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Differences in wayfinding inclinations among women and men: a matter of personality and affect, not just gender

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Abstract
Women report different levels of wayfinding inclinations than men. This study is an exploration of whether individual factors such as personality traits and affect can provide insights into the gender differences observed in wayfinding inclinations, such as in the attitudes toward exploring and spatial anxiety. The study involved 454 adults (271 women) who completed questionnaires on personality traits, affective state, attitudes toward exploring and spatial anxiety. Women reported lower positive attitudes toward exploring and higher spatial anxiety than men. Openness and positive affect were associated with positive attitudes toward exploring places in both genders whereas extraversion was associated with attitudes toward exploring places among men. Higher levels of extraversion were linked to lower spatial anxiety in both genders, higher levels of negative affect were associated with greater spatial anxiety among men, and lower levels of emotional stability were associated with greater spatial anxiety among women. Therefore, gender does not play a singular role in explaining differences in self-reported wayfinding inclinations. Instead, negative affect (at least for men) and low emotional stability (at least among women) tend to hinder such inclinations whereas openness and positive affect contribute to their promotion. These results provide insights into how the patterns of relationships among wayfinding inclinations, personality traits, and affect vary between men and women, with possible implications for assessment and intervention.

Keywords Gender · Spatial anxiety · Attitudes toward exploring · Personality · Emotional stability · Positive affect

Introduction

The ability to orient oneself in one's environment is fundamental in daily life; however, it depends on several individual factors. Among them, people's positive beliefs and attitudes on navigation abilities functionally support their orientation ability (Meneghetti et al., 2021). This set of self-reported factors related to wayfinding can be named wayfinding inclinations. They includes motivation-related aspects (e.g., self-reported spatial self-efficacy and sense of direction; Miola et al., 2021; Hegarty et al., 2002); strategic aspects (e.g., self-reported navigation preference, such as survey mode– bird's-eye view-like map representations; or for route mode– person point-of-view representations; Meneghetti & Pazzaglia, 2017; Nori & Piccardi, 2015); and emotion-related aspects, such as the pleasure felt in exploring places (Meneghetti et al., 2021) and the worry of getting lost (spatial anxiety; Lawton, 1994). An individual's set of feelings can either support or impair her/his mental representation of environments. For example, positive beliefs, such as pleasure in exploring, can enhance mental representation (Meneghetti et al., 2021) whereas negative beliefs, such as spatial anxiety, can hinder the environment learning performance (i.e., the ability to gain knowledge about landmarks, locations and paths after learning a new environment; Lawton & Kallai, 2002; Nori et al., 2009). Pleasure in exploring and spatial anxiety are negatively interconnected and can represent two different (opposite) spatial profiles (He & Hegarty, 2020). People who enjoy in exploring places generally have lower levels of spatial anxiety (Muffato et al., 2022b) and tend to indicate a greater preference for the survey mode (i.e., bird's-eye view) and a stronger sense of direction (De Beni et al., 2014). On the other hand, people reporting high spatial anxiety generally also report a weak

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sense of direction (De Beni et al., 2014) and a low preference for the survey mode (Lawton & Kallai, 2002).

Typically, research has consistently found gender differences in self-reported wayfinding inclinations. Women and men report different wayfinding inclinations, with women tending to report more negative inclinations than men (Gagnon et al., 2018; Walkowiak et al., 2022). In particular, women self-report less spatial ability than men, lower confidence in completing spatial and wayfinding tasks (Picucci et al., 2011; Nori & Piccardi, 2015), and greater spatial anxiety and more negative attitudes toward exploring places (Muffato et al., 2023). However, beyond gender, research has shown that more positive attitudes toward exploring and less spatial anxiety support environment learning (Miola et al., 2021; Muffato et al., 2022b). This opens up the issue that gender differences in self-reported wayfinding inclinations may depend on other individual characteristics relating to navigation ability rather than on gender per se. Indeed, factors other than gender can explain the underlying mechanisms behind these differences (as found for spatial abilities objectively measures, e.g., Reilly & Neumann, 2013).

Among other individual differences, personality traits and affect may be relevant factors to consider when investigating wayfinding inclinations between men and women. Personality traits can be defined as individual patterns of thoughts, emotions, and behaviors (McCrae & Costa, 2003), with the Big Five Factor model of personality proposing five dimensional traits (i.e. agreeableness, conscientiousness, emotional stability, extraversion, and openness). This model has been the most influential for the identification personality traits across cultures, which remain stable across the lifespan despite normative changes (such as increases in conscientiousness and decreases in extraversion; Costa et al., 2019). However, studies demonstrate potential malleability if individuals intend to change maladaptive traits (e.g., Hudson & Fraley, 2015). Wayfinding inclinations resemble traits in this sense. They can be seen as a stable individual trait (Lawton, 1994; Meneghetti et al., 2020), which tend to remain fairly stable over adulthood (Münzer et al., 2016), even if they are malleable (He & Hegarty, 2020).

Affect can also be related to wayfinding inclinations. Affect can be viewed as personal traits related to an individual's mood and feelings, reflecting the extent to which individuals feels positive and negative engagement. The dimensions of positive and negative affect are derived from commonly used terms to describe emotions (Watson et al., 1999). The investigation of positive and negative affect can also be relevant given that wayfinding inclinations have an emotional component, such as pleasure in exploring and spatial anxiety.

It is to note that both personality traits and affect can show gender differences. Specifically, gender differences are consistently found for emotional stability trait, with women reporting lower emotional stability than men (Costa et al., 2001; Schmitt et al., 2008). Smaller gender differences are also found for agreeableness and conscientiousness, with women reporting higher values on these traits than men (Schmitt et al., 2017; Zell et al., 2015). Several reasons can be drawn to explain these differences, from evolutionary to socio-cultural explanations (Schmitt et al., 2017). Even affect can show gender differences. Women tend to report higher levels of negative affect than men, while positive affect does not vary across gender (Fujita et al., 1991). Gender differences in negative emotions are further supported by findings related to anxiety levels (Donzuso et al., 2014) and depression level (Hyde & Mezulis, 2020), which appear to be higher among women than among men.

To sum up, gender plays a role in personality traits, affect, and wayfinding inclinations. Wayfinding inclinations, characterized by habitual patterns of navigation, may be related not only to gender but also to personality traits (patterns of thoughts, emotions, and behaviors) and affect (individual usual feelings), as shown in the following paragraph.

Personality, emotions and wayfinding inclinations

Research has shown a relationship between personality traits and navigation ability (e.g., Condon et al., 2015). Similarly, research has also shown a relationship between personality traits and self-reported wayfinding inclinations. Bryant (1982) found that flexibility, dominance, capacity for status, sociability, social presence, and self-acceptance were associated with higher sense of direction. Additionally, a lower sense of direction was in turn related to worrying about becoming lost (Bryant, 1982). Similarly, Condon et al. (2015) found that higher extraversion, conscientiousness, intellect (also referred to as openness to experience), and emotional stability (also referred as lower neuroticism) were related to higher self-reported sense of direction. Extraversion was also related to exploration behavior. Indeed, extrovert adolescents were more likely to explore distant places during leisure activities (Wyllie & Smith, 1996). Pazzaglia et al. (2018) found that attitudes toward exploring places were related to greater extraversion and openness whereas spatial anxiety was inversely related to extraversion, openness, and emotional stability. Higher conscientiousness was correlated with more favorable attitudes toward exploring places and higher spatial anxiety. Later, Meneghetti et al. (2020) reported links between wayfinding inclinations and extraversion, agreeableness, and openness (but not conscientiousness). Lower spatial anxiety and preferences for known places were correlated with higher emotional control, a facet of emotional stability indicating absence of anxiety or depression, and mood stability

(Meneghetti et al., 2020). Therefore, personal dispositions that are based on emotions (such as emotional instability/neuroticism) appear to have a negative role in wayfinding inclinations (Meneghetti et al., 2020; Pazzaglia et al., 2018). Indeed, people predisposed to personality traits and emotions related to anxiety may also be more anxious about finding routes and getting lost (Meneghetti et al., 2020). Regarding affect, Cheng (2019) assessed the trait's negative affect in the last week (selecting terms about concern or anxiety– e.g. guilty, scared, irritable– from the Positive and Negative Affect Schedule [PANAS], Watson et al., 1988). They found that negative affect is correlated with a weaker self-reported sense of direction and fewer survey-based strategies, as assessed through a questionnaire by Münzer and Hölscher (2011). On the other hand, Mendez-Lopez et al. (2020) found no relation between emotional dispositions (emotion regulation, trait anxiety, and emotional stability) and wayfinding-related fear (spatial anxiety and low feeling of personal safety) among men nor women. From this literature review, it seems that studies have mainly focused on the relationship between negative affect and wayfinding-related aspects. To our knowledge, no study has investigated the role of positive affect on wayfinding inclinations. Some research suggests a potential link between positive affect and– at least objectively measured– navigation ability (e.g., Ruotolo et al., 2019). Therefore, more research is needed to investigate the role of personality traits and affect, both positive and negative, in wayfinding inclinations, moving beyond gender alone and examining how various variables, as sources of individual differences, contribute to understanding wayfinding inclinations.

To sum up, the present study is based on the evidence that (i) women tend to self-report greater spatial anxiety and lower positive attitude toward exploring places (Muffato et al., 2023), but other factors besides gender can explain the underlying mechanisms behind these differences, and (ii) wayfinding inclinations may be related to affect and personality traits (Condon et al., 2015; Pazzaglia et al., 2018). An issue that merits investigation– yet to be explored– is whether positive/negative affect and personality traits can be factors contributing to the gender differences typically observed in wayfinding inclinations.

In this study, we therefore considered both positive (attitude toward exploring places; Pazzaglia et al., 2004) and negative (spatial anxiety; Lawton, 1994) wayfinding inclinations, given that they express an opposite spatial profile (negatively related to each other; Meneghetti et al., 2020). In fact, attitudes toward exploring are positively related to motivational beliefs (such as growth mindset and self-efficacy; Miola et al., 2023) and linked to positive environment learning performance (Muffato et al., 2020) while spatial anxiety is a hindering attitude/trait for environment learning performance (Lawton, 1994; Pazzaglia et 2018). Therefore, we collected attitudes toward exploring places and spatial anxiety questionnaires (De Beni et al., 2014; Lawton, 1994; Mitolo et al., 2015), the PANAS for positive and negative affect (Terraciano et al., 2003), and the 10-item Big Five Inventory (BFI-10) for personality traits (Guido et al., 2015).

Aims and hypotheses

The aim of the present study is to investigate whether positive/negative affect and personality are related to wayfinding inclinations in men and women. We will examine the similarities and differences in these relationships, suggesting that these factors may play a role in wayfinding inclinations beyond gender alone.

First, the present study aims to replicate:

Aim 1) Gender differences. The previously established finding that men score higher than women in wayfinding inclinations (e.g., Lawton, 1994; Mendez-Lopez et al., 2020; Nori & Piccardi, 2015).

Aim 2) The role of negative affect and personality on wayfinding inclinations. The previous finding that wayfinding inclinations are related to negative affect (e.g., Cheng, 2019) and personality traits (e.g., Condon et al., 2015; Meneghetti et al., 2020).

Then, the study newly aims to investigate:

Aim 3) The role of positive affect on wayfinding inclinations. It may not only be a matter of lacking negative emotions; the positive affect people experience can also explain differences in wayfinding inclinations, as suggested by the relationship between positive affect and environmental learning performance (e.g., Ruotolo et al., 2019). This could be particularly true for positive attitude in exploring places (given its positive association with emotional-motivational aspects; Miola et al., 2023).

Aim 4) The gender-specific differences in the relationship between positive/negative affect and personality, and wayfinding inclinations. In particular, these specificities might be found for negative affect and emotional stability personality traits, given that they are individual characteristics in which gender differences are consistently found (e.g., Costa et al., 2001; Fujita et al., 1991). This would indicate that the prevalence of negative affect and emotional instability in women compared to men contributes to explaining the gender differences found in wayfinding inclinations. On the other hand, we might find that positive affect and other personality traits could

be related to wayfinding inclinations in a similar way in both genders. This result would support the idea that differences in wayfinding inclinations arise not only from gender but also from those personal traits or affects.

Method

Participants

The study involved 454 adults (19 to 59 years old) recruited from a psychology university course in exchange for course credit and by word of mouth (271 women, *M age* = 39.29, *SD* = 13.35; 183 men, *M age* = 41.40, *SD* = 11.83).

The sample size was a-priori determined considering ten observations for each parameter estimated in the model (Bollen, 1989). Our model has 42 parameters (see the model in Fig. 1) therefore a sample of 420 participants was deemed sufficient. Given that more precise methods are recommended, following the Kock and Hadaya (2018) inverse square root method, we determined with a posteriori analysis that considering the minimum absolute value of the statistically significant path coefficient set at 0.15, a sample size of 275 participants would have sufficed (with $N = 454$, the minimum path coefficient is 0.1167).

Inclusion criteria: Italian mother tongue; 18–59 years old; and no history of psychiatric diseases, neurological diseases, or diseases capable of causing cognitive, visual, auditory and/or motor impairments. Exclusion criterion: people not identifying themselves as women or men (two participants excluded). The Ethical Committee for Psychological Research at University of Padova approved the study (No. C2DB911DA6C8BED1CC1195CBEB6775DA). All participants were informed about the purposes of the study before it was conducted and gave their informed consent in accordance with the Declaration of Helsinki (World Medical Association, 2013).

Materials

Affective status

PANAS (Italian version, Terraciano et al., 2003). The PANAS is a 20-item questionnaire used to assess positive (PANAS-PA, 10 items) and negative (PANAS-NA, 10 items) emotions of the past week on a scale from 1 (not all) to 5 (very much). The Cronbach's alpha was good for the PANAS-PA (Cronbach's $\alpha = 0.87$) and PANAS-NA (Cronbach's $\alpha = 0.85$).

Personality

BFI-10 (Guido et al., 2015). This scale measures agreeableness, conscientiousness, emotional stability, extraversion, and openness with two items (one of them to be reversed) for each factor. We found good internal consistency (normative sample and current sample Spearman–Brown coefficients ≥ 0.50) except for the current sample agreeableness and conscientiousness that shown lower reliability (Spearman–Brown coefficients = 0.32 and 0.35 respectively).

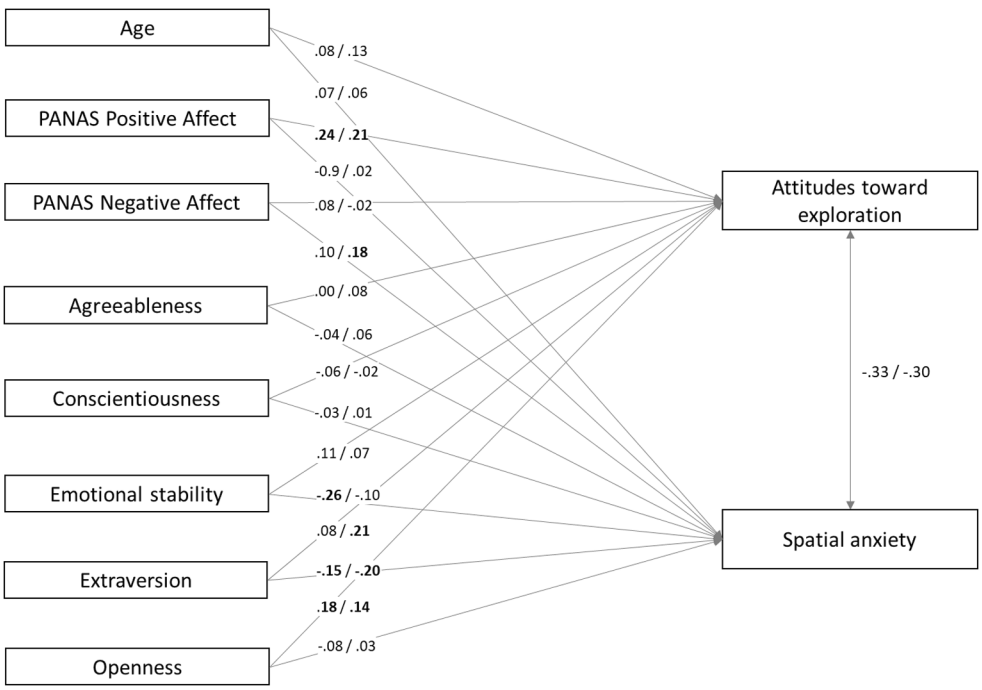

Fig. 1 Standardized betas (women/men) of the model that considered age, affect and personality traits to predict attitudes toward exploring and spatial anxiety. Coefficient of women are reported on the left and coefficient of men on the right. *Note*. Covariances between predictors (see values in Table S2) are in the model but not shown in the figure

Wayfinding inclinations measures

Attitudes toward Spatial Exploration Questionnaire (Mitolo et al., 2015). This questionnaire measures attitudes toward exploring (e.g., "I like to explore different places to find new ways to reach places"; 10 items; one was reverse scored). Responses range from 1 (not at all) to 4 (very much), and scores are summed (max 40). Cronbach's alpha = 0.78 for the normative sample (De Beni et al., 2014) and 0.75 for the present sample.

Spatial Anxiety Scale (De Beni et al., 2014; Lawton, 1994). This questionnaire measures anxiety experienced in wayfinding situations (e.g., "Going to an appointment in an unfamiliar part of the city"; 8 items). Responses range from 1 (not at all) to 6 (very much), and scores are summed (max 48). Cronbach's alpha = 0.87 for the normative sample (De Beni et al., 2014) and 0.89 for the present sample.

Procedure

Participants received a Qualtrics link. They signed the consent form, and then the single-session experiment began, lasting approximately 15 min. First, demographic questions were collected first to ensure eligibility for the study; then, in random order, the PANAS, the BFI-10 and wayfinding inclination questionnaires (Attitude to Spatial Exploration and Spatial Anxiety) were administered. The participants also completed cognitive tasks and questionnaires that are beyond the scope of the present paper (for a total of 35 min).

Data analysis

We conducted analyses using R (R Core Team, 2022). First (Aim 1; Gender differences), we ascertained a significant difference between men and women in affect, personality traits, self-reported spatial anxiety and attitudes toward exploration using t-tests. Then, to fulfill hypothesis regarding the relation of wayfinding inclinations and personality traits with negative affect (Aim 2; Negative affect and personality on wayfinding inclinations), positive affect (Aim 3; Positive affect on wayfinding inclinations) and how these variables are related to gender (Aim 4; The gender-specific differences in the relationship between positive/negative affect and personality, and wayfinding inclinations), we conducted a multivariate regression model. This allows to investigate the associations of affect state (PANAS-PA and PANAS-NA) and personality traits (BIG-five) with attitudes toward exploring places (attitudes toward orientation) and spatial anxiety (see Fig. 1). We considered covariance between predictors and dependent variables in the model (full model; see covariances in Supplementary material Table S2). We inserted age into the model as a control given its relationship with spatial anxiety and attitudes toward exploring (e.g., Muffato et al., 2022b). To determine whether the pattern of the relationships differed between men and women, we compared models with constrained and unconstrained coefficients between gender using a chi-square test on the Akaike Information Criterion (AIC, Wagenmakers & Farrell, 2004). We checked the assumption of the selected model and reported the variance explained by the model.

At the descriptive level, we computed correlations among variables among women and men (see Supplementary Material Table S1).

Results

Gender differences (Aim 1)

First, we found a significant difference between men and women in self-reported spatial anxiety and attitudes toward exploration ($p_s \leq 0.001$). See Table 1 for the descriptive statistics, t tests and Cohen's d.

Table 1 Means and standard deviation of all variables among women and men

	Women		Men				
	M	*SD*	*M*	*SD*	*t test*	*p*	*Cohen's d*
Age	39.29	13.35	41.40	11.83	-1.78	0.077	0.17
PANAS– PA*	31.31	7.45	32.93	7.10	-2.33	0.020	0.22
PANAS– NA*	20.37	6.84	19.08	6.90	1.96	0.050	0.19
Agreeableness	6.60	1.75	6.63	1.73	-0.22	0.828	0.02
Conscientiousness	7.84	1.58	7.54	1.81	1.80	0.072	0.18
Emotional stability***	5.86	2.10	6.63	2.00	-3.95	< 0.001	0.37
Extraversion	6.13	1.97	6.02	1.84	0.64	0.521	0.06
Openness*	7.29	2.11	6.89	2.18	1.99	0.047	0.19
Spatial anxiety ***	22.91	7.33	18.98	6.59	5.95	< 0.001	0.56
Attitudes toward exploration ***	26.02	5.12	28.21	5.20	-4.42	< 0.001	0.42

Note. PA = Positive Affect, NA = Negative Affect; Significant difference between gender with *$p \leq .05$, *** $p \leq .001$

Negative and positive affect and personality on wayfinding inclinations (Aims 2 and 3) and gender-specific differences in these relationship (Aim 4)

Then, the multivariate regression models showed that the model with unconstrained coefficients (i.e., the coefficients for men and women vary; AIC = 2380) was better than the constrained-coefficient model (AIC = 2392), $\chi 2(18) = 47.80$, $p < .001$. Table 2 presents standardized betas as well as CI and p values of the unconstrained model for attitudes toward exploring and spatial anxiety scales among men and women. The residuals were normally distributed, no homoscedasticity was found. The variance inflation factors did not reveal significant multicollinearity (VIF values < 1.17), and generalized Cook's distances (Cook, 1986) were lower than 1.

For the attitudes towards exploring places the results showed that the PANAS positive affect and openness were statistically significant predictors among both men and women whereas extraversion was a predictor among men only.

For spatial anxiety, extraversion was negatively related among men and women. Moreover, negative affect was positively related to spatial anxiety among men while emotional stability was negatively related to spatial anxiety among women (see Fig. 1). The total variance accounting for individual differences in attitudes toward exploring places and spatial anxiety was respectively 14% and 17% among women and 17% and 11% among men.

Discussion

This study aimed to investigate whether positive/negative affect and personality traits are related to wayfinding inclinations (in terms of self-reported attitudes toward exploring and spatial anxiety) and to newly examine whether this pattern of relationship is similar or different between men and women. This allows us to go beyond the role of gender difference per se in wayfinding inclinations (e.g. Lawton, 1994) by considering other individual factors involved in wayfinding inclinations. The factors identified are affect (e.g., Cheng, 2019) and personality traits (e.g., Condon et al., 2015; Meneghetti et al., 2020; Pazzaglia et al., 2018), given their relationship with wayfinding inclinations. A large group of men and women self-rated their wayfinding inclinations, considering positive attitudes toward exploring and spatial anxiety, positive/negative affect and personality traits.

The results showed that women reported slightly higher negative affect and lower emotional stability (e.g., Costa et al., 2001; Fujita et al., 1991). However, women also reported slightly lower positive affect and slightly higher openness

Table 2 Regression coefficients, CI and p values for attitudes toward exploring and spatial anxiety among women and men

	Attitude toward exploration						Spatial anxiety					
	Women			Men			Women			Men		
	Std β	CI	*p*	Std β	CI	*p*	Std β	CI	*p*	Std β	CI	*p*
Age	0.08	[-0.03,0.19]	0.15	0.13	[-0.03,0.29]	0.10	0.07	[-0.04,0.18]	0.22	− 0.06	[-0.21,0.09]	0.43
PANAS PA	**0.24**	**[0.13,0.35]**	**< 0.001**	**0.21**	**[0.06,0.35]**	**0.01**	− 0.09	[-0.21,0.02]	0.11	0.02	[-0.12,0.16]	0.78
PANAS NA	0.08	[-0.04,0.2]	0.19	− 0.02	[-0.18,0.14]	0.81	0.10	[-0.02,0.23]	0.10	**0.18**	**[0.02,0.33]**	**0.02**
Agreeableness	0.00	[-0.12,0.11]	0.94	0.08	[-0.06,0.23]	0.25	− 0.04	[-0.15,0.08]	0.53	0.06	[-0.08,0.19]	0.40
Conscientiousness	− 0.06	[-0.18,0.07]	0.37	− 0.02	[-0.16,0.13]	0.79	− 0.03	[-0.15,0.09]	0.63	0.01	[-0.12,0.15]	0.84
Emotional stability	0.11	[-0.01,0.23]	0.08	0.07	[-0.1,0.25]	0.41	**− 0.26**	**[-0.38,-0.14]**	**< 0.001**	− 0.10	[-0.27,0.06]	0.22
Extraversion	0.08	[-0.03,0.19]	0.15	**0.21**	**[0.07,0.35]**	**< 0.001**	**− 0.15**	**[-0.26,-0.04]**	**0.01**	**− 0.20**	**[-0.33,-0.06]**	**0.01**
Openness	**0.18**	**[0.07,0.30]**	**< 0.001**	**0.14**	**[0,0.27]**	**0.04**	− 0.08	[-0.2,0.04]	0.17	− 0.03	[-0.16,0.09]	0.60

Note. Significant coefficients with $p < .05$ in bold type

than men. Concerning wayfinding inclinations (Aim 1; Gender differences), women reported lower positive attitude toward exploring places and greater spatial anxiety than men, as expected (Lawton et al., 1994; Mendez-Lopez et al., 2020; Nori & Piccardi, 2015). Wayfinding inclinations were similarly predicted by some personality traits and affect among men and women, but some predictors were gender-specific (Aims 2 and 3– Negative and positive affect and personality on wayfinding inclinations and– Aims 4– gender-specific differences in these relationship). Overall, the study shows that higher levels of openness and positive affect were predictors of more favorable attitudes toward exploring places among both men and women. However, only among men higher levels of extraversion were associated with attitudes toward exploring places. Higher levels of extraversion were associated with lower levels of spatial anxiety among both men and women. However, only among men higher levels of negative affect were associated with higher levels of spatial anxiety. Only among women were lower levels of emotional stability associated with higher levels of spatial anxiety.

More specifically, regarding attitude toward exploration (i.e., positive wayfinding inclination), the study confirmed its association with openness (Meneghetti et al., 2020; Pazzaglia et al., 2018) and showed that this relationship holds true for men and women. Individuals who have a predisposition toward openness may have had more opportunities to explore their environments throughout their life course, which may have contributed to their tendency to report greater pleasure in this behavior. Indeed, at a behavioral level, some individuals tend to move around the same known locations repeatedly whereas others prefer to move around numerous places (Pappalardo et al., 2015). The study also confirmed the role of extraversion in predicting attitudes toward exploration, as previously shown (Meneghetti et al., 2020; Pazzaglia et al., 2018; in line with Condon et al., 2015), but it is specifically detected only among men. Extroverted men may be more likely to seek out new and unfamiliar environments and/or move far away to find and discover new places (as Wyllie & Smith, 1996 suggested), which could contribute to their positive attitudes toward exploring places. Regarding the role of affect, the study showed that a positive attitude toward exploring places is associated with higher levels of positive affect. Whereas Cheng (2019) only examined the relationship between negative emotions and wayfinding inclinations (in terms of sense of direction), the current study highlights the importance of positive emotions, as well. In summary, attitudes toward exploring places are supported by extraversion among men and openness and positive affect for both genders.

Regarding the spatial anxiety results (i.e., negative wayfinding inclination), the study confirmed the role of emotional stability and negative emotions (Cheng, 2019; Meneghetti et al., 2020; Pazzaglia et al., 2018) but also showed a gender difference. Emotional stability plays a role in women's spatial anxiety. Research has shown that low emotion stability (neuroticism) may be higher among women than among men (Costa et al., 2001; Schmitt et al., 2008), and women who have this trait may generalize their anxiety to the domain of spatial navigation. In contrast, negative emotions seem more strongly associated with spatial anxiety among men. Although women typically tend to report higher levels of negative affect and anxiety than men (Donzuso et al., 2014; Fujita et al., 1991), in our sample, at least, this difference is not so strong. These results suggest that men who report higher levels of negative emotions may have a general level of anxiety that also affects their navigation beliefs similarly to women.

Considering all the similar and different relations in men and women found between affect and personality traits in self-reported attitude toward exploration and spatial anxiety, it is possible to speculate that these factors matter for wayfinding inclinations, beyond gender differences per se. Differences in individuals' positive affect and personality traits such as openness and extraversion can explain, at least in part, the attitude toward exploration and spatial anxiety, independently of gender. However, the prevalence of low emotional stability in women compared to men (Costa et al., 2001) seems to contribute to explaining gender differences found in wayfinding inclinations (at least in the case of spatial anxiety). Future research should thoroughly explore other possible underlying individual factors, besides affect and personality, that can explain gender differences in self-reported wayfinding inclinations. While affect and personality have been identified here as potentially related, it is worth investigating other social and motivational factors as well (van der Ham & Koutzmpi, 2022).

The present findings suggest potential implications regarding the role of wayfinding inclinations in daily mobility across different individual conditions and suggest possibilities for their promotion. It is well proven that high spatial anxiety is associated with more dysfunctional moves (Lawton, 1994) and poorer spatial skills (Geer et al., 2024). At its extreme, spatial anxiety can manifest as a primary symptom in disorders such as agoraphobia (Kallai et al., 2007) or be symptomatic of conditions like Developmental Topographical Disorientation (Piccardi et al., 2022). Additionally, it can emerge as a feature that increases with aging, where older adults tend to go out less (Muffato et al., 2022a), becoming particularly relevant in pathological age-related declines (Davis & Veltkamp, 2020). It should be notice that attitudes toward exploring places– how individuals explore the environment, find, and reach destinations– are negatively related to spatial anxiety (as confirmed in the current study) and

can counteract the discomfort related to navigating the environment (He & Hegarty, 2020), favouring positive emotions both in women and men. Therefore, our results suggest expanding the perspective of wayfinding inclinations as a multicomponential aspect (Meneghetti et al., 2020). Considering both positive aspects (such as attitude toward exploration) and negative aspects (such as spatial anxiety) provides comprehensive information on individual profiles. This approach can be particularly informative in clinical conditions where environmental discomfort is relevant. Therefore, a practical implication is to consider a multi-set of self-report measures on wayfinding for clinical assessment. At the same time, our results offer insights into promoting spatial orientation across various life settings, considering different individual difference factors (Muffato & De Beni, 2020), not just gender. This could benefit individuals of all ages and clinical populations. This can be achieved by implementing psycho-educational programs for both women and men. Based on the findings presented here, these programs should aim to promote positive affect (which has been shown to be associated with environmental learning; Ruotolo et al., 2019), openness to environmental experiences to enhance functional exploration attitudes, and extraversion (in terms of social activity in the environment) to help reduce spatial anxiety. These interventions can significantly impact wellbeing and mental health in everyday life, aligning with national and international policies. These implications are certainly of interest and should be supported by actual promotional activities and systematic programs for all individuals, as well as specific interventions sensitive to different clinical profiles. This study provided new insights, but it also has some limitations that could be addressed in future research. First, a longitudinal study rather than a correlational one would provide stronger evidence of personal traits and the role of affect in wayfinding inclinations. Second, although self-evaluations have been found to be related to environmental performance among men and women (O'Laughlin & Brubaker, 1998; Walkowiak et al., 2022) and self-report is a modality to understand how individual factors work together, our results could be further strengthened by incorporating objective navigation and wayfinding measures, such as learning an environment and performing recall tasks. The balance between wayfinding self-reported measures and objective performance would provide stronger support for the individual factors implied (Weisberg et al., 2014). It is desirable that future research considers the role of gender and other individual factors considering both subjective and objective wayfinding measures. Furthermore, behavioral data about affect could be more informative than self-reported data. Indeed, another limitation is that women and men exhibit stereotyped bias when responding to self-report about wayfinding inclinations, affect, and personality traits, for which gender differences can be expected (van der Ham & Koutzmpi, 2022). This could have had an impact on the willingness and truthfulness of responses. Related to this, asking demographic information at the beginning of the session (such as gender) may have been enough to activate a stereotype, implicitly affecting the ratings (e.g. Banaji et al., 1993). Another point to observe is that personality traits could be investigated more specifically by considering their facets. Previous studies using the complete version of the Big Five questionnaire (rather than shorter, albeit practical versions as in the current study) allow for the consideration of facets, revealing the specific roles of some facets compared to others (such as the emotional control facet rather than the impulse control facet for emotional stability in spatial anxiety; Meneghetti et al., 2020), thereby providing more informative insights into which personality (sub)dispositions are involved. Additionally, it is worth mentioning that some traits in our sample (agreeableness and conscientiousness) had moderate reliability (as reported in the method) and therefore may have hidden their impact the pattern of the relations with wayfinding inclinations. The lack of involvement of these traits in wayfinding inclinations might be due to weakness in the scale used rather than to the disposition per se (given that previous studies have shown, at least in part, their involvement with wayfinding self-ratings; Condon et al., 2015; Meneghetti et al., 2020).

In conclusion, this correlational study offers, at least preliminarily, the possibility of better understanding the relation of wayfinding attitude, in terms of attitude toward exploration and spatial anxiety, with individual factors that go beyond the role of gender. Indeed, even though the results should be interpreted with caution considering the limitation described above, some personality traits (openness, extraversion and emotion stability) and affect (positive and negative) are related to attitude toward exploration and spatial anxiety in men and women, showing similar patterns of relation in some cases and different patterns of relations in others. This offers new insights, which merit further development, also concerning implications related to assessment and interventions, suggesting that individual differences in wayfinding inclinations can be explained not only by gender but also by (some) personality traits and affect.

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Data availability Data are available on Figshare at https://doi.org/10.6084/m9.figshare.23770473.v1.

Declarations

Ethical approval and consent to participate The Ethical Committee for Psychological Research at the University of Padova approved the study (univocal number: C2DB911DA6C8BED1CC1195CBEB-6775DA). All participants were informed about the purposes of the study and gave their written consent in accordance with the Declaration of Helsinki (World Medical Association, 2013).

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