Finding your way: Down's Syndrome and Navigation

What do we mean by navigation?

Research into navigation has suggested that whenever we learn our way around a new environment (e.g. a new town or a new school), there are three types of knowledge that we might gain.

1. **Landmark Knowledge**
   Landmarks are objects in the environment. We select landmarks that stand out to us, so that we can later recognise them and use them to help us to find our way. Landmarks can be *proximal* (close to you, e.g. a postbox on the street you are walking down) or *distal* (further away, e.g. a tall building in the distance). Useful landmarks are objects that are unique, permanent and don't move.
2. **Route Knowledge**
   Route knowledge describes the knowledge needed to learn a fixed route from A to B. That is, you learn a sequence of turns and associated landmarks, for example, you may think to yourself "I turn left at the bakery, and then I turn right at the bank."
3. **Configural Knowledge**
   The most sophisticated level of navigation draws on configural knowledge. This can be descibed as the relationship between landmarks and places within your environment. It is like having a map inside your head, and is sometimes referred to as a cognitive map. With this cognitive map, you can work out how to get from A to B, and, importantly, you are now able to adapt the route you take. For example, you can make short cuts, re-orient yourself if you become lost, and change your route if you encounter an obstacle (for example, a street may have access blocked because of road works).

Another navigation concept is referred to as a **spatial frame of reference**. Route knowledge uses an **egocentric** frame of reference – which means that the location of landmarks are considered in relation to the self. Configural knowledge, however, requires the use of an **allocentric** frame of reference, which is when the mental representation of each landmark is considered in relation to other landmarks or parts of the environment, rather than your own body. You are able to understand the spatial relationships between external objects, independently of your own viewpoint.

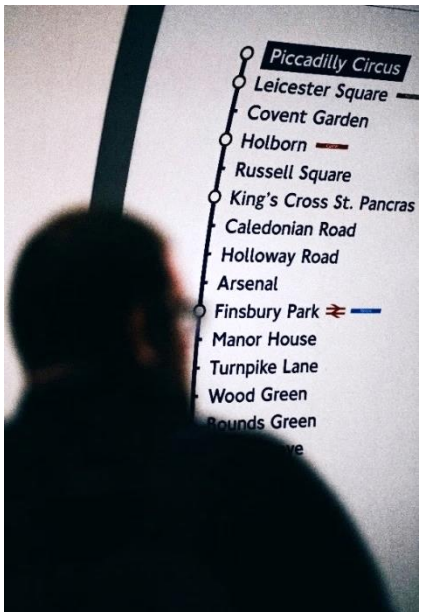
Of course, in a practical sense, navigation involves more than just learning a route. For example, knowing which bus stop to get off at, knowing how to buy a train ticket, and being able to keep track of the time are all important skills for navigation. It is important to appreciate that many factors affect the ability to independently navigate. Being able to successfully navigate around an environment is essential for an indvidual's independence, confidence, and self-esteem.

Down's Syndrome and navigation

We have found in our research that individuals with DS are able to develop both landmark knowledge and route knowledge, provided they are given sufficient practice, but commonly have limited configural knowledge [1, 3, 5]. However, research indicates that individuals with DS need significantly more practice to learn a new route than typically developing 8-year-old children [1, 2, 3, 6]. This ability to use route knowledge is encouraging as it indicates that individuals with DS are able to find their way, even if the learning process is relatively time consuming. Remember though, as stated above, route knowledge has limited flexibility, and so individuals with DS find it hard to adapt learnt routes should they need to (e.g. finding alternative routes in response to obstacles, or finding shortcuts).

Research suggests that instead of finding a shortcut, an alternative strategy used by individuals with DS is to add two known routes together [1, 3]. This is a really adaptive way of compensating for their difficulties in developing configural knowledge. It remains, however, a less efficient navigation strategy. The reliance on fixed routes means that individuals with DS are also vunerable to getting lost, as without configural knowledge, they cannot easily re-orient themselves. It has also been noted that individuals with DS are often not motivated to engage in independent exploration of environments [7], limiting oppurtunities to develop navigation skills.

Research demonstrates that individuals with DS can have an impaired ability to recognise landmarks [1, 5]. This is significant, given the importance of landmark recognition in route knowledge. Research also signals that individuals with DS can find it difficult to learn return routes (i.e. the way from A to B and back again) [3]. Research has also indicated that individuals with DS often find it difficult to use maps [7]. It is possible that training in map use could have a positive impact on route learning skills in this group. Equally, other skills could be drawn upon to compensate for these difficulties such as developing a series of audio and/or picture descriptions of a route to aid navigation. Research is needed in this area to determine which of these techniques benefits individuals with DS.

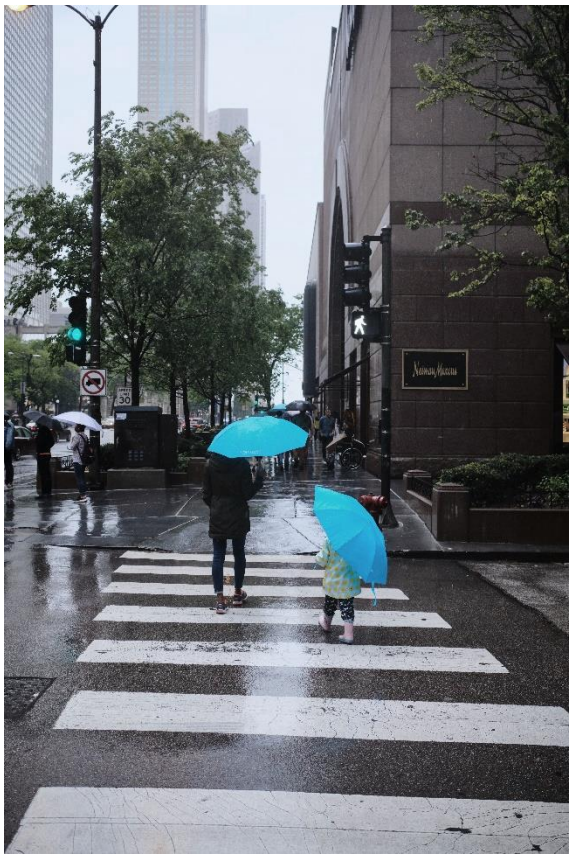


Additionally, anxiety has implications for independent navigation. For example, the reliance on fixed routes means that it is very distressing if something goes wrong with that route. An individual may also be anxious about getting lost, which may cause reluctance to practice independent navigation. Although individuals with DS may not themselves be anxious about wayfinding [7], their parents or guardians may feel anxiety concerning the individual's wayfinding abilities. This may limit the individual's oppurtunities to practice independent navigation, and may also negatively affect the individual's confidence in their wayfinding abilities [7]. Anxiety can affect many other aspects of navigation, such as using public transport, exploring new environments, or staying calm when a route is blocked. The impact of anxiety should be appreciated when helping the individual to develop their navigation skills.

Practical Tips for navigating with individuals with Down's Syndrome

- When learning a new route, it is essential for the individual with DS to practice it many times.
  Why? *Our research shows that individuals with DS need significantly more practice than typically developing children when learning a route* [1, 2, 3, 6].

- Provide opportunities to explore environments.
  Why? *Research links an active exploration of environments to better wayfinding skills* [7].



- As a new route is being learnt, encourage the individual to pay special attention to landmarks that you pass, and to also verbally identify them.
  Why? *Paying attention to and identifying landmarks improves route learning* [2].

- Break the route up into sections, and ask the individual to identify the landmarks within each section.
  Why? *This makes it easier for the individual to associate each landmark with an action: e.g. "At the bakery I turn left, then at the chemist's I turn right".*

- Teach the individual about which landmarks are most useful, and why.
  Why? *Similarly to typically developing individuals, the route learning abilities of individuals with DS are best served by more useful landmarks* [5, 6].
  - Unique landmarks are more useful than repetitive landmarks. For example, a distinct tree or building that stands out in its environment would be a unique landmark, while a streetlamp would be a repetitive landmark, as there are many other streetlamps along most routes that look alike.
  - Useful landmarks should not move. For example, a building would be more useful than a parked car as a building will remain in the same location, while a car is likely to be moved.
  - Proximal landmarks near junctions are also more useful than proximal landmarks along path sections. This is because landmarks near decision points can be paired in memory with the direction that you need to turn.
  - Distal landmarks are generally not very useful for learning a fixed route, but are still vital for developing configural knowledge.

- Make sure the individual has strategies to use if they should become lost, or if their usual route is unavailable.
  Why? *Knowing what to do in such situations can help the individual to stay calm and may reduce anxiety.*
  Such strategies could include:
  - Make sure the individual has someone that they can phone or text for help
  - Store pictures of landmarks along the route on the individual's phone (in the correct order). If the individual gets lost, they can look at the pictures to guide them.
  - Asking a safe person to help – for example, an employee in a nearby shop.

- Be aware that the return route should be learnt in addition to the original route. For example, one strategy could be to make the time to learn the sequence of landmarks for the original route in reverse order.
  Why? *Return routes should be learnt separately, as the order of turns and landmarks is reversed. This can cause difficulty in navigation.*

- Be aware of the impact of anxiety on navigation, and provide a safe and supportive environment in which the individual can practice and develop their skills.
  Why? *Parental anxiety can affect the wayfinding confidence of the individual with DS, as children often learn, and share, parental emotions* [7]. *Being aware of your own anxieties, can help to avoid inadvertently making the individual more anxious.*

- Use pedestrian crossings wherever possible.
  Why? *Issues with depth perception are common in DS* [4]*, and so judging the speed of oncoming traffic is difficult.*

- Using a virtual environment could be a safe way to practice exploration and navigation skills. This can be as simple as walking the route using a streetview app on a desktop computer.
  Why? *Potential hazards such as traffic, uneven ground, etc are not present in a virtual environment. Furthermore, learning in a virtual environment can improve real-world performance* [5].

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References

1. Courbois, Y., Farran, E. K., Lemahieu, A., Blades, M., Mengue-Topio, H., & Sockeel, P. (2013). Wayfinding behaviour in Down syndrome: A study with virtual environments. Research in Developmental Disabilities, 34(5), 1825–1831. doi: 10.1016/j.ridd.2013.02.023
2. Davis, M., Merrill, E. C., Conners, F. A., & Roskos, B. (2014). Patterns of differences in wayfinding performance and correlations among abilities between persons with and without Down syndrome and typically developing children. Frontiers in Psychology, 5. doi: 10.3389/fpsyg.2014.01446
3. Farran, E. K., Purser, H. R. M., Courbois, Y., Ballé, M., Sockeel, P., Mellier, D., & Blades, M. (2015). Route knowledge and configural knowledge in typical and atypical development: A comparison of sparse and rich environments. Journal of Neurodevelopmental Disorders, 7. doi: 10.1186/s11689-015-9133-6
4. Krinsky, M. S. J., Silverman, W., Gordon, J., Devenny, D. A., Oley, N., & Abramov, I. (2014). Vision deficits in adults with Down syndrome. Journal of Applied Research in Intellectual Disabilities, 27(3), 247–263. doi: 10.1111/jar.12062
5. N'Kaoua, B., Landuran, A., & Sauzéon, H. (2019). Wayfinding in a virtual environment and Down syndrome: The impact of navigational aids. Neuropsychology, 33(8), 1045–1056. doi: 10.1037/neu0000578
6. Purser, H.R.M., Farran, E.K., Courbois, Y., Lemahieu, A., Sockeel, P., Mellier, D., & Blades, M. (2014). The development of route learning in Down syndrome, Williams syndrome and typical development: investigations with virtual environments. Developmental Science, 18(4), 599–613. doi: 10.1111/desc.12236
7. Yang, Y., Faught, G. G., & Merrill, E. C. (2018). Parent reports of wayfinding by their children with Down syndrome. Journal of Intellectual & Developmental Disability, 43(4), 483–493. doi: 10.3109/13668250.2017.1284309