



## Piloting a Guide Dog Harness Evaluation Tool to Inform Evidence-Based Practice

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### ABSTRACT

**Introduction:** This study developed and piloted a new harness evaluation tool, comparing two new guide dog harnesses with the standard leather harness issued by guide dogs NSW/ACT, to identify the benefits and limitations of each and inform recommendations to guide dog handlers.

**Methods:** We used an exploratory, sequential mixed methods design to (1) Consult with current guide dog clients to identify problems with the standard issue harness, (2) Draft a new Harness Evaluation Tool (HET) scored out of 30 points, which also invites open comments from handlers, (3) Equip current guide dog handlers (n=22) to trial two new harnesses for one week each, and then (4) Complete four harness evaluations online *via* survey monkey (one rating each of the new harnesses, and two rating the standard harness pre-post trials).

**Findings:** Mixed methods data analysis showed that overall, the ruffwear unifty harness rated better than the Queensland harness or the standard guide dogs NSW/ACT harness. The three harnesses all enabled fluid, independent guide dog mobility but had different benefits and limitations. The HET created a precise, comparable evaluation of harness features with open feedback adding details. The HET was revised post-pilot, in response to participant feedback, to increase its validity.

**Conclusion:** Specific problems with the standard leather harness, such as an ill-fitting body piece and awkward clips, might be rectified by issuing one of the new harnesses or modifying the current harness. Although the ruffwear harness scored best, concerns about the dog overheating need to be explored. Person centered practice suggests that guide dog handlers could be offered a choice of harnesses, along with the HET to support shared decision making between handlers and guide dog mobility instructors. These findings can inform harness manufacturers about valued improvements to harness design, and the HET also provides a template for evaluating other assistance dog equipment.

**Keywords:** Guide dog harness; Guide dog mobility instructor; Guide dog handler; Assistance dog; Functional; Outcome measures

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## INTRODUCTION

Since world war 1, guide dogs have provided guidance, fluid travel and obstacle avoidance to a person with low vision or blindness. Guide dog mobility was established in Australia in 1951, and since then, travel environments have become more complex, with increased traffic, blended curbs, silent cars, ride share services, and more assistance animals [1]. There are now at least 22,939 guide dogs world-wide, and more than 800 dog guide handlers in Australia, diverse in their level of vision and range of comorbidities. 'Guide dogs' (a generic term, also agency specific or focusing on the dog) are now also known as seeing eye dogs, (agency specific, and dog guides (agency neutral, or comparing with a human guide). A guide dog in harness is working and vigilant whether walking, sitting or lying down. When navigating an upcoming hazard or obstacle, a guide dog must estimate a space wide enough for two, allow shoulder clearance on the handler's off-side (called 'right shoulder work') and avoid overhangs, such as low tree branches. In guide dog parlance, 'straight line travel' means the dog is travelling in the intended direction from curb to curb and resuming the path after detouring around obstacles as needed [2]. During travel, the harness conveys key information to the handler about the dog's attention, travel direction and responses to environmental cues, and the dog and handler work as a unit. A working guide dog might need to stand at a road crossing, sit at a bus stop, or curl up under a seat on public transport, in a cafe, under a desk, or in the foot well of a car. The harness is removed for toileting and off duty time, and this removal cues the dog to relax its vigilance. A guide dog harness should be comfortable to wear for hours but might also be fitted and removed many times a day, depending on the lifestyle and travel needs of the handler [3].

The standard harness issued by Guide Dogs NSW/ACT (GDNSW/ACT) has changed very little since 1965 (Figure 1). Available in five sizes, it caters for most labradors (22 kg-40 kg) and consists of a leather body piece and handle. In the 1980's the girth strap was altered, but both the dog's size and the harness leather can change over time causing an ill-fitting harness.



**Figure 1:** Guide dog in standard issue leather harness.

A systematic review of the biomechanical effects of harness use identified some dog related issues in harness selection, despite a dearth of studies and difficulty achieving statistical

power. Different harnesses affect the dog's gait, some harness styles can restrict the dog's back movement, and a "non-restrictive" harness can still limit the shoulder extension of the dog [4]. The pressure distribution of different harnesses varies significantly during straight line travel, curves and stairs, indicating more evaluation of the effects of harness types on dogs is needed. We are also interested in the effects on handlers and the ways the dog/handler team works together in the community. The travel characteristic least valued by guide dog handlers (n=61) is pulling or high tension on the harness or lead. It seems an ellipse-shaped handle and appropriate grip can reduce stress in the guide dog handler. In Australia, the National Disability Insurance Agency (NDIA) funds services, aids and equipment for people with a disability, putting the choice and control in the hands of the receiver/participant. Functional assessment tools are needed to inform evidence based decisions to ensure that appropriate, effective services and equipment are also cost efficient, reasonable, and necessary with guide dog handlers identifying problems with the standard guide dog harness, and a call from the NDIA for evidence based practice in guide dog mobility, the aims of this study were to:

- Compare two new harnesses with the standard leather harness issued by GDNSW/ACT to identify the benefits and limitations of each.
- Develop and pilot a harness evaluation tool which can be used to design and evaluate new equipment.

## MATERIALS AND METHODS

This exploratory, sequential mixed methods study with a QUAL/quant priority was undertaken by Guide Dog Mobility Instructors (GDMI) at GDNSW/ACT. This role combines specialist dog training with a dual qualification as an Orientation and Mobility (O and M) specialist, teaching dog handling skills, correcting dog and client behaviour so that the team travels safely and efficiently, optimizing the wellbeing of both [5].

It began with a survey to identify concerns from guide dog handlers about the standard guide dog harness, and features they thought were important in selecting and evaluating an effective guide dog harness. These data informed development of a new harness evaluation tool, which was piloted with current guide dog handlers (n=22) during 2020-2022, and then revised.

**Phase 1: Exploratory Study:** During 2019, a preliminary survey was sent out to all current guide dog clients at GDNSW/ACT (n=280), to identify specific problems with the standard leather harness, also considering the clients' travel experience with their dog and the functionality and aesthetics of the current harness. This inquiry was undertaken by a GDMI cadet, as part of her initial qualification [6].

**Phase 2: Harness evaluation pilot study** GDMI used the preliminary survey data to devise a new Harness Evaluation Tool (HET), initially using Likert scales to rate opinions about a range of identified harness features. However, opinions can

be subject to drift and without weighting of constructs, the ratings could not be aggregated to a meaningful, comparable score. After robust discussions about the relative importance of harness features, the GDMI team chose to measure 10 features/functions including individual harness components (body piece, clips, handle, rapid release), impact on the handler's travel experience (straight line travel, cornering, road crossings, tight places) and lifestyle factors (aesthetics, ease of care). A generic rating scale (3=elite, better than good, 2=good enough, competent, 1=basic, needing improvement, and 0=unsafe, dysfunctional) previously used in functional outcome measures was adopted, and performance indicators were written for each number on each of the ten sub scales to minimize drift in rating decisions. This meant the ten ratings could be aggregated on the spot, to a meaningful, comparable harness score out of 30 [7]. Two new harnesses were chosen by GDMI to address issues highlighted in the preliminary survey: The ruffwear unify (Figure 2) and the Queensland harness issued by guide dogs Queensland (Figure 3), which is based on the royal Dutch guide dog foundation design. The ruffwear harness came in two colors and three sizes: A bright yellow, high visibility large harness, and grey/denim harnesses in small and medium sizes.



Figure 2: Ruffwear unify harness.



Figure 3: Queensland harness.

Current guide dog clients of GDNSW/ACT (n=280) were invited *via* mail out in their preferred format (email, large print) to submit an expression of interest in the harness trials. To be eligible, they needed to have worked for at least 12 months with a dog less than eight years of age when registering their interest of the 36 guide dog handlers who responded, 25 were selected [8]. People in Sydney and Newcastle were selected randomly, and convenience sampling was used for resourcing reasons, to select clients in Northern and Southern NSW. This study was approved by the Swinburne university human research ethics committee (20202705-4906) and the animal ethics committee (20202807-4415). Each participant was notified of their selection in the study and gave informed, written consent. Participants were asked to trial two new guide dog harnesses, each for one week. They completed an evaluation of the original leather guide dog harness before the first harness trial and after the second harness trial, as well as an evaluation of each new harness after each trial week. They were encouraged to discuss their experience with others during this study, because conversation helps to articulate tacit, experiential knowledge. A survey monkey link to the HET was emailed to participants and if access to the survey was difficult, a GDMI recorded the results during a phone call with the handler [9]. GDMI that were issuing and collecting each trial harness were equipped with a checklist including standard instructions and tasks to guide the process. The GDMI observed the unit's working relationship and the dog's level of comfort using the trial harness over a familiar route, with the understanding that, if the dog did not settle within 15 minutes, or the unit's work seemed unsafe, or the participant felt unsafe, they should cease the trial. The research protocol intended that the two trial harnesses be allocated alternately to control for first trial bias, but COVID-19 delayed harness availability and restricted visits to clients' homes so that most participants were given the ruffwear harness to trial first. Two of the 25 participants were unresponsive to contact, and one dropped out between the first and second harness trials due to propping (when the dog refuses to move off the spot, requiring harness removal to get the dog moving again). After all trial harnesses were returned, the remaining participants (n=22) were encouraged *via* email or telephone to complete any unfinished surveys, resulting in 15 complete data sets including ratings and comments (8 females, 7 males; mean age 49.6, age range 22-70 years) and 8 partial datasets we could use for qualitative analysis (5 males, 3 females; mean age 44.13, age range 21-71).

### Data Analysis

Initially, statistical analysis produced percentages for categorical responses. Due to small sample size and the unknown population distribution, a non-parametric Friedman test was conducted to assess the difference of the average response on the four harness evaluations for the same group of participants [10]. Also, to examine the differences between the related groups Wilcoxon signed rank post-hoc tests were conducted separately. Data were analysed using SPSS version 28. Participants' comments from the HET were downloaded from survey monkey to an excel spreadsheet and first

analysed manually by harness feature/function and then in conjunction with statistical results.

## RESULTS

### Phase 1: Exploratory Study

The features of concern that handlers identified in the standard leather harness were:

- Heavy materials make a heavy harness.
- Body piece is ill-fitting.
- Branding not obvious.
- Clips are hard to use.
- Handle gets caught when going under a seat reflective tape on the handle looks tatty.
- Joint between the handle and the body piece impacts guiding.
- Handle is hard to get on and off.
- Unpleasant smell when the leather and dog get damp.

### Phase 2: Harness Evaluation Pilot Study Harness Evaluation

The statistical results (partly for the non-parametric test) were analysed first. Median response scores for the standard leather harness first trial, ruffwear unify harness, Queensland harness and leather harness second trial were 20 (14 to 28), 28 (19 to 30), 24 (11 to 29) and 23 (8 to 30), respectively.

The difference in total score depending on which of the new harnesses was trailed first was not statistically significant (*Chi-square* (3)=5.34,  $p=0.149$ ). However, post hoc analysis with Wilcoxon sign-rank test revealed a significant difference in scores between Leather Harness second trial and ruffwear unify harness ( $Z=-2.011$ ,  $p=0.044$ ), and between leather harness first trial and ruffwear unify harness ( $Z=-2.362$ ,  $p=0.018$ ) (Figure 4).

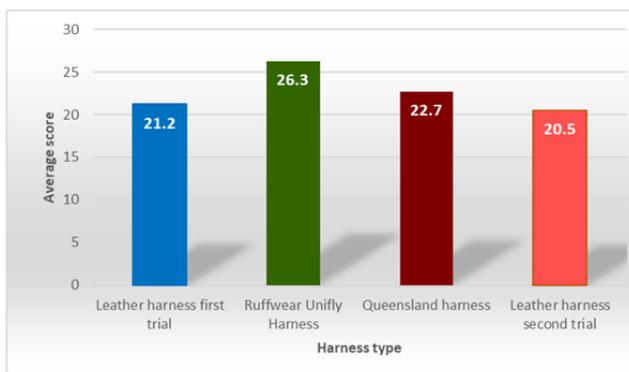


Figure 4: Bar graphs showing the mean score out of 30 for each harness evaluation.

There were no significant differences on the response score between Queensland harness and ruffwear unify harness ( $Z=-1.836$ ,  $p=0.066$ ), or between leather harness first trial and leather harness second trial ( $Z=-0.031$ ,  $p=0.975$ ), or between Leather Harness second trial and Queensland harness

( $Z=-0.974$ ,  $p=0.330$ ), or leather harness first trial and Queensland harness ( $Z=-0.912$ ,  $p=0.362$ ).

Analysis of the rating scales according to the level of scale indicated that all three harnesses were considered acceptable as guide dog equipment, but the ruffwear unify rated better than good, followed by the Queensland harness (Figure 5). Figure 6 indicates further breakdown of ratings according to harness features.

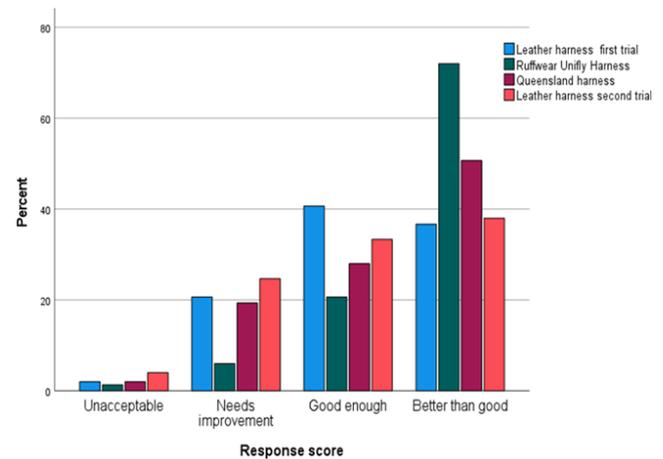


Figure 5: Bar graphs comparing the four harness ratings using the generic rating scale.

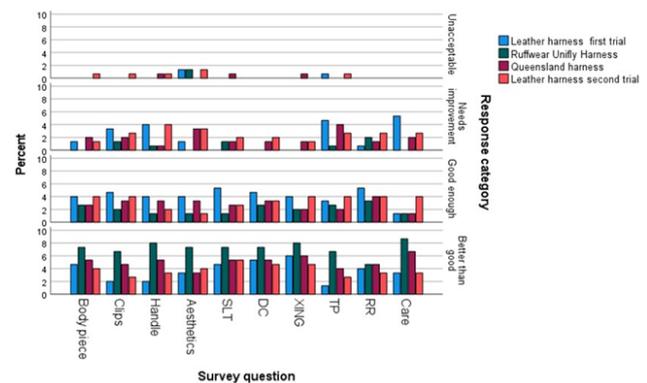


Figure 6: Bar graphs showing a detailed breakdown of harness features for the four harness ratings. SLT= Straight Line Travel; DC= Direction Changes, Xing= road crossings, TP= Tight Places; RR= Rapid Release of harness from dog, Care= Ease of care.

Participants' comments analysed alongside subscale ratings were grouped into three categories focusing on dog wellbeing, travel experience, and transitions between activities [11].

### Dog Wellbeing

Participants confirmed that all three harnesses were good enough, or better than good for guide dog mobility, but one participant preferred a product constructed from non-animal materials, for ethical and personal reasons.

Ten participants noted that the synthetic body piece of the ruffwear unify resulted in the dog "overheating" or at least getting hot [12]. Some suggested a thinner material would

make this harness a better fit for the dog; more flexible, more comfortable, and less likely to cause hotspots (acute, moist dermatitis caused by friction, though no hotspots developed during the one week trial.

### Travel Experience

The modern ruffwear unifi harness rated best for aesthetics, but some participants noted that the traditional leather harness is a publicly recognized identifier of the dog's guiding purpose, facilitating access to public places [13]. Opinions about the clips varied. The plastic clips on both trial harnesses prevented the dog's fur from being marked but the Queensland Harness clips were considered bulky and difficult to use one handed. The ruffwear clips rated well, but comments identified a preference for one clip, not two. Many participants valued the adjustability of the ruffwear handle and indicated that the Queensland harness would be better if also telescopic. Ms K suggested fixing the lightweight handle from the Queensland harness onto the standard leather harness, whereas others felt there was not enough give in the Queensland harness handle, and the grip was not wide enough for a large hand. A few participants enjoyed the light weight of the Queensland harness, while others disliked the colours and the lack of flexibility in the body piece.

### Transitions between Activities

A guide dog harness might be taken on and off many times a day, and the leather harness and the Queensland harness could both be swung over the handler's shoulder, fitting snugly under the arm, allowing the handler to use both arms. The ruffwear head hole seemed a little too small, making it difficult for some handlers to fit this harness over the dog's head, and the ruffwear harness was also difficult to hold while toileting the dog. However, Ms A explained that these negatives were overridden by her positive travel experience, finding it easier to follow the dog's movements through the ruffwear harness. The leather harness was considered good for tight places, but one participant suggested if the handle was easier to remove it would be easier to retrieve the dog if stuck under a seat. Handlers could more easily remove the handle of the ruffwear and Queensland harnesses. The Queensland harness rated well for care compared to the standard leather harness, but few comments were made about either, whereas the ruffwear harness was considered easy care.

### Revision of the Harness Evaluation Tool

The draft HET provided detailed information about harness features that mattered to participants in the preliminary inquiry and the tool was successful in reducing qualitative data to comparable scores. However, piloting showed that several subscales needed to be re-configured to better represent issues of concern in harness selection, rather than issues of concern in guide dog training or travel. Performance indicators in several of the scales were also revised for clarity.

### Body Piece and Dog Comfort Scales

The body piece in the three harnesses raised no particular concerns in relation to reading the dog's movement cues, but the unexpected issue of overheating highlighted the need to separate 'body piece-reading cues' from 'dog comfort' to ensure consideration of the body piece from both dog and handler perspectives.

### Aesthetics and Branding Scales

Piloting indicated that while both branding and aesthetics relate to sense of identity, they are sufficiently different to warrant a subscale each. Branding had more to do with public image and alignment with a particular community, or guide dog sub culture. Placement of brand, logo, and associated colours on the harness made the imposed work of guide dog ambassador easier by association with a reputable guide dog school, also supporting access to public places. Harness aesthetics seemed to be more about personal style—individual preferences for personal presentation, with consideration of safety. For example, one respondent disliked the brown and orange aesthetic of the Queensland harness but would be happy to have high visibility yellow on the harness for safety.

### Effective Travel Scale

Route travel accounts for a substantial amount of the guide dog's work in harness, and road crossings are one of the most complex travel challenges for a guide dog handler, so the GDMI team had split travel into the three components of straight line travel, cornering, and road crossings to give route travel more weight (9/30) in the overall HET score. However, road crossings received few comments perhaps respondents felt this function was already covered in straight line travel and direction changes. Successful road crossings depend less on harness design and more on the handler's traffic decisions, and if the harness works well for a varied ten-minute trip, it is likely also effective for extended trips encompassing footpaths and roads. Thus, we re-combined these three subscales into one 'effective travel' subscale. This coupled with 'reading cues' meant that in the revised tool, only 6/30 points were given to facilitating route travel [14].

### Wording

There was some confusion in 'rapid release' comments about whether this meant removing the whole harness from the dog, or just the handle from the body piece. Thus, this scale was reworded to mean removal of the whole harness. Other performance indicators were revised when dividing the body piece/dog comfort subscales and the aesthetics/branding subscales, and when combining the effective travel subscales (Table 1).

**Table 1:** Changes to the weighting of constructs in the Harness evaluation tool after piloting.

Pre-pilot constructs	Post-pilot constructs
Body piece	Body piece-reading cues
	Dog comfort
Clips	Clips
Handle	Handle
Aesthetics	Aesthetics-personal identity
	Branding-public image
Straight line travel	Effective travel
Cornering, changing direction	
Road crossings	
Tight places	Tight places
Rapid release (toileting, car travel)	Fitting and removing harness
Ease of care	Ease of care

## DISCUSSION

This study explored whether concerns about the standard guide dog harness issued by GDNSW/ACT could be resolved by either the ruffwear unify harness or the guide dogs Queensland harness. The pilot indicated all three harnesses were considered acceptable for guide dog mobility. The ruffwear harness scored better overall but raised concerns about the dog's comfort. The new HET provided an effective method for handlers to report their trial evaluations. The ratings distilled the merits and limitations of the three harnesses making comparisons easy, while open comments illustrated specific ways each feature/function impacted their guide dog work and lifestyle or might be improved. After piloting, some constructs were re-weighted and performance indicators reworded to better align with participants' priorities. The revised version of the HET is included.

### Harness Comparisons

Like Palya et al., we found that no equipment is perfect, and choosing involves trade-offs. While the primary purpose of a guide dog is to support safe, effective travel, it facilitates connections with others and fosters wellbeing of the handler, also empowering new life style possibilities. Thus, harness preferences have as much to do with the dog's comfort and the handlers' lifestyle, social identity, priorities, and convenience as with route travel itself.

Appleby, et al., highlighted the importance of client consultation prior to altering equipment used with assistance dogs, and our pilot provides harness manufacturers with guidance from handlers about ways that each product could be improved.

Guide dog handlers in our pilot wanted a harness that is comfortable for the dog and lightweight, providing timely

feedback. The attachments and fixing mechanisms need to be easy to use, and public identification of the animal's purpose as a dog guide is highly valued.

**The advantages of the ruffwear unify harness:** Handle, facilitating effective travel, fitting into tight places and general aesthetics were weighed up against the ill-fitting body piece and concerns from nearly half of respondents about the dog overheating.

The advantages of the Queensland harness, namely the clips and fitting into tight places, vied with lower ratings for aesthetics and reading direction changes.

The standard leather harness rated well for elements of effective travel, perhaps due to familiarity after years of experience using this harness, but difficulties persisted with removing the handle, and with manipulating metal clips that can knock the dog in the face and can mark the dog's fur.

### Reweighting the Harness Evaluation Tool

When developing new measures, validity and reliability are important, giving confidence that the resulting data are meaningful, and recommendations are robust. The HET was initially designed by GDMIs around features that guide dog handlers indicated were important, but subtle differences between the priorities of guide dog professionals and clients became evident in the redundancy of route travel details in the piloted scales. Feedback from pilot participants helped to shift the weighting of constructs and their performance indicators closer to handlers' priorities, increasing the validity of the HET as an outcome measure, also demonstrating the importance of researcher reflexivity and member checking in developing new measures. In considering the reliability of HET scores, we wondered if the trial of two novel harnesses might influence participants' perception of the standard leather

harness, either positively or negatively. However, ratings for the standard issue harness both before and after evaluating the two novel harnesses indicated no significant change in the overall score of the leather harnesses. This analysis suggests that the HET is a stable, reliable measure, not subject to drift, and Ms K commented on the value of familiarity: After using the trial harnesses and putting this one back on, both times I have been overwhelmed with gratitude for being reunited with this harness and slipping back into that feeling of absolute unity and smooth travel with my dog.

## Implications

In Australia, the NDIA that funds guide dog services and equipment places a priority on participants' choice and control and so it seems appropriate that guide dog handlers choose their own harness from a range of available options, in collaboration with their GDMI. Some clients, tired of waiting for changes in the standard issue harness now look online to source and trial new harness designs. The HET provides these initiators with a tool for independent harness evaluation as well as a framework for shared decisions with GDIMs, guide dog schools and funding bodies, or code sign with harness manufacturers and other stake holders in the harness industry.

The HET also provides an outcome measure for use in formal research. Harris et al., suggested a sample size of at least 27 subjects is needed to collect clinically relevant data about the biomechanical impact of harnesses on dogs, but such high participant numbers seem to be infeasible in this niche field. This study confirmed that a meaningful dataset can be generated from fewer participants in outcomes studies by using embedded mixed methods, where measures and qualitative data are generated from the same context and then analysed together to triangulate findings. This led to a richer understanding of the issues and complexities involved in harness selection than could be achieved when relying on statistical power alone to assert robust findings.

Although the ruffwear unify harness scored best of the three harnesses evaluated, concerns about the dog overheating warrant further investigation before widespread uptake can be recommended. Ruffwear manufacturers explained that the body piece needs to be sturdy to support the single point handle, but they are open to adapting this harness design to better suit handlers' needs.

Our pilot findings suggested that only minor modifications to the standard leather harness issued by GDNSW/ACT, are needed to update the design for current use, including a new handle that is easier to remove, with softer, more ergonomic clips.

## Limitations and Opportunities for Further Research

Our intended study design (n=25) was compromised by the COVID-19 pandemic, which restricted supply of harnesses to GDNSW/ACT, and delivery from GDIMs to clients. This meant we could not alternate allocation of the two novel harnesses to reduce the bias of primacy, and most participants trailed

the ruffwear harness first. While participants seemed to find the survey monkey format accessible, some found it tedious completing the HET four times in the study and some needed a reminder to complete evaluations once trials were finished. Although 22 participants' trailed the new harnesses, we only generated 15 complete datasets. A couple of dogs "propped" when fitted with the queensland harness and were not able to complete that trial week. Propping highlighted the need for further research into the animal side of equipment selection. A few clients commented that one week was not long enough to become familiar with each new harness, especially since COVID-19 restrictions limited their ordinary travel [15]. They considered that their dog's guiding and comfort level with either new harness would improve with practice, so an extended trial period seems warranted to increase familiarity and make a more comprehensive harness evaluation. The HET might have broader utility in the assistance dog industry, providing a template for how to measure equipment performance, based on features and functions that matter to handlers. Choosing 10 constructs, aggregating to a comparable score of 30, gave us a firm measurement framework within which to weigh and review the relative importance of each construct. Our study showed that the generic 3-2-1-0 rating scale originally used to assess human performance works equally well to evaluate harness performance and can easily be appropriated to other kinds of equipment, performance, and functional outcome measures.

## CONCLUSION

This pilot study showed that all three harnesses in the trial are considered acceptable guide dog equipment, and that the ruffwear unify harness shows promise as an innovative alternative to the standard leather harness issued by GDNSW/ACT. Person-centered practice suggests that guide dog clients be offered a choice of harnesses, then be involved in evaluating the options and selecting the best fit for their own needs. However, comparable feedback about the three harnesses can be used by GDIMs to inform client choices and tailor harness recommendations, and by guide dog schools to inform budgeting and resource allocation, making best use of limited resources.

The harness evaluation tool, devised and refined in this study, generates a valid, reliable mixed dataset about guide dog harness design and functionality. This functional evaluation frame work equips individual guide dog handlers and harness evaluation teams to reduce, standardize, quantify, and compare handler feedback about familiar and novel guide dog harnesses used in everyday lived environments, without needing to contrive standardized research tasks or venues. The result is practice based evidence to support informed harness choices and ongoing development of guide dog equipment that is fit for purpose.

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