

Title: Beyond Puppy Selection – Considering the Role of Puppy Raisers in Bringing Out the Best in Assistance Dog Puppies

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Introduction

It is commonly reported that assistance dog recipients may wait for more than a year to obtain a suitable dog (Wirth and Rein, 2008). This suggests that demand currently greatly exceeds supply. To qualify for an assistance role, such as performing as a guide dog, hearing dog, seizure alert dog, or mobility service dog (Howell et al., 2016), dogs usually go through a raising and training process which is costly and often has high failure rates. Studies have found that up to 38% of assistance dogs fail to perform at the level required for certification, mostly due to behavioral reasons (Dollion et al., 2019). For guide dogs, the largest group of assistance dogs, failure rates are reportedly up to 50% (Arata et al., 2010; Tomkins et al., 2011; Wirth and Rein, 2008). This has led to increased attention on selecting puppies most suited to this work (Wilsson and Sundgren, 1997), and on improving how assistance dogs are formally trained (Batt et al., 2008; Rein et al., 2006; Rooney et al., 2016; Todd, 2018; Wenthold and Savage, 2007). One factor that has been largely overlooked is the extent to which individual characteristics of puppy raisers – usually volunteers drawn from the community who raise a puppy at their home for up to 12 months – affect whether an assistance dog puppy proceeds through training to become a certified assistance dog. These volunteers are also identified as puppy walkers, or foster carers. For consistency, this paper will use the term puppy raisers. They are distinct from assistance dog trainers or handlers; those who conduct advanced training or who receive the assistance dogs once they are trained and certified. We could find very few studies pertaining to this critical role, and those that were available mostly referred to guide dogs rather than other types of assistance dog roles. Nonetheless, to the extent that puppy raising programs are similar across industry groups, we present here a discussion of puppy raising that we believe applies across categories.

It is evident that, although genetics have an important role to play in determining dog behavior, they are not entirely deterministic when it comes to development of desirable behaviors. Instead, developmental experiences are equally important in shaping a dog's adult behaviors. Such experiences commence prior to birth, with a small but growing literature documenting differences in puppy behavior in association with different dietary intakes (Wilsson & Sundgren, 1998) and maternal nursing styles (Bray et al., 2017; Wilsson & Sundgren, 1998). This literature is not revisited here; our interest being primarily in post-weaning influences. Because puppy raisers are responsible for caring for and educating puppies during important post-weaning developmental periods, it is likely that outcomes may be affected by individual differences, such as differences in experience and competency, and in parenting and attachment styles. Assistance dog provider organisations are limited in the degree to which they can choose puppy raisers, due to the voluntary nature of this role and a shortage of supply. Therefore, it is not feasible to argue that potential raisers should only be invited to raise a puppy if they demonstrate an optimal combination of characteristics. Instead, we argue that, in addition to working hard to retain experienced puppy raisers, organisations should attempt to maximise puppy raising success by adopting training processes that promote new puppy raisers' competency, and their adherence to the program's instructions.

General Systems Framework

In this paper, we develop a model following the general systems framework (Boulding, 1956; Von Bertalanffy, 1968), which describes three stages of a general system, where the *inputs* are processed during the *throughput* to produce the *outputs* (Amagoh, 2008; Capps and Hazen, 2002). Development of puppies' behavior is influenced not only by individual factors but also their joint effects. Therefore, instead of discussing relevant factors in turn and individually, we adopt a holistic approach based on a general systems framework

(Boulding, 1956; Von Bertalanffy, 1968), which serves both as a means to organise relevant evidence and as a context for understanding those factors in relation to one another.

It is well-established that during the puppy raising period, especially in the first six months of puppyhood, puppies' experiences interact with their genetically predisposed temperament to develop each dog's personality and adult behavior (Appleby et al., 2002; Freedman et al., 1961; Vaterlaws-Whiteside and Hartmann, 2017). This interplay is referred to as the nature-nurture effect, with ample evidence available to support this interaction of genetic and environmental factors on behavioral development (for a review, see Plomin and Asbury, 2005). Research has been successful at identifying individual effects of some genetic and environmental factors. However, to better understand interaction effects on puppies' behavioral development more holistically, it is helpful to consider these factors from a broader, systemic perspective.

With a universal framework and an ability to deal with complex networks of factors, general systems theory has been adopted in a wide variety of disciplines including, but not limited to, social and natural sciences (Boulding, 1956; Von Bertalanffy, 1968). Puppy raising as a system, with behavior as its outcome of interest, can be understood from this general systems perspective. Based on this framework, puppy raising as a process enrolls selected puppies (*input*) into a one-year puppy raising period (see Figure 1). During this stage (*throughput*), puppies are trained, socialized and reared to become suitable for advanced training (*output*).

[Figure 1 about here]

The ages at which puppies enter and exit puppy raising programs vary across different organisations, with behavioral outcomes also being measured at various time points during these programs, starting from as early as six weeks (Asher et al., 2013), through to five, eight, and 12 months old (Harvey et al., 2017). This means that the puppy raising period typically

spans across many critical developmental stages, particularly during the first six months (puppyhood and juvenile) and even into young adulthood at around 12 months old (Appleby et al., 2002; Freedman et al., 1961; Vaterlaws-Whiteside and Hartmann, 2017). This paper refers to all assistance dog prospects as puppies. This does not imply that the dogs in the studies reviewed in this paper were in the early developmental stage of puppyhood, but rather reflects the general systems perspective of the review, i.e., ‘puppies’ are identified as the primary inputs of a ‘puppy’ raising program, regardless of their exact age.

Following this proposed general puppy raising model, we will firstly review the *output*, i.e. behaviors deemed suitable and unsuitable to assistance roles, so to be admitted to advanced training. We will then discuss the *input* by briefly reviewing some ‘nature’ components (e.g. breed and sex) that contribute to development of desirable behaviors (*output*) of assistance dog puppies. What will be evident from this brief overview is that these are rarely fully deterministic. Instead, various puppy raising factors (*throughput*) contribute a great deal to ensuring puppies’ behavioral suitability (*output*) to be admitted into advanced training.

In addition to the three stages of the general systems model (horizontal dimension), we also categorise the *throughput* factors into three levels (vertical dimension), i.e. theoretical (evidence-based puppy raising model), organisational (program design), and individual (puppy raisers’ practices) levels (see Figure 1). What will be argued is that the three levels are distinctive, yet measures and actions should be considered in combination at all three levels. Without one or another, the effort to achieve best-practice puppy raising outcomes would be compromised.

The output – Behavioral suitability

To qualify as an assistance dog, candidates need to pass assessments for their health, working performance, and general behavior (Bremhorst et al., 2018). Health criteria are

relatively easily assessed using specific objective measures, such as diagnostic imaging techniques for detecting elbow dysphasia (Fitzpatrick et al., 2009), or the use of electrocardiography for heart defects (Stafford-Johnson, 2006). Working performance, meanwhile, refers to the dog's ability to carry out assistance-specific tasks and effectively mitigate the difficulties of a handler's disability. Thus, the dog-handler team is assessed for this criterion, rather than the dog alone (Bremhorst et al., 2018).

The third category of assessment, and the one that forms the focus of this review, is the general behavior of the dog in public spaces. General behavior is one of three main criteria for success as an assistance dog as regulated, for example, in the United States (*Americans with Disabilities Act Title III Regulations*, 2017) and Australia (Australian Government, 1992). Regardless of regulations, assistance dogs need to be comfortable in unfamiliar environments and are required to exhibit appropriate manners to safely function in various public and private settings (Bremhorst et al., 2018). Dogs that do not meet this requirement are unable to be accredited to work as assistance dogs. Sometimes, dogs that are not suitable for one role, such as guide dog, might be re-purposed for another more suitable assistance role (e.g. medical alert dog). Often, however, these dogs are rehomed as companion dogs, resulting in the waste of many resources.

In the assistance dog literature, undesirable personality traits that could be identified during the puppy raising stage include fearfulness, stress, anxiety (Dollion et al., 2019; Goddard and Beilharz, 1982; Mizukoshi et al., 2008; Serpell and Duffy, 2016; Vaterlaws-Whiteside and Hartmann, 2017) aggressiveness (Serpell and Duffy, 2016), and distraction (Goddard and Beilharz, 1982; Kobayashi et al., 2013; Takeuchi et al., 2009; Vaterlaws-Whiteside and Hartmann, 2017). Dogs who are fearful, anxious, or aggressive may exhibit behaviors such as whining, pacing, excessive object chewing, growling, and/or biting. Behaviors of easily distracted dogs may include jumping up on people or pulling on the lead.

Inappropriate at-home manners, such as barking, growling, mouthing and other destructive behaviors, have previously been discussed in the context of puppy raising (Koda, 2001). Puppies are born with a predisposed temperament, however, behaviors that they learn and develop during their puppy raising period determine if they are suitable for further training in assistance-specific tasks (i.e. guiding, alerting, or responding to their handler's critical medical condition) and eventually graduate or qualify as assistance dogs (Asher et al., 2017; Bremhorst et al., 2018).

The input – Puppy breeding and selection

Puppies' breed and their sex have been found to be associated with their tendency to develop certain behaviors and their chances of success as an assistance dog (Goddard and Beilharz, 1982; Takeuchi et al., 2009). In the assistance dog literature, the common breeds used are German Shepherds, Golden Retrievers, Labrador Retrievers, and their crossbreeds. In some studies, German Shepherds demonstrated less favourable training outcomes (Asher et al., 2017, 2013) and they were more inclined to develop aggression towards strangers (Serpell and Duffy, 2016) compared to the other breeds. For Labradors and Golden Retrievers, within-breed variations were also observed, with purpose-bred puppies more likely to graduate than those obtained from external sources (Asher et al., 2013; Goddard and Beilharz, 1982). An early study by Goddard and Beilharz (1982) analysed data from more than 1,000 dogs from a guide dog association in Australia. The puppies in this study were both purpose-bred from the organisation's in-house breeding program, and obtained from external sources, but were mostly Labrador retrievers. The results showed that, over a period of 12 years, this organisation enrolled more purpose-bred puppies into their puppy raising program (from 14% to 91% of the total puppies) and the success rates of those puppies increased significantly (from 24% to 40%). The purpose-bred puppies demonstrated less fearfulness and excitement, and better concentration. However, they were more likely to

develop aggression and be distracted by other dogs (Goddard and Beilharz, 1982). The improved success rate demonstrates the value of selective breeding in producing suitable dogs, yet with various types of undesirable traits, selective breeding has not led to perfect outcomes.

Puppy sex is not generally helpful in terms of predicting ultimate success (Harvey et al., 2017); however, it does appear to be promising when predicting specific behaviors (Goddard and Beilharz, 1982; Takeuchi et al., 2009). For instance, sex was not a significant predictor in Harvey et al.'s (2017) model of predicting training success. However, these authors looked at ultimate success as the outcome measure, which comprises a wide variety of criteria. On the contrary, sex differences were observed when the outcome measure was considered at a more specific behavioral level (Goddard and Beilharz, 1982; Takeuchi et al., 2009). Female dogs had higher levels of energy (Takeuchi et al., 2009), and were more likely to develop fearfulness, but also to be less distractible (Goddard and Beilharz, 1982) than their male counterparts. When considering ultimate success, which includes (but is not limited to) a lack of fearfulness and distractibility, the latter findings may help explain Harvey et al.'s (2017) non-significant results.

If genetics plays an important role in determining success as an assistance dog, one might presume that selecting puppies via a behavioral test for desirable personality and temperament traits might improve success rates (Asher et al., 2013; Vaterlaws-Whiteside and Hartmann, 2017). However, a review of relevant studies across the general dog population suggests that puppies' behavior profiles at an early age (e.g., two to three months old) are less predictive of their adult behaviors than behavioral profiles measured when they are six months or older (Fratkin et al., 2013; Goddard and Beilharz, 1982; Jones and Gosling, 2005). Research on the assistance dog population echoes this pattern in suggesting that some traits, such as anxiety and level of activity, were predictable in the puppy raising period at around 5-

months of age, but most traits, including distractibility and body sensitivity, were more consistent when the puppies were around one year old (Asher et al., 2017; Kobayashi et al., 2013). Ennik et al. (2006) examined whether some prospective guide dogs might benefit from being ‘passed back’ from their original training program to one in which dogs were at an earlier stage of training. One of their findings, that being passed back on the basis of ‘needing more work’ was advantageous for some breeds but not others, confirms that different breeds might have distinct developmental trajectories.

This temporal variance in dogs’ behavioral consistency can be explained by the process of social maturity, which underlies behavioral changes in dogs during their early adulthood (i.e., 12 to 18 months old), and is commonly thought to be complete when they are around two to three years old (Overall, 2013). There is strong evidence that explains this developmental process in neuronal terms (Sowell et al., 1999; Yakovlev & Lecours, 1967). Maturation of the brain is accompanied by two simultaneous processes, one of which, called neural pruning, refers to a reduction in grey matter (i.e., the body of the nerve cells located at the outermost layer of the brain) seen in human adults, for example, as compared to adolescents (Sowell et al., 1999). The other process, myelination, commences in the posterior regions of the brain before birth and gradually progresses toward the prefrontal lobe during early adulthood (Yakovlev & Lecours, 1967). During this process, connections between nerve cells are insulated with a layer of fat cells which form a myelin sheath, enhancing communication between the nerve cells (Yakovlev & Lecours, 1967). Both myelination and neural pruning processes act to enhance the function of different regions of the brain as they reach maturation. The latest region to mature is the frontal lobe, which, in humans, is known to be responsible for many executive functions that influence social behaviors, including but not limited to, behavioral inhibition and emotional regulation (Luna et al., 2004). Although there is evidence of the myelination process occurring in canines (Fox, 1971), the process of

brain maturation in this species has not been well researched. As Overall (2013) suggested, much existing knowledge remains an assumption based on research on human and rodents.

Regarding current practices in the assistance dog industry, puppy selection serves the important role of eliminating puppies known to be at risk of developing problem behaviors, yet this does not ensure that the promising ones do not develop undesirable behaviors during the puppy raising time. This requires appropriate measures be available to address any undesirable behaviors at an early stage, with remediation becoming more difficult once a dog has progressed through early stages of neuronal and behavioral plasticity to reach maturity. In the Ennik et al. (2006) study cited previously, trainee guide dogs who were passed back for behavioral reasons were, overall, only half as likely as dogs who completed training normally to eventually graduate as a guide dog.

The throughput – Assistance dog puppy raising practice

Assistance dog puppy raising is a practice whereby puppies, who are generally bred for specific purposes such as guiding the blind or assisting humans with other disabilities (Howell et al., 2016), spend the early stages of their life living and learning with a volunteer puppy raiser. These raisers, typically recruited from the general public, are crucial to the assistance dog training industry, as the puppies need to learn to live and work in community settings (Batt et al., 2010). Generally, puppies leave their litter between six and 12 weeks of age and live with a raiser for approximately one year (Batt et al., 2010). As previously mentioned, puppies go through several developmental stages (puppyhood, juvenile, and young adulthood), which are critical to the formation of their adult behaviors (Appleby et al., 2002; Freedman et al., 1961; Vaterlaws-Whiteside and Hartmann, 2017). In addition to conventional puppy raising practices, whereby raisers are recruited from the public, there has been an increase in popularity of institution-based programs. Puppies are now reared in correctional facilities (Cooke and Farrington, 2016) and higher education settings (Lahman,

2018), where they receive training as well as exposure to various inanimate objects and socialization to humans and, where possible, other dogs or puppies, including during sensitive neurodevelopmental periods.

Puppy raising programs differ in their organisational structure and operational model. However, they share common objectives of not just caring for and raising puppies, but also establishing a foundation for desirable adult behaviors (Appleby et al., 2002; Freedman et al., 1961; Vaterlaws-Whiteside and Hartmann, 2017). During this process, organisations provide puppy raisers with guidance and support to train and socialize the puppies to ensure they do not exhibit behaviors or personality traits generally deemed unsuitable for assistance roles. With these commonalities, relevant factors occurring in this puppy raising process can be categorised into three levels, namely *theoretical* (evidence-based models), *organisational* (specific program design), and *individual* (program implementation by puppy raisers). Factors at these three levels and their potential influences on desired outcomes are discussed in turn.

Influences at a theoretical level – Available evidence-based recommendations

At a theoretical level, research in the assistance dog industry has identified several influencing factors and thus proposed several key areas to help program providers improve the behavioral outcomes of their puppies. Fearfulness and anxiety are two behavioral traits associated with disqualification in assistance dogs (Goddard and Beilharz, 1982; Mizukoshi et al., 2008; Serpell and Duffy, 2016; Vaterlaws-Whiteside and Hartmann, 2017). To help reduce these traits during the raising period, Rooney et al. (2016) synthesised available scientific evidence and made three recommendations: selecting puppies suitable in nature for their assistance role; managing the rearing environment; and ensuring the puppies' have positive exposure by introducing them to various stimuli gradually, and in a controlled manner. These suggestions are consistent with the nature-nurture framework and somewhat

aligned with the general puppy raising model (see Figure 1); encouraging organisations to not only avoid enrolling unsuitable puppies (*input*) to begin with, but also to pay attention to the puppy raising process (*throughput*), the aim of which is to set up the selected puppies for success (*output*).

The review by Rooney et al. (2016) focused exclusively on strategies to ameliorate undesirable traits like fearfulness and anxiety, but there are other behaviors also considered as reasons for disqualification, such as aggressiveness, chasing and distraction (Arata et al., 2010; Gazzano et al., 2008; Tomkins et al., 2011). To guide standard puppy raising practices, it would be helpful for future research to extend Rooney et al.'s (2016) work to consider how to eliminate these other undesirable behaviors, particularly aggressiveness (Serpell and Duffy, 2016) and distraction (Goddard and Beilharz, 1982; Kobayashi et al., 2013; Takeuchi et al., 2009; Vaterlaws-Whiteside and Hartmann, 2017). Of equal if not greater importance, however, is the need for basic research to identify desirable traits, which can then be selected for and encouraged during early stages of development. Many extensive discussions are available which focus on identification and evaluation of puppies' behaviors, e.g., Jones and Gosling (2005), Gazzano et al. (2008), and Fratkin et al. (2013), and an in-depth discussion about desirable and undesirable characteristics is beyond the scope of this review. Our focus is on identifying and organising evidence of puppy raising factors that affect a puppy's general behavioral development. A significant limitation in our current understanding, nonetheless, is in specifying exactly what traits should be the subject of positive reinforcement during development. Eliminating undesirable behaviors is important, but identifying, eliciting and reinforcing desirable ones, like friendliness, calmness and task-focus, may well be more effective. Interestingly, an early study from our group focused on identifying the characteristics of an 'ideal' companion dog in Australia (King et al., 2009), an

exercise later replicated in an Italian sample (Diverio et al., 2016). Similar studies in assistance dogs are urgently needed.

Meanwhile, little is known about the feasibility of applying evidence-based recommendations in practice, particularly when puppy raising is generally carried out by volunteer raisers. Establishing how best, in theory, to raise assistance dog puppies is critical for long term success of the industry, but equally important is finding ways to implement those recommendations, in practice, as effectively as possible.

Influences at an organisational level – Specific program design

Although some evidence-based recommendations for puppy raising practices are available, research documenting how well puppy raising programs are implemented is scarce. One recent study (Vaterlaws-Whiteside and Hartmann, 2017), however, examined the effects of systematic and standardised socialization management on guide dog puppies prior to entering their puppy raising stage, revealing promising outcomes. Vaterlaws-Whiteside and Hartmann (Vaterlaws-Whiteside and Hartmann, 2017) evaluated the effectiveness of a newly developed early socialization program with a total of 33 puppies of different breeds, namely Golden Retriever, Labrador Retriever, and crosses of these two breeds. They performed a systematic procedure to expose 19 puppies in a treatment group to various stimuli, from zero to five weeks of age, in addition to the existing socializing protocol of their partnering organisation. There were no significant breed differences, when assessed at six-weeks-old, but the puppies in the treatment group scored significantly higher than the 14 puppies in the control group, who were exposed only to the existing program, on the Puppy Profiling Assessment (Asher et al., 2013). This test measures puppies' responses to stimuli under a controlled setting including, but not limited to, noise, being stroked, and the presence of moving model animals.

Interestingly, not all of the effects obtained at the end of this early socialization program were observed later when the puppies were in a puppy raising program, of which the quality and level of standardisation of implementation were unknown (Vaterlaws-Whiteside and Hartmann, 2017). At eight months old, approximately seven months after completion of the early puppy socialization treatment, all puppy raisers rated their puppies on different indices of the Puppy Training Supervisor Questionnaire (Harvey et al., 2017). The treatment group scored significantly more favourably on the separation, anxiety, body sensitivity, and distraction indices. Other traits, such as attachment, excitability, and animal chasing, were not significantly different between the two groups (Vaterlaws-Whiteside and Hartmann, 2017). Although many possible explanations exist for these mixed findings, one is that these traits may develop later, during the puppy raising process carried out by volunteer puppy raisers, which was not as controlled as the early socialization program. Hence, not only do these results highlight important roles for very early nurturing on puppy behavioral development, but they also suggest a potential benefit of providing continued care and education to puppies during puppy raising, preferably in a systematic and controlled manner.

The need for standardisation is particularly challenging in this context. While some organisations develop comprehensive programs for puppy raisers to follow, to be effective such programs need to be implemented correctly. This was achievable in the Vaterlaws-Whiteside and Hartmann (Vaterlaws-Whiteside and Hartmann, 2017) study described above, which occurred before the normal puppy-raising period, when standardised rearing conditions could more easily be imposed. Puppy raising programs carried out by volunteers, on the other hand, do not generally meet this condition. This may explain the results of a study by Batt et al. (2008). In their study, Batt et al. (2008) evaluated the effect on guide dog puppies of a training and socialization intervention focused on providing extra technical support to puppy raisers. They randomly allocated 60 raisers and their puppies into three groups (i.e. control,

socialization, training). During the first six weeks of their puppy raising, raisers in the control group were provided with two training and socialization sessions as per the organisation's existing protocol. However, they were also made aware of the opportunity to seek support from external training and socialization classes. For raisers in the socialization and training groups, weekly puppy socialization or training classes, respectively, were provided by the guide dog organisation. In addition, raisers in the training group had an opportunity to learn about dog training theories, and to practice a reward-based training technique. Despite the provision of extra support, and knowledge- and skills-based training, there were no significant differences in final accreditation rates.

The program in Batt et al. (2008) and the puppy raising phase of the program in Vaterlaws-Whiteside and Hartmann (Vaterlaws-Whiteside and Hartmann, 2017) study incorporated a sound program design with suitable puppies. Program providers in these studies might have considered the same conditions as recommended by Rooney et al. (2016), i.e. selecting quality puppies, managing raising environment, and ensuring positive socializing experiences for the puppies. However, the extent to which these programs were implemented by the puppy raisers outside of their formal training sessions was not documented. Outside of the formal training sessions, puppy raisers are responsible for managing what their puppies experience, including exposure to various environmental factors. Consistent puppy raiser uptake of the program may be a key condition for puppies to benefit and for the program to result in enhanced puppy raising outcomes.

In short, having suitable puppies and evidence-based puppy raising program designs are important for reducing behavior-related failure rates. What enables a good program design (*theoretical* and *organisational* levels of the *throughput* stage) to succeed in setting up the well selected puppies (*input*) for success, however, has been largely overlooked. These are the actual at-home practices of the volunteer puppy raisers, without which a program

provider cannot ensure proper implementation of their well-developed program. This, in turn, may negatively affect the experiences of the well-bred and carefully selected puppies.

Influences at an individual level - The puppy raisers' practices

High levels of control over puppies' experiences suggests that personal characteristics of puppy raisers may moderate the effectiveness of program designs and the organisations' activities on puppy raising outcomes. In fact, various levels of assistance dog handling experience (Serpell and Duffy, 2016; Svartberg, 2002; Takeuchi et al., 2009) have been found to be associated with the behaviors, and therefore success (*output*), of assistance dog puppies. Besides experience, other potential puppy raiser factors include competency, parenting styles, and attachment, which are discussed in turn below.

Experience. Research suggests that puppies raised by first-time raisers are likely to have less favourable outcomes (Serpell and Duffy, 2016; Svartberg, 2002; Takeuchi et al., 2009). Serpell and Duffy (2016) found that, at one year old, puppies of more experienced raisers received significantly lower scores on aggression and fearfulness in different situations, such as when they encountered unfamiliar dogs, human strangers, and novel objects. Also, for less experienced raisers, puppies were found to have heightened body touch sensitivity compared to those raised by more experienced puppy raisers. Despite these group differences, puppy raisers' experience did not statistically predict puppies' ultimate success in graduating as assistance dogs (Serpell and Duffy, 2016). This may be because, as mentioned earlier, certification for assistance dogs include criteria in addition to their behaviors (Bremhorst et al., 2018). What can be concluded from this study is that, when it comes to behavioral suitability, puppy raisers' experience and competency can have a positive effect on the behavioral development of puppies. This is unsurprising; similar benefits were reported in the companion dog owner population with puppies' development of desirable

behaviors being associated with their raisers' higher understanding of, and experience in, canine training (Blackwell et al., 2008; Philpotts et al., 2019).

To date, there has been no published research looking at what favours the experienced puppy raisers and what would have assisted the inexperienced ones in their puppy raising. However, the following discussion, based on an unpublished thesis (Fratkin, 2015) in assistance dog literature as well as literature in the general canine population, can provide tentative explanations for these differences. Most importantly, experience likely leads to increased competency. Competence develops through learning, which requires acquisition and application of knowledge in practice (Bloom, 1956). Although experience does not equate to competence, experienced puppy raisers have had more opportunities to learn and practice their puppy raising skills than the less experienced ones.

In contrast to those with considerable experience, those who are not experienced, and not so competent or familiar with puppy raising methods instructed by their organisation, would likely resort to their existing repertoires of dog handling methods, some of which may not be effective. To effectively train, socialize, and address puppies' undesirable behaviors, puppy raisers need to acquire specific understanding of puppy handling methodologies and skills. Wenger (1999) generally describes sets of methods, and actions in any particular practices, as *repertoires of practice*. Seaman and Coppens (2006) highlight the necessity of developing a specific repertoire of practice among those who are new to a practice. This concept is particularly relevant to the training of teachers (Athanasios and Achinstein, 2003) and health professionals (Fidler, 1996) to be able to address diverse needs of their students and clients. Unfortunately, puppy raisers enter a field of practice where there are no agreed upon best practice models or established training programs. Their 'repertoire of practice' must therefore be developed on the basis of their personal experiences and/or from formal instructions they receive from their program provider. At an industry level, program

providers often have in-house puppy raising protocols, but these have rarely if ever been published or validated. While there are thousands of books and websites devoted to companion dog socialization and training, there is, to our knowledge, no consensus on desirable skill sets that puppy raisers should set out to acquire.

For novice puppy raisers, as discussed earlier, it takes time and experience to expand the boundary of their repertoire of competent practice to what is instructed by their organisation. Meanwhile, they still have the responsibility to carry out the puppy raising tasks and are only able to practice within their existing repertoire, i.e., parenting and attachment styles. In the following sections, we discuss how competency may mediate the effect of experience on puppy outcomes. This will then explain the moderating effect of competency on the relationship between novice puppy raisers' existing repertoire of practice (parenting and attachment styles) and their puppy raising outcomes.

Competency. Research in puppy raisers' competency is scarce, with only one unpublished doctoral thesis (Fratkin, 2015) able to be located. Fratkin reports that experienced puppy raisers rated themselves significantly higher not only on satisfaction with their puppy raising but also on levels of knowledge of puppy raising, and levels of focus on obedience training (Fratkin, 2015). This suggests a correlation between puppy raisers' experience and competency. Furthermore, puppies of raisers who shared those attributes, i.e. more experienced and higher competency, scored more favourably on a measure of trainability and attachment (C-BARQ subscales; Serpell and Hsu, 2001). Note that for assistance dog puppies, these attributes, i.e. trainability and attachment, are important, as the puppies need to cope with visiting various places with their handlers, and many different situations, which can be stressful and unpredictable. These findings of an association between puppy raisers' competency and puppies' personality traits may explain why experienced

puppy raisers raised more successful puppies in past research (Serpell and Duffy, 2016; Svartberg, 2002; Takeuchi et al., 2009).

The importance of puppy raising competency in addressing puppies' undesirable behaviors can be illuminated further when considering an observational study by Koda (2001). In this study it was found that, when puppy raisers lacked technical knowledge and skills specifically in assistance dog puppy raising, they tended to adopt various strategies to deal with their puppy's inappropriate behaviors, though many of the techniques were not effective. Before moving on, it should be noted that the puppy raising program in Koda's (2001) study was provided by a guide dog organisation. However, to explore the puppy raisers' coping strategies and their effectiveness, the organisation did not provide the puppy raisers with any formal instructions for raising their puppies. Instead, they were asked to have a close relationship with the puppy and to refrain from using physical punishment. Prior to commencing puppy raising, the puppy raisers were made aware that the puppies in this study were not being considered for a future role as a guide dog. Koda (2001) did not explain this decision, however it appears to address a potential ethical concern associated with this experimental design. Specifically, not giving sufficient formal guidance to puppy raisers not only results in their general dissatisfaction with the puppy raising program (Chur-Hansen et al., 2015) but also seems unlikely to result in good outcomes for the puppies.

In this study, Koda (2001) visited their puppy raisers fortnightly and observed a play session with the puppy for 20 minutes. Without formal instructions, the puppy raisers used various strategies to control their puppy, including but not limited to: distracting the puppy, talking to it, rejecting interaction, restraining it, and forcing it to stop (Koda, 2001). Some of these strategies were not always successful when responding to specific behaviors. For instance, rejecting interaction was able to stop the puppies from biting, while only forcing them to stop was able to stop the puppies from damaging objects. Ignoring and not

responding were successful at stopping growling and/or barking. Knowing what works and what does not is likely to reflect experience levels, which are higher for those who have raised multiple puppies and might help explain why they achieved more favourable outcomes (Serpell and Duffy, 2016; Svartberg, 2002). For novice puppy raisers, Koda (2001) suggests there is a tendency for puppy raisers to resort to strategies most familiar to them.

Although it is unlikely in practice that organisations would leave their puppy raisers without guidance, it can be seen from Koda's (2001) and Fratkin's (2015) findings that effectiveness of puppy handling techniques (*competency*) may vary amongst puppy raisers with different levels of experience. The fact that Koda's puppy raisers, when lacking experience and competency, resorted to puppy handling techniques that were more readily available to them, also tentatively suggests a moderating effect of raisers' competency on the relationship between their existing techniques and their puppies' behaviors. A pertinent question, therefore, relates to the kinds of knowledge and experience drawn on by novice puppy raisers. We propose that parenting and attachment styles are likely to be important determinants.

Parenting styles. In relation to the ways in which humans respond to their canine partners, a concept similar to human parenting styles has been found to apply to people raising companion dogs, who fell into three broad groups: authoritative-intrinsic, authoritative-training, and authoritarian (Van Herwijnen et al., 2018). All three parenting styles reflect owners' high demands of their dogs. The first two involve high levels of input and responsiveness to the dog's needs, such as an inclination for giving in and prioritising psychological wellbeing of the dog (authoritative-intrinsic), and/or efforts to ensure positive learning experiences for the dog (authoritative-training).

Contrasting to these two parenting styles, owners practising an authoritarian style generally responded to their dog's undesirable behaviors by correcting them with the use of

verbal, emotional, and/or physical punishments (Van Herwijnen et al., 2018). In addition to these three, Kelly and Bennett (2018) found a fourth parenting style – permissive - whereby owners had low demands and were less supportive of their dogs. This parenting style was associated with a range of behavioral problems in dogs, such as: more nervousness, aggression, and separation anxiety; higher levels of excitability and reactivity; and less obedience (Kelly and Bennett, 2018). These authors also found that authoritarian parenting was associated with significantly increased disobedience, excitability and reactivity, while an authoritative parenting style was associated with significantly reduced undesirable behaviors and temperament traits.

There has been no research looking at parenting styles amongst raisers of assistance dog puppies. There is also no evidence supporting the applicability of constructs of parenting styles found in the general companion dog-owner population to the assistance dog puppy raiser population. Nonetheless, some aspects of parenting styles, as found in the former population, may still be relevant in the latter. For instance, because puppy raisers are generally aware of the future role their puppy may play (Chur-Hansen et al., 2015), the high demand aspect of the first three parenting styles (authoritative-intrinsic, authoritative-training, and authoritarian) is likely to be evident. Furthermore, as highlighted in the Koda's (2001) study, raisers' existing parenting styles might be more dominant in those who are new to assistance dog puppy raising, who tend to rely on their own methods of training/handling, e.g. giving in, reward-based, or forcing. It is not realistic to expect a novice puppy raiser, who joins a puppy raising program with a pre-existing parenting style, to fully adhere to an approach suggested by their organisation. Therefore, advising and enhancing competency of new raisers, while taking different parenting styles into account, may be one way to optimise programs which potentially influence puppies' behavioral development.

Attachment. The attachment style puppy raisers adopt when they interact with their puppy may also have different effects on the puppies' behavioral development. In human parent-child relationships, these characteristics are critically important in determining outcomes for children (Fraley, 2002; Lereya et al., 2013; McLeod et al., 2007), and they have also been implicated in successful human-companion dog relationships (Payne et al., 2016; Van Herwijnen et al., 2018). For instance, Rehn et al. (2017) found that dogs who received more emotional support and responsiveness from owners (i.e., secure attachment) were more confident to explore during an encounter with stressor stimuli. In contrast, dogs of owners who were emotionally distant (i.e., avoidant attachment) or too close (i.e., insecure-anxious) were less confident to explore and instead sought comfort and protection from their owners when faced with stressful stimuli (Rehn et al., 2017).

Considering attachment strength, another dimension of attachment, research has found that handlers develop high levels of attachment to their assistance dogs (Kwong and Bartholomew, 2011). This might be due to the semi-permanent nature of their relationship. Similarly, attachments between handlers and their search and rescue dogs, those who lived and worked together indefinitely, appeared to be stronger than companion dog-human relationships (Mariti et al., 2013). Assistance dog puppies, on the other hand, tend to be less attached to their puppy raisers (Valsecchi et al., 2010). Using a version of the strange situation test (a test developed by Ainsworth (1969) to assess relationships between human infants and their caregivers) that was modified for use with dogs by Fallani et al. (2006), assistance dog puppies at 11 months old expressed similar interest in strangers, and less discrimination of their puppy raisers. Instead, they developed strong attachments with their permanent handlers one year after leaving their puppy raisers (Valsecchi et al., 2010). This may be simply because the puppies were bred and socialized to be friendly to all people. Alternatively, puppy raisers' awareness of the temporary nature of the relationship they will

experience with their puppy might affect their intention or ability to develop a strong bond with that puppy. In contrast to companion dog owners and assistance dog owners, relationships between puppy raisers and their puppies are temporary and professional. Therefore, it is reasonable to expect that attachments characterising the different relationship types may differ in style or strength.

While attachment styles have not been extensively studied in puppy raisers, one might assume that novice puppy raisers, unfamiliar with their organisation's training methodology, would likely be strongly influenced by their existing attachment style. Psychoeducational programs have been shown to improve both parenting and attachment issues in human research (Bettmann and Tucker, 2011; Celik, 2004; Moretti et al., 2004; Solís-Cámara et al., 2000) and may be a promising intervention to assist novice puppy raisers.

How experience in puppy raising contributes to desirable behavioral outcomes

In short, it seems reasonable to argue that experience in puppy raising can contribute to raising behaviorally suitable puppies and, as illustrated in Figure 2, increased competency may be what favours experienced puppy raisers (*mediating effect*). That is, experience itself may not be the critical factor here, but it may be instrumental in that it provides the context in which increased competency is developed. Although findings on owner parenting and attachment styles are preliminary and generally focus on companion dogs, it can be argued that these factors are likely to also influence the outcomes of raising assistance dog puppies, especially for raisers who are less competent and who may be unfamiliar with effective puppy raising methods. In other words, the practices of the competent raisers likely adhere more to the organisations' desired methods, and they may be influenced less by personal factors than the less competent raisers (*moderating effect*). If so, training programs provided by organisations may affect experienced and novice raisers differently, producing results confounded by these personal attributes.

[Figure 2 about here]

Conclusion

A puppy's general behavior is one important criterion for entering advanced training and for qualification as an assistance dog (Bremhorst et al., 2018). It is determined by a complex network of inherited and environmental factors (Appleby et al., 2002; Freedman et al., 1961; Vaterlaws-Whiteside and Hartmann, 2017), few of which are well described or understood. To better understand the interplay effects of different factors on puppies' behaviors, relevant literature was considered within the framework provided by the general systems model, which holds that any general system can be understood as being comprised of inputs, which are processed during a period of throughput to produce outputs.

In relation to the input part of the model, it is well established that it is helpful to enrol suitable puppies to begin with (Goddard and Beilharz, 1982; Takeuchi et al., 2009), although exactly what determines suitability remains largely open to investigation. In terms of the output part, the aim of puppy raising is clearly to produce a young adult dog suitable for advanced training, although, again, the exact characteristics that determine suitability are poorly specified. Even less clear is what can and should take place during the period of throughput. We contend that much more research is needed to establish evidence-based, best-practice puppy raising techniques. It is also necessary that puppy raising program providers adapt those evidence-based recommendations that are available (Rooney et al., 2016) to their training, socializing and rearing protocols.

One area in which very little research has been conducted is program implementation. This is an important oversight because puppy raisers directly influence puppies' experiences, thereby determining the degree to which the puppies are trained, socialized and reared according to instructions. Experienced puppy raisers produce more behaviorally favourable puppies (Serpell and Duffy, 2016; Svartberg, 2002; Takeuchi et al., 2009). We propose that

this is not due to the increased experience itself, but occurs because experience is associated with changes in competency (Fratkin, 2015). Lacking both experience and competency, and in the absence of a validated repertoire of practice, novice handlers have no choice but to rely on existing personal attributes, such as parenting and attachment styles, to guide their rearing practices. Measuring and manipulating such human factors may therefore provide insights that could ultimately boost puppy raising success rates. Accounting for these potential influences may also aid interpretation of findings from research evaluating the predictability of puppy selection tools, or the effectiveness of training methodologies and socialization protocols.

In terms of practical considerations, it would be ideal, though perhaps not realistic, for program providers to select only very experienced and demonstrably competent volunteer puppy raisers. Where this is not possible due to limited availability, we recommend that organisations develop support and training interventions to ensure competency, especially in novice volunteers who lack experience. Encouraging retention of experienced puppy raisers is also recommended. This requires investment in research aiming to identify best practice approaches to puppy raising, and research to understand puppy raisers' preferences in skill acquisition, specifically in canine training. Importantly, puppy raisers need to know which behaviors to encourage and how to do this, as well as which should be discouraged, and how to achieve this using validated techniques that are both effective and humane. Given that most puppy raisers are volunteers, likely to have many other personal commitments, it is critical to ensure that supports are easily accessible and digestible – internet-based resources, including video demonstrations, may be ideal. Regular contact with experienced behavioral counsellors is recommended to address challenges as they arise, promote engagement of puppy raisers during their puppy raising and encourage retention of experienced puppy raisers.

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620 **Conflict of interest**

621 The authors declare no conflict of interest relevant to the content of this review.

622 **Ethical statement**

623 This publication does not require a human or animal ethics approval as it is a
624 literature review.

625

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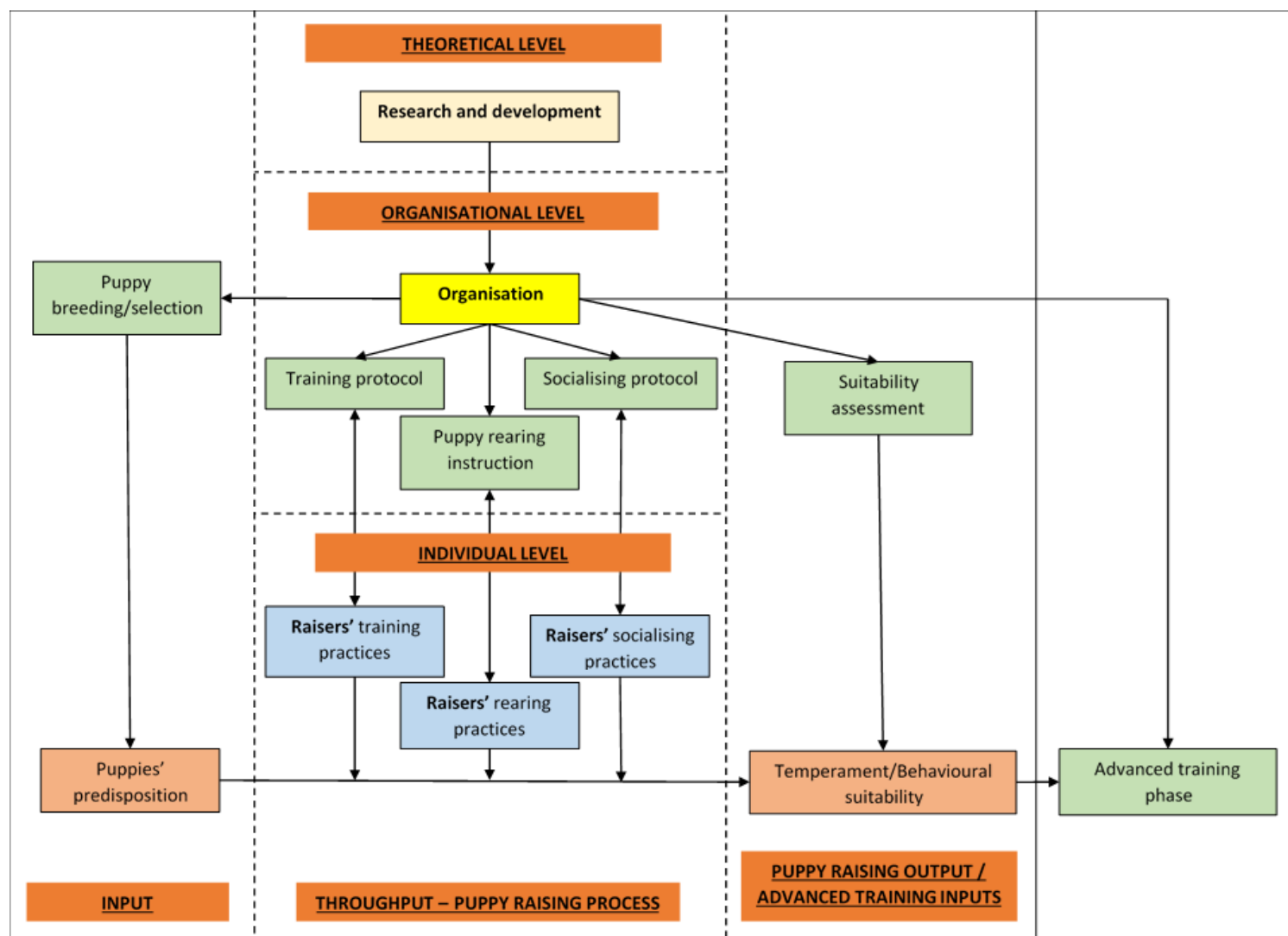
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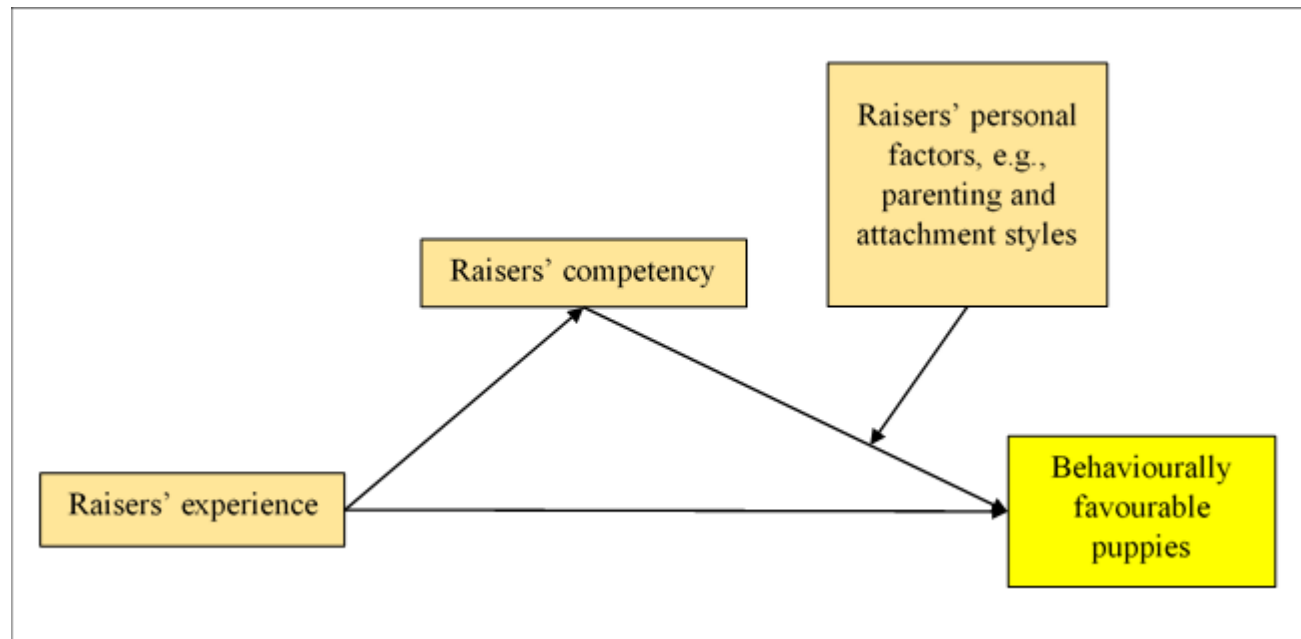
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836 Figure 1. Proposed general puppy raising model.

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839 Figure 2. Proposed model of puppy raisers' personal characteristics on puppies' behavioral outcomes.