaining the toy 50cm above the ground whilst not tugging or producing any actions not possible by the T-frame. In object-held trials the experimenter retreated out of the dog's view.

Sessions continued for a minimum of three minutes. After three minutes, if the dog was ignoring the object then filming was terminated. If the dog was attending to the object[2] after three minutes, then filming continued until the completion of the on-going play bout[3]. The dog was then returned to its kennel.

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[2] To avoid subjective decisions regarding motivation, throughout the experiments described in this chapter, no attempt was made to distinguish between exploration and play. Play was defined structurally as "any display of interest in the object consisting of tug, chase, hold/chase, contact or chase" (see Appendix 4 for definitions of behaviours).

[3] A bout was defined as commencing with a first display of interest in the object and terminating at the beginning of a period of more than 10 seconds of non-interest (Biben 1996).

4.3.2.5 Behavioural measures

Videos were analysed using the Observer package (Noldus Information Technology b.v. 1987). Random sessions (N=10) were observed twice and intra-observer reliability concordance calculated using the Observer package. Concordance between equivalent five second sample intervals was 84%. Bout lengths were calculated using the entire session, but the remaining variables were recorded during the first three minutes. The variables measured are shown in Table 4.2.

Table 4.2 Behavioural variables measured during object-oriented play experiments

Variable name	Description
Attention duration	Total time attending to object
Time spent in each play activity	Duration of each activity; tug, hold-chase, watch, contact, chase (as described in ethogram Appendix 4)
Bout frequency	Number of attention bouts commencing in the first three minutes
Mean bout length	Mean length of all bouts in whole session length
Maximum bout length	Maximum length of bout occurring in whole session
Approach latency	Time before first approach (within 1m of object)
Time close	Time spent <1m from object
Approach frequency	Number of approaches to within 1m of object
Chase latency	Time before dog first chases object
Rear frequency	Number of times dog rears up at object in three minutes

All times measured in seconds

4.3.2.6 Statistical analysis

A Wilcoxon Signed-Rank test was used to compare the number of trials in which each dog approached the object in the two conditions.

Two dogs exhibited less than two seconds of interest in the object over all four trials and so were excluded from subsequent analysis. I examined the frequency, latency and duration variables separately. The raw data violated the assumptions of ANOVA, as the

variances were not independent of the means, so it was necessary to transform the data to improve normality. A transformation of the form $Log_{10}(x+1)$ proved most effective at normalising all three categories of variable and so all subsequent analysis followed this transformation.

I tested the effect of condition (human-held or object-held) on the proportion of the attention duration spent in each play activity. I used a Repeated Measures ANOVA (see 3.4.2.5 for description of technique), and examined the interaction between condition and activity type. A significant interaction would suggest that the activities were affected differently by condition. Repeated Measures ANOVAs were then used to identify which activities varied in duration in the two conditions. In all cases *F*-ratios were calculated using the corresponding between-subjects mean square as the error term.

The remaining dependent variables (as listed in Table 4.2) were also tested using Repeated Measures ANOVAs. Main effects of condition were examined and probabilities of ≤0.05 interpreted to mean that the variable differed significantly between the human-held and object-held conditions.

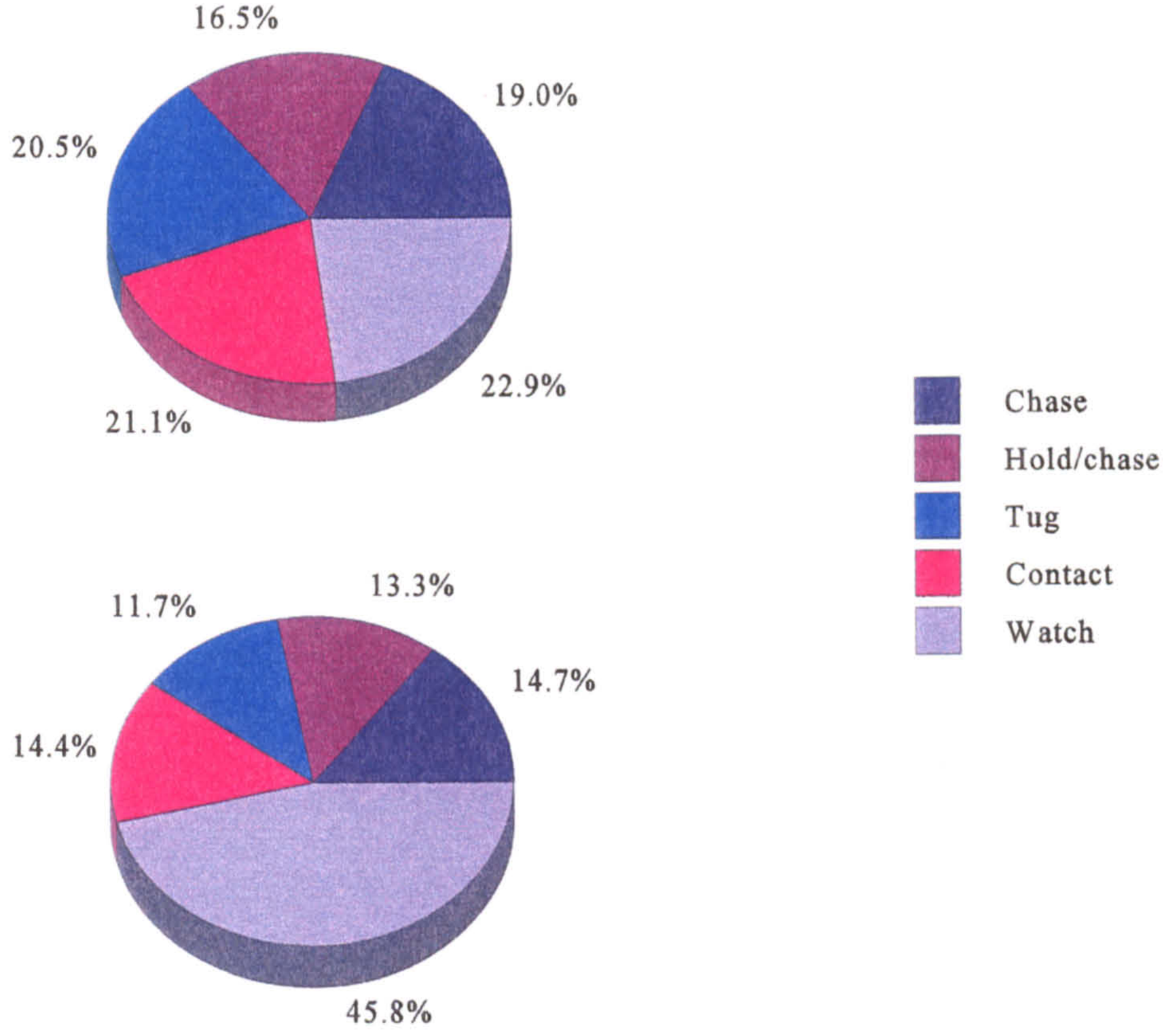
4.3.3 Results

All 14 dogs approached the object in both of the human-held trials whilst four did not approach during both object-held trials. This difference was not quite significant at the 5% level (Wilcoxon test; $z=1.89$, $n=4$, $p=0.06$).

The attention duration was higher when the object was held by a person ($F_{(1,11)}= 9.78$, $p<0.001$). Figure 4.3 shows the proportion of the interested time spent in each activity in the two conditions.

Figure 4.3 Proportion of the total attention duration devoted to each activity in the object-held and human-held conditions

a) object-held



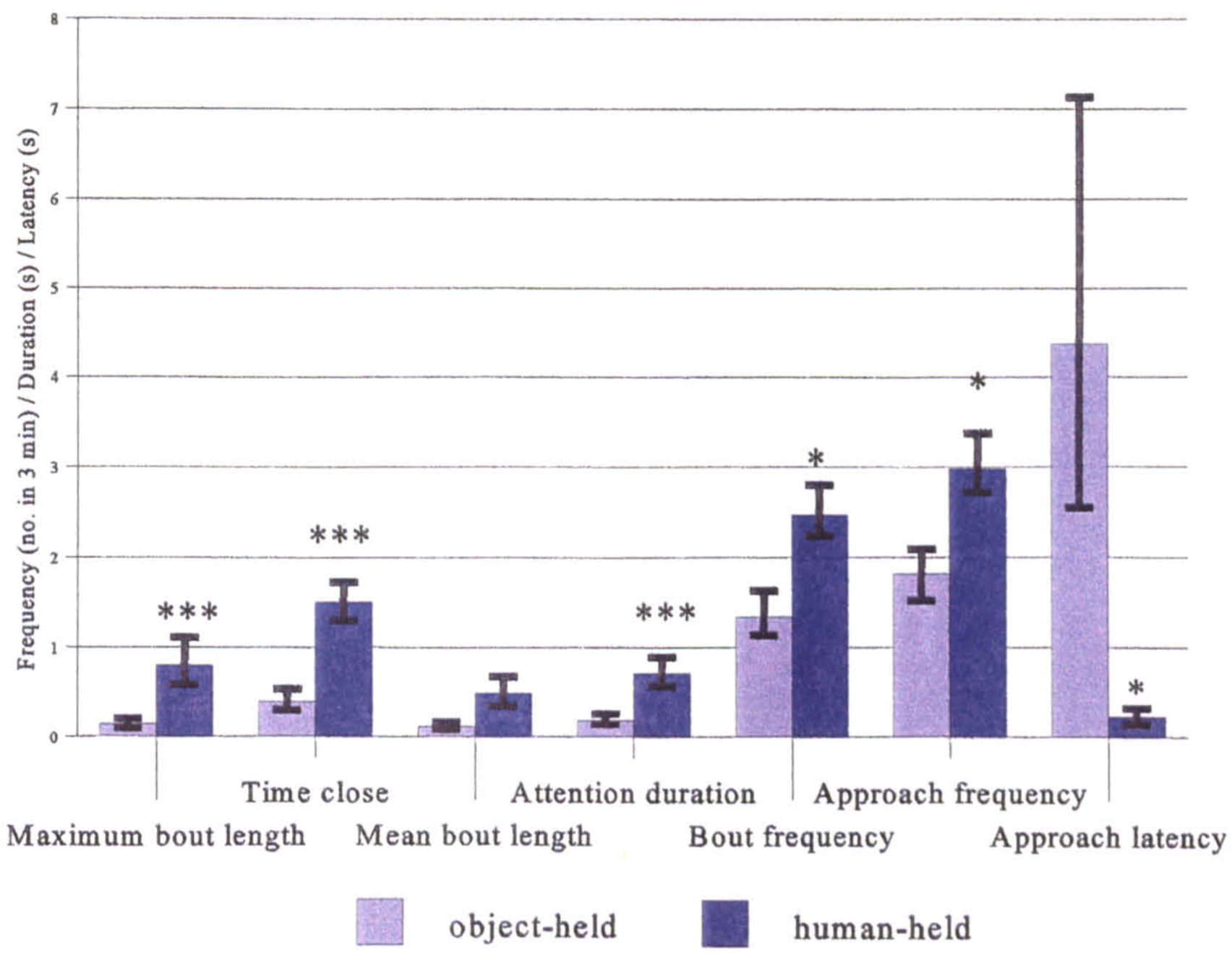
b) human-held

ANOVA showed that condition had different effects on the five play activities ($F_{(4,44)}$=4.0, p<0.05). Subsequent ANOVAs revealed the only activity whose duration was significantly affected was "watching"; dogs spent more time watching a toy when it was held by a person than when it was attached to a mechanical T-bar (14.1±3.0 s. vs. 2.6±0.8 s., $F_{(1,11)}$=148.2, p<0.001). Dogs spent a higher proportion of time tugging in the object-held condition, but this difference was not statistically significant ($F_{(1,11)}$=0.69, p>0.1).

Several dependent variables were significantly affected by condition. These are displayed in Figure 4.4. (A table showing all the ANOVA results can be found in Appendix 6,

[A6:1]). The latency to approach the object was shorter when the object was held by a person ($F_{(1,11)}$=9.59, p<0.05), although the time before the dog actually chased the toy was unaffected ($F_{(1,11)}$=2.00, p>0.1). The bout frequency was significantly higher in the human-held condition ($F_{(1,11)}$=8.28, p<0.05), as was the maximum bout length ($F_{(1,11)}$= 12.89, p<0.001). The total time that the dogs spent close ($F_{(1,11)}$= 19.64, p<0.001), and attending to ($F_{(1,11)}$= 9.78, p<0.001), the object increased when it was held by a person, as did the number of approaches ($F_{(1,11)}$=4.90, p<0.05). The frequency with which the dogs reared for the object did not vary significantly with condition ($F_{(1,11)}$= 2.03, p>0.1).

Figure 4.4 *Variables showing significant differences between object-held and human-held conditions*



*All variables shown differ between conditions at p<0.1: * p<0.05; *** p<0.005. This bar chart illustrates the results of statistical analysis which was performed on log transformed data. The values shown are therefore the reverse transformations of the mean and mean ± standard errors of the transformed data. All durations are shown in minutes and all frequencies as totals for the three minute period.*

4.3.4 Discussion

4.3.4.1 Object-oriented and object play are not structurally homogeneous

The dogs exhibited more interest in the object when it was held by a person. Although the overall composition of interested time differed, the only activity whose duration differed significantly was "watching". Dogs spent longer watching the object when it was held by a person than when it was attached to a T-frame, suggesting greater interest in the object in this condition. The other activities all involved contact with the object. Their durations were unaffected by condition ($p>0.4$). This suggests that the dogs were able to play with the toy similarly in the two conditions indicating a well-controlled experimental design. Subsequent differences are therefore likely to be a result of the behaviour of the dog and not physical constraints imposed by the different conditions.

Further aspects of the dogs' behaviour were significantly affected by condition. Dogs were quicker to approach the object when it was held by a person. They also engaged in more and longer play bouts. One interpretation of this is that, when held by a person, the object was perceived as more attractive than when it was held by a mechanical structure - the person increased the stimulus value of the toy. Since human participation affected the dogs' behaviour I reject the null hypothesis and conclude that object-oriented play is not homogeneous with object-play; the person does play an integral role.

4.3.4.2 What is the person's role?

However, the nature of that role is not clear. Why does a dog play more with an object when it is held by a person? This experiment does not allow distinction of whether the increase in play was a result of the person actually holding the toy, or merely their presence. The first possibility is that the person was viewed as a play partner, and within this playful context, a competitor for possession of the object. Thus, the increased play was a result of the dog competing for possession and being more strongly motivated to compete with a person than a T-bar. But, if competition were the sole reason, I would expect dogs to tug the object more when it was held by a human. This was not the case, in fact more time was spent tugging in the object-held condition (although the difference

was non-significant). Also, I have shown in the previous chapter (3.3) that possession is not the primary aim of dog-human object-oriented play.

The second possibility is that the presence of a person caused the dog to be more interested in the object. I suggest that participation is only partly responsible for the increased play levels and human presence is a contributing factor. In the following section I present an experiment designed to test this idea.

4.4 Is human presence sufficient to increase play levels?

4.4.1 Introduction

I have shown that object-oriented play is distinct from both social and object play. The person does play a role in increasing the dogs' interest in the object, but the nature of that role is unclear.

I have suggested two possibilities:

a) a person's physical participation increases the dogs' interest in the object,

b) a person's presence leads to increased interest in the object.

I hypothesise that possibility a) does not account exclusively for the increase in interest when a person holds the object, but that b) also contributes.

I designed an experiment to test this hypothesis. It followed the logic that, if physical participation were the reason for increased play, then the effect would be dependent upon the person actually holding the object. However, if participation were not the sole reason, then some increase in object attention would be apparent in the presence of a human (even without physical contact with the object). I therefore examined the effect of human presence upon dogs' play with an object.

4.4.2 Method

4.4.2.1 Design

The experiment followed a within-subjects design.

4.4.2.2 Subjects

The subjects were 14 adult Labrador Retrievers. There were 5 males and 9 females ranging in age from 24 to 62 months (mean=28 months). They were all pair-housed at the Waltham Centre for Pet Nutrition. None of the dogs were subjects in the previous experiment. Dogs were selected on the basis of those known to play with objects. To attain a standard motivational state, they were not permitted access to toys over the course of the experiment and were all penned for at least two hours prior to trials.

4.4.2.3 Apparatus

Trials took place in an outdoor concrete exercise area similar to that described in the previous experiment (4.3.2.3). Experimental apparatus was identical to that described above (see Figure 4.1).

4.4.2.4 Procedure

The experimental procedure was the same as Experiment 4.3, but the conditions compared were human present (with no participation) and human absent. In the human absent trials the rope, with attached toy, was clipped on to the T-frame, and the experimenter (myself; female, aged 25 years) remained out of sight (as in 4.3.2.4). In the human present trials the rope was again clipped onto the frame, but the experimenter stayed in the experimental paddock. I stood 2m away, and facing towards the T-frame, but did not interact with the dog. 2m was the chosen distance as this was outside the circumference of the swing of the object and was sufficient to distinguish approaches to the apparatus from those to the person. The experimental procedure was otherwise identical to that described above (4.3), with each dog being trialed twice in each condition.

4.4.2.5 Behavioural measures

The behavioural measures were the same as those in the previous experiment (Table 4.2).

4.4.2.6 Statistical analysis

Prior selection of playful subjects meant that it was not necessary to exclude any of the subjects from this experiment. Of the 14 dogs, 13 approached the object in all trials and all 14 exhibited a minimum of 84 seconds attention throughout the four trials.

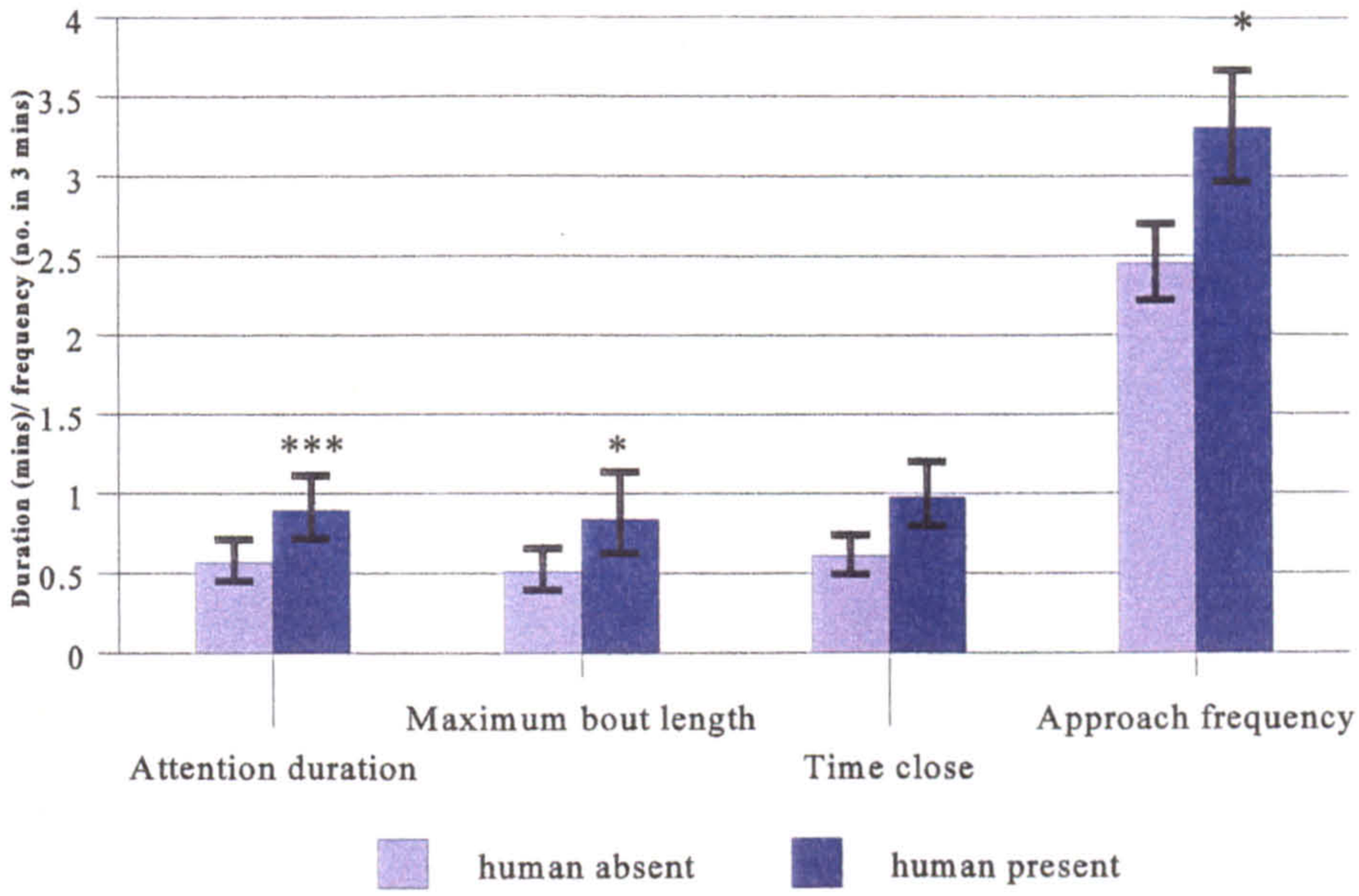
All variables were transformed and analysed as described in 4.3.2.6.

4.4.3 Results

The dogs spent significantly more time attending to the object when the person was present ($F_{(1,13)}$=13.4, p<0.005). ANOVA showed that condition did not exert significantly different effects upon the five play activities ($F_{(4,104)}$=2.0, p<0.1). So, the proportion of time spent in each activity remained similar; human presence caused a general increase in all play activities.

Two further dependent variables were significantly affected by condition (Figure 4.5). The maximum bout length ($F_{(1,13)}$= 7.83, p<0.05) was longer and the dogs made more approaches to the object ($F_{(1,13)}$=7.17, p<0.05) when there was a person present than when they were alone with the object.

Figure 4.5 Variables showing significant differences between the human present and human absent conditions



*All variables shown differ between conditions at $p<0.1$: * $p<0.05$; *** $p<0.005$. This bar chart illustrates the results of statistical analysis which was performed on log transformed data. The values shown are therefore the reverse transformations of the mean and mean ± standard errors of the transformed data.*

4.4.4 Discussion

4.4.4.1 The effect of human presence

Human presence had a significant effect upon the dogs' behaviour. Dogs approached the object more frequently, they spent longer attending to it, and their maximum play bout length was significantly longer when a person was present. This is an interesting result, as the presence of a person 2m away could have distracted the dog, leading to reduced attention duration. The reverse was in fact seen - the person's presence focussed the dog's attention upon the object.

Although the dog's overall interest in the object was increased by human presence, their latency to approach the object did not vary significantly between conditions. This may be due to the dogs' initial interest in the person and it was only once they found the experimenter ignored them that their interest in the object increased.

4.4.4.2 Comparing human presence to human participation

One must be cautious when comparing the results of this experiment with the previous one. The subjects in each were different and comparison of significance levels between trials is meaningless. However, it is legitimate to conclude that at least some of the increase in play observed when a person holds a toy can be achieved by human presence. It is not just the person's physical participation in the game which accounts for the elevated play levels.

4.4.4.3 Why did human presence increase play levels?

There are a number of possible explanations for the increase in object play when a person was present. Firstly, it is possible that attention levels did not increase in response to the person's presence, but they decreased in human absence. Play levels have been shown to decrease when an animal is stressed (Biben 1996). Distress caused by separation from the person may account for decreased interest in the object. Observation of the dogs' behaviour suggests that although some individuals did react to the departure of the person, the responses were short-lived so, whilst I can not discount this explanation entirely, I think it unlikely to be a major factor in explaining the results.

Secondly, increased play may be a result of the dog using the object to interact with the person. In Chapter 3, I showed that interaction is an important component of dog-human play. The dogs in this experiment were ignored by the experimenter and any attempts to instigate social interaction were not responded to. I suggest their increased interest in the object was an attempt to attract the experimenter's attention. Such efforts were unsuccessful throughout the trials, yet dogs continued to approach the object. I

hypothesise that this was because dogs had previously learnt that playing with an object is an effective strategy for attracting human attention.

A large proportion of interactions between dogs and people are in the form of object-oriented play, and 64% of owners reported their dogs delivering a toy to instigate play between them (2.3.3.6). Additionally many owners reward their dogs, both verbally and via food, for playful behaviour (pers. obs.). The subjects of this experiment did not have owners (in the conventional sense), but each had their own trainer and socialiser, both of whom regularly played object-oriented games with them (although only prior to this experiment as access to toys was not permitted between the trials). It is probable that the dogs had previously been rewarded, via human attention and other means, for playing with toys. Thus a conditioned reward expectancy is likely to be, at least partly, responsible for the increased play level observed in the presence of a person.

4.5 Can object play be increased by reinforcement?

4.5.1 Introduction

I have shown that dogs' interest in an object is increased in the presence of a person. I suggest that this is partly a result of the dogs having previously been rewarded for playing with objects. For this to be a plausible explanation, it must be possible to alter play levels via reinforcement. I therefore predict that;

a) object play levels can be increased by rewarding playful behaviour and
b) extinction, or at least decreased levels, of play can be produced via the cessation of reward.

An experiment was carried out to test these predictions. I rewarded one group of dogs for playing with an object. A second group was not rewarded. I hypothesised that the rewarded dogs would exhibit higher post-treatment play levels than the unrewarded dogs.

4.5.2 Method

4.5.2.1 Design

The experiment was a within-subjects design with between-group comparisons.

4.5.2.2 Subjects

Initially the subjects were 18 Labrador Retrievers. After the acclimatisation period they were screened and ten dogs retained for the experimental treatment. The selection criteria is explained below (4.5.2.4). The final ten subjects consisted of one male and nine females. They ranged in age from 14 to 60 months (mean=30 months). Five dogs had previously been subjects in Experiment 4.4. This should not have affected the current results as all comparisons were made within-subjects relative to a baseline measure.

Over the experimental period, the dogs did not engage in any object-oriented play with any humans. This ensured that they received no rewards for playing whilst on trial.

4.5.2.3 Apparatus

It was not possible to use the same apparatus as during previous experiments (4.3 and 4.4) as this trial took six hours per day and taking place in winter, required a covered, floodlit location. I therefore designed apparatus which could be used within a dog pen. The basic apparatus of an "Exelpet" plastic toy (Pedigree™) attached to the end of a 1m length of rope was retained. This was attached to a pulley system mounted on the corner pillar of a dog pen (see Figure 4.6). The rope was concealed within a metal tube with approximately 20cm of rope and the toy protruding at the bottom. The toy rested 50cm from the ground. The pulley was sprung, allowing the dog to tug the toy, extending the length of exposed rope, but upon release the toy was returned to its resting position. Dogs had encountered a similar pulley system previously but only with a rope and no dog toy attached. Whilst playing some dogs chewed the rope and toy, which were regularly replaced to maintain stimulus constancy.

All dogs at Waltham are housed in similar pens, consisting of an indoor heated area and an outdoor run connected via a swing door (see Appendix 1; Figure A1.2). This experiment took place in the outdoor area of one of these pens (measuring approximately $5m^2$). During training sessions, the swing door was closed to restrict the dog to the outside area, but during test sessions they also had access to the inside. To minimise distractions there were no dogs in either of the adjacent pens nor the adjoining paddock. All sessions were filmed using a video camera (Philips Explorer VKR6850) mounted on a tripod in the adjacent pen.

Figure 4.6 Apparatus used in reinforcement experiment

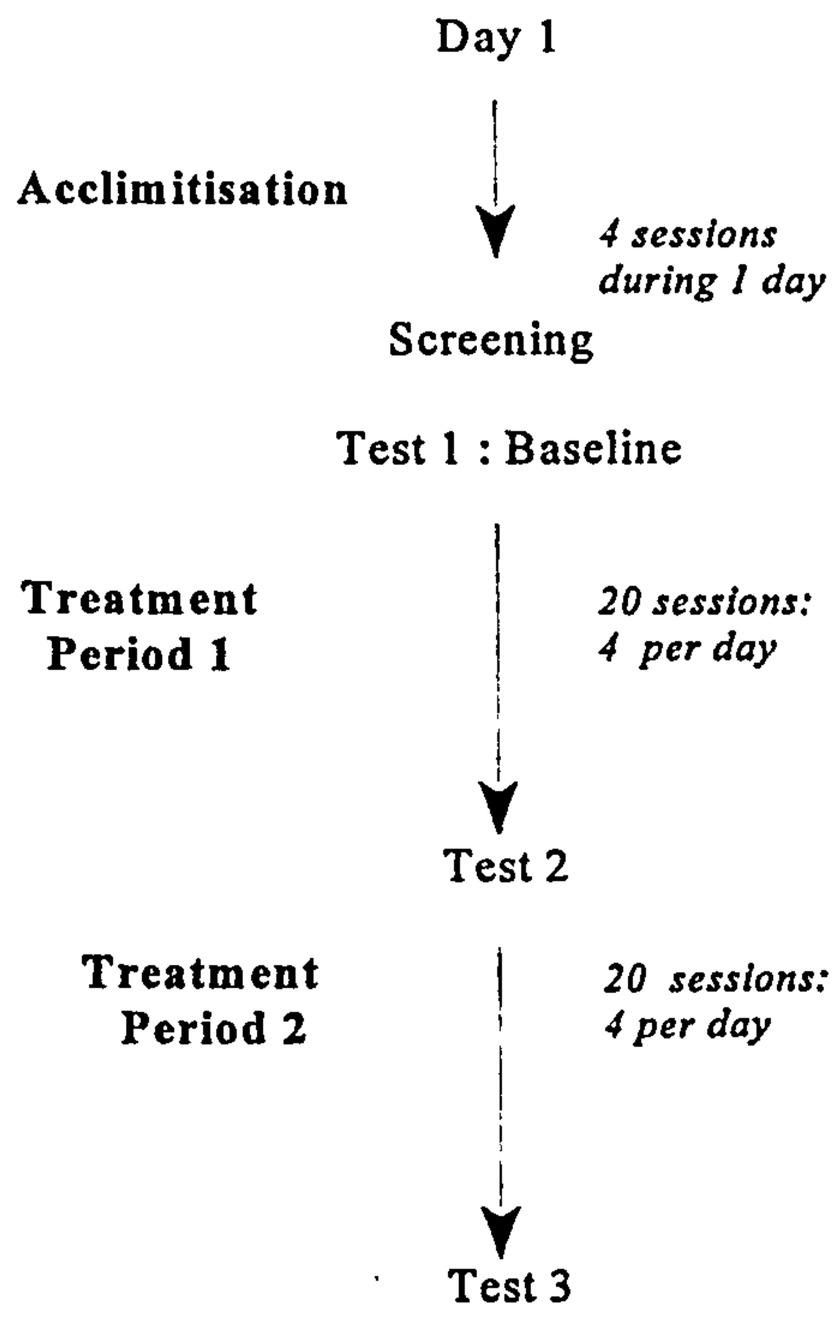


4.5.2.4 Procedure

The experimental procedure is summarised in Figure 4.7.

Acclimatisation Each of the 18 dogs initially took part in four acclimatisation sessions during one day (Day one). Sessions took place at 0800hr, 1030hrs, 1330hrs and 1600hrs. The dog was taken from its kennel and placed in the indoor area of the test pen. The experimenter (myself; female, aged 25 years) entered the outside area and activated the video camera. The swing door was then opened and the dog freed to enter the outside area. The experimenter stood at the rear of the pen approximately 2m from the object. She did not look at either the dog or the apparatus and did not interact with the dog in any way. The session continued for three minutes, after which the dog was encouraged to enter the indoor area, leashed and returned to its kennel.

Figure 4.7 Outline of the protocol for the play reinforcement experiment



Screening This experimental treatment involved rewarding playful behaviour. Subjects needed to exhibit sufficient baseline play levels to justify rewarding, so the dogs were screened. The total time each dog was interested in the object over the four acclimatisation sessions was calculated. Ten dogs which exhibited more than one minute of interest in total, were considered sufficiently playful and were retained, the other eight were rejected.

Baseline testing On the day following acclimatisation dogs were baseline tested. Testing commenced at 1600hr after all daycare staff had left and there were minimal distractions. All dogs were penned for the preceding hour to achieve a standard motivational state. Test sessions were the same as acclimatisation sessions, with the exception that they continued for a minimum of three minutes, but if the dog was attending to the toy after this time then the session continued until the termination of the ongoing bout (as described in 4.3.2.4).

Experimental treatment The subjects were divided into two groups: Group A was the reward group and Group B was unrewarded. The groups were balanced in the amount of object interest exhibited over the acclimatisation and baseline testing sessions ($t<0.3$, $d.f.=4$, $p>0.7$). Treatment commenced on the day following baseline testing. There were four treatment sessions per day, at the same times as the acclimatisation sessions. The order of dogs was randomised with respect to treatment groups, but remained the same for each treatment and testing session. This ensured a standard time between treatment sessions and that each dog always followed the same individual into the experimental pen, thereby minimising variations in olfactory distraction.

Treatment sessions followed the same general format as acclimatisation, but the dog was restricted to the outside of the pen and the experimenter stood approximately 30cm (instead of 2m) from the object. For Group A (reward group), whenever the dog made contact with the object, the experimenter looked towards the dog, leant forward and verbally praised it. As soon as contact ceased the experimenter retained an upright posture and continued to ignore the dog. Group B dogs were ignored throughout. The procedure was otherwise identical to acclimatisation sessions. Treatment Period 1 consisted of 20 sessions over five days. The day following the final treatment each dog was retested in the same way as during baseline testing (Test 2; see Figure 4.7).

Preliminary analysis revealed that the behaviour of the dogs in the groups was beginning to diverge, but the difference was not as yet significant. With restricted time available, it was decided not to swap the treatment groups (to achieve a balanced cross-over design), but to continue the treatment whilst increasing the intensity of the reward. So, after a gap of one day, treatment continued for a further 20 sessions (Treatment Period 2). The procedure remained the same, except that, on contacting the object, Group A dogs were now rewarded by the experimenter taking hold of the rope as well as delivering verbal praise. As soon as the dog lost contact, the experimenter let go of the rope and ceased praising the dog. The experimenter did not initiate any of the play bouts, but just rewarded them by participation. Group B dogs again received no reward. After five days (20 sessions) there was a final testing session.

4.5.2.5 Behavioural measures

In experiments 4.2 and 4.3 a number of variables were measured. In both, condition exerted the most significant effect upon attention duration. In this experiment, I restricted comparison to this single variable which was measured in real time during each treatment session. Daily totals for each subject were calculated and the pattern of change over the treatment period graphed for the dogs within each treatment group. For the test sessions attention duration was measured from videos, providing greater accuracy for statistical comparison.

4.5.2.6 Statistical analysis

This experiment investigated the *a priori* hypothesis that dogs in Group A would experience a bigger increase (or smaller decrease) in interest in the object over the experimental period, than those in Group B. Since the direction of the effect was predicted, the statistical techniques employed were one-tailed. I used Repeated Measures ANOVA. It was necessary to use a nested design[4] as dog identity was not independent of group. By examining the interaction between test number and group it was possible to identify whether dogs in the two groups changed differently over the experiment. The treatment procedure changed after test 2, so as well as examining changes over the whole experimental period, I compared test 1 with test 2 and test 2 with 3, independently. Paired t-tests[5] were also used to examine the inter-test differences for the dogs in each group. All analysis was performed on log(x+1) data as described in 4.3.2.6.

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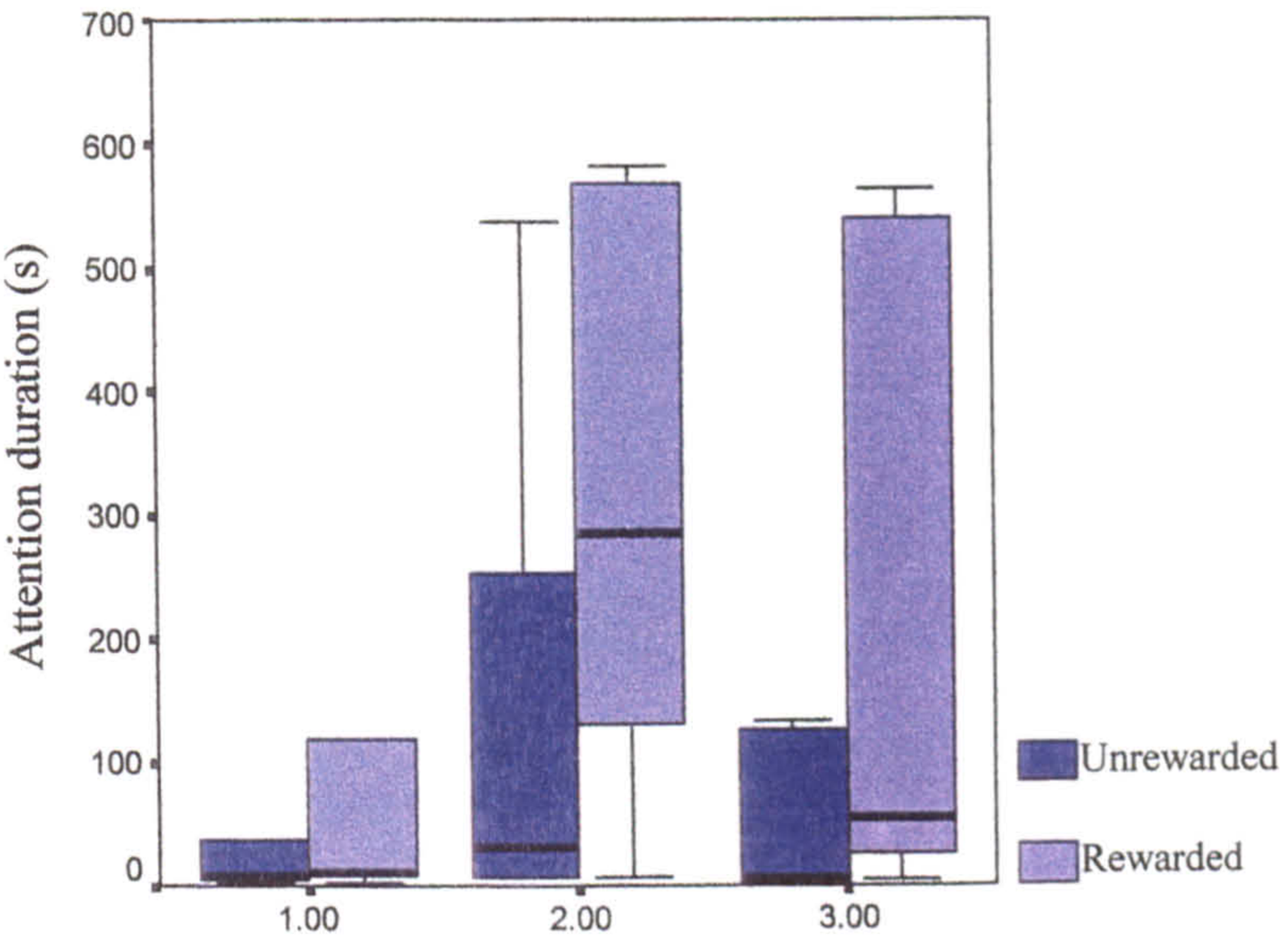
4 A nested design is used when the data can be classified by a system consisting of a unique order of classification criteria. It is hierarchic; the subordinate classification is nested within the higher level of classification (see Sokal and Rohlf 1995).

5 Paired t-test is a parametric test used to compare the means of two variables. It is used when the observations for the two groups can be paired in some way, *e.g.* when repeated measures of the same individual occur. It tests the null hypothesis that two population means are equal. To do so it computes the differences between values of the two variables for each case and tests whether the averages differ significantly from zero (see Fowler *et al.* 1998).

4.5.3 Results

The total attention duration in each test session, for members of each group is displayed in Figure 4.8.

Figure 4.8 *Box and whisker plot showing attention durations of the dogs in the rewarded and unrewarded groups during each test session*



A box and whisker plot is a summary plot based on the median, quartiles, and extreme values. The box represents the interquartile range which contains the central 50% of values. The whiskers are lines that extend from the box to the highest and lowest values, excluding outliers. The line across the box indicates the median.

There was little difference in the two groups during baseline testing (t-test; t=-0.14, *d.f.*=8, *p*=0.9). Both groups showed an increase in attention duration during test 2, but the increase was greater in the rewarded dogs (Group A). In test 3 the average attention remained higher in the rewarded dogs (Group A), but decreased to near baseline level in the unrewarded dogs (Group B). The inter-subject variation (as represented by the height of the bars), however, is great, especially within the rewarded group.

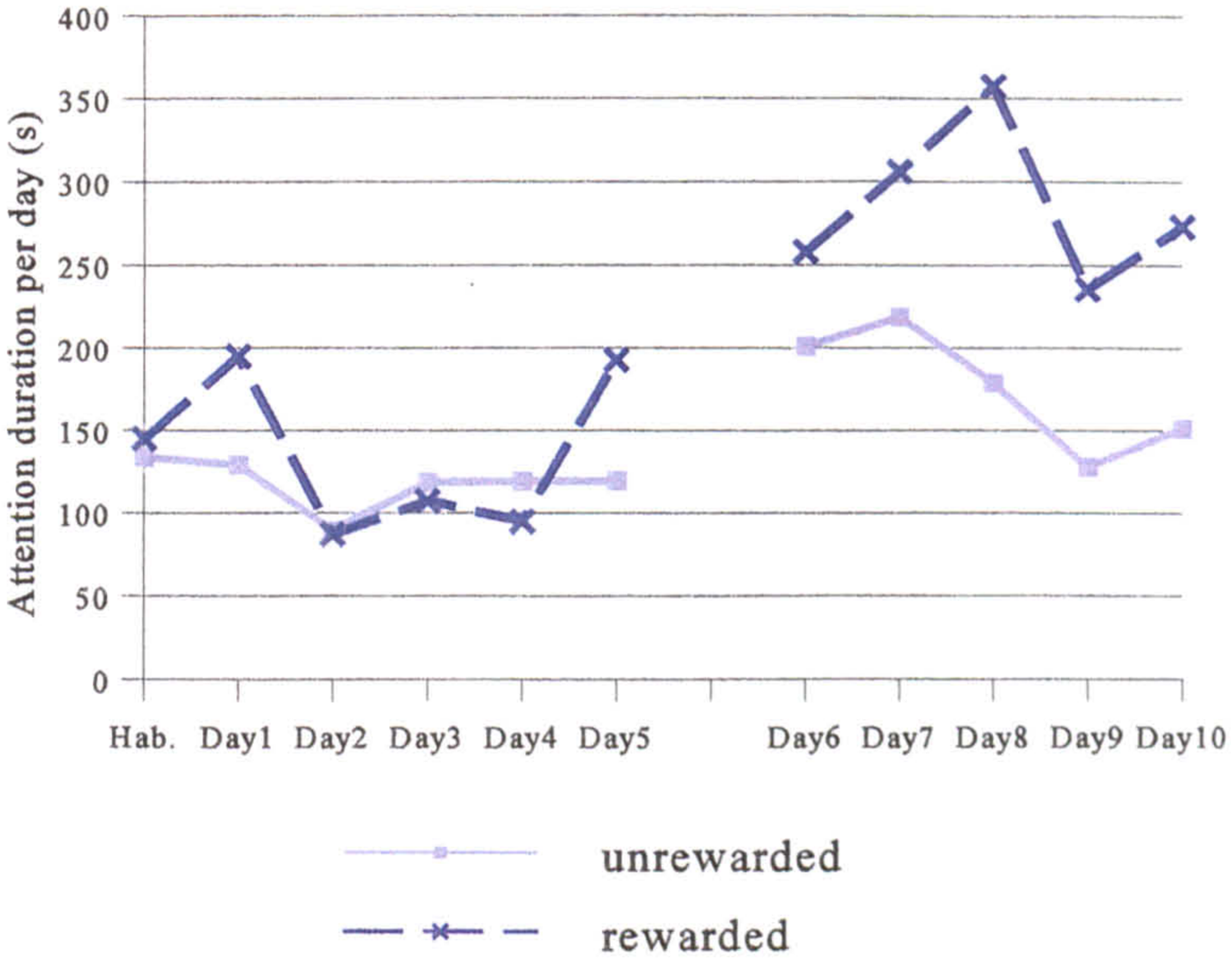
One-way Repeated Measures ANOVAs examined the effect of group upon the changes in interest between tests. The results for each test combination are displayed in Table 4.3.

Table 4.3 *Results of Repeated Measures ANOVAs testing the effect of treatment on the change in attention duration between tests*

Tests compared	**Mean square**	***F* ratio**	***d.f.***	***p* (1-tailed)**
1,2,3	0.25	1.67	2,8	0.11
1-3	0.50	2.27	1,9	0.085
1-2	0.53	2.55	1,9	0.075
2-3	0.12	4.46	1,9	0.035

Over the entire experimental period, the difference in the two groups was not significant (at $p<0.05$). However, when examining only the change between test 2 and 3 there was a significant difference between the two treatment groups; the unrewarded group showed a greater decrease in attention duration than did the rewarded group. Paired t-tests showed this decrease in the unrewarded group was significant ($t=7.8$, $d.f.=4$, $p=0.001$) whilst none of the other inter-test differences were. Interpretation of these results is aided by examination of the behaviour of the dogs during the training sessions (Figure 4.9).

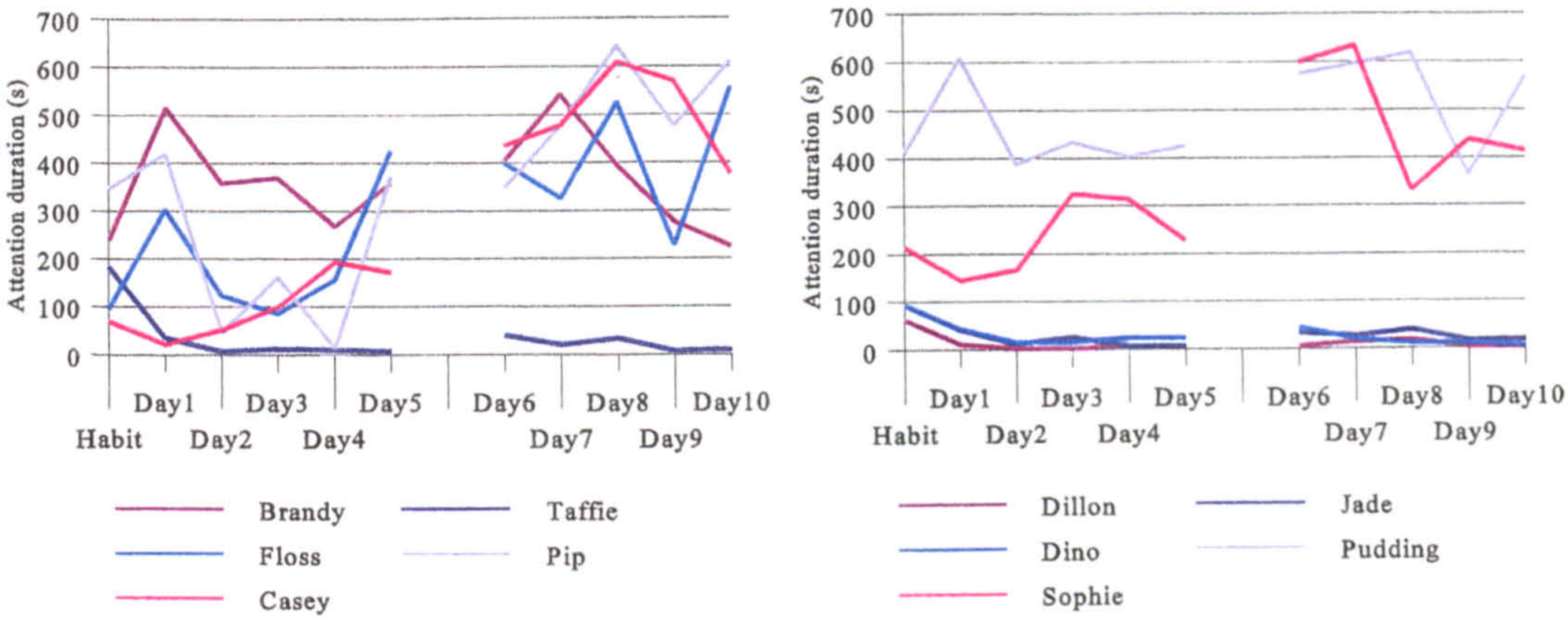
Figure 4.9 The mean attention duration per day, for dogs in each treatment group



Each session lasted 3 minutes, and there were four sessions per day so there was a maximum attention duration of 720 seconds possible

The two groups started to diverge on Day 5 and a maximum difference was seen on Day 8. This graph shows the mean values for all five dogs and suggests that, after day 4, the two groups are greatly different. However, examination of the distribution of the individual dogs (Figure 4.10) gives a more realistic picture.

Figure 4.10 Attention duration per treatment day for each subject in the two treatment groups



During training sessions there were large individual variations in both of the groups. Dogs varied considerably in their attention levels and subjects showed day-to-day fluctuations. In the rewarded group, four of the dogs maintained high levels over the course of the experiment. All four spent more than 200 seconds attending to the object on each day. There was one dog (Taffie) whose attention levels fell by Day 2 and remained at less than 50 seconds per day thereafter. In the unrewarded group, only two individuals (Sophie and Pudding) exhibited daily levels of more than 50 seconds subsequent to Day 2.

4.5.4 Discussion

4.5.4.1 Test sessions

The dogs which were not rewarded for play over the experimental period showed an initial increase in average attention duration between tests 1 and 2, followed by a significant decrease in test 3. Those dogs which were rewarded showed a greater increase in average attention duration between tests 1 and 2 and a non-significant decrease in test 3. Significant differences between the two groups occurred between tests 2 and 3

indicating that treatment affected the dogs' behaviour. Reward for playing with the object resulted in overall increased attention levels relative to the unrewarded dogs. I therefore conclude that object play can be increased by reinforcement and my initial hypothesis is confirmed.

4.5.4.2 Reward type

The two groups only differed significantly between tests 2 and 3. Reward by physical participation was incorporated during the period. This may suggest that this reward was more effective than verbal praise (as delivered between tests 1 and 2) at reinforcing play behaviour. It is possible, however, that the initial reward had delayed or cumulative effects and so comparison of the effects of these consecutive reward schedules must be interpreted cautiously. On the basis of this experiment, I can only conclude that a combined schedule of verbal praise followed by verbal praise and interaction was sufficient to cause increased attention levels in a group of dogs, relative to an unrewarded group.

4.5.4.3 Habituation

Figures 4.8 - 4.10 suggest that habituation to the toy is occurring in the dogs in Group B. This is similar to the findings of Hall (1998) who observed domestic cats to rapidly habituate to novel play objects. However, for the dogs in Group A, the reinforcement schedule appears to have counteracted the effects of habituation. Rewarding has served to retain the dogs' interest in the object, perhaps by increasing its stimulus value and thus reducing habituation effects.

4.5.4.4 Inter-dog variations

The inter-group differences during testing sessions were not highly significant (p=0.035), despite large differences in mean attention during treatment sessions (Figure 4.9). This is a result of large inter-dog variations (Figure 4.10). Whilst the majority of dogs in Group A maintained high attention levels when rewarded, there was one dog which did not respond to the treatment. Likewise, most unrewarded dogs showed cessation of attention,

but two subjects maintained interest in the object throughout. The extent of inter-dog variation will be apparent throughout this thesis. All subjects within this experiment had similar backgrounds, received the same husbandry and care, but they responded differently to identical experimental treatments. This individuality is an important consideration when drawing conclusions about average responses.

4.5.5 Conclusion

I have demonstrated that object play levels in the domestic dog can be altered by reinforcement, thereby supporting my initial hypothesis. Previous reward for object play thus remains a plausible explanation for increased play levels in the presence of a person, although its effect shows considerable variation between dogs.

4.6 General discussion

I have presented experiments which show that object-oriented dog-human play differs significantly in structure from both social and object play. It has previously been likened to both, so how can this disparity be reconciled?

4.6.1 A play continuum

I think the answer lies in the distinction between object and social play. There are data which suggest social and object play are not completely discrete categories. Bekoff (1974) observed that free-roaming dogs, when unsuccessful in eliciting social play, often immediately engaged in object play. Environmental enrichment using toys caused a decrease in social play in laboratory dogs (Hubrecht 1995). Jolly (1985) noted that when a marmoset, *Callithrix jacchus*, twin died there was a subsequent increase in object play in the survivor and Burghardt (1998) observed black bears, *Ursus americanus* to shift rapidly among all three play categories and to perform different types simultaneously. These findings suggest that object and social play may not be motivationally distinct. I believe that these play categories lie upon a continuum. Object-oriented play occupies an intermediate position, showing similarities to each, but homogeneity with neither. The relative importance of object and partner, and thus the position of object-oriented play along that continuum, may vary with species.

4.6.2 The person's role

During dog-human object-oriented play, the person plays an important role. I have shown that this is not entirely dependent upon their physical participation. The person's role may be multi-dimensional, consisting of several elements:

a) the person animates the toy, increasing its sensory value,

b) the person is a play partner with which the dog competes for the object,

c) the person is a source of reward and interaction, and play a means to achieve it.

The experiments presented here have shown that rewarding play can increase subsequent play levels, and so c) operates to an extent. I have shown that neither a) nor b) operates exclusively, but that all three roles may act in combination. Dogs show large individual variations and the role of the person within their object-oriented games varies. I suggest this is a result of innate predispositions and also previous experiences, including reinforcement.

4.6.3 Limitations and suggested future work

There are many sorts of object-oriented games. I have concentrated upon tugging games, for two reasons. Firstly, the role of person within a game is an important determinant of the effect of that game upon the dog-human relationship. Most hypotheses regarding the effects of play appertain to Tug-of-war games (see 1.3.2.4; Chapters 5 and 8). An understanding of how the dog perceives the person's role in tugging games is therefore useful when examining these hypothesised effects. Secondly, this game type is ideal for comparing social and object play as it can be performed without an animate partner. However, it would now be interesting to compare other game types, such as Fetch, and assess the person's role within these, but this will require sophisticated apparatus design.

4.6.4 Concluding comments

The objective of this chapter was to test General Hypothesis 1; that dog-human object-oriented play is a distinct category of play. I have shown that dog-human object-oriented play is homogeneous with neither social play (4.2) nor object play (4.3). In Chapter 3, I showed that dog-human object-oriented play is distinct from dog-dog object-oriented play. I therefore conclude that object-oriented dog-human play should be considered as a distinct category of play.

This chapter also aimed to explore the role of the person during object-oriented play. I have shown that a person acts partly to reinforce play via rewards. Their presence also increases play. The importance of each role, however, varies widely between dogs. Further work and inter-breed comparisons are necessary to fully elucidate this complex topic.

Chapter 5

The effects of play:

an experimental approach





"One animal invites another to play with it and certainly does not exert its utmost effort to overcome its playmate, else the weaker partner would have to give up play which is probably the last thing either player desires "

(Brownlee 1954, p.66)

5.1 Introduction

Play behaviour has been hypothesised to increase the inclusive fitness of animals in numerous ways (see 1.1.2.3). Decades of research have failed to identify a single exclusive benefit, but support has been found for a range of proximate effects in a wide variety of species. Amongst these are social effects; changing the relationship of the playing partners. Play is very common between dogs and owners (2.3.3.1), and if it can affect their relationship, it is important that we understand how. Two of the postulated effects of social play are particularly important.

5.1.1 Dominance-related effects

Dominance is the *"tendency of one member of a dyad to assert itself over priority of access to resources"* (1.3.2.3). It is an integral feature of canid societies and an important dimension of dog-human relationships. It is hypothesised that intraspecific dominance relationships can be established through play (*e.g.* Altmann 1962; Poirier and Smith 1974), and this idea has also been extended to the dog-human context. Many dog trainers and companion animal behaviour counsellors (*e.g.* Appleby 1997) believe that games which involve competition between the players can alter relationships. Perpetually allowing a dog to win games such as Tug-of-war (refer to Appendix 2 for definition) is claimed to give the dog the impression that it is stronger than its owner (*e.g* Rogerson 1992). The dog may then perceive its owner as relinquishing status, leading to subsequent conflict - the "dominance enhancement theory" (1.3.2.4). It is therefore recommended that such games are controlled or avoided (McBride 1995). Additionally, controlled games, which the owner wins, are regularly employed as part of the therapy for "problem dogs" to reaffirm hierarchical positions (*e.g.* Appleby 1997). This principle is acknowledged by the general dog-owning population; 7% of the questionnaire

respondents (2.3.3.4) described hierarchical affirmation as a benefit or reason to play with their dog and 22% listed training and increased control as possible benefits.

5.1.2 Attachment-related effects

A second hypothesised effect of play is enhanced social bonding between players; the "social cement" hypothesis (*e.g.* West 1974; Bekoff 1982). Attachment[1] is an important dimension of a dog-human relationship, and inappropriate levels can cause problems (1.3.3.2). Quantity of play is hypothesised to be a determinant in the attachment process (Bekoff 1972; Poirier and Smith 1974), but the quality of play may also be consequential. For example, attachment between dogs and humans is speeded up by physical contact (Cairns 1966). I have shown that non-object play involves increased levels of physical contact (4.2.3) and so predict that it exerts different effects upon attachment-dimensions of the players' relationship compared with object-oriented play. Attachment effects were also postulated by dog owners (2.3.3.4) - 43% listing "bonding" as a benefit from, or a reason to play with their dog.

5.1.3 Objectives

Dog-human play is an ideal candidate for the experimental study of play effects, as quantity and quality of play experiences can be independently controlled (see 1.1.4.2). Although there is common acceptance that the outcome of games has general consequences for dog-owner relationships, the idea remains, as yet, empirically untested. In this chapter I take an experimental approach and examine the effects of play upon quantifiable dimensions of the dog-human relationship. I concentrate on dominance and attachment-dimensions and test General Hypothesis 2:

"play between dogs and people has consequences outside the game".

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1 I refer to attachment as the one-sided process of dog becoming attached to human whereas bonding infers a two-way process (see 1.3.3.1).

5.1.4 Chapter outline

This chapter commences with a review of the evidence for and against dominance and attachment-related effects of intraspecific play in a range of species (5.2). I then re-examine the results of the questionnaire survey (2.3) exploring correlations between dog-owner play and perceived "attachment" and "aggression", and present the findings of a further survey of an additional 2585 owners (5.3). Next, I describe two experimental studies. Both make use of tests which I designed to quantify attachment and dominance-dimensions of a dog's relationship with an experimenter. The first (5.4) is a preliminary experiment used to develop methodologies and refine hypotheses. It tests the effects of four different game types (and a control treatment) upon the relationship of Labrador Retrievers with a specific person. The second study uses Golden Retrievers in a domestic environment and concentrates upon dominance-related dimensions, exploring the effects of controlled and uncontrolled Tug-of-war games (5.5).

5.2 Background

5.2.1 Is dominance status learnt through play?

Scientists have long advocated the importance of play in the establishment of dominance hierarchies (Altmann 1962; Carpenter 1964; Poirier and Smith 1974). In various species, correlations have been found between social status and characteristics of play behaviour. Dominant coyotes, *Canis latrans* play less than subordinate individuals (Bekoff 1974; Fox *et al.* 1976) and are less successful at soliciting play (Bekoff 1977). In coyote (Bekoff 1977) and wolf, *Canis lupus* (Lockwood 1976) litters middle ranking individuals, play together most often and wolf cubs play most with low ranking adult males (Zimen 1975). Habitual play partners have been noted to develop asymmetries in play (consistent winners and losers) at the time dominance relationships emerge in rats, *Rattus norvegicus* (Panksepp 1981) and rhesus monkeys, *Macaca mulatta* (Levy 1979 cited in Fagen 1981). Such findings have previously been used as evidence for the function of play in hierarchy formation (*e.g.* Altmann 1962), but this conclusion is premature. Correlations are not evidence that dominance relationships are determined via play. Features of play may simply reflect a dominance relationship which already exists, and there is growing support for this idea (*e.g.* Biben 1998).

Bekoff (1977) noted that coyote play levels peak after the dominance hierarchies are established, thus challenging dominance determination as a primary function of play. Children exhibit a preference for close-matched but weaker play-partners (Humphreys and Smith 1987), but this preference is only evident after dominance hierarchies have formed. This supports the idea of Clark *et al.* (1969, p.215) that the behaviour of nursery school children during free-play is "more a reflection of outside influences than a determinant of patterns of social behaviour".

Biben (1986) compared the dominance relationships of ten squirrel monkeys, *Saimiri sciureus* during play (indicated by the number of head grabs and pins), and during non-play interactions (indicated by head grabs). Dominance relationships were in the same direction but less skewed during play, and the monkeys preferred play partners which they could dominate. They initiated more directional wresting[2] when they were likely to win and more nondirectional wrestling when they were likely to lose (Biben 1989). Dominance relationships were stable throughout the study and Biben (1998) concluded that dominance was derived outside play, and non-play dominance status was not altered through play.

The most conclusive evidence of the link between play and dominance comes from a series of studies of murid rodents. Habitual rat play partners were previously believed to shift from an equal to an asymmetric pattern of pinning at the time of sexual maturity (Panksepp 1981), but Pellis and Pellis (1991) showed that asymmetries were detectable before maturity. Juvenile "subordinate-to-be" rats launched more playful attacks, and pinned their dominant partners more frequently than vice versa. This indicates that, for rats, winning is not critical for establishing dominance (Pellis and Pellis 1991). Testosterone propionate increases play without influencing the acquisition of dominance (Pellis *et al.* 1992). It was therefore concluded that "playfighting and aggressive systems subserving dominance relationships are differently controlled" (Pellis *et al.* 1992, p.437), and suggested that playful relationships may be influenced by temperamental variables which also underlie dominance-subordinate relationships (Pellis and Pellis 1993). This idea is supported by independent neurochemical research (Panksepp *et al.* 1984) showing that morphine increases play levels and also social assertiveness in rats. Finally, Smith *et al.* (1996) found that castrated male rats undergo age-related changes in frequencies and patterns of play, but do not develop dominance asymmetries, within or outside play. This implicates post-pubertal gonadal hormones in the activation of dominance relationships

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2 directional wrestling involves pinning and head grabs and has a clear winner and loser, whilst non-directional wrestling usually occurs whilst hanging from a branch, and involves no "pins" and no clear winner.

and shows that play asymmetry is a direct response to the establishment of dominance relationships.

For rats there is strong evidence disproving a deterministic role of play in dominance relationships. Squirrel monkeys' play appears to be strongly influenced by, but not the cause of dominance relationships and opinion regarding children's play favours a reflective rather than a deterministic role. I conclude that the function of play in the formation of intraspecific dominance relationships is limited, if existent at all. The role of interspecific play in dog-human relationships remains to be investigated.

5.2.2 Is attachment increased by play?

It is a popular belief that social play functions to establish and maintain social affinities or attachments (1.3.3.3). Play has been implicated in the development of social cohesion in cats, *Felis silvestris catus* (West 1974), the development of primate friendships (Baldwin 1982), and group recognition and cohesion in rodents (Wilson and Kleiman 1974). King (1954, p.328) described play as an "invitation to establish a more intimate relation" and Bekoff (1972) hypothesised that play functions in the maintenance of canid social organisation and affiliation, affecting an individual's probability of dispersal (Bekoff 1977).

Support for this function also comes mainly from correlations. Rats that play together remain close after play terminates (Hole 1991), as do children (Blurton Jones 1967; Humphreys and Smith 1987; Fry 1990), and children like their play partners more than chance would predict (Humphreys and Smith 1987). There are temporal correlations reported between times of maximum play and bonding; wolves and African hunting dogs, *Lycaon pictus* play prior to a hunt (Mech 1975); choz-choz, *Octodontomys gliroides* (Cavimorpha: Octodontidae) play upon waking (Wilson and Kleiman 1974), dogs play during courtship (Christie and Bell 1972), and there is a winter peak in both play and bonding in wolf packs (Zimen 1975). Lockwood (1979) analysed wolf behavioural

patterns and identified an "affiliation" factor whose component variables included both the frequency of play bouts and mean proximity to pack members. This indicates that an individual's play behaviour and affiliation to conspecifics are correlated. In contrast, a study of dog-human relationships showed an inverse relationship between proximity and play. Topàl *et al.* (1997) examined dog-owner behaviour in an unfamiliar situation test and noted that dogs that played for longer rested further from their owners.

Further evidence of a link between attachment and play comes from neurochemical work. Opioids modulate both play and attachment behaviour (see Panksepp *et al.* 1984). Morphine increases Rough-and-tumble play (Vandershuren *et al.* 1995) and can also decrease separation distress. Conversely, naloxone depresses play and increases separation distress. Panksepp *et al.* (1984) suggest that opioid activity may influence emotional changes which affect social needs and consequently play.

Support for an attachment function of play is not unanimous. Biben (1986) found no correlation between affiliative preferences (as indicated by huddling) and play partner preferences amongst squirrel monkeys. Female-female bonds are a prominent feature of squirrel monkey society, but females played much less frequently than males, which Biben (1986) posed as evidence against the "social cement" function of play. Smith (1982) claimed the lack of correlation between a species' play frequency and its group size, coupled with the occurrence of play in solitary species, made affiliation an unlikely function of play. However, Biben's dismissal of the affiliative function is based on ten captive animals and Smith's argument rests on inter-specific comparisons and the assumption of a single function of play. Bőth these arguments are dubious. I consider the evidence in support of a play/attachment link strong, but the link may reflect either correlation or cause.

An experimental approach is necessary to resolve this, but date only one research team has taken this approach. Mason *et al.* (1962) performed a range of experiments on a small number of captive chimpanzees, *Pan troglodytes*. Infant chimpanzees showed greater proximity to a person who had previously played with them than to a person who had

interacted via petting, grooming or allowing themselves to be groomed. Mason (1965) also tested preferences and found that chimpanzees consistently chose a play partner over a person delivering other interaction types (providing they were in a familiar room[3]). These findings were all interpreted as evidence for the development of a social preference for a person who played. Although the sample sizes are small and the methodologies not rigorous, these results do suggest that the link between play and attachment behaviour in chimpanzee-human relationships is causal. Assessment of whether or not this is true for the dog-human relationship is an aim of this chapter.

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3 In an unfamiliar room this preference was reversed; which was concluded to be an effect of increased arousal leading to clinging.

5.3 Questionnaires revisited

Preliminary investigation of correlations between dog-owner play and its hypothesised effects was achieved via two questionnaire surveys.

5.3.1 Survey 1

In my initial questionnaire survey (2.3), 110 respondents subjectively rated their dogs' attachment to themselves (on a scale of 1-5) and reported whether their dog had shown aggression[4] towards them. Both variables are subjective, but since owners' perceptions also determine whether the dog's behaviour is considered satisfactory, they are important measures. Comparison of these ratings between dog owners reporting different play regimes suggested tentative links between both attachment and aggression, and play schedules.

5.3.1.1 Dominance dimensions

There was a trend for a higher incidence of aggression in dogs which played Tug-of war games; 31% of players but only 17% of non-players showed aggression (Continency test - refer to 2.3.3.3. for description; χ^2=3.03, *d.f.*=1, p=0.08). None of the other game types were significantly related to aggression incidence. Since it is commonly claimed that Tug-of-war games lead to dominance related problems including aggression (*e.g.* Rogerson 1992), this trend was explored further (5.3.2).

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4 Aggression can be dominance-related (Overall 1997; see 1.3.2.3 and 2.3.3.7), and was therefore used in the assessment of dominance in this preliminary investigation.

5.3.1.2 Attachment dimensions

Frequency of play on walks was positively correlated to attachment rating (*Rho*=0.33, *d.f.*=109, $p<0.001$), although frequencies of indoor and non-object play were not. Players of Hide-and-seek were reported as less attached than were non-players (4.4±0.1 vs. 4.5±0.1, U=1139, $p=0.09$). This was also the case for players of Rough-and-tumble (4.4±0.1 vs. 4.6±0.1, U=1108, $p=0.09$). Conversely, Fetch players were perceived as more attached than non-players (4.6±0.1 vs. 4.2±0.2, U=691, $p=0.03$). The correlation between walk play frequency and attachment may be a result of Fetch being particularly common on walks (see 2.3.3.1). These results all suggest a tentative link between the playing of specific game types and attachment-dimensions of the dog-owner relationship, which needs to be explored experimentally.

5.3.2 Survey 2

I explored the link between aggression and Tug-of-war further by surveying a large population of dog owners. Questions were incorporated in the Masterfoods Survey (1997) which sampled 2585 dog owners in mainland UK.

5.3.2.1 Method

I designed questions to determine the frequency with which owners played each of six game types including Tug-of-war (see 3.3.2.1 for details). I also included the question "Has your dog ever shown any aggression towards you?" Respondents chose from the responses: 0-never; 1-only in the past; 2-occasionally; or 3-frequently.

5.3.2.2 Statistical analysis

Reports of high aggression frequencies were rare so responses were pooled. Each dog was categorised as a player or non-player of Tug-of-war and aggressive (score 1-3) or not aggressive (score 0). Contingency tests compared the proportion of aggressive dogs amongst players and non-players.

5.3.2.3 Results

There was no significant difference in the proportion of aggressive dogs between players and non-players of Tug-of-war (14.8% vs.13%, χ^2=1.7, *d.f.*=1, p=0.19).

5.3.2.4 Discussion

Survey 1 (5.3.1) indicated a trend for higher aggression incidence in players of Tug-of-war, but this remained statistically nonsignificant in Survey 2 (5.3.2). The results do not support the claims of a link between dominance and Tug-of-war. However, owners' reports are not always reliable, dominance is not always manifest as aggression, and correlations are not necessarily evidence of causal relationships. Also, the claims about the damaging effects of Tug-of-war often appertain only when the game is "uncontrolled" and the dog frequently allowed to win (*e.g.* O'Farrell 1992). It is impossible to ascertain which of the questionnaire respondents controlled their games. I therefore decided to explore these relationships further via controlled experimental studies.

5.4 A preliminary experimental investigation into the effects of different game types upon the dog-human relationship

5.4.1 Introduction

Questionnaire surveys (5.3) failed to support the commonly postulated link between Tug-of-war and dominance (as indicated by aggression), but pointed to possible relationships between games and attachment-dimensions of dog-owner relationships. I hypothesise that non-object games, which incorporate more contact and communication opportunities, exert different effects upon attachment-dimensions of the relationship, compared to object-oriented games (4.2.4.2). This study tests these ideas experimentally.

The aim was to determine whether the playing of different dog-human games leads to differences in the relationship which develops between the players. The three most common dog-human games; Fetch, Rough-and-tumble and Tug-of-war (as determined from the questionnaire 2.3.3.1), were investigated. Additionally a distinction was made between controlled Tug-of -war, during which the person won most competitions, and uncontrolled Tug-of-war, which was won by the dog. Behavioural tests were developed to compare dominance and attachment dimensions of the dogs' behaviour towards a person before and after a four week playing schedule. Changes in behaviour were quantified and compared between play treatment groups and a control group.

5.4.2 Rationale behind testing the dog-human relationship

Attachment and dominance are multi-dimensional constructs, the definition and quantification of which are difficult (1.3). I make no attempt to implicate their underlying mechanisms, but use the terms to describe specific characteristics of the dog-human relationship which can be satisfactory or problematic. I have developed techniques to

measure attachment and dominance dimensions for a specific dog-human partnership. I make no *a priori* assumptions about what constitutes each dimension, but take a *post-hoc* approach measuring the dogs' behavioural responses in a range of contexts and then apply statistical analysis to discover the underlying relationship dimensions.

5.4.2.1 Dominance test

I define dominance as "a tendency of one member of a dyad to assert itself over priority of access to resources" (1.3.2.3). This tendency can vary according to the resource under dispute (Wright 1980; van Hooff and Wensing 1987; Wickens 1993). When testing this dimension of a dog-human relationship, I examined the dog's behaviour in a variety of contexts and when challenged for a range of resources *e.g.* food, space, toys. I measured the dog's willingness to surrender each resource to the person. I also noted any accompanying behaviours or postures, including actions previously implicated as dominant and submissive (Fox 1969; 1970). My test was developed from the Kennelled Dog Temperament Test (Wickens *et al.* 1995). However, I needed to test the dogs' behaviour towards a specific human. The original test examined general behavioural tendencies and was therefore expanded and modified considerably.

5.4.2.2 Attachment test

I define attachment as "(a) dimension(s) of a dyadic relationship, characterised by specificity, and preferential responding" (1.3.3.1) as demonstrated by several operational criteria (Gubernick 1981):

a) preference for the attachment figure over another,
b) seeking and maintenance of proximity to that figure,
c) response to brief and extended periods of separation from the presumed attachment figure,
d) response to reunion with presumed attachment figure,
e) use of attachment figure as a secure base from which to explore the world.

In my attachment test, I provided opportunities for the dog to exhibit each of these operational criteria. I based my design on that of M^{c}Pherson (1998).

When testing each relationship dimension, the dogs' behaviour was observed in a variety of situations, and a large number of variables measured. Principal Components Analysis (P.C.A; described in 5.4.4.1) was then used to combine these variables into common factors. Several factors describing attachment and dominance dimensions were used as dependent variables thus allowing the multi-dimensional nature of these relationship traits to be taken into consideration.

5.4.3 Method

5.4.3.1 Design

The experiment followed a within-subjects design.

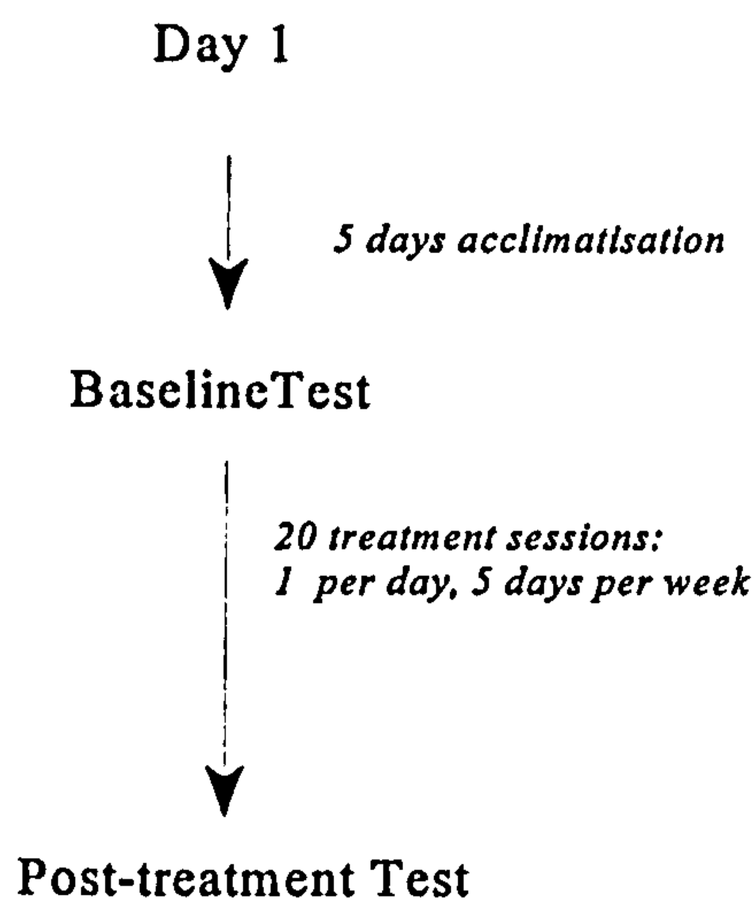
5.4.3.2 Subjects

The subjects were 30 Labrador Retrievers. There were 23 females and seven males, ranging in age from seven months to 119 months (mean=34 months). They were all housed at the Waltham Centre for Pet Nutrition (see 1.5.2.2 and Appendix 1). Seventeen were also subjects in experiments described in Chapter 4, but the current study took place first, so all dogs were unfamiliar with the experimenter at the outset.

5.4.3.3 Procedure

Prior to the experiment, dog-care staff rated each of the subjects for their dominance tendencies and playfulness, both on a scale of 1-5 (these ratings were used to achieve balance treatment groups as described below). The experiment took place over a six week period and followed the protocol outlined in Figure 5.1.

Figure 5.1 *Outline of experimental protocol for testing the effects of different game types on the relationship between Labrador Retrievers and an experimenter*



Acclimatisation A five day acclimatisation period introduced the dogs to the experimental room and the experimenter (myself; female, aged 24 years). This ensured the pre-treatment test assessed the dogs' behaviour towards a known individual and not their reaction to a stranger. On each acclimatisation day, the experimenter collected the dog from its kennel, leashed and walked it to the experimental room. This was rectangular measuring 7.5m x 1.4m with six adjoining dog pens (used for storage). In one pen there was a video camera (Philips Explorer VKR6850) mounted on a tripod. A wide-angle lens was added, allowing the entire room to be filmed. The dog entered from a door at one end of the room and was unleashed. At the opposite end there was a chair, the proximity to which was marked on the floor. The experimenter sat on the chair and allowed the dog to roam freely for five minutes. She did not initiate interaction with the dog, but if it approached, it received moderate petting[5] and friendly vocalisations. The dog was then leashed and returned to its kennel.

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5 "Moderate petting" is used in the acclimatisation period of this and all subsequent experiments. It involves the person stooping down to (but not crouching) stroking, and gently vocalising to the dog.

Pre-treatment test Two days after the last acclimatisation session, all dogs were baseline tested to assess their pre-treatment relationship to the experimenter. The order of subjects was random. The test involved 20 components, four designed specifically to assess attachment-dimensions and 13 to assess dominance-dimensions of the relationship. Three components (A1, A4 and D3) were used in the assessment of both dimensions[6]. The procedure during each test component is described below (the variables measured during each component are described in section 5.4.3.4);

Dominance test components

D1 *Lead walking* - The dog was walked on a leash from its kennel to the experimental room. No attempt was made to discipline the dog.

D2 *Approach* - The dog was allowed to habituate to the experimental room for one minute. The experimenter then approached the dog at walking pace, halting when 10cm away.

D3 *Call response* - The dog was allowed to roam freely for 20 seconds whilst the experimenter was seated on the chair. The experimenter then called the dog's name. If it did not approach, the call was repeated a maximum of three times with two second intervals.

D4 *Sit* - The experimenter stood facing the dog and gave the command "Sit". If the dog did not respond, the instruction was repeated a maximum of three times with five second intervals.

D5 *Eye contact* - The experimenter held the dog lightly under the chin and established eye contact with it. This was maintained for up to 30 seconds. If the dog broke eye contact the experimenter also looked away. This was performed three times.

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6 The components used to assess dominance dimensions will subsequently be referred to as the "dominance test" and correspondingly those components used to assess attachment dimensions the "attachment test". However, these components are not mutually exclusive and were all carried out within a single session.

D6 *Forced down* - This commenced with the dog in a sitting position. The experimenter placed their hand on the dog's shoulder and applied moderate pressure. They continued until the dog lay down, or for a maximum of 20 seconds. This was repeated once.

D7 *Rise latency* - After the dog had been forced down, the experimenter gave the command "Stay" and took five steps backwards. She remained facing the dog until it rose or for a maximum of two minutes. This was repeated after each forced down.

D8 *Toy removal* - The dog was given a squeaky toy and allowed to play freely for 20 seconds. The experimenter then stretched her arm towards the dog and gave the command "Give". If the toy was not surrendered the command was repeated at five second intervals. After three commands, vocalisations were accompanied by physical intervention of increasing force until the toy was surrendered. This was carried out twice.

D9 *Toy regain* - After retrieving the toy the experimenter held it out of the dog's reach for ten seconds. She then placed it on the floor in front of the dog and gave the command "Leave" once. This was repeated after each toy removal.

D10 *Shout* - The experimenter crouched and petted the dog for ten seconds. She then rose suddenly and shouted "No".

D11 *Door entry* - The dog was leashed. The experimenter walked the dog once around the experimental room and then approached and exited through a partially open door. The gap was sufficient to allow only one individual through at a time.

D12 *Food removal* - This took place at the dogs' regular feeding time. The dog was given its food by the usual member of staff and allowed to start eating. The experimenter then entered the kennel, said "Leave" once and removed the feeding bowl. The bowl was held above the dog's head for ten seconds. It was then placed on the floor and the command "Leave" given once. The experimenter placed their hand between the dog and the bowl until the dog commenced eating or for a maximum of 20 seconds. This was repeated once.

D13 *Lying* - The experimenter lay on their back on the floor and remained motionless for 30 seconds.

D14 *Grooming* - The experimenter used a brush to lightly groom the dog for one minute. She attempted to cover the whole dorsal surface.

Attachment test components

A1 *Kennel approach* - The experimenter approached the dog's home kennel, without vocalising or making eye contact with the dog.

A2 *Petting* - The dog was allowed to roam freely in the experimental room for three minutes. The experimenter remained seated on the chair. If the dog approached it received moderate petting.

A3 *Ignoring* - The dog was allowed to roam freely for a further three minutes. The experimenter remained seated and read throughout. If the dog approached it was ignored.

A4 *Following* - This test commenced with the dog in a sitting position. The experimenter stood by its side and called its name once. The experimenter then walked around the periphery of the room for two minutes.

A5 *Separation* - The experimenter stroked the dog and then left the experimental room via the entrance door. The video continued to run and the experimenter remained in an adjacent room for three minutes.

A6 *Return* - The experimenter re-entered the room and greeted the dog verbally. If it approached it was petted moderately.

The dominance and attachment test components were carried out within a single session and were presented in an order of increasing intensity (to minimise the effect of previous components upon subsequent measures): A1, D1, D2, A2, A3, D3, D4, A4, D5, D6, D7, A5, A6, D13, D14, D8, D9, D10, D11, D12.

The dog's behaviour during each component was described into a Dictaphone (Sony M-607 Micro-cassette recorder). Sessions were also filmed using the video recorder. The use of both media maximised detection of subtle behaviours.

Treatment On the day after baseline testing, the treatment period began. Dogs were assigned to five treatment groups. Groups were matched in age, sex, and staff's ratings for dominance and playfulness of the subjects. Each dog was treated once per day, five days a week for four weeks - a total of 20 sessions. The order of groups and of individuals within each group was randomised using a Graeco Latin Square design (Cochran and Cox 1957). Treatment sessions followed a similar format to acclimatisation sessions. The dog was taken from its kennel, leashed and walked to the experimental room. It remained there for five minutes, but its treatment varied according to group. Dogs in the control group received the acclimatisation treatment; they were petted whenever they approached the experimenter. Dogs in the four treatment groups all underwent a two minute acclimatisation period following which the experimenter stood up and gave the play signal of thigh slapping accompanied by encouraging vocalisations (for further discussion of play signals see Chapter 6). They aimed to continue playing for three minutes. The games played were:

Group 2 Rough-and-tumble - The experimenter encouraged the dog to engage in Rough-and-tumble play (for definitions of game types see Appendix 2) by the use of play bows and physical contact. Chase invitations were responded to. The experimenter aimed to maximise contact with the dog whilst sustaining play.

Group 3 Fetch - The dog was instructed to repetitively retrieve a rubber ball. If reluctant to surrender the ball, it was instructed to "Leave". Pretend throws (see Appendix 4 for definition) were incorporated at a rate of approximately one per five throws.

Group 4 Uncontrolled Tug-of-war - Play centred around a Ragger toy (Petlove Ltd; see 3.4.2.3) and primarily involved tugging contests. The dog was allowed to win the majority of the competitions and the experimenter avoided sole object possession. If the dog ran off with the toy it was chased to maintain mutual possession. At the end of three minutes, the dog was allowed to maintain possession of the Ragger until it dropped the toy voluntarily or, upon reaching its kennel, the Ragger was retrieved by a member of staff.

Group 5 Controlled Tug-of-war - Play centred around a Ragger and was mainly composed of Tug-of-war. The experimenter controlled the game by frequent "Leave"

commands, won the majority of competitions, and retained possession of the toy at the end of the game.

Throughout the treatment period all dogs continued to be exercised and trained by their usual trainers. The trainers were permitted to play with the dogs, but not to introduce any new games. They kept a log of all play interactions.

Post-treatment test After 20 treatment sessions the dogs were retested in an identical way to pre-treatment. The order of subjects was also the same.

5.4.3.4 Behavioural measures

From the Dictaphone and video tapes, the dogs' behaviour during each test was analysed. Preliminary observations were made to select variables for measurement. The selection criteria were that the variable must describe a behaviour exhibited by at least 10% of subjects and show variation in at least 10% of cases. When appropriate, rarer behaviours were combined into categories in order to reach the 10% threshold. During the dominance test, 48 variables described the dog's behaviour during the individual test components (Table 5.1). In addition, 23 behaviours could occur at various stages throughout the test. For these, I measured the number of components in which the dog performed the behaviour, out of a maximum of 16 (Table 5.2). A total of 71 variables were measured for each dog during the dominance test. During the attachment test, 43 variables were measured, all of which were specific to a particular test component (Table 5.3).

Table 5.1 Behavioural variables measured during specific components of the Dominance Test

Test component	Variable name	Description	Units
D1 Lead walking	Position ahead	Dog's average position relative to experimenter (0-behind; 1-level; 2-ahead; 3-pulling)	scale: 0-3
D2 Approach	Response positivity	Degree of dog's response to experimenter's approach (0-retreat; 1-unreactive; 2-approach; 3-jump up)	scale: 0-3
D3 Call	Call lag	Latency of dog's approach to experimenter (mean of 2 trials)	s
	Approach gait	Gait of dog's approach to experimenter (mean of two trials: 0-walk; 1-trot; 2-run; 3:-bound)	scale: 0-3
	Indirect approach	Dog takes non-direct route to experimenter or sniffs en route	0/1
	Contact	Dog contacts experimenter on approach	0/1
D4 Sit	Sit latency	Latency for dog to sit after command (mean of 2 trials)	s
	Orientate away	Dog sits facing away from experimenter	0/1
D5 Eye contact	Stare duration	Time before dog looks away from experimenter (mean of 3 trials)	s
	Stance height	Posture assumed by dog (0-lie; 1-sit; 2-stand; 3-move)	scale: 0-3
D6 Forced down	Comply latency	Time to force dog into lying position (mean of 2 trials)	s
	Shoulders first	Dog attains posture with fore-body lowered	0/1
D7 Rise	Rise latency	Latency for dog to rise from lie after forced down	s
	Reapproach gait	Gait of approach to experimenter following forced down (scale as in D3)	scale: 0-3
	No reapproach	Dog fails to reapproach experimenter after forced down	0/1
D8 Toy removal	Drop latency	Latency for dog to surrender toy after command (mean of 2 trials)	s
	Force required	Action required to retrieve toy from dog (0-command; 1-contact; 2-contact and command; 3-pull; 4-strong tug; 5-won't surrender)	scale: 0-5
	Brings toy	Dog brings toy to experimenter when instructed to leave	0/1
	Skirts/Blocks	Dog moves around experimenter evasively before surrendering toy	0/1

D9 Toy regain	Regain latency	Latency for dog to pick up toy following removal	s
D10 Shout	Stance height	Posture dog assumes after shout (0-lie; 1-sit; 2-stand; 3-move)	scale: 0-3
	Lower head	Dog lowers head immediately after shout	0/1
	Startle	Dog moves suddenly immediately after shout	0/1
	Move away	Dog moves away from experimenter after shout	0/1
	Change posture	Dog changes posture immediately after shout	0/1
D11 Door entry	Position ahead	Position of dog relative to experimenter when exiting door (0- behind; 1-attempts level; 2-ahead)	scale: 0-2
D12 Food removal	Response intensity	Strategy dog uses to regain food (0-none; 1-skirt; 2-push)	scale: 0-2
	Jump	Dog jumps for bowl held by experimenter	0/1
	Contact bowl	Dog contacts bowl whilst held by experimenter	0/1
	Feed latency	Stage when dog resumes feeding (0-bowl held by experimenter; 1-restrained; 2-unrestrained; 3-command; 4-experimenter exits)	scale: 0-4
D13 Lying	Step over torso	Dog steps over experimenter's torso without contact	0\1
	Stand on torso	Dog stands on experimenter's torso with weight	0/1
	Stand over torso	Dog stands over experimenter's torso without weight	0/1
	Lie on torso	Dog lies on top of experimenter's torso	0/1
	Nuzzle	Dog contacts experimenter with its head	0/1
	Step over legs	Dog steps over experimenter's legs	0/1
	Paw on torso	Dog places paw on experimenter's torso	0/1
	Lie by	Dog lies alongside experimenter	0/1
	Sit by	Dog sits next to lying experimenter	0/1
	Walk away	Dog walks away from lying experimenter	0/1
D14 Grooming	Time tolerated	Duration dog tolerates grooming without escape attempt	s
	Stance height	Posture of dog for most of grooming time (0-lie; 1-sit; 2-stand; 3-move)	scale: 0-3
	Bite brush	Dog bites brush whilst being groomed	0/1
	Follow brush	Dog follows movement of brush with eyes and head	0/1
	Cringe	Dog cowers when brushed on the head	0/1

A1 Kennel approach	Response positivity	Dog's reaction to experimenter's approach (0-retreat; 1-unreactive; 2-approach; 3-jump)	scale: 0-3
A4 Following	Position ahead	Average position of dog relative to experimenter (0- behind; 1-level; 2-ahead)	scale: 0-2
	Jump up	Dog jumps up placing fore-paws on experimenter	0/1

Abbreviations: freq-frequency; s-seconds; m-metres

Table 5.2 Behavioural variables measured over all 14 Dominance Test components- frequencies are the number of test components in which the behaviour occurs

Variable	Description	Units
Ears pricked	Dog pricks its ears	freq
Ears low	Dogs ears are low	freq
Tail movement	Dog wags its tail	freq
Lip smack	Dog makes noise by smacking its tongue on its lips	freq
Lick experimenter	Dog contacts experimenter with its tongue	freq
Mouth hand	Dog places its mouth around experimenter's hand	freq
Climb up	Dog jumps up at experimenter placing fore-paws on experimenter	freq
Low body position	Dog exhibits low posture	freq
Gaze aversion	Dog avoids eye contact with experimenter	freq
Tail tucked	Dog tucks its tail between its legs	freq
Lie	Dog lies down without command	freq
Nuzzle	Dog contacts experimenter with its head	freq
Sit	Dog sits uncommanded	freq
Roll	Dog rolls over on the floor	freq
Lick lips	Dog licks its lips	freq
Paw	Dog raises its paw or places paw on experimenter	freq
Display	Dog displays inguinal region towards experimenter	freq
Playful	Dog reacts playfully	freq
Avoid closeness	Dog avoids proximity by moving or orientating away from experimenter	freq

Other submissive		Dog performs "submissive" gestures, *e.g.* cringe	freq
Other dominant		Dog performs "dominant" behaviours *i.e* .growl, bark, bite lead	freq
Maintains contact		Dog maintains closeness by placing head on experimenter, moving arm onto self *etc.*	freq
Tail height		Dog's average tail throughout all components (1-tucked - 5-vertical)	scale: 1-5

Abbreviations: as in Table 5.2

Table 5.3 Behavioural variables measured during the Attachment Test

Test component	Variable name	Description	Units
A1 Kennel approach	Response positivity	Dog's reaction to experimenter's approach (0-retreat; 1-unreactive; 2-approach; 3-jump)	scale: 0-3
	Ears pricked	Dog pricks ears as experimenter approaches	0/1
	Ears low	Dog lowers ears as experimenter approaches	0/1
	Tail height	Dog's tail position on experimenter's approach (1-tucked - 5-vertical)	scale: 1-5
	Paw	Dog raises paw or contacts experimenter with paw when approached	0/1
	Mouth hand	Dog places its mouth around experimenter's hand when approached	0/1
	Lick hand	Dog contacts experimenter's hand with its tongue when approached	0/1
A2 Petting	No. withdrawals	No. of times dog moves to >1m from experimenter	freq
	Contact duration	Time dog maintains contact with experimenter	s
	Time close	Time dog spends <1m from experimenter	s
	Furthest distance	Furthest distance dog reaches from experimenter	m
	Lick experimenter	Dog's tongue contacts experimenter	0/1
	Paw	Dog places paw on experimenter	0/1
	Head in lap	Dog places head in experimenter's lap	0/1
	Mouth hand	Dog puts its mouth around experimenter's hand	0/1
	Jump up	Dog places both fore-paws on experimenter	0/1

A3 Ignoring	Duration close	Time dog spends <1m from experimenter	s
	Contact frequency	No. of times dog makes contact with experimenter	freq
	Furthest distance	Furthest distance dog reaches from experimenter	m
	Destructive	Dog chews furniture or fittings	0/1
	Paw	Dog places paw on experimenter	0/1
	Lick experimenter	Dog's tongue contacts experimenter	0/1
	Head in lap	Dog places its head in experimenter's lap	0/1
	Jump up	Dog places both fore-paws on experimenter	0/1
A4 Following	Time following	Time dog spends moving in same direction and behind experimenter <1m away	s
	Average distance	Mean distance of dog from experimenter	m
	Contact frequency	No. of contacts dog makes with experimenter	freq
A5 Separation	Time by door	Time dog spends <1.5m from exit door	s
	Whine frequency	No. of whine vocalisations	freq
	Scratch duration	Time dog spends scratching exit door	s
	Door jump	No. of times dog jumps up at exit door	freq
	Pant duration	Time dog spends panting audibly	s
	Chew duration	Time dog spends chewing furniture and fittings	s
	Sniff duration	Time dog spends sniffing at exit door	s
A6 Return	Greeting intensity	Subjective rating of dog's return greeting (0-none - 3-intense)	scale: 0-3
	Ears low	Dog greets experimenter with ears low	0/1
	Ears pricked	Dog greets experimenter with ears pricked	0/1
	Tail height	Dog's tail position on greeting experimenter (1-tucked - 5-vertical)	scale: 1-5
	Jumping	Dog jumps up placing fore-paws on experimenter during greeting	0/1
	Sit	Dog sits when experimenter re-enters room	0/1
	Lick experimenter	Dog licks experimenter on her return	0/1
D3 Call	Call lag	Latency of dog's approach following call	s
	Approach gait	Gait of dog's approach to experimenter (0-walk; 1-trot; 2-run; 3-bound)	scale: 0-3

Abbreviations: as in Table 5.2

5.4.4 Results

For simplicity the statistical techniques employed and their results are described in four stages.

5.4.4.1 Data reduction

A large number of behavioural variables were measured. To condense these into the relationship dimensions which they represent (see 5.4.2), I used a form of Factor Analysis - Principal Components Analysis (see Dytham 1999). This is a statistical technique which identifies underlying variables explaining the patterns of correlations within a set of measured variables. Thus the data set is reduced into a small number of factors which explain most of the variance observed. The factors are unique and do not overlap. Each factor PCA 1, 2, 3, *etc.* describes the data with decreasing efficiency *i.e.* PCA 1 describes the greatest amount of variability , PCA 2 describes more than PCA 3 *etc.* Eigenvalues quantify the contribution of each derived factor to the total variance in the data, with an Eigenvalue of 1.0 being equivalent to one measured variable. Plotting the Eigenvalues of successive factors produces a scree diagram. The gradient of the plot generally has a distinct break above which the factors are considered "useful" and explored further. Loading factors quantify the contribution of each observed variable to each useful factor. They can be positive or negative. As an arbitrary rule, those variables which have a loading factor of greater than half the maximum loading factor (irrespective of sign) are considered "key variables" for that factor.

The variables measured during each test (attachment and dominance) were treated as discrete data sets. Pre- and post-treatment scores were both included giving 60 data points for each variable. Scores for each variable were standardised (see Fowler *et al.* 1998). Principal Components Analysis was then carried out on the z scores. By definition, the factors for each test must be uncorrelated, but the factors produced for the two tests may

be correlated. The useful factors were therefore tested for correlations using's Pearson's Correlation test[7].

Dominance test

P.C.A. showed that the dominance test variables could be reduced into six useful factors which explained 40.4% of the initial variation. Examination of key variables revealed that Factors 3-6 were composed primarily (over 60%) of variables which were also loaded on Factors 1-2. Also, the combination of key variables in these later factors did not appear to represent the dimensions of the dog-human relationship which I was aiming to investigate, but reflected general temperament characteristics. Factors 3-6 were therefore rejected.

Attachment Test

Five useful factors were identified which accounted for 39.4% of the variation. Factors 4 and above were composed mainly of variables loaded on earlier factors, and did not represent attachment-dimensions. Factors 1-3 were retained for further examination.

Attachment Factor 1 was significantly correlated to Dominance Factor 1 (Pearson's Correlation test; P=0.77, $d.f.$=29, p<0.001) and Attachment Factor 3 was correlated to Dominance Factor 2 (P=0.39, $d.f.$=29, p<0.002). Examination of key variables showed that the dominance factors were best representative of the relevant dimensions of the relationship. Attachment Factors 1 and 3 were therefore rejected. Attachment Factor 2, and Dominance Factors 1 and 2 were retained. The key variables constituting each of these factors and their respective loading factors are shown in Tables 5.4-5.7.

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7 Pearson's test produces a correlation coefficient which is a measure of linear association between two variables. Values of the correlation coefficient range from -1 to 1. The sign of the coefficient indicates the direction of the relationship, and its absolute value indicates the strength, with larger absolute values indicating a stronger relationship (Dytham 1999).

Table 5.4 Key variables in Dominance Factor 1

Positively loaded variables			*Negatively loaded variables*		
Test component	**Variable name**	**Loading factor**	**Test component**	**Variable name**	**Loading factor**
All components	Tail movement	0.71	All components	Low body position	-0.80
All components	Lick experimenter	0.64	All components	Gaze aversion	-0.72
Lying	Stand on torso	0.56	Rise	Rise latency	-0.69
All components	Tail height	0.55	All components	Tail tucked	-0.62
Approach	Response	0.52	Sit	Orientate away	-0.52
All components	Mouth hand	0.51	Lying	Sit by	-0.52
Grooming	Stance height	0.50	Grooming	Time tolerated	-0.50
Call	Approach gait	0.50	All components	Lie	-0.47
All components	Climb up	0.46	Toy regain	Regain latency	-0.46
Lying	Step over legs	0.45			
Sit	Sit latency	0.44			
Shout	Stance height	0.41			
Rise	Reapproach gait	0.41			

Table 5.5 Key variables in Dominance Factor 2

Positively loaded factors			*Negatively loaded factors*		
Test component	**Variable name**	**Loading factor**	**Test component**	**Variable name**	**Loading factor**
All components	Maintains contact	0.54	Food	Response intensity	-0.36
All components	Display	0.54	Shout	Lower head	-0.35
All components	Roll	0.49	Toy removal	Drop latency	-0.34
All components	Nuzzle	0.44	Food	Contact bowl	-0.34
All components	Sit	0.39	Toy removal	Force required	-0.32
Toy removal	Brings toy	0.39	Call	Indirect approach	-0.32
Forced down	Shoulders first	0.38			
All components	Lick lips	0.37			
All components	Paw	0.34			
Shout	Change posture	0.33			
Lying	Step over torso	0.28			

Table 5.6 Key variables in Attachment Factor 2

Positively loaded variables			*Negatively loaded variables*		
Test component	**Variable name**	**Loading factor**	**Test component**	**Variable name**	**Loading factor**
Petting	Contact duration	0.65	Petting	No. withdrawals	-0.56
Ignoring	Duration close	0.60	Ignoring	Furthest distance	-0.44
Ignoring	Paw	0.48	Call	Call lag	-0.39
Petting	Paw	0.45	Ignoring	Destructive	-0.33
Return	Jumping	0.40			
Petting	Lick experimenter	0.35			
Return	Greeting intensity	0.33			
Kennel approach	Lick hand	0.33			

5.4.4.2 Construction of composite variables

P.C.A. procedure allocates each subject a score for each derived factor. These raw factor scores can be used as dependent variables in subsequent analysis (as in studies 5.5 and 8.2). However, in this case, the subjects are experimental animals. They belong to a single population which may be used for similar studies in the future. Use of factor scores would not permit inter-experimental comparisons as P.C.A. in subsequent experiments is extremely unlikely to produce identical factors. I therefore used the factors to construct composite variables. The same composite variables could be calculated in future studies, and the results compared to this experiment.

Each subject was assigned a composite score corresponding to each of the three factors. This was calculated by adding the z scores for each key variable within the factor. Scores for negatively loaded variables were given negative z scores. If a variable occurred in multiple factors, it was only included in the calculation of the one for which it was most heavily loaded. The composite variable scores were highly correlated to the raw factor scores (Rho>0.94, $d.f.$=29, p<0.001).

The three composite variables were assigned names which summarised the behavioural variables of which they were composed and hence the relationship dimensions they represented. The composite variable for Dominance Factor 1 was named "Confidence"; Dominance Factor 2 - "Amenability" and Attachment Factor 2 - "Contact seeking". These were used as dependent variables in subsequent analysis.

5.4.4.3 Distribution of pre-treatment scores

Age and sex

The effects of sex and age on the pre-treatment composite variables were tested. Two-way ANOVAs (see 3.3.2.3 for description of technique) determined the effect of each independent variable, and their interaction upon the three dependent variables. Neither Amenability nor Contact seeking were affected by sex or age of dog. Confidence, however, was affected by both sex (significant at p<0.1) and the interaction between sex

and age (Table 5.7). The direction of the effects of the independent variables on Confidence are shown in Table 5.8.

Table 5.7 *Results of two-way ANOVA exploring the effects of sex and age of dog on pre-treatment scores for each of the composite variables*

Variable	Sex Main Effect		Age Main Effect		Sex/age Interaction	
	$F_{(1,25)}$	*p*	$F_{(2,25)}$	*p*	$F_{(1,25)}$	*p*
Confidence	3.08	<0.1	2.70	>0.1	5.96	<0.05
Amenability	0.17	>0.1	0.82	>0.1	0.46	>0.1
Contact seeking	1.28	>0.1	1.24	>0.1	0.37	>0.1

Table 5.8 *Mean (± S.E.) Confidence scores of dogs in each sex and age class*

Sex	Age group	N	Mean (± S.E.) Confidence score
Female	<1 year	9	0.74 ± 0.23
	1-3 years	5	-1.03 ± 0.38
	>3 years	9	-0.53 ± 0.28
	Total	23	-0.14 ± 0.22
Male	<1 year	5	0.43 ± 0.36
	1-3 years	2	0.57 ± 0.28
	>3 years	0	-
	Total	7	0.47 ± 0.26

Overall males scored higher for Confidence than females, and young females scored higher than older females. These effects highlight the importance of achieving balanced treatment groups at the outset. I therefore examined the distribution of the pre-treatment scores, amongst the five treatment groups. One-way ANOVAs tested the effect of group upon each of the composite variables. The inter-group variation in pre-treatment scores for each variable differed non-significantly from that predicted by a random distribution (Confidence: $F_{(4,25)}= 0.95$, $p>0.4$; Amenability: $F_{(4,25)}= 0.78$, $p>0.5$; Contact seeking:

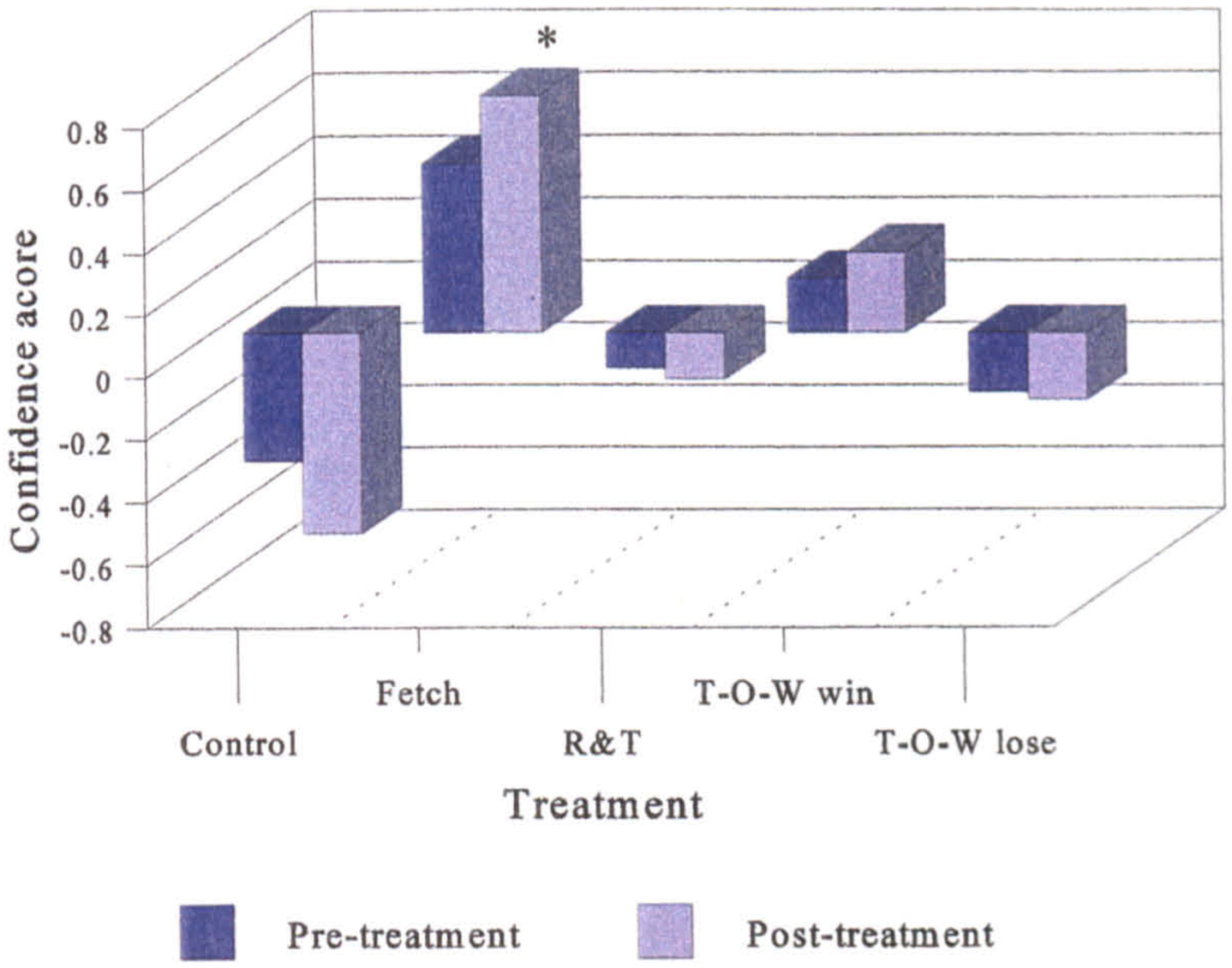
$F_{(4,25)}$= 0.13, p>0.9). I therefore concluded that the criteria used to divide the subjects between groups (5.4.3.3) had been effective in producing balanced treatment groups.

5.4.4.4 Changes over the treatment period

I tested whether there were general changes in the variables over the experimental period. Pre- and post-treatment scores for each of the 30 dogs (for each variable) were compared using paired t-tests (for description refer to 4.5.2.6). There was a general increase in "Amenability" over the treatment period (t=3.58, *d.f.*=29, p=0.001). The other two variables showed no general trend.

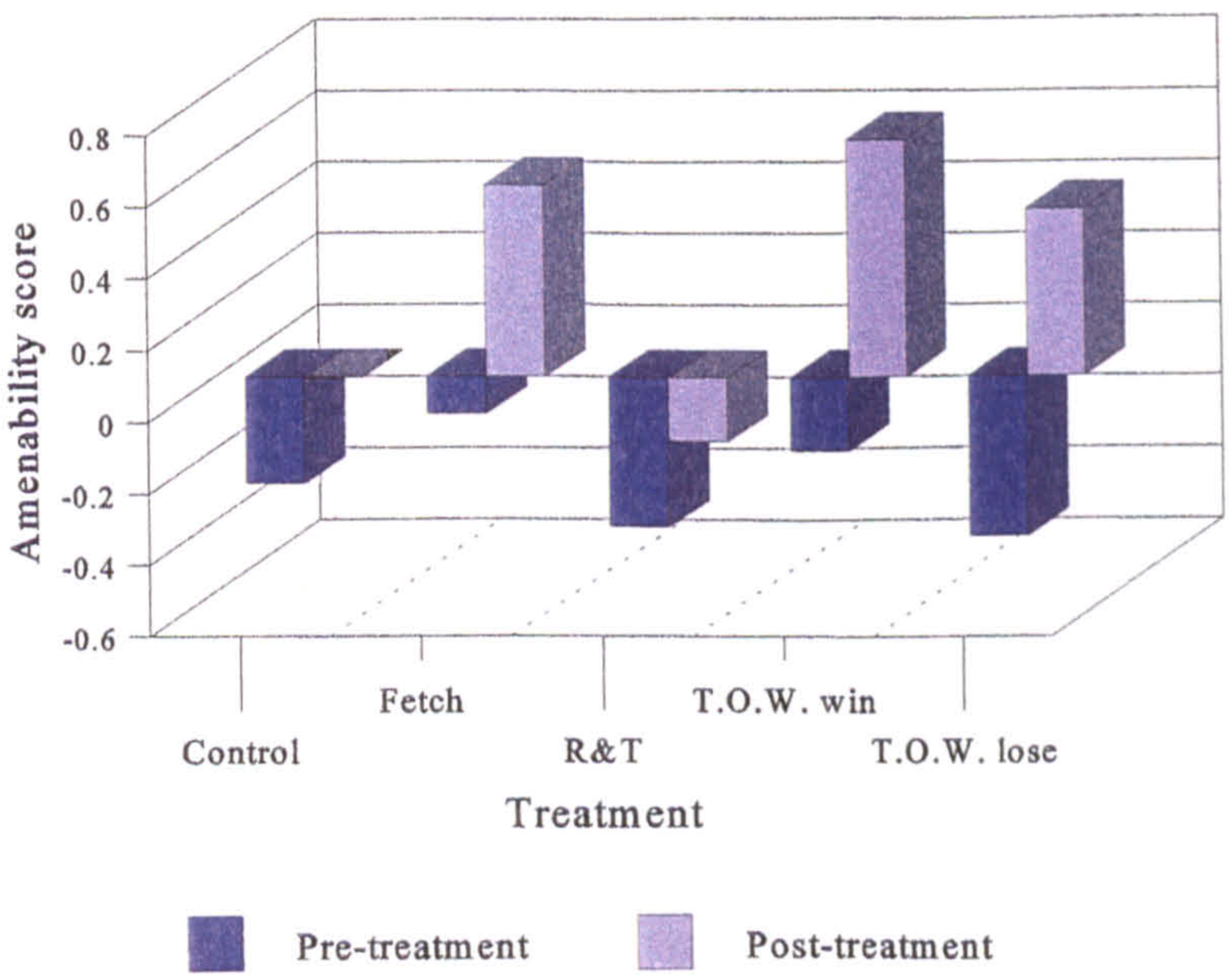
I next examined each treatment group individually, comparing the six dogs' pre- and post-treatment scores. Paired t-tests identified groups which had experienced significant changes in any of the three variables. Players of Fetch significantly increased in their Confidence scores over the treatment period (t=2.93, *d.f.*=5, p=0.03; Figure 5.2). Confidence was not significantly affected by the other play treatments. Amenability scores were higher post-treatment in all groups (Figure 5.3). The increase approached significance (t>2.2, *d.f.*=5, p<0.1) in controlled and uncontrolled Tug-of-war groups. Contact seeking scores decreased over the treatment period in the players of Rough-and-tumble, but not significantly (t=-1.2, *d.f.*=5, p=0.29; Figure 5.4). Controlled Tug-of-war players experienced a very small decrease in Contact seeking. The other two groups (uncontrolled Tug-of-war and control) increased in Contact seeking, but this was significant only in the control group (t=2.60, *d.f.*=5, p<0.05). No inter-group comparisons were made due to the small sample sizes.

Figure 5.2 *Changes in mean Confidence scores between pre- and post-treatment tests for dogs in each treatment group*



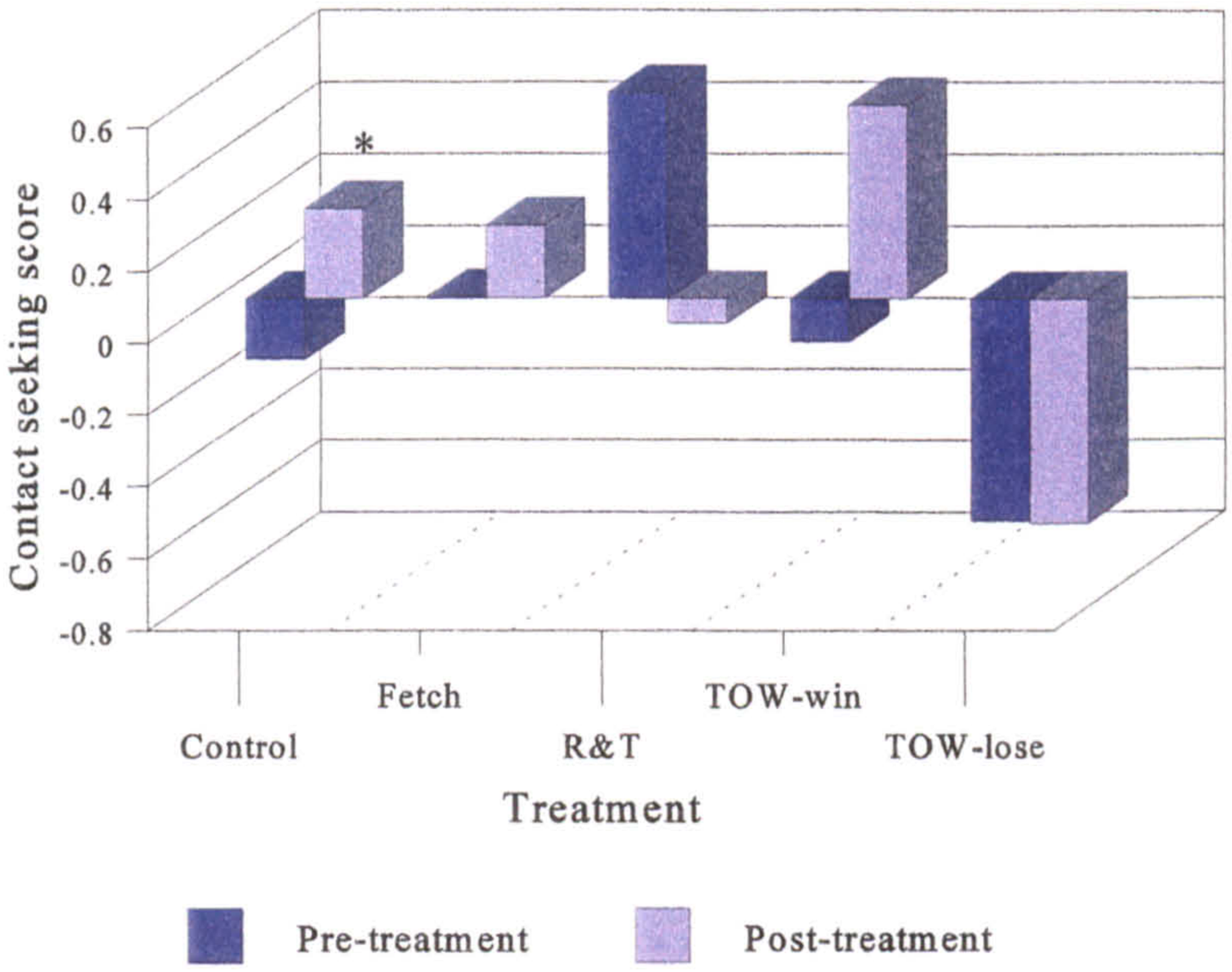
** p<0.05; Abbreviations: R&T - Rough-and-tumble; T.O.W win - Group 4, uncontrolled Tug-of-war; T.O.W lose - Group 5, controlled Tug-of-war*

Figure 5.3 *Changes in mean Amenability scores between pre- and post-treatment tests for dogs in each treatment group*



Abbreviations as in Figure 5.2.

Figure 5.4 *Changes in mean Contact seeking scores between pre- and post-treatment tests for dogs in each treatment group*



**p<0.05. Abbreviations as in Figure 5.2.*

I then explored whether the changes in the three composite variables were correlated. Between-test differences were calculated for each subject, and for each group, for all three variables. Spearman Rank Correlation tests (see 2.3.3.3 for description of technique) explored correlations between the three scores. When examining each subject, changes in Confidence were significantly correlated with changes in both Amenability (*Rho*=0.36, *d.f.*=29, $p<0.05$) and Contact seeking (*Rho*=0.39, *d.f.*=29, $p<0.05$). Dogs experiencing large changes in one dimension of their relationship were also likely to show changes in other dimensions. However, the mean changes per group showed no correlations between the variables (*Rho*<0.5, *d.f.*=4, $p>0.35$).

5.4.5 Discussion

The results show that specific dimensions of a dog-human relationship are affected by the playing of different games. This supports the General Hypothesis 2 that

"play between dogs and people has consequences outside the game".

The correlation between changes in the three variables suggests that some subjects were predisposed to alteration in their relationship with the experimenter, whilst others were less so. However, there was no correlation between mean group changes, indicating that the inter-subject variability was not a result of the different treatments, but an intrinsic characteristic of the individual dogs.

5.4.5.1 Dominance-related effects

The dominance test identified two relevant factors or relationship dimensions. Traditionally, a dog which exhibits behaviours which score either high in Confidence (*e.g.* high tail positions: Beaver 1982; standing over a lying person: Scott and Fuller 1965) or low in Amenability (*e.g.* reluctance to surrender a toy: Overall 1997; no rolling or displaying: Scott and Fuller 1965) would be described as behaving "dominantly" towards the experimenter. Here, Confidence and Amenability were found to be separate, uncorrelated factors, thus confirming the multi-dimensional nature of dominance.

5.4.5.1.1 Individual differences

Confidence was affected by characteristics of the dog. Males overall scored higher than females (significant only at $p<0.1$), but young females were the highest scoring sub-class. These differences imply that specific age and sex categories were predisposed to develop a highly Confident relationship with the experimenter and could be described as "assertive" (van Hooff and Wensing 1987; see 1.3.2.2). Amenability scores were not affected by age or sex, but did show a general increase over the treatment period. This suggests that Amenability is a property of a specific dog-human relationship and hence changes with familiarity of partners, whilst Confidence is influenced to a greater extent by

characteristics of individual the dog. Both dimensions can however, be altered by the pattern of interactions between dog and human.

5.4.5.1.2 Effects of Tug-of-war

The dominance enhancement theory predicts that uncontrolled Tug-of-war would lead to an increase in Confidence and/or a decrease in Amenability. Conversely, controlled Tug-of-war would be expected to decrease Confidence and/or increase Amenability. The results show that Confidence scores did increase slightly in the uncontrolled Tug-of-war group and decrease slightly in controlled Tug-of-war players, according to predictions, but neither difference was statistically significant. Amenability scores increased in both groups (significant at $p<0.1$) which was not expected in the uncontrolled Tug-of-war players.

5.4.5.1.3 Effects of other game types

Claims about other games include that Rough-and-tumble can induce dominance-related problems (similarly to uncontrolled Tug-of-war (McBride 1995)).The Rough-and-tumble group decreased very slightly in Confidence and increased in Amenability. Neither change was significant; both were in the opposite direction to those predicted and the same directions as the control group. These results suggest that Rough-and-tumble has little effect on dominance-dimensions of the dog-human relationship.

Fetch is a human-controlled game and is claimed to reinforce human dominance, similarly to controlled Tug-of-war (Rogerson 1992). Fetch players increased in Amenability, according to prediction, but they also experienced a significant increase in Confidence. This change was not predicted.

The results do not support any of the claims about dominance-related effects of games. There are two particular anomalies: a significant increase in Confidence in Fetch players, converse to that predicted, and an increase in Amenability in uncontrolled Tug-of-war players, also contrary to popular theory. So how can these results be explained?

5.4.5.1.4 Previous experiences

I suggest that the previous experiences of the dogs is an important factor. I examined the records of play interactions between the subjects and dog-care staff, for the experimental period. The vast majority (98%) of documented games were Fetch. Familiarity with this game type may explain why the dogs' Confidence increased. Tug-of-war did not feature in the play records. This was a new game for most of the dogs and many needed to be encouraged to play at the outset. Learning a new game may be an intimidating process which could account for the dogs' increased Amenability towards their play partner.

5.4.5.1.5 Current relationships

One possible reason for a lack of "dominance enhancement" via uncontrolled Tug-of-war is that the dog and human relationship was stable at the outset of the experiment. Bekoff (1977) claimed that hierarchy formation could not be the function of coyote play, as play peaked in ontogeny after the hierarchy was formed. Thus, if a dog-human relationship is already formed, Tug-of-war may have little effect. This possibility was controlled for, as the experimenter was unfamiliar to all dogs at the beginning of the acclimatisation period. However, these dogs were institutionalised and had regular contact with a large number of people. It is possible that they generalised their relationships with people, so although they had no specific relationship with the experimenter, they were generally "subordinate" to all humans. The experimenter wore distinctive clothing, novel to the dogs, to minimise this possibility but generalisation remains plausible. For this reason, further experiments (5.5) used dogs which were kept in a home environment and were more likely to develop a specific relationship with a new person.

5.4.5.1.6 Concluding comments

The results do not support the hypothesis of increased dominance caused by uncontrolled Tug-of-war, but as yet, I have insufficient evidence for its rejection. This study was designed as a preliminary investigation and methodologies were still under development. The sample was a single population of dogs, kept in a research environment. They represent one breed, and inter-breed differences in behaviour may affect the results (Bradshaw *et al.* 1996). Group sizes of six were relatively small, accentuating inter-dog variation and making statistical significance difficult to achieve. I therefore tested the dominance-enhancement theory further using a large sample of non-institutionalised dogs (5.5).

5.4.5.2 Attachment-related effects

The attachment test produced one factor describing a contact-seeking dimension of the dog-human relationship. Although it is likely that attachment is multi-dimensional, this factor is particularly useful as it represents an important aspect of the dog-human relationship. Dogs scoring high in Contact seeking sought and maintained proximity with the experimenter and showed a marked response to reunion with the experimenter following separation. Under Gubernick's criteria (1981) they would be described as "attached". Most owners require some degree of Contact seeking from their dog, yet very high scores for this trait can be undesirable. Such dogs may be described as "over-attached" (M^{c}Cune *et al.* 1995); a state thought to be a prerequisite for the development of separation problems (Clark and Boyer 1993).

5.4.5.2.1 Effect of different game types

Contact seeking was not affected by age or sex of dog, but it did change as a result of the different experimental procedures. The initial hypothesis was that Rough-and-tumble would produce different effects upon attachment dimensions compared to the object-oriented games. The players of Rough-and-tumble were the only group to show a marked decrease in Contact seeking (although not statistically significant), which suggests this game type has specific effects. The control group increased significantly in this measure

over the treatment period, whilst all play treatments resulted in less Contact seeking. This result is consistent with that of Topál *et al.* (1997) who observed decreased owner proximity by dogs that played for longer. The direction of this effect may seem surprising but there are a number of possible explanations.

5.4.5.2.2 Increased security

Firstly, one feature of an attachment is the "use of the attachment figure as a secure base from which to explore the world" (Gubernick 1981). A decrease in Contact seeking could represent an increase in this "security" element of attachment. Thus, decreased Contact seeking may be consistent with the "social cement" hypothesis about play. However, it is impossible to tease apart the effects of increased security (increased attachment) and decreased proximity maintenance (decreased attachment), both of which may manifest as similar behavioural changes.

5.4.5.2.3 Prevention of over-attachment

Clark and Boyer (1993) compared the behaviour of dogs which underwent a programme of obedience training to those whose owners were instructed by behavioural counsellors and a control, uninstructed group. The treatment groups both attained lower levels of "separation anxiety" (measured by response to being left alone) and showed a trend for lower proximity and tactility than the control group. They subsequently developed fewer behaviour problems and their owners became more attached to them. The authors inferred that the treatments had impeded the development of clinging and insecure behaviour ("over-attachment") and thus improved the dog-human relationship.

The current results can be interpreted in a similar way. Contact seeking is composed of variables measuring both proximity and tactility. All play treatments resulted in lower levels of Contact Seeking than the control petting treatment, so play may have impeded over-attachment, just as obedience training did - a positive effect. It follows that Rough-and-tumble was the most effective play treatment in reducing Contact seeking and may be considered the most beneficial play type. This could be a result of the amount of physical

contact which dog and human exchange during non-object play (4.2.3). This may fulfil the dog's need for contact which it no longer needs to seek. Similar trends are seen in laboratory rats as deprivation of social contact leads to an increased drive for Rough-and-tumble play (Ikemoto and Panksepp 1992). These results are preliminary and further evidence is needed to substantiate my ideas.

5.4.5.2.4 Dogs' expectations

Alternatively, these results may be caused by the experimental treatments affecting the dogs' expectations. Each time the dogs interacted with the experimenter, in the experimental room, the interaction was the same type - control dogs were petted and treatment dogs played. The control dogs may have learnt to seek contact in order to interact with the experimenter. Contrastingly, the dogs receiving the play treatment may have moved away in an attempt to instigate play (approach-withdrawal sequences being a canid play signal; Fox *et al.* 1976). However, this explanation does not account for the decrease in Contact seeking in the Rough-and-tumble group whilst Fetch, and uncontrolled Tug-of-war groups increased. The problem of learnt expectancies affecting attachment assessment is impossible to overcome in an experimental situation. Experimental studies are not representative of the natural situation where interactions between dog and owner are of many different varieties. To examine effects on attachment-dimensions of the dog-human relationship further, I therefore studied play within its natural context, the home (Chapter 8).

5.4.6 Concluding comments

From this preliminary experiment several tentative conclusions can be drawn, each of which is tested further in subsequent chapters:

a) Controlled and uncontrolled Tug-of-war have no effect on dominance dimensions of the dog-human relationship (5.5 and Chapter 8).

b) Play between dog and human reduces the performance of contact seeking behaviour by the dog (Chapter 8).

c) Rough-and-tumble play has the greatest effect on attachment-dimensions (Chapter 8) of the dog-human relationship.

5.5 An experimental study of the effects of controlled and uncontrolled Tug-of-war on the dog-human relationship

5.5.1 Introduction

Surveys (5.3) and a preliminary experiment (5.4) have failed to provide evidence in support of the "dominance enhancement theory" about dog-human games. From the previous study I drew the tentative conclusion that:

> *"uncontrolled and controlled Tug-of-war have no effect on dominance-dimensions of the dog-human relationship".*

The current experiment tests this further. The subjects were Golden Retrievers, a breed reportedly prone to behavioural problems, but which unlike the Labrador Retriever, shows a high incidence of owner-directed aggression (Mugford 1995). This experiment was carried out in the domestic environment.

5.5.2 Method

5.5.2.1 Design

The experiment followed a within-subjects, counter-balanced design.

5.5.2.2 Subjects

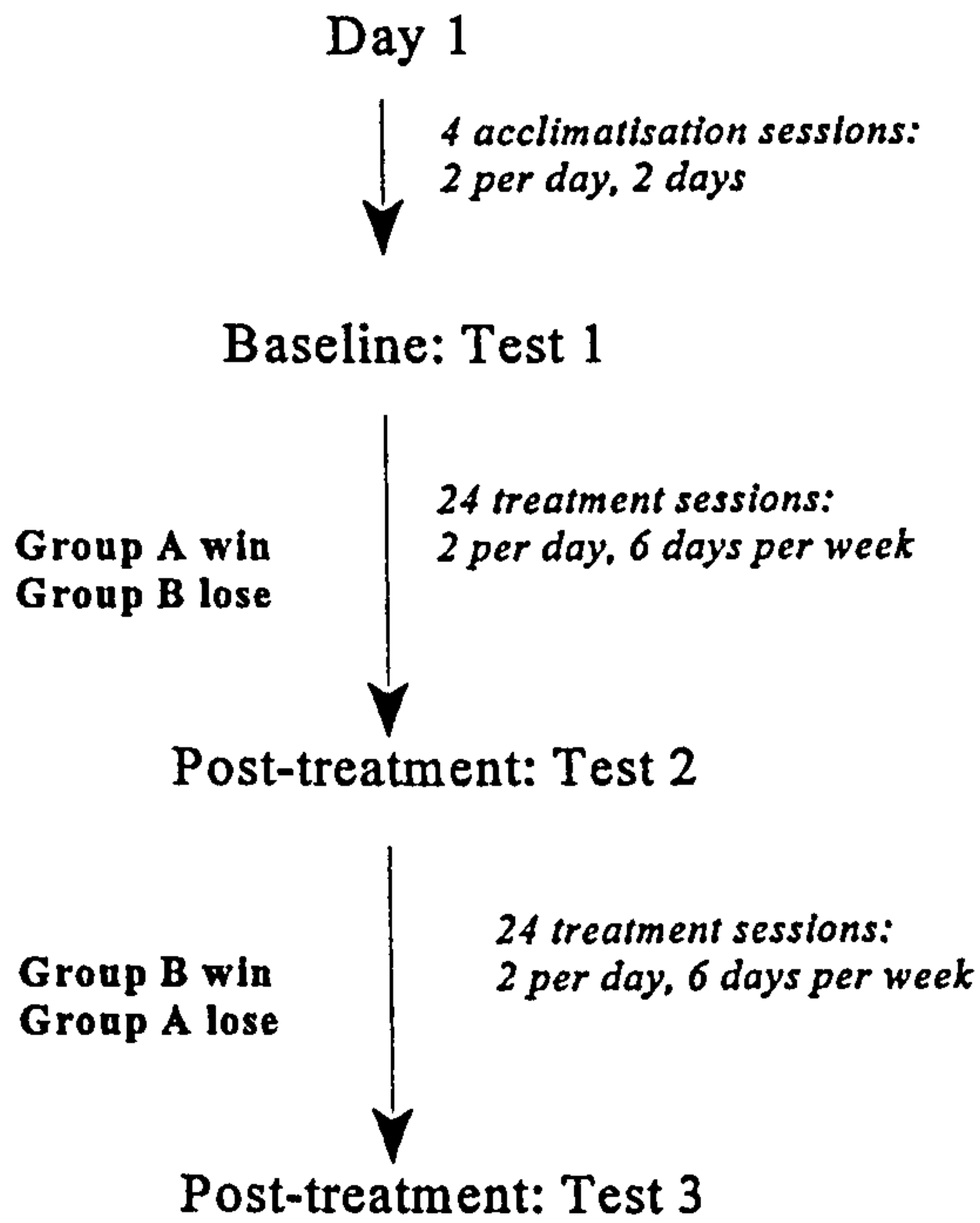
The subjects were 14 Golden Retrievers, three males and eleven females, ranging in age from 6 months to 11 years 3 months (mean=63.6 months). They were owned by Mr. and Mrs. F. Taylor (Applemore Kennels, Hampshire; OS grid reference: SU403068), and used for breeding and showing purposes. The dogs were housed in the kitchen and utility room of the family home and, during daytime, had unrestricted access to an outside yard area. Half way through the study the males were moved to a large kennel 200m from the

house, where they were housed communally for the remainder of the experiment. All dogs had met the experimenter on one occasion prior to the experiment.

5.5.2.3 Procedure

At the outset the owner subjectively rated each of the subjects for dominance (relative to herself) and playfulness, both on a scale of 1-5 (these ratings were used to achieve balance treatment groups as described below). The experimental procedure was similar to that in Experiment 5.4, but involved two acclimatisation and treatment sessions per day. The protocol is outlined in Figure 5.5.

Figure 5.5 *Outline of the experimental protocol for testing the effects of Tug-of-war games on the relationship between Golden Retrievers and an experimenter*



Acclimatisation Four five minute acclimatisation sessions were used to introduce the dogs to the experimenter. There were two sessions per day for two days, at 0830 hrs

and 1630 hrs. Each dog was taken into the garden adjacent to their living area. The garden was familiar to all the dogs. The experimenter sat on a chair and moderately petted (as defined in 5.4.3.3) the dog if it approached, but did not actively encourage it to do so.

Baseline Test Testing took place in a conservatory which linked the experimental garden area to the kitchen where the dogs lived. The conservatory measured approximately 6m x 6m. The door connecting the conservatory to the kitchen was closed to minimise disturbance, but the door to the garden was left open and the adjoining gardens used for some of the test procedures. Tests were filmed using a video camera (Sony Video 8 CCD-TR370E) on a tripod in the corner of the conservatory. All dogs were tested on one day, in a randomised order, but the order remained the same in subsequent tests.

The test was based upon the dominance test described above (5.4.3.3). To improve efficiency and accommodate the difference in location and facilities, several modifications were made:

a) components "D1- Lead walking" and "A4 - Following" contributed no key variables to either of the dominance factors, in the previous experiment, so were not included in the current test.[8]
b) component "D2 - Approach" was performed in the garden area,
c) component "D3 - Call" was performed whilst the dog was in the garden and the experimenter was in the conservatory,
d) component "A1 - Kennel Approach" was not possible as the dogs were not kennelled,
e) The order of the components was altered to accommodate the normal feeding routine and was;

D12, D3, D4, D5, D6, D7, D2, D13, D14, D14, D8, D9, D10.

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8 Tests "D5 - Gaze aversion" and "D10 - Door entry" also produced no key variables in the previous experiment, however Wickens (1993) suggests that there are inter-breed differences in the use of gaze and displacements so it was decided to retain these components in the current test.

Otherwise the test was identical to that used previously, and the behaviour of each subject during each component described into a Dictaphone and also video-taped. Components D9, D12 and D14 are illustrated in Figures 5.6-5.8 and component D5 is shown on the chapter header page.

Treatment Period 1 Dogs were divided into two groups, A and B. The subjects in each were balanced in age, sex, and their owner's ratings of dominance and playfulness. Each dog played with the experimenter for two three minute sessions per day. Sessions took place at the same times and in the same place as the acclimatisation sessions. Games revolved around a Ragger, but if the dog was reluctant to play with this, a preferred toy was used (*e.g.* a plastic tug-toy or squeaky toy). Group A dogs played uncontrolled Tug-of-war games; they were allowed to win the majority (at least two thirds) of the competitions and maintain possession of the toy at the end of the game (Figure 5.9). The dogs in Group B played controlled Tug-of-war and the experimenter won most of the competitions (Figure 5.10). These treatments are subsequently referred to as Tug-of-war "win" and "lose" respectively. During each play session the experimenter recorded the number of competitions won by each partner, and subjective ratings for "Involvement" and "Determination" to win displayed by the dog (both on a 1-5 scale).

Test 2 After 24 treatment sessions the dogs were re-tested using the same procedure and order as the baseline test.

Treatment Period 2 Twenty four further treatment sessions followed, but the treatment groups were reversed; Group B dogs played Tug-of-war win and Group A dogs Tug-of-war lose.

Test 3 The final test was identical to Tests 1 and 2 described above.

Figure 5.6



Test component D14 - Grooming

Figure 5.7



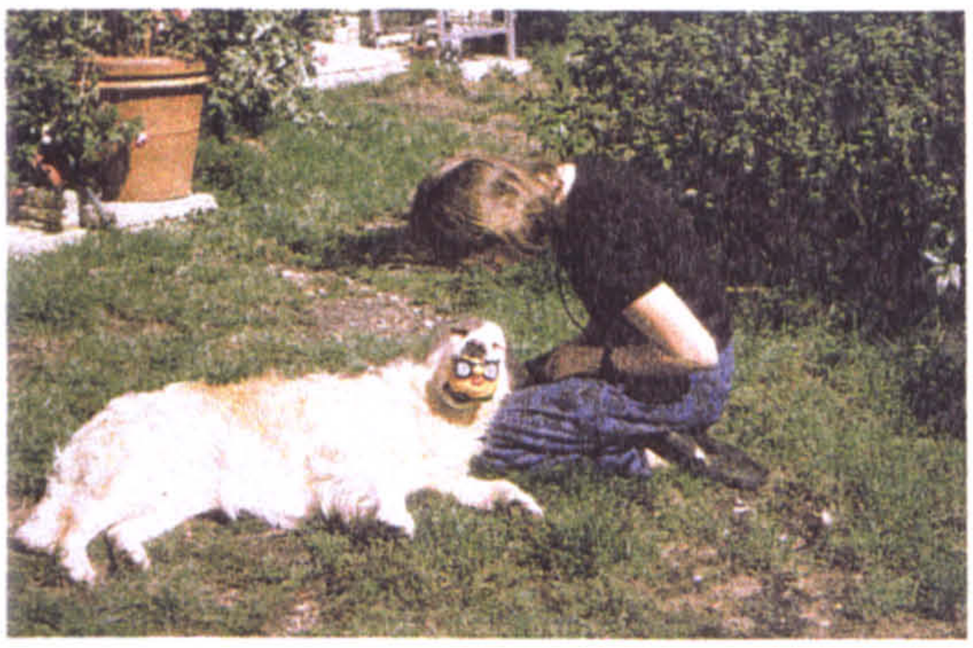
Test component D 12 - Food removal

Figure 5.8



Test component D9 - Toy regain

Figure 5.9



Uncontrolled Tug-of-war - dog retains possession of the toy in the majority of competitions

Figure 5.10



Controlled Tug-of-war - experimenter retains possession of the toy in the majority of competitions

5.5.2.4 Behavioural measures

Preliminary observations were used to identify variables which were exhibited by, and showed variation in, at least 10% of subjects (see 5.4.3.4). Ten new variables were identified which were not measured in the previous study (Table 5.9).

Table 5.9 New variables measured in current Dominance Test, but not defined in Tables 5.2 and 5.3

Test component	Variable name	Description	Units
D4 Sit	No. sit responses	No. of times dog responds to sit command (of a maximum of 2)	freq
D6 Forced down	No. comply	No. of times dog lies in response to pressure on its shoulders (of a maximum of 2)	freq
D13 Lying	Stance height	Posture assumed by dog for majority of 30 seconds whilst experimenter lies on the floor (0-lie; 1-sit; 2-stand; 3-move)	scale: 0-3
D10 Shout	Startle/change	Dog displays either startle or changes posture in response to shout (as described in Table 5.2)	0/1
	Approach	Dog approaches experimenter immediately following shout	0/1
All components	Head in lap*	No. of components in which dog places head in experimenter's lap	freq
	Growl / moan†	No. of components in which dog makes low pitched moaning or growling vocalisation	freq
	Submissive grin	No. of components in which dog pulls corners of mouth back laterally in a "submissive grin" (Fox 1970)	freq
	Whimper	No. of components in which dog makes high pitched whimpering vocalisation	freq
	Pant	No. of components in which dog pants audibly	freq

Key: included in "Maintains contact" in previous experiment; †included in "Other dominant" in previous experiment (both actions being more common in this population - performed by >10% of subjects)*

Those variables which had been measured in the previous experiment were screened further. In the previous dominance test, 71 variables were measured but only 40 figured as key variables in the two dominance-related factors (Tables 5.4 and 5.5). There was an

option to eliminate all variables which were not previously key variables from the current test. However, there are inter-breed differences in the use of behavioural patterns (Bradshaw *et al.* 1996), and so some variables may be important to Golden Retrievers, but not Labradors. I therefore considered each variable individually and made a decision based on how frequently the behaviour is documented as indicating "dominance", and whether other variables measured similar qualities. Twenty seven original variables were thereby eliminated and 42 retained (Table 5.10). In combination with the ten new variables, this produced a refined test with 52 variables measured during 13 components.

Table 5.10 Variables retained in current Dominance test (as defined in Tables 5.2 and 5.3), together with those described in Table 5.9

Test component	Variable	Test component	Variable
D2 Approach	Response positivity	D13 Lying	Stand over torso
D3 Call	Call lag		Nuzzle
	Approach gait		Sit by
	Indirect approach	All components	Ears pricked
D4 Sit	Sit latency		Ears low
	Orientate away		Tail movement
D5 Eye contact	Stare duration		Lick experimenter
D6 Forced down	Comply latency		Mouth hand
D7 Rise	Rise latency		Climb up
	Reapproach gait		Low body position
D8 Toy removal	Drop latency		Gaze aversion
	Force required		Tail tucked
	Brings toy		Lie
	Skirts/blocks		Lick lips
D9 Toy regain	Regain latency		Nuzzle
D11 Door entry	Position ahead		Sit
D12 Food removal	Contact bowl		Roll
	Response intensity		Paw
	Feed latency[9]		Display
D14 Grooming	Stance height		Maintains contact
	Cringe		Tail height

5.5.3 Results

5.5.3.1 Data reduction

Principal Components Analysis was carried out on the standardised scores of the 52 variables. Scores for each test were included giving 42 rows of data (three per subject). Examination of the scree diagrams pointed to nine "useful" factors, all with Eigenvalues

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9 In the previous experiment "Feed latency" was measured on a scale, but here standard conditions made it possible to measure it in seconds.

greater than 2.0 and jointly accounting for 66.4% of the variation in the data. In the previous experiment (5.4) the methodology was still under development, and comparisons were preliminary. I therefore restricted analysis to those factors clearly representing dominance-related dimensions of the relationship. The test used in this study was a refined version, but still generated nine useful factors. These all represent separate dimensions of the dog-human relationship and I therefore examined the effect of the treatment procedure on each of these factors. Tables 5.11 to 5.14 display only the most relevant factors; those which represent dominance-dimensions (Factor 1) or were affected by the treatments (Factors 3, 5 and 8). The tables show the key variables composing each factor, and their respective loading factors. Each factor were assigned a name which summarised its component variables and these are included in the title of each table. The remaining five factors are displayed in Appendix 7.

Table 5.11 Key variables in Factor 1: Confidence

Positively loaded variables			*Negatively loaded variables*		
Test component	**Variable name**	**Loading factor**	**Test component**	**Variable name**	**Loading factor**
Lying	Stand over torso	0.85	Toy regain	Regain latency	-0.62
All components	Tail height	0.76	All components	Gaze aversion	-0.58
All components	Tail movement	0.71	Grooming	Cringe	-0.55
Call	Call lag	0.70	All components	Roll	-0.57
All components	Climb up	0.65	Rise	Rise latency	-0.57
Approach	Response	0.64	All components	Tail tucked	-0.53
All components	Mouth hand	0.55	All components	Display	-0.53
Shout	Shout approach	0.54	All components	Lick lips	-0.51
Grooming	Stance height	0.53	All components	Ears low	-0.51
Lying	Stance height	0.51			
Door entry	Position ahead	0.49			
Toy removal	Force required	0.48			
All components	Maintains contact	0.47			

Table 5.12 Key variables in Factor 3: Obedient attentiveness

Positively loaded variables			*Negatively loaded variables*		
Test component	**Variable name**	**Loading factor**	**Test component**	**Variable name**	**Loading factor**
All components	Ears pricked	0.65	Food removal	Contact bowl	-0.50
Forced down	No. comply	0.61	All components	Gaze aversion	-0.44
All components	Paw	0.55	All components	Nuzzle	-0.37
All components	Lick experimenter	0.40	Forced down	Comply latency	-0.37
All components	Lie	0.41	Lying	Stance height	-0.36
Food removal	Feed latency	0.39	Food removal	Response intensity	-0.35
Eye contact	Stare duration	0.37			
Call	Call lag	0.35			

Table 5.13 Key variables in Factor 5: Demandingness

Positively loaded variables			*Negatively loaded variables*		
Test component	**Variable name**	**Loading factor**	**Test component**	**Variable name**	**Loading factor**
All components	Growl / moan	0.54	Grooming	Stance height	-0.30
All components	Ears low	0.50	Lying	Sit by	-0.29
Food removal	Response	0.49	Lying	Stance height	-0.26
Rise	Reapproach gait	0.48	Food removal	Feed latency	-0.28
All components	Maintains contact	0.47	All components	Lick experimenter	-0.27
Call	Indirect approach	0.45			
Toy removal	Drop latency	0.40			
All components	Head in lap	0.30			
All components	Display	0.29			
All components	Lie	0.28			
Forced down	Comply time	0.28			

Table 5.14 Key variables in Factor 8: Playful attention seeking

Positively loaded variables			*Negatively loaded variables*		
Test component	**Variable name**	**Loading factor**	**Test component**	**Variable name**	**Loading factor**
All components	Nuzzle	0.61	Forced down	No. comply	-0.41
All components	Paw	0.52	Sit	Sit latency	-0.38
All components	Submissive grin	0.42	Sit	Orientate away	-0.37
Food removal	Contact bowl	0.35	Door entry	Position ahead	-0.35
Call	Approach gait	0.31			

Factor 1 comprised ten of the 20 key variables in the Confidence factor in the previous experiment (5.4) and was therefore also named "Confidence". In future work, it may be useful to compare the test results for this sample to other dog populations. Comparison of factor scores is meaningless, but the distribution of key variables may be compared. Distribution of scores for Confidence key variables are presented in Appendix 8.

In the previous experiment composite variables were calculated to represent factors (5.4.4.2). This was done because the same dogs may feature in subsequent studies when composite variables can be regenerated. The current study used a privately owned population of dogs, which is unlikely to be used in subsequent work. The factor solution produced here is probably unique to this population (or possibly breed), and so there was no benefit in using composite variables. Therefore all subsequent analysis was performed using the raw factor scores.

5.5.3.2 Effects of play treatments

Repeated Measures ANOVAs were carried out to assess the effect of preceding treatment type upon the scores for each of the nine factors. Initial tests included three treatment types for each subject: none (baseline measure), Tug-of-war win and Tug-of-war lose. For

factors showing significant effects, *post-hoc* Tukey's Honestly Significant Difference tests[10] were used to determine homogeneous subsets.

Further analysis was performed using just the results of tests 2 and 3 (not baseline). Two-way Repeated Measures ANOVAS explored the effect of the play treatment (win or lose) and order (test 2 or 3) on each factor score. I present the results of the analysis on Confidence, as the hypothesis predicts change in this factor. Presentation of further results is restricted to the factors which show significant changes.

Factor 1 There was no consistent pattern of change in Confidence scores, but individual subjects were differently affected by the treatments (Figure 5.11a and b).

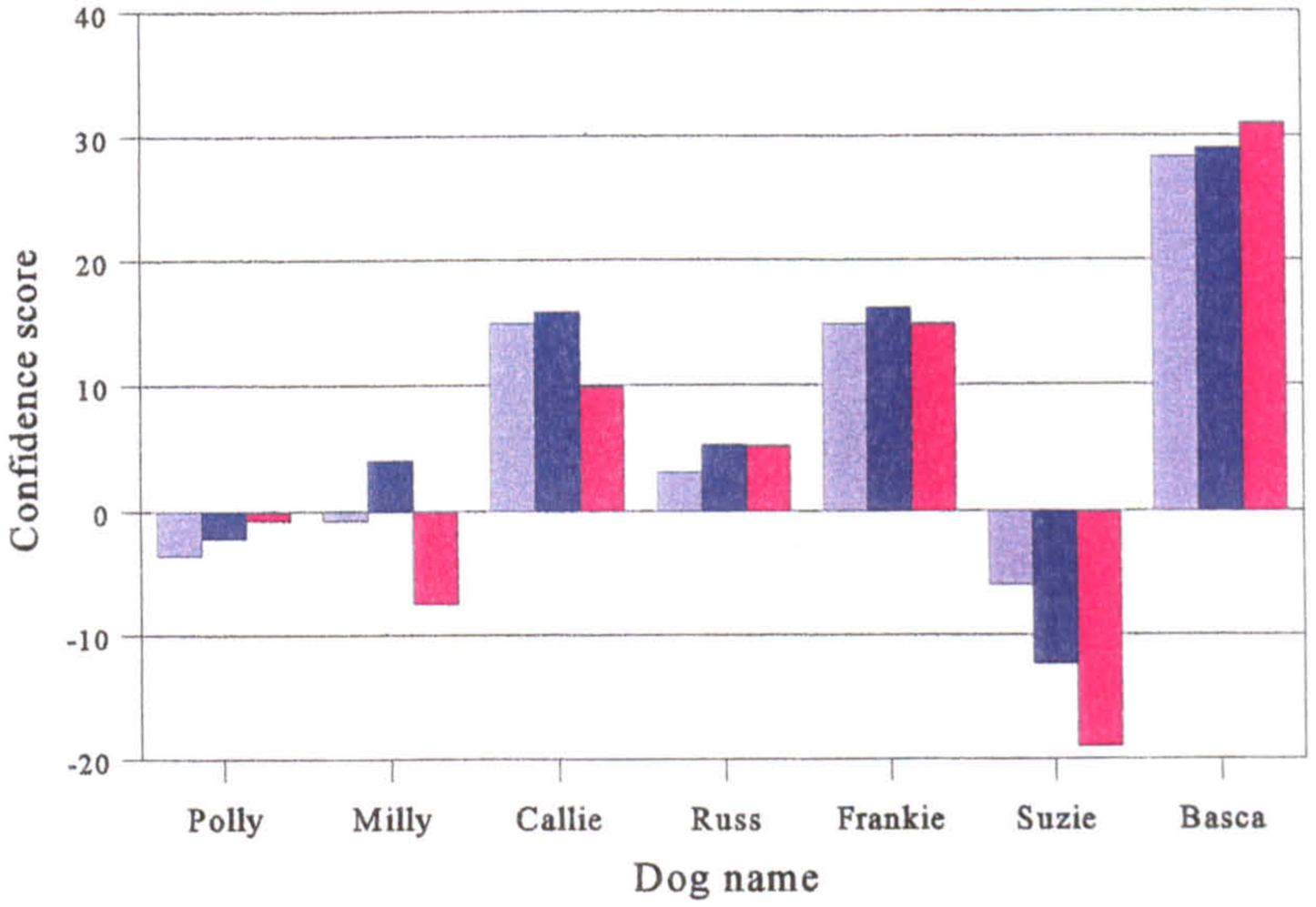
ANOVAS confirmed that treatment type did not significantly affect a dog's Confidence score ($F_{(2,13)}$= 1.56, p >0.2). The subjects' scores during each of the three tests were highly correlated (Pearson correlation test; P >0.94, $d.f.$=13, p<0.001).

10

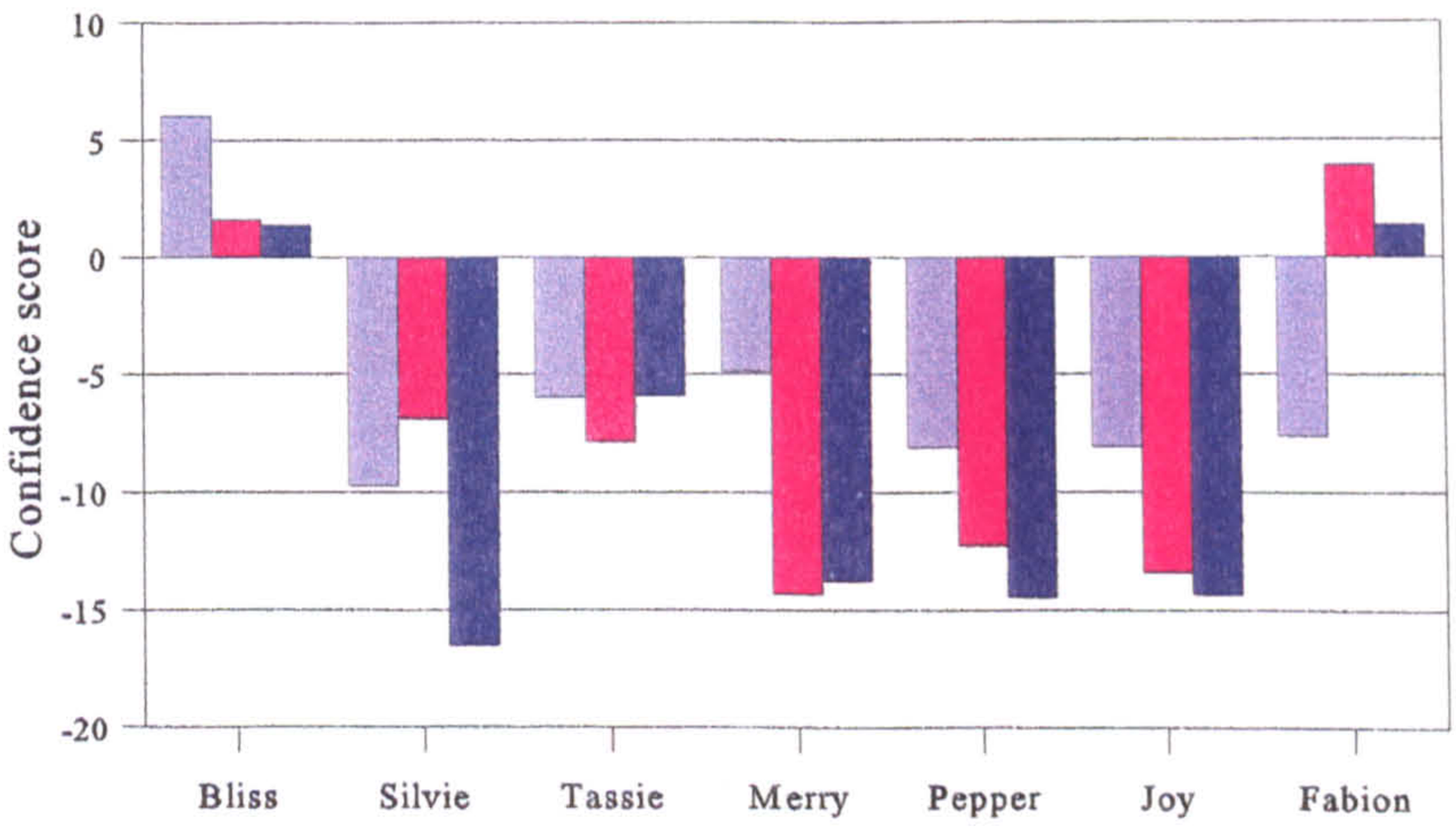
After determining that differences exist among the means, *post-hoc* range tests and pair-wise multiple comparisons are used to determine which means differ. Range tests identify homogeneous subsets of means that are not different from each other. Pair-wise multiple comparisons test the difference between each pair of means, and yield a matrix showing significantly different group means at an alpha level of 0.05. Tukey's Honestly Significant Difference test is a variety of *post-hoc* test which makes all pair-wise comparisons between means using the Studentised Range Distribution (see Fowler *et al.* 1998) .

Figure 5.11 *Confidence scores exhibited by members of two treatment groups of Golden Retrievers during tests 1, 2 and 3*

a) Group A

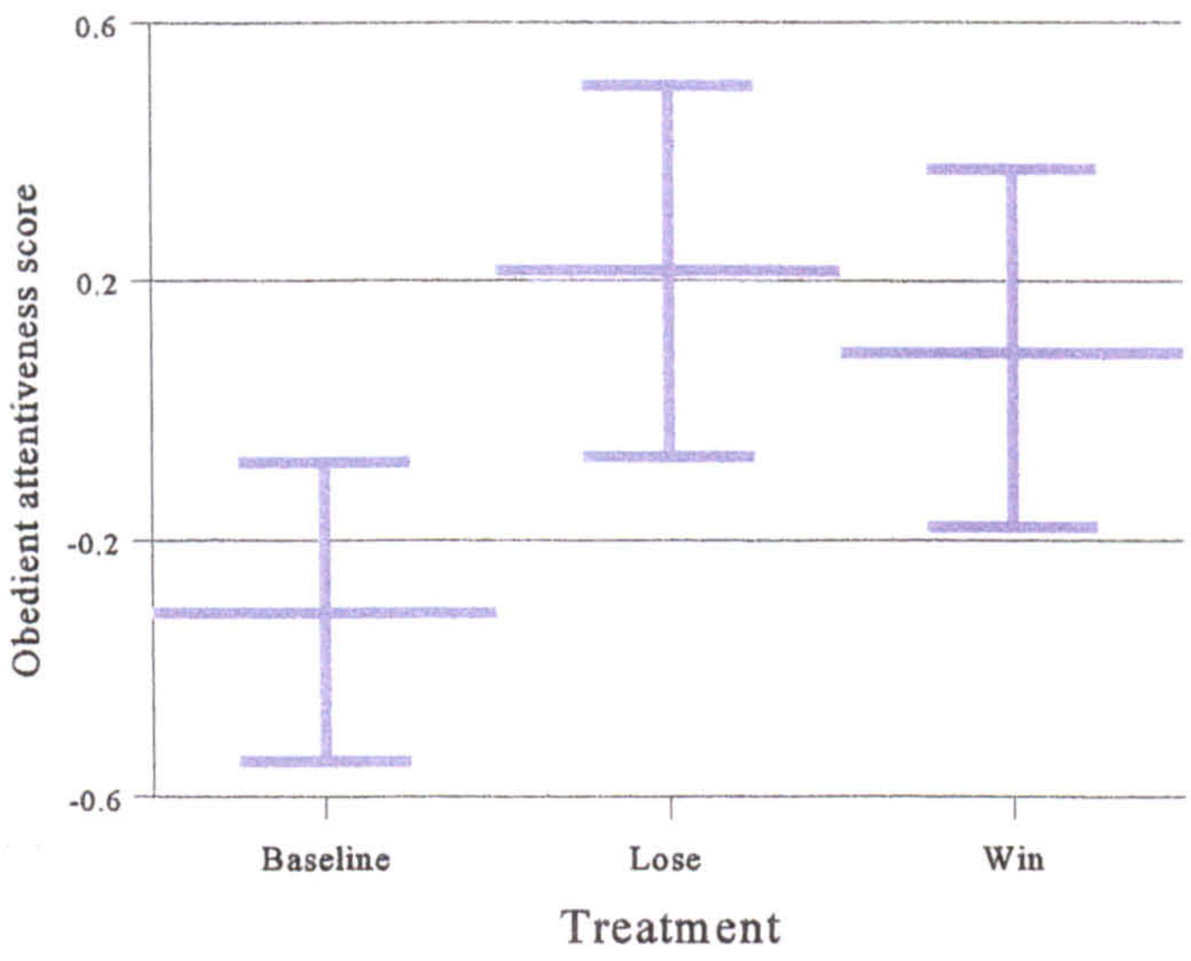


b) Group B



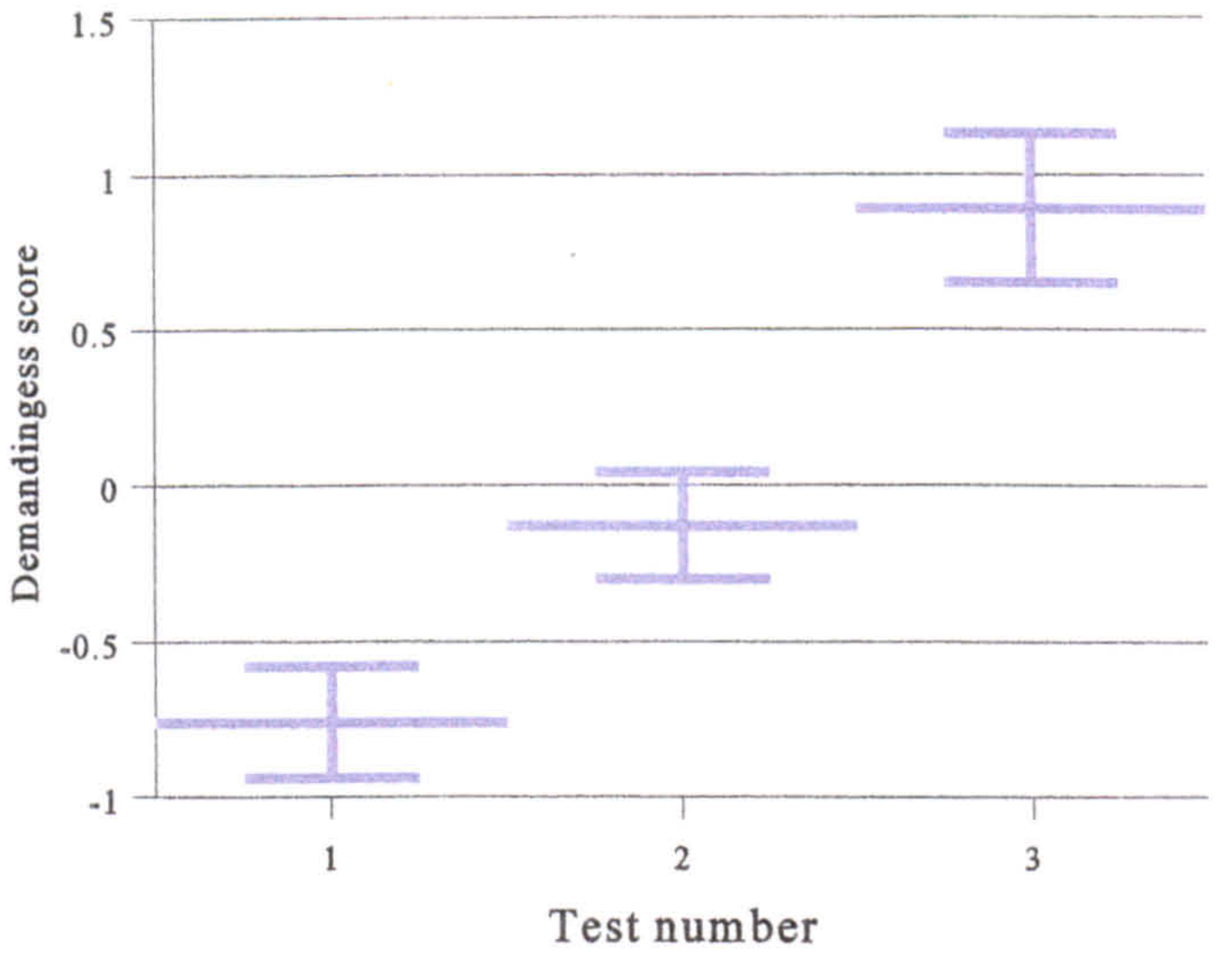
Factor 3 Obedient attentiveness scores were significantly affected by preceding treatment ($F_{(2,13)}$= 5.0, p=0.015). However, the two play treatments formed a homogeneous subset (Mean Difference=0.12, p=0.78; Figure 5.12). Considering just the post-treatment tests, two-way ANOVAS showed that neither treatment ($F_{(1,13)}$= 0.37, p>0.5), nor order ($F_{(1,13)}$= 2.05, p>0.1), significantly affected the scores.

Figure 5.12 Mean (± S.E.) "Obedient attentiveness" scores for 14 dogs following different treatment procedures



Factor 5 Demandingness was also affected by which of the three treatments preceded the test ($F_{(2,13)}$= 9.59, p <0.001; Figure 5.13). Again the two play treatments formed a homogeneous subset (MD=0.15, p=0.88). Considering only the post-treatment tests, treatment type exerted no significant effect ($F_{(1,13)}$= 0.47, p >0.5), but order had a powerful effect ($F_{(1,13)}$= 22.9, p<0.001). Figure 5.13 shows that Demandingness scores increased with successive testing sessions, irrespective of the order of treatments.

Figure 5.13 Mean (± S.E.) "Demandingness" scores of 14 dogs during three successive testing sessions

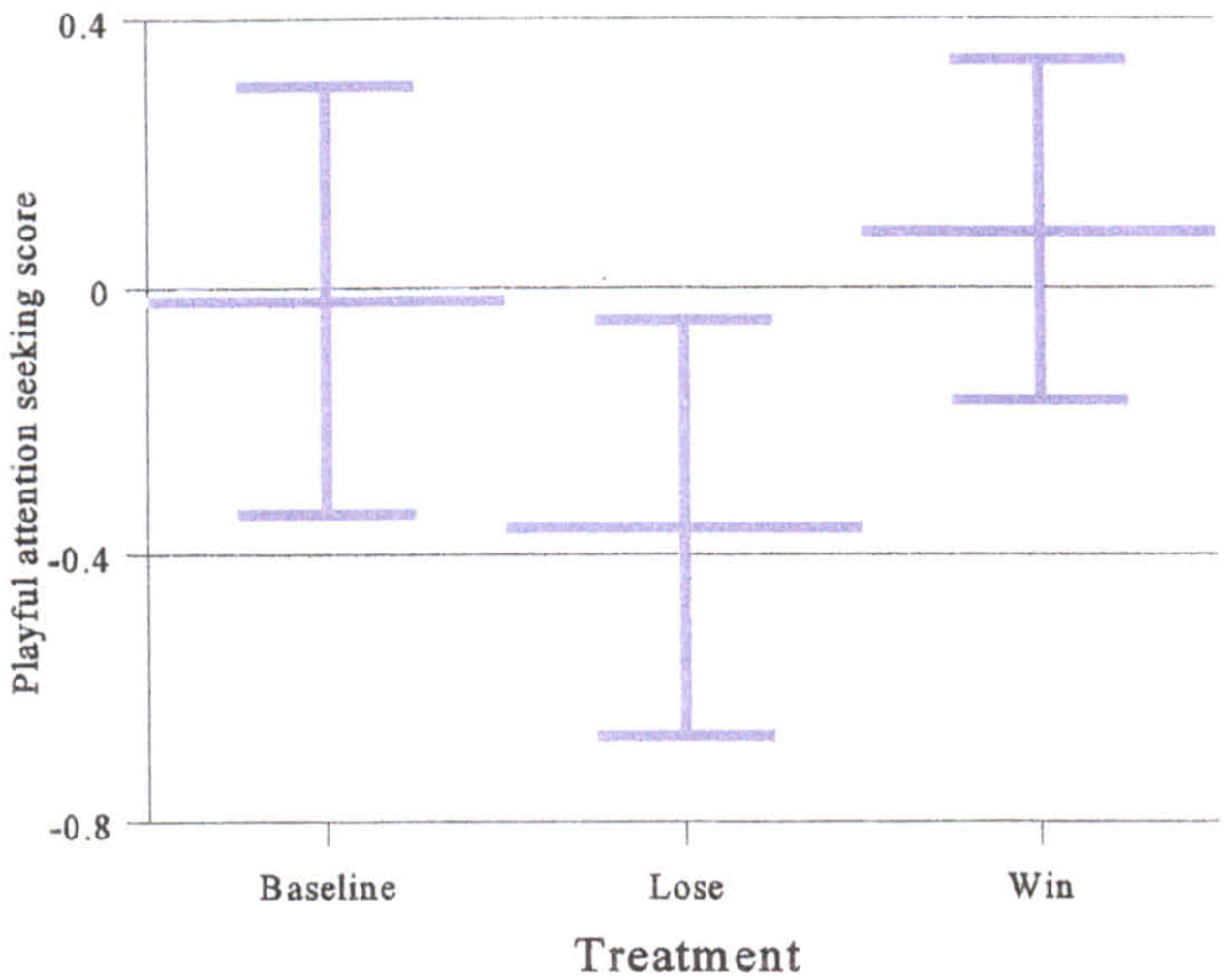


5.5.3.3 Restricting the sample

Not all dogs were equally playful, so it may be that the least playful dogs did not receive the appropriate experimental treatment. I therefore restricted the sample to those dogs that scored a mean of three or more for Determination and for Involvement during both Phases 1 and 2. Using these criteria, the four least playful dogs were eliminated and the analysis repeated.

The effects identified above (Factors 3 and 5) both remained significant within this restricted sample. In addition Factor 8 (Playful attention seeking) now showed a significant effect. Treatment type significantly affected Factor 8; after winning at Tug-of-war the ten dogs scored higher than after losing ($F_{(1,9)}$=5.2, p=0.05; Figure 5.14).

Figure 5.14 Mean (± S.E.) "Playful attention seeking" scores of ten most playful dogs following different treatments



5.5.3.4 Behaviour of dogs during play sessions

During each play session, the experimenter rated the dogs' Involvement and Determination. Average scores per group over all treatment sessions are displayed in Figures 5.15 and 5.16. The effect of treatment type upon each score was tested. Only the latter half of the treatment phases were analysed (to eliminate response lags and carry-over effects from the previous treatment phase), so scores during sessions 10-20 were compared to sessions 30-40. Each group (A and B) was considered separately. Repeated Measures ANOVAS tested the main effect of treatment (win/lose) upon the dogs' score for each dependent variable.

Group A won during Phase 1 and lost during Phase 2. During Phase 1 their Involvement and Determination scores were significantly higher than during Phase 2 (Involvement: 3.6±0.1 vs. 3.0±0.1, $F_{(1,6)}= 6.43$, $p<0.05$; Determination: 3.6±0.2 vs. 3.0±0.2, $F_{(1,6)}= 9.00$, $p<0.05$). Group B also scored higher during winning sessions (Phase 2), but the differences were not statistically significant (Involvement: $F_{(1,6)}= 3.25$, $p>0.1$; Determination: $F_{(1,6)}=1.48$, $p>0.1$).

Figure 5.15 Mean Involvement scores per group, each day over the treatment period

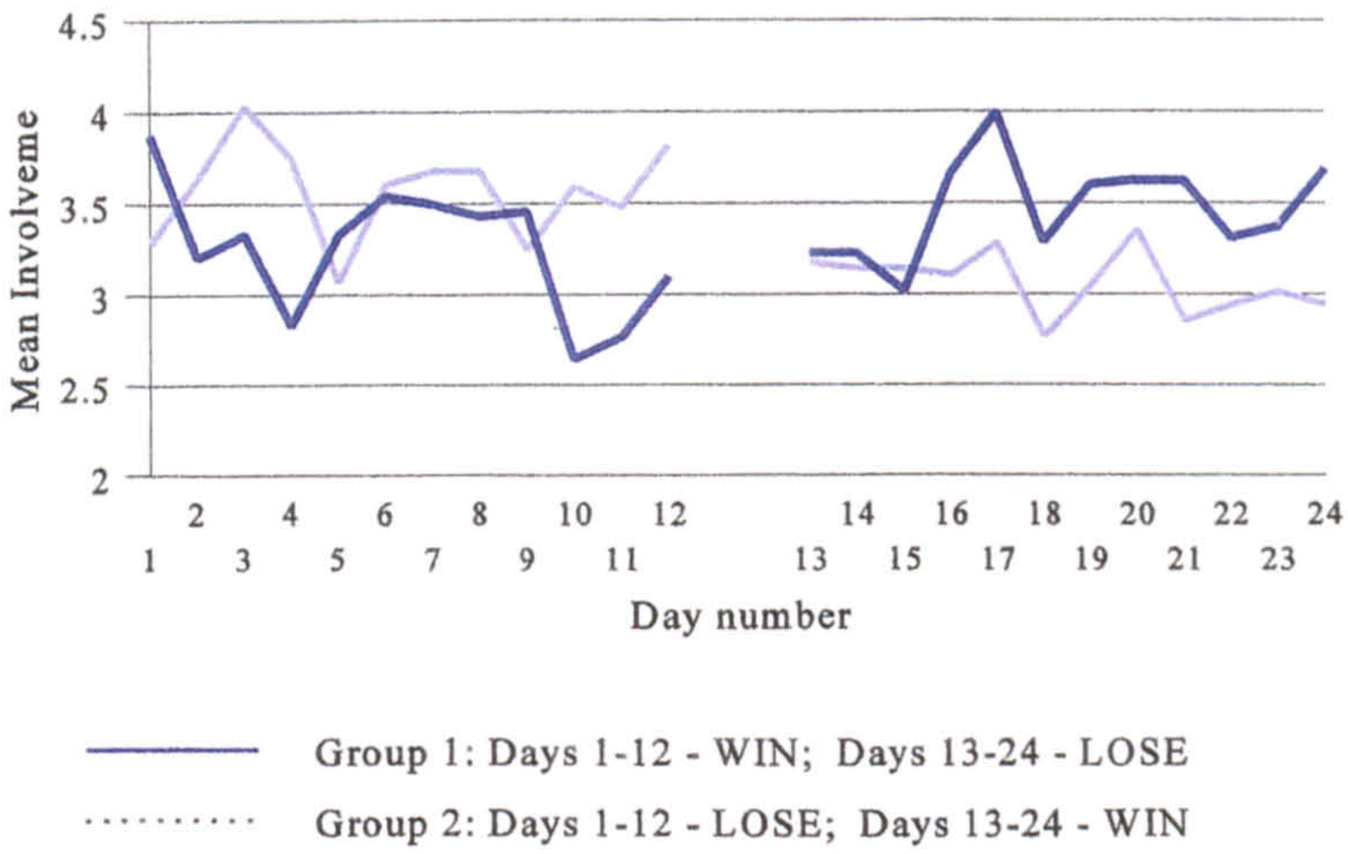
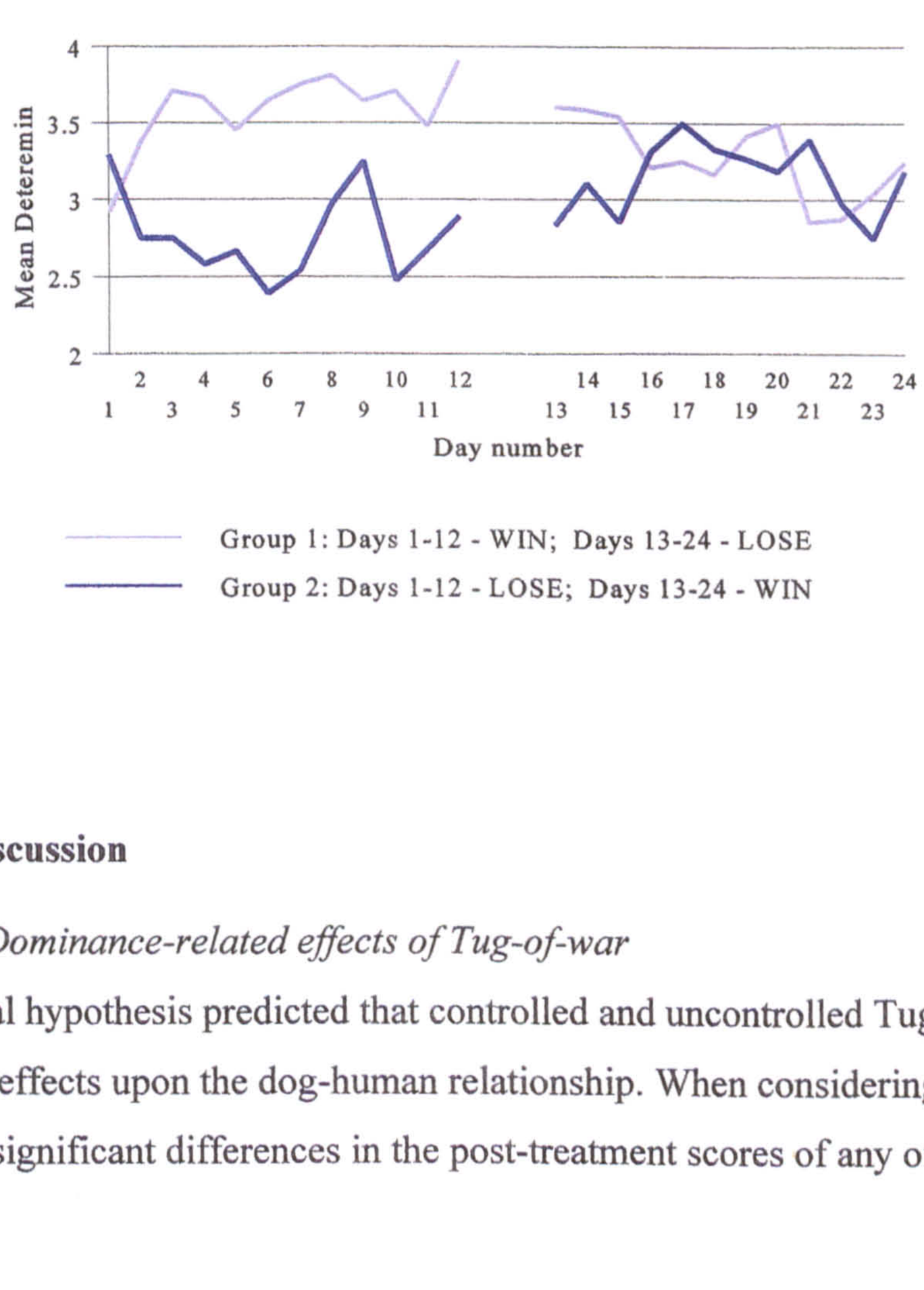


Figure 5.16 Mean Determination scores per group, each day over the treatment period



5.5.4 Discussion

5.5.4.1 Dominance-related effects of Tug-of-war

The initial hypothesis predicted that controlled and uncontrolled Tug-of-war would exert opposite effects upon the dog-human relationship. When considering all 14 dogs, there were no significant differences in the post-treatment scores of any of the measured

relationship dimensions following the two game types. "Confidence", the factor most resembling conventionally described "dominance", was not affected by the treatment procedure for the entire or the restricted sample, but remained unchanged throughout the three tests. This is consistent with the findings of the previous experiment; the outcome of Tug-of-war games do not affect dominance-dimensions of the dog-human relationship.

5.5.4.2 Detectable effects of play

Further analysis confirmed that the treatment procedure was adequate to produce, and the testing sufficiently sensitive to detect, changes in the dog-human relationship. Two relationship dimensions were significantly affected. Dogs scored higher for Obedient attentiveness post-treatment than during baseline testing. Since baseline testing occurred first, it is impossible to ascertain whether this represents a general effect of play or a result of increased familiarity. No order effect was found between tests 2 and 3, so if this change was due to familiarity it did not extend beyond treatment Phase 1. Demandingness also changed consistently. There was a gradual increase in this relationship dimension with successive tests, suggesting an effect of familiarity between dog and experimenter.

5.5.4.3 Restricting the sample

Restriction of the sample to the most playful dogs revealed a significant treatment effect. The factor " Playful attention seeking" was enhanced by winning Tug-of-war relative to losing. An increase in this factor corresponds to an increase in the frequency of behaviours such as nuzzling, pawing, and/or a decrease in variables such as sit latency and sitting orientated away from the experimenter. These changes cannot be interpreted by the conventional ideas of increased dominance, in fact some of the accentuated behaviours (*e.g.* paw) are commonly interpreted as "submissive" (Fox 1970). I conclude that an increase in the dimension Playful attention seeking does not represent an adverse effect upon the dog-human relationship and thus, there is no evidence for the damaging effects of uncontrolled Tug-of-war.

5.5.4.4 Winning enhances playfulness

Examination of dogs' behaviour during the treatment sessions (Figures 5.15 and 5.16) helps to explain the changes in Factor 8. Dogs were more involved and determined during Tug-of-war sessions which they were allowed to win. This was especially true of Group A, when the differences were significant. Increased Involvement suggests that the dogs were more highly motivated to play when winning than when losing. It has previously been shown that squirrel monkeys select player partners against which they can win (Biben 1986), and when no such partners are available they switch to nondirectional wrestling (Biben 1989; see 5.2.1). They are unlikely to play with a partner when the risk of losing is too great (over 60%; Biben 1989). Play is rewarding to rats (Pansksepp *et al.* 1984) and winning is thought to be more so than losing (Calcagnetti and Schechler 1992). Thus it is not surprising that dogs are more involved and determined during a play session they win. It also follows that they react more playfully towards a play partner, and seek their attention more in a test succeeding 20 winning play sessions than one succeeding 20 losing sessions.

5.5.4.5 Concluding comments

I conclude that winning and losing Tug-of-war treatments can produce subtle differences in dimensions of the dog-human relationship, but the effects are dependent upon the playful tendencies of the dog, and are not those often claimed by behavioural counsellors (*e.g.* Rogerson 1992). Allowing dogs to win at Tug-of-war did not alter dominance-dimensions of their relationship with the experimenter, but it did lead to the dog perceiving the experimenter as a more favourable play partner.

5.6 General discussion

These results support the General Hypothesis 2 that quality of

"***play between dogs and people has consequences outside the game***".

However, the consequences found were not those commonly postulated.

The results of Experiment 5.4 suggest that games affect attachment dimensions of the dog-human relationship. Play, especially Rough-and-tumble, reduced "Contact seeking" which may represent inhibition of the development of "over-attachment".

None of the results provide support to the "dominance enhancement theory". The theory rests on the assumption that games are competitive and winning possession of the object is the goal. In Chapter 3, I showed that dog-human play is less competitive than dog-dog play. There is little evidence that winning during intraspecific play enhances dominance (5.2), so it is not surprising that winning interspecific games does not. So why is dominance-enhancement such a commonly postulated theory?

5.6.1 Misidentification of cause and effect

In many species (5.2), there are correlations between dominance status and intraspecific play behaviour. Although it unlikely that dominance relationships are established in play, it is probable that play behaviour reflects a relationship that already exists. This is true for rats (Pellis and Pellis 1993) and squirrel monkeys (Biben 1998) and it may also be the case for dog-human relationships. If so, it is easy to see how the dominance enhancement theory has developed. Observations of a dog which frequently wins against its owner and also displays inappropriate dominance-related behaviour, may lead to the assumption that play is the cause of the problem. Furthermore, a dog-human relationship which changes (perhaps due to therapy) could result in changes in the partners' play behaviour so an observer could easily confuse cause and effect. Although the surveys (5.3) failed to detect

a significant association between play type and dominance, analysis was limited to owners' subjective reports of aggression, so this explanation cannot be rejected.

5.6.2 Common ownership styles

It is also possible that Tug-of-war is frequently associated with other factors which are the actual cause of "dominance-enhancement". Owners who allow their dogs to win at Tug-of-war may be prone to particular ownership styles, for example they may allow their dog unlimited access to resources *e.g.* space or food. Thus, other aspects of the owners' behaviour may affect their dog-human relationship. Tug-of-war is a common link (or correlate) which could be misidentified as the cause of the problem.

5.6.3 Individuality

Thirdly, I have looked at average changes within groups of dogs. I have shown that two breeds (Labradors Retrievers and Golden Retrievers) behave similarly and will later (Chapter 8) examine a mixed-breed population. However, as Figure 5.11 highlights, there are considerable individual differences in the effects of games within each population and there will inevitably be individuals which do not follow general trends. Dominance enhancement ideas are mainly perpetuated by pet behavioural counsellors. They observe a disproportionate number of extreme cases, so a minority group may have fuelled this theory. But, when would these exceptions arise?

5.6.4 Unstable relationships

One possibility is that game outcomes have significant consequences only when a dominance relationship is unstable. In fact, some theorists restrict their warnings about Tug-of-war to "potentially dominant dogs" (O'Farrell 1992). This explanation seems unlikely as wolf play decreases when rank disputes are unsettled (Zimen 1975). Also, evidence points to the reflection of relationships in play behaviour (5.2.1) and a reversal of cause and effect during unstable times is extremely implausible. I therefore propose a further hypothesis.

5.6.5 Confusion about the context

I hypothesise that dominance effects occur when there is confusion about the context of the interaction. Pellegrini (1989) found that, in contrast to "popular children", sociometrically rejected subjects were unable to differentiate between aggression and Rough-and-tumble play. Likewise, dogs in some situations may be unable to distinguish whether an interspecific interaction is playful, and a minority of dogs may never (or rarely) be able to make this distinction. For "true play" to occur both players must be aware of the playful nature of the interaction and this is generally achieved via play signals (see 1.4 and Chapter 6). I hypothesise that when "play signals" are absent or misinterpreted then the interaction may be perceived as competitive and dominance effects ensue. Thus, dominance enhancement theory is applicable not to "true play", but to interactions which fail to be perceived as play by the canine partner.

In the experiments described in this chapter, play was always accompanied by clear signals and produced no adverse effects. Winning at Tug-of-war retained the dogs' Involvement in games and increased their "Playful attention seeking" scores. Play reduced "Contact seeking" and possibly prevented over-attachment. The hypothesised effects of play signals are investigated in Chapters 6 and 7 and the relevance of these findings in the domestic environment assessed in Chapter 8.

Chapter 6

Interspecific play signals



"The casual observer who "knows" he sees play,
even if he doesn't know what it is, is not necessarily talking
off the top of his head "

(Miller 1973, p.89)

6.1 Introduction

Social play is typically composed of action patterns that are used in other contexts such as predation, fighting and mating (Bekoff and Allen 1998). When performed in the non-play context, these actions have obvious, often immediate, consequences for the actors, but during play, their functions are less apparent. A bite delivered during a dog fight, for example, may have significant fitness consequences for the actor (and recipient), whilst an inhibited bite delivered during play does not. It is therefore crucial that both players are aware whether an action is performed playfully or not. Communication of the play context is generally achieved via play signals. The phenomenon of intraspecific play signals is well-documented (see review by Bekoff and Allen 1998), but the nature of interspecific play signals is relatively unstudied.

In Chapter 5, I showed that the outcome of dog-human Tug-of-war games, which are apparently competitive, do not affect the dominance relationship of the players. I hypothesise that this is due to the playful context in which Tug-of-war occurs (5.6.5). Interspecific play signals establish the play "mood" and thereby prevent the game outcomes from assuming their non-play significance. I further hypothesise that when interspecific play signals are absent or ineffectual, then the game outcomes exert different effects. I test these hypotheses within this (Chapter 6) and the next two chapters (Chapters 7 and 8) and hence this section serves to introduce topics central to the remainder of this thesis.

6.1.1 What are play signals?

Play signals are actions which are used primarily in the context of play. They are clear and unambiguous (Bekoff 1976). They are performed at the beginning and throughout play bouts, and are generally accepted as important in the initiation and maintenance of

social play (Bekoff 1995). Play signals involve a range of sensory modalities, and are reported in a variety of species. The most commonly documented examples are two visual signals - the play face and the play bow, both of which were first described by Darwin (1898 in Fagen 1981 p.414). The play face is an expression, characterised by "the mouth being held open with unretracted lips only slightly exposing unclenched teeth" (Fedigan 1972). It has been reported in many primates, both human (van Hooff 1967) and non-human (Mason 1965; Fedigan 1972; Symons 1974) and a similar facial expression occurs during canid play (Fox 1970). A play bow is when an animal "crouches on its forelegs and elevates its hind-end, from which position it is able to perform a wide range of other movements" (Bekoff 1974). It has been observed in canids including domestic dogs (Fox *et al.* 1976), coyotes, *Canis latrans,* wolves *Canis lupus* (Bekoff 1974) and also lions, *Panthera leo* (Schaller 1972). Subsequently, many other visual play signals have been identified including pouncing by domestic cats, *Felis silvestris catus* (West 1974) and rats, *Rattus norvegicus* (Meany and Stewart 1981) and rolling (somersaulting and lateral rolling) by giant pandas, *Ailuropoda melanoleuca* (Wilson and Kleiman 1974).

Not all play signals are visual. Vocal signals in humans take the form of laughter (Blurton Jones 1967; Fry 1990), and in other primates, soft panting (Schaller 1963; Mason 1965; Fedigan 1972). Dogs exhibit play panting (Aldis 1975) and barking (Fedderson-Peterson 1986; 1991). Play vocalisations have been claimed to be the most effective play signals (Aldis 1975), but very little is known about them (Bekoff 1975). Tactile play signals are less common, but are reported in harbour seals, *Phoca vitulina concolor*, and olfactory cues are postulated to be important in rodents (Wilson and Kleiman 1974).

For all the actions listed above, their role as a play signal has been inferred from their temporal correlation with the onset of play behaviour. However, as I have highlighted in Chapters 1 and 5, concurrence is not evidence of cause and effect. There has been little attention paid to whether these behaviours serve the functions commonly attributed to them.

6.1.2 Function of play signals

I believe the role of a "play signal" is two-dimensional. It functions in:

a) *play-solicitation* - enticing a partner to interact and increasing the probability that play follows and

b) *metacommunication* - altering the context and thereby the significance of the acts which follow.

Although this distinction has not been explicitly made both functions have been discussed in the literature and there is evidence that intraspecific play signals achieve both.

6.1.2.1 Play-soliciting role

There is quantitative data to support a correlation between play initiation and specific actions. For example, 75% of a female panda's play bouts commenced with rolling, (Wilson and Kleiman 1974), and 90% of coyotes' play bouts were preceded by a play signal (Bekoff 1974). But there are few studies examining the effectiveness of play signals at inducing play. Bekoff (1974) investigated play-soliciting in three species of canids; wolves, coyotes and domestic dogs (beagles). He compared a variety of actions and calculated the proportion of occasions when social play followed each (the success rate). Several actions were found to be highly successful. For example, in beagles, "face pawing"[1] and "exaggerated approaches"[2] produced success rates of 96% and 80% respectively. Bekoff (1975) also made detailed observations of a pair of coyotes. The dominant female was successful in initiating chase play on only one out of 40 attempts - the one time she performed a play bow. These findings suggest that canid play signals do fulfil a soliciting role.

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1 Face pawing - extension of one of the forelimbs toward the face of the other animal.

2 Exaggerated approach - the animal approaches its prospective playmate in a loose bouncy gait at a speed greater than walking.

6.1.2.2 Metacommunication

Bateson (1955) introduced the concept of "metacommunicaton". This is communication about communication, or a set of "social messages which serve to alter the way in which other social messages are interpreted" (Altmann 1962). Play signals are assumed to fulfil a metacommunicative role carrying the message "What follows is play" (Bateson 1955; Altmann 1962; Fedigan 1972). However, to conclude that metacommunication has occurred it must be possible to demonstrate that "the performance of a particular behaviour(s) has served to alter the significance of subsequent signal(s)" (Altmann 1962; Bekoff 1972; 1975). Conclusive evidence of this role of play signals is very sparse. Bekoff (1975) compared the responses of a pair of coyotes during 92 interactions. The probability of observing submission after a threat was lower if the threat was preceded by a play signal than if it was not. He concluded that coyote play signals altered the meaning of subsequent aggressive signals. Play bows have also been shown to occur immediately before and after actions which could easily be misinterpreted as aggressive *e.g.* bites with head shaking (Bekoff 1995). Although not direct evidence of their effect, this suggests that play signals are well suited to a metacommunicative function.

In conclusion, there is some evidence that canid play signals (especially the play bow) perform both a play-soliciting and a metacommunicative function. However, supporting data are few as they are difficult to collect. Observations are required of identical situations in the presence and absence of play signals and a comparison made of the outcomes. During intraspecific play it is impossible to exert control over signalling and so data collection needs to be opportunistic and is consequently very time consuming. In the case of interspecific dog-human play, these difficulties can be overcome; the human play partner can control the play signals delivered, and the dog's behaviour can be compared in signalled and unsignalled situations. This makes interspecific play ideal for the study of play signal effects.

6.1.3 Interspecific play signals

Intraspecific play signals reported in dogs include play bows (Darwin 1898 in Fagen 1981; Bekoff 1974), the play face (Darwin 1898 in Fagen 1981; Fox 1970), exaggerated approach/withdrawal sequences (Bekoff 1974; Biben 1982), face pawing (Bekoff 1974), staring followed by head turns (Fox *et al.* 1976; Biben 1982), leaping, barking and other vocalisations (Fedderson-Peterson 1986; 1991). Human play signalling shows some similarities to dogs' (Aldis 1975); people use vocalisations and exhibit a play face similar to a canid play face (Blurton Jones 1967). However, there are also substantial differences. In primates the signalling area is reduced to the face; human play signals usually take the form of laughter and smiling (Blurton Jones 1967; van Hooff 1972; Fry 1990), and full motor invitations are rare (Loizos 1966). So, how can dogs and humans communicate their play intentions interspecifically?

In my questionnaire survey (2.3.3.5), 49% of owners reported half or more of their play sessions were solicited by the dog. They consistently identified behaviours, such as toy presentations, contact and vocalisations, which they interpreted as the dog "wanting to play" (see 2.3.3.6 and Figure 2.9). These may be described as dog-human play signals - delivered by the dog and received by the human. Additionally, 51% of owners reported themselves to start most of the play sessions (2.3.3.5) which suggests that people also deliver play signals which are successfully received by their dogs. But what form do these human-dog play signals take? Whilst observing dog-owner interactions, Smith (1983) was unable to identify any specific signals used to solicit play, and no further attempts are documented. Identification and investigation of the effects of human-dog play signals form the basis of the current and the next chapter.

6.1.4 Objectives

This chapter (and the next) concentrates upon human-dog play signals. I investigate General Hypothesis 3:

> ***"dogs are able to distinguish between play and non-play interactions"***.

Firstly, I explore the range of actions commonly used by dog owners as play signals. I then investigate whether they fulfil the functions of a play signal (see 6.1.2). The metacommunicative role will be dealt with in Chapter 7, but the current chapter concentrates upon the play-soliciting role.

I aim to determine whether interspecific play signals can be used to instigate play between owner and dog. I hypothesise that:

a) signals increase the probability the play follows and
b) signals vary in their effectiveness at this function.

I firstly examine the play signals used by owners in well established dog-owner partnerships (6.2). I explore the correlation between play signal delivery and play occurrence and identify the most effective signals. I then take an experimental approach and assess the play-soliciting capability of these signals (6.3). Auditory play signals are not well understood (Bekoff 1975). Since human vocalisations are common during play (4.2), I examine them specifically.

6.2 Interspecific play signals in the home environment

6.2.1 Introduction

I commence my study by describing the play signals employed by dog owners during play sessions with their dogs. I define a play signal as "any action performed by the human with the intention of initiating, or increasing the intensity of, play with the dog"[3]. Object-oriented and non-object play are distinct play categories (4.2) so I observed, and compared, play signalling during each. I assessed the effectiveness of commonly used signals and investigated whether usage was correlated to effectiveness. I utilised pre-recorded dog-owner play sessions (as used for the ethogram 2.4.1), to identify play signals and then to measure their success at initiating and sustaining play.

6.2.2 Method

6.2.2.1 Subjects

The subjects were 21 dog-owner partnerships[4]. The owners were all adults who reported regularly playing with their dogs. For further details of demographics and recruitment of subjects, refer to Chapter 2.4.

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[3] These actions remain putative play signals until their function is proven, which is the purpose of this chapter. However, to avoid confusing terminology, I refer to them throughout as "play signals".

[4] For the purpose of this study it was not necessary to reject any of the partnerships (as described in 2.4.1 and 4.2) as play signaling was clearly visible in all cases.

6.2.2.2 Procedure

Each partnership was filmed during two five minute play sessions - one object-oriented and one non-object (social). At the outset the owners were instructed to keep the dog playing, so consequently they included many play signals within their play sessions.

6.2.2.3 Behavioural analysis

The play sessions were all observed carefully, using the slow advance and frame-by-frame features of the video player. A description of each play signal and its frequency was recorded. All signals performed by more than two owners (*i.e.* >10% of the sample) were incorporated within the ethogram (shown in Appendix 4 and marked with ✣). During object-oriented sessions, it was impossible to determine whether the dog was responding to an action performed by the person, or to the movement of the object. Success rates were therefore calculated using only the non-object sessions. During these sessions the dog's behaviour immediately following each play signal was recorded and classified as playing or not playing. A dog was subjectively defined as "playing", if it displayed the characteristics outlined in 1.1.2.2, was responding to the person, and had an Involvement score of at least 3 (see Chapter 2.4.2).

6.2.2.4 Statistical analysis

The total number of signals performed and the number of varieties of signals were compared for the object-oriented and non-object play sessions. Comparisons were made within-subjects using Wilcoxon Signed-Rank tests (see 4.2.2.5 for description of technique).

Success rates were calculated for all signals used by three or more owners. The success rate represented the number of times play followed a given play signal, as a proportion of the total number of times that play signal was used. When a signal was used in combination (occurring simultaneously or in close succession to another signal) the response could not be attributed to a specific signal. These instances were excluded from success rate analysis. Success rates were derived for each partnership and then mean

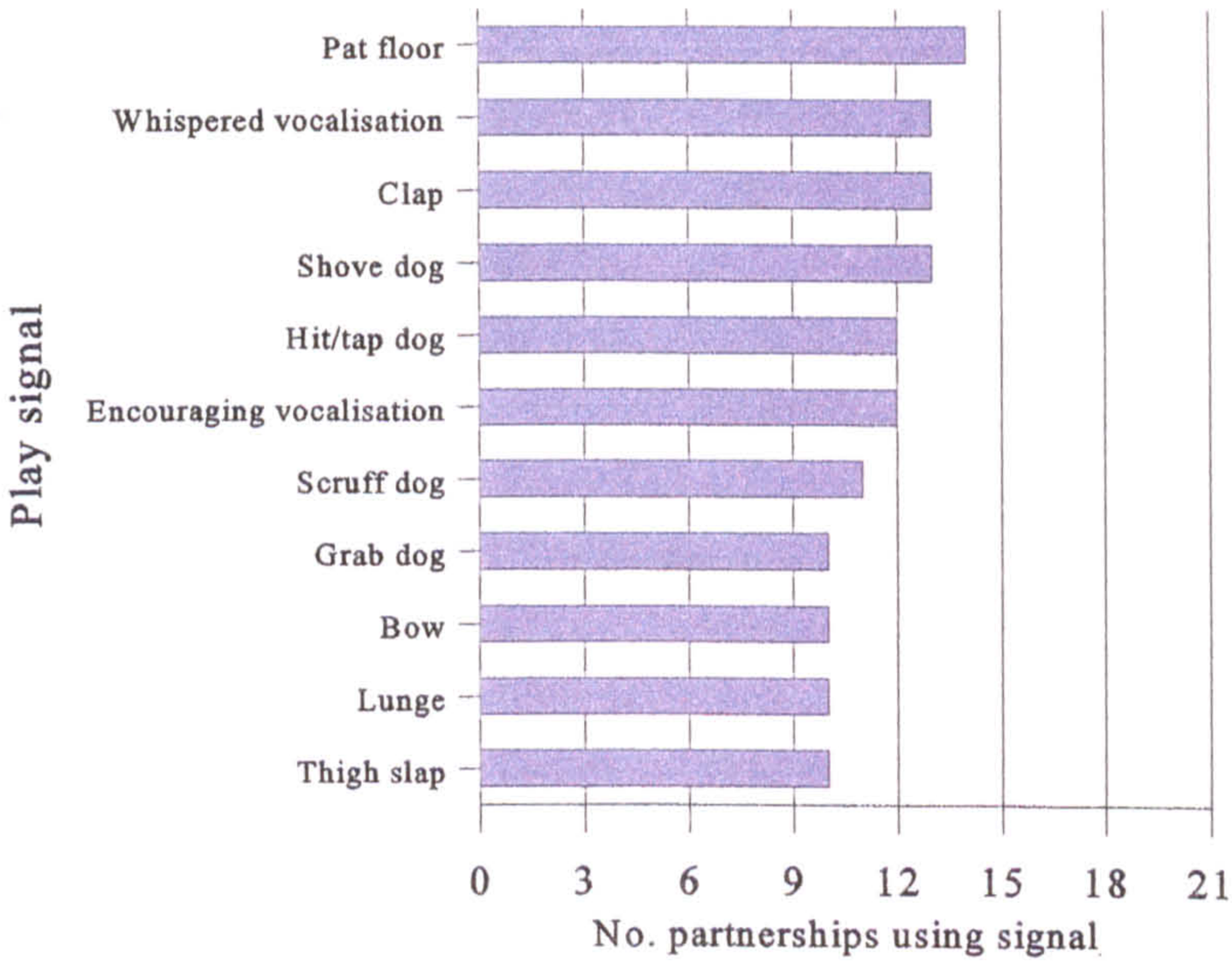
success rates calculated for each signal (using all partnerships exhibiting that signal). The frequency of each signal was compared to its efficiency. Spearman Rank Correlation tests (see 2.3.3.3 for description of technique) explored the correlation between, the frequency of a signal (represented by the number of partnerships using it and the total times it was used) and its mean success rate.

6.2.3 Results

6.2.3.1 Non-object sessions

During the non-object play sessions 46 varieties of play signal were delivered, 35 of which were used by three or more owners. The play signals used by the highest number of owners are displayed in Figure 6.1.

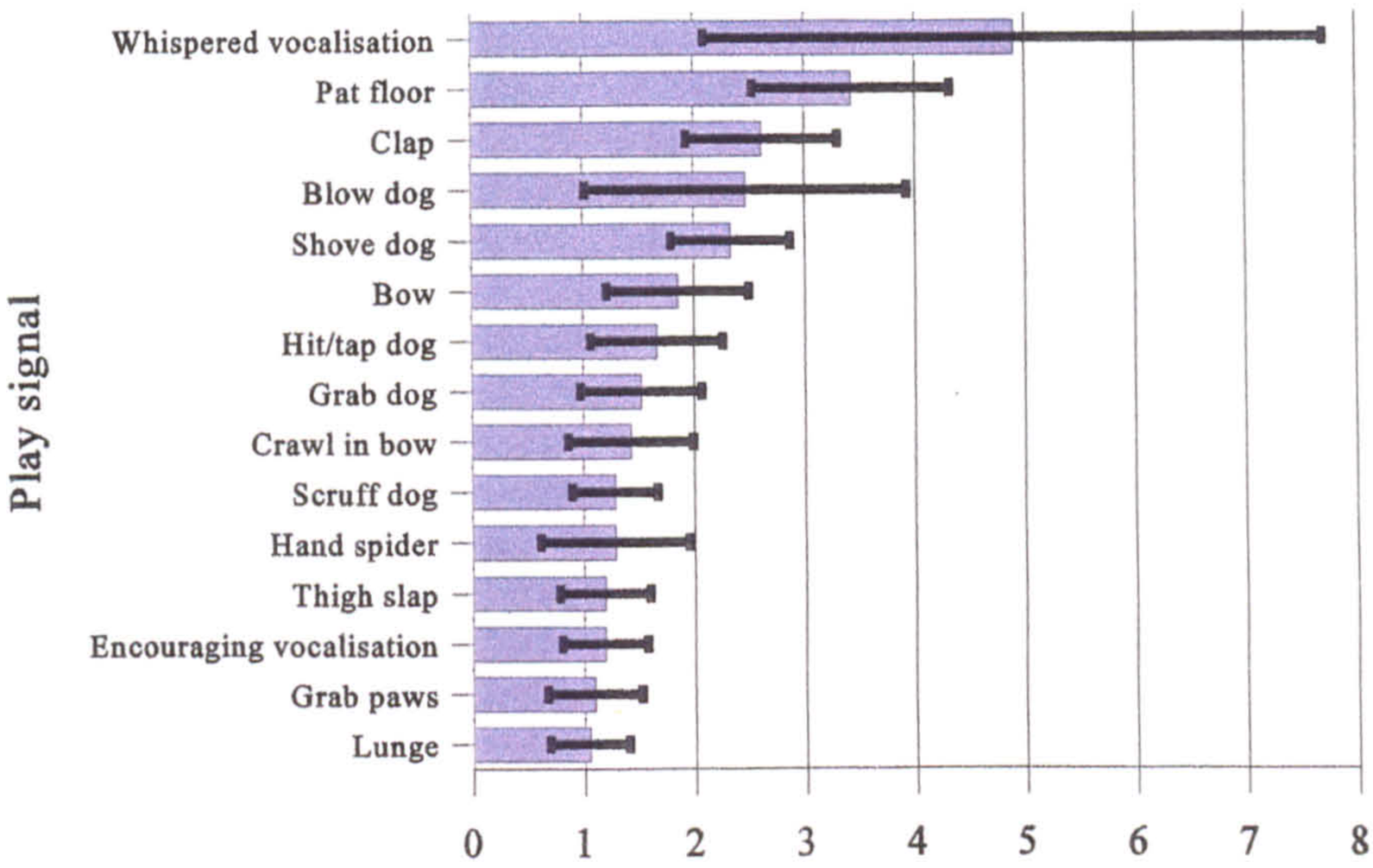
Figure 6.1 *The most commonly used human-dog play signals during non-object play sessions*



All signals exhibited by ten or more dog owners are shown.

Pat floor was the most common signal with 14 partnerships using it. Other popular signals included: whispered vocalisation, clap and shove dog, all of which were used by 13 partnerships. The frequency of use of these signals varied considerably between the 21 partnerships, as is evident in Figure 6.2.

Figure 6.2 Mean (± S.E.) frequency of popular human-dog play signals during non-object play sessions



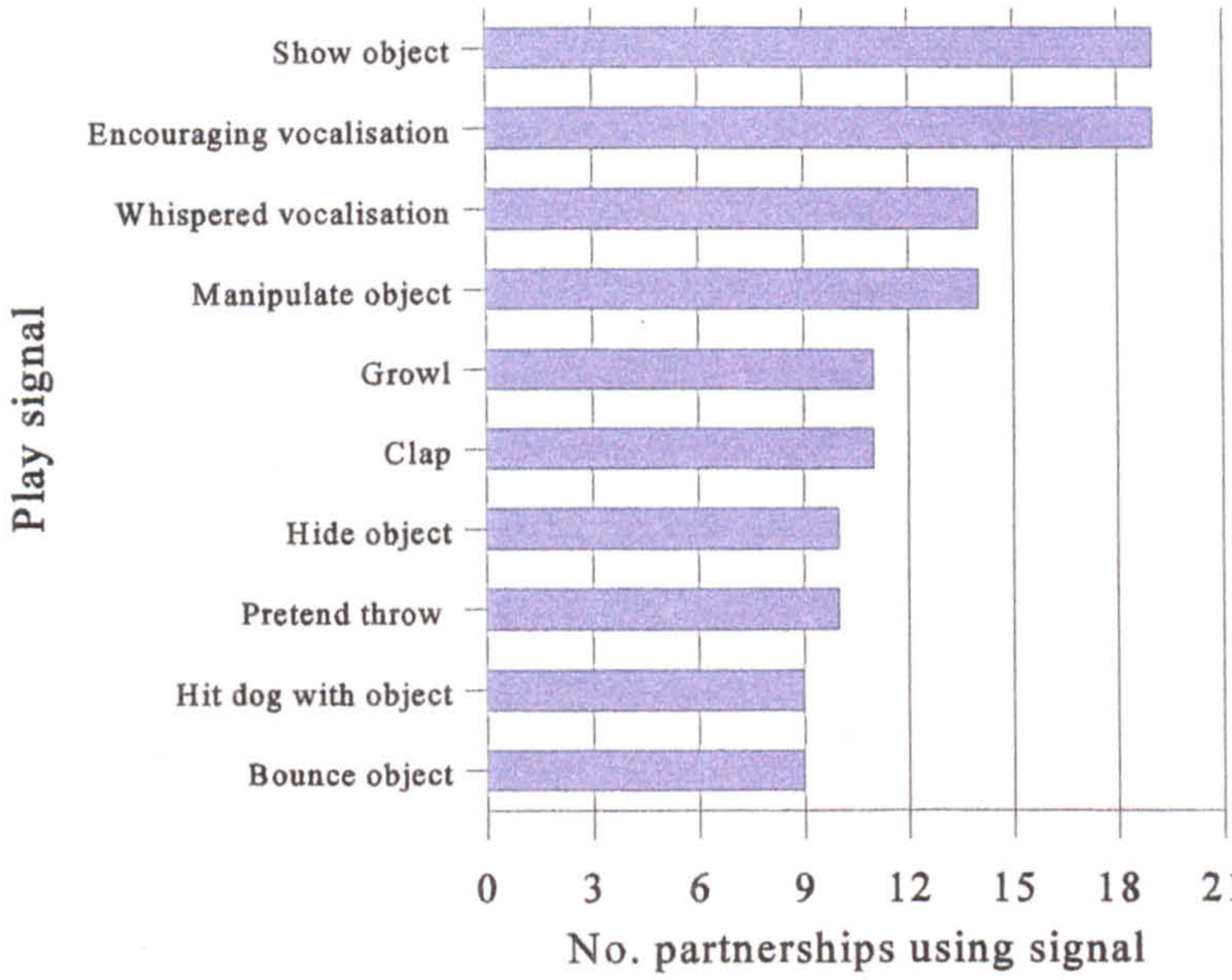
Mean frequencies are calculated over five minute sessions using all 21 partnerships. All signals occurring at mean frequency of >1 per session are shown.

The most frequent signal was a whispered vocalisation. Vocalisations were especially common in combination with other signals. 25.8% of all non-object signals were accompanied by a vocalisation. The mean number of signals per five minute session was 34.9 (±4.9) and the mean number of varieties was 13.9 (±1.3).

6.2.3.2 Object-oriented sessions

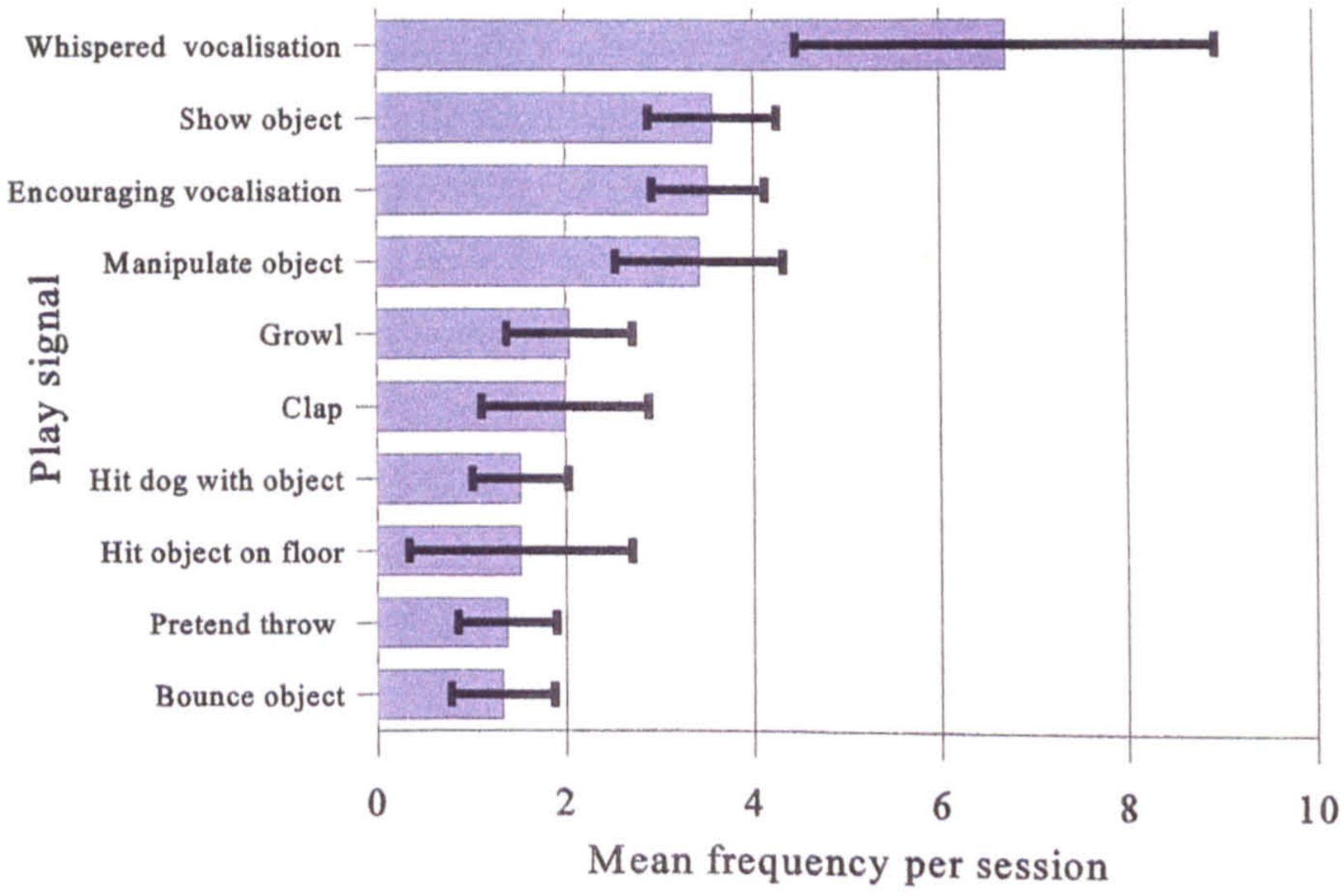
During object-oriented play, 45 signal varieties were used; 17 incorporated the object, whilst 28 were also used in non-object sessions. Of the ten most widely used object-oriented play signals (Figure 6.3), six incorporated the object. The average frequency of use of popular object-oriented signals is shown in Figure 6.4.

Figure 6.3 *The ten most commonly used human-dog play signals during object-oriented play sessions*



All signals used by nine or more dog owners are shown.

Figure 6.4 *Mean (± S.E.) frequency of popular human-dog play signals during object-oriented play sessions*



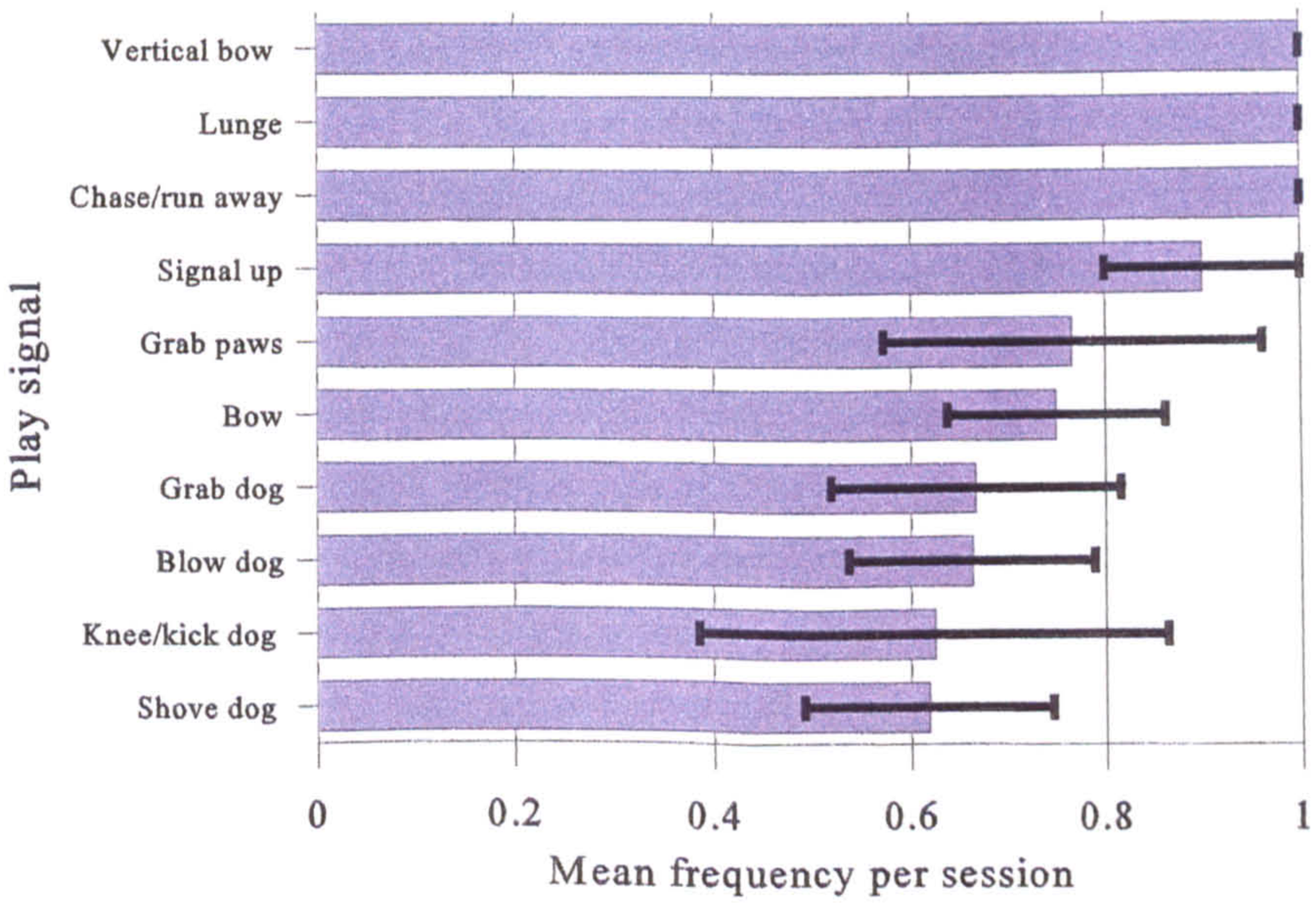
Mean frequencies are calculated over five minute sessions using all 21 partnerships. All signals occurring at mean frequency of >1.3 per session are shown.

As in non-object sessions, whispered vocalisation was the most frequently performed signal. The mean number of play signals per object-oriented session was 40.0 (±4.9) and the mean number of varieties of play signals was 13.0 (±1.4). Wilcoxon Signed-Rank tests showed that neither the number of signals ($z=1.2$, $n=20$, $p>0.2$), nor varieties ($z=0.9$, $n=20$, $p>0.35$) differed significantly between object and non-object sessions.

6.2.3.3 Success rates

Success rates were calculated for all signals used by three or more owners during non-object sessions. Mean success rates for individual signals ranged from 0 (kiss dog, bark, pick up dog) to 1 (vertical bow, lunge and chase/run away), with a mean of 0.53 (±0.05). The most successful signals are displayed in Figure 6.5. Three signals (vertical bow, lunge and chase/run away) were successful whenever they were used, thus giving success rates of 1±0.

Figure 6.5 Mean (± S.E.) success rates of human-dog play signals

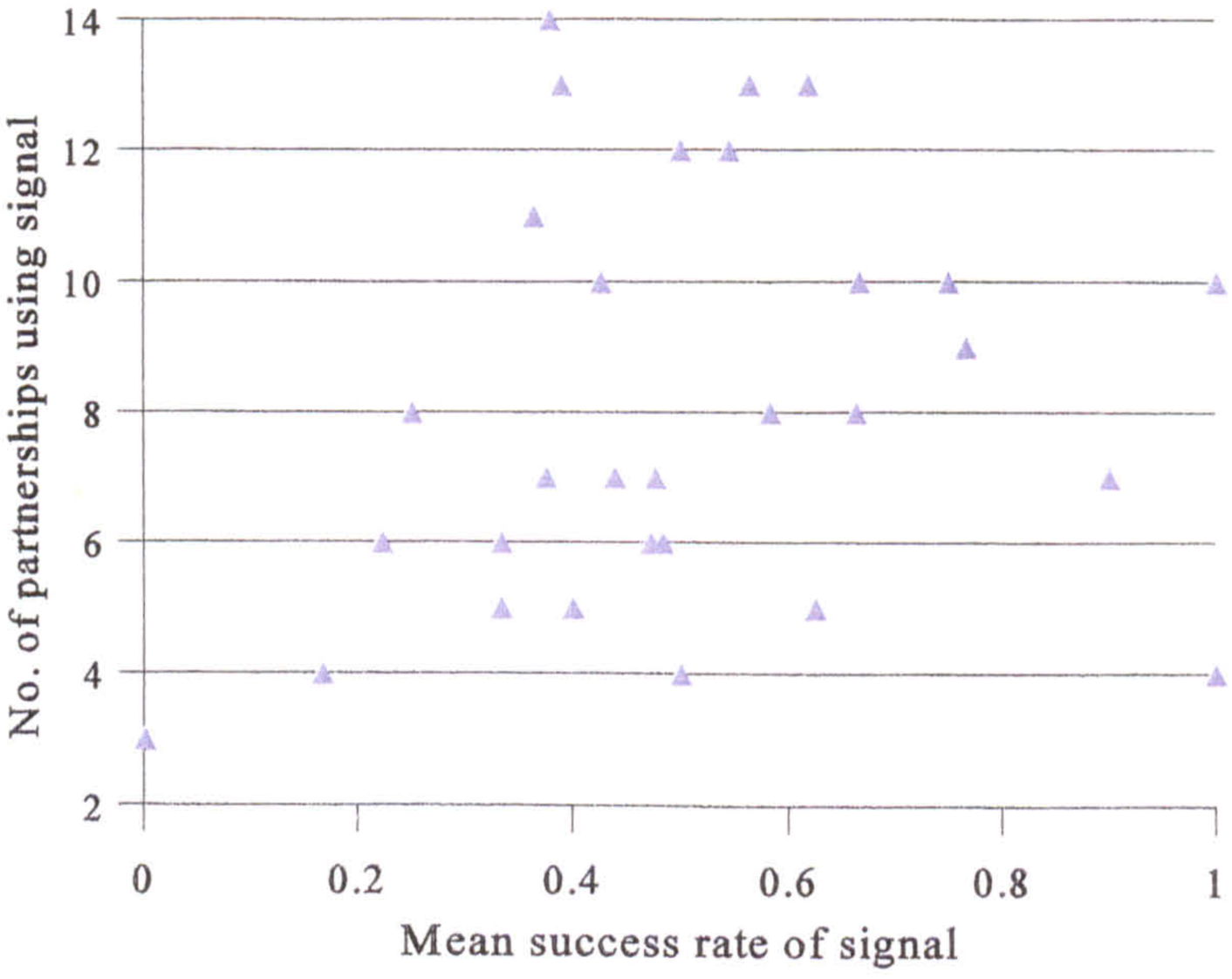


Success rates are calculated individually for each partnership and means derived for all partnerships using a particular signal. All signals used by ≥3 partnerships and showing mean success rates of >0.6 are shown.

6.2.3.4 Are successful signals used more frequently?

The frequency of a play signal may be represented by either the number of partnerships using it, or the total number of uses. These variables were found to be equivalent (*Rho*=1.0 , *d.f.*=45, *p*=0), so number of partnerships was subsequently used as an indicator of play signal frequency. The number of partnerships using a signal showed no significant correlation to its success rate (*Rho*=-0.64, *d.f.*=45, *p*>0.8) as depicted in Figure 6.6.

Figure 6.6 Relationship between the number of partnerships using a signal and its average success rate



Success rates are calculated individually for each partnership and means derived for all partnerships using a particular signal. All signals used by ≥3 owners are shown.

6.2.4 Discussion

6.2.4.1 Play signals used

During play sessions, owners performed a wide variety of play signals, many of which were consistently used by multiple owners. The frequency with which a play signal was used, was not related to its success at initiating or sustaining play. Whispered

vocalisation and pat floor were the two most widespread and frequently used play signals, yet play succeeded them on only 56% and 38% of occasions, respectively. Bekoff (1974) performed a similar study examining the success of intraspecific play signals at soliciting play. He noted negative correlations between frequency and success of play signals used by beagles (*Rho*=-0.48, *d.f.*=6, *p*=0.27) and wolves (*Rho*=-0.7, *d.f.*=4, *p*=0.19), but positive correlations in coyotes (*Rho*=0.87, *d.f.*=4, *p*=0.05). He attributed the lack of positive correlation in dogs and wolves to the high average success of all play signals, and the low aggression levels in their societies (relative to coyotes') making it less crucial to successfully signal play. These explanations may also apply to human-dog play, but I suggest there is an additional factor.

6.2.4.2 Communication breakdown

It is possible that humans use unsuccessful signals due to a breakdown in human-dog communication. Intraspecific canid play signalling generally involves postural and non-contact cues (Biben 1982) and contact signals are avoided due to the ease with which they can be misinterpreted as aggressive. Many of the signals people employ involve physical contact *e.g.* pick up dog, shove dog, hit/tap dog. These signals have low success rates (0, 0.16 and 0.26 respectively). Intraspecific play communication can break down and play degenerates into aggression (Altmann 1962; Miller 1973). So with the added problems of a species barrier, and contact signals it is only to be expected that human-dog communication play breaks down too. Dogs misinterpret some of the signals delivered by their owners and hence do not respond playfully, producing low success rates.

6.2.4.3 Vocalisations

Owners frequently use vocalisations to try to instigate play. These take the form of encouraging vocalisations, which are often high pitched, and whispers. Whispered human-dog vocalisations were the most frequently used play signal during both object-oriented and non-object play sessions. This trend for quiet play vocalisations has previously been noted in primates (*e.g.* Fedigan 1972), and is thought to be an anti-

predator adaption (Aldis 1975). Vocalisations were also used to accompany other play signals on 26% of occasions. Used alone, vocalisations were not the most successful signals (success rates were 0.56 for encouraging and 0.54 for whisper), but they are economical to perform and attention grabbing, and in combination with other signals they may perform a play-soliciting function.

It has previously been claimed (Mitchell and Edmonson 1999) that human vocalisations during dog-human play serve mainly to exert control over the dog. However, Mitchell and Edmonson (1999) examined only the words used and not their effect on the dogs' behaviour. I propose than vocalisations perform a play-soliciting role by increasing the success of the postural signals they accompany. This is the hypothesis I test in the following section (6.3).

6.2.4.4 The effect of learning

During object-oriented sessions many of the signals incorporated the object. The inclusion of an object might have led to fewer and less diverse signals, but this was not the case. Play signals varied non-significantly in number and variety between the two play types (object-oriented and non-object). Dogs also use objects to instigate play with humans; delivery of a toy was the most commonly reported dog-human play signal in my questionnaire sample (2.3.3.6). Such object-oriented play signals are not documented during intraspecific play. I suggest their prevalence during dog-human play is partly a result of learning. Dogs learn to associate specific objects with play via past experiences. Providing the object is used exclusively during play, its delivery becomes an unambiguous and effective play-soliciting signal. This idea also applies to non-object play signals. With repetitive play experiences, dogs learn to associate their owner's idiosyncratic signals with play, and hence respond to their subsequent performance. The large inter-subject variations in success rates of some signals *e.g.* knee/kick dog (6.2.3.3) support this idea; dogs which have been repetitively exposed to specific signals have learnt to interpret their meaning, whilst others have not. During intraspecific play, vervet monkey, *Cercopithecus aethiops* habitual play partners produce increasingly subtle play

signals (Fedigan 1972; Suomi 1979) which indicates that they too learn to interpret their partners actions through repetitive play experiences.

6.2.5 Concluding comments

I have examined the dog-owning community and identified a number of actions which frequently occur during and immediately before dog-human play. This temporal correlation suggests that these actions function as play signals. To test their role further requires experimental manipulation and examination of the effect of these actions upon the subsequent behaviour of the players.

6.3 Do human-dog play signals solicit play?

6.3.1 Introduction

In the previous section (6.2), I identified a number of human actions which are often temporally concurrent with dog-human play. I hypothesise these function as play signals and perform a play-soliciting role. Within this section I test this by investigating whether their performance affects the probability that play follows. I test two combination signals, each composed of multiple, commonly used and ostensibly effective play signals. I also test the hypothesis that play vocalisations increase the effectiveness of other actions.

6.3.2 Method

6.3.2.1 Design

The experiment followed a within-subjects design

6.3.2.2 Subjects

The subjects were 20 Labrador Retrievers. There were seven males and 13 females ranging in age from 24 to 96 months (mean=45.2 months). They were all housed in pairs at the Waltham Centre for Pet Nutrition (1.5.2.2.). One had been used in Experiment 3.3, twelve in the experiments described in Chapter 4, and seventeen in Experiment 5.4; and two dogs had not previously been used.

6.3.2.3 Play signal selection

Two composite play signals were selected for testing. Each was composed of two or three actions previously identified as common play signals (6.2). All component actions had been used by three or more of the 21 dog-owner partnerships in Experiment 6.2 and produced success rates of at least 38% (6.2.3.3). To ensure that the chosen actions were

also employed as play signals at the Waltham Centre, I examined ten random play sessions between dog trainers and their dogs (as described in Appendix 5). I analysed the first ten seconds of each session and listed the play signals delivered by the person. All chosen actions were used by at least one trainer and were therefore concluded to be appropriate play signals to test.

6.3.2.4 Procedure

Trials were carried out in a carpeted corridor measuring 14.5m x 1.5m (Figure 6.7). This was familiar to all subjects as a regular through route. The doors at each end of the corridor, remained closed and the windows and doors were blacked out to minimise disturbance. A video camera (Sony Video 8 CCD-TR370E) was mounted on a roof beam, such that the whole room could be filmed.

In each trial the dog was leashed and walked to the experimental room. It was released and allowed to acclimatise, in the experimenter's (myself; female, aged 25 years) presence for one minute. The experimenter did not initiate any interaction, but if the dog approached it was petted moderately (as defined in 5.4.3.3). The video camera was then activated and a three minute experimental phase began. The experimenter stood in the centre of the room facing the dog and took a step to one side then, during experimental sessions, performed a play signal. The side step was incorporated in both experimental and control treatments. It was designed to gain the dog's attention without vocalisation and thereby ensure that the dog reacted to the subsequent play signals and not just to the attention-gaining movement of the experimenter. The play signal varied according to condition and was performed twice, with a five second interval. The experimenter then stood upright and motionless, ignoring the dog. This sequence was repeated every thirty seconds for a total of six times. After three minutes, filming ceased and the dog was leashed and returned to its kennel.

The experimental signals were:

1) Bow - experimenter performs a Bow and simultaneously pats the floor.

2) Lunge - experimenter performs Shuffle feet followed by Lunge in a Vertical bow position.

These signals are illustrated in Figures 6.7 and 6.8. For definitions of the component actions refer to the ethogram (Appendix 4). Signals 3 and 4 were the same as 1 and 2 respectively, but were accompanied by play vocalisations. The vocalisation was "Come on, come on little dog". The first two words were given as a whisper and the last four were high pitched. These composite signals are referred to as:

3) Bow and vocalisation

4) Lunge and vocalisation.

Figure 6.7 *Bow play signal performed in experimental corridor at Waltham Centre for Pet Nutrition (the windows and doors were blacked out during the experiment)*



Figure 6.8 *Lunge play signal performed by the experimenter (not in experimental corridor)*



Each dog was trialled six times, on consecutive days. Trials took place between 2pm and 6pm each day. The order of subjects remained identical to ensure that each dog was tested at the same time and that distraction due to olfactory cues remained approximately constant between trials. They were presented with control treatments on day one and day six. The four experimental play signals were presented on days two - five in an order determined via a Graeco Latin Square (Cochran and Cox 1957).

6.3.2.5 Behavioural measures

Videos were analysed using a stopwatch and record sheet. The variables recorded are listed in Table 6.1.

Table 6.1 Behavioural variables measured during play signal experiments

Variable name	Description	Units
Play bout frequency	Number of discrete play bouts separated by ≥10s, commencing within three minute session (for definition of play refer to 6.2.2.3)	freq
Mean bout duration	Mean length of a play bout separated from other bouts by ≥10s	s
Fast duration	Time dog moves at pace faster than walk (*i.e.* trot, run or bound)	s
Attention duration	Time dog orientates towards and appears to attend to experimenter	s
Close duration	Time dog spends <1m from experimenter	s
Contact frequency	Number of times dog makes contact with experimenter	freq
Lick frequency	Number of times dog licks experimenter	freq
Paw frequency	Number of times dog raises paw or places paw on experimenter	freq
Mouth frequency	Number of times dog mouths experimenter	freq

All variables measured in seconds or frequency per three minute session
Abbreviations: freq - frequency; s - seconds; m - metres

Bow frequency was initially recorded but bows were exhibited during <10% of trials so this variable was eliminated from subsequent analysis.

6.3.2.6 Statistical analysis

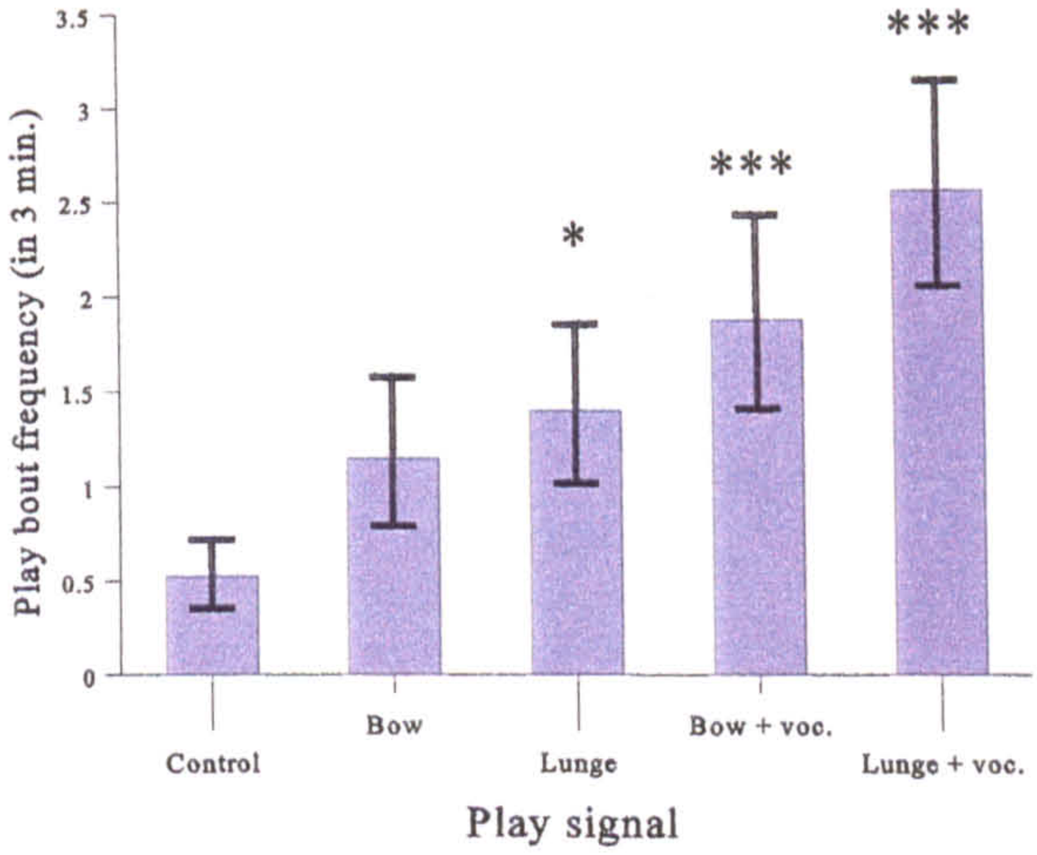
All variables were transformed using a Log (x+1) to improve normality. Mouth and Paw occurred too rarely to produce a normal distribution, so were eliminated from further analysis. There were two control sessions, one before and one after the treatment sessions. I performed paired t-tests (see 4.5.2.6 for description of technique) to find out whether the control sessions varied significantly in any of the measured variables. For five of the seven variables there was no significant difference ($t \leq 2$, $d.f.=19$, $p>0.05$). It was therefore legitimate to use an average of the two control sessions in subsequent analysis. However, for two variables (fast duration and attention duration), the two control sessions varied significantly ($t>3.2$, $d.f.=19$, $p<0.005$). In both cases, Control session 1 produced values most similar to the experimental sessions. Therefore, to avoid Type I errors (false rejections of the null hypothesis), all comparisons were made between the experimental treatments and the first control session only.

Repeated Measures ANOVA (see 3.4.2.5 for description) explored the effect of signal type (five conditions: four experimental and one control) upon each of the dependent variables. *Post-hoc*, Tukey's Honestly Significant Difference tests (see 5.5.3.2 for description) were used to determine which signals differed from the control treatment and from each other, for each dependent variable.

6.3.3 Results

I now consider each of the dependent variables and describe the signals which produced significantly different effects.

Figure 6.9 *Mean (± S.E.) play bout frequency following different play signals*

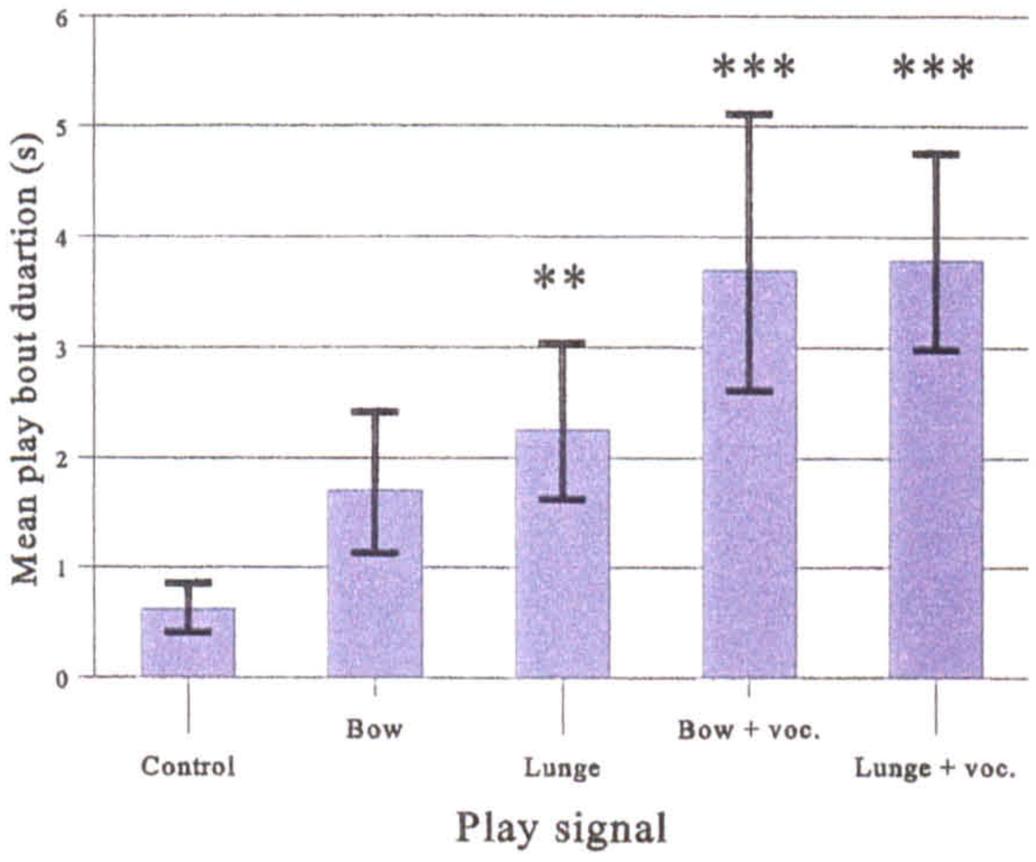


*This and all subsequent bar charts in this chapter illustrate the results of statistical analyses performed on log transformed data. The values shown are therefore the reverse transformations of the means and means ± standard errors of the transformed data. Asterisks denote treatments which differ significantly from the control treatment: *p<0.05; ** p<0.01; *** p<0.005.*

Play bout frequency varied significantly between treatments ($F_{(4,76)}$=10.22, p<0.001; Figure 6.9). Bow alone had no significant effect compared to the control, but lunge (Mean Difference=0.2, p=0.016), bow with vocalisation (MD=0.27, p<0.001) and lunge

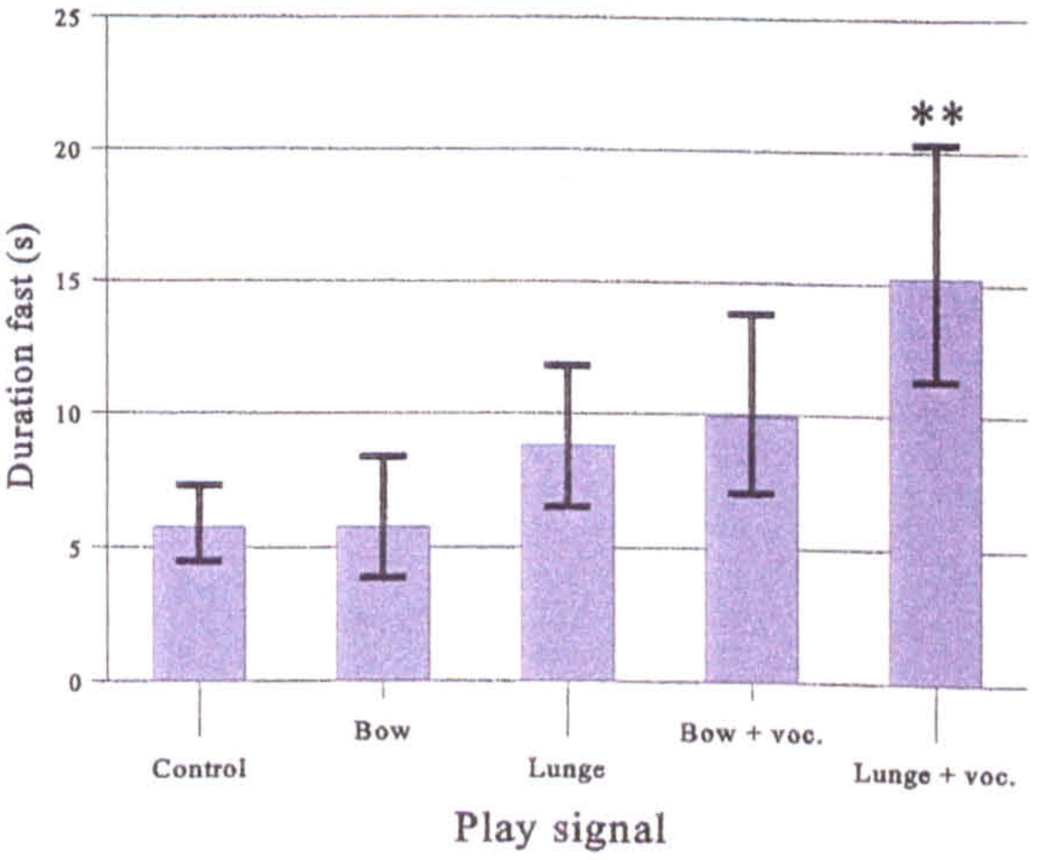
with vocalisation (MD=0.37, $p<0.001$) all increased the number of bouts. Lunge with vocalisation produced significantly more bouts than either bow (MD=0.22, $p=0.005$) or lunge (MD=0.17, $p=0.049$).

Figure 6.10 Mean (± S.E.) play bout duration occurring after different play signals



Mean bout duration varied between treatments ($F_{(4,76)}=11.11$, $p<0.001$; Figure 6.10). *Post-hoc* tests showed three of the play signals increased mean bout length relative to the control treatment (lunge: MD=0.30, $p=0.004$; bow with vocalisation: MD=0.63, $p<0.001$ and lunge with vocalisation: MD=0.47, $p<0.001$). Play bouts following bow with vocalisation (MD=0.26, $p<0.001$) and lunge with vocalisation (MD=0.24, $p=0.036$) were also significantly greater in length than bouts following bow alone.

Figure 6.11 Mean (± S.E.) duration dogs spent moving fast following different play signals



Key as in Figure 6.9

Time moving fast (run, trot or bound) showed significant differences between treatments ($F_{(4,76)}$= 4.72, p=0.002; Figure 6.11). Lunge with vocalisation, produced significantly more fast movement than either control (MD=0.38, p=0.004) or bow (MD=3.8, p=0.004). Attention duration was not significantly affected by the play signal performed ($F_{(4,76)}$=1.7, p>0.15; Figure 6.12).

Figure 6.12 Mean (± S.E.) attention duration exhibited by dogs following different play signals

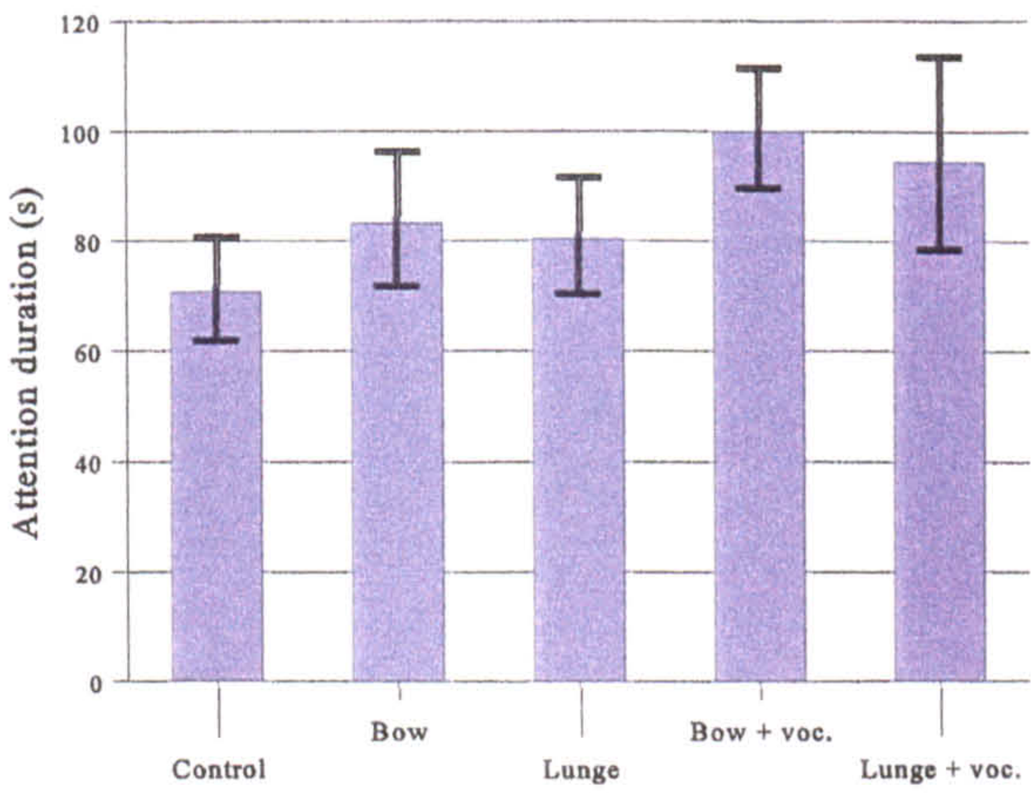
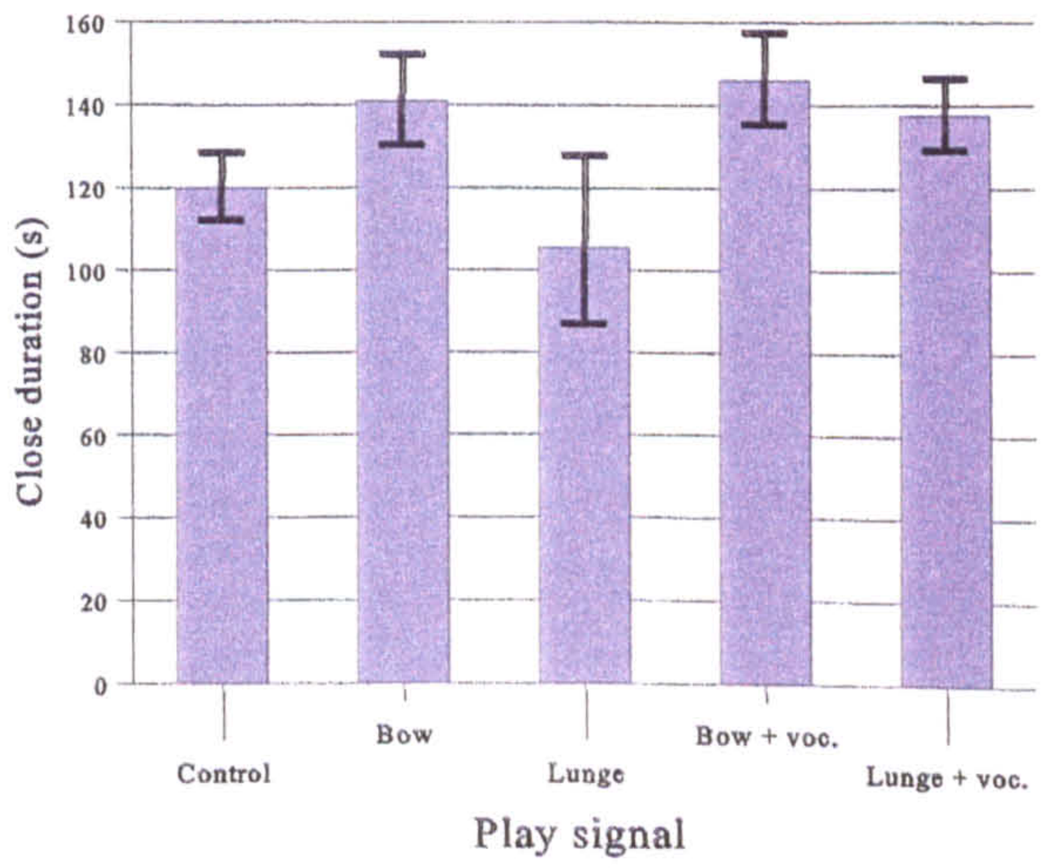


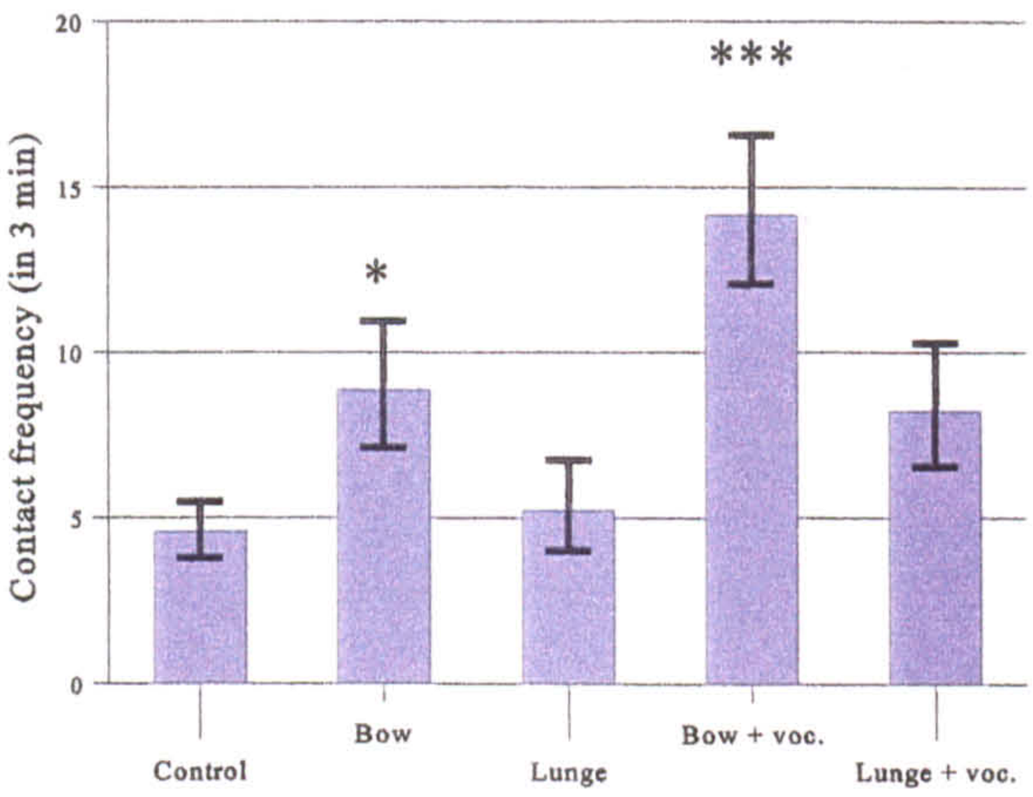
Figure 6.13 Mean (± S.E.) duration dogs spent close to experimenter following different play signals



Key as in Figure 6.9

The duration close to the experimenter was affected by the different treatments ($F_{(4,76)}$=2.73, p=0.035; Figure 6.13). None of the signals differed significantly from the control, but following bow with vocalisation the dogs spent significantly longer close than after lunge (MD=0.14, p<0.05).

Figure 6.14 Mean (± S.E.) frequency of contacting experimenter following different play signals



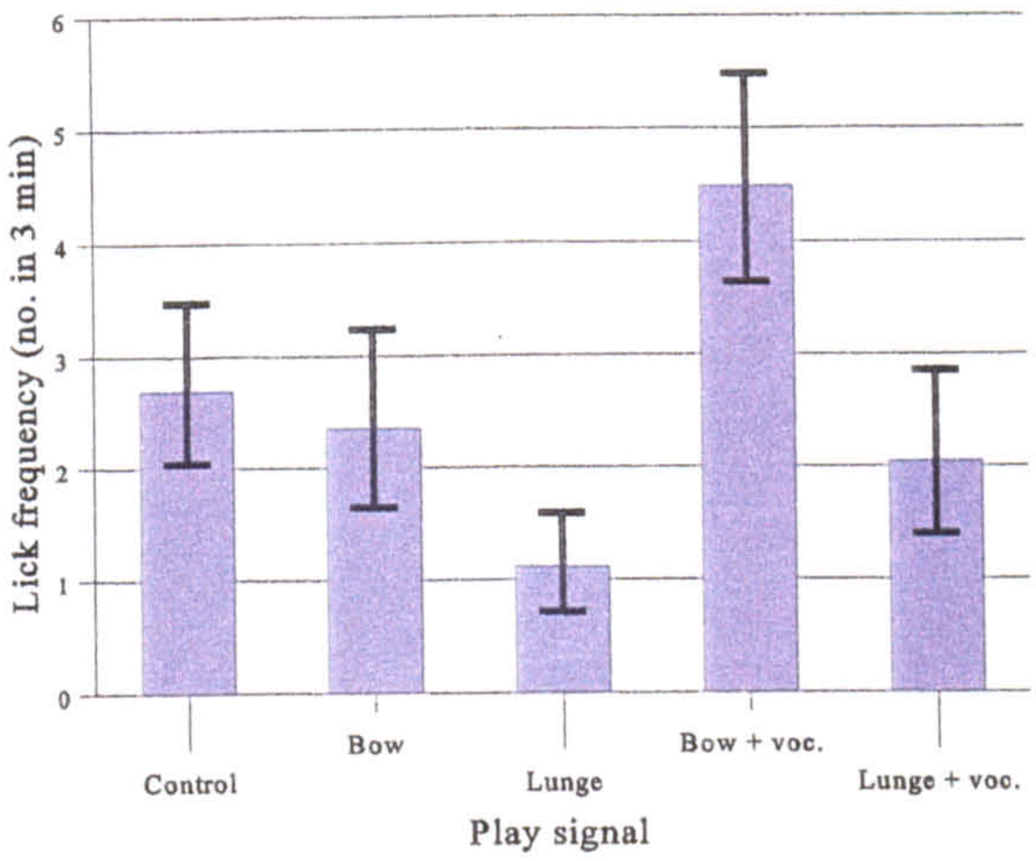
Key as in Figure 6.9

The number of contacts with the person varied significantly between treatments ($F_{(4,76)}$=9.47, p<0.001; Figure 6.14). A bow (MD=0.25, p=0.022) and a bow with vocalisation (MD=0.43, p<0.001) both produced increases in contact frequency relative to the control treatment. Contacts following bow with vocalisation were also significantly more frequent than after a lunge play signal (MD=0.39, p<0.001).

The number of times the dog licked the person was significantly affected by treatment ($F_{(4,76)}$=5.16, p<0.001; Figure 6.15). No play signals produced significant differences relative to the control treatment, but bow with vocalisation was followed by more licks than was the lunge play signal (MD=0.42, p<0.001).

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Figure 6.15 Mean (± S.E.) frequency of licking experimenter following different play signals



Key as in Figure 6.9

6.3.4 Discussion

The delivery of play signals did affect the dogs' behaviour, and different play signals had varying effects.

6.3.4.1 Variations in effectiveness

Play bouts increased in frequency and duration when play signals were delivered. Figures 6.9 and 6.10 show that signals 1-4 elicited play with increasing efficiency. Lunge with vocalisation produced the most and longest play bouts whilst bow produced the fewest, shortest bouts. Although bow increased play, relative to the control, the increase was not statistically significant. The lunge play signal significantly increased the duration and frequency of play bouts. However, the effects were much greater when the signals were accompanied by vocalisations. For example, when accompanied by a vocalisation the lunge signal produced significantly more play bouts than when it was unaccompanied and a bow with vocalisation produced significantly longer bouts than a bow alone. This shows that vocalisations do modulate the effect of visual play signals, in support of my initial hypothesis (6.2.4.3).

6.3.4.2 Objective measure of play

Play bouts were defined subjectively (according to predefined criteria) and so it may be argued there was experimenter bias. I therefore measured an objective indicator of play. I used duration fast because during play, animals perform actions with increased frequencies (Henry and Herrero 1974). This variable was highly correlated to both play bout frequency (Spearman Rank Correlation test; Rho=0.75, $d.f.$=119, p<0.001) and mean play bout duration (Rho=0.48, $d.f.$=119, p<0.001). It also showed a similar pattern of change, according to treatment, to the play bout variables. I therefore conclude that the subjective play measures were based on objective criteria and are valid.

6.3.4.3 Attention gaining or play-soliciting?

It may also be argued that the differences produced by the five treatments are a result of some play signals being more effective at gaining the dogs' attention, rather than actually soliciting play. The procedure of a side step served to attract attention during all conditions (including controls). Its effectiveness is evident as there were no significant differences in attention duration between any of the treatments. I therefore reject the attention gaining explanation and conclude that the play signals had differential play-soliciting effects. The lunge with vocalisation was the most effective play-soliciting signal, and vocalisations increased the efficiency of postural play signals.

6.3.4.4 Specificity of play signals

Examination of further variables (Figures 6.13-6.15) indicates that lunge and bow had differential effects on the dogs' behaviour. Following a bow with vocalisation, dogs spent longer close, and contacted the experimenter more frequently than following a lunge. Bow (with and without vocalisation) increased contact frequency relative to control levels, whilst lunge did not. These differences suggest that a bow acts as an invitation to approach and contact whilst a lunge signal does not. It is possible that a bow serves to solicit Rough-and-tumble, close contact play, whilst a lunge is more effective at instigating Chase games. This idea requires further investigation.

6.3.4.5 Possible ambiguity of play signals

Bow with vocalisation also produced more licking than the lunge play signal. This may merely be a consequence of increased contact. However, licking has been described as a submissive gesture (Fox 1970), thus the increased frequencies may indicate that the bow with vocalisation signal is ambiguous. Some dogs may be confused or threatened by this signal, and consequently react submissively to appease the experimenter. As I have shown in Chapter 5, evidence that gestures are "submissive" is lacking, and the explanation must be viewed with caution, but it is plausible (at least in some cases). It is therefore important not to use the bow play signal exclusively, but to combine it with the apparently unambiguous lunge with vocalisation in future experiments (Chapter 7).

6.3.4.6 Intraspecific and interspecific play signals

The bow signal mimicked the canid play bow, a successful intraspecific play signal. Conversely the lunge was composed of actions (lunge, shuffle feet and vertical bow) all unique to the dog-human context. Therefore, it may have been expected that the bow would be most effective at instigating play. This was not the case; the lunge signal was more successful and less ambiguous as a human-dog play signal. This difference could be a result of previous experience as the subjects' trainers might use lunge play signals more frequently than bows. However, personal observations suggests that this was not the case. Thus, I conclude that similarity to intraspecific signals does not increase the success of a interspecific play signal - dogs can successfully interpret signals morphologically very different from their intraspecific equivalents.

6.3.5 Concluding comments

I conclude that the performance of play signals by humans does alter the subsequent behaviour of dogs. Bow and lunge composite signals accompanied by vocalisations increase a dog's play behaviour. Thus, the actions commonly used as play signals by dog owners do fulfil a play-soliciting role and the initial hypotheses are confirmed:

a) human-dog signals increase the probability that play follows,

b) signals vary in their effectiveness at this function, and

c) vocalisations increase the success of the postural signals they accompany.

The same composite signals are therefore used to investigate the metacommunicative role of play signals (Chapter 7).

Chapter 7

Dogs' perceptions of dog-human games





"When one succeeds - neither seems to care; the loser is not the least ashamed, nor does the victor show any pride or pleasure"

(Groos 1898, p.146)

7.1 Introduction

7.1.1 Dominance enhancement theory

The dominance-enhancement theory (5.1.1) predicts that a dog which consistently wins Tug-of-war games against a specific person, will behave increasingly dominantly towards that person, whilst a dog which loses will show a decrease in dominance-related behaviour. In spite of wide support for this theory amongst behavioural counsellors (Appleby 1997; Anderson 1988), dog trainers (Rogerson 1992) and dog owners (Chapter 2.3.3.4). I have found no experimental evidence to support its predictions (Chapter 5).

The theory makes two assumptions. Firstly, that dogs distinguish between Tug-of-war games which they win and those which they lose, and secondly that this distinction leads to differences in their dominance-related behaviour. The lack of experimental evidence for the theory suggests that at least one of these assumptions is unjustified, but which one? During the experimental study (5.5), Golden Retrievers were more Involved and Determined whilst playing, and subsequently scored higher for Playful attention seeking, when a person had allowed them to win reiterative sessions of Tug-of-war. This suggests that the first assumption is justified; dogs do distinguish between winning and losing. However, experiments were unable to detect any dominance-related consequences of the games (5.4 and 5.5). Thus, the second assumption appears incorrect - game outcomes do not have dominance-related effects.

I hypothesise that the lack of dominance effect is because

"***dogs are able to distinguish between play and non-play interactions***"

(General Hypothesis 3), via the presence or absence of human-dog play signals (Chapter 6). These signals fulfil a metacommunicative role (6.1.2.2) by maintaining the playful context, and ensuring that the game outcomes do not acquire their non-play significance.

Within this chapter I re-test both assumptions of the dominance enhancement theory (7.2 and 7.3). I also explore the metacommunicative role of play signals (7.3). To do this, I utilise novel methodology; instead of measuring the longitudinal effects of repetitive play sessions, I examine single play sessions, and instead of observing the playing dog's behaviour, I measure the reaction of a spectator dog which has observed a dog-human Tug-of-war game. Since this approach is new, the results can only be viewed as preliminary support for or against the hypotheses.

7.1.2 Social learning

Social learning refers to learning that is influenced by observation of, or interaction with, another animal or its products (Galef 1988). There is substantial evidence that social interaction can play an important role in modifying the behaviour of animals of many species (Galef 1996). Studies have concentrated primarily on imitation of motor skills (see Galef 1988 for review), but aspects of social behaviour can also be affected by social learning (Heyes 1994).

It is commonly acknowledged by primatologists, that the behaviour of animal A towards animal B is influenced by A's prior observations of social interactions between B and other conspecifics *e.g.* C (de Waal 1982; Heyes 1994). This has been demonstrated in the field and experimentally. For example, third party chimpanzees, *Pan troglodytes* have been described to console an aggressed conspecific following a fight and to mediate reconciliation between opponents (de Waal and van Roosmalen 1979). Male Hamadryas baboons, *Papio hamadryas* are less likely to challenge a resident male who is highly preferred by his female partner (Bachmann and Kummer 1980) and pigtail macaques, *Macaca nemestrina* (Judge 1982) and olive baboons, *Papio anubis* (Smutts 1985) more frequently attack a bystander which is a close relative or affiliative partner of their aggressor.

It is assumed that domestic dogs are similarly influenced by the social interactions they

observe (*e.g.* Anderson 1988). Behavioural counsellors warn that, in multi-dog households, the nature of interactions between the owner and dog A, can affect both the relationship of the owner and the on-looking dog B (Messent 1979), and also the relationship of the two dogs (Anderson 1988; O'Farrell 1992). In particular dominance dimensions of the relationships are thought to be affected (Appleby 1997; Anderson 1988), but this has not been experimentally tested. If dogs do learn about social relationships via observation, there are important implications for dog training, management and also experimental design.

The experiments described in this chapter involve a spectator dog observing interactions between a demonstrator dog and a person (experimenter). The subsequent behaviour of the spectator towards the person and dog is analysed and compared following a variety of interactions. If dogs experience social learning, I predict that the spectator will behave differently dependent upon the nature of the observed interaction.

7.1.3 Objectives

In this chapter I aim to demonstrate that dogs can learn about the outcomes of Tug-of-war games via social learning. I present experiments to investigate whether a spectator dog modifies its behaviour towards members of a dog-human dyad, dependent upon who wins a Tug-of-war game (7.2 and 7.3). I also investigate how the spectator learns; whether the information is learnt entirely from watching the game or whether the spectator subsequently obtains cues from the exhibitor dog (7.3).

I use the spectator's behaviour to test the following hypotheses about games:

a) a dog can distinguish between the winner and loser of a dog-human Tug-of-war game,
b) outcomes of Tug-of-war games influence subsequent dominance-related behaviour,
c) the presence of human-dog play signals modifies the dominance-related consequences of Tug-of-war games.

Hypotheses a) and b) are tested by both Experiments 7.2 and 7.3, whilst hypothesis c) is tested by Experiment 7.3.

7.2 Can a spectator dog distinguish the winner of a dog-human game?

7.2.1 Introduction

This preliminary experiment was designed to develop and refine a novel experimental technique. It tests the hypotheses that:
a) a dog can distinguish between the winner and loser of a dog-human Tug-of-war game,
b) outcomes of Tug-of-war games influence subsequent dominance-related behaviour.

I examined the behaviour of a spectator dog which had observed two minute Tug-of-war play sessions between a familiar conspecific and a human. The subsequent behaviour of the spectator towards the players was compared after it had observed the human win, the dog win and a control petting interaction. Detectable differences in spectator behaviour in the dog-win and human-win conditions were taken to show that the spectator has undergone social learning and that hypothesis a) is true. Behaviours which are commonly believed to indicate "dominance" were also recorded. If outcomes of games have dominance-related consequences, I would predict the spectator would behave more dominantly towards a player when they had lost a game as compared to when they had won. The occurrence of such differences would support hypothesis b).

7.2.2 Method

7.2.2.1 Design

The experiment followed a within-subjects design.

7.2.2.2 Subjects

The initial subjects were 37 dogs of varying breeds all housed at the Waltham Centre for Pet Nutrition (1.5.2.2). All dogs underwent the experimental treatment, however they

were screened prior to statistical analysis (see procedure 7.2.2.4). The reduced sample of 21 dogs was composed of 18 Labrador Retrievers (five male and 13 female), two Springer Spaniels (both female) and one Golden Retriever (female). The dogs ranged in age from 6.5 to 85 months (mean=25 months). Nine of the Labrador Retrievers were previously subjects in Experiment 3.3 and one was a subject in Experiment 6.3. The subjects assumed the role of spectator and each required a partner - the demonstrator dog. Demonstrators were familiar to their spectator, which was either their kennel-mate or a regular exercise companion, and each demonstrator partnered only one subject. In 14 cases, the demonstrator was also an experimental subject. These pairs underwent the experimental procedure twice, (with roles reversed) with a minimum of two days between trials.

7.2.2.3 Procedure

Trials took place in a rectangular room (7.5m x 1.4m) with six adjoining dog pens (as described in Experiment 5.4). In one pen there was a video camera (Philips Explorer VKR6850) mounted on a tripod. A closed-circuit surveillance camera (Panasonic WV-CL502) was mounted on the opposite wall and using the two cameras the entire room could be filmed. The dog entered from a door at one end of the room. At the opposite end there was a chair, the proximity to which was marked on the floor. The room was unfamiliar to the dogs, but they had experienced similar rooms previously. Trials were carried out by an experimenter (myself; female, aged 23 years) and a handler (female, aged 24 years), both of whom were unfamiliar to the dogs.

Each subject was trialled three times. Trials took place on different days, at approximately the same time. Where possible, the three trials were on consecutive days, but when impractical there was a maximum of three days between successive trials. All trials were composed of three stages and followed the same format:

Acclimatisation

The subject and its partner (the demonstrator) were collected from their kennels, leashed and walked to the experimental room. They were unleashed and allowed to roam freely for two minutes in the presence of the handler and the experimenter. The humans did not instigate interactions with the dogs, but if the dogs approached they received moderate petting (as defined in 5.4.3.3).

Demonstration

The cameras were activated. The experimenter led the spectator dog (the experimental subject) to the door end of the room. The spectator dog was instructed to sit and gently restrained. It was positioned facing the handler who interacted with the demonstrator for two minutes. The types of interaction varied according to experimental treatment:

Petting - this was a control treatment. The handler remained seated on the chair. She stroked and spoke gently to the demonstrator dog.

Human-win Tug-of-war - the handler played with the demonstrator dog, giving frequent and varied play signals. The game centred around a Ragger toy (see 3.4.2.3 for description), and was composed mainly of Tug-of-war, but Chase was also included to maintain the dog's interest (see Appendix 2 for definition of game types). The handler retained possession of the toy in the majority (at least 80%) of competitions and at the end of the play session. She then gave the toy to the experimenter who placed it outside the room. The handler led the dog back to the starting position and sat on the chair with the dog beside her.

Dog-win Tug-of-war - the handler played Tug-of-war as described above, but this time the dog was allowed to win most of the competitions. The handler responded to chase invitations and manipulated the game to avoid sole possession of the toy. The demonstrator dog retained the Ragger at the end of the session, after which the experimenter retrieved it and placed it outside the room. The handler returned to the chair with the demonstrator alongside her.

All subjects experienced all three treatments. The petting treatment always occurred first. The subsequent order of dog-win and human-win treatments was randomised and

balanced within the sample.

Experimental recording

The experimenter released the spectator and quickly exited the room, where she remained out of sight and earshot for two minutes. The handler then released the demonstrator dog and remained seated on the chair. The dogs were free to interact and move around the room. If the spectator approached the handler it received moderate petting, but the demonstrator dog was ignored. If either dog jumped or climbed upon the handler or chair they were gently pushed away. After two minutes, filming was terminated, and the experimenter returned. The dogs were leashed and returned to their kennels.

7.2.2.4 Behavioural measures

Play sessions

The videoed play sessions (demonstration stages) were observed. I recorded the following:

the total time the dog exhibited interest in the toy,

the frequency of competitions,

the number of competitions won by the dog (for definitions refer to 3.4.2.4),

an Interactivity score for the play session (see Chapter 2.4.2).

Screening of subjects

The play session observed, represented the experimental treatment received by the spectator (subject). It was therefore important to standardise the play, so the initial sample was screened. Any session during which the demonstrator showed less than 90 seconds (out of two minutes) of interest in the object, or scored less than 2 out of 5 for Interactivity was considered insufficiently playful. Eleven demonstrators were insufficiently playful during at least one session, and their spectators were eliminated from subsequent analysis. The proportion of competitions won by each partner was also considered. In the human-win condition, the human always won at least 80% of the competitions. However, in the dog-win condition, five demonstrators won less than 50%

of the competitions and so their spectators were also rejected. The final sample constituted 21 spectator dogs which all observed at least 90 seconds of play in both play trials and observed dog-win sessions in which at least half the competitions were won by the dog.

Recording sessions

The behaviour of the remaining 21 spectators, during the experimental stages was observed. Their behaviour towards both the handler and the demonstrator dog was recorded using the Observer data recoding system (Noldus Information Technology b.v. 1987). Variables describing initial approaches required detailed repetitive observations and so were recorded manually. The variables measured are listed in Table 7.1.

Table 7.1 Behavioural variables measured for the spectator dog during the experimental stage

Variable	Description	Units
First approach to human	Individual which demonstrator approached first to within 50cm (0-dog; 1-human)	0/1
Behaviour towards demonstrator dog		
Latency of dog approach	Latency to spectator's first approach to within 50 cm whilst orientated towards demonstrator dog	s
Gait of dog approach	Gait of spectator's first approach to demonstrator dog: 0-no approach; 1-stand; 2-walk; 3-trot; 4-run; 5-bound	scale: 0-5
Tail height on dog approach	Tail position on spectator's first approach to demonstrator dog: 1-tucked - 5-vertically	scale: 1-5
Ear position on dog approach	Ear position on spectator's first approach to demonstrator dog: 0-back - 2-pricked	scale: 0-2
Dog approach frequency	No. of times spectator approaches to within 50cm of demonstrator dog	freq
Dog interaction duration	Time spectator spends interacting or in contact with demonstrator dog	s

Behaviour towards human handler		
Latency of human approach	Latency to spectator's first approach to within 50 cm whilst orientated towards human handler	s
Gait of human approach	Gait of spectator's first approach to human handler (scale as for dog approach)	scale: 0-5
Tail height on human approach	Tail position on spectator's first approach to human handler (scale as for dog approach)	scale: 1-5
Ear position on human approach	Ear position on spectator's first approach to human handler (scale as for dog approach)	scale: 0-2
Human approach frequency	No. of times spectator approaches to within 50cm of human handler	freq
Human interaction duration	Time spectator spends interacting or in contact with human handler	s
Jump frequency	No. of times spectator jumps or climbs upon human handler	freq

Abbreviations: freq - frequency; s - seconds

7.2.2.5 Statistical analysis

The proportion of first approaches to handler and demonstrator in the dog-win and human-win conditions were compared. It was not possible to use Chi-squared tests due to the repeated measures design of the experiment, so sign[1] tests were applied. Each dog was categorised on a scale of -1 to 1 dependent upon its responses in the two conditions. A human approach scored 1, a dog approach scored 0. The difference in scores between human-win and dog-win conditions was then calculated. So:

a) a subject which approached the same individual first in both conditions was assigned a score of 0,
b) a subject which approached the human first in the human-win and the dog first in dog-win conditions was assigned a score of 1,
c) a subject which approached the dog first in the human-win and the human first in dog-win conditions was assigned a score of -1.

---

[1] A sign test compares two related samples. It is not a quantitative test, but considers only the direction of the differences between pairs of measures testing the null hypothesis that the median difference between the two samples is zero (see Siegel and Castellan 1988).

These scores will subsequently be referred to as the "Human-win - Dog-win Difference" scores. A sign test was performed on the scores.

All subsequent variables were log transformed to improve normality. Repeated Measures ANOVAs (refer to 3.4.2.5 for description of technique) were then carried out to determine the effect of trial type (three levels: pet, human-win or dog-win) on each of the twelve dependent variables. Those variables which were significantly affected (at $p<0.1$) were analysed further via paired t-tests (see 4.5.2.6 for description) comparing the human-win and dog-win conditions.

7.2.3 Results

The proportion of first approaches to the demonstrator dog and the human handler are shown in Table 7.2.

Table 7.2 Proportion of the spectators' first approaches to the human handler and demonstrator dog following different trial types

Trial type	Proportion first approaches to dog	Proportion of first approaches to human
Petting	0.58	0.43
Human-win	0.29	0.71
Dog-win	0.52	0.48

A higher proportion of spectators approached the human first in the human-win trials, and likewise more spectators approached the dog first when it had won the preceding game. However, a sign test showed this difference did not reach statistical significance (N=7, k=1, p=0.12).

ANOVAs revealed that three of the dependent variables were significantly affected by trial type (at $p<0.1$) whilst the remaining ten variables were not ($F_{(2,40)}<1.5$, $p>0.2$; Table 7.3).

Table 7.3 Results of Repeated Measures ANOVAs exploring the effect of trial type observed (petting, human-win or dog-win) upon the behaviour of the spectator dog

Variable name	Petting mean (±S.E.)	Human-win mean (±S.E.)	Dog-win mean (±S.E.)	$F_{(2,40)}$ ratio	p
Gait of dog approach	1.66 ± 0.28	1.93 ± 0.18	2.54 ± 0.24	5.55	<0.01
Ear position on dog approach	1.02 ± 0.12	1.31 ± 0.12	1.37 ± 0.05	3.13	0.06
Latency of human approach	14.87 ± 5.45	5.41 ± 1.63	23.57 ± 9.73	3.41	0.04

All variables significant at $p<0.1$ are shown. All values are arithmetic means and standard errors.

Paired t-tests then compared the human-win and dog-win conditions for each of these three variables. Gait of dog approach was significantly faster following a dog-win than a human-win (t=2.96, *d.f.*=20, p=0.007) and latency of human approach was shorter following a human-win than a dog-win (t=2.50, *d.f.*=20, p=0.02). Ear position on dog approach did not vary significantly between the two conditions (t=1.36, *d.f.*=20, p=0.19).

7.2.4 Discussion

7.2.4.1 Distinguishing trial type

The behaviour of the spectator dog varied dependent upon whether it had observed a Tug-of-war game won by a dog or a human. Spectators approached the human handler sooner (with shorter latency) after they had won the game, and the demonstrator dog with increased gait after it had won. They were also more likely to approach the human first when the human had won the preceding Tug-of-war game than when the dog had won, although this difference was not statistically significant. These results support the first hypothesis that spectator dogs "can distinguish between winners and losers of a dog-human Tug-of-war game".

7.2.4.2 A winner is more attractive than a loser

Both significant differences between human-win and dog-win conditions indicate that the spectator approached an individual faster when it had won a game than when it had lost; they approached a winning dog with increased gait and a winning human with shorter latency.

One may question why condition affected the gait of dog approach, but not the latency, whilst the latency of human approach was affected, but not the gait. I suggest this is a result of the methodology. The human remained in a fixed seated position and so latency is a good indication of the spectator's motivation to reach them. However, the demonstrator dog moved around the room. The spectator's approach latency would be affected by the demonstrator's position, and so gait is a better indication of the spectator's keenness to reach the dog. I therefore conclude that a spectator dog is keener to approach the winner of a dog-human Tug-of-war game and a winning player is perceived as more attractive than a loser.

7.2.4.3 Dominance-related behaviour

The second hypothesis was that the outcomes of Tug-of-war games influence subsequent dominance-related behaviour. This predicts that the spectator dog would behave more dominantly towards an individual after it had lost, and more submissively when it had won. The behaviours measured here, which are frequently cited as indicators of dominance, and/or were found to contribute to the trait "Confidence" in Chapter 5 experiments, are high tail (Scott and Fuller 1965; Confidence factor in 5.4 and 5.5) and ear positions (Fox 1970; Confidence factor in 5.5), fast approaches (Confidence factor in 5.4) and jumping up at a person (O'Farrell 1992; Confidence factors in 5.4 and 5.5). The results show that the spectators' tail positions and jump frequencies were unaffected by trial type. Ear position during the first dog approach did vary with condition ($p<0.1$), but the difference between dog-win and human-win trials was non-significant and in the opposite direction to predicted - ears were higher when approaching a winning dog. I have also shown (7.2.4.1) that approaches were quicker towards winners, in opposition

to the idea of increased submission towards a winning partner. Therefore, these results provide no support for the hypothesis that the outcomes of Tug-of-war games influence dominance-related behaviour. It seems that, although who wins a dog-human game does affect a spectator dog's behaviour towards the players, their dominance-related behaviour remains unaffected.

7.2.4.4 Why is dominance-related behaviour unaffected?

I hypothesise that the lack of dominance-related effect is due to the playful context in which the Tug-of-war takes place. During all play trials, the handler delivered frequent and varied play signals which I suggest prevented the game outcomes from having dominance-related consequences. I predict that the spectators' behaviour would be different in the absence of play signals, when dominance effects would be apparent. This hypothesis requires empirical testing; this is the aim of the next experiment (7.3).

7.2.4.5 What cues does the spectator use?

Spectator dogs distinguish between games won by dogs and humans - but how? It is natural to assume that the dog observes the game, and reacts differently because of what it sees, but this is not necessarily true. For example, rats learn food preferences from conspecifics (Galef 1990). This social learning is not via observation (Galef and Wigmore 1983), but from olfactory cues on the demonstrator rat's breath (Galef *et al.* 1988). Similarly, the spectator dog in this experiment may have received cues from the demonstrator dog which allowed it to distinguish between the game outcomes. Whether the spectator uses direct observation of the game, or cues from the demonstrator, requires further investigation and is examined below (7.3).

7.3 Do human-dog play signals function in metacommunication?

7.3.1 Introduction

The previous experiment pioneered the use of social learning in the investigation of dogs' perceptions of games. I showed that spectator dogs are able to distinguish between winners and losers of Tug-of-war games, but I found no evidence of increased submission towards the winner. In the current experiment I aim to confirm these findings, and to test two further hypotheses:

a) the presence of human-dog play signals modifies the dominance-related consequences of Tug-of-war games, and
b) spectator dogs distinguish the winners and losers of games via direct observation of the game.

This experiment used a single-breed sample of Labrador Retrievers. It followed a similar design to 7.2, but included additional conditions. Subjects observed Tug-of-war sessions (dog-win and human-win) which incorporated no human-dog play signals, and their subsequent behaviour was compared to signalled sessions. Spectator dogs were also present during dog-win and human-win play sessions which they were unable to see (due to visual screening). The importance of direct observation in their ability to distinguish between human-win and dog-win conditions was thereby assessed.

7.3.2 Method

7.3.2.1 Design

The experiment followed a within-subjects design.

7.3.2.2 Subjects

The subjects were 22 Labrador Retrievers (three males and 19 females), ranging in age from 15 to 138 months (mean=59 months). Two of the dogs were previously subjects in Experiment 3.3, seven in experiments in Chapter 4, ten in Experiment 5.4, six in Experiment 6.3, four in Experiment 7.2. and six had not previously been subjects. As described above (7.2.2.2), subjects assumed the role of spectator and each had a partner - the demonstrator dog. To eliminate the necessity for post-experimental screening, only the most playful dogs were selected as demonstrators. Eleven Labrador Retrievers were chosen which were reported by dog-care staff to play Tug-of-war enthusiastically. None of these were subjects, but acted as demonstrators, each partnering two spectator dogs (subjects). In all cases demonstrator and spectator were familiar with each other.

7.3.2.3 Procedure

Trials took place in a octagonal room (approximately 7m x 3.5m). The room was surrounded on six sides by storage rooms, each of which had a wooden and glass door. Doors on the remaining two sides were the entry and exit routes. One of the storage room doors was removed and a wire holding cage (1.2m x 0.75m) fixed in the opening such that the cage could be entered from the experimental room and once inside a dog could see the whole of the experimental room (see Figure 7.1). Two video cameras (Philips Explorer VKR6850 and Sony Video 8 CCD-TR370E) were mounted on tripods in two of the adjoining rooms. Using both cameras the entire room could be filmed. A chair was placed at one end of the room opposite to, and facing, the cage. The room was previously unfamiliar to the dogs, so during the week preceding the experiment, all spectators and demonstrators were acclimatised. They were each walked through, and exercised in, the room on at least five occasions. Spectators were also acclimatised to the cage.

Each subject was trialled six times on consecutive days at approximately the same time. Demonstrators took part in two trials per day (one with each spectator partner) which were separated by at least four hours. Trials were carried out by an experimenter (male,

aged 21 years) and a handler (myself; female, aged 25 years), were composed of three stages and followed the same format as Experiment 7.2.

Figure 7.1 *Experimental room and apparatus used for social learning experiments - the spectator dog is in the cage watching the handler play Tug-of-war with the demonstrator dog*



Acclimatisation

This stage was identical to during Experiment 7.2.

Demonstration

The cameras were activated. The experimenter led the spectator dog (the experimental subject) to the cage and encouraged it to enter. The cage door was shut and, in unseen trials, a wooden board was placed over the door (see Figure 7.2).

Figure 7.2 *Unseen trials: a wooden barrier is placed in front of the cage to prevent the spectator dog from observing the Tug-of-war game*



The handler then interacted with the demonstrator for two minutes. The type of interaction varied according to experimental treatment:

1) Seen human-win - the handler played with the dog whilst the spectator was in the cage with no visual barrier. The handler delivered play signals consisting of the bow and lunge composite signals used in Experiment 6.3[2]. These were delivered at a mean rate of four per minute, and a minimum of two per minute. The handler also gave frequent play vocalisations, both encouraging and high pitched at a mean frequency of 65 ± 1.1 per session. The game centred around a Ragger toy (as described in 7.2.2.3). The handler retained possession of the toy in the majority (at least 80%) of competitions and at the end of the play session. She then gave the toy to the experimenter who placed it outside the room. The handler led the dog back to the starting position and sat on the chair with the dog beside her.

2) Seen dog-win - the handler played Tug-of-war, observed and signalled as described above, but the dog was allowed to win most (at least 80%) of the competitions.

2

Bow - experimenter performs a Bow and simultaneously pats the floor,

Lunge - experimenter performs Shuffle feet followed by Lunge in a Vertical bow position. For further description refer to 6.3.2.4 and Appendix 4.

The demonstrator dog retained the Ragger at the end of the session, after which the experimenter retrieved it and placed it outside the room. The handler returned to the chair with the demonstrator alongside her.

3) Unsignalled human-win - Trials were the same as seen human-win, but with the omission of any human-dog play signals or vocalisations.

4) Unsignalled dog-win - Trials were the same as seen dog-win, but the handler produced no play signals or vocalisations.

5) Unseen human-win - after the spectator entered the cage, the experimenter placed a wooden barrier in front of the cage door. The dog was unable to see the experimental room although its hearing was unimpaired. The handler and demonstrator played in an identical way to during seen human-win trials *i.e.* including play signals. After two minutes of play the handler led the demonstrator dog back to the starting position and sat on the chair with the dog beside her. The experimenter then removed the barrier.

6) Unseen dog-win - A barrier prevented the spectator dog from observing the game (as described above). The handler played identically to during seen dog-win trials.

Each subject experienced all six treatments. The order was randomised according to a Graeco Latin Square design (Cochran and Cox 1957) in such a way that dog-win and human-win trials alternated.

Experimental recording

The experimenter opened the cage and released the spectator before leaving the experimental room. The remainder of the stage was identical to Experiment 7.2 (refer to 7.2.2.3).

7.3.2.4 Behavioural measures

Play sessions

The videoed play sessions (demonstration stages) were observed. I recorded:

the frequency of competitions,

the number of competitions won by the dog, and
an Interactivity score for the play session (as described in 7.2.2.4).

All demonstrators exhibited a minimum Interactivity score of three (out of five) for all six trials. In all dog-win trials demonstrators won at least 75% of the competitions. There was therefore no need to screen the subjects.

Recording sessions

The behaviour of the spectator, during the experimental stage was recorded in the same way as Experiment 7.2. In the previous experiment all significant differences occurred during the initial approach, no frequencies or durations during the two minute recording session gave significant results. It is possible that a two minute period was too long to detect differences in the spectator's behaviour. In the current study, all measures (frequencies and durations) were therefore made during the first minute following the spectator dog's release. The variables measured were the same as those listed in Table 7.1, but two additional variables were included (Table 7.4).

Table 7.4 New behavioural variables measured for the spectator dog during the experimental stage, in addition to those described in Table 7.1.

Variable	Description	Units
Displacement frequency	No. of times spectator displaces demonstrator dog from position nearest to handler	freq
Following duration	Time for which spectator follows demonstrator - within 50cm and moving in the same direction	s

Abbreviations: freq - frequency; s - seconds

7.3.2.5 Statistical analysis

Initial comparisons were made between the dog-win and human-win trials under each of the three conditions (seen, unsignalled and unseen). The proportions of dog and human first approaches were compared. Each dog was assigned a "Human-win - Dog-win

Difference" score, calculated as described in 7.2.2.5. The distribution of scores was tested using sign tests.

The remaining 14 variables were transformed using Log (x+1). Paired t-tests then compared each variable in:

a) seen dog-win and seen human-win,
b) unsignalled dog-win and unsignalled human-win, and
c) unseen dog-win and unseen human-win.

The data set was then divided into two. Data set 1 included all seen and unsignalled trials - each subject being represented four times. The seen trials, included signals and could alternatively be described as "signalled". They were therefore used for comparison with unsignalled for analysis of the effect of signalling. Data set 2 included the seen and unseen trials. These 88 trials were used to analyse the effect of visibility. The 44 seen trials (dog-win and human-win) featured in both data sets.

Firstly, the effects of the independent variables on the proportion of first approaches to dog and human were assessed. This was done using Wilcoxon Signed-Rank tests (refer to 4.2.2.5 for description of technique). Using data set 1 the interactive effect of signal (present or absent) and winner (dog or human) was tested. For each dog, the "Human-win - Dog-win Difference" score, was compared for signalled and unsignalled trials. A significant result would indicate that winner had a different effect during signalled and unsignalled trials. Using data set 2, the interactive effect of visibility (seen or unseen) and winner was tested. Wilcoxon tests compared the "Human-win - Dog-win Difference" scores during seen and unseen trials.

Two-way Repeated Measures ANOVAs were used to test the remaining 14 independent variables. For data set 1, I examined the main effect of signal (present or absent) and its interaction with winner (dog or human), on each dependent variable. For data set 2, the independent variables tested were winner and visibility (seen or unseen).

7.3.3 Results

The results are divided into three sections, each describing one of the three conditions - seen, unsignalled and unseen.

7.3.3.1 Seen trials

Comparisons were made between seen dog-win and human-win trials. The proportion of spectators approaching the human first was higher after the human had won the Tug-of-war game (Table 7.5), but this difference was not statistically significant (N=11, k=4, p=0.54).

Table 7.5 Proportion of spectators approaching human handler and demonstrator dog first following dog-win and human-win seen trials

Winner	Proportion first approaches to dog	Proportion of first approaches to human
Dog	0.45	0.55
Human	0.32	0.68

Paired t-tests compared the remaining 14 variables in dog-win and human-win seen trials. Gait of dog approach was the only variable to vary significantly (see Table 7.6).

Table 7.6 Results of t-tests comparing dog-win and human-win seen conditions

Variable name	Human-win mean (± S.E.)	Dog-win mean (± S.E.)	t	*d.f.*	*p*
Gait of dog approach	1.91 ± 0.22	2.64 ± 0.23	3.17	21	0.005
Ear position on dog approach	0.93 ± 0.12	1.17 ± 0.11	1.90	21	0.07
Latency of human approach	13.26 ± 2.68	17.08 ± 4.84	0.38	21	0.71

The variables displayed are those significantly ($p<0.1$) affected during the current and the previous experiment. All values are arithmetic means and standard errors.

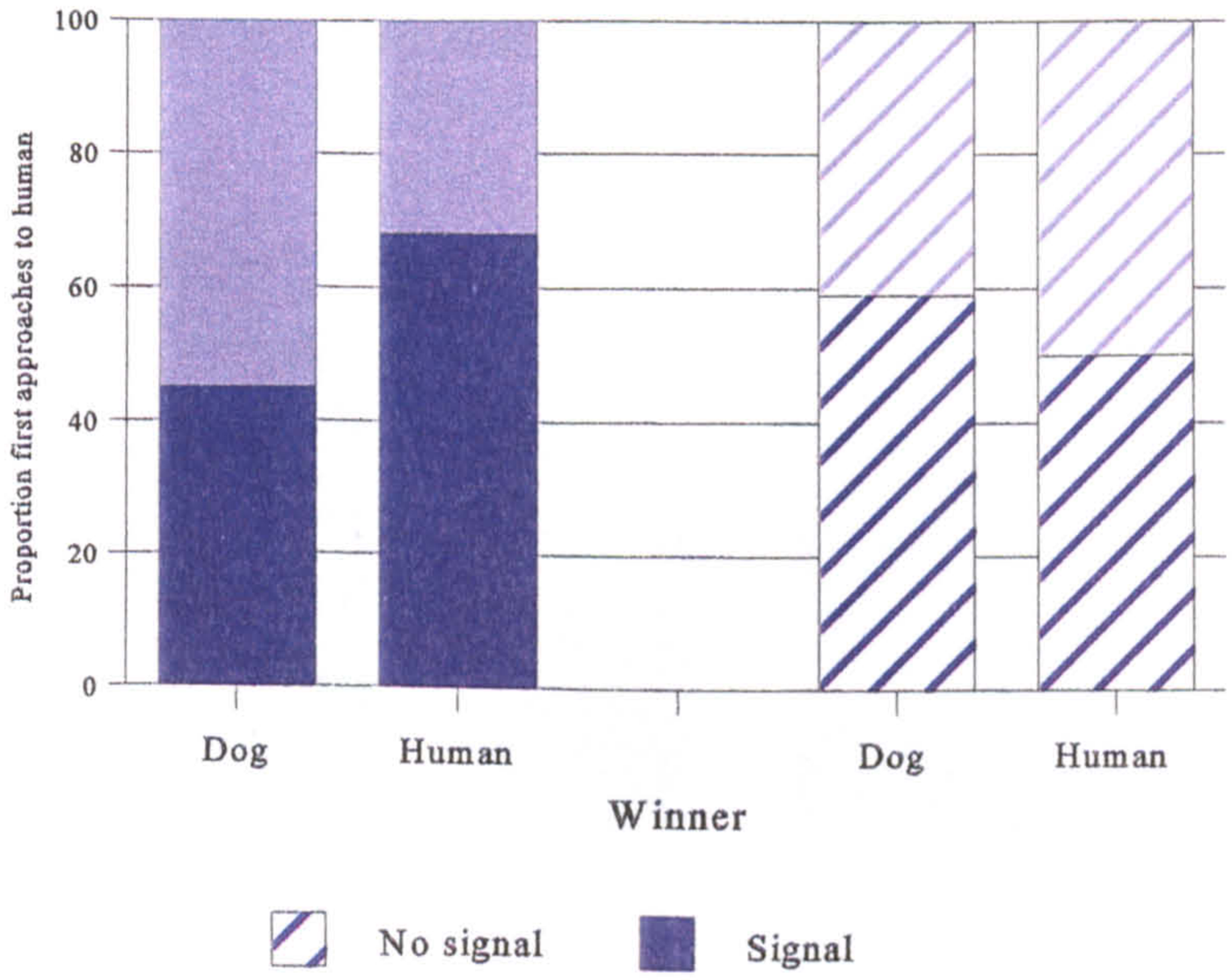
7.3.3.2 Unsignalled trials

Initial comparisons were made between unsignalled dog-win and human-win trials. There was no significant difference between the proportion of spectators approaching the human first after they had won or lost the Tug-of-war game (Table 7.7; N=10, k=4, p=0.75). These proportions were compared to those during seen (signalled) trials (Figure 7.3).

Table 7.7 *Proportion of spectators approaching human handler and demonstrator dog first following dog-win and human-win unsignalled trials*

Winner	Proportion first approaches to dog	Proportion of first approaches to human
Dog	0.41	0.59
Human	0.50	0.50

Figure 7.3 *The proportion of spectators approaching the human handler (dark blue) and demonstrator dog (light lilac) first in dog-win and human-win trials, in the presence (solid bars) and absence (hatched bars) of signals*



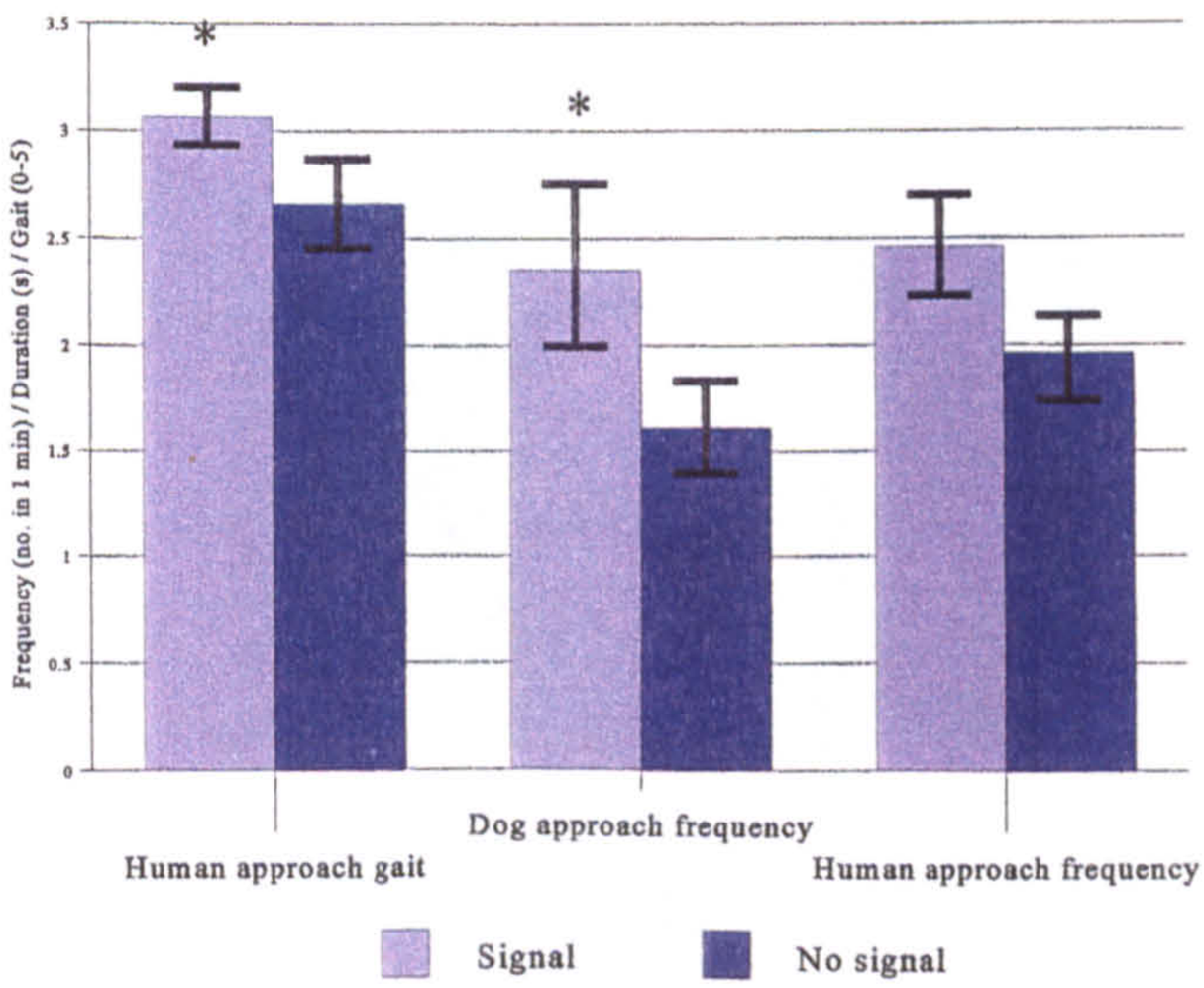
When signals were included, a higher proportion of spectators approached the human first after the human had won the Tug-of-war game. When signals were omitted the preference was reversed; a higher proportion of dogs made first approaches to a losing human than a winning human. But, Wilcoxon Signed-Rank tests showed that the effect of

signal presence on the "Human-win - Dog-win Difference" scores was not statistically significant (z=-1.23, n=11, p=0.22).

Paired t-tests revealed that one variable varied significantly between unsignalled dog-win and human-win trials. During dog-win trials the spectator jumped upon the human with significantly greater frequency than during human-win trials (0.47±0.14 vs. 0.28±0.11, t=2.67, $d.f.$=21, p=0.01). The gait of dog approach did not differ significantly between human-win and dog-win unsignalled trials (t=0.56, $d.f.$=21, p>0.5).

Two-way ANOVAs showed that the presence of signals significantly affected the variables gait of human approach ($F_{(1,21)}$= 4.25, p=0.05) and dog approach frequency ($F_{(1,21)}$= 5.40, p<0.05). Both were higher following trials in which play signals were delivered. There was also a trend for higher human approach ($F_{(1,21)}$= 2.9, p<0.1) in signalled trials (see Figure 7.4).

Figure 7.4 Effect of play signal presence upon the spectator dogs' behaviour



*This bar chart illustrates the results of statistical analysis which was performed on log transformed data. The values shown are therefore the reverse transformations of the mean and mean ± standard errors of the transformed data. All variables significantly affected at p<0.1 are displayed *p≤0.05.*

Figure 7.5 *Interactive effect of winner and signal presence upon mean (± S.E.) gait of spectator's approach to the demonstrator dog*

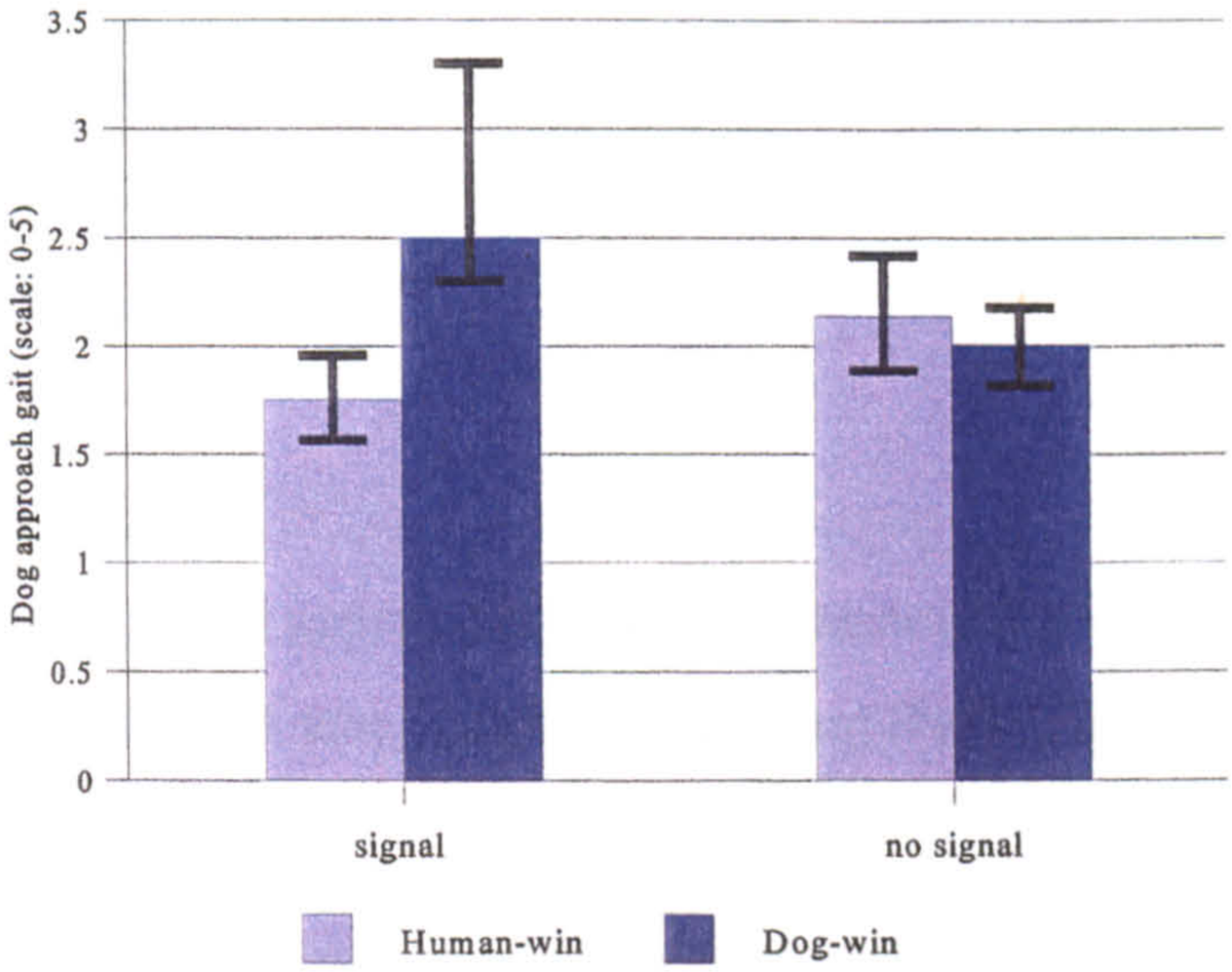
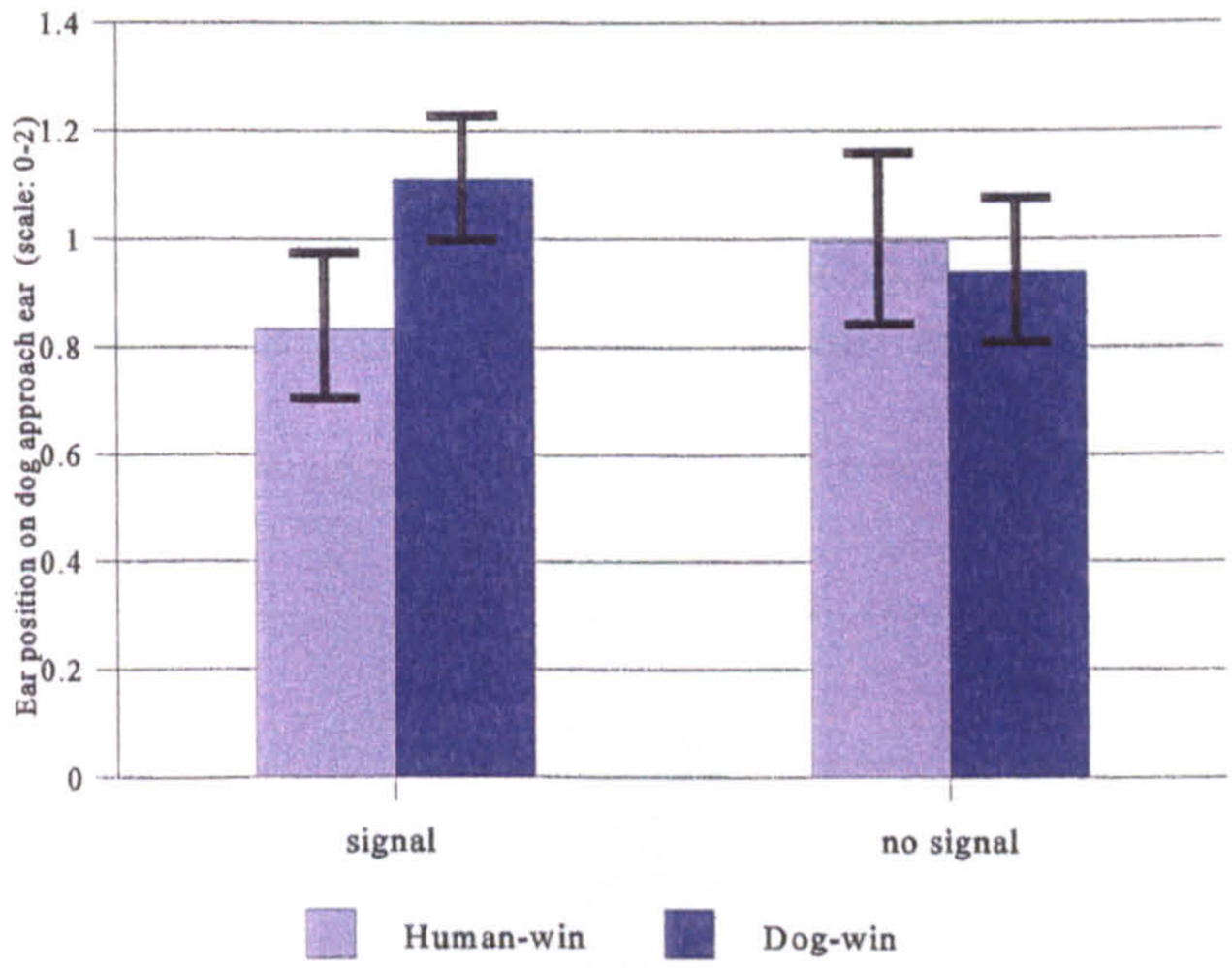


Figure 7.6 *Interactive effect of winner and signal presence upon mean (± S.E.) ear position on spectator's approach to the demonstrator dog*



These bar charts illustrate the results of statistical analysis which was performed on log transformed data. The values shown are therefore the reverse transformations of the mean and mean ± standard errors of the transformed data.

There were significant interactive effects between winner and signal presence on dog approach gait ($F_{(1,21)}$= 8.50, p<0.01; Figure 7.5) and ear position on dog approach ($F_{(1,21)}$= 6.60, p<0.05; Figure 7.6). Spectator dogs approached the demonstrator dog with a faster gait and higher ear positions after it had won, but only when signals were incorporated in the session. Contrastingly, when signals were omitted, the spectator approached the dog slower and with lower ear positions after it had won the game than after it had lost.

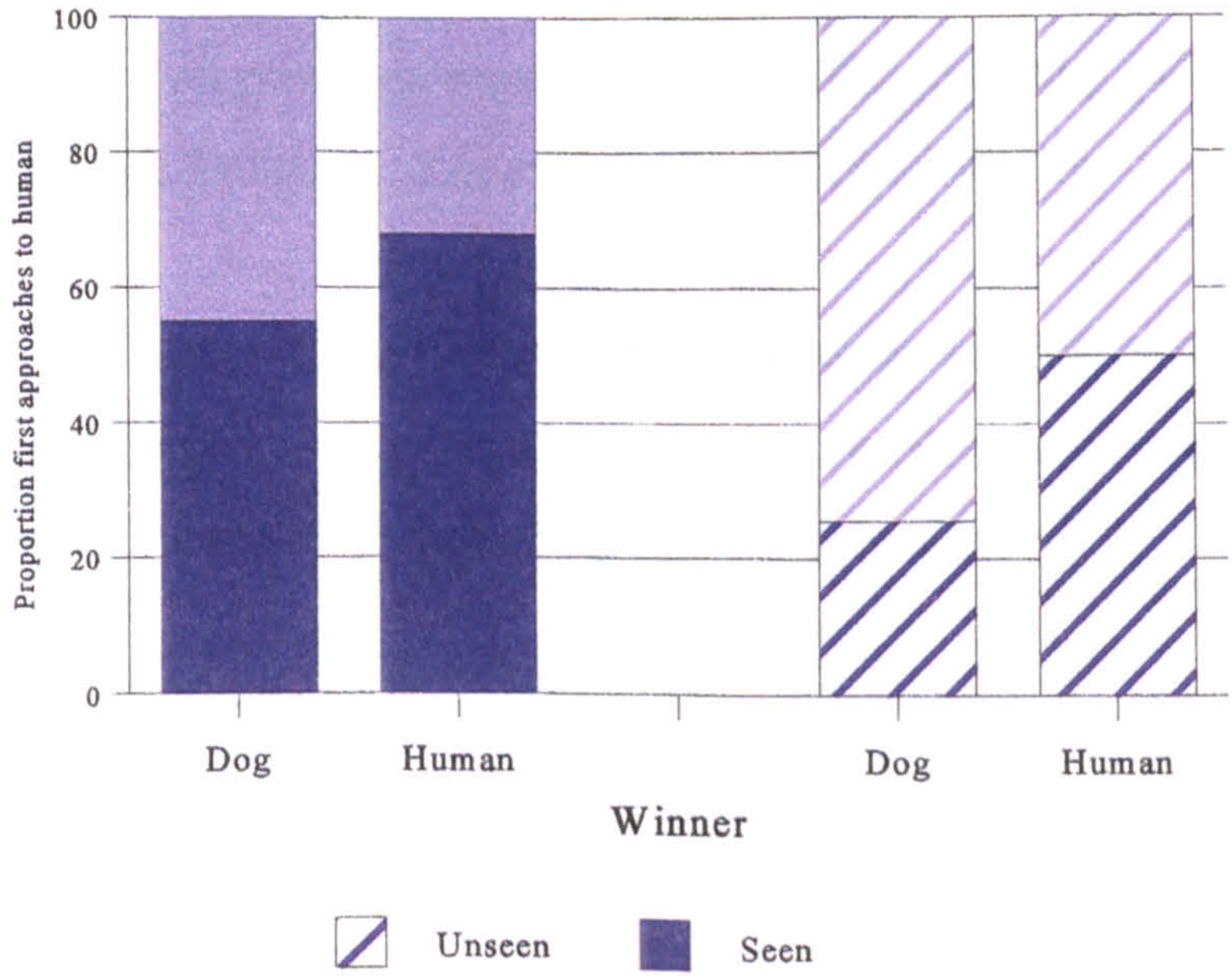
7.3.3.3 Unseen trials

The proportion of first approaches to the human was higher when they had won the game, but the variation was not quite significant (N=10, k=2, p=0.1; Table 7.8)

Table 7.8 *Proportion of spectators approaching human handler and demonstrator dog first, following dog-win and human-win unseen trials*

Winner	Proportion first approaches to dog	Proportion first approaches to human
Dog	0.77	0.23
Human	0.50	0.50

Figure 7.7 *Proportion of spectators approaching the human handler (dark blue) and demonstrator dog (light lilac) first in dog-win and human-win trials, in seen (solid bars) and unseen (hatched bars) conditions*



To explore the effects of visibility on the proportion of first approaches to the human, these unseen trial results were compared to seen trials (Figure 7.7). The proportion of first approaches to the human was higher when the human had won than when they had lost the game, both when the game was seen and unseen. Wilcoxon Signed-Rank tests showed that the "Human-win - Dog-win Difference" was not significantly affected by visibility (z=-0.55, n=16, p=0.58).

Paired t-tests showed that two variables varied significantly between dog-win and human-win unseen trials. Dog approach frequencies were higher following a dog-win and the spectator displaced the demonstrator dog more frequently following a human-win (Table 7.9). The gait of dog approach did not vary significantly in the unseen trials (t=0.17, *d.f.*=21, p>0.8).

Table 7.9 Results of t-tests comparing dog-win and human-win unseen trials

Variable name	Human-win trials mean (± S.E.)	Dog-win trials mean (± S.E.)	t	*d.f.*	*p*
Dog approach frequency	1.86 ± 0.24	3.19 ± 0.54	2.23	21	0.037
Displacement frequency	0.68 ± 0.21	0.09 ± 0.06	2.72	21	0.01

All variables significantly affected by winner type at p<0.1 are displayed. All values are arithmetic means and standard errors

Two-way ANOVA showed that visibility exerted a significant main effect on human approach tail height. Tail positions were higher when the preceding trial was seen than when it was unseen (2.7±0.07 vs. 2.53±0.09, $F_{(1,21)}$= 5.58, p<0.05).

There were also interaction effects between the independent variables visibility and winner. Dog approach gait ($F_{(1,21)}$= 4.80, p<0.05; Figure 7.8) and displacement frequency ($F_{(1,21)}$= 7.91, p=0.01; Figure 7.9) were both significantly affected.

Figure 7.8 *Interactive effect of winner (dog or human) and visibility (seen or unseen) upon the mean (± S.E.) dog approach gait*

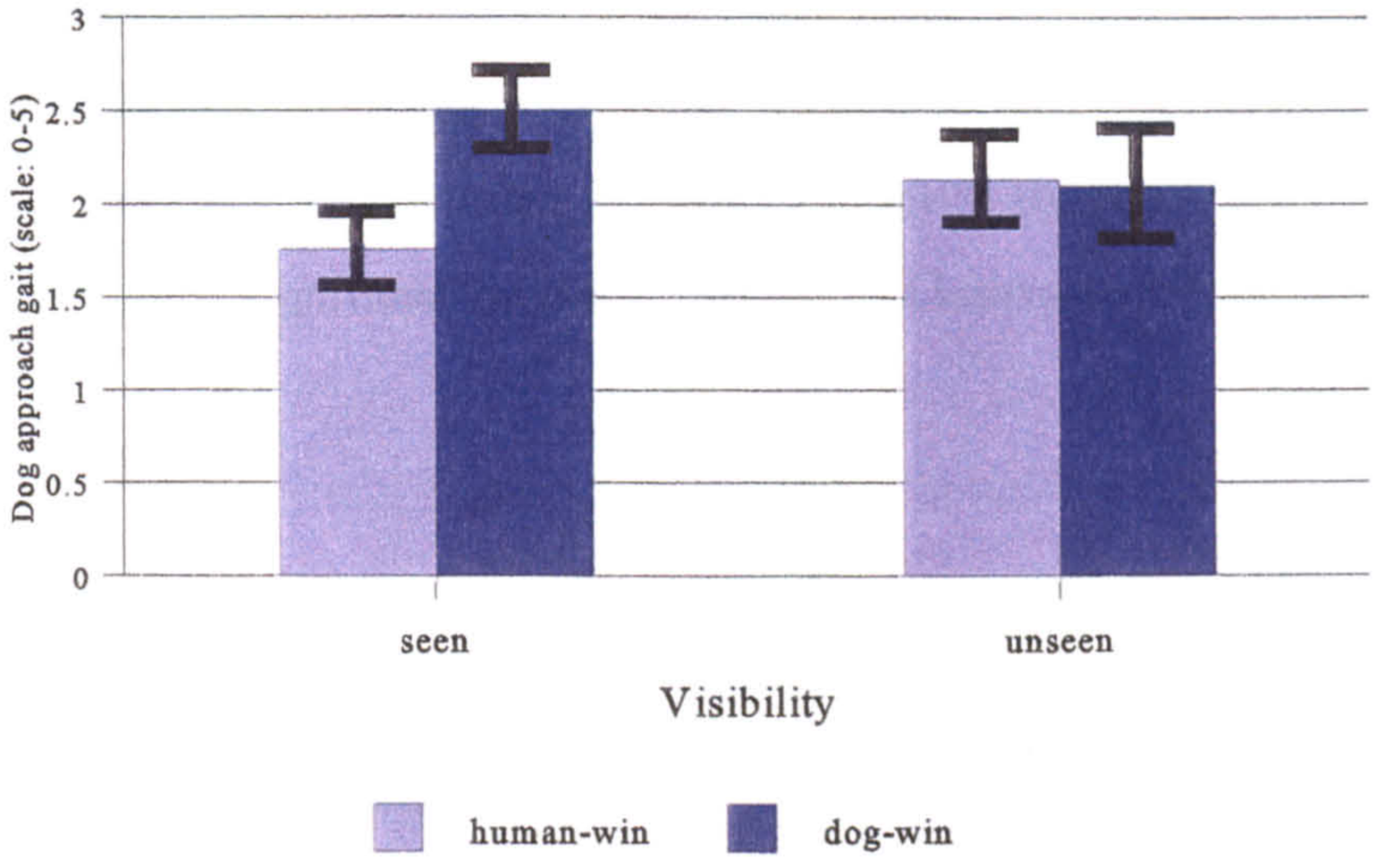
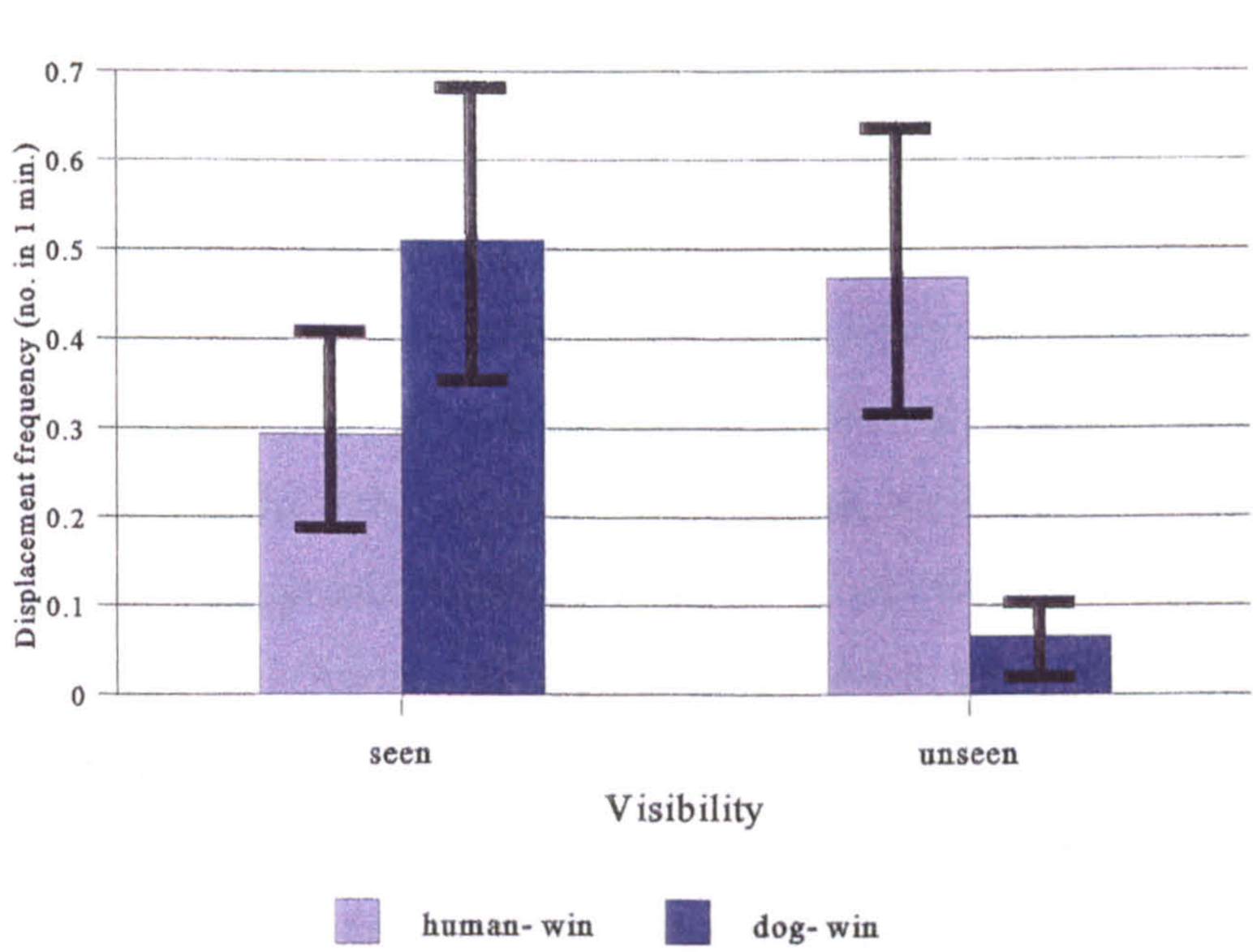


Figure 7.9 *Interactive effect of winner (dog or human) and visibility (seen or unseen) upon the mean (± S.E.) displacement frequency*



These bar charts illustrate the results of statistical analysis which was performed on log transformed data. The values shown are therefore the reverse transformations of the mean and mean ± standard errors of the transformed data.

When the play session was seen, the spectator dog approached the demonstrator with a significantly faster gait when the dog had won the play session. When the game was unseen, there was no longer a significant difference between the dog-win and human-win trials (Figure 7.8). When sessions were observed the displacement frequency was slightly higher (p>0.1) following a dog-win. Conversely, in unseen trials displacement frequencies were significantly higher following a human-win play session (p=0.01; Figure 7.9).

7.3.4 Discussion

7.3.4.1 Distinguishing trial type

The results of the current seen trials support the findings of Experiment 7.2 - the behaviour of a spectator dog varied dependent upon whether it had observed a Tug-of-war game won by a dog or a human, but dominance-related behaviour was unaffected. In the previous experiment (7.2) spectators were keener to approach a play partner who had won the preceding game. They showed a higher proportion of first approaches to a winner (although non-significant at p<0.1), faster gaits of dog approach in dog-win trials and shorter latencies to approach a winning human. These trends were repeated in the current experiment. The proportion of first approaches was higher to a winning than a losing human, but again statistical significance was not reached. The gait of dog approach was significantly higher (p=0.005) when the dog had won the game and the latency of human approach was less when the human was the winner (although not significant at p<0.1). Additionally, in this experiment, there was a trend for higher ear positions on dog approaches after the dog had won (p<0.1). This variable was also important in the previous experiment, varying significantly with trial type (petting, dog-win and human-win), with dog-win trials scoring higher than human-win, but not significantly so. High ear positions can indicate increased attentiveness (as well as Confidence) and so I suggest this difference shows that a spectator was more interested in the demonstrator dog when it has won the game than when it has lost.

The consistency of results between the two experiments (in both direction of differences and identity of significant variables) indicates that the methodology is robust despite variations in subjects, breeds and experimental procedures (*e.g.* the use of a cage). The most significant difference between dog-win and human-win trials, in both experiments was the gait of dog approach. This is therefore an important indicator variable when comparing seen to unsignalled and unseen trials. All the differences indicate that a spectator dog was keener to reach a winning play partner than a loser, but there was no indication of increased submission to a winner. I conclude that the results of this and the previous experiment, support the hypothesis that spectator dogs "can distinguish between winners and losers of a dog-human Tug-of-war game", but oppose the hypothesis that "the outcomes of Tug-of-war games influence subsequent dominance-related behaviour". These findings are consistent with those of the longitudinal studies of play (Chapter 5). It thus appears that the dominance enhancement theory of play is correct in the assumption that winning and losing games are distinguished, but the assumption breaks down on its premise that "the outcomes of Tug-of-war games influence subsequent dominance-related behaviour".

7.3.4.2 The effect of play signals

Soliciting interaction

The presence of human-dog play signals affected the spectator dogs' behaviour. When signals were included spectators approached the human with increased gait and approached the dog more frequently than when play signals were absent. These differences indicate that spectators were keener to reach and interact with both play partners when their Tug-of-war had included play signals than when it was unsignalled. I suggest that this is because the spectator perceived a signalled game as "play", and approached the partners in an attempt to join in the game. The delivery of play signals served to increase spectator arousal, and enticed it to interact with the players. This is further evidence of the play-soliciting function of human-dog play signals, but do they also fulfil a metacommunicative role?

Metacommunication

During signalled trials, a spectator showed a tendency to approach the handler first when the handler had won the game. During unsignalled trials the reverse was true; spectators made a higher proportion of first approaches to a losing human (although neither difference was statistically significant). Also, the presence of signals modified the effect of winner upon the indicator variable, gait of dog approach. In the presence of signals, the spectator approached a winning demonstrator dog with increased gait, but in the absence of signals, dog-win trials resulted in slower dog approach gaits than human-win trials. Additionally, initial approaches to a winning dog were accompanied by higher ear positions when the session included play signals, but when no signals were present a winning dog was approached with lower ear positions. Thus, in signalled or "true play" trials, spectators were keener to approach a player which they had observed to win, but, when signals were omitted, spectators were less keen to approach an individual after winning than after losing.

Winning at Tug-of-war had different effects upon the spectators' behaviour in the presence and absence of signals. This shows that signals altered the significance of the observed dog-human Tug-of-war. Altmann (1962) identified the criteria for metacommunication as demonstration that "the performance of a particular behaviour(s) has served to alter the significance of subsequent signal(s)". I therefore conclude that human-dog play signals serve a metacommunicative function during Tug-of-war games.

Dog-human signalling was uncontrolled

During these trials no attempt was made to control or record the play signals delivered by the demonstrator dog. Some playing dogs continued to give play signals even in the absence of human-dog signals. However, the spectators' behaviour still differed dependent upon whether the human delivered play signals. Thus, human delivered signals significantly alter a spectator dogs' perception of a game, but the importance of dog-human signals remains unresolved.

Dominance related effects

I also hypothesised that play signals prevent Tug-of-war interactions from having dominance-related effects. This idea predicts that, in the absence of play signals, Tug-of-war outcomes would affect dominance-related behaviour; the spectator would behave more dominantly towards an individual when it had lost Tug-of-war than when it had won. The differences in initial approaches described above may be interpreted as supporting this prediction. Fast approaches can indicate high levels of Confidence (Experiment 5.4) and as can high ear positions (Fox 1970; Confidence factor in 5.5). Spectators approached a losing dog with a faster gait in unsignalled trials, (but slower in signalled trials), and also with higher ear positions (but lower in signalled trials). These results both support the idea of increased dominance-related behaviour.

An additional variable differed significantly between unsignalled dog-win and human-win trials; the spectator jumped upon the human handler more frequently when she was the loser than when she was the winner. Jumping up at, an individual is also a commonly cited dominance indicator (O'Farrell 1992) and was a component in the Confidence factor in Experiments 5.4 and 5.5. Increased jumping on a losing human further supports the idea that the spectator viewed a losing person as having decreased dominance status.

These results collectively support the hypothesis that dominance-related consequences of games are modified by the presence of human-dog play signals. I believe that, in the presence of signals, a winning play partner is attractive and approached rapidly. Conversely, in the absence of signals, Tug-of-war is perceived as competitive so winning has dominance-related consequences. A winner is avoided or approached slower and with lower ear positions, whilst a loser (human) is jumped upon. Further work is necessary to confirm or refute these ideas.

7.3.4.3 The effect of visibility

When the spectator dog was prevented from seeing the dog-human game, its behaviour towards the players was altered. The spectator approached the human with a lower tail position following unseen trials. Low tail positions are characteristic of submissive approaches (Scott and Fuller 1965), and in Chapter 5, were found to be correlated to low Confidence scores. So approaches to the human in unseen trials were more cautious or less confident than in seen trials.

Discriminating winners and losers

There was a significant interaction between winner and condition (unseen or seen) upon the indicator variable. When prevented from visual observation of the game, the gait with which the spectator approached the demonstrator dog no longer showed significant differences in dog-win and human-win trials (Figure 7.8). However, spectators were still able to distinguish between the two trial types, but this discrimination was apparent in different aspects of their behaviour. Displacement frequency varied non-significantly between seen dog-win and human-win trials, but in unseen trials a losing dog was displaced significantly more often than a winner. Also, when trials were unseen, a winning dog was approached more frequently than a losing dog.

I conclude that without visual observation of the game, a spectator dog can still distinguish between dog-win and human-win trials. They do not discriminate in the gait of their first approach to the demonstrator dog, as is the case in seen trials, but still show a tendency to approach a winner first and exhibit further differences in their behaviour over the subsequent minute. I suggest that dogs distinguish the winner in unseen trials via cues obtained from the demonstrator dog. The demonstrator behaves differently when it has won and lost which in turn affects the behaviour of the spectator. However, it is also possible that the spectator uses auditory cues to distinguish the winner, or that the handler delivers cues. Examination of the videos suggests that neither explanation is likely, but they can not be definitively ruled out.

The finding that the gait of dog approach does not vary in unseen dog-win and human-win trials, suggests that direct observation plays some role in producing variations in the spectators' behaviour. Perhaps during unseen trials the cues delivered by the demonstrator are not immediately detected and so variables describing the spectators' behaviour over a one minute period are more sensitive to the dog-win / human-win distinction whilst the gait of first approach is not. I thus conclude that the spectators' ability to distinguish between dog-win and human-win trials is partly a result of direct observation of the game and partly via cues obtained from the demonstrator dog.

7.4 General discussion

This is the first time that social learning experiments have been employed in the study of dog-human interactions. Social learning is a topic fraught with conceptual and methodological difficulties (see Heyes 1994). So in isolation these results cannot be interpreted as definitive proof for or against the hypotheses tested. However, my results do suggest that this technique is potentially very useful for increasing our understanding of dog-human interactions. In light of these limitations I now review the four hypotheses tested in this chapter and summarise the extent to which each has been supported.

1) **"A dog can distinguish between the winner and loser of a dog-human Tug-of-war game"**. Both experiments 7.2 and 7.3 detected significant differences in the spectators' behaviour, indicating that this hypothesis is true.

2) **"Outcomes of Tug-of-war games influence subsequent dominance-related behaviour"**. During neither experiment did the spectators' behaviour differ in aspects indicative of dominance-related effects. When Tug-of-war is well signalled and therefore clearly playful, there is no evidence to support this hypothesis.

3) **"The presence of human-dog play signals modifies the dominance-related consequences of Tug-of-war"**. Spectator dogs' behaviour was affected differently by the outcome of Tug-of-war games in the presence and absence of play signals (7.3); a result which supports this hypothesis.

4) **"Spectator dogs distinguish the winners and losers of games via direct observation"**. The ability of visually screened spectator dogs to distinguish between games won by the human and the dog suggests that direct observation does not operate exclusively. Spectators probably utilise a combination of both direct observation of the game and cues from the dog after it has finished playing, but identification of these cues requires additional study.

Chapter 8

The effects of play:
a home-based study



"The full grown dog romps with its master, his make believe is fully developed and conscious for his bite is intentionally only a mumbling, his growl pure hypocrisy"

(Groos 1898, p.294)

8.1 Introduction

8.1.1 Why a home-based study?

The previous five chapters describe experimental studies. However, this is an applied thesis and it is important that its findings are relevant to the general dog-owning community. Within dog-owner relationships, play is just one of a wide variety of interactions and dogs in general are far more diverse than Labradors and Golden Retrievers (the experimental subjects thus far). Therefore, the actual effects of games may differ from those detected in a controlled setting. To ensure the applicability of my findings and ideas, I conclude my research with a final study of the dog-owning community.

Previous studies of dog-human relationships have mainly relied on owners' reports (*e.g.* Goodloe and Borcheldt 1998). In Chapter 2, owners' questionnaire responses were analysed to explore correlations between play and other dimensions of dog-human relationships. Although useful for obtaining large samples, this methodology is extremely subjective and third party assessments are required to accurately assess factors affecting relationships. Whilst case studies of problematic dog-human relationships are numerous (*e.g.* Anderson and Foster 1988; Overall 1997), there have been very few attempts to objectively measure dimensions of apparently healthy relationships (McPherson 1998).

The study presented in this chapter empirically examined fifty dog-owner partnerships. Dominance and attachment dimensions were quantified and compared to aspects of play behaviour between dog and owner. Additionally, I used a questionnaire to sample owners' opinions and ownership styles which I also compared to the measured relationship dimensions.

8.1.2 Exploring additional factors

My experimental studies have suggested that the types of games played and the usual winner of those games do not play a major deterministic role in dog-human relationships. The current study aims to confirm these findings, extend them to a wider variety of breeds, and it also provides an opportunity to explore an additional question:
"***If games do not determine dog-human relationships, then what does?***"

The popular literature contains claims of numerous factors believed to affect dog-owner relationships. These include characteristics of the dog and features of the owner's behaviour towards it. Examples of common assertions are that:
a) dogs who have continual access to toys will often become dominant (Rogerson 1992),
b) allowing dogs to sleep in the bedroom can lead to over-attachment (Appleby 1997),
c) dogs which are frequently allowed to initiate social interactions (including play) behave with increased dominance towards their owner (O'Farrell 1992).

Studies of the relative importance of such factors are few (*e.g.* Jagoe 1994; M^{c}Pherson 1998). I therefore consider a range of variables describing ownership styles and explore their association to objectively measured relationship dimensions.

8.1.3 Objectives

A primary objective of this study was to develop novel methods for objective assessment of attachment and dominance dimensions of dog-owner relationships. Using these methods I aimed to explore general trends, to further investigate ideas and confirm experimental findings described in previous chapters, within the home environment. The general hypotheses under investigation were:

General Hypothesis 2 - "***play between dogs and people has consequences outside the game***"

General Hypothesis 3 - "***dogs are able to distinguish between play and non-play interactions***".

The specific questions asked were:

a) Are attachment dimensions of dog-owner relationships correlated to the games played, in particular Rough-and-tumble? (suggested in Chapter 5.4)

b) Are dominance dimensions of dog-owner relationships related to the frequency with which the dog wins possession of objects during games? (Experiments 5.4 and 5.5 suggest not)

c) Do the frequency and types of human-dog play signals delivered (especially the proportion of postural signals) correlate to dominance dimensions of the dog-owner relationship? (suggested in Chapter 7)

d) Do attachment and dominance dimensions of dog-owner relationships show correlations to any further aspects of play behaviour between dog and owner?

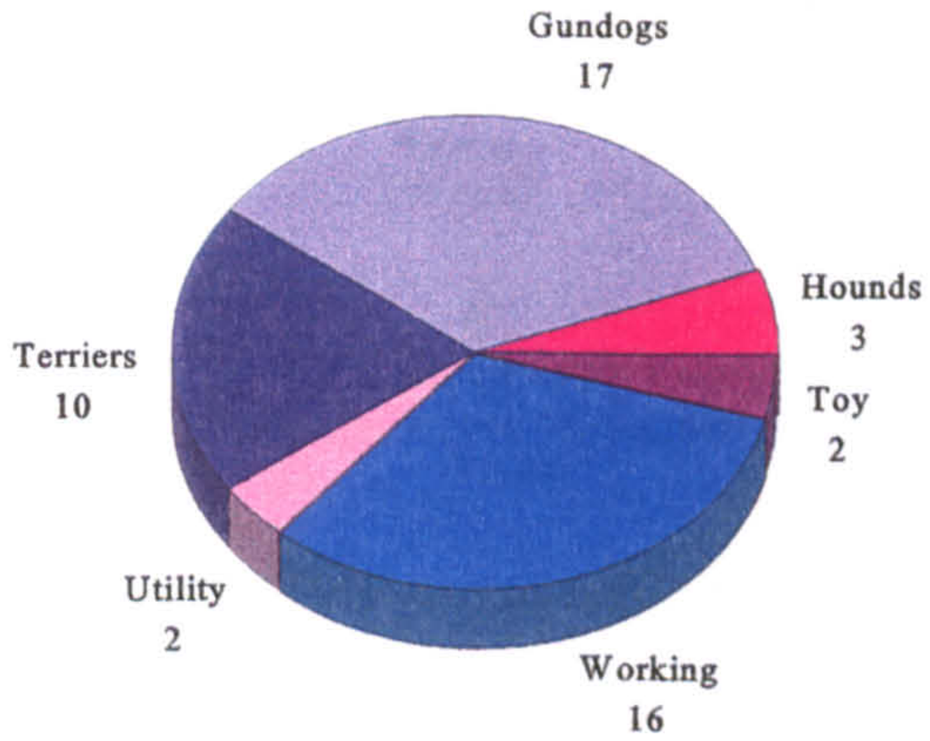
e) Do attachment and dominance dimensions of dog-owner relationships vary with any of the factors commonly postulated to affect them *e.g.* the sleeping location of the dog (Appleby 1997), the removal of focal toys (Rogerson 1992) and the proportion of interactions initiated by the dog (O'Farrell 1992; Rogerson 1992)?

8.2 Methods

8.2.1 Recruitment of subjects

Via personal contacts and posters in veterinary surgeries in Southampton (Hampshire, southern England) and the Wirral (Cheshire, north-west England), 50 dog owners were recruited. All had owned a single dog for at least one year and were willing to be filmed. The sample comprised 35 women and 15 men. The dogs were 29 males and 21 females. 52% of the males and 76% of the females were neutered. They ranged in age from 20 months to 14 years, with a median of 7 years (25^{th} percentile - 4.5; 75^{th} percentile - 9). There were 19 cross-bred dogs and 31 pure bred/pedigree dogs representing 17 different breeds. Dogs were classified according to Kennel Club categories. Cross-breeds were categorised according to the breed that they most closely resembled (as agreed by experimenter and owner). The distribution of breed types amongst the sample is illustrated in Figure 8.1.

Figure 8.1 Distribution of breed types amongst the sample of fifty dogs

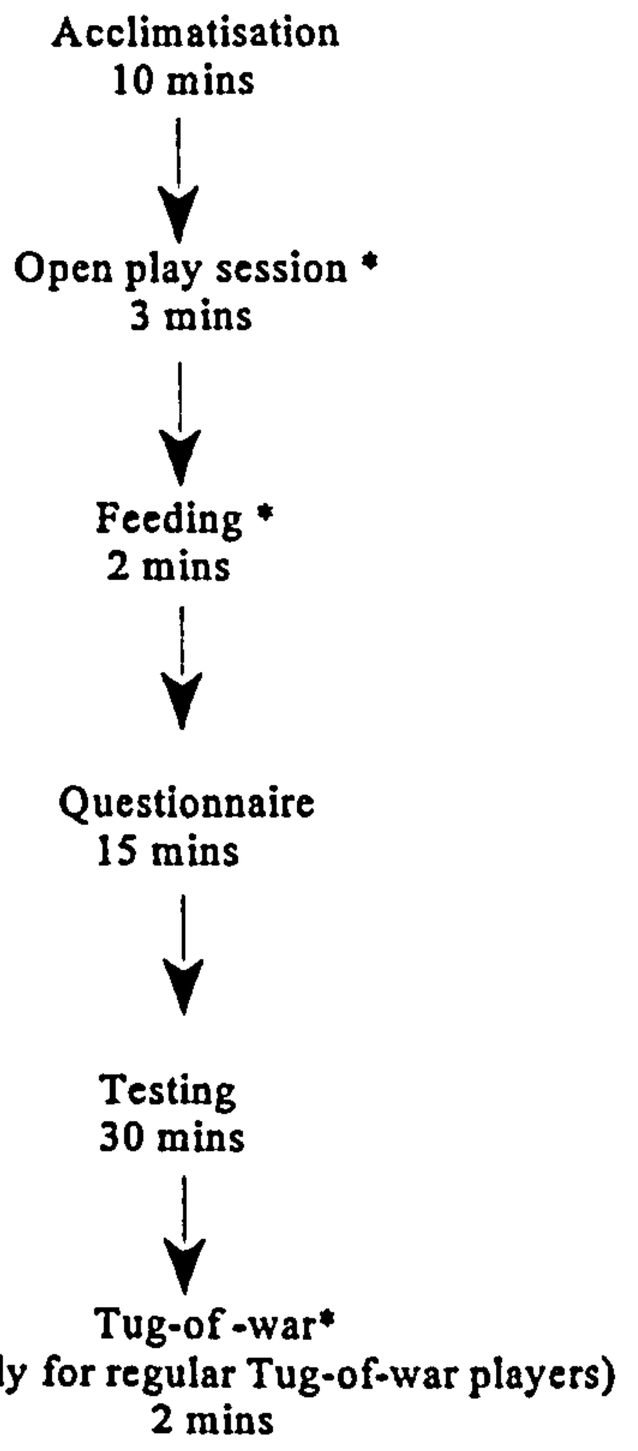


8.2.2 Procedure

8.2.2.1 The visit

The experimenter (myself; female, aged 25 years) visited each dog owner in their own home once. The visit lasted approximately 1-1.5 hours. When possible it took place at the dog's usual feeding time and when the owner and dog were alone. When this was impossible, additional people were requested to remain in a different part of the house and to avoid interrupting the procedure or attracting the dog's attention. The visit followed the protocol outlined in Figure 8.2.

Figure 8.2 Outline of the protocol for the visit to the volunteer dog-owner's home



** filmed via camera held by experimenter, all other parts filmed by camera on tripod*

8.2.2.2 Acclimatisation

None of the dogs had previously met the experimenter so there was a ten minute familiarisation period. This allowed the dog to acclimatise to the experimenter and the

equipment and the owner to relax. During this time the experimenter chatted to the owner, petted the dog if it approached and set up the equipment. She also outlined the protocol. The most commonly used room was selected as the filming location (usually the living room, but in some cases the kitchen). A tripod was placed in the corner of the room. Mounted on this was a video camera (Sony Video 8 CCD-TR370E) with an additional wide angle lens. The camera was positioned to allow the maximum floor area to be viewed whilst minimising the risk of damage by the dog.

8.2.2.3 Open play session

The owner was instructed to play with their dog for approximately three minutes. They were urged to play as they would normally, to ignore the experimenter and to start and end the session in their usual way. The games played and the precise session length were determined by the owner. The experimenter remained seated and filmed the session by hand.

8.2.2.4 Questionnaire

The questionnaire was composed of 23 questions (see Appendix 9). It was designed to obtain information about normal play routines and ownership style, which was not observable during a single testing session, and also to sample the owner's perceptions of their relationship with their dog. The experimenter sat opposite to, and at least 2m away from, the owner. She asked the questions, taking care to standardise presentation, and made a written record of the owner's responses along with any additional relevant comments. The petting test (described below) was carried out concurrently.

8.2.2.5 Testing

The test was designed to assess attachment and dominance-dimensions of the dog's relationship with its owner. It was based on the tests developed during experimental studies (5.4.3.3 and 5.5.2.3), but the current study needed to measure the dog's behaviour towards its owner, not an experimenter. It was important that the test was easily replicable by different dog owners, was unaffected by the size and shape of the room and

accommodated the presence of an additional person (the experimenter). The experimental test was therefore modified; five of the original components were eliminated and one new component was added (Novel object[1]). The new test had 16 components, five designed specifically to assess attachment-dimensions, ten to assess dominance-dimensions and one for the assessment of both. They are subsequently referred to as the "attachment test" and "dominance test". The procedure during each component is described below:

Attachment test components

A1 *Petting* - This test took place while the questionnaire was being answered. The owner and experimenter were seated at least 2m apart. The owner was instructed to let the dog roam freely and to pet it only if it approached. If the dog approached the experimenter it was also petted moderately. The first ten minutes were analysed.

A2 *Ignoring* - This test lasted for three minutes. The owner was instructed to read silently and not to interact with the dog in any way. The experimenter did the same. If the dog approached owner or experimenter it was ignored.

A3 *Novel object*[1]- The experimenter encouraged the dog to approach her and petted it. She then took a motorized child's toy (CE, Motorized Crazy Shaker) from a bag, turned it on and placed it on the ground half-way between the owner and herself. The toy vibrated and moved along the floor. After twenty seconds it was turned off and placed out of reach.

A4 *Call response*- The experimenter crouched on the floor and petted the dog. The owner was seated opposite, and called the dog by name. If the dog did not respond, the call was repeated until it did, or for a maximum period of 30 seconds. This component was repeated once and also formed part of the dominance test.

1

The presence of an additional person in this home-based study allowed this component to be performed. It was developed by M°Pherson (1998) and was designed to test the dog's tendency to approach the owner when presented by a potentially frightening stimuli. It thus provided opportunities for the dog to demonstrate "use of the attachment figure as a secure base from which to explore the world"- one of Gubernick's (1981) criteria for attachment (see 5.4.2.2).

A5 *Separation* - The owner was asked to behave towards the dog as they usually did when leaving it alone *e.g.* to give commands, put on coats and collect keys. They then left the room and if possible the house. They closed the door, leaving the experimenter and dog alone. The experimenter remained seated for one minute, petting the dog if it approached. She then exited via the same door as the owner and remained outside with the owner, out of sight and earshot of the dog, for a further three minutes.

A6 *Return* - The experimenter re-entered the room and greeted the dog moderately. She sat down and petted the dog if it approached. Thirty seconds later, the owner re-entered and also greeted the dog in their usual manner.

Dominance test components

D1 *Food removal* - This component was carried out after the open play session and before the questionnaire. This ensured all dogs were similarly satiated and prevented begging from interfering with their behaviour during the remaining test components. The owner followed their normal feeding routine, but once the dog had been given its food and had commenced eating, the owner was asked to remove the bowl. They used the necessary force to stop the dog feeding and to pick up the food bowl. They held the bowl above the dog's head for ten seconds before returning it to the floor. They then instructed the dog to "Leave" and attempted to prevent it from touching the food for 20 seconds. The dog was then allowed to resume eating. This component was repeated, but the second time, when the food was replaced on the floor only a single verbal command was given.

D2 *Sit* - The owner instructed the dog to sit. If it did not respond the command was repeated, until it did, or over a maximum period of 30 seconds. This component was repeated once.

D3 *Forced down* - Whilst the dog was sitting, the owner placed their hand on its shoulders and attempted to push it into a lying position. They continued for a maximum of 20 seconds or until the dog lay down. This was repeated once.

D4 *Rise latency* - After the dog had been forced down, the owner instructed it to "Stay" and took five steps backwards. They remained facing the dog until it rose, or for a maximum of one minute.

D5 *Approach* - The experimenter crouched on the floor and petted the dog. The owner then approached the dog at walking pace and halted when 10cm away. This was repeated once.

D6 *Lying* - The owner was requested to lie on their back on the floor and remain motionless for 30 seconds.

D7 *Grooming* - The owner groomed the dog lightly for one minute. They were encouraged to groom the entire surface including the head.

D8 *Toy removal* - The owner was given a small plastic squeaky toy, which they gave to their dog. After 20 seconds the owner was asked to retrieve the toy. They initially commanded the dog, but if this failed, they applied the necessary force in order to retrieve the toy. This was carried out twice.

D9 *Toy regain* - After retrieving the toy, the owner held it out of the dog's reach for ten seconds. They then placed it on the floor in front of the dog and instructed the dog to "Leave". If it was still obeying after 20 seconds it was praised and allowed to regain the toy. This component was repeated after each toy removal.

D10 Shout - The owner was asked to crouch down and pet the dog for ten seconds before rising suddenly and shouting "No".

All attachment and dominance test components were carried out within a single session. They were presented in a standard order with successive components increasing in intensity:

D1, A1 (during questionnaire), A2, A3, A4, D2, D3, D4, A5, A6, D5, D6, D7, D8, D9, D10.

The owner was instructed before each component and also prompted when necessary. At the outset it was stressed that they could refuse to perform any of the components and were free to pet and interact with their dog between components. The dog's behaviour was filmed using the video camera and written records were made of any subtle behaviours observed during testing.

8.2.2.6 Tug-of-war

During the questionnaire owners were asked whether they ever played Tug-of-war. Those who said they did were filmed in a final play session. They were instructed to play Tug-of-war for approximately two minutes, using their chosen toy. Owners were urged to play as they usually did.

8.2.3 Behavioural measures

The behaviour of the dog during each phase of the visit was recorded from the video tapes.

8.2.3.1 Open play session

I recorded all the game types which were played during the open play session. These were classified according to the types defined in Appendix 2. All play signals given by the owner were identified (see Chapter 6.2) and the frequency of each type recorded. A total of 18 variables was measured as listed in Table 8.1.

Table 8.1 Behavioural variables measured during the open play session

Variable name	Description	Units
General play variables		
Rough-and-tumble	Presence of Rough-and-tumble in open play session	0/1
Tug-of-war	Presence of Tug-of-war in open play session	0/1
Fetch	Presence of Fetch in open play session	0/1
Chase	Presence of Chase in open play session	0/1
Keep-away	Presence of Keep-away in open play session	0/1
Involvement	Subjective rating of dog's Involvement in open play session (2.4.2)	scale: 1-5
Interactivity	Subjective interactivity score for open play session (2.4.2)	scale: 1-5
Play duration	Time for which dog plays with owner over three minute session: 0 <160 seconds; 1≥160 seconds	0/1
Play control variables		
Proportion of dog wins	Proportion of object competitions following which dog maintains possession of the object	prop
Dog winner	Session winner as derived from proportion of dog wins: 0-even/human win, proportion of dog wins < 0.66; 1-dog win, proportion dog wins ≥ 0.66	0/1
Dog possession duration	Duration for which dog has sole possession of the object	s
Toys removed	Focal toy is retained by the owner at the end of the play session	0/1
Command frequency	Total number of commands given by the owner to the dog	freq
Play signal variables		
End signal	Owner ends session with an (apparently) obvious signal	0/1
Signal frequency	Total number of play signals (as defined in 6.2.1) given by the owner- measured over the first 10 seconds and also the full 3 minute session	freq
Signal diversity	Number of different play signals types used by the owner - measured over the first 10 seconds and also the full 3 minute session	freq
Proportion of postural signals	Proportion of the total play signals which are postural *i.e.* involving no physical contact or vocalisation	prop
Proportion of physical signals	Proportion of the total number of play signals which involve physical contact with the dog	prop

Abbreviations: prop - proportion; freq - frequency; s- seconds

8.2.3.2 Tug-of-war play session

During the Tug-of-war session, nine variables were measured (Table 8.2). In the open play sessions, signal frequency and diversity were measured over two time periods: ten seconds and three minutes. The values using each period were highly correlated (signal frequency: Rho=0.62, $d.f.$=40, p<0.001; signal diversity: Rho=0.40, $d.f.$=40, p<0.005). The first ten seconds were therefore a good representation of the entire play session and so, in Tug-of-war sessions, signals were recorded only during the first ten seconds.

Table 8.2 Behavioural variables measured during the Tug-of-war play session

Variable name	Description	Units
Determination	Subjective rating of dog's determination to win possession of the toy	scale: 1-5
Attention duration	Total time for which dog shows interest in the toy	s
Proportion of dog wins	As defined in Table 8.1	prop
Dog winner	As defined in Table 8.1	0/1
Dog possession duration	As defined in Table 8.1	prop
Signal frequency	As described in Table 8.1 - in the first ten seconds	freq
Signal diversity	As described in Table 8.1 - in the first ten seconds	freq
Proportion of postural signals	As described in Table 8.1 - in the first ten seconds	prop
Proportion of physical signals	As described in Table 8.1 - in the first ten seconds	prop

Abbreviations as in Table 8.1

8.2.3.3 Testing

Preliminary observations of the videos were used to select variables. The selection criteria were the same as those used in the experimental studies (5.4.3.4) *i.e.* the variable must describe a behaviour exhibited by, and showing variation in, at least 10% of subjects. When appropriate, rarer behaviours were combined into categories in order to reach the 10% threshold. Many of the variables selected were used in previous

experimental studies, but due to subtle differences in procedure it is clearer to redefine all variables here.

Attachment test

During the six attachment test components, 38 variables were measured which described the dog's behaviour towards the owner and the experimenter (Table 8.3).

Table 8.3 Behavioural variables measured during the Attachment Test components

Test component	Variable name	Description	Unit
A1 Petting	Owner interaction duration	Time dog spends in contact with, or <50cm from, and attending to, owner	s
	Owner approach frequency	Number of times dog approaches to within 50cm of owner	freq
	Owner vocalisations*	Number of vocalisations dog makes whilst facing owner	freq
	Owner resting dist.	Distance, from owner that dog sits/lies for the longest time	m
	Owner furthest dist.	Furthest distance from owner which dog reaches	m
	Owner toy presentations	Number of times dog contacts owner with toy	freq
	Owner- lick, paw, nuzzle, jump	Number of times dog contacts owner via lick, paw, nuzzle or jump	freq
	Expt. interaction duration	Time dog spends in contact with, or <50cm from and attending to, experimenter	s
	Expt. approach frequency	Number of times dog approaches to within 50cm of experimenter	freq
	Expt. resting dist.	Distance, from experimenter that dog sits/lies for the longest time	m
	Expt. furthest dist.	Furthest distance from experimenter which dog reaches	m
	Expt. toy presentations	Number of times dog contacts experimenter with toy	freq
	Expt.- lick, paw, nuzzle, jump	Number of times dog contacts experimenter via lick, paw, nuzzle or jump	freq
	Duration object interest	Time for which dog attends to object	s

A2 Ignoring	Owner contact frequency**	Number of times dog makes contact with owner	freq
	Owner attention duration	Time dog spends in contact with, or <50cm from and attending to, owner	s
	Owner vocalisations	Number of vocalisations dog makes whilst facing towards owner	freq
	Owner resting dist.**	Distance from owner that dog sits/lies for the longest	m
	Expt contact frequency**	Number of times dog makes contact with experimenter	freq
	Expt. attention duration	Time dog spends in contact with, or <50cm from and attending to, experimenter	s
	Expt. resting dist.**	Distance from experimenter that dog sits/lies for the longest	m
A3 Novel object	Avoid	Dog withdraws from object	0/1
	Investigate	Dog approaches or contacts object	0/1
	Vocalisation	Dog vocalises while facing towards object	0/1
	Owner response level	Degree of response towards owner: 0-none; 1-look; 2-approach; 3-contact	scale: 0-3
	Expt. response level	Degree of response towards experimenter: 0-none; 1-look; 2-approach; 3-contact	scale: 0-3
	First approach owner	Person approached first: 0-none; 1-experimenter; 2-owner	categoric
A4 Call	Response lag	Latency of approach following first call	s
A5 Separation	Accomp. attend door duration**	Time dog spends oriented towards and attending to exit door while experimenter is present	s
	Accomp. near door duration	Time dog spends <50cm from exit door while experimenter is present	s
	Accomp. vocalisation frequency**	Number of vocalisations dog makes while experimenter is present	freq
	Time with expt.	Time dog spends <50cm from and oriented towards experimenter while owner is absent	s
	Alone attend door duration	Time dog spends oriented towards and attending to exit door while experimenter and owner are absent	s
	Alone near door duration	Time dog spends <50cm from exit door whilst experimenter and owner are absent	s

A5 Separation	Alone vocalisation frequency	Number of vocalisations dog makes while experimenter and owner are absent	freq
	Alone contact door frequency	Number of times dog contacts exit door while experimenter and owner are absent	freq
A6 Return	Owner greeting intensity*	Subjective rating of dog's greeting of owner: 1-none; 2-moderate; 3-intense	scale: 1-3
	Expt. greeting intensity	Subjective rating of dog's greeting of experimenter: 1-none; 2-moderate; 3-intense	scale: 1-3

Abbreviations: expt.- experimenter; accomp. - accompanied by experimenter; dist. - distance
** and ** denote variables which were eliminated during analysis; this process will be described within the section on Data Reduction (8.2.4.2).*

Dominance test

A total of 50 variables were measured which described the dog's behaviour towards its owner. Of these, 29 were specific to individual test components (Table 8.4). A further 21 behaviours could occur at various stages throughout the test. For these, I measured the number of components in which the dog performed the behaviour, out of a maximum of eleven (Table 8.5).

Table 8.4 Behavioural variables measured during specific components of the Dominance Test

Test	Variable name	Description	Unit
A1 Food removal	Response intensity	Strategy dog uses to regain food: 0-none; 1-skirt; 2-push	scale: 0-2
	Restrain force	Force used by owner to remove food from dog: 0-one command; 1-multiple commands; 2-gesture; 3-contact; 4-restraint; 5-not removed.	scale: 0-5
	Feed latency**	Time for dog to resume feeding following first food replacement	s
	One command eat	Time for dog to resume feeding following second food replacement - with one command	s
A2 Call	Response lag	Latency for dog to approach owner following first call (mean of 2 trials)	s
	Approach gait	Gait of dog's approach to owner: 0-none; 1-walk; 2-trot; 3-run; 4-bound	scale: 0-4
	Indirect approach	Dog takes non-direct route to owner	0/1
D2 Sit	Sit latency	Latency for dog to sit following first command (mean of 2 trials)	s
	Orientate away	Dog sits facing away from owner	0/1
D3 Forced down	Number comply	Number of times owner successfully forces dog into lying position (out of two trials)	freq
	Comply latency	Time owner takes to force dog into lying position (mean of 2 trials)	s
D4 Rise	Rise latency	Latency for dog to rise from lie after forced down	s
	Reapproach gait	Gait of dog's approach to owner after forced down: 0-none; 1-walk; 2-trot; 3-run; 4-bound	scale: 0-4
D5 Approach	Response positivity	Degree of dog's response to owner's approach: 0-retreat; 1-unreactive; 2-approach; 3- jump up	scale: 0-3
D6 Lying	Stance height	Posture assumed by dog for most of 30 seconds: 0-lie; 1-sit; 2- stand; 3-move	scale: 0-3
	Ignore	Dog shows no response to owner lying down	0/1
	Nuzzle**	Dog nuzzles owner	0/1
	Step over legs	Dog steps over owner's legs	0/1
	Stand on/over torso	Dog stands on or over owner's torso: 0-never; 1-head over; 2-body over	scale: 0-2

D7 Grooming	Stance height*	Posture of dog for most of grooming time: 0-lie; 1-sit; 2-stand; 3-move	scale: 0-3
	Cringe*	Dog cringes when brushed on the head	0/1
	Time tolerated	Duration dog tolerates grooming without escape attempt	s
D8 Toy removal	Force required	Force required for owner to retrieve toy from dog: 0-command; 1-contact; 2-contact and command; 3- pull; 4-strong tug; 5-won't surrender	scale: 0-5
	Drop latency**	Latency for dog to surrender toy after first command (mean of 2 trials)	s
	Brings toy	Dog brings toy to owner when instructed to leave	0/1
D9 Toy regain	Regain latency	Latency for dog to pick up toy following removal (mean of two trials)	s
D10 Shout	Stance height	Posture dog assumes after shout: 0-lie; 1-sit; 2-stand; 3-move	scale: 0-3
	Startle**	Dog moves suddenly immediately after shout	0/1
	Change posture	Dog changes posture immediately after shout	0/1

Abbreviations and symbols are the same as in Table 8.3, with the addition of cont: continuous scale

Table 8.5 Behavioural variables measured over all ten Dominance Test components

Variable name	Description	Units
Ears pricked	Dog's ears are pricked	freq
Ears low	Dog's ears are low or back	freq
Tail movement	Dog wags its tail	freq
Lick owner	Dog contacts owner with its tongue	freq
Mouth owner	Dog places its mouth around owner's hand	freq
Climb up	Dog jumps up placing fore-paws on owner	freq
Low body position	Dog exhibits low posture	freq
Gaze aversion*	Dog avoids eye contact with owner	freq
Tail tucked	Dog's tail is tucked between its legs	freq
Lie**	Dog lies down uncommanded	freq
Nuzzle	Dog contacts owner with its head	freq
Sit	Dog sits uncommanded	freq

Roll	Dog rolls over on floor	freq
Lick lips	Dog licks its lips	freq
Paw	Dog raises paw or places paw on owner	freq
Display	Dog displays inguinal region	freq
Playful	Dog reacts playfully	freq
Head in lap	Dog places its head in owner's lap	freq
Growl	Dog growls at owner	freq
Bark	Dog barks at owner	freq
Tail height	Average tail position throughout all components: 1-tucked - 5-vertical	scale: 1-5

All frequencies were measured as the number of test components during which the behaviour occurred

8.2.4 Statistical analysis

8.2.4.1 Descriptive statistics

The variables recorded during the play sessions and via the questionnaire were explored and preliminary analysis carried out to describe their distribution within the population.

8.2.4.2 Data reduction

A large number of behavioural variables was measured in the attachment and dominance tests. To condense these into a smaller number of underlying factors, I used Principal Components Analysis (P.C.A.; for description of this technique refer to 5.4.4.1). Five partnerships failed to complete one of the test component due to the owner's choice or physical disabilities. The missing variables were replaced with the mean value calculated using the remainder of the sample. The variables measured during attachment and dominance tests were treated as discrete data sets. I applied P.C.A. twice to each. The initial application served to reduce the number of variables and the second, identified the relevant factors.

Attachment test

Preliminary P.C.A. was carried out on the 38 attachment variables. This identified six useful factors the key variables of which were examined. Any of the 38 measured variables which:

a) did not feature in any of these factors, or

b) always occurred in the same factors as another variable, the accompanying variable having a higher loading factor in the first factor,

were eliminated from further analysis. Two variables were eliminated for reason a) and six for reason b). These variables are labelled with one and two asterisks respectively in Table 8.3. A final P.C.A. was then run on the remaining 30 variables. This produced seven useful factors which jointly explained 65% of the initial variance in the data. Factors five and above were composed primarily (over 80%) of variables which were also key variables in earlier factors. The latter three factors were therefore rejected. The key variables constituting factors one to four and their respective loading factors are shown in Tables 8.6-8.9.

Table 8.6 Key variables in Attachment Factor 1

Positively loaded variables			*Negatively loaded variables*		
Test component	**Variable name**	**Loading factor**	**Test component**	**Variable name**	**Loading factor**
Petting	Expt. approach frequency	0.87	None		
	Expt. toy presentations	0.86			
	Owner approach frequency	0.83			
	Owner toy presentations	0.74			
	Duration object interest	0.57			

Table 8.7 Key variables in Attachment Factor 2

Positively loaded variables			*Negatively loaded variables*		
Test component	**Variable name**	**Loading factor**	**Test component**	**Variable name**	**Loading factor**
Petting	Expt. resting dist.	0.73	Petting	Expt. interaction duration	-0.67
Novel object	First approach owner	0.67	Call	Response lag	-0.45
Novel object	Owner response level	0.65	Ignoring	Expt. attention duration	-0.42
Petting	Duration object interest	0.44			
Petting	Owner interaction duration	0.43			
Petting	Owner toy presentations	0.43			
Petting	Expt. furthest dist.	0.39			
Petting	Owner approach frequency	0.37			

Table 8.8 Key variables in Attachment Factor 3

Positively loaded variables			*Negatively loaded variables*		
Test component	**Variable name**	**Loading factor**	**Test component**	**Variable name**	**Loading factor**
Separation	Accomp. near door duration	0.76	Separation	Time with expt.	-0.67
Ignoring	Owner vocalisations	0.56			
Ignoring	Owner attention duration	0.50			
Petting	Owner resting dist.	0.41			

Table 8.9 Key variables in Attachment Factor 4

Positively loaded variables			*Negatively loaded variables*		
Test component	**Variable name**	**Loading factor**	**Test component**	**Variable name**	**Loading factor**
Petting	Expt. - lick, paw, nuzzle, jump	0.49	Call	Response lag	-0.48
Petting	Expt. interaction duration	0.47	Separation	Alone contact door frequency	-0.44
Petting	Owner resting dist.	0.46	Separation	Alone near door duration	-0.41
Novel object	Expt. response level	0.35	Petting	Owner interaction duration	-0.35
Petting	Owner furthest dist.	0.35	Return	Expt. greeting intensity	-0.31
			Separation	Alone attend door duration	-0.31
			Novel object	Investigate	-0.26

Each factor was assigned a name to summarise the key variables of which it was composed and hence the relationship dimension it represented:

Attachment factor 1 - Non-specific attention-seeking,

Attachment factor 2 - Preference for owner,

Attachment factor 3 - Separation-related behaviour, and

Attachment factor 4 - Preference for unfamiliar person (experimenter).

Dominance test

The 50 variables measured during the dominance test were analysed in the same way as the attachment test variables (see above). Preliminary P.C.A. identified five useful factors. Three of the measured variables were not key variables in any of these factors (marked * in Tables 8.4 and 8.5) and five variables occurred only in the same factors as another variable, the accompanying variable having a higher loading factor in the first factor (marked ** in Tables 8.4 and 8.5). These eight variables were eliminated from subsequent analysis. A final P.C.A. was run on the remaining 42 dominance variables

and produced seven useful factors, jointly explaining 51% of the original data variance. Factors three and above were composed primarily (over 70%) of variables featuring as key variables in earlier factors and were therefore rejected. The key variables constituting the first two factors and their respective loading factors are shown in Tables 8.10 and 8.11.

Table 8.10 Key variables in Dominance Factor 1

Positively loaded variables			*Negatively loaded variables*		
Test component	**Variable name**	**Loading factor**	**Test component**	**Variable name**	**Loading factor**
All	Roll	0.68	All	Ears pricked	-0.52
All	Low body position	0.65	Food removal	Response intensity	-0.52
All	Ears low	0.64	Call	Response lag	-0.52
All	Display	0.62	Toy removal	Force required	-0.51
Food	One command eat	0.61	Forced down	Comply latency	-0.43
All	Tail tucked	0.60	Call	Indirect approach	-0.43
All	Head in lap	0.51	All	Mouth owner	-0.41
Toy regain	Regain latency	0.43	All	Climb up	-0.39
Rise	Rise latency	0.44	All	Tail height	-0.35
Grooming	Time tolerated	0.44			
Toy removal	Brings toy	0.41			
All	Lick owner	0.41			

Table 8.11 Key variables in Dominance Factor 2

Positively loaded variables			*Negatively loaded variables*		
Test component	**Variable name**	**Loading factor**	**Test component**	**Variable name**	**Loading factor**
All	Tail movement	0.65	Call	Response lag	-0.46
Call	Approach gait	0.61	Lying	Ignore	-0.33
All	Playful	0.55	All	Tail tucked	-0.33
All	Lick owner	0.53			
Lying	Stand on/over torso	0.53			
Grooming	Stance height	0.53			
Rise	Reapproach gait	0.51			
All	Sit	0.49			
All	Tail height	0.48			
All	Bark	0.46			
All	Paw	0.46			
Approach	Response positivity	0.44			

Names were selected to summarise the key variables in these two factors:

Dominance factor 1 - Amenability and

Dominance factor 2 - Confident interactivity.

8.2.4.3 Hypothesis testing

8.2.4.3.1 Dependent variables

The six factors (four attachment and two dominance) were used as dependent variables. Since they were derived from observation they are referred to as "measured" dependent variables.

Additionally, four "reported" dependent variables were derived from the owners' questionnaire responses. Owners' subjective ratings for their dog's "dominance" and "attachment" were treated as ordinal dependent variables. Owners were asked if their dog

had ever exhibited aggression[1] towards them and when it had last occurred. If they described aggression as on-going, they scored 1 for the categoric (0/1) variable "Current aggression". They were also asked to describe the form the aggression took. Their responses were ranked: 0-none; 1-growling; 2-baring teeth; 3-snapping or 4-biting. This ordinal variable was named "Aggression intensity".

Examination of these dependent variables revealed that they were not normally distributed and so all subsequent statistics are nonparametric and all descriptions of data are in the form of medians and percentiles (instead of means and standard errors).

The ten dependent variables all describe dimensions (measured and reported) of dog-human relationships. A range of independent variables was selected, each of which were hypothesised to affect relationship dimensions.

8.2.4.3.2 Independent variables

The independent variables described demographics, features of dog-owner play and ownership style. They were measured during the play sessions (8.2.3.1 .and 8.2.3.2)[2] and were derived from the questionnaire responses (Table 8.12).

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1 Aggression was defined as "any exhibition of growling (not playful), baring teeth, snapping or biting directed towards the owner". Since aggression can be dominance-related (Overall 1997) and may thus be affected by the same factors, aggression variables are subsequently considered within the dominance variables section.

2 Attachment dependent variables were compared only to the general play variables during the open play session (Table 8.1). The remaining open play variables (Table 8.1) and all the Tug-of-war session variables (Table 8.2) were analysed in relation to dominance/aggression dependent variables only.

Table 8.12 Variables extracted from the questionnaire and used as independent variables for testing relationships with attachment and dominance dependent variables

Variable name	Description	Units	Variable type	Dependents tested
Demographics				
Dog age	Age of dog at time of visit	years	continuous	a d
Dog breed type	Kennel Club category of dog breed, or breed most closely resembled	scale: 1-7	categoric	a d
Pure breed	Reported pure bred or pedigree dog	0/1	0/1	a d
Dog sex	Sex of dog: 0-male; 1-female	0/1	0/1	a d
Owner gender	Gender of owner: 0-male; 1-female	0/1	0/1	a d
Play behaviour				
Play frequency	No. of dog-owner play sessions per week	freq	continuous	a
Rough-and-tumble	Reported playing Rough-and-tumble in unguided play question	0/1	0/1	a d
Tug-of-war	Reported playing Tug-of-war in unguided play question	0/1	0/1	a d
Fetch	Reported playing Fetch in unguided play question	0/1	0/1	a d
Chase	Reported playing Chase in unguided play question	0/1	0/1	a d
Keep-away	Reported playing Keep-away (or un-retrieved fetch) in unguided play question	0/1	0/1	a d
Dog initiates	When asked how they start play, owner volunteers that dog usually starts play sessions	0/1	categorical	d
Intended winner	Winner owner believes makes a good game: 0-human; 1-even; 2-dog	0-2	ordinal	d
Owner style				
Daily time together	Time owner spends with dog in an average day	min	continuous	a
Daily interaction time	Time owner spends interacting with dog in an average day	min	continuous	a
Current training time	Time spent training dog per week: 0-none; 1-<10mins, 2-10-30mins; 3->30mins	0-3	ordinal	d

Training method	Training method used: 0-none, 1-self, 2-classes	0-2	categorical	d
Sleeping location	Dog's usual night sleeping place: 0- other room; 1-locked in other room; 2- owner's bedroom; 3-owner's bed	0-3	categorical	a
Dog's behaviour				
Proximity	Dogs usual location in home: 0-in room of own choice, 1-usually same room as owner; 2- always in same room as owner; 3-always close to owner	0-3	ordinal	a
Attention demands	Frequency with which dog demands attention: 0-never; 1- sometimes; 2-frequently	0-2	ordinal	a
Separation response	Dog known to currently react to separation via vocalisation, elimination or destruction	0/1	0/1	a

Abbreviations: a-attachment; d- dominance and aggression

8.2.4.3.3 Exploring relationships between variables

Attachment

The five dependent variables, four measured (Non-specific attention-seeking, Preference for familiar, Separation-related behaviour and Preference for unfamiliar) and one reported (Owner's attachment rating) were tested for correlations to one another. I also tested their relationships to 25 independent variables (nine measured and 17 reported).

Dominance

There were five dependent variables, two measured (Amenability and Confident interactivity) and three reported (Owner's dominance rating, Current aggression and Aggression level). Their relationships to one another and to 41 independent variables (27 measured and 14 reported) were tested.

Statistical tests

Four nonparametric statistical tests were used and the choice of test in each case depended upon the combination of variable types being explored as illustrated in Table 8.13.

Table 8.13 Statistical tests used for each combination of dependent and independent variable types

Dependent variable type	Independent variable type	Statistical test used
Continuous/ Ordinal (*i.e.* attachment and dominance)	Continuous/Ordinal	Spearman Rank Correlation [3]
	Categorical (k samples)	Kruskal -Wallis[4]
	0/1	Mann Whitney U [5]
0/1 (*i.e.* aggression variables)	Continuous/Ordinal	Mann Whitney U[6]
	Categorical (k samples)	Contingency [3]
	0/1	Fisher Exact[7]

[3] Spearman Rank Correlation test and Contingency test - for description refer to 2.3.3.3

[4] Kruskal-Wallis One-way Analysis of Variance by Ranks is the nonparametric equivalent to one-way ANOVA (see 3.3.2.3). It tests the null hypothesis that several independent samples are from the same population or identical populations with the same median. The test assumes that the underlying variable has a continuous distribution, and requires an ordinal level of measurement (see Siegal and Castellan 1988).

[5] Mann Whitney Test - for description refer to 2.3.3.7

[6] The parametric test for the effect of a continuous independent variable upon a 0/1 dependent variable would be logistic regression. There is no non-parametric equivalent of this test so the dependent and independent variables are reversed and a Mann Whitney U test carried out.

[7] Fisher's Exact test is a probability test used when the numbers in a 2 x 2 contingency table are small. It computes exact probabilities without relying on approximations (see Siegel and Castellan 1988).

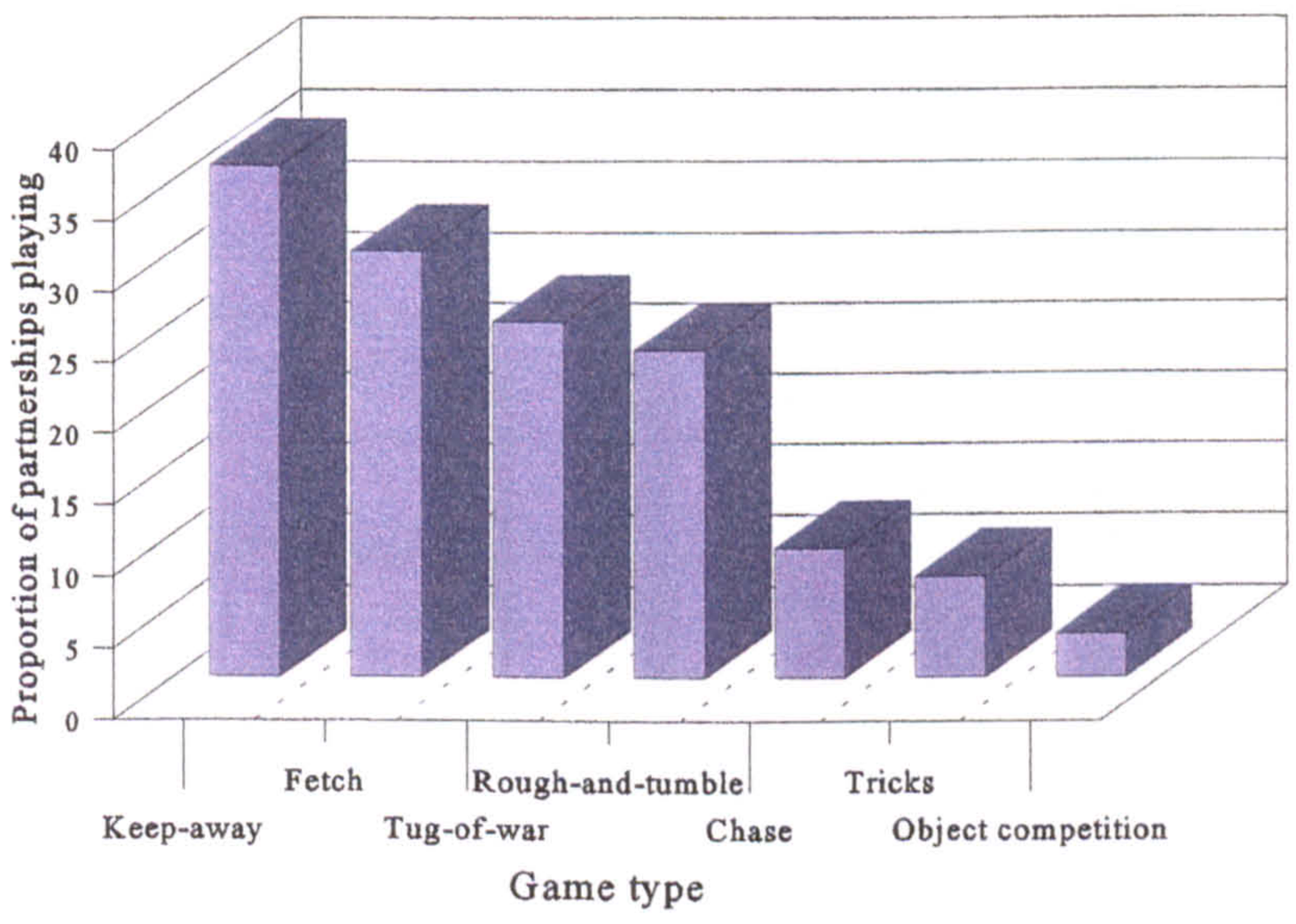
8.3 Results

8.3.1 Open play session

8.3.1.1 General play characteristics

The proportion of the dog-owner partnerships playing each of the game types is illustrated in Figure 8.3.

Figure 8.3. Number of dog-owner partnerships (out of 50) observed to play each game type during the open play session



The most common game type was Keep-away which was played by 36 of the 50 partnerships. Involvement and Interactivity scores both ranged from 1 to 5, with medians of 3.9 (25th percentile - 2.5, 75th percentile - 4.5)[8] and 3.6 (2.6, 4.5) respectively. The median play duration was 158 (101, 180) seconds and 24 dogs played for 160 seconds or more and were classified as "long players".

[3] All averages stated subsequently are medians accompanied by 25th and 75th percentiles in this format.

8.3.1.2 Effects of demographics on general play behaviour

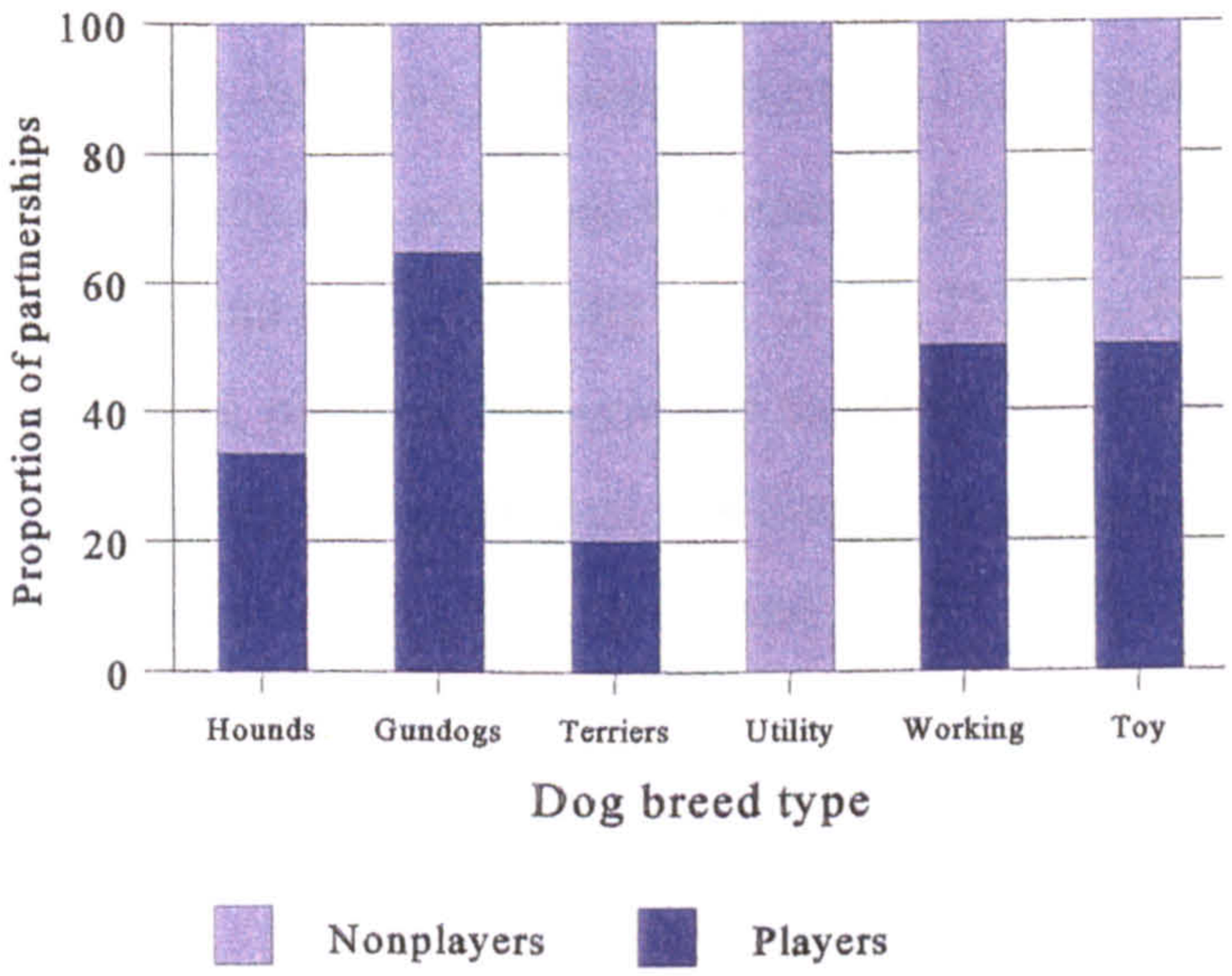
Dog age

The dogs observed to play Fetch were significantly younger than non-players (5.3 years (3.0, 8.6) vs. 8 years (7, 11), Mann Whitney U test; U=164, $p<0.01$). No further variables were affected by age.

Dog breed type

The games played appear to be influenced by breed type (Figure 8.4). Unfortunately, insufficient numbers of some breed categories meant that the requirements of the Chi square test were not met and the relationship was statistically untestable.

Figure 8.4 Proportion of dogs of different breed types observed to play Rough-and-tumble in the open play session



Dog sex

Female dogs scored higher for Involvement in the open play session than did male dogs (4.5 (2.9, 5.0) vs. 3.5 (2.5, 4.5), U=630, $p<0.05$).

Owner gender

Male owners were more likely to engage in Rough-and-tumble play than were females (67% vs. 52%, Contingency test; $\chi^2=6.5$, $d.f.=1$, $p<0.05$).

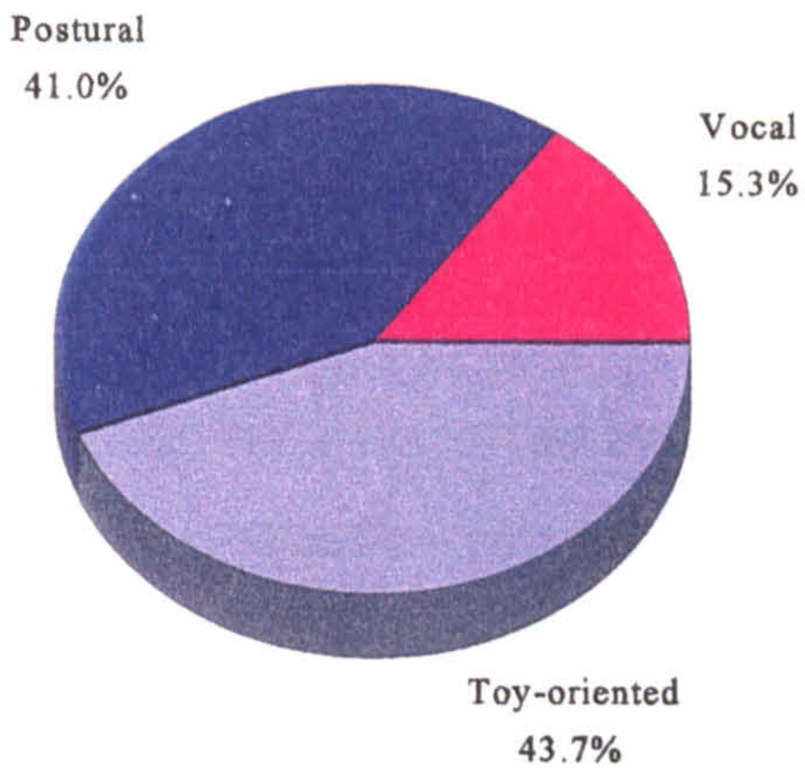
8.3.1.3 Play control variables

Thirty nine of the owners incorporated commands within their play, giving an average of 6 (1, 13) per session. Seven partnerships did not include a toy in their game, so the remaining play control variables were measured on a reduced sample of 43. The proportion of dog wins varied from 0 to 1 with a median of 0.17 (0, 0.5). Seven partnerships were classified as dog winners (≥0.66 dog wins). The dog possession duration ranged from 1 to 173 seconds, with a median of 78 (32, 104). Eighteen owners removed the toy at the end of the play session whilst 25 dogs had continual access to the focal play toy.

8.3.1.4 Play signal variables

All play signal variables were originally calculated over ten second and three minute periods. In all cases there were strong correlations between the two time scales (Spearman Rank Correlation test; $Rho \geq 0.4$, $d.f.=49$, $p<0.01$) so I subsequently analysed only the three minute values. Owners produced an average of 85 (65, 109) play signals per session, and the median signal diversity was 15 (12, 19). The signals were divided into four categories: vocal, physical, toy-oriented and postural. The median proportion of signals in each category (per partnership) is illustrated in Figure 8.5. Twenty seven of the dog owners were observed to give a clear "end signal", whilst 23 gave no detectable end signal.

Figure 8.5 *Proportion of human-dog play signals of each type (postural, vocal, physical and toy-oriented) during open play session*



physical signals are not included as their median proportion was 0

8.3.2 Tug-of-war play session

Forty one of the dog owners reported playing Tug-of-war with their dogs and were filmed playing this game. Determination ratings for the sessions varied between 1 and 5 with a median of 4.5 (3.5, 5) and the average attention duration was 120 (106, 120) seconds. The proportion of dog wins varied between 0 and 1 with a median of 0.2 (0, 0.5). Eight partnerships were classified as dog winners. The average dog possession duration was 5 seconds (0, 15), but this variable showed no significant correlation to the win proportion (*Rho*=0.19, *d.f.*=40, $p>0.25$) and was therefore retained as a separate variable. The median play signal frequency during the first ten seconds of Tug-of-war was 8 (6, 10.5) consisting of an average 5 (4, 6) types. Vocal (50%) and toy-oriented (43%) signals were very common, whilst only 6% of the signals were postural.

Seven of the variables measured during Tug-of-war sessions were also measured in open play sessions. Whilst two of these showed strong relationships between the two sessions (proportion of dog wins: *Rho*=0.50, *d.f.*=34, $p<0.01$ and signal frequency: *Rho*=0.33, *d.f.*=40, $p<0.05$), the remaining five did not (*e.g.* dog possession duration: *Rho*=-0.23,

d.f.=34, p>0.2). I therefore retained the variables from both sessions for subsequent hypothesis testing.

8.3.3 Questionnaire

8.3.3.1 Play behaviour

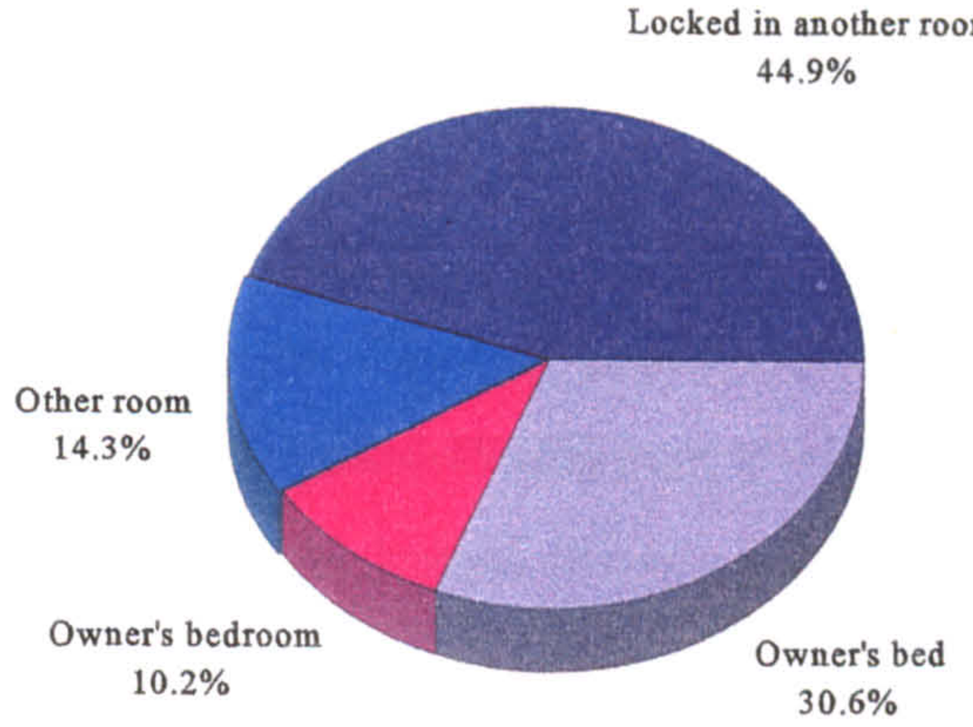
The reported frequency of play sessions varied between 0 and 42 per week, with a median of 7 (7, 21). When listing the games they played, 58% of owners mentioned Fetch; 50% Rough-and-tumble; 48% Tug-of-war; 30% Chase and 36% Keep-away. For the first four of these game types, the owners' reports showed significant relationships to the games they were observed to play in the open session (χ^2>3.5, *d.f.* =1, p<0.05). However, some individuals were observed to play games, they did not report playing, and in the case of Keep-away there was a large disparity between reported and observed partnerships (χ^2=47, *d.f.* =1, p>0.45). Whilst observed games have the advantage of objectivity, owners' reports can give an insight into usual play routines. I therefore retained both reported and observed games as independent variables for subsequent analysis.

When asked how they usually started play, 29 of the 50 owners said that the dog was often the initiator. Approximately half (48%) of owners thought that a good game was usually won by the dog, 16 % thought a human win made a "Good game" and 8 % preferred an even game.

8.3.3.2 Ownership style

Owners spent between 4 and 24 hours per day (median=13 hours (7, 17.5)) with their dog. An average of 1.75 hours (1.5, 2.5) of this time was spent interacting. On acquiring the dog, 36% of owners had attended classes, 56% trained the dog themselves and 8% undertook no training. However, the majority (72%) of owners currently devoted no time to training their dog, and only 14% spent more than 30 minutes per week training. The reported sleeping locations of the dogs are illustrated in Figure 8.6.

Figure 8.6 Proportion of the sample reported to spend the majority of nights sleeping in each location



8.3.3.3 Dog's behaviour

Ratings for proximity spanned the whole scale (0-3) with an average of 1 (0.5, 2). The median attention demands score was 1 (1, 2), but the scores were highly correlated to proximity scores (*Rho*=0.51, *d.f.*=49, $p<0.001$) so the variable attention demands was excluded from further analysis. Twenty owners reported their dogs to currently show some separation-related behaviour.

8.3.4 Attachment dimensions

8.3.4.1 Relationships between attachment variables

The reported variable, owner's attachment rating was recorded on the scale 1-5, but skewed use of the scale meant that values only ranged from 2 to 5 with a median of 4.5 (4, 5). These ratings were not significantly correlated to any of the four measured attachment variables (*Rho*<0.1, *d.f.*=49, $p>0.6$).

8.3.4.2 Effects of demographics upon attachment variables

Dog age

Preference for owner was negatively corelated to the dog's age (*Rho*=0.29, *d.f.*=49, $p<0.05$), but the other attachment dimensions were not significantly affected by age.

Dog breed type

Preference for unfamiliar was the only attachment dimension to vary significantly according to breed type (Kruskal-Wallis test; $\chi^2=13.1$, *d.f.*=5, $p<0.05$). Hounds scored the highest and terriers scored the lowest (Figure 8.7).

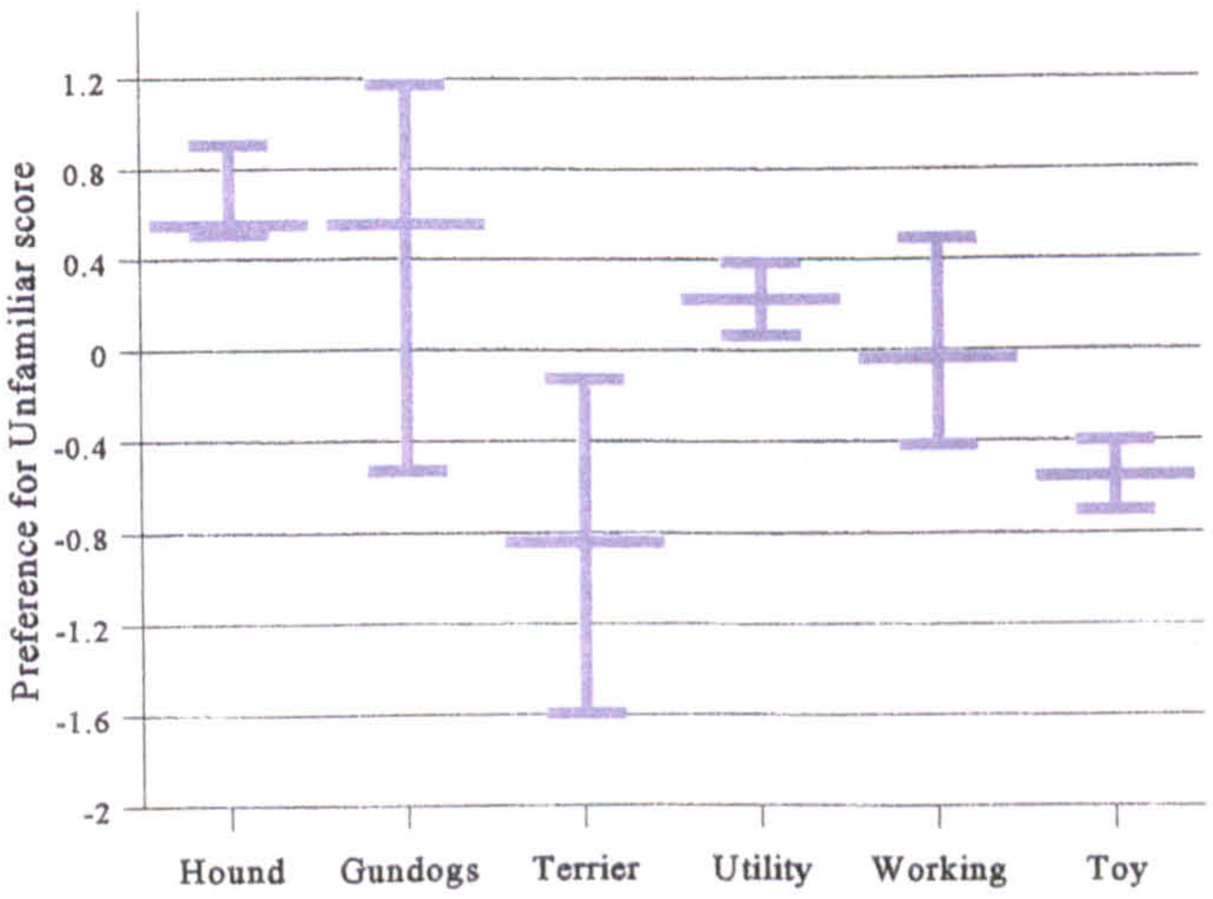
Pure breed

Cross bred dogs scored significantly higher for Preference for owner than did pure bred dogs (0.4 (-0.5, 0.9) vs. -0.3 (-0.8, 0.6), U=196, $p=0.05$).

Dog's sex and owner's gender

Attachment dimensions were not significantly affected by the dog's sex or the owner's gender.

Figure 8.7 Variation in median scores for "Preference for unfamiliar" scores between dogs of different breed types



The middle bars represent the median values, the bottom and top show the 25th and 75th percentiles, respectively.

8.3.4.3 Effects of play on attachment dimensions

Open play session variables

Dogs observed to play Rough-and-tumble scored lower for Separation-related behaviour than did non-players (-0.6 (-0.9, 0.2) vs. 0.4 (-0.6, 1.1), U=210, p=0.05). Interactivity scores were significantly correlated to scores for Preference for unfamiliar (*Rho*=0.36, *d.f.*=49, p=0.01). Dogs classified as "long players" scored higher for Preference for owner than did "short players" (0.3 (-0.4, 1.0) vs. -0.5 (-1.1, 0.5), U=196, p<0.05). Involvement scores and other game types played showed no significant relationships to any of the attachment dimensions.

Questionnaire variables

The game types which the owner reported playing were significantly related to attachment dimensions. Dogs reported to play Rough-and-tumble had higher Non-specific attention-seeking scores (-0.1 (-0.4, 0.6) vs. -0.3 (0.9, 0.2), U=213, p=0.05) and also lower Separation-related behaviour scores than non-players (-0.5 (-1.0, 0.3) vs. 0.3 (-0.6, 1.1), U=210, p<0.05). Players of Keep-away scored higher for Separation-related behaviour than non-players (0.5, (-0.6, 1.1) vs. -0.6 (-0.9, 0.1), U=174, p<0.05) and dogs reported to play Chase were reported to have lower owner's attachment ratings than dogs which did not play Chase (4 (3.5, 5) vs. 5 (4, 5), U=171, p<0.05).

8.3.4.4 Relationships between ownership style and attachment dimensions

Neither daily time together, nor the daily interaction time, showed significant correlation to the attachment dependent variables (*Rho*<0.2, *d.f.*=49, p>0.15). No attachment dependent variables were affected by the dog's sleeping location (K.W; χ^2>240, *d.f.*=3, p>0.4).

8.3.4.5 Dog's behaviour

The reported variables, proximity and separation response, bore no significant relationship to any of the measured variables ($p>0.18$), but owner's attachment ratings were correlated to proximity (*Rho*=0.35, *d.f.*=49, $p=0.01$).

8.3.5 Dominance dimensions

8.3.5.1 Relationships between dominance variables

Owners' dominance ratings ranged from 1 to 4 (on a 1-5 scale), with a median of 2 (2, 3). Owners' ratings were negatively correlated to Amenability (*Rho*= 0.30, *d.f.*=49, $p<0.05$), but unrelated to Confident interactivity (*Rho*=0.15, *d.f.*=49, $p>0.3$).

Reported aggression levels ranged from 0 to 4 with a median of 1 (0, 1). Twelve owners reported their dog as showing current aggression. But current aggression showed no significant relationship to the measured ($U>210$, $p>0.7$) or reported dominance variables ($U=160$, $p>0.1$), so the effects of all independent variables were tested upon both the dominance and aggression dependent variables.

8.3.5.2 Relationships between dominance and attachment variables

There were significant correlations between measured attachment and dominance dimensions. Amenability scores were correlated to Preference for unfamiliar scores (*Rho*=0.29, *d.f.*=49, $p<0.05$) and Confident interactivity was correlated to Preference for owner (*Rho*=0.28, *d.f.*=49, $p=0.05$).

8.3.5.3 Effects of demographics upon dominance variables

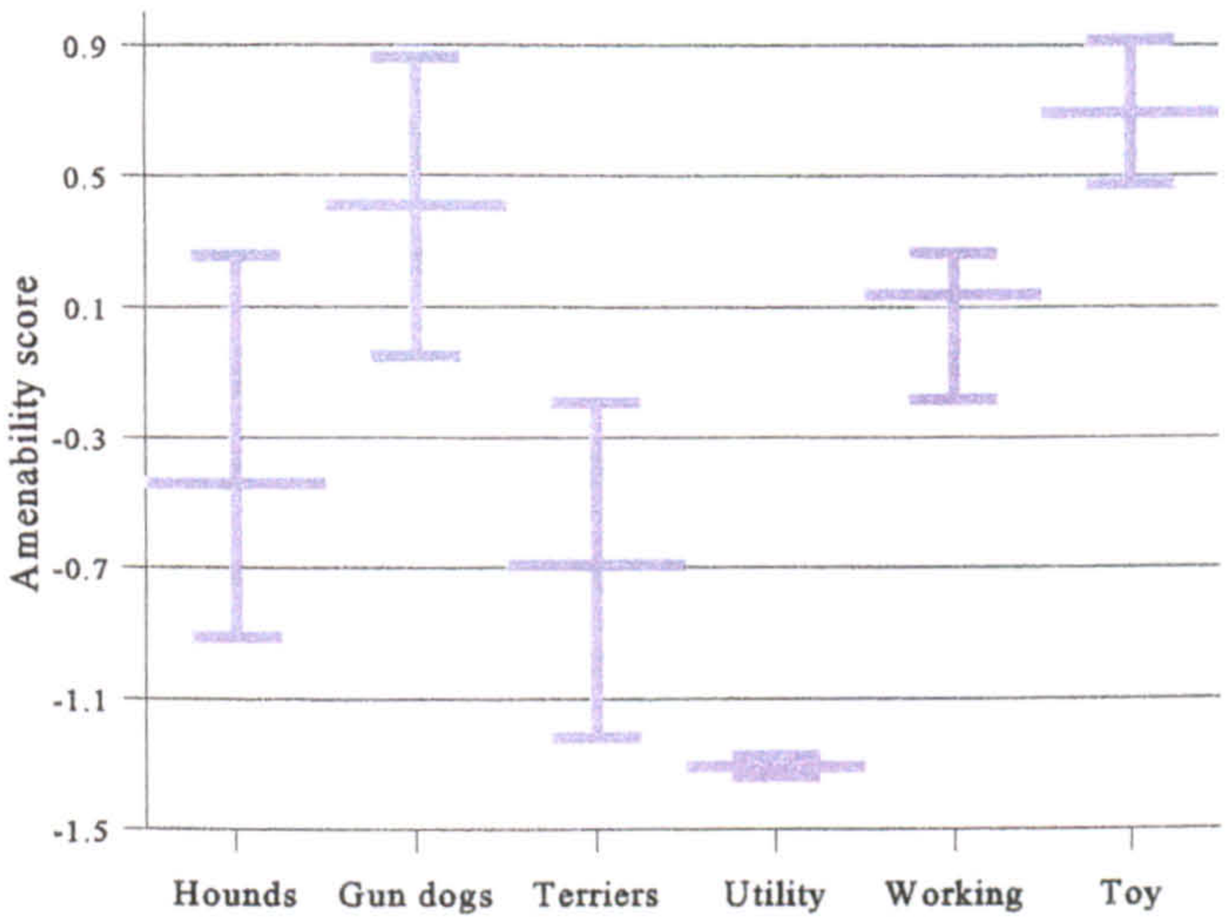
Dog age

Confident interactivity scores decreased with the age of the dog (*Rho*=-0.39, *d.f.*=49, $p=0.005$). The remaining dependent variables were unaffected by age.

Dog breed type

Amenability scores varied significantly between the breed types (K.W; χ^2=14.7, *d.f.*=5, p=0.01). Utility breeds had the lowest average Amenability scores and toy breeds scored highest (Figure 8.8).

Figure 8.8 Variation in median "Amenability" scores between dogs of different breed types



The middle bars represent the median values, the bottom and top show the 25th and 75th percentiles, respectively.

Pure breed

Cross bred dogs obtained higher scores for Amenability than did pure bred dogs (0.4 (-0.2, 0.9) vs. -0.1 (-1.2, 0.2), U=189, p<0.05).

Dog's sex

Measured dominance variables did not vary with sex (at p<0.1), but owners subjectively rated male dogs as more dominant than females (3 (2, 3) vs. 2 (1, 2.8), U=200, p<0.05).

Owner's gender

The dominance variables were not significantly affected by owner gender.

8.3.5.4 Effects of play on dominance dimensions

8.3.5.4.1 Open play session variables

General play - Dogs observed to play specific game types differed from non-players in dominance dimensions. Players of Tug-of-war scored significantly higher for Confident interactivity than did non-players (0.4 (-0.5, 1.2) vs. -0.4 (-0.7, 0.0), U=197, $p<0.05$). Similarly players of Fetch obtained higher scores for Confident interactivity than did non-players (0.2 (-0.5, 1.1) vs. -0.4 (-0.7, -0.1), U=192, $p<0.05$) and players of Rough-and-tumble scored higher for Amenability than dogs which did not play this game type (0.2 (-0.1, 0.9) vs. -0.2 (-1.2, 0.3), U=207, $p<0.05$). Dogs which played Keep-away received lower owner dominance ratings than non-players (2 (1.5, 3) vs. 3 (2, 3), U=159, $p<0.05$). Involvement in the open play session was highly correlated to Confident interactivity (*Rho*=0.43, *d.f.*=49, $p<0.005$) and Interactivity correlated to Amenability (*Rho*=0.30, *d.f.*=49, $p<0.05$). Also dogs described as "long players" scored higher for Confident interactivity than did "short players" (0.3 (-0.5, 1.3) vs. -0.3 (-0.9, 0.0), U=197, $p<0.05$).

Control of play - None of the control variables measured during the open play session showed significant relationships to the measured dominance variables, the owner's dominance rating or the reported aggression level. However, current aggression was more common in dogs that took part in a "dog winner" open play session (Fisher's Exact Test; $p<0.01$). Five of the seven "dog-win" sessions involved currently aggressive dogs (of the nine aggressive dogs playing with toys). Command frequency had no effect on any of the dependent variables.

Play signals- None of the measured play signal variables showed any significant relationship to the dominance dimensions measured and reported.

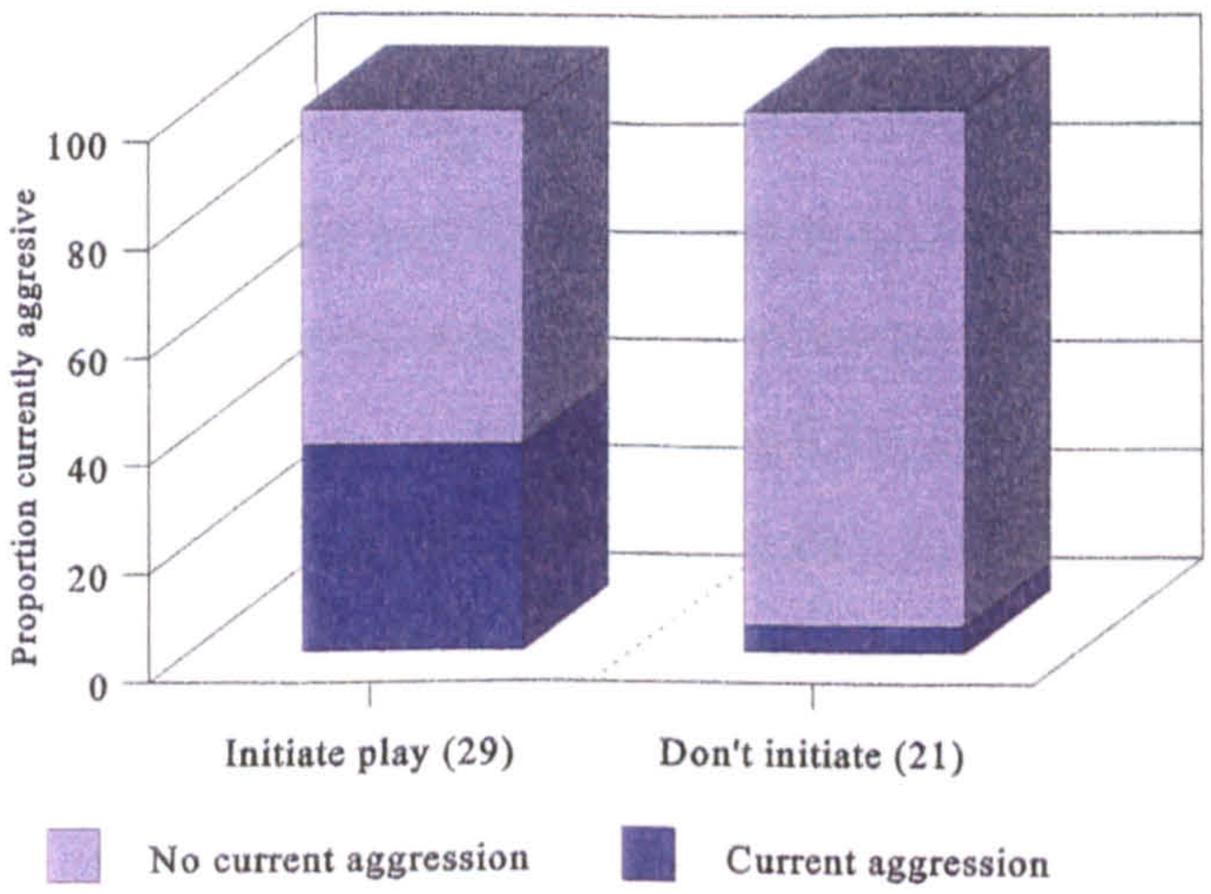
8.3.5.4.2 Tug-of-war variables

Determination scores were correlated to Confident interactivity (*Rho*=0.50, *d.f.*=40, $p<0.01$). The proportion of dog wins, dog winner and dog possession duration showed no relationship to any of the dominance dependent variables. Signal diversity correlated significantly to Confident interactivity (*Rho*=0.31, *d.f.*=40, $p<0.05$), but the remaining signal variables (signal diversity, proportion of postural signals, proportion of physical signals) showed no significant relationships.

8.3.5.4.3 Questionnaire variables

The reported frequency and types of games did not significantly affect the dominance variables. Intended winner showed no relationship to the observed dog winner in the open or the Tug-of-war sessions and had no effect on any of the dominance variables (Fisher's Exact tests; $p>0.2$). The variable "dog initiates" showed very significant associations to a number of dependent variables. Dogs that were reported to initiate play scored lower for Amenability than dogs who did not initiate play (-0.2 (-1.2, 0.3) vs. 0.2 (0, 1), U=162, $p=0.005$). Dogs which initiated play also had higher owner dominance ratings than the other dogs (2.5 (2, 3) vs. 2 (1, 3), U=206, $p<0.05$) and were more likely to exhibit current aggression (Fisher's Exact test; $p<0.01$). Of the twelve currently aggressive dogs, eleven were reported to initiate play (see Figure 8.9).

Figure 8.9 Relationship between dogs which initiate play sessions and those which exhibit current aggression



8.3.5.5 Effects of ownership style on dominance dimensions

The time currently devoted to training and the method used did not affect any of the measured dominance variables.

8.3.6 Examining different breed types

Amenability scores were significantly affected by breed type (see 8.3.5.3 and Figure 8.8). It is possible that breeds which are predisposed to be more Amenable are affected differently by the games they play than breeds which are less Amenable. To examine this, I divided the sample into high and low Amenability breeds. Hounds, terriers and utility breeds were categorised as low Amenability, making a total of 14 dogs. Gundogs and toy breeds were categorised as high Amenability (n=19). Working dogs showed intermediate Amenability and were excluded from this analysis. All the statistical tests previously used on dominance and aggression variables were repeated using each of these sub-samples.

8.3.6.1 High Amenability breeds

The playing of Tug-of-war was the only factor which significantly affected the measured dominance variables. Dogs which were observed to play Tug-of-war in the open session scored higher for Confident interactivity than did non-players (0.7 (-0.2, 1.7) vs. -0.2 (-1.2, 0.3), U=19, $p<0.05$). Similarly, the dogs which were reported to play Tug-of-war scored significantly higher for Confident interactivity than did non-players (1.0 (-0.2, 1.7) vs. -0.2 (-0.8, 0.2), U=19, $p<0.05$). Owners' reports were related to a number of variables. Dogs which were currently aggressive scored lower for Involvement (2 (1.3, 4.2) vs. 4 (3.5, 5), U=10.5, $p<0.05$) and for Interactivity (2.3 (1.3, 4) vs. 4.5 (4, 4.8), U=8.5, $p<0.05$) in the open play session. Low Involvement and Interactivity scores were also corelated to high dominance ratings (*Rho*<-0.49, *d.f.*=18, $p<0.05$), and high reported aggression levels (*Rho*<-0.58, *d.f.*=18, $p<0.01$). Additionally, dogs which were "long players" were reported to show lower aggression levels than were "short players" (0 (0, 1) vs. 3 (0.5, 4), U=20, $p<0.05$). Dogs classified as winners of the open play session were

more likely to exhibit current aggression (100% of winners vs. 9% of others, Fisher's Exact test; $p<0.05$).

8.3.6.2 Low Amenability breeds

The playing of Tug-of-war had no significant effect upon the low Amenability dogs, but other characteristics of their play did. Command frequency during the open play session was positively correlated to Amenability (*Rho*=0.55, *d.f.*=13, $p<0.05$), as was the proportion of postural signals (*Rho*=0.36, *d.f.*=13, $p<0.05$). The proportion of Tug-of-war physical signals was correlated to the Confident interactivity score (*Rho*=0.6, *d.f.*=11, $p<0.05$). Dogs reported to initiate play scored significantly lower for Amenability than dogs which did not initiate play (-1.2 (-1.4, -0.2) vs. 0 (-0.8, 1.2), U=6, $p<0.05$).

8.4 Discussion

8.4.1 How reliable are owners' reports?

This study provided an opportunity to compare owners' reports to objective measurements and observations. There was a large degree of discrepancy.

8.4.1.1 Attachment scores

Owners' ratings of their dog's attachment to them were positively correlated to their proximity ratings, suggesting that the dog's usual location was one criteria owners used to assess attachment. However, these subjective ratings bore no relationship to any of the measured attachment dimensions. It is likely that owners, especially first-time owners, had little to compare their dog's behaviour to and so rated attachment relative to their own desired levels, rather than any absolute measure.

8.4.1.2 Dominance scores

Owner's ratings of their dog's dominance status relative to themselves showed a moderate negative correlation to the factor "Amenability" (Rho=0.3, $d.f.$=49, p<0.05). This indicates that owners were more objective in their assessment of dominance than attachment dimensions of their relationship, but this ability was still limited.

8.4.1.3 Separation-related behaviour

There was no association between the measured factor "Separation-related behaviour" and owners' reports of such behaviour. I suggest that this discrepancy is due to two reasons. Firstly, the factor score was composed of behaviours measured during numerous test components, not just separation. Therefore, it may not equate exactly to what owners perceive as separation-related behaviour. Secondly, owner's accounts are often unreliable.

Unless it is destructive, separation-related behaviour can be difficult to detect, simply because it occurs in the owner's absence. Many owners remain unaware of how their dog reacts to their departure and it is only via filming that their behaviour can be revealed.

8.4.1.4 Games played

The games owners reported playing did not correspond exactly to what was observed. In many cases, owners were observed to play games which they did not report. The game type which showed the largest inconsistency was Keep-away. Reports were much rarer, and often in different partnerships, than this game type was observed. So, although questionnaires can provide an insight into usual routines, they are often erroneous due to differences in categorisation and inaccurate owner reports and ideally should be used in combination with direct observations.

8.4.1.5 Control of games

When asked what they thought constituted a good game, 24 owners stated that their dog winning was an important factor. This belief was not reflected in their measured play control variables. Dogs belonging to owners who thought a dog-win was good were no more likely to win games than were dogs belonging to owners who stated a human-win made a good game. This demonstrates that owners often behave towards their dogs differently to how they believe they should, or even differently to how they perceive they do.

8.4.1.6 Factors affecting owners' reports

Owner's reports were influenced by the sex of their dog. Male dogs were perceived as significantly more dominant than females, but their measured dominance-dimensions varied non-significantly. Although the behaviour of male and female dogs has previously been shown to differ (Wells and Hepper 1999), the lack of a detectable difference in this sample suggests that the difference in reported dominance was a result of owner's subjective ratings being shaped by their expectations of how their dog should behave.

8.4.1.7 Overview

Owners reports are not 100% reliable. They are influenced by expectancies, gender and personal opinions when accounting their dog's behaviour. Although questionnaire surveys can be useful, direct observation of behaviour is also essential if we are to further our understanding of the influence of causal factors upon dog-owner relationships.

8.4.2 Attachment test

8.4.2.1 Attachment is multidimensional

Testing attachment in an experimental setting was problematic and results were confounded by the dog's learnt expectancies (see 5.4.5.2.4). Only one attachment dimension was detectable in Experiment 5.4 - "Contact seeking". The current home-based test had the advantage of measuring the dog's behaviour in its natural environment and the presence of an additional person allowed distinction between a dog's general affinity for people and a specific attachment to its owner. This test yielded four meaningful attachment factors. Thus, the multi-dimensional nature of attachment is more apparent in the home setting and this test seems to be an effective means of measuring it.

8.4.2.2 Effect of demographics

Preference for owner decreased with age and was higher in cross-bred dogs. Cross-bred dogs are more likely to have multiple owners (M^{c}Crave 1991). Since re-homing affects the attachment process, possibly leading to over-attachment and separation-related problems (Mugford 1995), this may explain their increased owner preference. Preference for unfamiliar was significantly associated with breed type, suggesting that characteristics of the dog play a important role in determining this attachment dimension.

8.4.2.3 The link between Rough-and-tumble play and attachment dimensions

In my experimental study (5.4), play treatments led to lower levels of Contact seeking than did the control petting treatment, and Rough-and-tumble games had the most marked effect. I hypothesised that play, especially Rough-and-tumble play, prevented the development of "over-attachment" (see 5.4.5.2.3). The results of the current study support this idea. This study did not detect any relationships between attachment dimensions and the quantity of play, but the types of games played were important. Once again, Rough-and-tumble figured prominently. The dogs observed to play this game type scored significantly lower for Separation-related behaviour than did non-players. This difference was also apparent when using owners' reports as well as observed games.

This is a correlational study, so in isolation provides no evidence that Rough-and-tumble is the cause of, and not a result of or correlate to, reduced separation-related behaviour. However, the factor "Separation-related behaviour" (current study) shows some overlap with the "Contact seeking" factor in the experimental study (5.4). In both cases, players of Rough-and-tumble scored lower. Collectively these results suggest that there is a causal relationship between the playing of Rough-and-tumble and attachment-related behaviour. This game inhibits the exhibition of Separation-related behaviour, which is a beneficial effect. Additionally, dogs reported to play Rough-and-tumble scored higher for Non-specific attention seeking. This trait, in moderation, can be desirable, so this may be a further benefit of this game type.

8.4.2.4 Further game types

Dogs reported to play Keep-away scored higher for Separation-related behaviour and reported Chase players were reported as less attached to their owners. The experimental study did not examine either of these play types and so it is impossible to conclude whether the relationships are causal or correlational. A predisposition to play these game types may be caused by a underlying trait which also affects attachment-related behaviour, but this requires experimental study.

8.4.3 Dominance test

8.4.3.1 Dominance factors

This home-based dominance test yielded two meaningful factors - Amenability and Confident interactivity. These equate well to the factors derived during the experimental studies. An Amenability factor was found in Experiment 5.4, composed of many of the same variables as the current Amenability factor. Also, the Confidence factors in Experiments 5.4 and 5.5 show similarities to the current Confident interactivity factor. This dominance test is therefore useful, with modifications, in the home as well as the laboratory context.

Amenability is a desirable quality in a dog-human relationship. Low scores for Amenability can be problematic since they describe a dog which refuses to leave its food, or its toys, or doesn't respond to a call. Confident interactivity, although including many behaviours which may be described as dominant, is also a desirable trait when in moderation. A dog scoring high in Confident interactivity is likely to be playful, lick its owner frequently and approach them quickly when called. Factors which decrease Amenability are therefore potentially more harmful than those which increase Confident interactivity.

8.4.3.2 Dissociation between dominance and aggression

I found no significant relationship between reported aggression incidence and the measured dominance dimensions. This is likely to be because aggression is multi-causal; it can be a result of territoriality, fear and pain (Overall 1997) as well as being dominance-related. Presumably, many of the dogs reported to show aggression did so for reasons other than dominance.

8.4.3.3 Effects of demography

The dominance dimensions were very strongly affected by characteristics of the dogs. Confident interactivity decreased with age (p=0.005) and Amenability varied with breed type (p=0.001). These results suggest that biological factors play a major role in the

determination of dominance dimensions of dog-human relationships, and the effects of individual treatments are comparatively weak. Thus game and ownerships style may only modify dominance tendencies which are already strongly pre-determined.

8.4.3.4 Does playing Tug-of-war enhance dominance?

Tug-of-war players scored higher for Confident interactivity than did non-players. When the sample was split according to Amenability of breed, this effect was apparent in the high Amenability breeds only. Although this could be interpreted as supporting the dominance-enhancement theory, further evidence suggests it does not. Dogs which played Fetch in the open play session also scored higher than non-players. A link between Fetch and Confidence was also found in Experiment 5.4, when the group of dogs which played Fetch increased significantly in Confidence. Fetch is human-controlled, so the dominance-enhancement theory would predict Fetch players to have lower scores for Confident interactivity or higher scores for Amenability. The current results do not support these predictions.

My previous experimental studies have failed to identify any significant dominance-related effects, and links between dominance and Tug-of-war in the current study are indiscernible from those between dominance and Fetch. I therefore conclude that playing Tug-of-war does not alter dominance-dimensions of the dog-human relationship.

8.4.3.5 The effects of other game types on dominance dimensions

Dogs which were observed to play Rough-and-tumble games scored higher for Amenability than non-players. Amenability is a desirable trait so this link does not support O'Farrell's (1992) warnings that Rough-and-tumble should be avoided. Experimental studies (5.4) showed no significant effects of Rough-and-tumble on dominance dimensions, which implies this link is correlative not causal.

Players of Keep-away scored lower on owner dominance ratings. No measured variables support this link so it is likely to be a correlative relationship. It is possible that owners who perceive their dogs as dominant do not allow them to play Keep-away.

8.4.3.6 Control the game, control the dog?

Whilst it is often advised that Tug-of-war games should be avoided (*e.g.* M°Bride 1995), a crucial factor in the dominance-enhancement theory is claimed to be which partner (human or dog) controls the game (Rogerson 1992). Previous experimental studies (5.4 and 5.5) have failed to find any differences in dominance-related behaviour of dogs after playing controlled and uncontrolled games.

In the current study I examined the effect of control, in terms of proportion of competitions won (as measured previously), but additionally I analysed the human command frequency, and dog possession duration, during open play and during Tug-of-war games. None of these variables affected the measured dominance dimensions. However, there was a significant trend for dogs reported to be currently aggressive to be "dog winners" *i.e.* winning at least 66% of competitions during the open play sessions. When splitting the sample this effect was apparent in the high, but not the low, Amenability breeds. This appears to support the link between winning games and aggression, but there is no evidence that this aggression was dominance-related. Although five of the seven winning dogs were aggressive they did not differ significantly in dominance dimensions to the control sample. Also, we cannot be sure which factor is the cause and which the effect. It is equally likely that owners allow their dogs to win possession of the toy because they are aware of the dog's aggressive tendencies, rather than winning causing aggression. Longitudinal studies may prove useful in resolving this issue.

8.4.3.7 Evidence of metacommunication

I have shown experimentally, that human-dog play signals alter the meaning of Tug-of-war games (7.3), and hypothesised that signalling affects the dominance-related effects of

games on dog-owner relationships (7.3.4.2). In the current study, when analysing the whole sample, I was unable to detect any correlations between the number, diversity or proportion of postural owner-dog play signals and any dominance-dimensions. However, when examining just low Amenability breeds, the effects of signalling were apparent. Owners that gave a large proportion of postural play signals in the open session had more Amenable dogs. This supports the hypothesis that postural signals are effective at communicating the play intention and preventing game outcomes from increasing dominance - or decreasing Amenability. Also Confident interactivity was correlated with the proportion of physical signals in the Tug-of-war session. Physical play signals can be ambiguous (Chapter 6.2.4.2), and therefore ineffective at ensuring the context is playful. Increased Confident interactivity may be a result of Tug-of-war ensuing a competitive context, when many signals are of this type.

This is a preliminary exploration and a much larger study would be necessary to fully elucidate the role of play signals in the home environment. The situation here was artificial as all owners were asked to play for three minutes. Consequently they all employed play signals which may not represent their usual behaviour. Also, the sample included dog winners, even play sessions and human winners. Play signalling is unlikely to have a universal effect. If I examined a sample consisting exclusively of dog-winners, I believe the effect of signalling may be more apparent, but a very large sample would be required.

8.4.4 Popular theories or common myths?

This study has allowed preliminary examination of a number of popular theories (8.1.2) and I will now review the extent to which each is supported by these results.

8.4.4.1 Do dogs which have continual access to toys become dominant?

Rogerson (1992) claims that dogs which have continual access to toys learn to dictate interactions and often become dominant over their owners. I found no difference in

dominance dimensions of those dogs who retained toys at the end of the observed games, and those dogs whose owners retained the toys. This finding does not support Rogerson's claims.

8.4.4.2 Does allowing dogs to sleep in the bedroom lead to over-attachment?

The importance of the dog's sleeping location is stressed by many behavioural counsellors (*e.g.* Appleby 1997). In her longitudinal study, M^{c}Pherson (1998) was unable to detect any effects of sleeping location upon the development of separation-related problems in Labrador Retrievers, Border Collies or a sample of re-homed dogs of many breeds. Within this mixed-breed sample, I too found no association between sleeping location and any of the attachment dimensions of the dog-owner relationship.

8.4.4.3 Does interaction initiation affect dominance?

It is claimed that dogs which are frequently allowed to initiate social interactions (including play) behave with increased dominance towards their owner (*e.g.* O'Farrell 1992). This study provides strong evidence for this claim. Dogs that were reported to initiate play frequently were found to score lower for Amenability, to have higher Owner dominance ratings and were more likely to exhibit aggression. These results were all highly significant, and were more applicable to low than high Amenability breeds.

The nature of the link between initiation of play and dominance-dimensions, (including aggression) is not clear. O'Farrell (1992) maintains that interaction initiation, by the dog, is the cause of increased dominance, but there are alternative explanations:

a) Play initiation may reflect a dominance relationship which already exists. Dominant hamsters, *Mesocricetus auratus* (Pellis and Pellis 1993) and squirrel monkeys, *Saimiri sciureus* (Biben 1998), more frequently initiate play with subordinate conspecifics. Dogs may similarly instigate play with their owners, only when they are sufficiently "dominant" to do so.

b) Allowing dogs to initiate play may reflect a general ownership attitude. Dogs which determine the timing of play sessions may also dictate other aspects of their

routine, for example they may allowed access to all areas of the house, demand attention and beg for food. The owner may reinforce their dog's status in a great number of ways and responding to play initiation is just one symptom of this.

c) When owners initiate play, they usually perform human-dog play signals (6.2). Play sessions which are initiated by the dog are likely to involve reduced human-dog signalling. The link between dog initiation and decreased Amenability (and increased aggression) may result from the reduced metacommunication allowing games to assume competitive consequences. This finding may thus be interpreted to support the hypothesis discussed in 8.4.3.7, but further study is required to confirm the correlation between play initiation and human-dog play signalling.

8.4.5 Play as a window on dog-human relationships

This study points to some factors which may play a deterministic role in dog-human relationships, for example Rough-and-tumble games. However, it also identifies a number of features of a dog's play behaviour with its owner which correlate to quantifiable aspects of their relationship. These include:

a) Interactivity in open play sessions was positively correlated to Preference for unfamiliar and to Amenability,

b) Dogs which were long players showed higher Preferences for their owners,

c) Involvement in open play, and Determination in Tug-of-war sessions were both highly correlated with Confident interactivity,

d) For high Amenability breeds, Involvement and Interactivity in play showed a negative relationship to owners' dominance ratings and to aggression incidence.

It is unlikely that these play characteristics are the cause of their associated relationship dimensions, but more likely that features of an established dog-owner relationship determine the way they play, or that play behaviour and relationship dimensions are controlled by the same over-riding traits. Play behaviour reflects relationship patterns in children (Clark *et al.* 1969), squirrel monkeys (Biben 1998) and rats, *Rattus norvegicus*

(Smith *et al.* 1996) and I suggest also in dog-human relationships. Since quantifiable aspects of play correlate to both attachment and dominance dimensions of dog-human relationships, examination of play sessions may give an insight into a dog-owner relationship. There is potential, with further research, to use play as a probe in the assessment of dog-human relationships.

8.4.6 The importance of breed

I have identified a number of factors which have significant effects on the dominance-dimensions of this sample of fifty dog-owner relationships. However, by dividing the sample according to breed type, I demonstrated that some factors affected the high and low Amenability breeds differently. Dominance dimensions of the relationship between an owner and a high Amenability dog varied, depending upon whether they played Tug-of-war and whether the dog won the open play session. Contrastingly, for low Amenability breeds, significant factors included the proportion of postural signals given by the owner and whether the dog initiated play. This suggests that the effects of certain external factors vary according to natural predispositions of the dog. It would therefore be interesting to carry out experimental studies similar to those which I have performed on gundogs, using subjects of different breed types.

8.5 Concluding comments

In this chapter I have illustrated the importance of empirical, objective research in the study of dog-owner relationships. I investigated five initial questions (8.1.3). I now review the extent to which each has been answered, and summarise the main findings of this study.

a) ***Are attachment dimensions of dog-owner relationships correlated to the games played?*** This study supports the experimental finding that Rough-and-tumble play affects attachment dimensions of a dog-human relationship, causing a reduction in Separation-related behaviour.

b) ***Are dominance dimensions of dog-owner relationships related to the frequency with which the dog wins possession of objects during games ?*** Dogs which frequently won possession in open play sessions, showed a high incidence of aggression. There was no evidence of differences in dominance-related behaviour. I suggest that winning is not the cause of aggression.

c) ***Do the frequency and types of human-dog play signals delivered (especially the proportion of postural signals) correlate to dominance dimensions ?*** No relationship between signalling and dominance-dimensions was detectable within the whole sample. However, there was evidence of a link between the proportion of postural play signals and Amenability in specific breeds of dog (low Amenability breeds).

d) ***Do attachment and dominance dimensions of the dog-owner relationship show correlations to any further aspects of play between dog and owner?*** Attachment and dominance-dimensions of the dog-owner relationship were correlated to the Interactivity, Involvement and Determination ratings of their play sessions. This illustrates the potential for using play as an indicator of relationship dimensions.

e) ***Do attachment and dominance dimensions of dog-owner relationships vary with any of the factors commonly postulated to affect them ?*** This study provides no support for the links between sleeping location and attachment or between toy removal and dominance. It strongly supports the association between dogs which are allowed to initiate play interactions and dominance-dimensions of their relationship with their owner. Dog initiators scored lower for Amenability and more often aggressive, but whether the link is causal remains unproven.

Chapter 9

General discussion



"Happiness is never better exhibited than by young animals such as puppies, kittens, lambs etc when playing together like our own children.

(Darwin 1871, p.448)

9.1 Chapter aims and outline

In this final chapter I aim to consolidate the main findings of this thesis. I summarise the results presented in chapters 2-8, examine the extent to which the initial hypotheses have been supported, and also consider the wider applications of this project.

The chapter is divided into five sections. In the first (9.2), I discuss the three General Hypotheses central to this thesis. I then propose a conceptual framework which combines the main results of my studies (9.3).

In the third section (9.4) I take a wider perspective, exploring the possible implications of this work for our understanding of the function of dog-human play. I then examine practical applications for dog-owners, trainers and behaviour counsellors, and consider the value of play for dog-owner partnerships (9.5). I conclude this chapter with a discussion of the limitations of this study and my suggestions for future work (9.6).

9.2 The General Hypotheses

In Chapter 1 I introduced three General Hypotheses which underlie all the studies in this thesis. I now summarise the evidence for and against each.

9.2.1 General Hypothesis 1: "*Dog-human object-oriented play is a distinct category of play*"

In Chapter 3, I compared dog-human play to dog-dog play. Focal sampling of dog walks (3.2) and a questionnaire survey of dog owners (3.3), revealed that dogs housed with other dogs showed no reduction in their frequency of dog-human play when compared to singly housed dogs. A comparison of the structure of object-oriented play (3.4) showed that Labrador Retrievers played differently with familiar humans than with familiar conspecifics. When playing with another dog they were more motivated to compete for possession of an object, but when playing with a person, social interaction was more important. These differences suggest that dog-dog and dog-human play are neither motivationally nor structurally homogeneous.

The experiments presented in Chapter 4 examined the structure of dog-human object-oriented play. A study of dog-owner partnerships showed that object-oriented play differed structurally from non-object (social) play (4.3); object-oriented games involved less contact, facing time and vocalisations between the players. Experiments using Labrador Retrievers revealed that object-oriented play was distinct from object play. When a toy was held by a person it attracted more attention from a dog than when it was held by an inanimate object (4.4). People were also able to increase dogs' interest in a toy via their presence (4.5) and a protocol of rewards (4.6).

Dog-human object-oriented play differs significantly in structure from dog-dog object-

oriented play, from dog-human social play and from object play. On this basis, I conclude that General Hypothesis 1 is supported and dog-human object-oriented play should be considered as a distinct category of play behaviour.

9.2.2 General Hypothesis 2: *"Play between dogs and people has consequences outside the game"*

I concentrated specifically upon whether play has dominance and attachment related consequences for the players' relationship.

9.2.2.1 Dominance related consequences

Two questionnaire surveys (5.3) detected a trend for increased aggression in dogs which played Tug-of-war with their owners. Detailed study of dog-owner partnerships showed that dominance dimensions of their relationships correlated to measured aspects of their play behaviour (Chapter 8). Dogs which played Tug-of-war scored higher for "Confident interactivity" than dogs which did not play this game, and dogs which tended to win possession of the object during play were more likely to be aggressive towards their owners.

However, experimental studies showed that playing Tug-of-war games and allowing the dog to win, did not *cause* significant changes in dominance dimensions. Winning at Tug-of-war led to increased "Playful attention seeking" in Golden Retrievers (5.5), and no significant changes in the dog-human relationships of Labrador Retrievers (5.4). I conclude that, at least within the relationships I have examined, play does not have dominance related consequences, but does affect other aspects of the dog-human relationship.

9.2.2.2 Attachment related consequences

A questionnaire survey revealed a trend for dogs which played Rough-and-tumble and Hide-and-seek to be perceived by their owners as less attached (2.3.3.7). In a study of

dog-owner partnerships, dogs which played Rough-and-tumble scored lower for "Separation-related behaviour" and higher for "Non-specific attention seeking". An experimental study of Labrador Retrievers showed that a schedule of Rough-and-tumble caused a reduction in "Contact seeking" behaviour (but this was not statistically significant; 5.4). The consistency of these results is tentative support that Rough-and-tumble play may *cause* changes in attachment dimensions of dog-human relationships.

Collectively, these results support the hypothesis that dog-human play has consequences outside the game, but they provide no evidence of dominance-related effects.

9.2.3 General Hypothesis 3: *"Dogs are able to distinguish between play and non-play interactions"*

Dog owners consistently used a number of actions to initiate play with their dogs (2.3.3.6 and 6.2). Two composite play signals, Lunge and Bow, were experimentally shown to function in play instigation. When performed by a human, these visual signals increased the amount of play behaviour exhibited by Labrador Retrievers and when they were accompanied by vocalisations their efficacy was improved.

A series of experiments examined the behaviour of spectator dogs after they had observed dog-human interactions (Chapter 7). Spectators were able to distinguish between Tug-of-war games won by the dog and those won by the person. However, their behaviour towards the winner and loser was significantly different when the interaction included play signals and was clearly a game, than when the interaction was unsignalled. These findings support General Hypothesis 3 and show that human-dog play signals are the means by which dogs distinguish between play and non-play interactions.

I have summarised my main results within three discrete themes. But how are these concepts linked?

9.3 A conceptual framework

Central to this thesis is the concept of dominance and testing of the commonly asserted "dominance enhancement theory". My findings suggest that this theory is not generally correct; I found no evidence to suggest that dominance dimensions of dog-human relationships are affected by the outcomes of Tug-of-war games. But why not?

Dominance is the "tendency of one member of a dyad to exert itself over priority of access to resources" (as defined in 1.3.2.3). However, this tendency is affected by the resource under dispute; individuals are more likely to exert themselves over a resource they value highly than one of less value (Wickens 1993). Dominance relationships can be altered by the outcome of previous dyadic contests between the two individuals (Gautheraux 1978). Thus, if Tug-of-war games represent a contest for the resource of an object, their outcome would be expected to influence the dominance relationship of the players; this is the idea on which dominance enhancement theory is based. I have shown that during dog-dog play, partners compete for the object with the apparent objective of gaining sole possession (see Experiment 3.4). However, during dog-human play, dogs are much less competitive and interaction with their partner is more important. I suggest that, when playing with people, the important resource is not the object, but human attention.

Since humans provide domestic dogs with food, water and protection, human attention is a vital resource. My studies of the structure of object-oriented play support this idea (Chapter 4). An object held by a person was more interesting to a dog than a object held by a mechanical device, but they did not compete more determinedly for the human-held object. Human presence, and previous rewarding by a person, both increased dogs' interest in an object. These findings all suggest that human attention is highly valued during play.

If interaction with a person is the key resource during dog-human play, the outcome of games in terms of object possession is irrelevant. However, what is more important is which partner instigates the interaction. By initiating play, the dog is exerting itself over access to the key resource - human attention. So a tendency to start play would be a sign, or even a cause, of increased dominance in dog-human relationships. My home-based study strongly supports this prediction. Dogs which were reported to initiate play scored significantly lower for "Amenability", were rated as more dominant, and were more likely to exhibit aggression.

However, for this explanation to be functional, dogs must be able to distinguish between playful and non-playful interspecific competitions. This distinction is achieved via play signals. Human-dog signals communicate to the dog that the interaction is playful, and hence a means to obtain human attention, rather than a non-play competition during which a valuable object and consequently dominance status can be won or lost. Thus, so long as clear, unambiguous play signals are delivered by the person and received by the dog, there are no dominance-related consequences for the winner of object possession games. However, communication can break down. Some commonly used human-dog signals show low success rates (see 6.3) and interactions which follow or incorporate such signals may fail to be perceived as playful by the dog. I suggest there are also some individual dogs which are unable to interpret play signals. Children with behavioural disorders have difficulty in participating in normal Rough-and-tumble play (Humphreys and Smith 1984), and sociometrically rejected children are unable to distinguish play from aggression (Pellegrini 1989), which is possibly a result of their misinterpreting play signals (Humphreys and Smith 1984). A minority of dogs may suffer from a similar communication problem and for them, object possession may assume increased significance.

9.4 Theoretical implications: a function of dog-human play

My evidence suggests that dog-human play does not function in the establishment of dominance relationships. However, it is an extremely common example of the otherwise rare phenomenon of interspecific play. Why is it so common and what is its proximate function?

I make no attempt to implicate the ultimate function of play in the ancestral wolf, nor do I rule out any of the numerous hypothesised functions of play, for, as I have previously highlighted, it is likely that play serves many functions (1.1.2.3). However, before dealing with the practical applications of this study, I briefly speculate on one of the possible proximate functions of dog-human play behaviour.

I propose that play between dogs and owners fulfils a socialising role. A feature of play is often claimed to be the fading of dominance distinctions and apparent lack of conflict (Fagen 1981), and, as I have shown, the outcomes of playful contests have little significance. For these reasons, the players are free to interact without anxiety (Berman 1982) and without conflicting psychological and environmental pressures (Loizos 1966; 1967). These characteristics make play an ideal way by which players can get to know one another. My studies of the effects of familiarity (Appendix 5) illustrate how reiterative play sessions lead to increased contact between dog and human, as the dog becomes more acquainted with its human play partner. So, as King (1954, p.328) states, play serves as "an invitation to establish a more intimate relation".

For dog-human relationships this socialising function is especially important. Both domestic dogs and humans are naturally highly sociable animals. When living in intraspecific groups (in good conditions), a large percentage of the time budgets of both species are devoted to social interaction. When dogs live in human society, social

interactions remain important, but these are primarily interspecific interactions with people. The majority of dog-owner partnerships frequently interact in a multiplicity of ways - but most dog-human relationships are not based upon equality. More commonly the relationship is one of domination and control, and most interactions reflect this state. However, there is one interaction type which is common in the intraspecific repertoires of both humans and dogs, and during which the two partners can interact on a mutualistic basis. This interaction is play.

Play serves as a common language. Whilst many canine behaviour patterns have to be modified to fit human society, and new dog owners need to learn to interact with their pets, in contrast play comes naturally. This is especially true for Rough-and-tumble play. Play appears ahierarchical (Miller 1973): rank orders are ignored (Bertrand 1969) and even reversed (Fox 1972). This freedom to interact without the constraints of non-play interactions is pleasurable. Messent and Serpell (1981, p.15) believe that it is the "non-competitiveness" of dog-human play which makes it attractive to humans, and may even have shaped the choice of species (and, I suggest, individuals) for domestication.

But empirical research has shown that play *is* asymmetrical. Dominance relationships are detectable in the play behaviours of rats, *Rattus norvegicus* (Pellis and Pellis 1991), squirrel monkeys, *Saimiri sciureus* (Biben 1998), human children (Clark *et al.* 1969) and, I have shown, dog-human relationships. This is an apparent contradiction, but it can be explained. The degree of asymmetry is less during play (hence it has escaped detection by some workers), and is merely a reflection of non-play relationships. I think this is unsurprising. Play interactions occur in a stress-free environment and the players act without constraint, so it is only natural that their behaviour should reflect elements of the partners' relationship.

In summary, play serves as a fun, stress-free interaction, which aids the establishment and maintenance of dog-human relationships. I have considered a plausible function of dog-human play, but what is its practical value, and how can my findings be applied to the general dog-owning community?

9.5 Practical applications: the value of dog-human play

9.5.1 The importance of empirical research

This study has highlighted the importance of empirical research in investigating commonly believed, yet scientifically unfounded theories. Husbandry, training and behavioural therapy of dogs revolves around many unproven ideas and techniques. In this thesis I have challenged and tested a number of these.

In particular I have examined the common ideas that Tug-of-war (Anderson and Foster 1988) and Rough-and-tumble (O'Farrell 1992) games can cause problems in dog-human relationships and should be avoided (Beaver 1982; M°Bride 1995). Additionally, I have explored the claims that sleeping positions (Appleby 1997), toy retention (Rogerson 1992) and interaction initiation (O'Farrell 1992) can have detrimental effects. Of all these, I found support only for the latter claim. Dogs which initiated play scored higher for "Confident interactivity" and were more prone to owner-directed aggression. However, whether dogs won Tug-of-war, had continual access to toys, or slept on their owner's bed appeared to have no damaging effects upon their dog-owner relationship. And I present evidence that the playing of Rough-and-tumble is associated with beneficial effects: reduced Contact seeking and Separation-related behaviour and increased Amenability.

In addition, I explored the frequently stated idea that dog-human play is a substitute for dog-dog play (Whitney 1989; Rogerson 1992; Askew 1996). This too was found to be incorrect. The ideas I have tested represent only a few of the multitude of unsubstantiated claims which abound the popular dog literature. Further scientific research is critical if we are to weed out the fact from the fiction.

The warnings about dog-human play which appear in most dog training and behaviour books may in fact have damaging consequences. Play can provide many benefits to dogs and owners and advice which leads to suppression of play is therefore bad. I now examine some of the possible negative effects of inappropriate recommendations and highlight some of the probable values of dog-human play.

9.5.2 The importance of relaxation

Important characteristics of play which I have highlighted above (9.4) are that the partners are free to interact without anxiety and conflicting pressures (Loizos 1966; 1967; Berman 1982). When asked about the benefits of play, dog owners frequently mentioned that play is relaxing and reduces stress (2.3.3.4). This suggests that when playing with their dog they were free from anxiety and pressures. However, once an owner is warned of the apparent dangers of inappropriate play, their behaviour is likely to change. They may be more constrained, self conscious and consequently achieve less relaxation and corresponding health benefits.

9.5.3 Manipulating the game spoils the fun

Another feature of play behaviour, commonly described by scientists, is the decreased asymmetry between the partners relative to non-play interactions (Bekoff and Byers 1981; Fagen 1981). During play, role reversals are frequent and dominant animals generally "self-handicap"; they allow their subordinate partner to win a proportion of the games (Aldis 1975; Biben 1998). This functions to retain the subordinate animal's interest in playing (Brownlee 1954), a phenomenon familiar to any human parent playing with their child. Part of the attraction of playing is believed to be having the opportunity to win, and the feeling of "empowerment" which accompanies winning (Biben 1998). Repeatedly losing is no fun.

When games are controlled, as dog-human Tug-of-war is advised to be (O'Farrell 1992), self-handicapping no longer takes place. Owners are recommended to win games, and hence their dogs become perpetual losers. In my experimental study, when Golden Retrievers were made to lose at Tug-of-war, they became less involved in playing and subsequently scored lower for "Playful attention seeking" than when they were allowed to win. When denied the opportunity to win, a dog's motivation to play is reduced. Given the potential value of play, (as discussed below) this can be a great loss. Additionally, Thompson (1996) observed sable antelope, *Hippotragus niger* which lost playfights, to often become aggressive. The potential for dogs which are continually forced to lose, to grow frustrated and ultimately aggressive is an interesting concept which to my knowledge has not been considered.

9.5.4 Play as a window on relationships

Studies of intraspecific play of several species (*e.g.* squirrel monkey: Biben 1998; rat: Pellis and Pellis 1992; 1993), and my studies of dog-human interactions, suggest that relationship dimensions are reflected in aspects of play behaviour. For example, dogs which scored high for Interactivity during a play session with their owner were likely to also score highly on "Preference for unfamiliar person" during the Attachment test. Similarly, dogs which were highly Involved in playing with their owner and Determined during Tug-of-war (8.3.4.3), were likely to score high for "Confident interactivity" in the Dominance test (8.3.5.4).

I think there is potential to use play behaviour as an insight into a dog-human relationship. Just as intraspecific play levels are used as an indicator of good welfare conditions (*e.g.* Jensen *et al.* 1998), quality of play could be used as an indicator of healthy dog-human relationships. This idea is supported by a small study by Koda (1997). He analysed the play behaviour of five potential Guide dogs with their volunteer puppy walkers and compared this to their future success at Guide dog training. The one dog which was rejected had played more Tug-of-war and destroyed more objects than the

other dogs. Contrastingly, the dog which was selected as a Guide dog dam possessed the toy gently and for longer during play. This study is small and uncontrolled, but supports the concept of using play as an indicator of important aspects of dog-human behaviour.

9.5.5 The comforting touch

When focal sampling dog walking locations (3.2), I observed that men were more likely to play with their dogs than were women, but this difference was not statistically significant. I also observed a gender difference in my home-based study (see Chapter 8); male owners were significantly more likely to play Rough-and-tumble than were women. Males of many animals species more frequently engage in play, especially playfighting, than do their female counterparts (*e.g* rats: Meaney and Stewart 1981; ponies, *Equus caballus*: Crowell-Davis *et al.* 1987; human children: Boulton 1996). This sex difference is often used as evidence for a practice function of play. In the case of dog-human play, Katcher (1981) believes that the majority of men find it difficult to express or receive contact and affection in public situations and so playing with a dog provides them with a comforting touch. Although a strict sex distinction may be inappropriate, it is fair to say that for people who find intraspecific physical contact difficult, the comforting touch of playing with an animal may be particularly beneficial.

9.5.6 Play for human children

The importance of play for human children is widely acknowledged by educationalists and psychologists. A common factor in the history of drunk drivers and mass murderers is abnormal and insufficient play (Brown 1998), and children who play Rough-and-tumble frequently, tend to be more sociable and less aggressive (Blurton Jones 1972). As the number of children in households has recently decreased, pet-oriented play has a potentially important role for single children (Mugford 1980), although obviously dogs of appropriate temperaments would need to be selected and play sessions supervised.

9.5.7 The rewarding nature of play

Play is rewarding, possibly due to the pleasure (or Motivationally Affective State: Fraser and Duncan 1998) which accompanies it. Rats will learn instrumental responses (Panksepp *et al.* 1984) and will reverse their place preferences in a T maze (Calcagnetti and Schechter 1992) for the opportunity to play. Dog-human play can similarly be used as a motivator or reward during training (Fisher 1992; Rogerson 1992), which further emphasises the importance of maintaining a dog's enthusiasm for play.

9.5.8 Possible advice for dog owners

On the basis of my findings, it seems that the recommendations to avoid certain game types and manipulate game outcomes are unnecessary for the average dog-owner partnership. I suggest that more appropriate advice to owners may be to spend time developing unambiguous human-dog play signals. Although humans and dogs show similarities in their intraspecific play signalling (Blurton Jones 1967) which probably predispose them to be able to play together, there is still potential to improve the efficiency of interspecific communication. By using actions exclusively within the context of play, owners can teach their dogs new play signals (pers. obs.). The subsequent use of these signals will ensure that play sessions do not have serious consequences but remain a source of invaluable interaction.

9.5.9 Concluding comments

In conclusion, I agree with Messent and Serpell (1981, p.15) that "*the non-competitive qualities of pet oriented play provide an absorbing and harmless form of recreation for human beings of all ages*", and I suggest that the experience is absorbing, harmless and beneficial for the canine partner as well.

9.6 Future work

The topic of dog-human play has previously received very little rigorous study. For this reason I chose to investigate a wide range of concepts rather than concentrate on a single theme. Consequently, I have identified a number of areas which would benefit from further investigation and I shall now outline a few of these.

9.6.1 Breed types

Several of the studies in this thesis have involved mixed-breed samples of dog-owner partnerships. However, for the experimental studies, I decided to concentrate upon two breeds - Labradors and Golden Retrievers. There were good reasons for this choice (1.5.2.1), but the selection of two gundog breeds also has limitations. Different breed types have been selected for varying purposes and their behavioural traits differ significantly (Hart and Hart 1985; Bradshaw *et al.* 1996). Thus, I cannot assume that all my findings would have been identical had I selected, for example, terriers or a working breed as my subjects.

In my home-based study (Chapter 8), I showed that different breed types are predisposed towards certain traits in their relationship with their owners. For example, toy breeds were generally very Amenable, whilst utility breeds were the least Amenable breed type. I also presented some evidence that breed types with different Amenability tendencies were differentially affected by the way they played with their owners (8.3.6). However, I also identified some factors, such as play initiation, which exerted a significant effect upon the entire sample of 17 different breeds. This suggests that although there may be some inter-breed variability and the strong temperamental predispositions of some breeds may mask more subtle effects, there are also universal effects common to all breed types.

However, I feel it is crucial that similar studies, in particular experimental investigations into the effects of play, are carried out using dogs of other breed types. Only then, will it be possible to conclude whether the principles identified in this study are universally applicable to all breeds of dog.

9.6.2 Why is Rough-and-tumble play important?

My results suggest that Rough-and-tumble play may have beneficial effects for dog-human partnerships. However, I have not examined the mechanism by which this occurs. There are two factors which I suggest may be important.

Firstly, Rough-and-tumble is unusual amongst dog-human games, in that it is common to the intraspecific play repertoires of both dogs (Bekoff 1974) and humans (Fry 1990). The benefits of stress-free interactions described above (9.4), may therefore be enhanced during this game type.

Secondly, I have shown that non-object play, of which Rough-and-tumble is an example, involves increased levels of physical contact between the players, relative to object-oriented games (4.2). A trade-off between contact and play has been demonstrated in rats; following restricted social contact, they showed increased levels of play behaviour (Ikemoto and Panksepp 1992). Touch is a very important element of the dog-human relationship (Katcher 1981), so the contact which Rough-and-tumble provides may explain the decreased levels of Contact-seeking (Experiment 5.4) and Separation-related behaviour (Chapter 8) associated with this game type. Dogs denied Rough-and-tumble play may exhibit increased levels of Contact seeking and Separation-related behaviour in an attempt to obtain contact with humans. Correspondingly, dogs which obtain the human contact they require via Rough-and-tumble play no longer need to seek it and therefore exhibit lower levels of Contact seeking and Separation-related behaviour. These ideas would explain my results, but they are tentative and require systematic study.

9.6.3 Social learning experiments

The experiments presented in Chapter 7 utilise the process of social learning in order to answer questions about dogs' perceptions of dog-human play. I showed that a spectator dog could distinguish between the outcomes of games which it observed, and demonstrated the metacommunicative role of play signals. I suggest that this technique of analysing a spectator animal's behaviour may have great potential for furthering our understanding of dog-human behaviour. Similar studies could be carried out to look at a variety of interaction types as well as play, and to discover the potential importance of social learning within dog-dog and dog-human social groups.

9.6.4 The role of play for young dogs

All the studies presented here have been limited to older dogs; the home-based studies used dogs of at least 18 months of age, and the experimental studies used animals of six months or over. Play differs in form (West 1974; Gomendio 1988) and possibly function (Beach 1945) according to the age of the animal. It is feasible that play has different consequences for puppies than it does for adult dogs. This is why my studies concentrated on adult and sub-adult subjects, but comparative studies using puppies may prove interesting.

9.6.5 Testing dog-human relationships

I have developed tests for quantifying aspects of dog-human relationships. Previous dog behaviour tests have concentrated on measuring behavioural tendencies, for use in re-homing establishments (Wickens *et al.* 1995; van der Borg *et al.* 1991; McPherson 1998), and for temperament testing young puppies (Campbell 1972; Young 1988; Beaudet *et al.* 1994; McPherson 1998). My tests were designed specifically to look at dominance and attachment dimensions of established dog-human relationships. The tests appear to function well, both in an experimental setting when testing relationships between Labradors and Golden Retrievers and an experimenter, and also, with modification, in a

home-setting when assessing dog-owner relationships of a variety of breeds. I used these tests as tools for a specific purpose, but they could prove very useful in subsequent behavioural work, for assessing the effects of varying treatments and therapies on dog-human relationships. Therefore, it would be useful to further develop the tests, and to assess them for intra- and inter-observer reliability and validity.

9.6.6 Which factors affect dog-human relationships?

My results suggest that play between dog and owner is not a primary determinant of their dominance relationship; so what is? I suggest that there are a great many contributing factors, such as breed type, predispositions of individual dogs, the owner's general attitude and the cumulative effect of numerous non-play interactions. O'Farrell (1997) demonstrated that owner attitude affected the incidence of dog behavioural problems. It is likely that an owners' attitude influences many aspects of their behaviour towards their dog, which in turn affect the dog's relationship with them. Further testing of dog-human relationships and exploration of ownership styles may allow determination of which of these factors are important.

9.6.7 Exceptional cases

It has been apparent throughout this thesis that there is a wide variability between individual dogs and, indeed, individual dog-owner relationships. As Bekoff (1977, p.719) said, with reference to coyotes, *"variability is the rule not the exception"*. This natural diversity makes experimental study of dog behaviour problematic in that statistical significance is difficult to achieve. For example, when I rewarded play behaviour (Experiment 4.5), four of the five subjects attained high levels of play, whereas one individual failed to respond to the reinforcement. Since all dogs were Labradors, raised and housed at the Waltham Centre, one may ask why this individual was different to the other four. I believe there is much to be learnt from such exceptions, as case studies of deviant animals may tell us a lot about normal behaviour. This is especially true with

respect to the effects of play. I have proposed that there are some dogs which are unable to distinguish play from non-play interactions - the canine equivalent of the sociometrically rejected children identified by Pellegrini (1989). Identification and empirical study of these individuals, may reveal much about the processes used by the majority of "normal" dogs.

9.6.8 The clinical population

Many of the theories about the potential effects of dog-human play are propagated by companion-animal behaviour counsellors. The counsellor's role is primarily in the correction of behavioural problems of animals whose relationship with their owner is unsatisfactory. These are a minority of the domestic dog population, and therefore, the dogs which counsellors encounter may not be representative. It is possible that the case studies on which many theories are founded involve a disproportionate number of the "exceptional cases" described above (9.6.7). Whilst studies of deviant individuals can be useful, such cases are, by definition, not the norm. Thus ideas about dog training and behavioural modification, whilst appropriate to the clinical population, may have little relevance, and even detrimental consequences, for the majority of non-problem dog-human partnerships.

I conclude with the words of Grand (1983, p.700):

> ***"Clearly whatever it is or is not, play is a complicated behavioural expression"***

which evidently warrants much further scientific attention.

Housing and husbandry of dogs housed at the Waltham Centre for Pet Care and Nutrition [1]

Housing

Design

The Waltham Centre is designed to provide a ring of linked, but separate, single storey petcare buildings around which personnel and visitors can move and see both the inside and outside of the buildings with no inaccessible areas.

The study dogs were housed primarily in the three main dogcare buildings. Each building houses between 30 and 60 dogs and consists of two or three kennel wings around a central services area (Figure A1.1). Each wing is of octagonal design; the central octagon is a top-lit court. This is surrounded by up to seven octagons, each of which is divided into two dog kennels. The building is surrounded by grass and/or paved exercise areas.

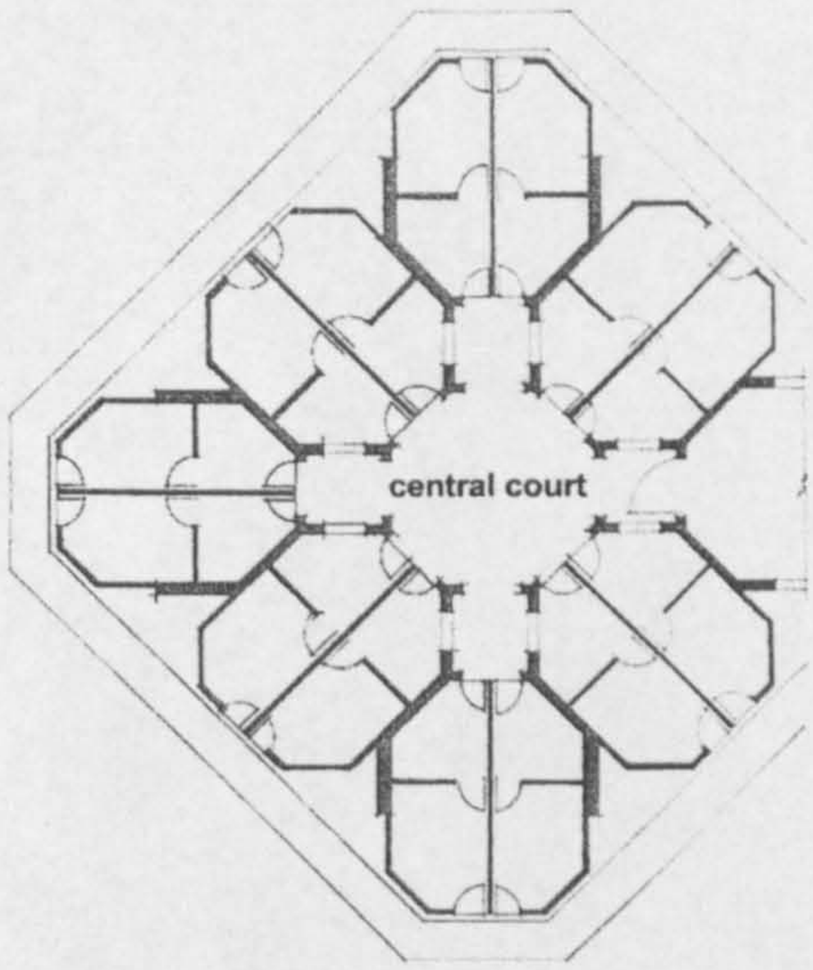


Figure A1.1 Typical kennel wing

[1]Information extracted from Loveridge (1998) or obtained from Healey (pers. comm.)

The octagonal design provides flexibility and a compact configuration with maximum work areas, minimum travelling distances and environmental enrichment for the dogs. The kennels all face inwards allowing dogs to hear, see and smell other dogs and to observe human activity, thereby maximising sensory stimulation.

Each dog kennel consists of an inner eating and sleeping area, with a raised under-heated bed and a covered outer exercise area to which the dogs have 24 hour access, whatever the weather (Figure A1.2). The inner and outer areas are separated by a door in which there is a transparent dog flap, so the dog always has a choice of inside or outside. From the outer part the dog can observe the activities in the exercise areas, and movement in the glass windowed corridors linking the buildings. Where appropriate inner pen doors are low enough to allow the dogs to be petted from the central court, thereby maximising human-dog interaction. The floors and lower walls are covered in an epoxy cement material. There are three pen sizes:

7.5 m^2 for small breeds,

9.5 m^2 for medium breeds,

19 m^2 for giant breeds.

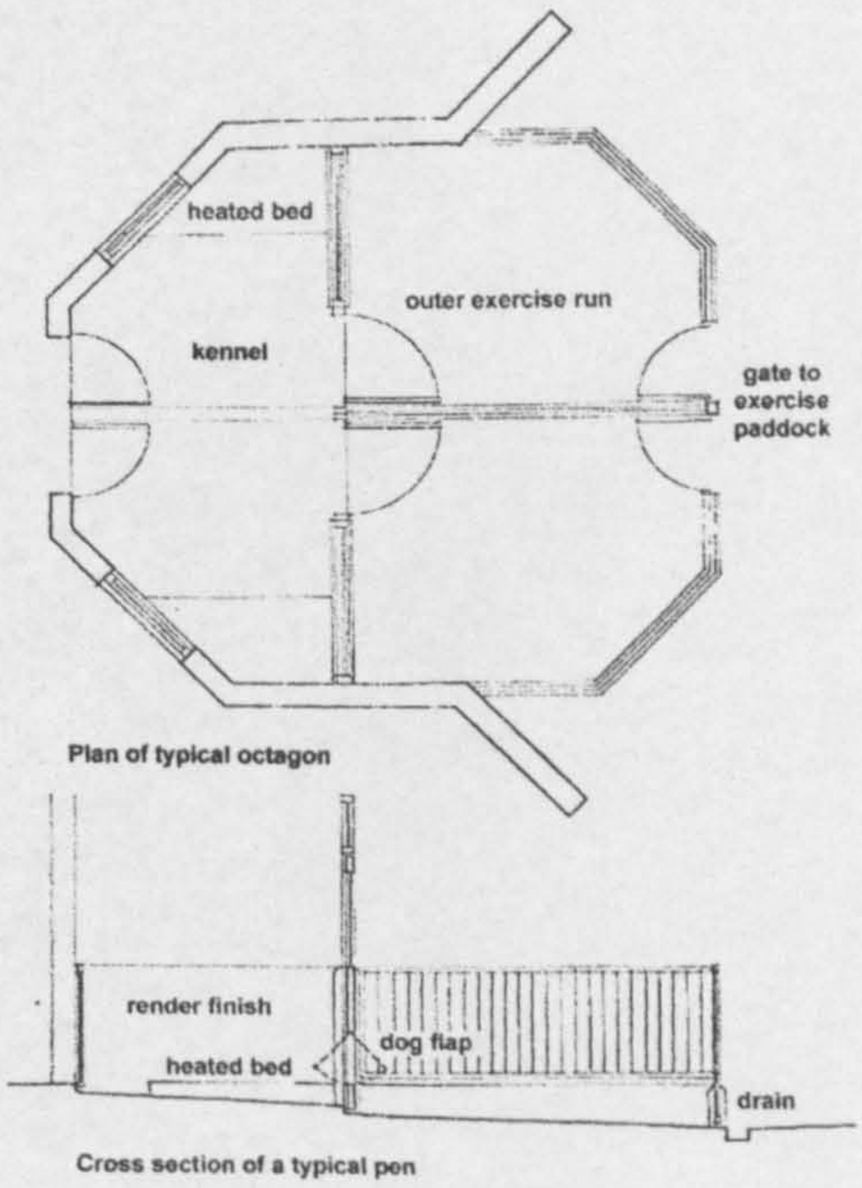


Figure A1.2 Typical pen layout

Services

The buildings are heated by warm air systems that maintain a pressure gradient towards the outside providing ten to twelve air changes per hour. Air is vented out through the dog flaps in each pen door. The temperature is maintained between 18 and 24°C.

The building design incorporates large areas of glass that allow maximum natural light in all kennels and central areas. Artificial light is provided mainly by fluorescent strip lights controlled automatically by time clocks, giving approximately twelve hours of light per day. All pens have automatically controlled water bowls that provide a continuous supply of a small quantity of fresh mains water.

Husbandry

Penning

Dogs are housed in pairs whenever possible. Stud dogs and dogs on digestibility trials where faeces are collected, are housed individually and are given more stimulation through group exercise when not on collection and increased human contact via lead walking and training.

Cleaning

Faeces are monitored and removed from the kennels as early as possible each morning and throughout the day. Pens are thoroughly cleaned each morning.

Bedding

In addition to an under-floor heated bed, each dog is provided with removable bedding. The type depends upon the requirements and preferences of the individual dog, but most are fleecy, soft beds.

Feeding

Dogs are fed on commercially prepared foods designed for optimal adult dog maintenance. Foods can be wet or dry dependent upon the current trial. Quantities are calculated for each individual dogs taking into account weight, age and condition. Adult dogs are fed once per day at approximately 11am. Younger dogs are fed more frequently as appropriate to their current life stage and breed.

Health care

The condition of each dog is monitored closely with full health checks and weighings weekly. Twenty four hour veterinary care is provided. Dogs are all groomed and bathed on a regular basis.

Contact with other dogs

From birth to 8 weeks, litters are housed together, thereafter dogs are housed in pairs. In addition to their kennel-mate, dogs are socialised with many other dogs. Each dogcare building is ringed by grass or paved paddocks where all dogs receive daily group exercise and socialisation. Each dog spends an average of four hours per day, in a paddock with several familiar dogs. Additionally, when lead-walked, and during training sessions, adult dogs are allowed to socialise with dogs they are not housed with.

Contact with humans

A regular program of socialisation begins following the birth of a puppy and continues for life. Human contact is provided in a number of ways including regular husbandry care: feeding, weighing, grooming, clipping, health checks and exercise. In addition all dogs receive dedicated social contact time of at least 20 minutes per day. This takes the form of either lead-walking or supervised group sessions in the paddocks.

Carers spend time in the paddocks playing with the dogs and a variety of toys are provided including balls, hard chews, ropes and pulls. The toys are varied on a regular basis to give variety and novelty. During the summer, water baths and pools are provided.

Group socialisation sessions take place approximately four times per week and last, on average, 20 minutes. In addition all dogs are lead walked at least once every two days. Lead walking is restricted to the grounds of WCPN to ensure that no contact with outside dogs occurs.

Training

Although dogs are lead-walked and group-exercised by a number of carers, each dog is also assigned a specific handler who is responsible for its training. This system ensures that dogs' individual needs are met and human contact is maximised, yet it also allows for bonding between dogs and their handlers.

Trained handlers run daily dog training classes. Each dog undergoes a continual basic obedience training programme with its own handler. The dogs learn to perform a variety of behaviours to command, including: to sit, to lie down, to walk to heel (on and off the lead) and to stay. Training takes place in grass and paved areas adjacent to the buildings and indoors during extreme weather. In addition, more general training is carried out within the animals' housing on an continual basis. The training programme is designed to ensure control of the dog both inside the accommodation and while at exercise, as well as providing physical and mental simulation for both dogs and handlers. All training is based upon positive reinforcement using praise and reward.

Game type definitions

Fetch:	object is repeatedly thrown by person and retrieved by dog
Rough-and-tumble:	partners wrestle, involving no focal object, and high levels of contact between the players
Tug of war:	two partners simultaneously pull upon a single object, each apparently aiming to gain sole possession
Chase:	partners reciprocally chase and run away from one another
Hide-and-seek:	person hides from dog and encourages it to find them
Keep-away:	one player possesses object, and tries to retain it often whilst enticing their partner to pursue (usually part of un-retrieved Fetch)
Object competition:	partners both attempt to gain sole possession of a single object, but not via tugging
Football:	object is kicked by person, and retrieved or competed for by dog
Search:	person hides object from dog and entices dog to find it

Tricks:	person entices dog to perform command driven tasks, often using rewards
Signalling:	players interact via facial expressions and/or vocalisations, without physical contact or the use of an object
Hand movements:	person uses their hands to interest the dog usually by simulating the movement of an insect or other animal; usually involves no contact and no object

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DOG-OWNER PLAY

I am a postgraduate student at the University of Southampton, conducting a three year study of the play behaviour of the domestic dog. As part of my work, I am looking at the ways in which owners play with their dogs.

This is a questionnaire designed for owners of a single dog. If you fall into that category, I would be most grateful if you could spare the time to answer the questions overleaf. There are no right and wrong answers so please feel free to give your honest opinions and to answer in your own words.

Please return the completed questionnaire in the pre-paid envelope enclosed.
Thank you for your help.

QUESTIONNAIRE FOR ONE-DOG OWNERS

OWNER DETAILS

Sex of owner Male ☐ Female ☐

Age class <25 ☐ 25-40 ☐ 40-60 ☐ 60+☐

DOG DETAILS

1) What sex is your dog Male ☐ Female ☐

Is it neutered / spayed? Yes ☐ No ☐

2) What breed is your dog? .....

3) How old is your dog? .....

4) How old was the dog when you acquired it? .....

5) How many people live with you and the dog? .....

6) Do have any other pets? If so please give details .....

.....

7) Who do you think the dog is most attached to? .....

8) On a rating scale of 1-5 how attached would you say the dog is to you?

(please tick the box which is most appropriate)

1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐

not attached very attached

9) Has your dog ever showed any aggression towards you ? ❒ Yes ❒ No

If yes, when did it occur and what form did the aggression take?

.....

10) Do you ever play games with your dog which do **NOT** involve any toys or objects? ❒ Yes ❒ No

If yes, approximately how often?.....

Please fill in the table to describe any such games.

Type of game	What the dog does	What you do	Where you play
.....	.....	.....	.....
.....	.....	.....	.....
.....	.....	.....	.....

11) How often do you usually walk your dog? .....

12) How often do you play with the dog whilst on walks?

Please tick the most appropriate response

- ❒ Always
- ❒ On most walks
- ❒ On approximately half of all walks
- ❒ Occasionally
- ❒ Never

13) Describe in your own words the sort of games you play whilst on walks? Please list in order of most to least frequently played.

Type of game	What you do	What the dog does
.....	.....	.....
.....	.....	.....
.....	.....	.....
.....	.....	.....
.....	.....	.....
.....	.....	.....

14) What objects do you play with whilst on walks?
List in order of the most often to least often used objects.
.....
.....
.....

15) How often do you play with your dog at home (i.e. indoors)?
.....

16) Describe the sort of games which you play with your dog indoors?
List in order of most to least frequently played.

Type of game	What you do	What the dog does
.....	.....	.....
.....	.....	.....
.....	.....	.....
.....	.....	.....
.....	.....	.....
.....	.....	.....

17) What objects do you play with, with your dog, indoors?
List in order, starting with most often played with.
.....
.....

18) What would you consider to be the main reason why you play with your dog?
.....
.....
.....

19) What benefits do you think the dog receives from playing with you?
List in order of importance (beginning with the most important).
.....
.....
.....

20) Do you benefit from playing with your dog? If so it what ways?
List in order of importance (beginning with the most important)

.....

.....

.....

21) Does anyone else play with your dog? If so, who, and how often?

.....

.....

22) Whilst on a walk, how likely is your dog to play with other dogs?

- ☐ extremely likely
- ☐ quite likely
- ☐ equally likely as not
- ☐ not likely
- ☐ it never does

23) When playing with you, what sort of games does your dog like best?

.....

.....

.....

24) When playing with your dog, what sort of games do you like best?

.....

.....

.....

25) On rating scale of 1-5, how playful would you say your dog is?
(Please tick the box which is most appropriate)

1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
not playful				very playful

26) How often does your dog begin the play sessions as opposed to you being responsible for starting them?

- ☐ dog begins game every time we play
- ☐ dog begins game most times we play
- ☐ dog begins game approximately half of the time
- ☐ dog occasionally begins game
- ☐ dog never begins game

27) If your dog starts the game, how do you know that it wants you to play?

.....

.....

28) How often is your dog responsible for ending the play session as opposed to you terminating it?

- ☐ dog ends the game every time we play
- ☐ dog ends the game most times we play
- ☐ dog ends the game approximately half of the time
- ☐ dog the occasionally ends the game
- ☐ dog the never ends the game

29) How do you usually decide that the play session is over?

.....

.....

30) What do you think is a sign of a good play session between you and your dog?

.....

.....

.....

THANK YOU FOR YOUR CO-OPERATION

As part of my study, I shall need to video some owners playing with their dogs, in their own homes. If you feel that you could be of assistance in this way, please could you fill in your name, address and telephone number below, and I shall contact you in the near future.

NAME .....

ADDRESS .....

.....

.....

.....

TEL NO. .....

DOG-HUMAN PLAY ETHOGRAM

Dog

Movements / Postures

WALK	dog moves with slow gait, always retaining one foot in contact with the ground - may be directed towards, away from or circling an object, or towards, away from, circling or alongside a person; may be carrying an object
RUN	dog moves with fast gait, four feet are never simultaneously in contact with the ground - may be directed towards, away from or circling an object, or towards, away from, circling or alongside a person; may be carrying an object ✢ ☆
STAND	dog remains stationary with upright posture and all four paws in contact with the ground
SIT	dog assumes position with front paws and rump in contact with the ground, front legs straight and rear legs bent
LIE	dog assumes horizontal position with back, front or side of abdomen in contact with the ground
GAMBOL	dog moves with a loose bouncy gait, direction of movement changes frequently and movement appears frisky; may be carrying an object

Key to studies in which terms are utilised: Experiment 3.4☆; Experiment 4.2 ♡; Experiment 4.3 ▼; Experiment 4.4 ❖; Experiment 4.5✳; Chapter 6 ✢; Chapter 2 ○

BOUNCE	dog exhibits excited jumping and rearing, usually in anticipation of the throwing of an object
WIGGLE	dog moves with exaggerated tail wag, frequently changing direction and covering a very small area

Actions: non-specific

POUNCE	dog crouches with head held low, then leaps forward and upward rapidly extending its hind legs; may be directed towards object or person
PAW	dog raises paw towards person or object, and may establish contact ✢
HEAD SHAKE	dog rapidly moves head from side to side, often whilst holding object in its mouth
LICK	dog passes tongue over inedible object or part of person
TAIL WAG	dog moves tail from side to side ♡ ❍
LEAP	dog jumps into the air - all four paws leave contact with the ground; may commence from standing or running
REAR	dog stands up on its hind legs, fore-paws may be resting on an object or person ☆ ✢ ✳ ♡ ❍

Key to studies in which terms are utilised: Experiment 3.4☆; Experiment 4.2 ♡; Experiment 4.3 ▼; Experiment 4.4 ❖; Experiment 4.5✳; Chapter 6 ✢; Chapter 2 ❍

ROLL OVER	dog turns over on the ground, the body remaining in contact with the ground
IRRELEVANT	dog performs an action apparently unrelated to play *e.g.* chews grass, urinates

Actions: Person-oriented

CONTACT	dog touches person with part of their body ✢
BOW	dog assumes a posture with lowered forequarters and outstretched front legs ✢ ☆❖
WATCH	dog orientates toward person with eyes following their movement
MOUTH PERSON	dog places a part of the person or their clothing in its mouth and repeatedly opens and closes its jaws around it
VOCALISE	dogs makes an oral noise ☆ ✳ ✢ ♡ ○ This category can be divided into three types:
BARK	dog utters a sharp explosive vocalisation
GROWL	dog makes a guttural sound
OTHER VOCALISE	dog makes oral sound other than bark or growl, *e.g.* whine

Key to studies in which terms are utilised: Experiment 3.4☆; Experiment 4.2 ♡;
Experiment 4.3 ▼; Experiment 4.4 ❖; Experiment 4.5✳; Chapter 6 ✢; Chapter 2 ○

Actions: object-oriented

PICK UP OBJECT	dog gains possession of stationary object
HOLD OBJECT	dog retains possession of object
DROP OBJECT	dog releases object
TUG OBJECT	dog pulls jerkily on object which is simultaneously held by person or mechanical device☆ ✳▼ ❖
SHAKE OBJECT	dog moves head from side to side whilst holding object between its teeth ☆
WATCH	dog orientates towards object with eyes following the movement of object ☆ ✳ ▼ ❖
CATCH OBJECT	dog gains possession of object, intercepting it while it is still in the air
CHASE OBJECT	dog moves in same direction as moving object, without contact☆ ▼ ❖
HOLD CHASE	dog moves in direction of moving object whilst staying in contact with it. The object is held by a stationary play partner ☆▼ ❖
CHEW OBJECT	dog places object in its mouth, repeatedly opening and closing its jaws around it ✳ ☆

Key to studies in which terms are utilised: Experiment 3.4☆; Experiment 4.2 ♡; Experiment 4.3 ▼; Experiment 4.4 ❖; Experiment 4.5✳; Chapter 6 ✢; Chapter 2 ○

DEVOUR OBJECT	dog chews a part of an object it has previously (during play) detached ✳
STAND OVER	dog assumes a position with torso over the object
CONTACT OBJECT	dog touches object without taking hold ▼ ❖ ♡
OBJECT HUNT	dog appears to actively search for object (usually sniffing as well as using visual cues)
MUTUAL RUN	dog moves in same direction as partner whilst both simultaneously holding the toy - no tugging is apparent☆

Key to studies in which terms are utilised: Experiment 3.4☆; Experiment 4.2 ♡;
Experiment 4.3 ▼; Experiment 4.4 ❖; Experiment 4.5✳; Chapter 6 ✢; Chapter 2 ○

Human

Movement / Posture

WALK	person moves with slow gait, always retaining one foot in contact with the ground - may be directed towards, or away from the object or towards, away from or alongside the dog; may be carrying an object
RUN	person moves with a fast gait, both feet are never simultaneously in contact with the ground - may be directed towards, or away from the object or towards (chase), away from (run-away) or alongside the dog; may be carrying an object ✢
STAND	person stands stationary and upright with both feet in contact with the ground
SIT	person assumes a position on the ground or a chair with weight supported primarily on the rump
CROUCH	person bends their knees to assume a position with their arms and head closer to the ground than when standing, feet remain in contact with the ground
LIE	person assumes horizontal position, with their back, front or side in contact with the ground
CRAWL	person moves with knees and palms of hands in contact with ground

Key to studies in which terms are utilised: Experiment 3.4☆; Experiment 4.2 ♡; Experiment 4.3 ▼; Experiment 4.4 ❖; Experiment 4.5✳; Chapter 6 ✢; Chapter 2 ○

Actions: non-specific

POINT	person points finger in direction of dog or object ✢
VERTICAL BOW	person bends forward and downwards until torso is horizontal and level with waist ✢
BOW	person assumes posture similar to dog bow, palms and knees are in contact with the ground, forequarters are lowered and arms outstretched ✢
PAT FLOOR	person strikes palms of their hands audibly on the ground
STAMP	person places their feet heavily and audibly on to the ground ✢
SHUFFLE FEET	person rapidly moves their feet whilst in a standing or sitting posture ✢
CLAP	person strikes palms of their hands audibly together ▼ ❖ ♡
SLAP THIGH	person audibly strikes their thighs with the palms of their hand ✢
IRRELEVANT	person performs action seemingly irrelevant to play *e.g.* talks to another person, arranges hair.

Key to studies in which terms are utilised: Experiment 3.4☆; Experiment 4.2 ♡;
Experiment 4.3 ▼; Experiment 4.4 ❖; Experiment 4.5✳; Chapter 6 ✢; Chapter 2 ○

Actions: Dog-oriented

PET DOG	person strokes or pats dog ✢
SHOVE DOG	person makes contact with dog's body and pushes it away ✢
SHOO HANDS	person moves hands quickly away from self in a manner mimicking the scattering of corn ✢
GRAB DOG	person lifts dog or pulls it, decreasing the distance between themselves and the dog ✢
EMBRACE DOG	person surrounds dog in their arms
SCRUFF DOG	person shakes or roughly pets dog ✢
TICKLE DOG	person applies repetitive light touches to dog's body, like tickling movements made to human infants ✢
LUNGE	person makes sudden quick movement towards dog ✢
GRAB PAWS	person makes sudden contact with or takes hold of dog's paws ✢
KNEE/KICK	person's foot or knee contacts dog ✢
SIGNAL UP	person taps own chest or makes other gesture, with arms or hands, to entice dog to rear ✢
BLOW DOG	person ejects air from mouth in direction of dog ✢

Key to studies in which terms are utilised: Experiment 3.4☆; Experiment 4.2 ♡; Experiment 4.3 ▼; Experiment 4.4 ❖; Experiment 4.5✳; Chapter 6 ✢; Chapter 2 ○

HIT/TAP DOG	person makes short rapid contact with dog ✢
NUZZLE	person's head makes contact with dog ✢
HAND SPIDER	person moves their hand or fingers simulating the movement of an insect or other creature and trying to interest dog ✢
KISS DOG	person contacts dog with their lips ✢
PICK UP DOG	person lifts dog off the ground ✢
VOCALISE	person makes oral sound ❍ ♡; This category may be divided into 5 types:
WHISPER	person vocalises in a soft quiet tone ✢
ENCOURAGING	person makes high pitched or other vocalisation intended to stimulate the dog ✢
INSTRUCT	person commands dog to perform an action by use of a previously learnt command
GROWL	person imitates dog growl vocalisation ✢
BARK	person imitates dog bark ✢

Key to studies in which terms are utilised: Experiment 3.4☆; Experiment 4.2 ♡;
Experiment 4.3 ▼; Experiment 4.4 ❖; Experiment 4.5✳; Chapter 6 ✢; Chapter 2 ❍

Actions: Object-oriented

PICK UP OBJECT	person gains possession of stationary object
HOLD OBJECT	person retains possession of object
DROP OBJECT	person releases object
THROW OBJECT	person makes object available to the dog by throwing or rolling it
PRETEND THROW	person gestures to throw, but does not let go of object, also known as "fake-out" ✢
KICK OBJECT	person strikes object with their foot making it available to dog
KICK ACTION	person gestures to kick object, but their foot does not make contact
BOUNCE OBJECT	person drops and then re-catches object ✢
TAKE OBJECT	person removes object from dog's possession
TUG OBJECT	person pulls jerkily on object which is simultaneously held by dog
KNOCK OBJECT	person strikes object which is held by dog ✢
HIDE OBJECT	person places object out of view of dog ✢
SHOW OBJECT	person moves object to indicate its position to dog, but maintains possession ✢

Key to studies in which terms are utilised: Experiment 3.4☆; Experiment 4.2 ♡; Experiment 4.3 ▼; Experiment 4.4 ❖; Experiment 4.5✳; Chapter 6 ✢; Chapter 2 ○ A4.10

OBJECT HUNT	person actively searches for object
MANIPULATE OBJECT	person moves object whilst maintaining possession ✢
HIT DOG WITH OBJECT	person moves object to make contact with dog, but retains possession ✢
HIT OBJECT ON FLOOR	person bangs object on the ground whilst retaining possession ✢
SQUEAK TOY	person squashes object to make a squeak noise

Key to studies in which terms are utilised: Experiment 3.4☆; Experiment 4.2 ♡; Experiment 4.3 ▼; Experiment 4.4 ❖; Experiment 4.5✳; Chapter 6 ✢; Chapter 2 ○ A4.11

The effects of familiarity upon the structure of dog-human play

Introduction

Play between dogs and humans shows many characteristic features, but also large inter-dyad variation. One factor contributing to this variation is the degree of familiarity between the play partners. Previous experimental studies have compared the structure of play between familiar (dog-owner) and unfamiliar dog-human partnerships[1] (Mitchell and Thompson 1991b; 1993) and have shown that they differ in a number of ways:

a) Play signalling

Mitchell and Thompson (1991b) observed fewer and more idiosyncratic play enticements between familiar than unfamiliar dog-human partners. A similar trend was observed in vervet monkeys, *Cercopithecus aethiops* (Fedigan 1972; Suomi 1979). Increased familiarity between monkey play partners leads to an increase in the subtlety and a decrease in the number of detectable play signals.

b) Deception

Deception is very common during dog-human play (*e.g.* pretend throws, hiding objects; Mitchell and Thompson 1986; 1991a). There are two conflicting theories as to the effect of familiarity on the incidence of deception:

i) increased knowledge of the partner's responsiveness facilitates deception (Mitchell 1988),

ii) familiarity leads to the eradication of deception (Dawkins and Krebs 1978).

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1 All 23 humans were filmed playing with their own dogs and also a strange dog. Likewise each dog was filmed playing with its owner and also a strange human.

Mitchell and Thompson (1993) found increased deception and more counter-deceptive strategies during the play of familiar than unfamiliar dog-human partnerships which supports Mitchell's (1988) theory.

c) Object-oriented play

When comparing the composition of play, Mitchell and Thompson (1991b) saw that dogs which played with unfamiliar people as well as their owners more frequently engaged in specific object-oriented projects[2], (*e.g.* obtain object and keep object from human) than did dogs which played exclusively with their owner (these differences were generalised to both humans). Correspondingly, humans who were able to sustain play with an unfamiliar dog spent more time in chasing and competing for objects.

These findings indicate that object-oriented play is accessible to unfamiliar play partners. I suggest non-object play is (to a greater extent) a feature of very familiar, and exclusive play partnerships. This is supported by observations that individual jackal-poodle hybrids with a high readiness to play, prefer contact play with a single partner (Wilkomm 1990).

d) Non-object play

Based on the Axelrod and Hamilton's (1981) theory of the evolution of cooperation, Fagen (1984; 1992) made predictions about the effects of familiarity on play behaviour. He predicted that familiarity between partners would lead to increased physical contact (Fagen 1984) and hence wrestle/chase ratios (Fagen 1992). Mitchell and Thompson did not examine the structure of non-object play. However, experiments on young chimpanzees, *Pan troglodytes* show that as Rough-and-tumble play increases in vigour, individuals exhibit increased preferences for contact with a single familiar human partner (Mason 1965).

---

2 "Projects" are defined as "sequences of actions that are repeated in order to calibrate an organism's control over these actions or the actions of the play partner" (Mitchell and Thompson 1991a, p.189)

Objectives

Comparisons of the play of familiar and unfamiliar dog-human partners suggest that familiarity alters the structure of dog-human play, in numerous ways. However, the experimental design used by Mitchell and Thompson means that several questions remain unanswered :

1) Are the differences a result of the dogs' behaviour towards the humans, or simply due to humans reacting differently to their own and strange dogs ?

2) Are the changes in play a result of reiterative play interactions or just increased acquaintance of the partners?

3) Does play structure change due to familiarity of the play partners, or due to the partners' increased exposure to the specific game types being played?

4) Does the wrestle/chase ratio change with repetitive non-object play interactions as Fagen (1984) predicts?

I designed an experiment which aimed to answer these questions. Dog's play behaviour with a single person was examined before and after a play schedule. This allowed the human element to be controlled, and changes in the dog's behaviour identified. Initial acclimatisation meant that all subsequent effects could be attributed to play rather than general familiarity. Examination of the dogs' play with a second person before and after the treatment phase, allowed changes to be ascribed to familiarity with the play partner or with the game types played. In addition to object-oriented games, I examined non-object play specifically.

Method

Design

The experiment followed a within-subjects design. It utilised the subjects and much of the experimental procedure described in Experiment 5.4. The Fetch and Rough-and-

tumble groups were used as these were represented both object-oriented and non-object play.

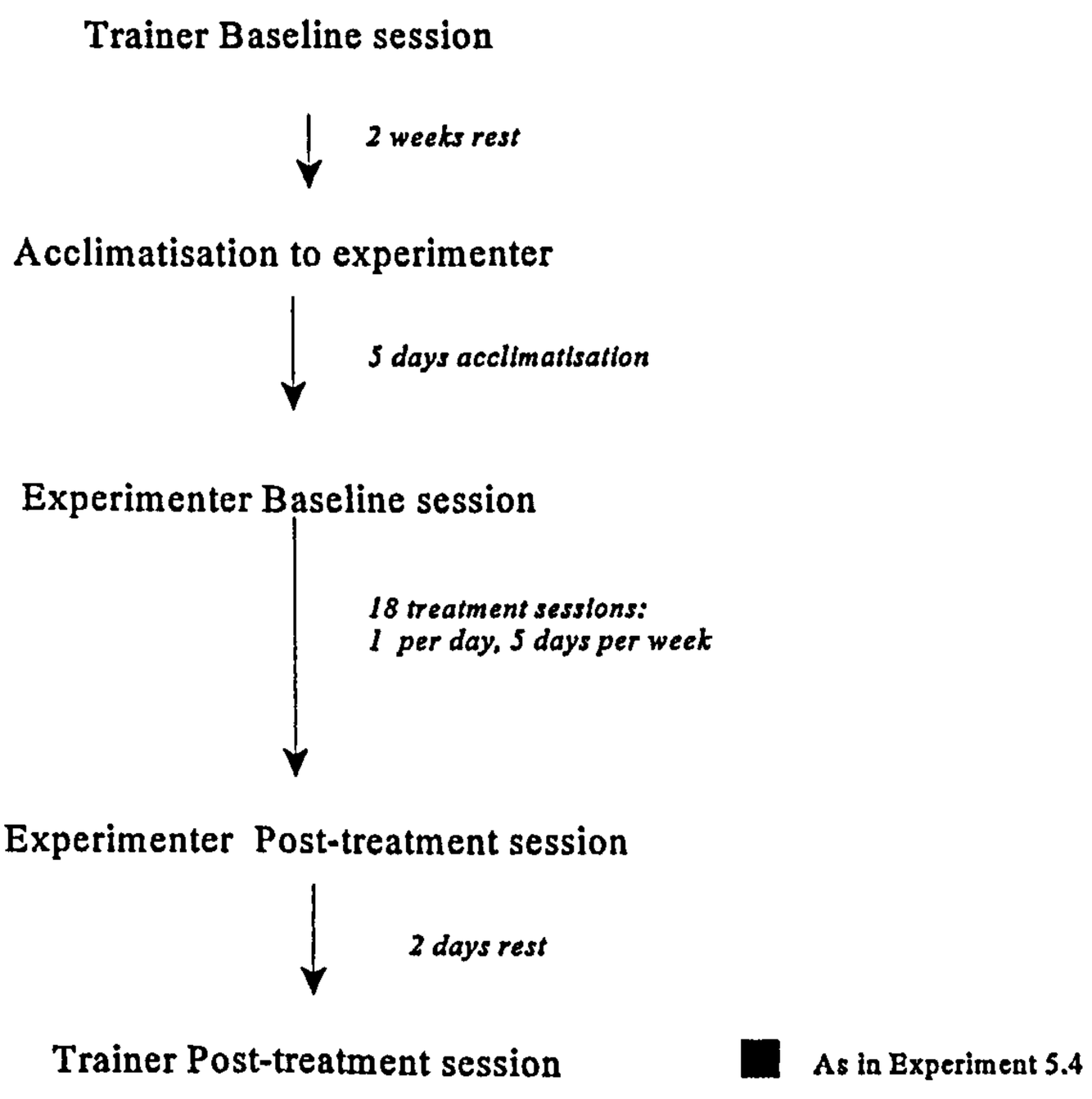
Subjects

The subjects were 18 Labrador Retrievers which constituted experimental groups 1 (Control), 2 (Rough-and-tumble) and 3 (Fetch) in Experiment 5.4. There were four males and 14 females, ranging in age from 7 to 117 months (mean=42 months).

Procedure

The experiment took place over a nine week period and followed the protocol outlined in Figure A5.1.

Figure A5.1 *Outline of experimental protocol for testing the effects of familiarity of partners on dog-human play behaviour*



Trainer baseline sessions

Trainer baseline sessions took place over a two day period during which each subject was filmed playing with its own trainer. The trainers were Waltham dog care staff (see 1.5.2.2) who had responsibility for exercising and training individual dogs and therefore had most one-to-one contact with the subjects. Three trainers were responsible for more than one of the subjects and so there were 15 trainers in total, all of whom were female.

Play sessions took place in a carpeted corridor measuring 20m x 1.5m, which was familiar to all the dogs. The dogs in Groups 1 and 2 played Rough-and-tumble and those in Group 3 played Fetch. The trainers were requested to sustain play for three minutes whilst aiming to:

Rough-and-tumble	- maximise the amount of contact between person and dog, respond to chase invitations from the dog.
Fetch	- retain control of the game via commands, include frequent pretend throws.

The sessions were filmed using a video camera (Philips Explorer VCR) held by the experimenter (myself; female, aged 24 years). For eight weeks following the baseline session, trainers were requested to continue exercising, training and playing with their dogs as usual, but not to introduce any new games. They were also asked to keep a log of all play interactions.

Acclimatisation to experimenter

Two weeks after the trainer baseline session, the subjects began to be acclimatised to the experimenter, and the experimental room. The protocol is detailed in 5.4.3.3 and highlighted in blue in Figure A5.1. Each dog interacted with the experimenter for five minutes per day. For the five day acclimatisation period the interaction took the form of petting.

Experimenter baseline, treatment and post-treatment sessions

For the subsequent four weeks (twenty sessions) the dogs continued to interact with the experimenter for five minutes per day. The Control group (1) continued to be petted, but Groups 2 and 3 received two minutes of petting followed by three minutes of play. Group 2 played Rough-and-tumble and Group 3 played Fetch. The experimenter played in the same way and followed the same instructions as the trainers (outlined above). The first (1) and last (20) sessions were filmed using a tripod-mounted video camera (Philips Explorer VCR) and constituted the experimenter baseline, and post-treatment sessions respectively.

Trainer post-treatment session

Between one and three days after the experimenter post-treatment session, each subject was filmed playing with its trainer for a second time. The procedure was identical to the trainer baseline session.

Behavioural measures

All videoed play sessions (trainer baseline, trainer post-treatment, experimenter baseline and experimenter post-treatment) were scored manually. I measured variables which described the extent to which the aims of the games were achieved, and which preliminary observations suggested were affected by familiarity. For Rough-and-tumble games one variable was measured and for Fetch games two were measured (Table A5.1)

Table A5.1 Behavioural variables measured during baseline and post-treatment play sessions

Game type	Variable name	Description
Rough-and-tumble	Wrestle/chase ratio	Duration dog is in physical contact with human / Duration dog is chasing or running from human
Fetch	Retrieve time	Mean time dog takes to recover ball, bring and surrender it to the human
	Recovery time	Mean time dog takes to re-orientate towards human following a pretend throw

Statistical analysis

The measured variables were not normally distributed and transformations failed to improve their distribution. I therefore used ranked scores in all subsequent analysis.

Paired t-tests compared each dog's scores in the experimenter baseline and post-treatment sessions. For the Fetch group, two t-tests were carried out, one using each of the measured variables (retrieve time and recovery time). For Rough-and-tumble players, wrestle/chase ratios were compared for each dog during the baseline and post-treatment tests. Significant results would indicate the dogs' play behaviour with the experimenter had changed over the experimental period.

Paired t-tests were also performed on the trainer baseline and post-treatment sessions, for all three groups (Control, Rough-and-tumble and Fetch). These identified whether play behaviour with the trainer changed significantly over the experimental period.

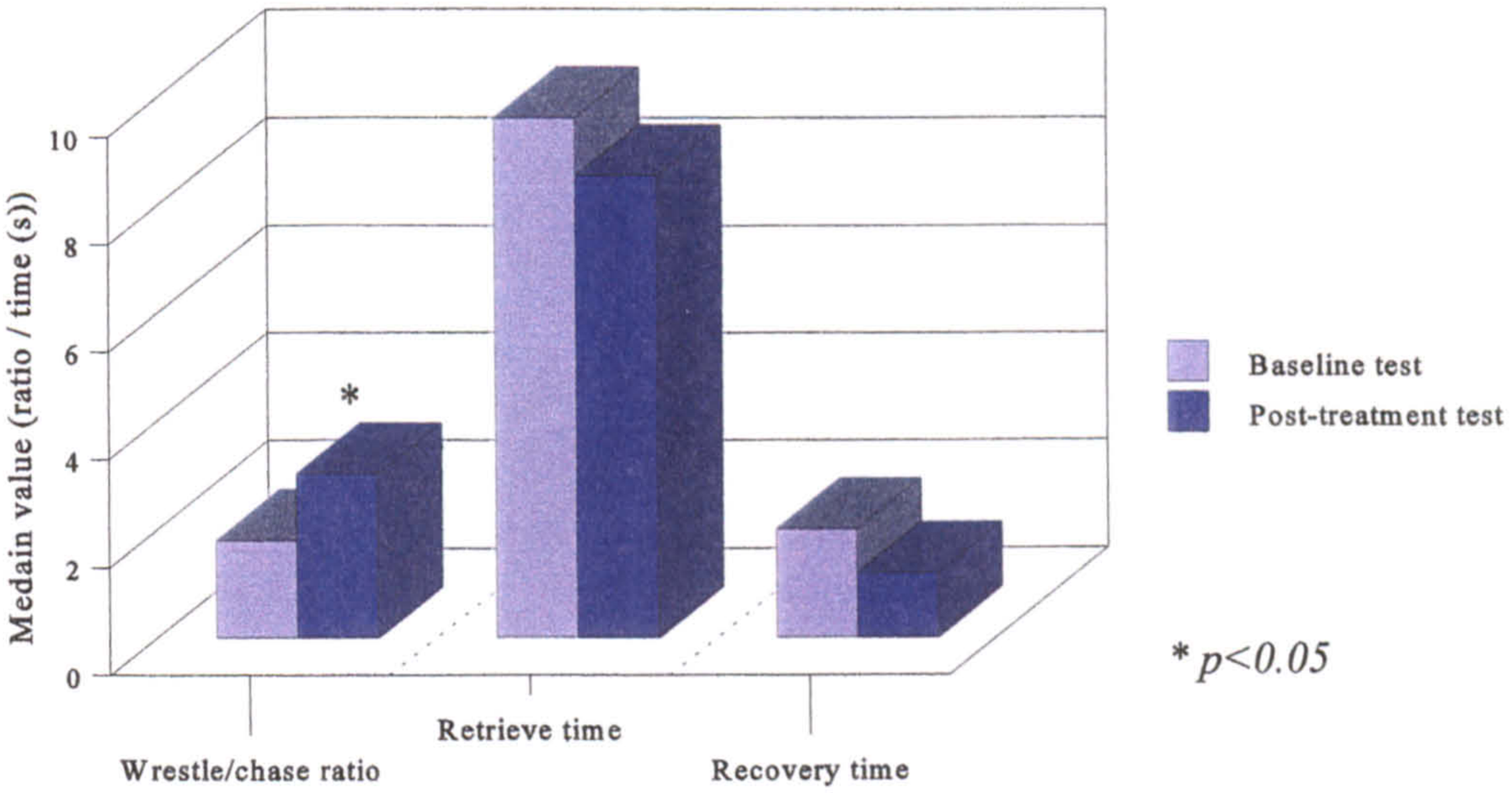
For the two treatment groups Repeated Measures ANOVAs were performed on each of the measured variables. These explored the effect of the two independent variables, player (experimenter or trainer) and session (baseline or post-treatment), and their interaction, upon the measured dependent variables. A significant interaction would indicate that the subjects' play with the experimenter (who delivered the play treatments) changed differently than their play with their trainers.

Results

Play behaviour with the experimenter

The players of Rough-and-tumble showed a significant increase in wrestle/chase ratio, over the experimental period, when playing with the experimenter ($t=2.94$, $d.f.=5$, $p<0.05$; Figure A5.2). Players of Fetch showed a decrease in retrieve time and recovery time, between the experimenter baseline and post-treatment sessions (Figure A5.2), but neither change was statistically significant ($t<1.7$, $d.f.=5$, $p>0.1$).

Figure A5.2 *Changes in play behaviour with the experimenter between baseline and post-treatment sessions in Rough-and-tumble and Fetch groups*



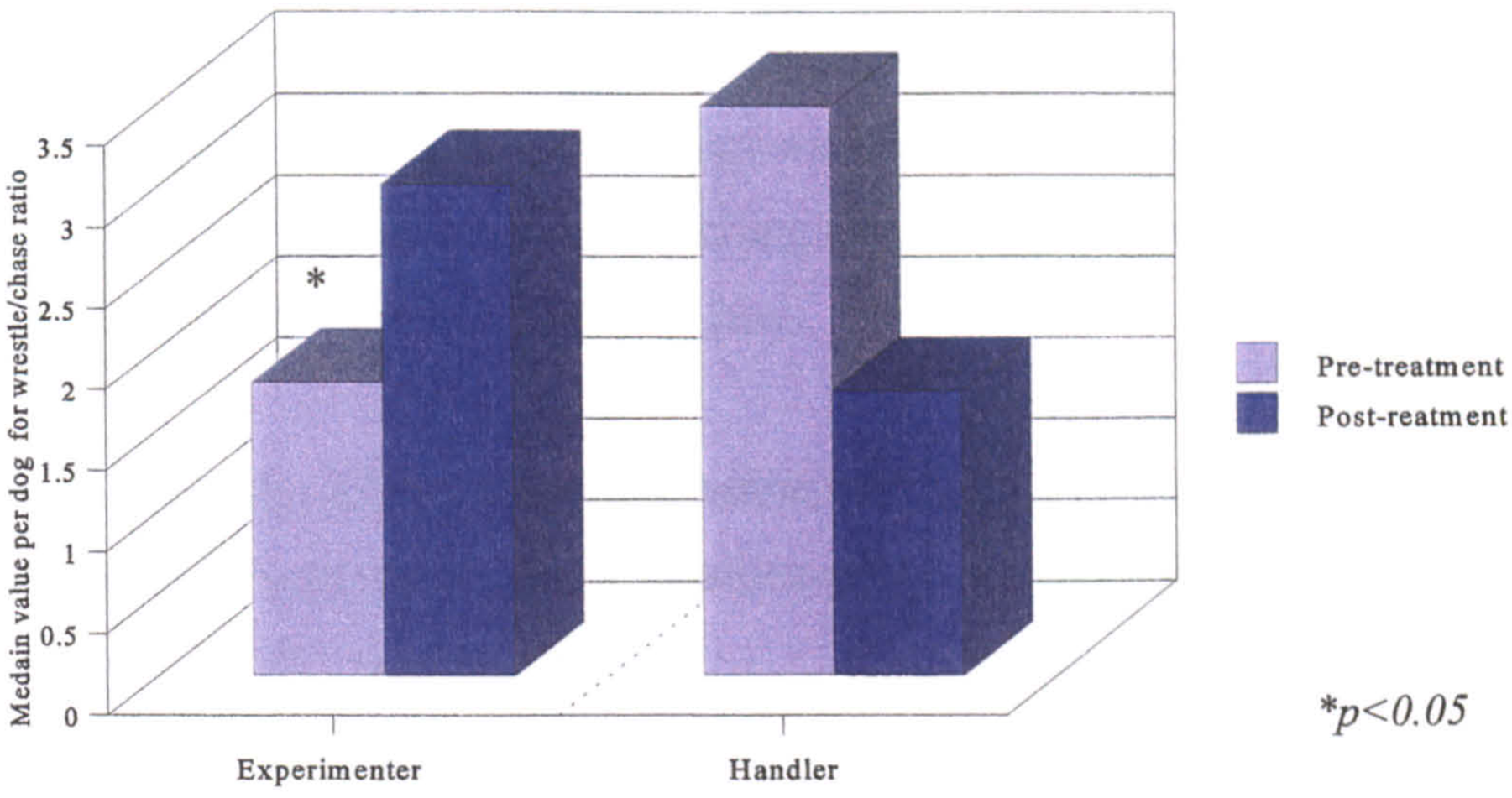
Play behaviour with the trainers

None of the measured variables differed significantly between the baseline and post-treatment handler sessions for any of the groups (Control wrestle/chase ratio: t=0.00, *d.f.*=5, p=1.0; Rough-and-tumble wrestle/chase ratio: t=-0.88, *d.f.*=5, p>0.1; Fetch retrieve time: t=-0.38, *d.f.*=5, p>0.1; recovery time: t=-0.96, *d.f.*=5 p>0.1).

Comparing changes with experimenter and trainer

For Rough-and-tumble players, the wrestle/chase ratio when playing with the experimenter decreased between the baseline and post-treatment sessions. Conversely, when playing with their trainer, the same dogs showed an increase in wrestle/chase ratios between baseline and post-treatment sessions (Figure A5.3). ANOVA showed that the interaction between player (experimenter or handler) and session (baseline or post-treatment) significantly affected the wrestle/chase ratio ($F_{(1,5)}$=6.38, p<0.05). This suggests that the decrease in the ratio was specific to the play partner.

Figure A5.3 Changes in wrestle/chase ratios in Rough-and-tumble group between baseline and post-treatment session, when playing with the experimenter and their handler



The interaction between player and session was non-significant for both of the Fetch variables (retrieve time: $F_{(1,5)}$=0.65, p>0.4; recovery time: $F_{(1,5)}$=0.61, p>0.4).

Discussion

Effects of familiarity on play behaviour

These results confirm the findings of Mitchell and Thompson (1991b; 1993); dog-human play behaviour is affected by the familiarity of the play partners. Players of Rough-and-tumble increased their wrestle/chase ratios with the experimenter, over the treatment period. Since maximising contact was the one of the human's aims for this game type, the subjects can be considered to have improved their efficiency at Rough-and-tumble. Fetch players showed decreases in their mean retrieve times and their time to recover from the experimenter's pretend throws, between the baseline and the post-treatment sessions (but neither decrease was significant). Both these changes represent improved efficiency when playing Fetch. Additionally, the decreased recovery time, indicates that with increased familiarity, the dogs learnt to avoid the human's deceptive pretend throws. Mitchell and Thompson (1993) also observed an increase in counter-deceptive strategies with increased familiarity of play partners.

Object-oriented versus non-object game types

The players of Rough-and-tumble experienced significant changes in their play behaviour between the baseline and post-treatment experimenter sessions, whilst the Fetch players did not. Contact play has high risks associated with its performance, as it can easily degenerate into fighting (Fagen 1984). Rough-and-tumble play involves high levels of physical contact (4.3), and so it is not surprising that it is more sensitive to the effects of familiarity than is low risk object-oriented play.

This difference further highlights the distinction between non-object and object-oriented play (4.2), and indicates that Rough-and-tumble play is a suitable candidate for further examination of the effects of familiarity

Effect of repetitive play interactions

The dogs were acclimatised to the experimenter prior to the experimenter baseline session. Over the treatment period they continued to interact, and therefore increase in familiarity, with their trainers. However, increased wrestle/chase ratios were observed only when playing with the experimenter, not the trainers. I therefore conclude that these changes were due to repetitive meetings in the context of play and not merely general familiarity between dog and human.

Specificity of the effects

Over the experimental period there was an increase in the Rough-and-tumble players' wrestle/chase ratios when playing with the experimenter. This trend was not apparent (it was reversed and non-significant) when the same dogs played with their handlers. This suggests that the increased ratio was specific to the person with whom the dog had repetitively played. Thus, changes in play behaviour can be attributed to a shared play history with the experimenter and not just increased familiarity with Rough-and-tumble games.

Limitations of the experiment

There are a number of sub-optimal factors in the design of this experiment. The sample sizes of six dogs in each group are relatively small. Examination of records of the subject's normal play routines revealed that the subjects regularly played Fetch with their trainers, but that Rough-and-tumble was very rare. Differences in the effects may thus be confounded by the variations in the dogs' familiarity with the two game types.

To confirm that the changes in wrestle/chase ratio were a result of repetitive play and not general familiarity, ideally I would have compared the changes in the Rough-and-tumble group's play with the experimenter to the Control group's play over the same period. However, the subjects and the protocol were concurrently used to investigate the effects of play upon the dogs' relationship with the experimenter (5.4). Their interactions with the experimenter were therefore controlled and it was impossible to perform an experimenter baseline session with the Control group. This dual use of the subjects also meant that the periods between the baseline and post-treatment were not identical for trainer and experimenter sessions.

There was thus some confounding of independent variables and it would also be useful to repeat the experiment with a larger sample. However, the results do increase our knowledge of the effects of familiarity on dog-human play behaviour and shed some light on previously unanswered questions.

Concluding comments

The results of this experiment support the predictions of Fagen (1984) - wrestle/chase ratios increase with familiarity between a dog and its human play partner. I suggest that this change is dependent upon repetitive play encounters, not general familiarity and is due to a shared history with the specific human and not familiarity with a game type played.

Table A6.1 Results of ANOVA for effect of human-held and object-held conditions on behavioural variables (all means are arithmetic)

Variable	Mean for human trials	Mean for object trials	$F_{(1,11)}$	p
Rear frequency	4.19	1.81	2.02	>0.10
Maximum bout length	131.00	26.46	12.89	<0.001
Bout frequency	2.79	1.65	8.28	<0.05
Chase latency	4.74	17.81	2.00	>0.10
Mean bout length	53.12	20.68	3.55	<0.10
Approach frequency	3.29	2.13	4.90	<0.05
Approach latency	0.32	28.66	9.59	<0.05
Time spent close	104.63	47.51	19.64	<0.001
Attention duration	69.19	32.02	9.79	<0.001

Table A6.2 Results of ANOVAs for effect of human presence on behavioural variables (all means are arithmetic)

Variable	Mean for human present trials	Mean for human absent trials	$F_{(1,13)}$	p
Rear frequency	3.04	2.71	1.76	>0.10
Maximum bout length	138.85	74.66	7.83	<0.05
Bout frequency	2.64	1.89	4.32	>0.1
Chase latency	4.53	6.96	0.103	>0.1
Mean bout length	103.63	65.18	2.71	>0.1
Approach frequency	3.04	2.88	7.17	<0.05
Approach latency	5.01	7.62	0.23	>0.1
Time spent close	83.49	60.54	3.97	<0.1
Attention duration	81.69	59.25	13.40	<0.005

Table A7.1 Key variables in Factor 2

Positively loaded variables			*Negatively loaded variables*		
Test component	**Variable name**	**Loading factor**	**Test component**	**Variable name**	**Loading factor**
Shout	Startle /change	0.70	All components	Ears pricked	-0.51
All components	Low body position	0.53	Sit	No. sit responses	-0.49
All components	Gaze aversion	0.44	Eye contact	Stare duration	-0.44
All components	Mouth hand	0.43			
All components	Climb up	0.41			
Call	Approach gait	0.40			

Table A7.2 Key variables in Factor 4

Positively loaded variables			*Negatively loaded variables*		
Test component	**Variable name**	**Loading factor**	**Test component**	**Variable name**	**Loading factor**
Rise	Reapproach gait	0.49	Toy removal	Skirts / block	-0.64
All components	Sit	0.46	Food removal	Feed latency	-0.58
Grooming	Groom stance	0.44	All components	Roll	-0.42
All components	Whimper	0.41	Sit	Orientate away	-0.36
Food removal	Response intensity	0.37	Rise	Rise latency	-0.32
Toy regain	Regain latency				

Table A7.3 Key variables in Factor 6

Positively loaded variables			*Negatively loaded variables*		
Test component	**Variable name**	**Loading factor**	**Test component**	**Variable name**	**Loading factor**
All components	Lick	0.51	Lying	Nuzzle	-0.34
All components	Sit	0.49	Toy removal	Force required	-0.33
Lying	Sit by	0.45	Eye contact	Stare duration	-0.31
Sit	No. sit responses	0.44	Sit	Sit latency	-0.26
Sit	Orientate away	0.39			
All components	Submissive grin	0.33			
All components	Tail movement	0.32			
All components	Display	0.3			
All components	Tail height	0.3			
All components	Roll	0.29			
Rise	Reapproach gait	0.28			
Door entry	Position ahead	0.26			

Table A7.4 Key variables in Factor 7

Positively loaded variables			*Negatively loaded variables*		
Test component	**Variable name**	**Loading factor**	**Test component**	**Variable name**	**Loading factor**
Toy removal	Brings toy	0.49	Toy removal	Force required	-0.55
Call	Approach gait	0.33	Toy removal	Drop latency	-0.52
Approach	Response positivity	0.32	All components	Pant	-0.49
All components	Display	0.32	All components	Sit	-0.38
All components	Growl / moan	0.3			
Food removal	Contact bowl	0.3			
Eye contact	Stare duration	0.29			
Toy regain	Regain latency	0.28			
Forced down	No. comply	0.28			

Table A7.5 Key variables in Factor 9

Positively loaded variables			*Negatively loaded variables*		
Test component	**Variable name**	**Loading factor**	**Test component**	**Variable name**	**Loading factor**
All components	Tail tucked	0.48	All components	Lie	-0.47
All components	Growl / moan	0.41	Toy removal	Brings toy	-0.41
Lying	Nuzzle	0.41	All components	Low body	-0.29
Lying	Sit by	0.34	All components	Display	-0.28
Forced down	Comply latency	0.29	Food removal	Contact bowl	-0.25
Toy removal	Skirts / blocks	0.28			
Forced down	No. comply	0.27			

Table A8.1 Description of the Golden Retriever population in terms of the key variables contributing to Confidence (Dominance Factor 1) - averages are calculated using median values per dog over the three tests

a) variables contributing positively to factor score

Test component	Key variable	Average value	Mean or median	Minimum value	Maximum value	Range
Lying	Stand over torso	0	md	0	3	3
All components	Tail height	1.56	md	0.81	2.66	1.85
All components	Tail movement	6.88	md	1.75	12.5	10.8
Call	Call lag	0.95	md	0.63	3.06	2.44
All components	Climb up	0	md	0	1.67	1.67
Approach	Response positivity	0	md	0	1.5	1.5
All components	Mouth hand	0	md	0	3	3
Shout	Shout approach	0.35	mn	0	1	1
Grooming	Stance height	0.38	md	0	2	2
Lying	Stance height	0.5	md	0	3	3
Door entry	Position ahead	0.23	md	0	1	1
Toy removal	Force required	1.5	md	0	3	3
All components	Maintains contact	0	md	0	1	1

b) variables contributing negatively to factor score

Test component	Key variable	Average value	Mean or median	Minimum value	Maximum value	Range
Toy regain	Regain latency	30	md	0.62	30	29.38
All components	Gaze aversion	1	md	0	7	7
Grooming	Cringe	0.62	mn	0	1	1
All components	Roll	1	md	0	2.5	2.5
Rise	Rise latency	120	md	5.12	120	114.9
All components	Tail tucked	0.5	md	0	2.5	2.5
All components	Display	0.25	md	0	3	3
All components	Lick lips	5	md	1	7	6
All components	Ears low	5.13	md	1.25	8.5	7.3

Abbreviations: Mean - mn, Median - md (mean calculated for 0/1 variables and median for frequency, scale and duration variables)

QUESTIONNAIRE VERBALLY DELIVERED ON HOME VISIT

GENERAL DETAILS

Owner's name .....

Owner's address .....
.....
.....

Owner's tel. no. .....

Dog's name .....

Dog's sex ○ Male ○ Female ○ Neutered ○Entire

Dog's breed .....

Dog's age .....

1) How did you train your dog when you initially obtained it?
   - ○ classes .....wks
   - ○ self
   - ○ none

2) At the moment how much time do you spend on obedience exercises per week?
   - ○ <10mins
   - ○ <10-30mins
   - ○ >30mins

3) How much time do you spend with the dog on an average day?

4) How much time per day do you spend interacting directly with the dog?

GAMES PLAYED

5) How often do you play with your dog?

6) Approximately how much time per week do you spend playing?

7) What are the games that you most often play with your dog?

a) .....
b) .....
c) .....
d) .....
e) .....

8) For each of the game types I mention, please state whether you play them regularly, sometimes or never.

Fetch	O	never
	O	sometimes
	O	regularly
Rough-and-tumble	O	never
	O	sometimes
	O	regularly
Tug-of-war	O	never
	O	sometimes
	O	regularly
Chase with object	O	never
	O	sometimes
	O	regularly

9) What do you think makes a good game of tug-of-war?

- O dog win
- O even
- O intense
- O human win

other.....

10) When starting a game, how do you tell the dog that you want to play?

- O show toy
- O voice change
- O clap
- O posture

other.....

ATTACHMENT BEHAVIOUR

11) Is the dog attached to any one particular person?

- O yes: me
- O yes: other
- O no

12) On a scale of 1-5, how attached do you think the dog is to you?
(5 being the most attached and 1 the least)

1	2	3	4	5

13) Where does the dog sleep?

- O shut in another room
- O other room (not shut in)
- O owner's bedroom
- O owners' bed

14) Does the dog demand attention from you?

- O frequently
- O sometimes
- O no

15) If you are in the house and moving around doing your usual routine would you say that the dog is:

- O always close to you
- O always in the same room as you
- O usually in the same room as you
- O in a chosen room regardless of your whereabouts

16) How does the dog react to being left?

- O well / no response
- O vocalises
- O eliminates
- O destructive

other/ details.....

<u>DOMINANCE BEHAVIOUR</u>

17) Who does the dog obey most readily?

- O me
- O other
- O all

18) How dominant would you say the dog is towards yourself? (5 being the most dominant)

1	2	3	4	5

19) Has the dog ever exhibited aggression towards you?

- O yes
- O no

20) If so what circumstances has it occurred under?

- ○ food
- ○ toy
- ○ space

other / details.....

21) How long ago was the last time the dog was aggressive towards you ?

22) Approximately how many times has this occurred?

23) On a rating scale of 1-7 how satisfied are you with your dog?
(7 being the most satisfied)

1	2	3	4	5	6	7

<u>OTHER OBSERVATIONS/ DETAILS</u>

REFERENCES

Abrantes, R. 1997. *Dog Language: An Encyclopaedia of Canine Behaviour*. Walkan Janka Publisher, Illinois, USA.

Adell-Bath, M., Krook, A., Sanqvist, G. and Skantze, K. 1979. *Do we need dogs? A study of dogs' social significance to man*. University of Gothenburg Press, Gothenburg.

Ainsworth, M.D.S. 1973. The development of infant-mother attachment. In: B.M. Caldwell and H.N. Ricciuti (eds.) *Review of Child Development Research, Vol. 3.* University of Chicago Press, Chicago. pp. 1-94.

Aldis, O. 1975. *Play Fighting.* Academic Press, New York.

Alpers, A. 1965. *A Book of Dolfins.* Houghton Mifflin, Boston.

Altmann, S.A. 1962. Social behaviour in anthropoid primates: analysis of recent concepts. In: E.L. Bliss (ed.) *Roots of Behavior.* Harper and Bros., New York. pp. 277-285.

Anderson, R.K. 1988. Examples of recommendations. In: R.K Anderson and R.J. Holmes (eds.) *Dogs: Companions or Nuisances, Public Seminars* **22.** Werribee Veterinary Clinical Center, Victoria, Australia. pp. 35-51.

Anderson, R.K. and Foster, R.E 1988. Understanding your dog.In: R.K Anderson and R.J. Holmes (eds.) *Dogs: Companions or Nuisances, Public Seminars* **22.** Werribee Veterinary Clinical Center, Victoria, Australia pp. 29-35.

Anon. 1995. International Pet Food Market. *Anthrozoös* **8**(1): 55-56.

Appleby, D. 1997. *Ain't Misbehavin': a Good Behaviour Guide for Family Dogs.* Broadcast Books, Bristol.

Askew, H.R. 1996. *Treatment of Behavioural Problems in Dogs and Cats: a Guide for the Small Animal Veterinarian.* Blackwell, Oxford.

Axelrod, R. and Hamilton, W.D. 1981. The evolution of cooperation. *Science* **211**: 1390-1396.

Bachmann, C. and Kummer, H. 1980. Male assessment of female choice in Hamadryas baboons. *Behavioural Ecology and Sociobiology* **6**: 315-321.

Baldwin, J.D. 1982. The nature-nurture error again. *Behavioural and Brain Sciences* **5**: 155-156.

Baldwin, J.D. and Baldwin, J.I. 1976. Effects of food ecology on social play: a laboratory simulation. *Zeitschrift fur Tierpsychologie* **40**: 1-14.

Barrett, P. and Bateson, P. 1978. The development of play in cats. *Behaviour* **66**: 106-120.

Bateson, G. 1955. A theory of play and fantasy. *Psychiatric Research Reports* **2**: 39-51.

Beach, F.A. 1945. Current concepts in play of animals. *American Naturalist* **79**: 523-541.

Beaudet, R., Chalifoux, A. and Dallaire, A. 1994. Predictive value of activity level and behavioral evaluation of future dominance in puppies. *Applied Animal Behaviour Science* **40**: 273-284.

Beaver, B.V. 1982. Distance-increasing postures of dogs. *Veterinary Medicine: Small Animal Clinic* **77**: 1023-1024.

Bekoff, M. 1972. The development of social interaction, play and metacommunication in mammals: an ethological perspective. *Quarterly Review of Biology* **47**: 412- 433.

Bekoff, M. 1974. Social play and play-soliciting by infant canids. *American Zoologist* **14**: 323-340.

Bekoff, M. 1975. The communication of play intention: Are play signals functional? *Semiotica* **15**: 231-240.

Bekoff, M. 1976. Animal play; problems and perspectives. In: P.P.G. Bateson and P.H. Klopfer (eds.) *Perspectives in Ethology, vol. 2* Plenum Press, New York. pp. 165-188.

Bekoff, M. 1977. Mammalian dispersal and the ontogeny of individual behavioural phenotypes. *American Naturalist* **3**: 715-732.

Bekoff, M. 1982. Functional aspects of play as revealed by structural components and social interaction patterns. *Behavioural and Brain Sciences* **5**: 156-157.

Bekoff, M. 1995. Play signals as punctuation. The structure of social play in canids. *Behaviour* **132**: 419-429.

Bekoff, M. and Allen, C. 1998. Intentional communication and social play: how and why animals negotiate and agree to play. In: M. Bekoff and J.A. Byers (eds.) *Animal Play: Evolutionary, Comparative and Ecological Perspectives.* Cambridge University Press, Cambridge. pp. 97-114.

Bekoff, M. and Byers, J.A. 1981. A critical reanalysis of the ontogeny of mammalian social and locomotor play: an ethological hornet's nest. In: K. Immelmann , G.W. Barlow, L. Petrimovich and M. Main (eds.) *Behavioural Development, The Bielefeld Interdisciplinary Project*. Cambridge University Press, New York. pp. 296-337.

Berman, M. 1980. Early agonistic experience and rank acquisition among free ranging infant rhesus monkeys. *Journal of Primatology* **1**: 153-170.

Bernstein, I.S. 1980. Activity patterns in a stumptail macaque group (*Macaca arctoides*). *Foilia Primatologica* **33**: 20-45.

Bertrand, M. 1969. The behavioural repertoire of the stumptail macaque. *Biblotheca Primatologican.* no 11, Skarge Basel, New York.

Biben, M. 1982. Object play and social treatment of prey in bush dogs and crab-eating foxes. *Behaviour* **79**: 201-211.

Biben, M. 1983. Comparative ontogeny of social behaviour in three South American canids, the maned wolf, crab-eating fox and bush dog; implications for sociality. *Animal Behaviour* **31**: 814-826.

Biben, M. 1986. Individual and sex-related strategies of wrestling play in captive squirrel monkeys. *Ethology* **71**: 229-241.

Biben, M. 1989. Effects of social environment on play in squirrel monkeys: resolving Harlequin's Dilemma. *Ethology* **81**: 72-82.

Biben, M. 1996. The squirrel monkey: A prime example of primate play. *Program of Animal Behaviour Society Conference.* Northern Arizona University, 3rd-8th August 1996.

Biben, M. 1998. Squirrel monkey playfighting: making the case for a cognitive training function for play. In: M. Bekoff and J.A. Byers (eds.) *Animal Play: Evolutionary, Comparative and Ecological Perspectives.* Cambridge University Press, Cambridge. pp. 161-182.

Blackshaw, J.K. 1985. Human and animal inter-relationships, Review Series 3. Normal behaviour patterns of dogs: Part 1 *Australian Veterinary Practitioner* **15**(3): 110-112.

Blurton Jones, N.G 1967. An ethological study of some aspects of social behaviour in children in nursery school. In: D. Morris (ed.) *Primate Ethology* pp. 347-368.

Blurton Jones, N.G 1972. Categories of child-child interaction. In: N.G. Blurton Jones (ed.) *Ethological Studies of child behaviour*. Cambridge University Press, Cambridge. pp. 97-127.

Boitani, L., Francisci, P., Ciucci, P. and Andreoli, G. 1995. Population biology and ecology of feral dogs in central Italy. In: J. Serpell (ed.) *The Domestic Dog: its Evolution, Behaviour and Interactions with People*. Cambridge University Press, Cambridge. pp. 217-244.

Borcheldt, P.L. 1983. Separation elicited behaviour problems in dogs. In: A.H. Katcher and A.M. Beck (eds.) *New Perspectives on our Lives with Companion Animals*. University of Pennsylvania Press, Philadelphia. pp.188-196.

Borcheldt, P.L. and Voith, V.L. 1982. Diagnosis and treatment of separation-related behavior in dogs. *Veterinary Clinics of North America: Small Animal Practice* **12**(4): 625-635.

Boulton, M.J. 1996. A comparison of 8 and 11 year old girls' and boys' participation in specific types of rough and tumble play and aggressive fighting: implications for functional hypotheses. *Aggressive Behaviour* **22**: 278-287.

Bradshaw, J.W.S. and Smart, F.R.E. 1993. Behavioural differences between kittens homed singly and in pairs. *Journal of the Feline Advisory Bureau* **30**(4): 141-143.

Bradshaw, J.W.S., Goodwin, D., Lea, A.M. and Whitehead, S.L. 1996. A survey of the behavioural characteristics of pure-bred dogs in the United Kingdom. *The Veterinary Record* **138**: 465-468.

Brown, S. 1998. Play as an organizing principle: clinical evidence and personal observations. In: M. Bekoff and J.A. Byers (eds.) *Animal Play: Evolutionary, Comparative and Ecological Perspectives.* Cambridge University Press, Cambridge. pp. 205-220.

Brownlee, A. 1954. Play in domestic cattle: an analysis of its nature. *British Veterinary Journal* **110**: 48-68.

Bryant, B. 1985. The neighbourhood walk: sources of support in middle childhood. *Monographs of the Society for Research in Child Development:* **50**(3) Serial No. 210.

Burghardt, G.M. 1988. Precocity, play, and the ectotherm-endotherm transition: profound reorginization or superficial adaption? In: E.M. Bass (ed.) *Handbook of Behavioral Neurobiology, Vol. 9.* Plenum Press, New York. pp. 107-148.

Burghradt, G.M. 1998. The evolutionary origins of play revisited. In: M. Bekoff and J.A. Byers (eds.) *Animal Play: Evolutionary, Comparative and Ecological Perspectives.* Cambridge University Press, Cambridge. pp. 1-26.

Burghardt, G.M., Ward, B. and Rosscoe, R. 1996. Problem of reptile play: environmental enrichment and play behavior in a captive Nile Soft-Shelled Turtle, *Trionyx triunguis*. *Zoo Biology* **15**: 223-238.

Byers, J.A. 1977. Terrain preferences in the play behaviour of Siberian ibex kids (*Capra ibex sibrica). Zeitschrift fur Tierpsychologie* **45**: 199-209.

Byers, J.A. 1998. Biological effects of locomotor play: getting into shape, or something more specific? In: M. Bekoff, and J.A Byers (eds.) *Animal Play: Evolutionary, Comparative and Ecological Perspectives.* Cambridge University Press. Cambridge. pp. 205-220.

Cairns, R.B. 1966. Attachment behavior of mammals. *Psychological Review* **73**(5): 409-426.

Cairns, R.B. 1972. Fighting and punishment from a developmental perspective. *Nebraska Symposium on Motivation* **20**: 59-124.

Cairns, R.B. and Johnson, D.L. 1965. The development of interspecific social preferences. *Psychonomic Science* **2**: 337-338.

Calcagnetti, D.J. and Schechter, M.D. 1992. Place conditioning reveals the rewarding aspect of social interaction. *Physiology and Behavior* **51**(4): 667-672.

Campbell, W.E. 1972. A behaviour test for puppy selection. *Modern Veterinary Practice* **12**: 20-33.

Caro, T.M. 1980. The effects of experience on the predatory patterns of cats. *Behavioural and Neural Biology* **29**: 1-28.

Caro, T.M. 1988. Adaptive significance of play: are we getting closer? *TREE* **3**(2): 50-54.

Caro, T.M. 1995. Short term costs and correlates to play in cheetahs. *Animal Behaviour* **49**: 333-345.

Caro, T.M. and Alawi, R.M. 1985. Comparative aspects of behavioural development in two species of free-living hyrax. *Behaviour* **95**: 87-109.

Carpenter, C.R. 1964. *Naturalistic Behavior of Nonhuman Primates.* The Pennsylvania State University Press, U.S.A.

Christie, D.W. and Bell, E.T. 1972. Studies on canine reproductive behaviour during the normal oestrus cycle. *Animal Behaviour* **20**: 621-631.

Clark, A.H., Wyon, S.M. and Richards, M.P.M. 1969. Free play in nursery school children. *Journal of Child Psychology and Psychiatry* **10**: 205-216.

Clark, G.I. and Boyer, W.N. 1993. The effects of dog obedience training and behavioural counselling upon the human-canine relationship. *Applied Animal Behaviour Science* **37**: 147-159.

Clutton-Brock, J. 1995. Origins of the dog: domestication and early history. In: J. Serpell (ed.) *The Domestic Dog: its Evolution, Behaviour and Interactions with People.* Cambridge University Press, Cambridge. pp. 7-20.

Cochran, W.G. and Cox, G.M. 1957. *Experimental Designs, Second Edition.* John Wiley and Sons Inc., New York.

Corbett, L. and Nesome, A. 1975. Dingo society and its maintenance: a preliminary analysis. In: M.W. Fox (ed.) *The Wild Canids: their Systematics, Behavioral Ecology and Evolution.* Van Norstrand Rheinhold Co., New York. pp. 369-379.

Crowell-Davis, S.L., Houpt, K.A. and Kane, L. 1987. Play development in Welsh pony (*Equus caballus*) foals. *Applied Animal Behaviour Science* **18**: 119-131.

Darwin, C. R. 1871 / 1936. *The Descent of Man and Selection in Relation to Sex. Modern Library Edition.* Random House, New York.

Davis, S. J.M. and Valla, F.R. 1979. Evidence for domestication of the dog 12,000 years ago in the Natufian of Israel. *Nature* **276**: 608-610.

Dawkins, R. and Krebs, J.R. 1978. Animal signals: information or manipulation? In J.R. Krebs and N.B Davies (eds.) *Behavioural Ecology: an Evolutionary Approach.* M.A Sinauer, Sunderland. pp. 282-309.

de Waal, F.B.M. 1982. *Chimpanzee Politics, Power and Sex among Apes*. Jonathan Cape, London.

de Waal, F.B.M. and van Roosmalen, A. 1979. Reconciliation and consolation among chimpanzees. *Behavioural Ecology and Sociobiology* **5**: 55-66.

Drews, C. 1993. The concept and definition of dominance in animal behaviour. *Behaviour* **125**(3-4): 283-311.

Dytham, C. 1999. *Choosing and Using Statistics: A Biologist's Guide.* Blackwell Science. Oxford.

Einon, D.F., Morgan., M.J. and Kibbler, C.C. 1978. Brief periods of socialisation and later behaviour in the rat. *Developmental Psychobiology* **11**: 213-225.

Fagen, R.M. 1981. *Animal Play Behaviour*. Oxford University Press, New York.

Fagen, R.M. 1984. Play and behavioural flexibility. In: P.K. Smith (ed.) *Play in Animals and Humans*. Basil Blackwell Ltd., Oxford. pp. 159-173.

Fagen, R.M. 1992. Play, fun and communication of well-being. *Play and Culture* **5**: 40-58.

Fagen, R.M. 1996. Brown bear play at Pack Creek Admiralty Island Alaska. *Program of Animal Behaviour Society Conference.* Northern Arizona University, 3rd-8th August 1996.

Fagen, R.M. and George, T.K. 1977. Play behaviour and exercise in young ponies (*Equis caballus* L.). *Behavioural Ecology and Sociobiology* **2**: 267-269.

Feddersen-Petersen, D. 1986. Observations on social play in some species of Canidae. *Zoologischer Anzeiger* **217**(1/2): 130-144.

Feddersen-Peterson, D. 1991. The ontogeny of social play and agonistic behaviour in selected canid species. *Bonner Zoologische Beiträge* **42**: 97-114.

Fedigen, L. 1972. Social and solitary play in a colony of vervet monkeys (*Cercopithecus aethiops*). *Primates* **13**(4): 347-364.

Ferchmin, P.A., Eterovic, V.A. and Levin, L.E. 1980. Genetic learning deficiency does not hinder environment-dependent brain growth. *Psychology and Behaviour* **24**: 45-50.

Fowler, J., Cohen, L. and Jarvis, P. 1998. *Practical Statistics for Field Biology, Second Edition.* John Wiley and Sons, Chichester.

Fisher, J. 1992. *Dogwise. The Natural Way to Train Your Dog.* Souvenir Press, London.

Fraser, D. and Duncan, I.J.H. 1998. 'Pleasures', 'pains' and animal welfare: toward a natural history of affect. *Animal Welfare* 7(4): 383-396.

Friedmann, E. 1995. The role of pets in enhancing human well-being: physiological effects. In: I. Robinson (ed.) *The Waltham Book of Human-Animal Interactions: Benefits and Responsibilities of Pet Ownership.* Pergamon Press, Oxford. pp. 33-53.

Fox, M.W. 1969.The anatomy of aggression and its ritualization in Canidae: a developmental study: a developmental and comparative study. *Behaviour* **35**: 242-258.

Fox, M.W. 1970. A comparative study of the development of facial expressions in canids; wolf, coyote and foxes. *Behaviour* **36**: 49-73.

Fox, M.W. 1972. Socioecological implications of individual differences in wolf litters: a developmental and evolutionary perspective. *Behaviour* **41**: 298-313.

Fox, M.W. and Stelzner, D. 1967. The effects of early experience on the development of inter and intraspecies social relationships in the dog. *Animal Behaviour* **15**: 377-386.

Fox, M.W., Halperin, S., Wise, A. and Kohn, E. 1976. Species and hybrid differences in frequencies of play and agonistic actions in canids. *Zeitschrift fur Tierpsychologie.* **40**: 194-209.

Fry, D.P. 1990. Play aggression among Zapotec children: implications for the practice hypothesis. *Aggressive Behaviour* **16**: 321-340.

Galef, B.G. Jr. 1988. Imitation in animals: history, definition, and interpretation of data from the psychological laboratory. In: T.R. Zentall and B.G. Galef, Jr. (eds.) *Social Learning: Psychological and Biological Perspectives*. Lawrence Erlbaum Associates Publishers, Hillsdale, New Jersey. pp. 1-27.

Galef, B.G., Jr. 1990. An adaptionist perspective on social learning, social feeding and social foraging in Norway rats. In: D.A. Dewsbury (ed.) *Contemporary Issues in Comparative Psychology.* Sinauer Associates Inc., Sunderland, Massachusetts. pp. 55-79.

Galef, B.G., Jr. 1996. Social learning and imitation. In: C.M. Heyes and B.G. Galef Jr. (eds.) *Social Learning in Animals: the Roots of Culture*. Academic Press, San Diego. pp. 3-15.

Galef, B.G., Jr. and Wigmore, S.W. 1983. Transfer of information concerning distance foods: a laboratory investigation of the "information centre" hypothesis. *Animal Behaviour* **31**(3): 748-758.

Galef, B.G., Jr., Mason, J.R., Pereti, G. and Bean, N.J. 1988. Carbon disulfide can mediate socially-induced diet choice in rats. *Physiology and Behaviour* **42**(3): 119-124.

Gautheraux, S. Jr. 1978. The ecological significance of behavioural dominance. In: P.P.G. Bateson and P.H. Klopfer (eds.) *Perspectives in Ethology*. Plenum Press, New York and London. pp. 17-54.

Gomendio, M. 1988. The development of different types of play in gazelles: implications for the nature and fun of play. *Animal Behaviour* **36**: 825-883.

Goodloe, L.P. and Borcheldt, P.L. 1998. Companion dog temperament traits. *Journal of Applied Animal Welfare Science* **1**(4): 303-338.

Grand, G.I. 1983. Animal Play Behaviour by Robert Fagen (book review). *American Anthropologist* **85**: 700-701.

Groos, K. 1898. *The Play of Animals*. Appelton, New York.

Gubernick, D.J. 1981. Parent and infant attachment in mammals. In: D.J. Gubernick and P.H. Klopfer (eds.) *Parental Care in Mammals*. Plenum Press, New York and London. pp. 243-304.

Hall, S. L. 1998. Object play by adult animals In: M. Bekoff and J.A. Byers (eds.) *Animal Play: Evolutionary, Comparative and Ecological Perspectives.* Cambridge University Press, Cambridge. pp. 45-60.

Hall, S.L. and Bradshaw, J.W.S. 1998. The influence of hunger on object play by adult domestic cats. *Applied Animal Behaviour Science* **58**: 143-150.

Happold, M. 1976. The ontogeny of social behaviour in four conilurine rodents (Muridae) of Australia. *Zeitschrift fur Tierpsychologie* **40**: 265-278.

Harcourt, R. 1991. The development of play in the South American fur seal. *Ethology* **88**: 192-202.

Harlow, H.F. and Suomi, S.J. 1971. Social recovery by isolation-reared monkeys. *Proceedings of National Academy for Science* **68**: 1534-1538.

Hart, L.A. 1995a. The role of pets in enhancing human well-being: effects for older people. In: I. Robinson (ed.) *The Waltham Book of Human-Animal Interactions: Benefits and Responsibilities of Pet Ownership.* Pergamon Press, Oxford. pp. 19-31.

Hart, L.A. 1995b. Dogs as companions: a review of the relationship. In: J. Serpell (ed.) *The Domestic Dog: its Evolution, Behaviour and Interactions with People.* Cambridge University Press, Cambridge pp. 161-179.

Hart, B.L. and Hart, L.A. 1985. Selecting pet dogs on the basis of cluster analysis of breed behavior profiles and gender. *Journal of American Veterinary Medical Association* **186**: 1181-1185.

Hediger, H. 1964. *Wild Animals in Captivity - an Outline of the Biology of Zoological Gardens*. Dover publications, New York. pp. 162-169.

Hediger, H. 1965. Man as a social partner of animals and vice versa. *Symposium of the Zoological Society of London* **14**: 291-300.

Heinrich, B. and Smolker, R. 1998. Play in common ravens In: M. Bekoff and J.A. Byers (eds.) *Animal Play: Evolutionary, Comparative and Ecological Perspectives. Cambridge University Press, Cambridge.* pp. 27-44.

Henry, J.D. 1986. *Red Fox, the Catlike Canine*. Smithsonian Institute Press, Washington D.C.

Henry, J.D. and Herrero, S.M. 1974. Social play in the American Black Bear, its similarity to canid social play and an examination of its identifying characteristics. *American Zoologist* **14**: 371-389.

Hersher, L., Richmond, J.B. and Morre, A.U. 1963. Modifiability of the critical period for the development of maternal behaviour in sheep and goats. *Behavior* **20**: 311-320.

Heyes, C.M. 1994. Social cognition in primates. In: N. J. Mackintosh (ed.) *Animal Learning and Cognition: Handbook of Perception and Cognition, Second Edition.* Academic Press, London. pp. 281-300.

Hill, H. L. and Bekoff, M. 1977. The variability of some motor components of social play and agonistic behaviour in infant eastern coyotes, *Canis latrans var. Animal Behaviour* **25**: 907-909.

Hole, G. 1991. Proximity measures of social play in the laboratory rat. *Developmental Psychobiology* **24**(2): 117-133.

Holmes, R.J. 1988. Principles of dog training. In: R.K. Anderson and R. J. Homes (eds.) *Dogs: Companions or Nuisances, Public Seminars* **22.** Werribee Veterinary Clinical Center, Victoria, Australia. pp. 1-8.

Hubrecht, R.C. 1995. Enrichment in puppyhood and its effects on later behaviour of dogs. *Laboratory Animal Science* **45**(1): 70-75.

Humphreys, A.P. and Smith, P.K. 1984. Rough-and-Tumble in preschool and playground. In: P.K. Smith (ed.) *Play in Animals and Humans*. Basil Blackwell. pp. 241-266.

Humphreys, A.P. and Smith, P.K. 1987. Rough and tumble, friendship and dominance in school children. Evidence for continuity and change with age. *Child Development* **58**: 201-212.

Ikemoto, S. and Panksepp, J. 1992. The effects of early socialisation on the motivation for social play in juvenile rats. *Developmental Psychobiology* **25**(4): 261-274.

Jagoe, J.A. 1994. *Behaviour Problems in the Domestic Dog: a Retrospective and Prospective Study to Identify Factors Influencing their Development.* Unpublished PhD thesis, University of Cambridge.

James, W.T. 1949. Dominant and submissive behaviour as indicated by food intake. *Journal of Genetic Psychology* **75**: 33-43.

Jensen, M.B., Vestegaar, K. and Krohn, C.C. 1998. Play behaviour in dairy calves kept in pens: the effect of social contact and space allowed. *Applied Animal Behaviour Science* **56**: 97-108.

Jolly, A. 1985. *The Evolution of Primate Behaviour, Second Edition*. Macmillian, New York.

Judge, P.G. 1982. Redirection of aggression based on kinship in a captive group of pigtailed macaques. *International Journal of Primates* **3**: 301.

Katcher, A.H. 1981. Interactions between people and their pets: form and function. In: B. Fogle (ed.) *Interactions between People and Pets.* Charles C. Thomas, Springfield, Illinois. pp.41-67.

King, J.A. 1954. Closed social groups among domestic dogs. *Proceedings of the American Philosophical Society* **98**(5): 327-336.

Koda, N. 1997. Behaviours of potential guide dogs for the blind in a play situation with voluntary raisers. *Abstract of the 3rd Annual Meeting of the Society of Human-Animal Relations.*

Lazar, J.W. and Beckhorn, G.D. 1974. Social play or the development of social behaviour in ferrets (*Mustela putonous*)? *American Zoologist* **14**: 405-444.

Lewis, M. 1982. Play as whimsey. *Behavioural and Brain Sciences* **5**: 166.

Lockwood, R. 1976. *An Ethological Analysis of Social Structure and Affiliation in Captive Wolves (Canis lupus)*. Unpublished PhD. thesis, Washington University. pp. 362.

Lockwood, R. 1979. Dominance in wolves: useful construct or bad habit. In: E. Klinghammer (ed.) *Behaviour and Ecology of Wolves*. Garland Press, New York. pp. 225-244.

Loeven, J.C. 1996. Play has rhythm: the temporal structure of social play in carnivores. *Program of Animal Behaviour Society Conference.* Northern Arizona University, 3rd-8th August 1996.

Loizos, C. 1966. Play in mammals. *Symposium of the Zoological Society of London* **18**: 1-9.

Loizos, C. 1967. Play behaviour in higher primates: a review. In: D. Morris (ed.) *Primate Ethology.* Weidenfeld and Nicolson, London. pp. 176-218.

Lorenz, K.Z. 1956. Plays and vacuum activities. In: *L'Instinct dans le Comportement des Animaux et de l'Homme*. Masson, Paris. pp. 633-645.

Loveridge, G. 1998. Environmentally enriched housing for dogs. *Applied Animal Behaviour Science* **59**: 101-113.

M^{c}Bride, A. 1995. The human-dog relationship. In: I. Robinson (ed.) *The Waltham Book of Human-Animal Interactions: Benefits and Responsibilities of Pet Ownership.* Pergamon Press, Oxford. pp. 99-112.

M^{c}Crave, E.A. 1991. Diagnostic criteria for separation anxiety in the dog. *Veterinary Clinics of North America: Small Animal Practice* **21**: 247-255.

M^{c}Cune, S. 1992. *Temperament and the Welfare of Caged Cats*. Unpublished PhD thesis, University of Cambridge, Cambridge.

M°Cune, S., M°Pherson, J.A. and Bradshaw, J.S.W. 1995. Avoiding problems: the importance of socialisation In: I. Robinson (ed.) *The Waltham Book of Human-Animal Interactions Benefits and Responsibilities of Pet Ownership.* Pergamon Press, Oxford. pp. 71-86.

Macdonald, D.W. and Carr, G.M. 1995. Variation in dog society: between resource dispersion and social flux. In: J. Serpell (ed.) *The Domestic Dog: its Evolution, Behaviour and Interactions with People.* Cambridge University Press, Cambridge. pp. 199-216.

MacDonald, K.B. 1987. Development and stability of personality characteristics in pre-pubertal wolves: implications for pack organisation and behavior. In: H. Frank (ed.) *Man and Wolf.* Dr W. Junk Publishers, Dordrecht, The Netherlands. pp. 293-312.

M°Pherson, J.A. 1998. *Aetiology, Characterisation and Prediction of Separation Induced Behaviour in the Domestic Dog*. Unpublished PhD thesis, University of Southampton.

Martin, P. and Bateson, P. 1993. Measuring Behaviour: *an Introductory Guide, Second Edition.* Cambridge University Press, Cambridge.

Martin, P.M. and Caro, T.M. 1985. On the function of play and its role in behavioural development. *Advances in the Study of Behaviour* **15**: 59-103.

Mason, W.A. 1965. Determinants of social behaviour in young chimpanzees. *Behaviour of Nonhuman Primates* **2**: 335-364.

Mason, W.A., Hollis, J.H. and Sharpe, L.G. 1962. Differential responses of chimpanzees to social stimulation. *Journal of Comparative and Physiological Psychology* **55**(6):1105-1110.

Mason, W.A and Kenney, M.D. 1974. Redirection of filial attachments in rhesus monkeys: dogs as mother surrogates. *Science* **183**: 1209-1211.

Meaney, M.J. and Stewart, J. 1981. A descriptive study of social development in the rat. *Animal Behaviour* **29**: 34-45.

Mears, C.E. and Harlow, H.F. 1975. Play: early and eternal. *Proceeding of the National Academy of Science* **72**(5): 1878-1882.

Mech, D.L. 1970. *The Wolf.* The Natural History Press, New York.

Mech, D.L. 1975. Hunting behaviour in two similar species of social canids. In: M.W. Fox (ed.) *The Wild Canids: their Systematics, Behavioral Ecology and Evolution.* Van Norstrand Rheinhold, New York. pp. 363-368.

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

Messent, P.R. 1979. *Understanding Your Dog*. Quarto Publishing Ltd., London.

Messent, P.R. 1983. Social facilitation of contact with other people by pet dogs. In: A.H. Katcher and A. M. Beck (eds.) *New Perspectives on our Lives with Companion Animals*. University of Pennsylvania Press, Philadelphia. pp. 37-46.

Messent, P.R. and Serpell, J.A. 1981. A historical and biological view of the pet-owner bond. In: B. Fogle (ed.) *Interactions between People and Pets*. Charles C. Thomas, Springfield, Illinois. pp. 5-22.

Miller, F.L. 1975. Play activities of black-tailed deer in North Western Oregon. *Canadian Field Naturalist* **89**(2): 149-155.

Miller, S.N. 1973. Ends, means and galumphing: some letimorphs of play. *American Anthropologist* **75**: 87-98.

Miller, R.E., Caul, W.F. and Mirsky, I.A. 1967. The communication of affects between feral and socially isolated monkeys. *Journal of Personal and Social Psychology* **7**: 231-239.

Mitchell, R.W. 1988. Ontogeny, biography and evidence for tactical deception. *Behavioural and Brain Sciences* **11**: 259-260.

Mitchell, R.W. and Edmonson, E. 1999. Functions of repetitive talk to dogs during play: control, conversation or planning? *Society and Animals* **7**(1): 55-81.

Mitchell, R.W. and Thompson, N.S. 1986. Deception in play between dogs and people In: R.W. Mitchell and N.S. Thompson (eds.) *Perspectives on Human and Nonhuman Deceit.* State University of New York Press, New York. pp. 193-204.

Mitchell, R.W. and Thompson, N.S. 1991a. Projects, routines and enticements in dog-human play. In: P.P.G. Bateson and P.H. Klopfer (eds.) *Understanding and Animal Awareness: Perspectives in Ethology Vol. 9*. Plenum Press, New York and London. pp. 189-217.

Mitchell, R.W. and Thompson, N.S. 1991b. The effects of familiarity on dog-human play. *Anthrozoös* **4**(1): 24-43.

Mitchell, R.W. and Thompson, N.S. 1993. Familiarity and the rarity of deception: Two theories and their relevance to play between dogs (*Canis familiaris*) and humans (*Homo sapiens*). *Journal of Comparative Psychology* **107**(3): 291-300.

Morse, D.H. 1974. Niche breadth as a function of social dominance. *The American Naturalist.* **108**: 818-830.

Mugford, R.A. 1980. The social significance of pet ownership. In: S.A. Corson, E.O. Corson, and J.A. Alexander (eds.) *Ethology and Nonverbal Communication in Mental Health*. Pergamon Press, Oxford. pp. 111-122.

Mugford, R.A. 1985. Attachment vs. dominance. In: *The Human-pet Relationship. International Symposium of the 80th Birthday of Konrad Lorenz Proceedings*. I.E.M.T. pp. 157-160.

Mugford, R.A. 1995. Canine behavioral therapy. In: J. Serpell (ed.) *The Domestic Dog: its Evolution, Behaviour and Interactions with People*. Cambridge University Press, Cambridge. pp. 139-152.

Nesbitt, W.H. 1975. Ecology of a feral dog pack on a wildlife refuge. In: M.W. Fox (ed.) *The Wild Canids: their Systematics, Behavioural Ecology and Evolution*. Van Norstrand Rheinhold Co., New York. pp. 391-395.

Nott, N.M.R. 1992. Behavioural development of the dog. In: C. Thorne (ed.) *The Waltham Book of Dog and Cat Behaviour*. Pergamon Press, Oxford. pp. 65-78.

O'Farrell, V. 1992. *Manual of Canine Behaviour, Second Edition*. British Small Animal Veterinary Association, Cheltenham.

Overall, K.L. 1997. *Clinical Behavioural Medicine for Small Animals*. Mosby Year Book Inc., St. Louis.

Panksepp, J. 1981. The ontogeny of play in rats. *Developmental Psychobiology* **14**: 327-332.

Panksepp, J., Siviy, S. and Normansell, L. 1984. The psychobiology of play: theoretical and methodological perspectives. *Neuroscience and Biobehavioural Reviews* **8**: 465-492.

Pellegrini, A.D. 1989. What is a category? The case of rough and tumble play. *Ethology and Sociobiology* **10**: 331-342.

Pellis, S.M. 1991. How motivationally distinct is play? A preliminary case study. *Animal Behaviour* **42**: 851-853.

Pellis, S.M. and Pellis, V.C. 1991. Role reversal changes during the ontogeny of play fighting in male rats: attack versus defence. *Aggressive Behavior* **17**: 179-189.

Pellis, S.M. and Pellis, V.C. 1992. Juvenilised play fighting in subordinate male rats. *Aggressive Behavior* **18**: 449-457.

Pellis, S.M. and Pellis, V.C. 1993. Influence of dominance on the development of play fighting in pairs of Male Syrian Golden hamsters (*Mesocricetus auratus*). *Aggressive Behaviour* **19**: 293-302.

Pellis, S.M., Pellis, V.C. and Kolb, B. 1992. Neonatal testosterone augmentation increases juvenile play fighting but does not influence the adult dominance relationship of male rats. *Aggressive Behaviour* **18**: 437-447.

Podberscek, A.L. 1997. Illuminating issues of companion animal welfare through research into human-animal interactions. *Animal Welfare* **6**: 365-372.

Poirier, F.E. and Smith, E.O. 1974. Socializing functions of primate play behaviour. *American Zoologist* **14**: 275-287.

Rasa, O.A.E. 1984. A motivational analysis of object play in juvenile dwarf mongooses (*Helogate undulata rufula*). *Animal Behaviour* **32**: 579-589.

Robinson, I. 1992. Behavioural development of the cat. In: C. Thorne (ed.) *The Waltham Book of Dog and Cat Behaviour*. Pergamon Press, Oxford. pp. 61-95.

Robinson, I. 1995. *The Waltham Book of Human-Animal Interaction: Benefits and Responsibilities of Pet Ownership*. Pergamon Press, Oxford.

Rogers, J., Hart, L.A. and Boltz, R.P. 1993. The role of pet dogs in casual conversations of elderly adults. *Journal of Social Psychology* **133**: 265-277.

Rogerson, J. 1992. *Training Your Dog*. Popular Dogs Publishing Co. Ltd., London.

Russell, E.S. 1936. Playing with a dog. *The Quarterly Review of Biology* **11**: 1-11.

Schaller, G.B. 1963. *The Mountain Gorilla*. University of Chicago Press, Chicago.

Schaller, G.B. 1972. *The Serengeti Lion*. University of Chicago Press, Chicago.

Schjelderup-Ebbe, T. 1922. Beiträge zur Sozialpsychologie des Haushuhns. *Zeitschrift fur Tierpsychologie* **88**: 225-252.

Scott, J.P. 1962. Critical periods in behavioural development. *Science* **138**: 949-957.

Scott, J.P 1963. The process of primary socialization in canine and human infants. *Monographs of the Society of Research into Child Development* **28**: 345-354.

Scott, J.P. 1971. Attachment and separation in dog and man: theoretical propositions. In: H.R. Scaffer (ed.) *The Origins of Human Social Relations*. Academic Press, New York. pp. 227-246.

Scott, J.P. 1992. The phenomenon of attachment in human-non-human relationships. In: H. Davis and D. Balfour (eds.) *The Inevitable Bond: Examining Scientist-Animal Interactions*. Cambridge University Press, Cambridge. pp. 72-92.

Scott, J.P. and Fuller, J.L. 1965. *The Genetics and Social Behaviour of the Dog.* University of Chicago Press, Chicago.

Siegel, S. and Castellan, N.J. Jr. 1988. *Nonparametric Statistics for the Behavioral Sciences, Second Edition.* M°Graw-Hill Inc., New York.

Serpell, J.A. 1995. *The Domestic Dog: its Evolution, Behaviour and Interactions with People*. Cambridge University Press, Cambridge.

Serpell, J.A. 1996. *In the Company of Animals: a Study of Human-Animal Relationships.* Basil Blackwell Ltd., Oxford.

Serpell, J.A. and Jagoe, J.A. 1995. Early experience and the development of behaviour. In: J. Serpell (ed.) *The Domestic Dog: its Evolution, Behaviour and Interactions with People*. Cambridge University Press, Cambridge. pp. 79-103.

Serpell, J.A. and Paul, E. 1994. Pets and the development of positive attitudes to animals. In: A. Manning and J. Serpell (eds.) *Animals and Human Society: Changing Perspectives.* Routledge, London. pp. 127-144.

Smith, L.K., Field, E.F, Forgie, M.L. and Pellis, S.M. 1996. Dominance and age-related changes in the play fighting of intact and post-weaning castrated male rats (*Rattus Norvegicus*). *Aggressive Behaviour* **22**(3): 215-226.

Smith, P.K. 1982. Does play matter? Functional and evolutionary aspects of animal and human play. *Behavioural and Brain Sciences* **5**: 139-184.

Smith, S.L. 1983. Interactions between pet dogs and family members: an ethological study. In: A.H. Katcher and A.M. Beck (eds.) *New Perspectives on our Lives with Companion Animals.* University of Pennsylvania Press, Philidelphia. pp. 29-36.

Smutts, B. 1985. *Sex and friendship in baboons.* Aldine, New York.

Sokal, R.R. and Rohlf, F.J. 1995. *Biometry: the Principles and Practice of Statistics in Biological Research, Third Edition.* W.H. Freeman and Co., New York.

Sommer, V. and Medoza-Grandos, D. 1995. Play as an indicator of habitat quality- a field study of langur monkeys (*Presbytis entellus*). *Ethology* **99**(3): 177-192.

Stallones, L., Marx, M. B., Garrity, T.F. and Johnson, T.P. 1988. Attachment to companion animals among older pet owners. *Anthrozoös* **2**(2): 118-124.

Suomi, S.J. 1979. Peers, play and primary prevention in primates. In: M.W. Kent, J. E. Rolf and N. H. Hanover (eds.) *Primary Prevention of Psychopathology, vol. 3.* University Press of New England, New South Wales, Australia. pp. 127-149.

Suomi, S.J. 1982. Why does play matter? *Behavioural and Brain Sciences* **5**: 169-170.

Symons, D. 1974. Aggressive play and communication in rhesus monkeys (*Macaca mulatta*). *Amercian Zoologist* **14**: 317-322.

Symons, D. 1978. *Play and Aggression, a Study of Rhesus Monkeys*. Columbia University Press, New York.

Thompson, K.V, 1996. Self assessment in juvenile play. *Program of Animal Behaviour Society Conference.* Northern Arizona University, 3rd-8th August 1996.

Thompson, K.V. 1998. Self assessment in juvenile play. In: M. Bekoff and J.A. Byers (eds.) *Animal Play: Evolutionary, Comparative and Ecological Perspectives.* Cambridge University Press, Cambridge. pp. 183-204.

Topàl, J., Milóski, A., and Csányi, V. 1997. Dog-human relationship affects problem solving behaviour in the dog. *Anthrozoös* **10**(4) 214-224.

van der Borg, J.A.M., Netto, W.J. and Planto, D.J.U. 1991. Behavioural testing of dogs in animal shelters to predict problem behaviour. *Applied Animal Behaviour Science* **32**: 237-251.

van Hooff, J.A.R.A.M. 1967. The facial displays of the catarrhine monkeys and apes. In: D. Morris (ed.) *Primate Ecology*. Aldine, Chicago. pp. 9-88.

van Hooff, J.A.R.A.M. 1972. A comparative approach to the phylogeny of smiling and laughing. In: R.A. Hinde *Nonverbal communication*. Cambridge University Press, Cambridge. pp. 209-241.

van Hooff, J.A.R.A.M. and Wensing, J.A.B. 1987. Dominance and its behavioural measures in a captive wolf pack. In: H. Frank (ed.) *Man and Wolf.* Dr W. Junk Publishers, Dordrecht, The Netherlands. pp. 219 -251.

Vanderberg, B. 1982. The essentials of play. *Behavioural and Brain Sciences* **5**: 171-172.

Vanderschuren, L.J.M.J., Spruijt, B.M. Hol, T., Niesink, R.J.M., Vanree, J.M. 1995. Sequential analysis of social play behaviour in juvenile rats: effects of morphine. *Behavioural and Brain Sciences* **72**(1-2): 89-95.

Vilà, C., Savolainen, P., Malonado, J.E., Amorim, I.R., Rice J.E., Honeycutt, R.L., Crandell, K.A., Lundeberg, J. and Wayne, R.K. 1997. Multiple and ancient origins of the domestic dog. *Science* **276**: 1687-1689.

Vincent, L.E. and Bekoff, M. 1978. Quantitative analyses of the ontogeny of predatory behaviour in coyotes, *Canis latrans*. *Animal Behaviour* **26**: 225-231.

Wells, D. and Hepper, P. 1999. Male and female dogs respond differently to men and women. *Applied Animal Behaviour Science* **61**(4): 341-349.

West, M. 1974. Social play in the domestic cat. *American Zoologist* **14**: 415-426.

Whitney, L.F. 1989. *Dog Psychology: the Basis of Dog Training*. Howell Book House, New York.

Wickens, S.M. 1993. *Social Relationships in the Domestic Dog: the Effect of Learning and Breed on Behaviour Within Status Relationships*. Unpublished PhD Thesis, University of Southampton.

Wickens, S.M., Astell-Billings, I., McPherson, J.A., Gibb, R., Bradshaw, J.W.S. and M°Bride, E.A. 1995. The behavioural assessment of dogs in animal shelters: inter-observer reliability and data redundancy. *Proceedings of the 29th International Congress of the International Society of Applied Ethology*, Universities Federation for Animal Welfare.

Wilkomm, S. 1990. Quantitative analysis of the ontogeny of play behaviour in canid hybrids. *Ethology* **86**: 287-302.

Wilson, E.O. 1975. *Sociobiology. The New Synthesis*. Harvard University Press, Cambridge.

Wilson, S.C. and Kleiman, D.G 1974. Eliciting play: a comparative study. *American Zoologist* **14**: 341-471.

Wright, J.C. 1980. Early development of exploratory behavior and dominance in three litters of German Shepherds. In: E.C. Simmel (ed.) *Early Experiences and Early Behaviour: Implications for Social Development*. Academic Press Inc., London. pp. 181-206.

Young, M.S. 1988. Puppy selection and evaluation. In: R.K. Anderson and R.J. Holmes (eds.) *Dogs: Companions or Nuisances, Public Seminars* **22.** Werribee Veterinary Clinical Center, Victoria, Australia. pp.8-15.

Zar, J.H. 1996. *Biostatistical Analysis, Third Edition*. Prentice-Hall International Inc., London.

Zimen, E. 1975. Social dynamics of the wolf pack. In: M.W. Fox (ed.) *The Wild Canids: their Systematics, Behavioral Ecology and Evolution.* Van Norstrand Rheinhold Co., New York. pp. 336-362.