many questions remain (e.g., what areas of functioning see the greatest effect?). The present study asked the question: Might a school-based canine-assisted literacy support produce a different impact to a traditional adult-led model on children’s reading comprehension and oral literacy, social behaviour, and attitude towards reading? This study directly compared traditional literacy and canine-assisted interventions to examine the efficacy of what is becoming a more commonly used practice (Steele et al., 2021).

**Literature Review**

The process of reading typically begins in the home, with parents engaging children in both informal and formal literacy activities (e.g., focusing on printed words and letters, linking sounds, etc.). These activities are an important first step, as research shows the more parents engage their children in both formal and informal literacy activities in the home, the more likely it is that those children will have increased motivation for reading (Senechal, 2006). While the process of learning to read begins organically, the code breaking required of written language necessitates the
systematic instruction typically delivered by trained educators. Teacher characteristics, such as educational attainment, have long been linked to literacy outcomes (Brown et al., 2008). However, even volunteers without teaching credentials but who have been trained to support children’s literacy have been found to benefit early readers (Otaiba & Pappamihiel, 2005; Pullen et al., 2004). School curriculums generally start targeting reading between the ages of 6 to 8 years of age. Yet current estimates indicate over 1 million Canadian children have weak literacy skills (DeLoitte, 2020) – a worrisome statistic given that childhood literacy is predictive of later academic achievement, earning potential, educational attainment (Ritchie & Bates, 2013), and even physical and mental health (Boyes et al., 2016). Some early readers experience more difficulty decoding text and often do not understand what they have read. In Canada, it is estimated that one out of four younger elementary school children experience these extra difficulties (DeLoitte, 2020). Compounding the difficulties that some early readers face is the finding that the children who find the task of reading particularly difficult often have lower motivation to read (Melekoğlu & Wilkerson, 2013) and greater anxiety related to reading (Ramirez et al., 2019).

One way to reduce the level of anxiety in order to strengthen a child’s progress in learning to read is the use of Animal-Assisted Interventions (AAI). Research shows children’s general anxiety can be reduced simply by interacting with a dog (Crossman et al., 2020) and that the presence of a dog decreases children’s physiological stress responses (cf. Beetz, 2017). These findings coincide with research in adult populations that find stress is reduced through AAI (Friedmann & Son, 2009; Pendry et al., 2020; Scoresby et al., 2021). Generally, AAI research with dogs demonstrates the positive impact they can have on young learners’ academic performance (Lane & Zavada, 2013), emotional regulation, and social skills (Beetz et al., 2012). Indeed, the presence of a dog in the classroom has been shown to improve children’s social competence and empathy (Hergovich et al., 2002), suppress aggression and hyperactivity (Kotrschal & Orthbauer, 2003), and improve the emotional stability of children with severe emotional disorders (Anderson & Olson, 2006). For example, Schuck et al. (2015, 2018) randomly assigned children with ADHD to engage in a cognitive behavioural intervention that did or did not include a canine-assisted AAI. Their studies found that the social functioning of children improved in both conditions but significantly more so for those who engaged with dogs. It appears that children’s psychological well-being and social functioning are improved with canine-assisted AAI, but are findings similar where children’s literacy is concerned?

The origins of canine-assisted literacy interventions are often attributed to the Reading Education Assistance Dogs (R.E.A.D.®) program that was initiated in 1999 by Intermountain Therapy Animals (Friesen & Delisle, 2012). R.E.A.D.® garnered the attention of both researchers and the public resulting in a proliferation of AAI literacy programs appearing in local libraries and school settings across both Europe and North America (e.g., Friesen, 2010; Paradise, 2007). Although there have been some promising findings related to the efficacy of such programs, much of the early research investigating this promise has been limited in experimental validity (Hall et al., 2016). For example, an early case study of three 7- to 11-year-olds with social and emotional difficulties by Bassette and Taber-Doughty (2005) indicated that reading to dogs helped to improve reading. Additionally, after an 8-week-long canine-assisted reading intervention for 11 Australian 7- to 8-year-olds, Henderson et al. (2020) interviewed children and suggested that reading to dogs promoted positive sentiment for reading. More recent research incorporating stronger methodological controls has supported earlier inferences. In 2014 le Roux et al. found grade 3 children randomly assigned to a canine-assisted reading program for 10-weeks made significantly bigger gains in their reading comprehension, rate, and accuracy than those children assigned to read to either an inanimate object, an adult, or when provided with no support. Levinson et al. (2017) conducted a study comparing oral reading fluency and attitudes before and after children in grades 2–5 either read to a dog or peer over a 5-week-long period before being swapped into the other condition for a similar amount of time. While children, especially those in grade 2, showed the biggest improvements when reading to dogs compared to when reading to peers, there was no change in attitudes towards reading. It is noteworthy that these children were not identified as readers needing extra supports, demonstrating that canine-assisted literacy programs can benefit all children. This also may explain the lack of difference in reading attitudes, as readers who are having more difficulties are often more likely to show gains in reading attitudes (Rousseau & Tardif-Williams, 2019). However, while canine-assisted literacy interventions improve children’s reading-related behaviours (e.g., motivation, affect) this does not always extend to their actual reading performance (Uccheddu et al., 2019; Wohlfarth et al., 2014). Interestingly, when questioned about their perceptions of canine-assisted supports for literacy, teachers report that they believe that AAI benefits primarily the ‘soft skills’ related to reading such as confidence and motivation (Daly & Suggs, 2010; Steel et al., 2021). Indeed, a recent meta-analysis examining AAI’s impact on early learning shows that the biggest perceived gains are of a social nature (Reilly et al., 2020).

From a theoretical standpoint, one of the more prevalent explanations for the success of canine-assisted AAI is the
idea that motivation for reading may be key. Improving motivation for reading positively impacts children’s reading performance (Wigfield et al., 2016) and evidence shows that the presence of a dog promotes motivation to engage with and successfully complete motor and cognitive tasks (Gee et al., 2007, 2010), and increases students’ intrinsic motivation to read (Heyer & Beetz, 2014). Hall et al. (2016) suggest that the presence of dogs triggers positive valence in children, increasing positive mood and/or decreasing stress. This then increases the likelihood of reading behaviours such as motivation and confidence, ultimately leading to better reading performance. Dogs can improve our mood (McArthur & Syrnyk, 2018) and reduce stress (Pendry et al., 2020) – both are likely tied to the collective belief that dogs are nonjudgmental (Friesen, 2010; Lane & Zavada, 2013). Indeed, the presence of calm animals produces a physiological relaxation response (e.g., lower blood pressure, cortisol levels) in most people, promoting the psychological perception of safety (cf. Levine et al., 2013). This goes both ways as dogs are known to be socially attached to their companions, gaining from them a sense of safety and solace (Kurdek, 2008), which can help reduce their own stress as evidenced by physiological and behavioural measures (Gacsi et al., 2013). This ability to intuitively understand one another’s inner worlds may stem from the thousands of years spent attuning to each other in shared living and hunting situations (Schleidt & Shalter, 2003).

However, literacy is a cognitive ability and cognitive performance can be negatively impacted by anxiety and stress. In their critical review of the literature, Alfrey (2021) suggests that it is generally accepted that dogs reduce stress and anxiety in both adults and children, and that increases in either can impede human cognition, including the ability to engage and understand written text. Therefore, the simple presence of a dog may reduce a child’s cognitive load by reducing (reading) anxiety, resulting in better reading performance, or vice versa. Research with preschoolers lends support to this cognitive model as preschool children show better memory when in the presence of a dog, compared to when not (Gee et al., 2009, 2012).

Before Covid-19, this research set out to examine the efficacy of a school-based canine-assisted literacy support program known as PuppyPals. Based on the design and impact of other reading to dog programs and research (e.g., le Roux et al., 2014; Levinson et al., 2017), PuppyPals is a pedagogical initiative currently in two schools within Calgary, Alberta, Canada. Initiated as a pilot project in 2015 by a teacher experienced in literacy and AAI, this program has provided additional literacy support to over 100 grade 1–4 students identified as needing extra support for reading. We set out to formally compare the efficacy of this canine-assisted program by comparing it to an adult-assisted literacy intervention. Although research in this area is growing, there are few studies with a strong control comparison, as Hall et al. (2016) noted in their meta-analysis. A later review by Reilly et al. (2020) reaffirmed that more high-quality research is needed. In addition, there is limited research that has examined the impact of canines on children’s literacy and social functioning, in the same study. Therefore, the purpose of this mixed methods study was to investigate if the literacy level (looking at both oral ability and comprehension skills), social functioning, and reading self-efficacy of 7-to 9-year-old children, identified as needing extra support in reading, differs when reading to a dog or to an adult. Heeding previous researchers’ recommendations, two reading conditions (reading to a dog vs. adult) were used. We hypothesized that a canine-assisted support would be more effective at improving reading self-efficacy, social functioning and reading performance (both oral and reading comprehension) than the adult-assisted literacy support. Finally, in an effort to provide context about these supports, teachers, parents, and students were asked for their perceptions of these reading supports.

Method

Participants

This study was conducted at two elementary (Kindergarten to grade 4 and to grade 5) schools in Calgary. Schools were similar in terms of size (approximately 360 and 540, respectively), socio-economic background (respectively: median incomes of $139,000 and $107,000), and diversity of students (80% of the surrounding school communities report their primary language to be English). Prior to recruitment research ethics approval was obtained from both the authors’ university and the school board. Data was collected at both schools to gain as many participants as possible. At the beginning of the school year, Grade 3 classroom teachers were recruited to participate in this study. Consenting teachers used school-based Response to Intervention (RTI) protocols to identify students in their classrooms who would require additional literacy supports. These procedures were standard school protocol in identifying and providing support for readers needing extra support. Parents of these students were contacted by participating teachers who explained that their child had been identified as a student who would benefit from additional, outside the classroom literacy support and, alongside this, invited them to participate in this study. Parents were assured their child’s participation did not affect the provision of support and that they could withdraw their child from the study at any time. This yielded a total of 24 student participants (12
from each school), 14 male and 10 female, with an average age of 7 years and 8 months (07:06–08.10 years). In addition, parents and teachers provided their perceptions of their children’s literacy and attitudes towards reading. Although no specific demographic information from the parents was gathered (so as not to overwhelm the parents), as indicated above, the general information on the schools provides some insight here.

Measures

The oral and comprehension literacy, reading self-efficacy, and social functioning of all students were assessed before and after receiving each reading support using, respectively, the Brigance Comprehensive Inventory of Basic Skills II (CIBS-II; Brigance, 2010), the Reader Self-Perception Scale (RSPS; Henk & Melnick, 1995), and the School Social Behavior Scales-2 (SSBS-2; Merrell, 2002).

A popular assessment tool amongst educators for its usefulness as an identification tool, the CIBS-II is used to measure student achievement for reading, English language arts, and mathematics. For the purposes of this study only oral reading and reading comprehension were targeted using CIBS II subscales ‘F – Reading Comprehension (short passages)’ and ‘E – Oral Reading’. Both subscales have been shown to demonstrate good internal validity with Cronbach’s α of 0.95 to 0.98 (French & Glascoe, 2010). Consisting of 33 items across four categories (progress, observational comparison, social feedback, and physiological states), the RSPS (Henk & Melnick, 1995) demonstrates good internal reliability [0.81-0.84] and provides an effective means of gauging students’ sentiments for their own reading abilities with higher scores being interpreted as more positive self-perception. To assess the social functioning of students, the SSBS-2 (Merrell, 2002) has been shown to be a robust measure of social skills and behaviour (Corder et al., 2015). The measure consists of 64 items, yielding a score for social competence (SC) and antisocial behaviour (AB). While both scales include their own subscales higher total SC and AB scale scores indicate greater levels of competence or problems, respectively. Research has found the SSBS-2 to have strong psychometric properties (Corder et al., 2015) including excellent internal consistency (Cronbach’s α = 0.905, Raimundo et al., 2012).

To supplement our understanding of students’ reading abilities and attitudes, at the start of the study and after completion of either condition, parents and teachers were asked to complete brief questionnaires that consisted of 5 Likert rated questions (1 = strongly disagree to 5 = strongly agree) evaluating how much they believed the student enjoys reading, willingly engages in reading, reads aloud in a smooth voice, has an easy time selecting level appropriate books, and feels anxious about reading. These questionnaires also included two open-ended questions that prodded respondents for their reflections on students’ reading abilities and their goals for the student. Finally, at the end of the study students engaged in an exit interview that consisted of a series of open-ended questions querying how they felt about their overall participation, what they liked or disliked, and about reading in general.

Procedure

Each student participated in both reading conditions: (1) adult and (2) dog, with the order of conditions randomly assigned equally among students. The adult intervention was led by a school volunteer with training in student literacy support. The dog intervention involved an unpaid volunteer from a local, human-animal non-profit group, who, along with their dog, were trained by the non-profit (who is accredited with Assistance Dogs International) to interact with people of all kinds and in different locations (e.g., schools, hospitals). In general dogs are chosen for their calm demeanor. As part of their training handlers were attentive to indications of stress in dogs and would stop proceedings if necessary. Interventions were held once a week during school hours in a small, dedicated room onsite. Each session lasted approximately 15 min and occurred over an 8-week-long period. No student declined to participate.

Students in the adult intervention arrived at sessions with at least three books preselected by their classroom teacher to be geared to their level of literacy. They spent the first few minutes of each session in non-instructional conversation with a school volunteer. This was to put the student at ease upon arrival at each session. A researcher was also in the room to unobtrusively supervise the intervention. The student then read their books to the volunteer whom they were sitting next to. If the student required prompting or support during the session, the volunteer responded by coaching them to use a strategy, asking if they need more time, assisting with unfamiliar words, or offering encouragement to continue. After this, each student was asked, “How did you feel about your reading today?” This was to provide the student with an opportunity to reflect on their progress and to engage in some informal conversation to wind down the session. After each session, the researcher, who worked at the school as a learning diversity teacher with expertise in literacy support, communicated with the student’s classroom teacher regarding their performance during the session, so they could select books accordingly for the next session. The dog condition used the same procedure as the adult condition with the difference being instead of the child reading to a volunteer the student read to the dog (seated beside them); the dog’s handler was also present.
and provided assistance to the student, if necessary (i.e., the same as with the adult condition). After reading, students were invited to interact with (e.g., pet) the dog and they were also asked the wind down question. Following completion of the first 8-week-long intervention, the first set of post-intervention evaluations were completed and then students completed another 8-week long intervention (either the dog or adult condition, whichever they had not yet participated in). This resulted in both quantitative (i.e., CIBS-II, RSPS, SSBS-2) and qualitative (i.e., closed- and open-ended questions) data being collected at three different times: September 2019 (prior to any intervention), December 2019, and March 2020. The unfortunate coincidence of the final data collection period and onset of the pandemic meant that a small amount of the final data was not captured. This was compounded by staffing issues in one school impacting data collection, particularly in December, 2019. Despite this we believe the results of this study have value and report our findings as follows.

**Results**

**Literacy Measures**

A mixed model repeated measures ANOVA with Time (Before or After intervention) and Condition (adult or dog) as the within-groups variables and Start Condition (dog-first or adult-first) as the between groups variable, and oral reading level (ORL) as the dependent variable, found a significant main effect of Time ($F(1, 21)=81.66, p<0.001, \eta^2_p=0.803$). This shows that learner’s oral reading improved over the course of the study. In addition, the Time x Condition x Start Condition interaction approached significance ($F(1, 20)=4.27, p=0.052, \eta^2_p=0.176$). In order to examine this three-way interaction in more detail, separate 2 (Time: before, after) by 2 (Start Condition: dog-first, adult-first) mixed model ANOVAs were conducted for the dog condition and the adult condition. For the dog condition, there was a significant main effect of Time ($F(1, 21)=51.74, p<0.001, \eta^2_p=0.711$) and the Time x Start Condition interaction approached significance ($F(1, 21)=4.16, p=0.057, \eta^2_p=0.062$). Protected t-tests showed that, participants scores improved from before ($M=4.00; SD=2.72$) to after ($M=5.55; SD=2.94$) the intervention when reading to the dog as the second intervention ($t(21)=3.58, p=0.002$). However, when reading to the dog was the first intervention, this improvement was even larger (before: $M=2.08; SD=1.56$; after: $M=4.83; SD=1.70$; $t(21)=6.65, p<0.001$). A similar analysis for the adult condition only yielded a significant main effect of Time ($F(1, 21)=29.54, p<0.001, \eta^2_p=0.584$), with ORL scores improving significantly from before the program ($M=3.04; SD=2.29$) to after the program ($M=5.00; SD=2.65$) (see Figs. 1 and 2). These findings show that oral reading improved for both the adult and dog conditions, however, for the dog condition there is the potential impact of timing. That is, although scores improved for the dog condition, the improvement was slightly greater when this was the first condition the participants experienced.

The same 3-way analysis conducted with reading comprehension level (RCL) as the dependent variable also found a significant main effect of Time ($F(1, 18)=38.61, p<0.001, \eta^2_p=0.682$). An interaction effect between Time x Condition was borderline significant ($F(1, 18)=3.79, p=0.067, \eta^2_p=0.174$). Follow-up protected t-tests showed that for the adult condition, RCL scores improved from before the intervention ($M=3.60; SD=2.19$) to after the intervention ($M=4.55; SD=2.48$) ($t(18)=3.26, p=0.004$). However, for the dog condition this improvement (Before: $M=3.05; SD=2.21$; After: $M=4.85; SD=2.60$) in scores was even larger, $t(18)=5.47, p<0.001$. Unlike with the ORL scores, the Time x Condition x Start Condition was not significant.
found that only the main effect of Condition approached significance ($F(1, 18) = 3.80, p = 0.067, \eta^2_p = 0.174$). This showed that participants saw greater gains in the dog condition ($M = 1.80, SD = 1.43$) relative to the adult condition ($M = 0.95, SD = 1.27$), and the order that conditions were experienced in did not affect this finding (see Fig.4).

**Social Functioning**

A mixed model repeated measures ANOVA with Time (Before or After intervention) and Condition (adult or dog) as the within-groups variables and Start Condition (dog-first or adult-first) as the between groups variable, and social competence total score (SCT) as the dependent variable, found a significant main effect of Time ($F(1, 18) = 17.76, p = 0.001, \eta^2_p = 0.497$). That is, learners became more socially skilled over the course of the study. A significant Time x Condition x Start Condition was also found ($F(1, 18) = 8.07, p = 0.011, \eta^2_p = 0.310$). In order to examine this three-way interaction in more detail, separate 2 (Time: before, after) by 2 (Start Condition: dog-first, adult-first) mixed model ANOVAs were conducted for the dog condition and the adult condition. For the dog condition, there was a significant main effect of Time ($F(1, 18) = 7.22, p = 0.015, \eta^2_p = 0.286$), and the Start Condition main effect almost reached significance ($F(1, 18) = 4.01, p = 0.06, \eta^2_p = 0.182$), as did the Time x Start Condition interaction ($F(1, 18) = 4.02, p = 0.06, \eta^2_p = 0.182$). Protected t-tests showed that, when participants read to the dog as the first intervention, there was no significant change in SCT scores from before ($M = 94.38; SD = 16.92$) to after the intervention ($M = 95.63; SD = 15.40; t(18) = 0.44, p > 0.05$). However, when the participants read to the dog for the second intervention, there was a significant improvement in SCT scores from before the intervention ($M = 107.58; SD = 19.12$) to after the intervention ($M = 116.17; SD = 21.62; t(18) = 3.72, p = 0.002$). For the adult condition, only the main effect of Time was significant ($F(1, 18) = 16.86, p < 0.001, \eta^2_p = 0.485$), with SCT scores significantly improving from before the intervention ($M = 99.25; SD = 16.19$) to after the intervention ($M = 107.45; SD = 18.53$). This suggests that in the dog condition, social competence was improved only after first experiencing the adult condition. However, learner social competence improved in the adult condition whether it was experienced first or second.

The same analysis was conducted with the antisocial behaviour total score (ABT) as the dependent variable. The interaction between Condition x Time was found to be borderline significant ($F(1, 18) = 4.14, p = 0.057, \eta^2_p = 0.187$) while an interaction between Time x Condition x Start Condition was significant ($F(1, 18) = 5.57, p = 0.03, \eta^2_p = 0.236$). To examine this three-way interaction in more detail, separate 2 (Time: before, after) by 2 (Start Condition: dog-first,
learners were in the dog condition, anti-social behaviour increased when interaction (\(t(18) = 4.14, p = 0.057, \eta_p^2 = 0.187\)), while when participants experienced the dog condition first, the adult condition (\(M = 11.63, SD = 13.64\)) led to significantly larger gains compared to the dog (\(M = 1.25, SD = 4.06\)) condition (\(t(18) = 2.92, p = 0.009\)). However, when participants experienced the adult condition first there was no significant difference between the conditions (\(p = 0.37\)). For ABT scores, the Condition main effect was almost significant (\(F(1, 18) = 4.14, p = 0.057, \eta_p^2 = 0.187\)), while the Condition x Start Condition interaction was significant (\(F(1, 18) = 5.57, p = 0.03, \eta_p^2 = 0.236\)). Protected t-tests showed that when participants experienced the dog condition first, the adult condition (\(M = -5.38, SD = 9.99\)) led to significantly larger gains compared to the dog (\(M = 2.50, SD = 3.38\)) condition (\(t(18) = 2.84, p = 0.011\)). However, when participants experienced the adult condition first there was no significant difference between the conditions (\(p = 0.80\)).

**Correlational Analyses**

To examine the relationship between the measures of literacy (ORL and RCL) and the behavioural measures (SCT and ABT) correlational analyses were conducted on the Time 3 scores (at the conclusion of both interventions) as well as on the change in scores (Time 3 minus Time 1). Not surprisingly, the literacy measures were correlated with each other, both at Time 3 (\(r(18) = 0.822, p < 0.001\)) and when looking at difference scores (\(r(18) = 0.659, p = 0.002\)). Likewise, the behavioural measures were correlated with each other at Time 3 (\(r(22) = -0.615, p = 0.001\)) and when examining difference scores (\(r(19) = -0.603, p = 0.004\)). However, we were also interested in the relationship between the literacy measures and the behavioural measures. Although none of these correlations were significant, the strongest relationship was between SCT and the literacy measures (\(r(20) = 0.333\) and \(r(18) = 0.345\), with \(p = 0.129\) and 0.136, respectively). In addition, when looking at difference scores, the correlation between change in RCL and change in SCT drew our attention (\(r(16) = 0.366, p = 0.136\)). The small sample size likely impacted the power of these tests.
Reading Affect

Due to the minimal data collected after the first intervention, measures of reading affect at the start and end of the study were compared. A repeated measures ANOVA with Time (Start vs. End of study) and Start Condition (dog-first or adult-first) as the within-groups variables with each of the 4 RSPP scales (progress, observational comparison, social feedback, and physiological states) as the dependent variables only found one scale, observational comparison, to be borderline significant \((F(1, 16)=4.43, p=0.051, \eta_p^2=0.217)\). This suggests that learners’ perception of their reading ability in comparison to their classmates improved from the start of the study \((M=17.39; SD=2.85)\) to the end of the study \((M=19.17; SD=4.11)\), and the order that the interventions were experienced did not have an impact on this.

Questionnaires

Closed-Ended Questions

The five quantitative questions assessing students’ reading ability and attitude towards reading were summed, reversing the scoring for the fifth question, to yield a total score. A 2 (Group: Teachers or Parents) x 2 (Condition: Dog or Adult) x 2 (Time: Before or After intervention) repeated measures ANOVA with total questionnaire score as the dependent variable was run. Only a main effect for Time was found \((F(1, 9)=43.47, p<0.001, \eta_p^2=0.828)\). This shows that for both conditions, both teachers and parents reported students to be more positive about reading after completing either reading support \((M=17.87; SD=2.42)\) than before \((M=15.40; SD=3.03)\).

Similar analyses were run for all five questions separately. For Question 1, “My student/child enjoys reading” a main effect of Time was found \((F(1, 9)=8.11, p=0.019, \eta_p^2=0.474)\), showing that students reported enjoyment of reading increased from before \((M=3.32; SD=0.890)\) to after \((M=3.72; SD=0.814)\). An interaction effect between Group x Time was also found to be borderline significant \((F(1, 9)=5.06, p=0.051, \eta_p^2=0.360)\). Protected t-tests found a significant difference \((t(21)=5.16, p=0.000)\) between before \((M=3.22; SD=0.767)\) and after \((M=3.75; SD=0.685)\) scores for teachers but not parents \((p=0.221)\), showing that teachers drove this interaction effect.

For Question 2, “My student/child willingly reads daily” an interaction effect of Group x Condition x Time was found to be significant \((F(1,10)=6.00, p=0.034, \eta_p^2=0.375)\). To tease apart this three-way effect a 2 (Group: teachers, parents) x 2 (Condition: dog, adult) repeated measures ANOVA using the difference variable (final response - first response) as the dependent variable was conducted. As expected, a significant interaction between Group x Condition was found \((F(1, 10)=4.92, p=0.05, \eta_p^2=0.360)\). Examination of the data suggested that in the adult condition only teacher difference scores were greater \((M=0.769; SD=1.00)\) than those of parents \((M=0; SD=1.16)\). A protected t-test confirmed this difference to be significant \((t(12)=2.37, p=0.035)\), showing that teachers, not parents, were more likely to report an increase in daily reading behaviour only after reading to an adult.

Regarding Question 3, “My student/child reads aloud in a smooth and expressive voice” significant main effects were found for Group \((F(1, 9)=28.64, p<0.001, \eta_p^2=0.761)\), Condition \((F(1, 9)=5.87, p=0.038, \eta_p^2=0.395)\), and Time \((F(1, 9)=15.54, p=0.003, \eta_p^2=0.633)\). These effects show that parents scores here were greater \((M=3.40; SD=0.705)\) than those of teachers \((M=2.52; SD=0.945)\), that scores related to the dog condition were greater \((M=3.15; SD=0.923)\) than those of the adult condition \((M=2.77; SD=0.727)\), and that children’s oral reading abilities were reported to improve after the study \((M=3.20; SD=0.841)\) compared to before \((M=2.72; SD=0.809)\).

For Question 4, “My student/child has an easy time finding the right book” a significant main effect for Time \((F(1, 10)=61.78, p<0.000, \eta_p^2=0.861)\) was found, with greater agreement for post-test \((M=3.36; SD=1.038)\) than pre-test scores \((M=2.75; SD=1.009)\) for this question. A main effect for Group was marginally significant \((F(1, 10)=4.54, p=0.059, \eta_p^2=0.312)\), suggesting that parent scores were greater \((M=3.43; SD=1.038)\) than those of teachers \((M=2.68; SD=0.836)\) and had a more positive perception about readers ease for selecting books. An interaction effect was also found between Group x Time \((F(1, 10)=8.71, p=0.014, \eta_p^2=0.466)\). Examination of the results followed up with a protected t-test showed teachers drove the difference between pre \((M=2.54; SD=0.864)\) and post scores \((M=3.37; SD=0.711)\) for this question \((t(10)=7.41, p<0.001)\), not parents. So, although parent scores were greater than teachers, teachers scores were more sensitive to changes over the intervention period.

Finally, analysis of Question 5, “My student/child appears less anxious about reading”, yielded significant main effects for Group \((F(1, 10)=11.31, p=0.001, \eta_p^2=0.531)\) and Time \((F(1, 10)=37.37, p=0.001, \eta_p^2=0.789)\). This showed that teacher responses to this question were more positive \((M=3.63; SD=1.113)\) than parents \((M=2.72; SD=0.981)\), and that post-test scores were greater \((M=3.54; SD=1.043)\) than pre-test scores \((M=2.81; SD=1.052)\) overall. An interaction between Condition x Time was also found to be significant \((F(1, 10)=6.61, p=0.028, \eta_p^2=0.398)\). Protected t-tests found learners were reported to be significantly less
anxious about reading after \((M = 3.34; SD = 0.774)\) compared to before \((M = 2.69; SD = 0.947)\) in the adult condition \((t(12) = 3.42, p = 0.005)\) only. To better understand this unexpected effect a 2 (Condition) x 2 (Time) repeated measures ANOVA, with Order (Dog-first or Adult-first) as the between group variable, using collapsed teacher and parent scores together for an overall average as the dependent variable, was conducted. While this found, unsurprisingly, a Time effect again \((F(1, 9) = 41.48, p = 0.001, \eta^2_p = 0.822)\), an interaction between Condition x Order \((F(1, 9) = 22.64, p = 0.001, \eta^2_p = 0.716)\) was also found. This shows that readers were reported to have less anxiety in the adult condition provided they first experienced the dog. Taking this together, this suggests that reading anxiety may be reduced in an adult reading intervention provided readers first experience reading to a dog.

Open-Ended Questions

At the start of the study (i.e., prior to the interventions) teachers and parents were asked to respond to open-ended questions that asked them if there was anything that might help to support their student’s/child’s reading, and to describe their goals for their student/child. At later data collection points the first question was replaced to query how each program had been perceived by teachers, parents, and students. This was done to give context to the qualitative results lending a voice to the perceived efficacy of the supports. Qualitative software Nvivo 1.6.1 was used to conduct content analyses. This involved coding patterns in responses (references) to identify themes. Where possible, word coverage, (the percentage of coded content that represents a theme) was also reported.

Pre-Testing

Prior to testing, teachers \((n = 21)\) and parents \((n = 20)\) were asked to describe reading goals they had for learners. A content analysis identified four themes including reading deficits (29 references, 20% coverage), negative attitudes for reading (15 references, 13% coverage), reading strengths (15 references, 4% coverage), and reading-related problems (14 references, 11% coverage). Respondents had three main goals for learners: To improve reading skills (27 references, 25% coverage), to gain confidence (25 references, 20.5% coverage), and to come to enjoy reading (20 references, 16% coverage). Teacher and parent responses differed for the theme of reading skills as teachers made the majority of contributions here (18 references vs. 9 from parents), and their responses referenced specific reading skills with words like ‘decoding’, ‘fluency’, and ‘stamina’. These words occurred over 15 times in the teacher sample and not at all in the parent sample.

Post-Testing

To better understand stakeholders perceived efficacy of the supports, teachers \((n = 20)\) and parents \((n = 14)\) were asked to reflect on their experience with the canine-assisted reading support. A content analysis identified 3 main themes: positivity for reading (50 references, 17.5% coverage), reading improvement (36 references, 19% coverage), and enthusiasm for the reading support (36 references, 21% coverage).

Respondents were keen to comment on children’s growing positivity for reading (26 references) saying, for example, “He loved it”, “[Student] gets excited about reading now”, and “[Student is] excited to participate”. There were two equal pillars to this theme of positivity: children’s burgeoning affection for reading (14 references) and confidence for reading (10 references). Comments here included, “X is starting to enjoy reading”, “I have seen a confidence boost in X when she reads”, and “It gave him more confidence.” The second most prevalent theme here focused on comments relating to the improvement of reading skills (21 references). For example, “Reading skills have improved. Seems more willing to read.” The last theme (19 responses) showed a tendency to mention children’s affection for the dog-led condition. This included “…enjoyed reading with the puppy” and “…knowing that the dog liked to be read to”.

The same analysis was conducted after children had completed the adult condition. When asked how the program had affected the student/child, 21 teachers and 15 parents responded. Given the sample size \((n = 36)\) was like that of the dog condition, a content analysis found the same 3 themes were evident, only slightly less robust. These included positivity for reading (21 references), reading improvement (16 references), and enthusiasm for the reading support. Concerning the last theme, most of these comments focused not on the adult support but on the dog support. While respondents were directed to comment on the reading support they had just completed (in this case the adult support), 12 of the 17 references here made explicit mention of the dog support. For example, “She really enjoyed reading with a dog.” It is worth noting that the opposite pattern did not occur following the dog support (i.e., respondents did not comment on the adult support).

Comparing the themes based on whether children had read to a dog or adult suggests that those in the dog condition accounted for slightly more references in both the larger themes (i.e., positivity and reading improvements) than those in the adult condition. Unsurprisingly, the third theme resulted exclusively from responses related to the
dog condition. Further examination of responses from both groups for enthusiasm for condition suggests that of the 36 overall references, 17 of these showed a directional relationship between reading to dogs and enjoying reading. For example, “X seemed to enjoy reading during the PuppyPals.” Indeed, 9 out of 10 references attributed to the dog condition, referenced the child’s enjoyment of the reading support (90%). This was not as strong in the adult condition with only 3 of the 9 responses (33%) referencing the reading support. A chi-square test determined there was a significant difference between the proportion of adult and dog responses for reading enjoyment ($\chi^2(18) = 6.57, p = 0.010$).

These themes were also examined across parents and teachers for any differences in reporting. The overall pattern and prevalence of themes were the same in both groups although it is noted that teachers were more specific in their comments relating to the second theme (i.e., reading improvement), providing more details and specifics about the types and areas of reading skills. For example, one teacher noted, “Expanded sight word vocabulary. Greater persistence when encounters unknown words.”

Parents and teachers were also asked if either reading support helped the learner achieve reading goals. Upon completing the dog condition 36 responses to this question were collected (23 teachers, 13 parents). A content analysis identified 4 main themes: goal status (32 references), positivity for reading (19 references), reading improvement (17 references), and reading deficits (8 references). In terms of goal status theme, the majority of responses (references = 27, 75% of responses) here noted that goals had fully, or in-part been met, while a minority did not feel that goals had been met or were unsure (5, 14%). It seems that respondents were also keen to mention that learner reading still required attention, commenting, “…unable to recognize letters” and “I think she still has a ways to go”.

Following completion of the adult condition 35 responses (21 teachers, 14 parents) to this question of goals were collected. Content analysis found the same 4 themes that were identified in the dog condition: goal status (26 references), reading improvement (20 references), positivity for reading (18 references), and reading deficits (5 references). Regarding goal status, most respondents ($n = 18$) felt the adult condition had helped children to partially or fully attain their reading goals. Some did not feel that this condition had met goals or were unsure ($n = 8$). A chi-square analysis examining if goal status (achieved or not) was related to condition (adult or dog) was insignificant.

Qualitative data was also examined for differences in content between teachers and parents. While both groups made similar types and amounts of comments for the first two themes, for the theme of reading improvement, teacher’s responses again provided more information and detail than did parents. Furthermore, groups also differed somewhat on the deficit theme with teachers providing more details about the type/manner of deficit. They also made more comments overall ($n = 9$) than did parents ($n = 5$). Among all respondents the most frequent words included ‘read’ ($n = 74$), ‘confidence’ ($n = 33$), and ‘improved’ ($n = 29$).

Overall, both teachers and parents were enthusiastic about the literacy support the child was receiving, whether it was from a dog or an adult. Most were satisfied that these supports had benefited the child’s reading, helping them to reach their goals. Teachers provided more detail about the strengths and weaknesses of students reading abilities, likely because they have the training and expertise to do so, and they may have had more opportunity to directly observe the child reading.

**Exit Interviews**

At the end of the study the students themselves were invited to comment on their experience of the reading support they had just completed (dog or adult). This resulted in 12 interviews conducted with children who had just completed the adult condition and 18 with those who had just completed the dog condition.

When asked to categorize how much they were reading at school after just completing the adult condition, 42% of children (5) responded “the same”, 33% “more” (4), and 25% with “less” (3). The pattern of responses (18) was similar after finishing with the dog condition (respectively, 56%/10, 33%/6, and 5%/1). When asked how much they were reading at home after either program, responses from the adult and dog conditions were similar (chi-square test was insignificant) with 58% (7) and 61% (11), respectively, reporting that they were reading more at home because of the program, 33% (4) and 28% (5) reading about the same, and, finally, only 1 from both saying they were reading less.

A thematic content analysis of the 4 open-ended questions was conducted on both data sets. Regarding those that ended with the adult condition, when asked how they felt about the reading program children’s responses were mixed. Almost half (5) reported feeling negative (6 references) saying, for example, “I wasn’t good at reading” and “Nervous”. However, five other children had positive reports of themselves, describing themselves as “Good” (5 references). Comparing this to those that ended with the dog condition ($n = 18$) ten children were positive about their reading (12 references) and eight were negative (9 references). A chi-square test of independence examining the relation between these variables was insignificant showing that when finishing with either condition children’s feelings were the same.
When asked what they liked best about reading to the adult, children (12) tended to focus on the adult’s positive characteristics in supporting their reading (8 references, 8 responses) saying for example, “She is nice and helped me with reading”. Similarly, children finishing with the dog condition (and asked what they liked about reading to the dog) focused on the positive characteristics that the dog lent to their reading (10 references, 9 responses). For example, one child commented “I like reading to dogs because they are great listeners”, and another “I like reading to and petting the dog”. Even more popular was children’s tendency to use positive affirmations to describe their experience, saying, for example, “I love the dogs, they were the best” (14 references, 11 responses).

The third question asked children to comment on what aspects of their reading improved since their participation in the program. After the adult condition most children (10 of 12) mentioned the improvement of specific reading skills, saying, “I can read bigger words” and “I can read more words”. Some children also made some reference to personal improvement (4 references, 4 responses), commenting that “I got a little more comfortable”, for example. A similar vein of responses was found after children completed the dog condition with most children (12) noting improvements to specific reading skills. Many children (9) made positive comments about their personal improvement (12 references) with some (4) drawing on the dog’s positive characteristics. For example, one child noted, “[The dog] was a good listener” and another, “[The dog] helped me to keep trying because I didn’t feel judged...”.

Lastly, when asked how they felt after the adult (12) and dog (17) conditions, the majority of children responded with positive affirmations (15 references, 11 responses; 23 references, 16 responses, respectively) about both programs (chi-square n.s.) with children frequently using the words “good” and “happy”. Notably, the word “calm” appeared six times in the dog-led condition, and not at all in the adult-led.

Overall, while children were fairly pragmatic about their reading deficits at the beginning of the program, they believed their reading at home increased more than their reading at school as a result of participating in either reading support. Children’s reflections on their reading improvements focused on personal gains and this appeared to be more prevalent after the dog condition. However, overall, they spoke positively about both conditions.

Discussion

This study sought to examine differences in measures and perceptions of literacy, social function, and reading affect in readers identified as requiring extra supports exposed to canine-assisted and adult-assisted literacy supports. We found that while reading improved in both conditions, the canine-assisted reading support contributed to greater gains in both oral reading and reading comprehension scores than did the adult-assisted intervention. This finding aligns with other studies that also show evidence that reading gains are more likely to be driven by canine-assisted reading supports than reading to another person (Le Roux et al., 2014; Levinson et al., 2017). Our findings also show that the dog condition had the biggest overall impact on children’s reading comprehension. So far research in this area has only focused on oral reading as a measure of literacy so it is notable that larger gains were in the more difficult to assess factor of comprehension. It is worthwhile to consider the role of order as the dog condition had the most impact on reading performance when it was the first support in which learners engaged. Levinson et al. (2017) found a similar pattern of results – also swapping conditions halfway through, they observed that reading to dogs was most beneficial to oral fluency in the first half of their study, compared to the second. While they did not have the power to investigate statistical differences, they did argue that the observed difference of order may be attributed to a novelty effect. Indeed, this is a fair interpretation given that our findings demonstrate that the canine-assisted support drove gains in oral reading and comprehension more than the adult condition, and for oral reading most prominently in the first half of the study. However, in our study we did not observe this order effect when looking at the reading comprehension levels, as the dog group outperformed the adult group, regardless of timing. In addition, it does not explain what we observed in terms of our measure of social functioning (behaviour). That is, while we found that young readers’ social competence improved and their antisocial behaviour decreased (although not significantly), it is interesting that changes in both social measures were driven by the adult condition: while overall social functioning improved in the adult condition regardless of order, this was not the case for the dog condition. Learners first had to experience the adult reading support followed by the canine-assisted support in order to benefit behaviour, which is the opposite timing pattern we found for oral reading. A similar pattern of results was evident in the antisocial behaviour measure wherein exposure to the adult support was required before a slight improvement could be observed in the dog condition. That is, while the adult condition resulted in increased social competence and decreased antisocial behaviour regardless of order, the same results could only be reproduced in the dog condition provided learners were initially exposed to an adult support.

Therefore, overall, we found not only a different pattern in timing effects between literacy and social measures, but also found that the canine-assisted condition outperformed
on literacy, and the adult condition outperformed on the social competence measure. This contrasts with what was expected, since other studies have found that most people believe reading to dogs can have a positive impact on children’s socio-emotional and behavioural development (Daly & Suggs, 2010; Reilly et al., 2020). For example, Steel et al., (2021) suggest that AAI’s perceived benefits to reading behaviour outweigh benefits to reading performance. In their self-report surveys of teachers, the number of questions evaluating behaviour (n = 22) outweighed those of literacy (n = 2) making it likely that reading performance was simply under assessed. Previous research suggests that adaptive behaviour, particularly in terms of self-management and engagement, is predictive of literacy, notably reading comprehension, and that both fluency and comprehension are predictive of adaptive behaviour (Hirvonen et al., 2010). The pattern observed in our exploratory correlations, while not significant (possibly due to a lack of power), align with the expectation that better behaved learners make bigger reading gains, and that a change in social behaviour is related to a change in reading performance. That is, canine-assisted reading supports appear to directly benefit the cognitive performance of neurotypical children requiring extra reading support, while adult interventions are necessary for behavioural benefits to be observed. Future research needs to deftly examine just how much and when behaviour and reading performance impact one another when AAI is in use, as our findings indicate that it is more complicated than simply exposing learners to AAI. In fact, AAs may be most impactful for readers that have been identified as requiring extra supports when it is practiced alongside, or indeed after, adult-led reading supports.

Our finding that learners’ self-perception of their reading abilities relative to their peers increased after exposure to either condition aligns with other studies that show reading affect improves after canine-assisted reading supports (Kinnan et al., 2016) and adult-led supports. It is unfortunate that our data here (RSPS) was incomplete as it would have been useful in teasing apart whether confidence plays a mediating or causal role for children’s reading. In their review of the literature Hall et al. (2016) conclude that reading to dogs likely improves the learning environment (i.e., increases motivation and confidence for reading). While this study cannot discern whether reading to dogs improved reading, which lead to more confidence or vice versa, it is clear that more research is needed. Although this study was limited in the data that was collected from the RSPS, the closed-ended questions showed that both teachers and parents believed affect for reading increased after either intervention, but more so for the dog condition, aligning with previous research (e.g., Daly & Suggs 2010; Reilly et al., 2020). Findings from questionnaires showed that adults believed children made greater strides in oral reading when in the dog condition compared to the adult condition. Overall, teachers drove this difference more than parents. It is possible that since teachers are more familiar with the functional practicalities that literacy requires, that this knowledge made them better reporters of literacy. In addition, teachers likely simply had more opportunities to observe children’s reading behaviours. Interestingly, the tendency for teacher sensitivity also seems to be more robust in the adult condition when addressing children’s willingness to read daily (question 3) and (most peculiarly) in their perception of reading anxiety. That is, while teachers were more sensitive to lessening anxiety in the students than parents, this occurred in the adult condition only. However, further analysis suggests that improvement to reading anxiety in the adult condition may perhaps only occur on the condition that these readers first read to a dog.

The qualitative side of this study showed that the majority of responders at the end of both interventions believed that goals had been met. It is perhaps also understandable that while parents made more deficit comments than teachers, teacher’s comments were much more specific and detailed in terms of the nature of such deficits. It seems obvious that teachers, given their expertise, were much more descriptive than parents overall when it came to reading skills. Over the course of the study both conditions’ main themes reflected affection for reading and reading improvements. These themes were certainly more robust after the dog condition. It is interesting that even when having just completed the adult condition, responses made mention of the dog condition, and the reverse of this was not found. Indeed, respondents’ comments were more enthusiastic for the dog condition overall. While it is possible this may simply be due to a novelty effect there is sound evidence demonstrating that the primary effect of AAI is one of affect: that is because our socio-emotional well-being is improved in the presence of animals, notably dogs (Beetz et al., 2012; Hall et al., 2016), this suggests that the benefit of dogs to children may be in reducing stress levels. In line with these arguments is our finding that children used the word ‘calm’ following the dog condition, but not the adult condition. In their exit interviews, when queried about how either reading support had made them feel even children were relatively bipartisan. This highlights the importance of directly comparing an adult-led and canine-assisted intervention. For example, Henderson et al. (2020) found children’s reading affect increased after engaging in a canine-assisted literacy support, however, due to the lack of comparison group in that study we cannot draw conclusions as to whether this would be any different with an adult-led intervention. From our study we can conclude that when presented with these two literacy supports, students’ appreciation extended to
both. It is noteworthy that in the exit interviews children commented on exactly why researchers believe dogs can be beneficial. That is, children made comments about the dog being a “good listener” and that they “didn’t feel judged”. For example, Linder et al. (2018) state that reading improvements may be related to the “…unconditional acceptance offered by companion animals” (p. 324), while Steel et al. (2021) noted that “Proponents of RTD (reading to dogs) suggest that dogs provide a non-judgemental companion…” (p. 280).

Implications & Limitations

While many studies report the benefits of AAI for school-age children’s cognitive abilities, including language and literacy, behaviour, and physiological responses, it is clear that there is variation in the design and external factors that may influence results (Brelsford et al., 2017; Hall et al., 2016). For example, our research included 8 week-long intervals – might our findings have been different had a shorter or longer interval been applied? More work needs to be done to investigate just how long canine-assisted AAI for literacy needs to be to achieve efficacy. This is especially important as more and more AAI are applied to learning situations. To our knowledge, our study is the first to look at literacy, social functioning, and reading self-efficacy. While this study shows that canine-assisted reading supports contribute to greater reading gains than adult supports the same cannot be said for behaviour. Our assessment is that the link between literacy and social functioning, in neurotypical children, may not be as strong as what may be perceived. However, future research should endeavor to examine these constructs in further detail to uncover the exact relationship between them, specifically, in relation to AAI. Additionally, although it was not our intention to examine the order of these interventions (this was after all a control feature of our study) the findings suggest that future research should examine this in more detail. Whether these findings are related to the time of year or the combination of the two types of interventions (reading to an adult or reading to a dog) is unclear.

Furthermore, while teacher and parent perceptions are in the same vein, it is clear that teachers are more sensitive reporters than parents. And while parents and teachers were more enthusiastic about the dog condition, children were more conservative. Is it possible that the novelty of a canine-assisted approach has the potential to override adult objectivity? Future studies need to assess reporter reliability for AAI since adult input is necessary for its application, and as this research suggests, its outcomes too.

The main limitations of our study were related to the start of the COVID-19 pandemic and sample size. The first impacted our final time of testing as this coincided with students moving out of the classroom and into online learning. In addition, the difficulties with data collection for the RSPS was also unfortunate and impacted our analysis here. We endeavored to improve the rigor of research on this topic through controlled comparison of a targeted sample of learners – we did this while coping with the realities of working within the constraints of schools to target a sample of learners with real needs addressed through ecologically sound reading interventions. Our resulting sample size ($n = 24$) is satisfactory but not ideal. Future research should aim to improve power through larger sample sizes, while navigating the needs and realities of conducting research in schools.

Conclusion

As the first study to use random assignment and controlled conditions (incorporating reading comprehension, oral reading, and social functioning) to directly compare two school-based literacy supports for readers who have been identified as requiring extra supports, our research shows that a canine-assisted reading intervention leads to bigger gains in reading performance than a traditional adult-led reading intervention. Findings here suggest that these interventions may be impacted by timing and exactly what aspect of literacy is assessed. Canine-assisted supports should not necessarily be seen as a replacement for adult-led supports, but possibly, in combination. This study shows that canine-assisted AAI is not a panacea and we must continue to gain a robust, scientific understanding about when and how AAI may or may not benefit humans, especially young learners. Additionally, future research in this vein should also consider how AAI, when used to support literacy, can also facilitate humane education for young learners encouraging the cause of animal welfare, especially for that of canines with whom we share a special biopsychosocial bond. Finally, this study also provides unique insight from parents, teachers and children about their perceptions of these interventions and their participation. It is clear that much promise remains in canine-assisted literacy interventions, however, future research needs to attend to the impact of methodological constraints on the outcomes for learners and what this means for everyday practice.

Acknowledgements In memory of Bob Campbell and Steve King for their support of the Puppy Pals program.
Declarations

Conflict of interest Partial financial support was received from St Mary’s University Faculty Research and Scholarship Grant. The authors have no relevant financial or non-financial interests to disclose.

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