

What makes a good dog-owner team? – A systematic review about compatibility in personality and attachment

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ABSTRACT

Satisfying dog-ownership has shown to have physical and psychological advantages for humans, whereas dysfunctional ownership due to canine behavioural problems leads to growing numbers of the relinquishment of dogs. This systematic review investigates 29 studies with the aims to find out (1) What are determinants of a functioning and satisfying dog-owner relationship (2) how these are different to owners' actual acquisition motivation (3) how relevant knowledge can improve future ownership. Aggregation of the included studies showed that individual personality and attachment aspects, as well as certain combinations of those, can impact ownership in negative or positive ways. Owners with the tendency to be highly attached and with an avoidant attachment style might represent a risk factor for a dysfunctional dyad. Compatible matches were reached via similar expressions on the traits warmth; sharing possessions and enjoyment of running outside. Furthermore, owners were compatible with dogs that possess higher expressions than themselves on the traits openness; agreeableness and neuroticism. While many studies have reported that cuteness and general appearance are among the most important purchase motives of owners, this review suggests that future owners should focus more on personality and attachment aspects in the acquisition process instead. Compatibility between owners and their dogs may help unfold advantages of dog ownership, and prevent canine behavioural problems and their adverse consequences.

1. Introduction

The relationship between human and dog (*Canis familiaris*) is a bond that has lasted for several millennia, despite colossal changes that have occurred in the environment since. Archaeological evidence suggests that domestication emerged about 30,000 B.P. (Thalmann and Perri, 2018). Since these ancient days, the dog-human relationship has evolved to the point where we speak of dogs as the “man’s best friend”. Indeed, studies of the last decade have shown that dogs are highly motivated to cooperate with humans and show several prosocial behaviours, such as sharing and informing, when they receive cues signalling the need for help (Bräuer, 2015). Additionally, dog ownership has been associated with a variety of physical health benefits for the human such as lower blood pressure levels (Arhant-Sudhir et al., 2011) and lower mortality in general (Mubanga et al., 2017), as well as psychological benefits, including higher happiness and self-esteem (Crawford et al., 2006), reduction in stress (Zilcha-Mano et al., 2011) and lower feelings of depressiveness (Hart and Yamamoto, 2015).

In our modern society, however, increasing numbers of relinquished dogs, especially rising with dogs acquired during the Covid-19 pandemic, are reported in the popular press (Koegel, 2021), suggesting cracks in the harmonious image of the friendship between dog and human. Although this may have multiple reasons, the animal factor reported as the number one reason for the returning of dogs is canine behavioural problems, such as aggression and separation-related problems (Jensen et al., 2020).

Taking this development into account, the question arises what psychological findings can contribute to prevent the relinquishment of dogs, by preventing canine behavioural problems and assuring functional ownership. Personality will be one main focus of study of this review, as traits of both owner and dog have been shown to affect their relationship (e.g., Cavanaugh et al., 2008; Curb et al., 2013). Though research on dog personality has not yet established a widely-accepted theoretical model, dogs and humans probably share the same core-traits characterised by the *Big Five Factor model of personality* (FFM; Digman, 1990), except for consciousness (Gosling and John, 1999;

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Gosling et al., 2003), and bearing in mind that operational trait definitions might greatly differ (Draper, 1995).

There are two possible ways how personality traits may influence the quality of ownership. Firstly, certain traits of dog and owner may make them a “good handler” (Canejo-Teixeira et al., 2020; Kurdek, 2008) or an “easy to handle” dog (King et al., 2009; Diverio et al., 2016). Secondly, a good match of certain combinations of personality traits may promote functioning dog-owner dyads. In fact, both aspects play a role in satisfying ownership (e.g., Eken Asp et al., 2015; Turcsán et al., 2012).

Besides personality, attachment between dog and human is a factor which is believed to interact with these personality aspects, and to influence dyad functioning (e.g., Bauer and Woodward, 2007; Konok et al., 2015) making attachment a second focus of this review. Dogs show typical behaviours, which closely resemble those reported in human infants (Prato-Previde et al., 2003; Hare and Tomasello, 2005) and which may indicate the existence of an attachment bond between dog and owner. Nagasawa et al. (2015) provide physiological evidence for this bond in both dogs and owners. Their findings support the existence of an interspecies oxytocin-mediated positive loop facilitated and modulated by gazing, where oxytocin release in both humans and dogs is central to the deepening of mutual relationships and bonding.

Considering these theoretical implications, and keeping in mind that dog and owner traits may adapt to each other over the time of ownership, it can be expected that a deeper understanding of the dog-human relationship enables optimal pairings of dog and owner based on their personalities and attachment styles. As suggested by the prevalence of canine problems and relinquishments, these optimal matches likely differ from actual acquisition motivation of owners. Though research suggests an interdependence between attachment, personality and problematic behaviour (Gobbo and Zupan, 2020; Konok et al., 2015), no study exists that investigates all of those aspects together. This review therefore aims to close this gap by addressing (1) what are determinants of a functioning and satisfying dog-owner relationship, (2) how these are different to owners' actual acquisition motivation, and (3) how relevant

knowledge can improve future ownership.

2. Methods

We conducted a systematic review to evaluate the following hypotheses: (1) Attachment and personality aspects individually impact functioning and satisfying dog-owner relationships, (2) the combination of dog and owner personality and/or attachment features impact dog-owner relationships, and (3) owners' actual acquisition motivations can be incongruent with those features of functioning dog-owner relationships. Accordingly, we included studies that contribute to the understanding of dog-owner relationships in respect to compatibility, and that uncover aspects of acquisition that can potentially be improved. Studies investigating problematic dyads or problematic dog behaviour and personality matching or attachment aspects were screened. The flowchart shown in Fig. 1 gives a graphical overview of the literature research. The electronic library *Web of Science*, the Database *PsycInfo* and the Database *PsycArticles* were searched using the following term: "TS= (Dog OR Cani*) AND TS=Owner AND TS= (Compatibility OR Acquisition OR Attachment OR problematic behaviour OR problematic ownership OR behavioural problems OR Problems ownership OR problematic dyad OR problematic relationship OR personality similarity* OR trait similarity* OR personality matching OR trait matching OR satisf* dyad OR satisf* ownership OR satisf* relationship)".

Searches were performed on May 5, 2021. The described search term revealed 727 studies through the Database *Web of Science*, 295 studies through *PsycInfo* and seven studies through *PsycArticles* (see Fig. 1). In addition to the bibliographic search, two studies were identified through the snowball method. Furthermore, an adapted version of the search term was used to perform research for grey literature in the database *OpenGrey*. Two unpublished studies were found, which both did not meet inclusion criteria. The final sample of included literature consists of 29 studies.

To structure the systematic literature search and use appropriate and

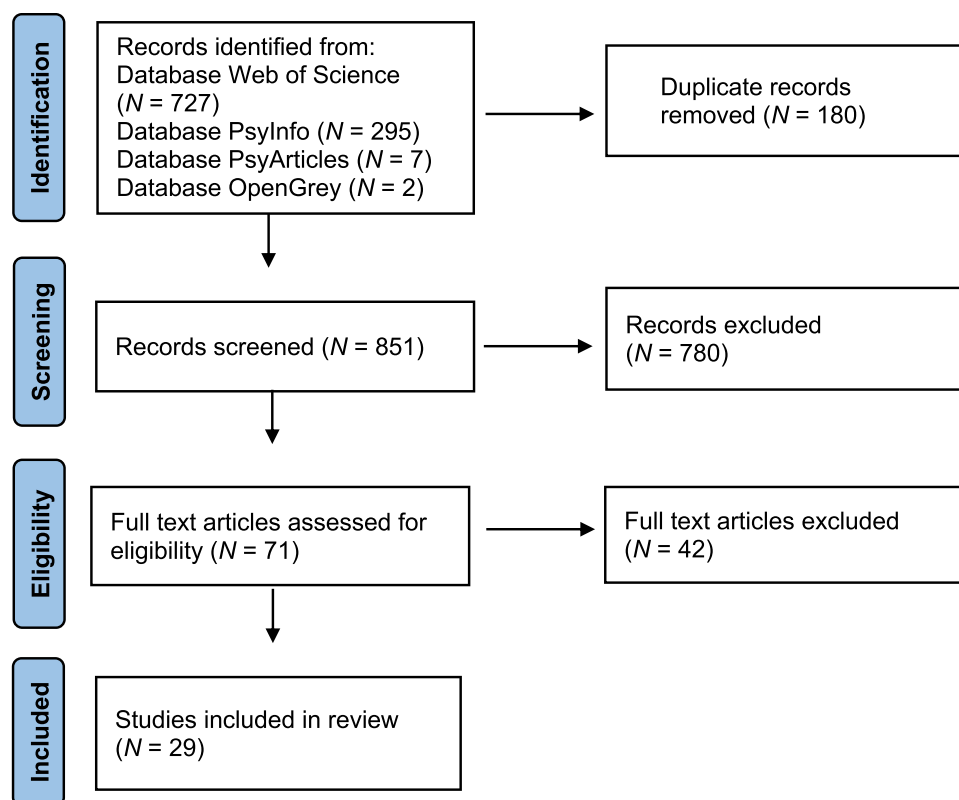


Fig. 1. Flowchart of Progress of the Literature Research.

individual search terms, we decided to assign the literature to different topical categories, based on their aim and methodological approach, which are *attachment*, *personality*, *problematic behaviour*, and *acquisition motivation*. The exclusion criteria reported in Table 1 were chosen based on these categories. Furthermore, applying to all categories we decided to exclude studies investigating behaviour of trained dogs or dogs used for specific tasks (e.g., police dogs, herding dogs or assistance dogs), because requirements and trainings for those dogs are different as certain traits are considered to make them successful in their field (e.g., high levels of energy among police dogs; Brady et al., 2018). Therefore, the compatibility between those dyads is not well comparable to pet dog-owner dyads. Also, only studies in English language were included.

Note that although every study was methodologically assigned to one topic category for literature search reasons, their relevant results might overlap between categories or even differ from those. For this reason, some studies will be reported within other categories in the following results section.

3. Results and discussion

Please find a detailed overview of the methods and results of all included studies in Table S1 in the Supplemental Material. In this section we first consider the main aspects of our systematic review separately (attachment, personality, problematic behaviour, acquisition motivation), then draw our general conclusion about what makes a good dog-owner team. Effect sizes and statistical parameters are only given for results that do not meet the criteria of a "moderate" effect according to APA guidelines. If these are not given, the reader can assume that at least a moderate effect was found. For results included in the section *acquisition motivation* almost no effect sizes existed, but preferences were often stated via percentual numbers (e.g. Blackman et al., 2019; Marston et al., 2005; Cohen and Todd, 2019). We therefore decided to name the studies' sample size in this section instead.

3.1. Attachment

Table 2 shows the main findings linked to attachment.

Table 1
Overview of the Exclusion Criteria and Included Studies.

Category	Specific Exclusion Criteria	Number of Included Studies
Attachment	Attachment behaviour not measured in relation to a certain outcome, nor as an outcome itself; for the latter one or both of the following aspects were not investigated: Individual dog (personality or typical behaviour, perceived wellbeing or satisfaction) and owner aspects (personality, habits and typical behaviour towards the dog except for only training methods, satisfaction with the relationship).	6
Personality	Assessment of only dog's or owner's personality, not the relationship between owner characteristics and dog personality traits; no outcome of the personality traits of the dyad (e.g., satisfaction with the relationship, problematic behaviour).	8
Problematic Behaviour	No inclusion of individual aspects of the dog (personality, attachment aspects, or typical behaviour) or owner (personality, habits and typical behaviour towards the dog except for only training methods, satisfaction with the relationship, attachment aspects).	6
Acquisition	Report of only the source or circumstances (e.g., dog as a present) of acquisition, not specific criteria/motivation of the owner.	9

3.1.1. Aspects linked to high global attachment

The finding that high interpersonal complementarity between dog and owner is linked to higher global attachment (Bauer and Woodward, 2007) is not surprising, as similar linkages have been found in human relationships. Interpersonal complementarity based on the interpersonal circumplex model of personality (Henry et al., 1986) means that owner and dog are located on opposite sides of the dimension of dominance and submissiveness and similar on the dimension of friendliness and hostility. Ansell et al. (2008) found that college roommates feel more cohesive when there is a high degree of complementarity, and married couples report higher relationship quality with stronger interpersonal complementarity (Markey and Markey, 2007).

The finding that a longer relationship is also linked to higher attachment (Marinelli et al., 2007) can be explained by the extended time to gain trust and make positive experiences. This is also supported by previous studies about dog-owner relationships (Bagley and Gonsman, 2005), even though the authors also found a negative association between length of the relationship and level of care, as well as quality of life of the dog. They argue that this seeming inconsistency can be explained by the fact that, as the length of the relationship increases, owner attention to the dog's needs decreases; old dogs generally receive less medical assistance, while dog attachment to the owner gets stronger. Perceived positive pet behaviour can be considered a generally positive aspect which likely improves and eases the overall relationship, which is further linked to stronger attachment (Mikulincer and Shaver, 2016).

Dogs may especially be able to fulfil needs regarding autonomy, competence, and relatedness because they are not critical, judgmental, or restrictive (Archer, 1997), and are able to provide unconditional affection and attention (Smith, 1983). The link between satisfaction for needs regarding autonomy, competence, and relatedness and high global attachment (Kurdek, 2008) is therefore reasonable and in line with self-determination theory (La Guardia et al., 2000). Owners' experience with pets could positively influence the relationship itself (Marinelli et al., 2007), because experienced owners know about their responsibility, negative aspects of dog ownership and handling of dogs in advance, so that they have the right expectations of dog ownership. This is in line with Patronek et al. (1996) who found inappropriate care expectations to be a main risk factor for the relinquishment of dogs. Another possible reason for the positive influence of owners' experience with pets on the relationship, could lie within a person's general preference to turn to dogs over other figures during emotional stress, which has already taken place in previous pet-owner relationships (and possibly correlated with the following factors found by Kurdek, 2009: Being male; divorced or widowed; showing high levels of care; low levels of self-disclosure and high levels of relatedness). The number of emotional bonds an owner has could allow conclusions on his or her ability to form meaningful relationships, which could relate to the ability to form a strong bond with the dog, too.

That owners who do not live with children experience higher attachment to their dogs (Marinelli et al., 2007; Meyer and Forkman, 2014) does not only make sense in view of the socially frequently used cliché that childless couples treat their dog like a child, but actually has scientific relevance. Blouin (2013) found a humanistic orientation towards one's own dog as one of three possible orientation forms, which is often characterized by spoiling the dog and treating it like a child. People with this orientation often report that it changes after they have their first child. Owners with children also usually have less time, which explains why research supports that they engage less in shared activities with their dog, see their dog less as a friend, and spend less time and money on their care (Bennett and Rohlf, 2007; Dotson and Hyatt, 2008). Marinelli et al. (2007) found complementing evidence for this correlation: Sharing the property with other people was linked to low global attachment. That people who live alone form closer bonds to their dogs, can be put into the context of a study by Chur-Hansen et al. (2009). The authors report that elderly women, who are overly high attached to their

Table 2
Overview of Attachment Aspects and Their Impact on the Dog-Human Relationship.

Authors	Aspects Linked to High Global Attachment
Bauer and Woodward (2007)	Complementarity between owner and pet interpersonal styles; perceived positive pet behaviour.
Marinelli et al. (2007)	Length of relationship ($r_s = 0.20$, $p = .04$); owners' experience with pets ($Z = -2.14$, $p = .03$); number of emotional bonds of the owner ($r_s = 0.25$, $p = .02$).
Marinelli et al. (2007), Meyer and Forkman (2014)	When owners did not live with children ($Z = -2.13$, $p = .033$; $t(414) = -2.48$, $p < .005$)
Kurdek (2008)	Care for the dog; openness, agreeableness ($r_s = 0.18$, $p < .01$) and conscientiousness ($r_s = 0.21$, $p < .01$) of the owner; energy, affection ($r_s = 0.22$, $p < .01$), and intelligence of the dog; satisfaction for needs regarding autonomy, competence, and relatedness of the owner.
Kurdek (2009)	Using dogs for attachment feature safe heaven was higher for being male ($\chi^2(7, N = 975) = 75.35$, $p < .01$); divorced or widowed; showing high levels of care ($\chi^2(7, N = 975) = 65.59$, $p < .01$); low levels of self-disclosure ($\chi^2(7, N = 975) = 70.29$, $p < .01$) and high levels of relatedness ($\chi^2(7, N = 975) = 154.93$, $p < .01$).
Aspects Linked to Low Global Attachment	
Marinelli et al. (2007)	Owning pure breed dogs ($Z = -2.88$, $p = .004$); sharing the property with other people ($r_s = -0.23$, $p = .03$).
Other Findings Linked to Attachment Styles	
Green et al. (2018)	An anxious attachment style of the owner was associated with turning to the dog in times of stress and spending time with the dog instead of spending time with a human.
Konok et al. (2019)	Dogs of owners with an anxious attachment style were mostly securely attached; dogs of avoidant attached owners were either avoidant attached or anxious attached and dogs of securely attached owners were securely attached themselves.
Green et al. (2018)	Both attachment anxiety ($t(476) = -1.74$, $p = .08$) and avoidance ($t(476) = -2.64$, $p = .01$) were found to be related to lower levels of caregiving behaviours.

pets, often suffer from mental health problems. While further research is needed to draw reliable conclusions, this could hint at unhealthy consequences in owners who are excessively attached to their dogs and do not have many other persons in their household. Indeed, Green et al. (2018) found that avoidant attached dog-owners often desire to replace human relationships.

Involvement in care correlated with high attachment to the dog (Kurdek, 2008). This is in accord with other findings that primary caregivers generally report more intimacy with their pets than do non-primary caregivers (Holcomb et al., 1985). Caregiving also generally provides opportunities for attachment bonds to develop, as it has been shown in parents and infants (Ainsworth and Bowlby, 1991). Those aspects might even become reciprocal over time.

Openness of the owner being linked to strong attachment bonds gets support from human relationship research, where openness has been found to be associated with satisfaction in romantic relationships (Donnellan et al., 2004; Neyer and Voigt, 2004). Though, studies have shown that openness in humans, at least measured as an individual trait and not as compatibility, is largely unrelated to attachment as such (for an overview see Nofle and Shaver, 2006). Agreeableness, by definition, refers to the tendency to be diplomatic, cooperative, helpful and trusting (Digman, 1990) thus likely improving general relationship quality. Studies have furthermore shown a positive correlation between a secure attachment style and agreeableness (Nofle and Shaver, 2006). Conscientiousness could be one of the traits making an owner a per se good handler, as he or she possesses the sense of responsibility to care for the dog's wellbeing. The dog traits energy, affection and intelligence also represent stable characteristics that promote positive interactions (Hazan and Zeifman, 1999). Energy and intelligence might be traits that improve the affinity of the dog to learn tricks, which is furthermore linked to owner satisfaction and perceived closeness (Chopik & Weaver, 2019). The fact that dog-owner dyads that share more activities are faced with less behavioural problems (Bennett and Rohlf, 2007) supports this hypothesis.

3.1.2. Aspects linked to low global attachment

Besides the above discussed positive influences on the bond of dog and owner, owning pure breed dogs is linked to low global attachment (Marinelli et al., 2007). Potentially, the acquisition motives of these owners were based on the breed and look of the dog. Pure breed dogs are sometimes seen as status symbols (Hirschman, 2002) and status dog ownership is believed to have less personal meaning for the owner, but is more motivated by showing wealth and peer acceptance (Maher et al.,

2017).

3.1.3. Other findings linked to attachment style

The attachment style of an owner was found to be linked to ownership in the following way: generally, greater anxiety was associated with turning to the dog in times of stress and spending time with the dog instead of spending time with a human (Green et al., 2018). An anxious attachment style is characterized by one's concern with being accepted or rejected by others, often resulting from negative childhood experiences (Bowlby, 1973). This result therefore is reasonable, as dogs are considered to be very loyal, and to provide unconditional love (Coren, 2002). For anxious attached persons, the relationship to their dog could therefore feel more reliable than human relationships. Both attachment anxiety and avoidance were found to be related to lower levels of caregiving behaviours (Green et al., 2018). This is in line with the previously discussed result of Kurdek (2008), that care for the dog is positively correlated with high attachment.

One study found indications that owners' attachment and caregiving style might affect the dogs' attachment style: dogs of owners with an anxious attachment style were mostly securely attached; dogs of avoidant attached owners were either avoidant attached or anxious attached and dogs of securely attached owners were securely attached themselves (Konok et al., 2019). That persons with an anxious attachment style mainly own securely attached dogs is in some contrast with research on human mother-infant relationships, in which the insecure attachment attributes often show in the child, too. One possible explanation for this discrepancy could be that, in a less complex dog-human relationship, experiencing that its owner enjoys spending time with them has a general positive impact on the dog. That dogs of avoidant attached owners were either avoidant attached or anxious attached, is more in line with human attachment research, where both combinations of parents' and childrens' attachment styles co-occur frequently. Overall, the study by Konok et al. (2019) found avoidant attached owners to be the greatest risk factor for an insecure attachment style in the dog.

3.2. Personality

Table 3 shows the main findings linked to personality.

3.2.1. Combination of traits linked to owners' relationship satisfaction

Looking at the results, two different sets of trait combinations become clear: similar traits and distinct ones. Similar traits exist more often in actual dog-owner dyads (Dodman et al., 2018; Kis et al., 2012).

Table 3
Overview of Personality Aspects and Their Impact on the Dog-Human Relationship.

Authors	Combination of Traits Linked to Owners' Relationship Satisfaction
Cavanaugh et al. (2008)	When the owner perceived their dog to be more open; agreeable and neurotic than themselves.
Curb et al. (2013)	Similar expression of the traits sharing possessions; enjoyment of running outside ($r(88) = 0.249, p = .007$); whether or not they engage in destructive activity ($r(88) = 0.212, p = .022$) or whether or not they are able to get along with their peers ($r(88) = 0.195, p = .036$).
Individual Aspects Linked to Owners' Relationship Satisfaction and Perceived Closeness	
Chopik & Weaver (2019)	High levels of owner agreeableness; active/excitable dogs; dogs' responsiveness to training.
Cavanaugh et al. (2008)	Dogs with high traits of openness and agreeableness.
Curb et al. (2013)	Less territorial dogs ($r(86) = -0.213, p = .023$) and dogs that less likely display a tendency to destroy objects ($r(86) = -0.279, p = .003$); lower levels of owners' relationship satisfaction were associated with dogs running right up to the owner without hesitation ($r(86) = -0.239, p = .010$).
Meyer and Forkman (2014)	Dogs' social fear was positively correlated with owners' perception of emotional closeness ($t(414) = 2.61, p = .009$). Keeping a dog only for company was associated with low emotional closeness.
Other Findings Linked to Personality Traits	
Szánthó et al. (2017)	Owners who rated themselves as empathic perceived their dog as more reactive to their emotions ($r = 0.229, p < .01$) and more empathic owners had fewer problems with their dogs.
Kotrschal et al. (2009)	Owners high in neuroticism were more attached and paid more attention to their dogs, but those dyads were less successful in an operational task, Extraverted owners considered their dog as a companion for shared activities, but less as social supporters.
Zeigler-Hill and Highfill (2010)	Compatibility based on the interpersonal circumplex model was only related to reported positive attitudes of owners towards their dogs for the warmth dimension.

While some authors conclude that similarity improves satisfaction (Gaunt, 2006; Holland, 2019) there has also been research that found neither similarity nor dissimilarity to predict relationship satisfaction (Gattis et al., 2004; Robins et al., 2000). However, the results by Cavanaugh et al. (2008) and Curb et al. (2013) (Table 3) indicate positive consequences from both combinations.

That dogs' scoring higher than their owners on openness and agreeableness is linked to high relationship satisfaction (Cavanaugh et al., 2008) could be explained by the potential general positive perception of these traits (see above). As a qualification, for human relationships, Brehm et al. (2002) reported that openness does not contribute to success and satisfaction. A different explanatory approach can be found within the social support hypothesis (O'Haire, 2010), which proposes that companion animals act as facilitators of social interactions between other human beings and provide social support themselves (Beck and Katcher, 2003). Openness and agreeableness of the dog could represent traits which enable them to facilitate these social interactions especially well. Particularly in cases where the owners do not possess these traits, they might benefit greatly from their presence in their dogs. For neuroticism, there also is a contradictory finding relative to research on human relationships, which reveals a negative impact of neuroticism on relationship satisfaction (Karney and Bradbury, 1997). It is not immediately evident why the opposite occurs in dog-human relationships where dogs score higher on this trait than their owners (Cavanaugh et al., 2008).

The positive impact of similarity in sharing possessions and whether or not dog and owner are able to get along with their peers (but note that the latter is only supported by very small effect sizes, see Table 3) can be explained by the general positive attribution of these aspects (Belk, 2009). Furthermore, these aspects are likely linked to other positive traits (e.g., getting along with peers may correspond with other prosocial attributions like being friendly). For enjoyment of running outside, dogs and humans enjoying an active lifestyle complement each other. This is both intuitive and reminiscent of research suggesting that same hobbies strengthen a relationship in married couples (Gager and Sanchez, 2003) or friendships (Johnson, 1989).

3.2.2. Individual aspects linked to owners' relationship satisfaction and perceived closeness

The positive impact of the individual aspects agreeableness, activity level and openness is quite intuitive and has already been discussed. Dogs' responsiveness to training might enable both owner and dog to experience a sense of achievement and can be related to the above-described phenomenon that same hobbies strengthen the relationship.

The same applies to sharing engagement in destructive activity. This is also in line with the fact that keeping a dog only for company and not engaging in other shared activities such as agility is connected to lower emotional closeness (Meyer and Forkman, 2014). Territorial dogs, dogs that display a tendency to destroy objects and dogs that run right up to the owner without hesitation, can furthermore all be considered problematic. Not surprisingly, undesirable behaviour is linked to unsatisfying ownership as will be explained in more detail in the next section.

Dogs' social fear level was positively correlated with owners' perception of emotional closeness (Meyer and Forkman, 2014). This association could reflect that fearful dogs might search for their owner's attention and generally initiate contact with their owner more often (Wedl et al., 2010), thus promoting perceived closeness. Another possible explanation is that owners who feel very close to their dogs show high levels of care and influence the dogs so that they become more fearful, in broad analogy to findings from infant-parent relationships suggesting that children of overprotective parents tend to be fearful (Segrin et al., 2013; Triger, 2013).

3.2.3. Other findings linked to personality traits

Empathic owners perceived their dog as more reactive to their emotions and also had fewer problems with their dogs (Szánthó et al., 2017). This result is in line with the fact that similar expressions of traits of dog and owner often co-occur. The outcome that similarity in empathy leads to fewer problems may reflect that empathy also represents a prosocial trait (Decety et al., 2016).

Owners higher in neuroticism were more closely attached and paid more attention to their dogs (but were less successful as dyads in an operational task, Kotrschal et al., 2009). As already described above for the case of dogs, this result is surprising, as neuroticism is linked to low relationship satisfaction in humans (Karney and Bradbury, 1997). In the case of owner neuroticism, one could think of its negative impact on the relationships with other people and a therefore stronger bond with their dog that compensates for it.

Extraverted owners considered their dog as a companion for shared activities, but less as social supporters (Kotrschal et al., 2009). This result can be brought in line with the above reported result by Marinelli and colleagues (2007). An extraverted person might enjoy a broad social life, but could potentially still have less meaningful and emotionally close bonds (Pollet et al., 2011). Human extraversion therefore could promote lower attachment to a pet dog, which likely is connected to not viewing the dog as a social supporter.

Compatibility of owner and dog characteristics was only related to reported positive attitudes of owners towards their dogs for the warmth

dimension (Zeigler-Hill and Highfill, 2010). Complementarity in warmth is unsurprisingly linked to positive owner attitudes, though in the study by Bauer and Woodward (2007), high global attachment was found to be linked to both dimensions (warmth and dominance/submissiveness) of complementarity between owner and pet interpersonal styles. Attachment and positive attitudes are two different constructs, but one would still expect them to be connected enough, to show similar results concerning the interpersonal circumplex model. Especially surprising might be Zeigler-Hill and Highfill's negative findings regarding dominance, which may be expected to be of particular importance in dog-owner relationships which have a natural power imbalance. In adult human relationships, attachment bonds can be considered symmetrical by default and both counterparts can alternate between the attachment and the caregiving behavioural system (Julius et al., 2014); dog-owner relationships are asymmetrical, also because dogs depend on the care of their owners.

3.3. Problematic behaviour

Table 4 shows the main findings linked to problematic behaviour.

3.3.1. Aspects linked to aggression in dogs

The linkage of high stranger-directed aggression to more physical punishment, higher dog-directed aggression and dogs that were acquired as puppies or for guarding purposes (Hsu and Sun, 2010) is in line with the finding in humans that early experiences of violence often result in aggressive behaviour towards others (Dodge et al., 1990). Acquiring a dog as a puppy might reinforce the impact as experiences during a dog's first weeks of life contribute to shaping its long-term behaviour (Foyer et al., 2013). This effect might be particularly relevant when dogs are specifically acquired for guarding purposes, as these dogs are often wanted to show stranger-directed aggression (Maher et al., 2017). Nevertheless, it should be kept in mind that the direction of these effects is unclear; for instance, it could be that owners can observe aggressiveness in older dogs more easily than in puppies and therefore do not choose aggressive adult dogs as often. Similarly, owners could use physical violence to punish dogs that already show aggressive behaviour.

The result that dogs of anxious attached owners are less aggressive towards strangers (Gobbo and Zupan, 2020) seems surprising, considering evidence from humans that anxious mother-infant attachment increases the risk of child aggression (Amani, 2016), and shows that there is no easy comparison between owner-dog and mother-infant combinations (Prato-Previde et al., 2003; Savalli and Mariti, 2020). Owner-directed aggression was found to be linked to avoidant attached

owners (Gobbo and Zupan, 2020). The authors explain this through the characteristic behaviour in avoidant attached adults of being ignorant and not providing enough affection, intimate contact and availability (Hazan and Shaver, 1987). As a result, the dog might be unable to use its owner as a secure base, which further evokes fear, one of the most common origins for aggressive behaviour (Flint et al., 2017). This idea gains further support from the study by Konok et al. (2019), who found that avoidant attached owners (but not anxious attached ones) represent a risk factor for an insecure attachment style in dogs.

High neuroticism and low sociability of the owner were found to be generally linked to human-directed aggression of the dog (Gobbo and Zupan, 2020). Similar, owners who are neurotic and score low on the lie/social desirability scale, have been found to often belong to a dysfunctional dyad (expressed by dogs' aggression, Canejo-Teixeira et al., 2020). These findings are complemented by other canine research: low sociability has found to be linked to stranger-directed and child-directed aggression (Kaneko et al., 2013) and sociable dogs were found to be more comfortable around strangers, resulting in lower stress levels and better social control (Yang et al., 2017). The connection between owner neuroticism and problematic aggression of the dog is in line with neuroticism being linked to low relationship satisfaction in humans (Karney and Bradbury, 1997), but further stresses the contradiction of the result by Kotrschal et al. (2009), that neurotic owners are more closely attached to their dogs.

Dogs that spend more than five hours a day with their owners scored lower on dog-directed aggression (Hsu and Sun, 2010), which is supported by research showing a linkage between dog welfare and time they are left alone at home per day (Rehn, Keeling, 2011; though it should be kept in mind that the direction of this correlation could also be the other way round, i.e. lower aggression may lead to spending more time together). This also stresses the importance of an adequate treating of the dog that may be able to prevent behavioural problems to some degree (e.g., Hsu and Sun, 2010). Furthermore, high perceived costs of ownership can be related to high canine aggression and/or disobedience (van Herwijnen et al., 2018). Owners with aggressive or disobedient dogs may experience higher costs, for example because they cannot easily take their dog to social events. Also, the influence of different aspects differs depending on whether or not a dog is categorized as aggressive. Gobbo and Zupan (2020) found several trait correlations which only occurred within certain groups and which connections have to be clarified in future research. To name one example, the authors found that within the group of non-aggressive dogs, more playful dogs were more sociable. They explain this by the evolutionary function of social play, which is to enable a better socio-cognitive development and thus contributes to appropriate (non-aggressive) social behaviour of

Table 4
Overview of Different Aspects Influencing Canine Behavioural Problems.

Authors	Aspects Linked to Aggression in Dogs
Hsu and Sun (2010)	Stranger-directed aggression was positively related to physical punishment; dog-directed aggression was linked to being aggressive towards strangers and dogs that were acquired as puppies or for guarding purposes; dogs that spent more than five hours a day with their owners scored lower on dog-directed aggression.
Gobbo and Zupan (2020).	Dogs of owners which were anxious attached were less aggressive towards strangers; owner-directed aggression was linked to avoidant attached owners; high neuroticism ($F = 3.85, p = .03$) and low sociability of the owner were linked to human-directed aggression of the dog.
Canejo-Teixeira et al. (2020)	Owners which are neurotic ($F(1, 253) = -2.096, p = .037$) and score low on the lie/social desirability scale ($F(1, 253) = 4.767, p = .037$).
Van Herwijnen et al. (2018)	High perceived costs of ownership ($rs = -0.15, p < .001$) were related to aggression and/or disobedience ($rs = -0.21, p < .001$).
Aspects Linked to Separation Related Problems	
González-Ramírez et al. (2018)	Highly attached owners ($Z = -3.331, p = .001$); lower trainability scores ($Z = -3.073, p = .002$); worse general dog-owner relationship ($Z = -2.092, p = .036$); owners perceiving high costs of ownership ($Z = -2.294, p = .022$).
Konok et al. (2015)	High avoidance score of owners and neurotic dogs.
Lenkei et al. (2018)	Dogs of lenient owners rather barked than whined in a separation test ($F(2,24) = 5.952, p = .008$); dogs with owner-reported separation related problems whined less frequently than dogs without separation problems, if they had lenient owners ($F(2,24) = 8.453, p = .002$).
Aspects Linked to General Behavioural Problems	
Bennett and Rohlf (2007)	Low engagement in training activities, as well as shared activities.

dogs.

3.3.2. Aspects linked to separation related problems

The positive impact of trainability has previously been described, so the association of low trainability with behavioural problems as found by González-Ramírez et al. (2018) and Bennett and Rohlf (2007) is not surprising. The same applies for associations of separation related problems with bad dog-owner relationship and perceived high costs of ownership (González-Ramírez et al., 2018), as well as the association of low shared activities and canine behavioural problems in general. That highly attached owners often owned dogs with separation related problems (González-Ramírez et al., 2018) might be because the owners themselves are very worried about the imminent spatial separation, which in turn creates a negative feeling in the dogs. This is supported by the fact that children of anxious parents, who might suffer from separation anxiety themselves, have a higher risk of separation anxiety (Last et al., 1991). Avoidant attachment in owners, as well as the dog trait neuroticism (Konok et al., 2015) have already been discussed. The positive correlation of these factors with separation related problems, again points towards the high risk of avoidant attached owners and the influence of neuroticism (which remains to be clarified).

Dogs that bark in a separation test more likely had lenient owners and dogs with separation related problems whined less frequently than non-problematic dogs, if they had lenient owners (Lenkei et al., 2018). One simple explanation for this finding might be that barking, compared to whining, is a more noisy and disturbing behaviour, which stricter owners will likely stop at early stages. Also, Lenkei and colleagues assume that lenient owners may not notice fear-related separation related problems, where the main form of vocalisation is whining (Pongrácz et al., 2017).

3.3.3. Aspects linked to general behavioural problems

Furthermore, Bennett and Rohlf (2007) found that low engagement in training activities, as well as low shared activities in general, are linked to problematic dog behaviour, which gets support and can be linked to the previously reported results by Curb et al. (2013), that similar expressions in the way they like to spend their time (running outside, engaging in destructive activity, getting along with peers), correlates with relationship satisfaction.

3.4. Conclusion of Hypothesis 1 and 2

The above discussed results regarding attachment, personality and problematic behaviour provide evidence that the first and second research hypothesis receive support from the surveyed studies. In short, attachment styles and personalities of both owner and dog impact functioning and satisfying dog-owner relationships, as well as the occurrence of canine behavioural problems. They do so in multiple yet systematic ways, and both individually and in specific combinations. It has to be kept in mind though, that the surveyed studies did not control for one set of characteristics, when investigating the effect of the other, so that potential connections and interdependencies may be left undiscovered.

3.5. Acquisition motivation

The inclusion of studies investigating acquisition motivation of owners aims at identifying a possible discrepancy between factors associated with successful ownership and *actual* choice criteria of owners (in line with research aim 2). According to this objective, this section only identifies and summarises the most important acquisition motivation and does not discuss its background in detail. Table 5 gives an overview of the most important acquisition motives.

Besides the acquisition motives reported in Table 5, some studies found other interesting aspects linked to the purchase of a dog. In one study, 50% of all dog acquisitions were reported to be unplanned and

Table 5

Overview of Acquisition Motivation.

Acquisition motives	Authors
Distinctive appearance	Blackman et al. (2019; N = 2158), Marston et al. (2005; N = 62), Ozcan et al. (2019; N = 581), Sandøe et al. (2017; N = 846)
Breed attributes, convenience	Sandøe et al. (2017)
The dog's size; it's behaviour; compatibility with the household and temperament during the first meeting	Blackman et al. (2019)
Calm behaviour; soft eye contact; friendly approach and reaction to physical contact; the dog's reaction to an existing pet; response to children	Marston et al. (2005)
Friendliness, playfulness, age and intelligence	Cohen & Todd (2019; N = 145)
Adaptation ability, social influence, working expectation, and breed characteristics in their choice of dog	Ozcan et al. (2019)

reasons to keep the dog included a prior relationship with the dog, a quickly evolving emotional attachment, the dog's vulnerability, or the dog's physical appearance (Holland et al., 2021; N = 142).

Another study (Blackman et al., 2019) found two different types of future owners. The first type prioritises a rescued dog and is mainly looking at their temperament on the first meeting and their perceived compatibility with their household. The second type looks for a particular morphotype of dog and, in addition to compatibility with the household and temperament on the first meeting, prefers those that they believe to be good breeders. Owners of the first type were reported to be slightly less satisfied with their choice than owners of the second type. This could be because the handling of a rescued dog can be more difficult and at times frustrating, as such dogs often have had negative experiences with humans.

A study by Sandøe et al. (2017) found a difference between owners' acquisition motivation of breeds that are considered to be healthy, compared to others that are known to be breeds with several health issues, due to the way they are bred. Owners of "healthy breeds" were significantly more motivated by breed attributes, like health, and less motivated by the distinctive appearance of the dog. These owners experienced the lowest level of attachment compared to the other breeds. The authors see one possible explanation for this in the intrinsic or extrinsic motivation of the owner. They argue that the owners of the "unhealthy breeds" acquire their breeds for status reasons, which are of extrinsic nature. Nevertheless, they might perceive their dog as helpless and in need of care and control. The intrinsically motivated owners of the "healthy breeds" might more likely appreciate the individuality and autonomy of the dog, and may perceive their dogs as friends rather than "children in need". As a perspective, further investigations into differences in owner attachment between "healthy breeds", "unhealthy breeds" and mixed breeds might be warranted, as Marinelli et al. (2007) found owning a pure-bred dog to be linked to low global attachment in general.

Retrospectively, the majority of owners believed their dog fulfilled their expectations at least most of the time after the first month of adoption (Marston et al., 2005). Young age of the dog at acquisition, history of losing or abandoning a dog and cuteness as acquisition motivation were the strongest determinants of current unsuccessful ownership (Weng et al., 2006; N = 295). Poor selection, escaping, separation-related problems, aggression and chasing wildlife were named as reasons for returning the dog (Marston et al., 2005). Recent dog adopters also reported an overall drop in the number of friends they spent time with (Green et al., 2018; N = 144), which could potentially influence the decision of dog relinquishment as well. An interesting aspect of the present review may be the linkage between cuteness (possibly related to young age of the dog at acquisition, Weng et al.,

2006) and unsuccessful ownership. This finding can stress the importance of all above reported influences of personality and attachment on behavioural problems and satisfaction with ownership.

Most owners purchased the breed they had planned. Future owners with high levels of self-efficacy and who frequently talked to others about dog acquisition perceived lower costs of ownership. These results are in line with self-efficacy theory (Bandura, 1977) as those owners might feel more efficient in the handling of the dog, especially if they have dealt with the topic a lot, for example in conversations with others. Future owners who frequently visited dog acquisition websites perceived higher costs and were less satisfied with their dogs (Bouma et al., 2020; $N = 193$). Frequently viewing pictures of dogs might indicate that owners prioritize on dog appearance, and although the mechanisms and consequences involved remain to be studied in more detail, this could potentially fit the finding that cuteness as acquisition motivation implicates unfavourable perspectives (Weng et al., 2006).

3.6. Conclusion of Hypothesis 3

In conclusion, the third hypothesis – that owners' actual acquisition motivation is not well informed by knowledge about the antecedents of optimal dog-owner pairings – receives considerable support as well. While stated acquisition motives are numerous, only one study found perceived household compatibility to motivate the purchase decision. Remarkably, compatibility in terms of personality dimensions or the influence of attachment were not once named amongst the acquisition motives, despite the fact that their importance has been well documented (it has to be considered though, that most included studies gave already defined response categories and owners might still have considered compatibility within these categories, e.g. friendliness). In contrast, the look of the dog was often reported to be an important acquisition motive, although cuteness as one aspect of looks is actually related to unsuccessful ownership.

3.7. Limitations of this review

Due to the aim of this review, to identify what determines functioning and satisfying dog-owner dyads, the inclusion criteria were chosen to include both owner and dog aspects and a certain outcome. This was done to draw conclusions and future councils in terms of which dogs fit to which owners and how to use this knowledge in acquisition processes. The compatibility and match of those aspects were directly investigated in only very few studies (e.g., Bauer and Woodward, 2007); more typically, they were considered individually. Although this review attempts to synthesise the findings and contributes to the stated research objective, there clearly remains a large gap in research that calls for more specific research into interactive effects of dog and owner characteristics.

It also generally has to be considered, that the included studies concerning attachment and personality, investigated already existing dog-owner pairs, where the two partners had time to adapt to each other. The influence of this process needs to be investigated in future research. In turn, it also needs to be mentioned that most of the acquisition studies investigated the purchase motives of puppies, where development of personality is not fully completed (Beaudet et al., 1994). This knowledge might have impacted owners not to mention personality as a motive.

In systematic reviews, both significant and non-significant results must be considered. Unfortunately, non-significant results tend to be de-emphasised in publications, or studies with non-significant findings are not published at all (Fanelli, 2012). Although we aimed at including grey literature in our search for this review, publication bias (Sterling, 1959) remains a limitation.

Moreover, limited generalisability of individual studies, due to a small number of participants or an over-representation of participants who identified as female, must be taken into consideration when

interpreting the findings. Additionally, all included studies surveyed voluntary participants. This partly explains the high numbers of satisfied dog owners and results in the fact, that no representative sample is given. The assessment furthermore took place via questionnaires, a method which only considers the owners opinion about the relationship. This one-sided assessment is likely biased, compared to human-human relationships. Also, the majority of the reported results was only found in a single study. Confirmation from an independent researcher or population can therefore not be provided.

Another limitation of this review is that only very few of the studies used methodological approaches, such as longitudinal designs, to assess the direction of the effects. This means that the question whether two complementing traits in dog and owner evolved over time of ownership (and in this case whether the dog influenced the owner, the owner influenced the dog, or other circumstances influenced both) or whether the owner consciously or unconsciously chose a dog with certain traits, remains open.

It has to be mentioned that the acquisition studies showed an influence of the dog's breed on the owner's choice and expectations of ownership. It is therefore possible, that the way owners treat and perceive their dogs, also depends on the breed, an aspect which was not included in the investigations of this review (but see: Morrill et al., 2022). Finally, there is also evidence that (consciously or unconsciously) perceived self-similarity could be an idiosyncratic aspect of physical appearance that can influence dog selection (Roy and Christenfeld, 2004; Payne and Jaffe, 2005). This was beyond the scope of the present review, simply because self-similarity was not among the stated acquisition motives in the surveyed studies. Nevertheless, and given how systematically self-similarity affects perceived trust in human perception (e.g., DeBruine (2002), this is another aspect that may deserve future research.

4. General conclusions

This section will address the last research aim of this review – determining what impact the knowledge on functioning and satisfying dog-owner dyads can have on future ownership. The following gives initial guidance on what owners should look for in their dogs, based on their own personality and attachment style. To accomplish a compatible match, owners should choose dogs that share similar expressions of warmth, sharing possessions and enjoyment of running outside. Moreover, owners should look for dogs with higher expressions than themselves of openness, agreeableness and neuroticism (though evidence regarding neuroticism will require further confirmation). Regarding dominance vs submissiveness, opposite expressions (either dog submissive and owner dominant or dog dominant and owner submissive) are ideal, although the combination of a dominant dog and a submissive owner appears to be challenging in practical ownership.

Regarding owner features, high number of emotional bonds of the owner, openness, agreeableness, conscientiousness, and empathy are all linked to functioning ownership. In contrast, avoidant attachment style, high expression of neuroticism, low expression of social desirability and the tendency to be highly attached can be seen as potential risk factors that are often found in owners belonging to a dysfunctional dyad. In regards to dog ownership, being highly attached, has been found to be related to being divorced, widowed or living without a child - possibly correlated with a humanistic orientation towards the dog. These factors might represent additional risk factors for an overly high attachment bond to the dog, resulting in dysfunctional ownership. If owners perceive themselves as having low expressions on traits linked to functioning ownership and/or possess some of the risk factors, it might be especially important to choose a dog which possesses more positive and less of potential risk factors. Traits in dogs linked to satisfying ownership include energy, affection, intelligence, openness, agreeableness and responsiveness to training. In turn, dog risk factors may include social fear, low training engagement, territorial dogs and dogs that display a

tendency to destroy objects.

Besides these comments on compatibility, the studies investigating problematic dog behaviour also emphasize the importance of environmental conditions including household factors, training methods and how much time the owner spends with the dog. The results show that what is commonly considered as “treating the dog well” can already contribute to preventing behavioural problems, especially those connected to aggression. Other important factors are the appropriate expectations about ownership, such as care expectations, that have been found to be a main risk factor for the relinquishment of dogs if unrealistic.

5. Future directions

The conclusions discussed here could potentially be used to develop a test, that assesses owner characteristics such as personality, attachment style and living conditions and matches this with complementing traits that the future dog should possess. This could happen based on the known attributions of a breed or, for more precision, on an examination of the individual dog personality. Especially for adult dogs in animal shelters who already have a stable personality and attachment style, this process could be very promising. The development of such test could also profit from recent research on the influence of dogs' sex on their attachment style (D'Aniello et al., 2022). As previously described, appropriate matching could help forming dyads which are functional, satisfying and experience less behavioural problems in the dog. Further research is needed that examines the putative reciprocal nature of the different dog and owner aspects.

Either way, this review has shown the potential influence of modifiable aspects that can help prevent dysfunctional dyads. The potential of this scientific area therefore is very promising. It is hoped that future research closes the outlined research gaps and extends the to date small field of research. Ultimately, this may contribute to the solution of canine behavioural problems and the reduction of relinquishment of dogs, both issues with a high social and societal relevance.

CRedit authorship contribution statement

Each author declares substantial contributions through the following: the conception and design of the study, or acquisition of data, or analysis and interpretation of data, (2) drafting the article or revising it critically for important intellectual content. Yana Bender (1,2) Contribution to all named aspects. Juliane Bräuer (1,2) Contribution to conception, interpretation and revision. Stefan R. Schweinberger (1,2) Contribution to conception, interpretation and revision.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Appendix A. Supporting information

Supplementary data associated with this article can be found in the online version at doi:10.1016/j.applanim.2023.105857.

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