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Original article

Understanding the relative importance of micro-level design characteristics of walking paths in parks to promote walking among older adults

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A R T I C L E I N F O

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A B S T R A C T

Walking paths have been consistently highlighted as important for facilitating older adults' physical activity in parks. However, little is known about the micro-level design characteristics of walking paths that are most appealing for older adults to be active during their park visits. This study aimed to examine the relative importance of selected micro-level design characteristics of walking paths preferred by older adults and to investigate if preferences varied by gender, park accompaniment, and mobility status. Older adults (n = 383, 65–93 years; 56% female) completed a series of Adaptive Choice- Based Conjoint tasks in an online survey to identify the relative importance scores and part-worth utilities of micro-level design features of walking paths using Hierarchical Bayes analyses (Sawtooth Software). The ten micro-level design features that were examined included: gradient; width; surface type; benches, shady trees, garden beds, water body and light fixtures along the path; continuous walking loop; and access from carpark. For the overall sample, the three most important features of walking paths were the gradient of the path (21.3%, 95%CI=19.6–22.9), shady trees along the path (21.2%, 95%CI=20.1–22.4), and surface type (13.3%, 95%CI=12.2–14.4). For these top three features, the part-worth utility scores showed that paths with gentle slopes; lots of shady trees; and rubber surfaces were preferred respectively. This study helps inform which micro-level design characteristics to prioritise when (re)designing walking paths to encourage and facilitate active park use by older adults.

1. Introduction

Population ageing is a global phenomenon with nearly every country in the world experiencing an increase in the population of older adults (≥65 years) (United Nations, 2020). In Australia, the proportion of people aged 65 and over has risen from 12% in 1995 to 16% in 2020 and is expected to reach up to 23% of the total population by 2066 (Australian Institute of Health and Welfare, 2021). Older age has been associated with an increased risk of chronic diseases, disability, and frailty (Clegg et al., 2013; Guzman-Castillo et al., 2017; World Health Organization, 2010). As the world's population continues to age, World Health Organization recommends older adults to be more physically active to reduce the risk of chronic diseases and improve overall quality of life (Chodzko-Zajko, 2014; World Health Organization, 2002, 2015).

Parks are a valuable resource and an important setting for older adults to be physically active, socialise with family and friends, and relax in nature. However, past studies have reported older adults to be among the least observed age groups visiting parks and the least active when in the park (Cohen et al., 2019; Evenson et al., 2016; Evenson et al., 2019; Joseph and Maddock, 2016). Previous research has suggested that park use among older adults varies from other age groups as they have different needs and preferences, however, the design of parks often does not consider the specific preferences of older adults or their needs (Ibes et al., 2018; Onose et al., 2020). Considering the physical limitations that older adults tend to experience as they age, incorporating age- appropriate features that cater specifically to older adults can lead to greater autonomy, thereby motivating them to visit parks more often (Gibson, 2018).

Walking paths have been consistently highlighted as an important park feature to facilitate physical activity and park visitation (Duan et al., 2018; Pleson et al., 2014; Veitch et al., 2020; Zhai et al., 2021; Zhang et al., 2019). In a recent study in Australia that used Adaptive

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Choice-Based Conjoint analysis, walking paths were found to be of critical importance to older adults, being the most important park feature for encouraging physical activity and the third most important for encouraging park visits and social interaction in parks in this age group (Veitch et al., 2022). In order to enhance the park experience and encourage physical activity among older adults, it is necessary to examine the micro-level design characteristics of walking paths. Micro-level design characteristics of walking paths include specific and detailed design features that contribute to overall function, and aesthetics (Cain et al., 2014), such as the type of surface, width, and presence of trees, flowers or benches along the path. This is a critical aspect as the design of walking paths can have a significant impact on how older adults perceive the space and further influence use or physical activity (Schmidt et al., 2019; Zhai et al., 2021). Furthermore, incorporating or modifying micro-level design characteristics in a park could be a relatively easy, and cost-effective method to create an environment that promotes older adults to visit parks and encourages them to walk during their visit (Cain et al., 2014; Schmidt et al., 2019). Previous studies have assessed micro level environmental factors that affect older adults' walking for transportation (Van Cauwenberg et al., 2016; Van Cauwenberg et al., 2014); however, older adults' preferences related to micro-level design characteristics of walking paths in parks are not well understood.

To date, few studies have examined the micro-level design characteristics preferred by older adults. A study conducted among adults aged $\geq$ 60 years in two urban parks in China explored the micro-level design characteristics of walking paths by observing and interviewing older adults and found that older adults preferred walking paths with soft even pavement without steps, presence of benches, flowers and light fixtures along the path, width of 3–3.9 m wide, and near to water bodies (Zhai and Baran, 2017). These findings are consistent with another study among older adults in China that found older adults mostly preferred walking paths with features such as vegetation, views along the paths, ground cover plants, seating with arms and backrests, and colourful flowers along the pathways (Wang and Rodiek, 2019). The findings of these studies are limited to park visitors in China, and their generalisability to other regions is uncertain. Further research is required for a comprehensive understanding of the needs/ preferences for design features of walking paths among older adults in different locations. Additionally, these studies have not examined preferences for other micro-level design features of walking paths that may be important to facilitate walking, such as slope, and layout, nor investigated which micro-level design features of walking paths older adults value the most relative to others.

Preferences regarding design features of walking paths among older adults may also differ based on gender, mobility status, or park accompaniment. In a study conducted among older adults in China, the authors found that male participants preferred walking paths with non-obstructed views while female participants preferred "colourful flowers" more than male participants (Wang and Rodiek, 2019). In previous studies, older adults with mobility limitations valued having seating opportunities en route and in parks, alongside walking paths, and the provision of handicapped parking (Alves et al., 2008; Ward Thompson, 2013; White et al., 2010). While the evidence is limited, these findings indicate diversity among older populations in terms of their preferences for design features. Additionally, older adults often visit parks with other people (Veitch et al., 2022; Veitch et al., 2020) and it is possible that preferred design features vary according to the accompaniment. However, current knowledge regarding the preference for micro-level design characteristics of walking paths among subgroups (e.g. gender, mobility status, park accompaniment) of older adults is scarce. Further research is needed to better understand differences in preferences for design features of walking paths across different sub-groups of older adults so that walking paths that are accessible and inclusive to diverse groups of older adults can be created.

This study aimed to assess the relative importance of micro-level design characteristics of walking paths in parks to encourage walking among older adults in Australia. It also explored differences in preferences according to subgroups (gender, mobility status and park accompaniment). This research is novel and significant as it extends the existing limited body of knowledge by providing a deeper understanding of micro-level walking path design features older adults value the most. This is important as it will help policymakers, urban designers and architects understand what features should be prioritised when designing and managing walking paths, which may enhance the appeal of walking and to facilitate use (and more frequent use) by a wider range of older adults in the community. This evidence is especially important in a planning context when resources are limited.

2. Methods

Older adults ($\geq$65 years) completed an online survey hosted in Sawtooth software (Lighthouse studio 9.2.1) from September 2021 to December 2021. Ethical approval was provided by Deakin University Human Ethics Advisory Group (HEAG-H 110_2021).

2.1. Participants

Participants included older adults, living in Australia, and living independently (i.e., not in a nursing home or care home). Recruitment incorporated multiple strategies. Organisations such as PROBUS, Men's Sheds, University of the Third Age (U3A), retirement villages, and neighbourhood centres were approached via email and asked to disseminate information about the study and the link to the survey to their members. The study was also advertised on Facebook, where paid advertisements were placed targeting adults aged 65 years and over living in Australia. Additionally, participants (n = 208) from a previous study (Veitch et al., 2022) who agreed to be contacted for future studies, were sent an invitation to participate via email, along with the link to the survey. Informed consent was obtained prior to starting the survey. As compensation for their time, participants were offered the chance to go in a draw to win one of five $100 gift vouchers.

2.2. Procedures and measures

Adaptive Choice-Based Conjoint (ACBC) analysis was used in this study. ACBC is a unique approach that is comparable to real-world choices as decisions are made based on a range of co-existing features rather than individual features in isolation (Orme, 2010). It uses an interactive process that adapts choice tasks to the preferences and decisions of each participant (Orme, 2010; Sawtooth Software Inc., 2014). This method was used to examine the value respondents assign to certain features, and is considered a useful method to identify the relative importance of specific design features (Orme, 2010). ACBC tasks have previously been used to examine the relative importance of selected park features among older adults (Veitch et al., 2022), adolescents (Rivera et al., 2021; Van Hecke et al., 2018; Veitch et al., 2017) and children (Veitch et al., 2021).

The survey consisted of three parts: 1) structured items to collect socio-demographic information including age, gender, country of birth, education status, living status, marital status, employment status and mobility status (see Table 1); 2) a series of ACBC tasks relating to the design of walking paths in a park and a series of ACBC tasks relating to the design of outdoor fitness area in a park, presented in random order (data related to outdoor fitness equipment not reported here); 3) items on participants' usual park visitation over the past three months, including frequency and duration of park visitation, park-based physical activity, mode of transport to park, walking in parks, and park accompaniment, and frequency of physical activity undertaken in a usual week (see Table 1). To assess mobility status, participants were asked if they had a problem with balance and walking (Yes/No). Responses were categorised as: limited mobility (yes); no mobility limitations (no). To

Table 1
Participant demographic characteristics.

	N = 383
Age, mean [SD]	73.1 [5.38]
Gender, n(%)[b]	
Male	167 (43.6)
Female	215 (56.1)
Country of birth, n(%)	
Australia	253 (66.1)
Other	130 (33.9)
Area-level socioeconomic status (SES), n(%)	
Low SES	54 (14.1)
Mid SES	82 (21.4)
High SES	247 (64.5)
Remoteness of residence, n(%)[c]	
Urban area	339 (88.7)
Regional area	43 (11.3)
Dog ownership, n(%)	97 (25.3)
Highest level of education	
Some high school	27 (7.0)
Completed high school	32 (8.4)
Technical or trade school certificate or apprenticeship or diploma	72(18.8)
Tertiary qualification	248 (64.8)
Current employment status, n(%)	
Working full-time	14 (3.7)
Working part-time	32 (8.3)
Unemployed	2 (0.5)
Retired	335 (87.5)
Marital status, n(%)	
Married/de-facto	255 (66.6)
Separated/ widowed/ divorced	105 (27.4)
Never married	23 (6.0)
Living Status, n(%)[a]	
Alone	114 (31.6)
Partner	244 (67.6)
Children	17 (4.7)
Other family member	9 (2.5)
Other	14 (3.9)
Problem with balance or walking, n(%)	
Yes	108 (28.2)
No	275 (71.8)
Use mobility aids, n(%)	25 (6.5)
Usual frequency of park visits in the past 3 months, n(%)	*n = 361*
Not visited in the past 3 months	53 (14.7)
Everyday	39 (10.8)
1–6 times per week	207 (57.3)
2–3 times per month	28 (7.8)
Once per month	25 (6.9)
< once per month	9 (2.5)
Usual duration of park visits in the past 3 months, n(%)	*n = 361*
Not visited in the past 3 months	53 (14.7)
< 30 mins	53 (14.7)
30 min to 1 h	174 (48.2)
> 1 to < 2 h	63 (17.5)
2 or more hours	18 (5.0)
Usual accompaniment of park visits in the past 3 months, n(%)	*n = 361*
Not visited in the past 3 months	53 (14.7)
Alone (without a dog)	101 (28.0)
Other adult family member(s)	103 (28.5)
My child(ren)	4 (1.1)
My grandchild(ren)	26 (7.2)
Friends	59 (16.3)
Organised groups	9 (2.5)
Other	6 (1.7)
Usual activities during park visits in the past 3 months, n(%)[a]	*n = 361*
Not visited in the past 3 months	53 (14.7)
Went for a walk (excluding dog walking)	242 (67.0)
Walked the dog(s)	74 (20.5)
Went for a jog/run	11 (3.0)
Rode a bike	39 (10.8)
Played ball games	13 (3.6)
Did other exercise(s)	27 (7.5)
Supervised grand/child(ren)	57 (15.8)
Watched sports	10 (2.8)
Relaxed	127 (35.2)
Had a BBQ or picnic	69 (19.1)
Socialised with family/friends	127 (35.2)
Attended major event/ celebration/ birthday/fair	11 (3.0)
Visited café / restaurant	69 (19.1)
Spent time in nature	168 (46.5)
Other	28 (7.8)
Mode of transport to parks in past 3 months, n(%)[a]	*n = 361*
Not visited a park in the past 3 months	53 (14.7)
Walked	200 (55.4)
Jogged	3 (0.8)
Cycled	29 (8.0)
Public Transport	12 (3.3)
Car	166 (46.0)
Other	5 (1.4)
Time to walk from their home to park they visited most often in past 3 months	*n = 361*
Not visited a park in the past 3 months	53 (14.7)
1–10 min	150 (41.5)
11–30 min	92 (25.5)
> 30 min	66 (18.3)
Usual time spent walking within the park on each visit	*n = 361*
Not visited a park in the past 3 months	53 (14.7)
1–10 min	35 (9.7)
11–30 min	120 (33.2)
31–60 min	111 (30.7)
> 60 min	42 (11.6)
Days physically active for at least 30 min in a typical week, mean (SD)	*n = 361* 5.3 (2.3)

[a] Multiple responses allowed
[b] One participant preferred not to mention their gender
[c] Remoteness of one postcode could not be identified

assess park accompaniment, participants reported who they visited the park with most often in the past three months. Responses were dichotomised i.e.visit park alone or visit park with someone.

The ACBC tasks included ten different micro-level design features of walking paths: gradient; width; surface type; benches, shady trees, garden beds, water body, and light fixtures along the path; continuous walking loop; and access from carpark. The features included were selected based on previous research which had identified different design and environmental characteristics of parks that appeared to be important among older adults (Cohen et al., 2017; Kou et al., 2021; Lu, 2010; Mahmood et al., 2012; Moran et al., 2014; Veitch et al., 2020; Wang and Rodiek, 2019; White et al., 2010; Zhai and Baran, 2017; Zhai et al., 2021; Zhai et al., 2018). Where relevant, the features/levels have been modified to suit the Australian context. For example, a study conducted in two parks in Beijing found that brick paved path and soft pavement such as plastic track was used more by older adults (Zhai and Baran, 2017). In Australia, however, plastic track and brick paved paths are not commonly used in parks instead prevalent pavement surfaces were included in this study, such as rubber, concrete, asphalt, and natural compacted surfaces. Each feature had 2–3 levels. For example, the levels for the feature 'surface type' included 'concrete/asphalt surface', 'rubber surface' and 'natural compacted surface' (see Table 2 for the list of features and levels). Similar to the previous ACBC studies (Rivera et al., 2021; Veitch et al., 2022; Veitch et al., 2017), ACBC tasks consisted of written descriptions of features and levels. To increase familiarity with features and levels, images and/or written descriptions of features and associated levels were presented before starting the ACBC tasks.

The ACBC tasks were undertaken in multiple steps (refer Supplementary file 1 for screen capture of different questions within various steps of an ACBC task). Firstly, ten different micro-level design features were presented in a "pre-screener" question, asking participants to choose six features that were the most important for them in a walking path. The subsequent steps would display the tasks using only these selected features. Next, in the "build-your-own" section, participants were asked to select a preferred level for features that had levels other

Table 2
Design features and feature levels of walking paths.

Features	Feature levels
1. Surface type	i. Concrete/ asphalt surface (hard)
	ii. Rubber surface (cushioned)
	iii. Natural compacted surface (e.g. sand, gravel)
2. Width of path	i. Wide path
	ii. Narrow path
3. Gradient of path	i. Path with no slopes
	ii. Path with gentle slopes
	iii. Path with steep slopes
4. Bench along path	i. Regularly spaced benches along path
	ii. No benches along path
5. Shady trees along path	i. Lots of shady trees along path
	ii. A few shady trees along path
	iii. No shady trees along path
6. Garden bed along path	i. Presence of garden bed along path
	ii. No garden bed along path
7. Water body along path	i. Presence of water body(e.g. pond) along path
	ii. No water body along path
8. Light fixtures along path	i. Presence of light fixtures along path
	ii. No light fixtures along path
9. Continuous walking loop	i. Continuous walking loop
	ii. Continuous walking loop branched to other areas
	iii. Not a continuous walking loop
10. Access from carpark	i. Walking path is easily accessible from carpark
	ii. Walking path is not easily accessible from car park

than presence/absence. Next, participants were presented with a series of six "screening" questions, where four design profiles of walking paths with different combinations of features and levels were presented. These design profiles included a combination of the levels of the same six features participants had selected in the first step. For each profile, participants indicated whether the shown design profile would encourage them to walk on that walking path (i.e. I would/would not like to walk on this path). If particular features were consistently 'avoided' by the respondent, they were asked to indicate which of the 'avoided' features was the most 'unacceptable'. Likewise, if some features were consistently 'included' in the design concept, respondents were asked to select one feature that was an absolute requirement for them. These "unacceptable" and "must-have" questions determined if specific features were non-compensatory for choice and the program ensured that the remaining tasks included the levels which would best meet each individual's needs. Lastly, a series of 13 "choice tasks" were presented that included two design profiles of walking paths with different combinations of pre-selected feature levels. Participants chose one design profile out of two that they found most appealing to walk on. Design profiles were determined by the software's algorithm. Any feature levels that were the same in both profiles were faded (but still legible) to make it easier for the respondent to determine differences between design concepts.

2.3. Data analysis

A total of 383 participants completed ACBC tasks relating to walking paths, of which 361 also completed park use and physical activity behaviour questions. Descriptive statistics were calculated using Stata/BE 17.0 (Stata Corp. College Station, TX, USA). ACBC data were analysed using Sawtooth Software SSI Web Lighthouse Studio 9.12.1. Hierarchical Bayes (HB) analysis was used to generate two parameters: part-worth utilities and average relative importance scores (Orme, 2010). A part-worth utility represents the preference for the feature level. A higher value for the feature level indicates greater desirability for that level within each feature (Orme, 2010). For example, if the feature level for surface type, 'rubber surface', 'concrete surface' and 'natural compacted surface' had part-worth utility values of 20, − 15 and − 5 respectively, this indicates that 'rubber surface' is the most preferred and 'concrete surface' is the least preferred level within that feature. Relative importance scores are presented as a percentage and indicate the maximum effect each feature has on choice (Orme, 2010). For example, a feature with an importance score of 30% is twice as important as a feature with an importance score of 15%.

Standard errors and 95% confidence intervals were calculated using Microsoft Excel (2016) for each part-worth utility and importance score to determine significant differences between each feature (importance score) and the levels of each feature (part-worth utilities). Non-overlapping confidence intervals implied significant differences between relative importance scores and part-worth utilities. To interpret the overall fit of the conjoint model, Root Likelihood (RLH) values (ranges from zero to one, with a higher value indicating a better fit of the model) were used (Orme, 2010). RLH values ranged between 0.75 and 0.77. We also examined variations in preferences of design features of walking paths according to subgroups, i.e. by gender, mobility status, and park accompaniment. HB estimations were completed for the overall sample (n = 383), divided in males (n = 167), and females (n = 215), those with mobility limitations (n = 108) and no mobility limitations (n = 275), and those who visited the park alone (n = 101) and with someone (n = 207).

3. Results

The demographic characteristics of the sample are presented in Table 1. Participants had a mean age of 73.1 years (SD= 5.38, 65–93 years) and 56% were female. Around 28% reported having a problem with balance and walking, and 7% reported using mobility aids. Approximately 68% reported visiting a park at least once per week in the past three months, 63% usually visited for one hour or less, 28% usually visited alone, and 55% walked to parks. Almost half reported usually engaging in moderate-intensity physical activities during a park visit in the past three months, 67% reported that walking was their usual activity during park visits, and 42% reported walking for more than 30 min during each visit.

3.1. Relative importance

3.1.1. Overall sample

For the overall sample (n = 383) (Fig. 1), the gradient of the path (21.3%, 95%CI= 19.6, 22.9) and shady trees along the path (21.2%, 95%CI=20.1, 22.4) were the two most important features. These features were followed by surface type (13.3%, 95% CI=12.2, 14.4) and accessibility from a carpark (11.8%, 95%CI=10.6, 13.0) which were significantly lower than the top two features but did not differ significantly from each other. The fifth most important feature was benches along the path (9.4%, 95%CI=8.6, 10.2) and the sixth most important feature was the width of path (9.3%, 95%CI= 8.5, 10.2). These were both significantly lower than surface type and access to a carpark, but their importance scores were not significantly different from each other. Importance scores were significantly lower for continuous walking loop (5.9%, 95%CI= 5.1, 6.7), and waterbody along path (3.9%, 95%CI= 3.3, 4.5). The last two remaining features scored were significantly lower than the previous features and were not significantly different from each other, light fixtures (2.0%, 95%CI= 1.6, 2.4), and garden bed along path (1.9%, 95%CI= 1.5, 2.3).

3.1.2. Gender

Although a few differences were observed in the relative order of the features, the differences in the importance scores were not significant (see Fig. 2a).

3.1.3. Mobility status

Some differences in the relative importance scores were observed by mobility status (Fig. 2b). For those with limited mobility (n = 108), the top five features were: gradient of path (25.9% 95%CI= 22.8, 29.0); shady trees along path (17.4%, 95%CI= 15.6, 19.2); access from carpark (13.2%, 95%CI= 10.9, 15.4); surface type (12.3%, 95%CI= 10.6, 14.0);

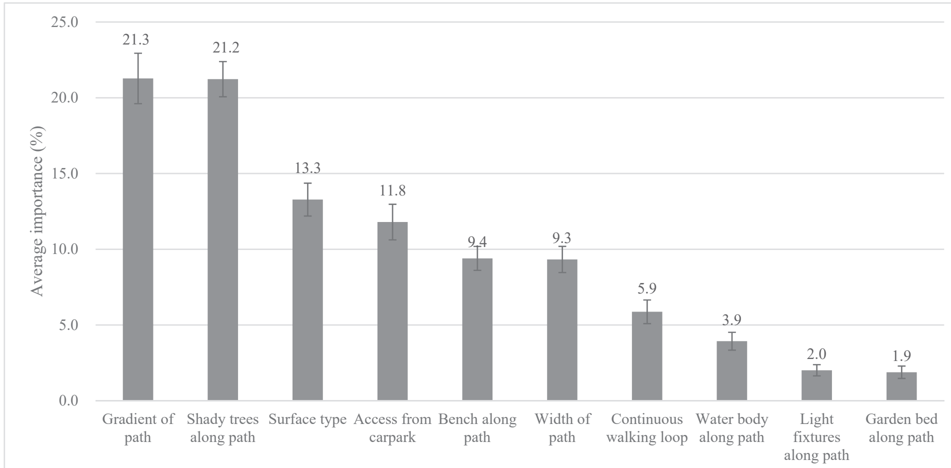

Fig. 1. Average relative importance of design features for walking paths for overall sample (n = 383).

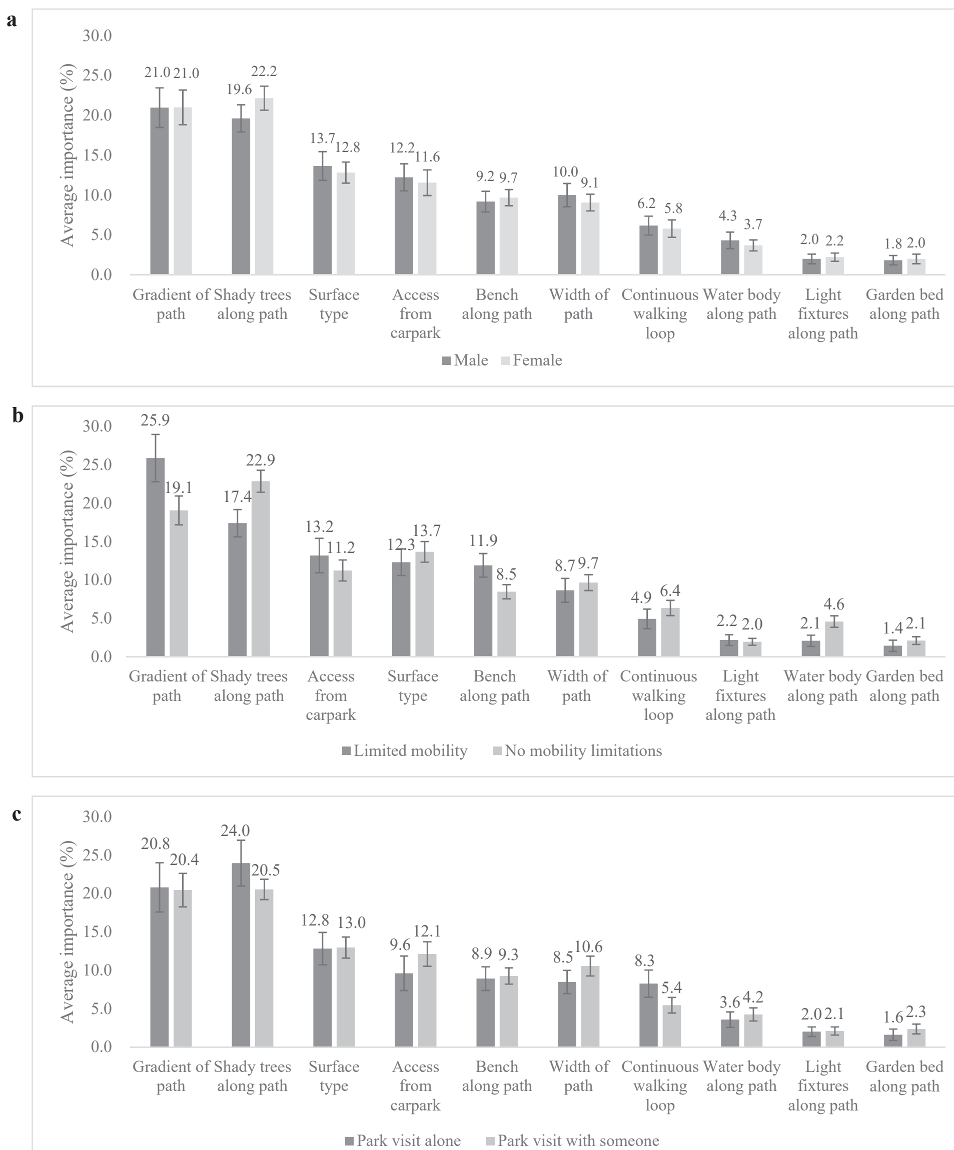

Fig. 2. Average relative importance of design features for walking paths a) by gender; male (n = 167), female (n = 215) b) by mobility status; limited mobility (n = 108), no mobility limitations (n = 275) c) by park accompaniment; park visit alone (n = 101), park visit with someone (n = 207).

and bench along path (11.9%, 95%CI= 10.4, 13.5) respectively. For those with no mobility limitations (n = 275), the top five features were: shady trees along path (22.9% 95%CI= 21.4, 24.3); gradient of path (19.1% 95%CI= 17.2, 20.9); surface type (13.7% 95%CI= 12.3, 15.0); access from carpark (11.2% 95%CI= 9.9, 12.6); and width of path (9.7% 95%CI= 8.6, 10.7) respectively. Compared to those with no mobility limitations, gradient of path and benches along path had significantly higher relative importance among those with mobility limitations.

3.1.4. Park accompaniment

The top four features were in the same order for those who usually visit parks alone (n = 101) and for those who usually visit parks with someone (n = 207) (Fig. 2c). Although a few differences were observed in the relative order for the other six features, the difference in the importance score was not significant.

3.2. Part-worth utilities

Most of the part-worth utilities showed a higher value in the expected direction for the overall sample (Fig. 3). For features with presence/absence as the two levels, the presence of a feature was always preferred over its absence and part-worth utilities values were significantly different from each other. For example, the presence of regularly spaced benches along a path (46.7, 95%CI= 42.7, 50.7) was preferred over no benches along a path (−46.7, 95%CI= −50.7, −42.7). For features with sequential order, higher sequential order was generally preferred. For example, 'lots' of shady trees along path (75.9, 95%CI= 69.9, 81.9) was preferred over 'a few' shady trees (45.9, 95%CI= 42.4, 49.3), which was preferred over 'no' shady trees (−121.8, 95%CI= −128.4, −115.1). However, for the feature 'gradient of surface', a path with gentle slopes (77.6 95%CI= 71.6, 83.7) was preferred over a path with no slope (45.9, 95%CI= 39.6, 52.1) which was preferred over a path with steep slopes (−123.5, 95%CI= −134.7, −112.3) and these were significantly different to each other. For other features with no sequential order such as, surface type: rubber surface (13.3, 95%CI=, 6.6, 19.9) had a higher preference than the natural compacted surface (1.8, 95%CI= −6.0, 9.5) which again had a higher preference than concrete/asphalt surface (−15.0, 95%CI= −22.6, −7.5). The rubber surface and natural compacted surface did not differ significantly from each other, but these were significantly different to the concrete surface. Finally, a continuous walking loop branched to other areas (27.3, 95% CI= 23.6, 31.1) was preferred over a continuous walking loop (2.6, 95% CI= 0.8, 4.3), and a non-continuous walking loop (−29.9, 95%CI= 34.1, −25.7).

For gender (Supplementary file 2), the order of preferences for levels was the same as that of the overall sample. For other subgroups, the preferred levels for sub-groups were mostly similar to the overall sample, except for the feature "surface type". For those with mobility limitations (Supplementary file 2), rubber surface (18.0, 95%CI= 7.8, 28.2) was the most preferred level followed by concrete/asphalt surface

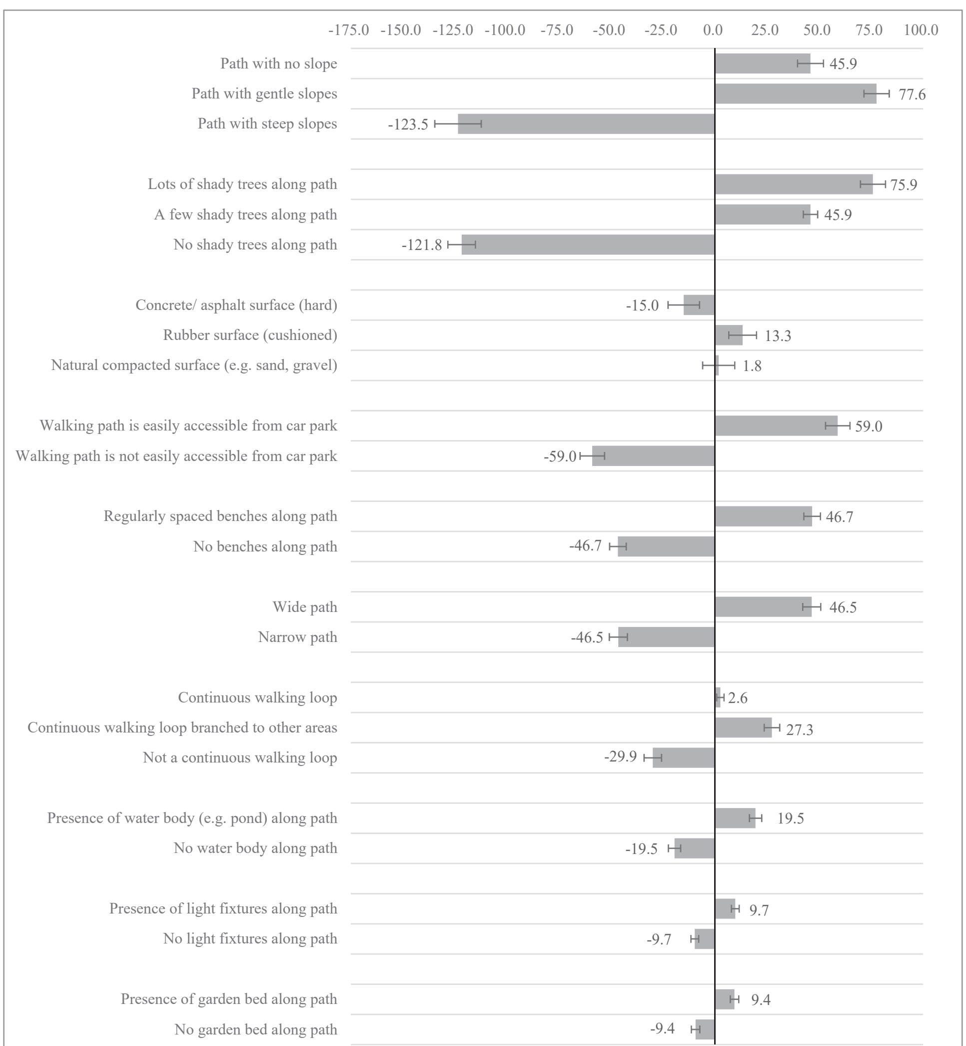

Fig. 3. Average part-worth utilities of design features for walking paths for overall sample (n = 383).

(−3.4, 95%CI= −16.3, 9.4), but no significant difference was found between them. Natural compacted surface (−14.6, 95%CI= −27.6, −1.6) was the least preferred level for this subgroup, and this was significantly different to rubber surface. For those with no mobility limitations, rubber surface (11.7, 95%CI= 3.4, 20.0) was most preferred level followed by natural compacted surface (8.1, 95%CI= −1.2, 17.4). These were significantly different to concrete/asphalt surface (−19.8, 95%CI= −29.1, −10.6) which was the least preferred level. Furthermore, for those visiting a park alone (Supplementary file 2), the levels for the surface type were not significantly different to each other, whereas, for those visiting a park with someone, rubber surface (12.9, 95%CI= 4.3, 21.4) was the most preferred level and was significantly different to concrete/asphalt surface (−15.5, 95%CI= −26.0, −5.1), but it was not significantly different to the natural compacted surface (2.7, 95%CI= −6.7, 12.0).

4. Discussion

To our knowledge, this is the first study to examine the relative importance of micro-level design characteristics of walking paths among older adults and to investigate if the preferences varied across different sub-groups of older adults. Identifying which design characteristics of walking paths are most important can help stakeholders prioritise these design features when (re)designing walking paths. The findings from our study showed that “path gradient”, “shady trees along path”, “surface type” and “access from carpark” were the four most important design features of walking paths. A few differences were observed in the order of relative importance according to gender and park accompaniment; however, the differences were not significant and only a small number of significant differences in findings were observed according to mobility status. This implies general consistency in needs and preferences of walking park characteristics regardless of gender, park accompaniment and mobility status. However, as this is the first study to examine this topic by gender, mobility status and park accompaniment of older adults, more studies are needed.

The gradient of a path was one of the most important design features of walking paths for the overall sample and each of the subgroups of older adults, particularly those with limited mobility. ‘Steep slopes along path’ was the least preferred level within this feature, however, unexpectedly, ‘gentle slopes’ was preferred over ‘no slope’ for the overall sample and all subgroups. Although it should be noted that the part-worth utility scores between gentle slopes and no slopes were not significantly different for those with limited mobility. In our study, around two-thirds of older adults mentioned walking as their usual activity during park visits. Walking on a gentle slope may be more challenging for older adults than walking on a flat surface, but this may be seen as important for fitness, or taken as a challenge. A gentle slope may also be perceived as more interesting to walk on than a flat surface. In a previous qualitative study conducted to identify physical environmental factors influencing older adults’ park use in the UK, a few participants expressed having difficulties walking on the steep slopes, while some expressed their preferences for relatively steep paths to challenge their fitness (Kou et al., 2021). It is also possible that our use of the word “gentle” for the feature level may have appealed to older adults, and they may have interpreted it as a very mild slope. According to previous research, the gradient of a path up to five per cent is not expected to exert older adults, including those with mobility limitations, and a slope up to eight per cent is considered acceptable (Alves et al., 2020). However, our finding on the preference for gentle slopes requires further investigation. Future studies should undertake in-depth interviews with older adults to understand their perceptions regarding the path gradient and examine what degree of gradient they would prefer.

Another highly valued feature to encourage walking in parks among older adults was having shady trees along the path. Older adults’ preferences for natural elements in parks such as shady trees have been highlighted in several past studies (Alves et al., 2008; Finlay et al., 2015; Veitch et al., 2022; Veitch et al., 2020). Greenery has also been positively associated with leisure-time physical activity and walking among older adults (Van Cauwenberg et al., 2018). In a qualitative study using walk-along interviews with older adults in Australia, participants discussed the need for walking paths with large trees and shade (Veitch et al., 2020). A recent study conducted in Australia using ACBC determining the relative importance of park features also found shady trees to be the most important park feature for park visitation and the second most important for physical activity and social interaction in the park (Veitch et al., 2022). These findings contrast with those of a Danish study which found the presence of shade on the walking path to be negatively associated with walking among older adults (Schmidt et al., 2019). This highlights potential contextual differences, as Denmark has mild summers where people may prefer sun over shade, compared to Australia where summers can be extreme and shade may therefore be critical for an age group vulnerable to heat stress (Schmidt et al., 2019). This underscores the need to perform country-specific research. It should be acknowledged that trees not only provide shade but also make the environment aesthetically pleasing, offer greenery, and reduce glare. Future studies could explore the reasons behind older adults’ preferences for large shady trees along walking paths in Australia. Results suggests that stakeholders should prioritise incorporating and maintaining large shady trees along paths. They may consider planting deciduous trees along the path so that they admit sunlight in colder months.

Surface type and accessible walking paths from car parks were the third and fourth most important features for walking paths for the overall sample of older adults respectively, however, no significant difference in scores was found between these two features implying they had similar importance. Considering surface type, rubber surfaces were the most preferred, significantly more so than concrete surfaces which were the least preferred for the overall sample. As noted in previous studies, a high proportion of outdoor falls occurs while walking (Li et al., 2006) and the risk of injury due to falls is less on soft surfaces such as rubber (Chalmers et al., 1996), which might be why rubber surfaces were most valued among older adults. Additionally, rubber surfaces are easier on joints and knees and may also prevent slipping (Tessutti et al., 2008). A previous study conducted in China also found older adults preferred soft pavement (Zhai and Baran, 2017). In contrast to other groups, for those with mobility limitations, natural compacted surfaces were the least preferred level in the current study. This might be because older adults with limited mobility may find it difficult to manoeuvre mobility devices on naturally compacted surfaces, and the surface may become uneven and cause a tripping hazard. In Australia, most paths in parks have natural compacted surfaces or are paved with concrete or asphalt, and rubber surfaces are not as common. Future studies could examine whether the installation of rubber surfaces increases walking in parks among older adults. Walking paths easily accessible from the car park was another important feature for older adults. Around half of older adults in our study stated that they visit parks by car, which may explain why this is so important. Our results also showed that for people with mobility limitations, access to walking paths from the car park was more important than for people with no mobility limitations. Previous research, examining neighbourhood environment features among disabled older adults found that the availability of handicapped parking had a positive effect on their physical activity (White et al., 2010). Continuous accessible paths from the car park, which are firm, level and slip-resistant should be designed for older adults.

Benches along the path were another important feature of walking paths for older adults. The presence of regularly spaced benches along pathways can attract and encourage older adults to walk on the walking paths. Several studies have indicated that seating and benches are associated with higher park usage and increased physical activity among older adults (Mahmood et al., 2012; Veitch et al., 2020; Zhai et al., 2018). Benches provide a rest area for older adults who are tired, afford a sense of control for older people who are unsure about how far they can walk and may encourage outdoor social interaction (Lu, 2010). We also found that wider paths were preferred over narrower paths. (Zhai and Baran, 2017; Zhai et al., 2021). Wider paths can create a sense of safety as they offer more space for people to comfortably pass, leading to less risk of injury from cyclists and other pedestrians. Wider paths can also more easily accommodate benches on the side. Therefore, to promote walking among older adults, park designers/planners should install wider paths with regularly spaced benches if conditions allow.

Walking loops, particularly walking loops that branch to other areas were the seventh most important feature of walking paths. Walking loops are designed specifically for uninterrupted exercise as they support continuous walking (Lu, 2010). Walking loops branched to other areas may be preferred as they provide an alternative to continuously walking or visiting other areas. Walking loops can also be used by older adults to measure how far they have walked. Previous research has found that parks with walking loops had greater patronage from older adults, more of whom engaged in moderate to vigorous physical activity than those without a walking loop (Cohen et al., 2017). Easily navigable walking loops branched to other areas may be a particularly effective way to increase the appeal of paths to support physical activity.

A waterbody along the path (i.e., pond, lake), light fixtures and garden beds along the path were the three least important features of walking paths for older adults. This is in contrast to previous findings that walking paths with light fixtures were used more by older adults in a study conducted in urban parks in China (Zhai and Baran, 2017). In Australia, park use after dark is not common so this may be why the presence of light features was less important. In the same aforementioned study in China, having a water body along a path and a visual connection with water was important for older adults (Zhai and Baran, 2017), while in another study, older adults, especially females, highly preferred colourful flowers along the path (Wang and Rodiek, 2019). In our study, these features were relatively less important when compared to other features, which suggests that if park designers and relevant stakeholders have limited resources, they should prioritise other practical elements such as gradient, surface type, trees and benches compared to these features.

5. Strengths and limitations

This study is novel as it is the first to use ACBC to examine the relative importance of micro-level design characteristics of walking paths among older adults. In contrast to previous studies that typically examined single design features in isolation, ACBC mimics real-life choices by considering multiple features simultaneously (Orme, 2010). It involves an interactive process that tailors choice tasks to the preferences and decisions of each participant and assesses the value that respondents place on particular features, making it a useful tool for determining the relative significance of specific design features (Sawtooth Software Inc., 2014). Examining preferences according to gender, mobility status and accompaniment is also significant as it will help to ensure future park design meets the needs of diverse groups of older adults. This evidence may also inform future interventions designed to target or benefit a specific group of older adults. The participant sample also included a cross-section of older adults (65–93 years) with varying levels of physical activity, including those with limited mobility, living in urban or regional areas, and varying levels of park use. This ensured the preferences of older adults with diverse backgrounds and experiences were represented.

There were a few limitations to this study. Only ten pre-selected features were included, and it is possible that other features might be more/less important. However, including more features would have increased the number of tasks required which would have increased participant burden. Participants also completed ACBC tasks relating to outdoor fitness areas. Although these the two ACBC tasks were randomised, the order may have affected responses for some. Another limitation is the use of descriptors rather than images when presenting the features. While images can help with the degree of task realism, they can be hard to produce to accurately reflect the combination of levels and features and it may be difficult for older adults to notice differences between images of parks (e.g., rubber vs gravel path) when completing the ACBC tasks. Written descriptions were therefore used, although, it is acknowledged that participants were reliant on their subjective capacity to imagine the features and levels, and they may have been interpreted differently. However, more detailed explanations and visual examples of the features were provided before starting ACBC tasks to minimise this potential limitation. It should also be acknowledged that these findings do not provide information on which of these features would discourage walking. Further, this study only examined the design features of walking paths. Other aspects of walking paths, such as maintenance, may also be important. This survey was computer-based, thus excluding older adults without access to a computer or those not confident in completing an online survey and findings reflect preferences only and actual behaviour might be different. Nevertheless, the study is significant as it enhanced the current evidence by providing a comprehensive understanding of walking path design features that older adult value most. This is important as it can inform future park planning and future intervention and longitudinal studies. Future studies should consider natural experiment designs to test the impact of actual changes to walking path design on walking among older adults.

6. Conclusion

Walking paths are highly desirable and an important feature for older adults for active park visitation. This study employed distinctive methodological approach (i.e. ACBC) to provide a detailed understanding of older adults' preferences for the micro-level design characteristics of walking paths. This can help to inform relevant stakeholders when designing parks and inform interventions aiming to increase older adults' use of walking paths in parks. Based on the findings of this study, it may be important to consider gradient when designing the paths, avoiding steep slopes in particular; and it may be important to plant and maintain shady trees along the path; prioritise rubber surfaces; ensure walking paths are easily accessible from car parks, and have regularly space benches along paths. Incorporating these findings into design policy and practice may increase the appeal and use of parks by older adults, promote physical activity, improve walkability, and potentially improve the health and quality of life of older adults. Future research could explore additional features of the walking path material, such as rugosity and safety considerations, to further enhance the design.

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CRediT authorship contribution statement

CP: Conceptualisation, Data collection, Formal analysis, Interpretation, Writing- Original draft preparation, and Writing - Review & Editing. **AT, VL, BD, JS and JV**: Conceptualisation, Interpretation, and Writing - Review & Editing.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Appendix A. Supporting information

Supplementary data associated with this article can be found in the online version at doi:10.1016/j.ufug.2023.128129.

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