

Supplementary Information

Optimising technology to measure functional vision, mobility, and service outcomes for people with low vision or blindness: Protocol for a prospective cohort study in Australia and Malaysia

Appendix 1: The VROOM/OMO tools

The VROOM (table 1) and OMO (table 2) tools are intended for use by an orientation and mobility (O&M) specialist or dog guide instructor who is assessing a client's functional vision and mobility status during travel in the community. Both assessment tools are co-rated together by the assessor, the client, and any other relevant stakeholders present (e.g. family members, professionals).

The tools use the same measurement template: Part A measures elements of observed travel (out of 30), and Part B measures elements of wellbeing (out of 20). Subscales within each tool are aggregated to a score out of 50 on the spot so that scores can be compared and discussed with the client.

When to assess VROOM and OMO

The VROOM and OMO tools can be scored multiple times in different situations, facilitating functional comparisons:

- At Referral. Benchmark the client's functional skills, explore relationships between vision, mobility, and wellbeing, identify service options, and define program goals.
- To measure fluctuations. If the client's skills are known to vary in different conditions, assess in daytime or in best conditions and again at whatever time the client's skills are worst (e.g., light: compare day/night travel; fatigue: compare morning/late afternoon travel).
- To measure program outcomes. Assess before and after training/intervention in the same conditions (e.g., without, then with a new mobility aid).
- To measure change over time. Assess at regular intervals over time to measure functional deterioration (e.g., progressive vision or medical conditions) or functional improvement (e.g. consolidating new functional vision or mobility skills).

Instructions for assessors

1. During ordinary O&M assessment, interview the client about functional vision and mobility, then go for a walk together. Start the functional assessment in a familiar place (e.g., client's

home, school) and observe the client engaged in at least three travel-related tasks, then move to more dynamic places relevant to the client and observe at least three more travel tasks.

2. Discuss patterns and variations in behaviour with the client as you score each VROOM and OMO subscale together in any order. The co-rating conversation can be woven throughout your ordinary assessment, or happen at the end. Work out your own style.
3. The rating process is shared, but the weight of opinion can shift: the assessor might initiate ratings in Part A Observed Travel after seeing the client in action; the client's opinion might weigh more in Part B Wellbeing, which considers action in the previous month.
4. Differences of opinion might be due to lack of information or lack of insight. You might need to observe the client in more situations and/or involve other stakeholders in co-rating.
5. When there is indecision between two levels on a sub-scale, always choose the lower rating (before and after intervention). This captures the client's worst performance and gives room to improve.
6. Ratings need to be justified, so where possible, record brief comments from the client, the assessor, and other stakeholders near the relevant ratings.
7. Once you have scored every cell, aggregate the total VROOM and OMO scores, then discuss implications with the client.

Abbreviations in the VROOM and OMO tools

ECS: O&M Environmental Complexity Scale

Aids: SG=sighted guide; dog=dog guide; LC=long cane; SC=support cane; ID=identification cane; WC=wheelchair; Sc=motorised mobility scooter; MG=miniguide; GPS=global positioning system (e.g. Trekker Breeze, phone app); Ph=phone; Other=might include low vision aids.

O&M Environmental Complexity Scale (ECS)¹

The VROOM and OMO tools use the O&M Environmental Complexity Scale to compare different travel environments (figure 1). The six levels of scale assume that travel challenges are cumulative, so the assessor only needs to note the highest level of complexity encountered during assessment.

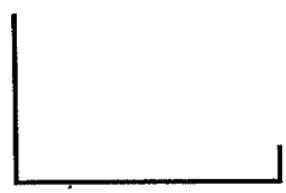
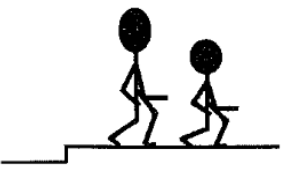
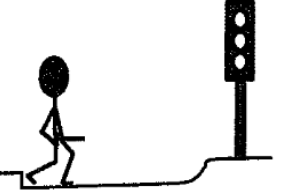
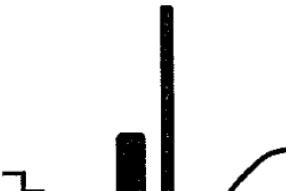
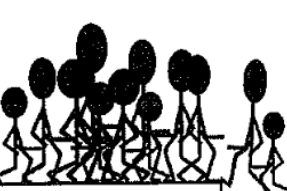
		Static, uninhabited	Dynamic, social			
		No movement; predictable	Pedestrian-paced	Traffic-paced		
Simple	Level 1		Level 3		Level 5	
	Complex	Level 2		Level 4		Level 6

Figure 1: O&M environmental complexity scale

- Level 1:** Static, uninhabited places with level groundplane, no obstacles e.g., empty corridor, gymnasium or sports ground
- Level 2:** Static, uninhabited places with varying groundplane and/or obstacles e.g., steps, ramps, loose surfaces, furniture, poles
- Level 3:** Pedestrian-paced places (no faster than jogging) with a clear, continuous path of travel e.g., quiet residential footpath, workplace, or school corridors during class-time
- Level 4:** Pedestrian-paced places where the pathway is repeatedly obstructed and wayfinding is tiring e.g., market, busy car park
- Level 5:** Traffic-paced places where infrastructure supports crossing decisions e.g. traffic lights, islands, chicanes, crossing guards, zebras
- Level 6:** Traffic-paced places where the traveller must judge when it is safe to cross the road, e.g., mid-block priority roads, or places where traffic ignores the road rules

¹ Deverell L. O&M environmental complexity scale. *International Journal of Orientation & Mobility* 2011;4(1):64-77.

Table 1: VROOM tool

VROOM Part A: Observed Travel Vision-Related Outcomes in O&M Date: Starting time: Client: Assessor: Observed / Interview only		Stable, familiar conditions; no hurry e.g., home, local block	Dynamic conditions; timeliness needed e.g., road crossings, shops, crowds
SCORING 3 = Vision is primary No touch or aid is needed 2 = Vision needs back-up Rely on vision; use non-visual strategies to confirm 1 = Vision is secondary Rely on non-visual strategies Vision sometimes useful 0 = Vision is useless Use non-visual strategies		Getting your bearings Where am I? Which way do I go? Venues: _____ Highest ECS: 1 2 3 4 5 6 Light: Bright Dim Dark Aids: NoAid SG Dog LC SC ID EWC MWC Sc MG GPS Ph Other:	Venues: _____ Highest ECS: 1 2 3 4 5 6 Light: Bright Dim Dark Aids: NoAid SG Dog LC SC ID EWC MWC Sc MG GPS Ph Other:
		Checking groundplane What's underfoot? Is it safe to step out? /3	/3
		Wayfinding Is this the path? Is anything in the way? /3	/3
		Recognising moving parts Who is around? Do I seek or avoid them? /3	/3
		Finding things What am I looking for? How do I find it? /3	/3
ECS=O&M Environmental Complexity Scale; Aids: SG=sighted guide; dog=dog guide; LC=long cane; SC=support cane; ID=identification cane; EWC=electric wheelchair; MWC=manual wheelchair; Sc=motorised mobility scooter; MG=miniguide; GPS=global positioning system (e.g. Trekker Breeze, phone app); Ph=phone			

VROOM Part B: Wellbeing	Score together from observations and discussion about activities within the past month	Comments & Score
Reading	0 I have no useful vision for reading text 1 If I'm close enough, I can identify large signs (e.g., stop sign) by text, size, shape, colour 2 I can sometimes read vehicle number plates & shop signs 3 I can sometimes identify different foods by looking at text and packaging (e.g., milk) 4 I can read regular print (i.e., letters, N12)	/4
Visual certainty	0 My vision is never useful when I'm moving around; too little, too late 1 I can't rely on my vision when I'm doing things 2 My vision causes hesitation and frustration; it undermines confidence when I'm moving 3 My vision has its limitations, but I know how to work with it 4 My vision is reliable for travel; I don't really have to think about it much	/4
Mobility aids (beyond home)	0 I use non-visual skills (cane/dog/guide) beyond home – my vision is useless 1 I rely on my cane/dog/guide – vision provides some extra information 2 I need non-visual skills sometimes (e.g., night travel, fluctuating vision) 3 I can go without, but a mobility aid gives me confidence, relieves fatigue, expands options 4 My vision is good enough for travel – I don't need a mobility aid	/4
People	0 I can't see people's shapes or movement; or see if a conversation partner moves away 1 I can see a body moving past, but I can't tell who it is; I sometimes collide 2 I can recognise people by their shape, colours, size or gait; I can usually avoid collisions 3 I can see faces, but not details; I do miss some social cues 4 I can recognise faces, read facial expressions and social cues	/4
Pleasure	0 My vision is un-motivating; it rarely or never prompts a closer look 1 My vision is limited or frustrating; often more trouble than it is worth 2 My vision is useful for some things, but not for others 3 I can see interesting things; it is usually worth the time it takes to look 4 I can see beautiful or engaging things that bring calm, contentment, excitement, even bliss	/4
RECOMMENDATIONS		
Part A: ____/30 Part B: ____/20 Total Score: ____/50		

Table 2: OMO tool

OMO Part A: Observed Travel O&M Outcomes Date: Starting time: Client: Assessor: Observed / Interview only		Stable, familiar conditions; no hurry e.g., home, local block	Dynamic conditions; timeliness needed e.g., road crossings, shops, crowds	
SCORING 3 = Elite skills Graceful, fluent, safe & effective in most places 2 = Competent skills Safe & effective, but not always graceful & fluent 1 = Basic skills Limited effective skills; needing consolidation 0 = Beginner skills Unsafe/inadequate for the context		Getting your bearings Where am I? Which way do I go?	Venues: _____ Highest ECS: 1 2 3 4 5 6 Light: Bright Dim Dark Aids: NoAid SG Dog LC SC ID EWC MWC Sc MG GPS Ph Other:	Venues: _____ Highest ECS: 1 2 3 4 5 6 Light: Bright Dim Dark Aids: NoAid SG Dog LC SC ID EWC MWC Sc MG GPS Ph Other:
		Checking groundplane What's underfoot? Is it safe to step out?	/3	/3
		Wayfinding Is this the path? Is anything in the way?	/3	/3
		Recognising moving parts Who is around? Do I seek or avoid them?	/3	/3
		Finding things What am I looking for? How do I find it?	/3	/3
		ECS=O&M Environmental Complexity Scale; Aids: SG=sighted guide; dog=dog guide; LC=long cane; SC=support cane; ID=identification cane; EWC=electric wheelchair; MWC=manual wheelchair; Sc=motorised mobility scooter; MG=miniguide; GPS=global positioning system (e.g. Trekker Breeze, phone app); Ph=phone		

OMO Part B Wellbeing	Score according to discussion about skills, attitudes and activities within the past month	Comments & Score
Activities	0 I find activities overwhelming 1 My mix of activities is not quite right; I don't know how to fix it, or I'm not yet ready for change 2 I like some of my activities, but I'm ready for new directions 3 I'm satisfied with my current mix of activities 4 I find my mix of activities challenging and enriching	/4
Connections	0 I feel isolated and lonely much of the time; I find it hard to connect with others 1 The people I know all do things for me; I feel quite dependent on others; I feel I have little to offer 2 I know where to find people; I'm linked in with some people or groups 3 I meet with people regularly; I feel welcomed and included 4 I have mutual friendships; we're there for each other; I actively contribute	/4
Life-space	0 I'm house-bound; I rarely go beyond the front gate 1 I do routine travel, only in well-known local areas (e.g., home block, local shops) 2 I explore in my local community; I like to try different routes 3 I travel to known places beyond the local community (e.g. commuting for work, visiting friends) 4 I like to explore beyond the local community, discovering new places	/4
Orientation	0 Even at home, I get disorientated; I have trouble understanding shapes, angles and distances 1 I can find the way at home by myself; beyond home, I need a companion or I get lost 2 I travel independently beyond home; if I get anxious or lost, I rely on help from other people 3 I travel independently beyond home; if I get anxious or lost, I can usually work it out by myself 4 I can go anywhere independently; I use mental mapping and I'm rarely disorientated for long	/4
Self-determination	0 My travel is managed by other people; I don't make the decisions 1 I need travel restrictions – I'm not always aware of what's safe and what is not 2 I'm aware of my own limitations, but I limit my travel rather than learning new skills 3 I'm aware of my own limitations; I plan ahead, source information and get help with my travel skills 4 I'm in charge; I evaluate my travel and learn from experience as I go; I develop my own skills	/4
<p>RECOMMENDATIONS</p> <p style="text-align: right;">Part A: ____/30 Part B: ____/20 Total Score: ____/50</p>		

Appendix 2: Socio-demographic and health questions

1. Age
2. Gender
3. Highest level of education (no formal schooling, primary/secondary school, post-secondary certificate/diploma, bachelor's degree, post-graduate certificate/diploma/ masters/PhD).
4. Occupation (full-time paid work, part-time paid work, unpaid work – home & family duties, volunteer work – community, student).
5. Is your income enough to meet your goals (sufficient, some compromises needed, insufficient)?
6. Language/s spoken at home
7. Vision condition/s
8. Onset of first vision condition/s (congenital: birth-first year, childhood: 1-18 years, adult >18 years), and pace of onset (gradual, abrupt).
9. Clinical vision measures if available (visual acuity, visual fields).
10. Where do you live (city, country town/village, isolated property or farm)?
11. Who you live with (alone, with immediate family members, with friends, relatives or acquaintances, in supported accommodation/aged care facility/hostel)?
12. Do you have issues that make your life complicated? If so, what?
13. Rate your overall physical fitness (very poor, poor, OK, good, very good).
14. Other than vision, what are your main barriers to travel (limited goals/motivation, disorganisation, family dynamics/demands, poor health/fatigue, finances, inaccessible physical environment, limited access to information, limited access to transport (public or private), safety concerns, get lost easily, self-conscious in public, other)?
15. Have you used any of the following to support your travel in the past month (private transport, public transport, taxi/Uber, sighted guide/travel companion, dog guide, long cane, id cane, support cane, Miniguide, braille, print, audio/voice-over, computer/internet, GPS, mobile phone/platform, best apps, other)?

Appendix 3: Technology survey for O&M clients

Q1. Gender

- Male
- Female

Q2. Age

- Less than 10
- 10-19
- 20-29
- 30-39
- 40-49
- 50-59
- 60-69
- 70 +

Q3. How would you describe your sight?

- No light perception
- Low vision and legally blind (eligible for pension)
- Low vision, but not eligible for pension
- Full vision

Q4. How do you travel beyond home?

- Long cane
- Dog guide
- Sighted guide
- Taxis/Ubers
- Public transport
- Private car
- Wheelchair
- Scooter
- Bicycle
- Other. Please explain:

Q5. Do you use any of the following devices? (can choose more than one)

- Mobile phone/s. Make and model:
- Tablet. Make and model:
- Portable braille notetaker Make and model:
- Laptop computer. Make and model:
- Desktop computer. Make and model:
- Standalone GPS. Make and model:
- Standalone OCR (optical character recognition) device. Make and model:
- CCTV (closed circuit television). Make and model:
- Personal activity monitor (e.g. Fitbit, SmartWatch). Make and model:
- Handheld sonar (e.g., Miniguide). Make and model:
- Sonar built into another device (e.g., Ultracane) Make and model:
- Barcode Reader. Make and model:
- Other. Please describe:

Q6. What formats do you use to support your travel? (can choose more than one)

- Print on paper
- Screen magnifier (zoom)
- Screen reader (voice-over)
- Voice recorder
- Braille
- I plan and/or travel with someone else
- Other. Please explain

Q7. Which apps do use to plan or carry out travel?

- Please list:
- I don't use apps.

Q8. What features do you particularly like in the apps you use?

- Please explain.
- I don't use apps.

Q9. Do you have access to technology training for travel purposes?

- Yes. Please describe:
- I would like more training. Please describe:
- No

Q10. Do you have ideas about how technology could be developed or enhanced to support your travel?

- Yes. Please explain:
- No.

Q11. Are you happy to be contacted by a Swinburne researcher to discuss your technology ideas?

- Your name:
- Best phone number:
- Best email address:

Q12. How did you respond to this survey?

- Independently
- With some assistance

Appendix 4: Technology survey for O&M professionals

Q1. Gender

- Male
- Female

Q2. Age

- Less than 10
- 10-19
- 20-29
- 30-39
- 40-49
- 50-59
- 60-69
- 70 +

Q3. What is your vision like?

- Full vision
- Low vision, but not legally blind
- Low vision, and legally blind (< 6/60 acuity and/or <10° fields)
- No light perception

Q4. What is your role? (you might have more than one)

- O&M specialist
- Dog guide instructor
- CBR fieldworker
- Other. Please explain:

Q5. What clients do you work with? (you may choose more than one)

- Adults
- Children
- People with neurological limitations / acquired brain injury
- People with intellectual disability

- People with physical limitations (e.g., use a support cane, wheelchair, scooter)
- People with mental health problems
- People with multisensory limitations (e.g., deafblind)
- Other. Please explain:

Q6. What devices do you use to support your O&M client work? (you may choose more than one)

- Mobile phone/s. Make and model:
- Tablet. Make and model:
- Portable braille notetaker Make and model:
- Laptop computer. Make and model:
- Desktop computer. Make and model:
- Standalone GPS. Make and model:
- Standalone OCR (optical character recognition) device. Make and model:
- CCTV (closed circuit television). Make and model:
- Personal activity monitor (e.g, Fitbit, SmartWatch). Make and model:
- Handheld sonar (e.g., Miniguide). Make and model:
- Sonar built into another device (e.g., Ultracane) Make and model:
- Barcode Reader. Make and model:
- Other. Please describe:

Q7. What O&M assessment resources have you used with clients?

- Agency assessment forms
- Checklists or rating scales. Please list:
- Books or theoretical approaches. Please list:
- Electronic resources (e.g., devices, apps). Please list:
- Physical materials. Please list:
- Other. Please explain:

Q8. What features do you like in the apps you use?

- Please describe.
- Not applicable

Q9. Do you use any accessibility features with a mobile phone? (list as many as you like)

- No
- Zoom/large print
- Reverse contrast
- Voice-over
- Other. Please describe:

Q10. Do you have concerns about using a mobile phone app to collect O&M assessment information?

- No.
- Yes. Please explain:

Q11. Do you have ideas about how technology could be developed or enhanced to support O&M practice (for you or the client)?

- Yes. Please explain:
- No.

Q12. Are you happy to be contacted by a Swinburne researcher to discuss your technology ideas?

- Your name:
- Best phone number:
- Best email address: