Social Sciences & Humanities Open 13 (2026) 103015

Contents lists available at ScienceDirect

Social Sciences & Humanities Open

journal homepage: www.sciencedirect.com/journal/social-sciences-and-humanities-open

Regular Article

Behave well in someone else's place! Genderization of urban spaces influences environmental behavior in public settings

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ARTICLE INFO

Keywords:
Gender stereotypes
Urban space
Environmental behavior
Social norms

ABSTRACT

Gender differences in environmental behavior are well-documented, yet research has largely overlooked how behaviors can be influenced by social meanings attributed to physical space. Urban spaces are inherently imbued with gendered traits, a concept grounded in feminist geography theory and supported by recent findings on space-focused stereotyping processes. Building on this evidence, Study 1 (N = 130) revealed the influence of gendered urban space perceptions on social expectations regarding gender differences in environmental behavior. Study 2 (N = 170) replicated these findings using a Gender Face Recognition Task indirectly measuring the cognitive association between masculinity and urban environments. Study 3 (N = 204) experimentally manipulated the cognitive accessibility of (counter-)stereotypical beliefs about urban spaces. Despite a manipulation backfire effect, results highlighted gender role norms as a mechanism influencing the gendering of environmental behaviors in public settings. Across studies, stereotypical beliefs about urban spaces and gender roles help explain gender gaps in environmentalism. We discuss implications for socio-environmental psychology and for urban designs that acknowledge gender dynamics to promote inclusive, sustainable public spaces.

1. Introduction

Climate change and environmental threats such as ecosystem pollution and resource depletion affect everyone (IPCC, 2023). Yet, individuals' responses differ by values, beliefs, and membership to specific social categories. Extensive research has revealed that women are more sensitive to environmental issues and more likely to adopt sustainable behaviors than men (Bloodhart & Swim, 2020; Briscoe et al., 2019; Zelezny et al., 2000). This does not necessarily mean that women are inherently more inclined toward environmentalism. Rather, from a social constructivist perspective (DeLamater & Hyde, 1998; Schudson & Gelman, 2023), beliefs, attitudes, and behaviors are shaped by individuals' social group memberships and by culturally shared norms and stereotypes that are learned and internalized (Ellemers, 2018; Koenig & Eagly, 2014). Gender, in particular, provides a powerful lens through which people understand themselves and navigate social interactions: it is a highly salient social construct that develops early through socialization processes (Bussey, 2011; Carter, 2014; Fagot et al., 2012; Stockard, 2006). As such, it can profoundly influence self-definition, being closely tied to the broad dimensions of agency and communion (Schmader & Block, 2015), and shapes adherence to social norms and roles (Eagly & Wood, 2012; Guhin et al., 2021; Morgenroth & Ryan, 2021). Gender stereotypes (Ellemers, 2018) help organize the social world but often become rigid standards limiting access to resources, opportunities, and care, thereby affecting quality of life and interactions with both social and physical environments (Gansen, 2019; Goldberg et al., 2012; Granger et al., 2017; Li & Wong, 2016; MacPhee & Prendergast, 2019; Wong & Yeung, 2019; Young, 1980).

Although the literature on gender stereotypes is extensive and well-established within social psychology, prior research has primarily focused on their influence on perceptions of the outgroup, the ingroup, and oneself. Nevertheless, despite limited empirical investigation (e.g., Bonam et al., 2016, 2017), social stereotypes also extend beyond social categories to physical spaces inhabited by social groups, profoundly influencing our perception of those spaces and our behavior towards and within these settings. Building on these space-stereotyping processes

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https://doi.org/10.1016/j.ssaho.2026.103015
Received 4 November 2025; Received in revised form 26 April 2026; Accepted 27 May 2026
Available online 2 June 2026

and on evidence of a gender gap in environmentalism, this work investigates how *gendered* perceptions of urban spaces, predominantly associated with masculinity (Sacchi et al., 2025), affect the evaluation of environmental behaviors in public (versus domestic) contexts. The aim is twofold: to expand research on space-focused stereotypes by analyzing the city-masculinity association long theorized in feminist geography, and to further shed light on the gender gap in pro-environmental behavior by testing mechanisms of normative social influence within gendered urban contexts.

Throughout the present work, unless otherwise specified, we conceptualize urban space (hereafter also "public urban space" or "public space") as publicly accessible city settings such as streets and squares where social interactions unfold and meanings are constructed (Cruz et al., 2018). We further conceptualize gendered perceptions of space as primarily shaped by socially produced roles and power relations that influence how public space is represented and experienced (Di Masso, 2025). The present studies adopt a cognitive-psychological epistemological framework aimed at identifying general mechanisms underlying cognition and social perception related to physical environment (Götz et al., 2025). The studies employed experimental procedures based on symbolic representations of urban settings and a quantitative approach relying on psychometric scales, involved participants from a specific sociocultural context (Italy), and focused on perceptions and evaluations of environmental behaviors rather than directly observed behavior.

2. The gendered production of urban space and urban inequalities

Places are not neutral background to human behavior but hold meanings shaped by social interaction (Relph, 1976; Tuan, 1979). Space plays an active role in the dynamics of social life, as emphasized by human geography and urban sociology, which theorize its deep social construction and reciprocal constitutive relationship with social processes (Jessop et al., 2008). Among the many social constructs that shape space and the meanings attached to it, gender is undoubtedly a central one. Feminist geography argues that gender is profoundly intertwined with urban structures and that the spatial organization of cities reinforces gender, race, and class unequal relationships (Bondi & Rose, 2003; Weisman, 1994). Feminist research has been pivotal in connecting the social categories of masculinity and femininity with another pervasive dualism: the symbolic distinctions between the public and private spheres. Men occupy the "productive" public domain, whereas women inhabit the "reproductive" domestic one (Bondi, 1992, 1998; Duncan, 1996; Massey, 1994; Nicholson, 1986). Urban development (at least in the Western context) historically embodied this gendered labor divide, reproducing inequality through physical design (Hubbard, 2004; Spain, 2014). City and suburban growth in the US, for instance, has been permeated by the idea of creating different spaces for men and women (McDowell, 1983; Saegert, 1980): hence, the public domain of the urban center came to be associated with masculine-coded spheres such as work, production, and economic and political power, whereas suburban development reinforced ideals of nuclear-family domesticity (Lewis & Foord, 1984; Kim, 1993; Manzo, 2003).

Urban architecture and planning also reproduce gender bias, often privileging the needs of men and heteronormative families (Beebeejaun, 2017; Spain, 2014). Men-dominated design traditions foster environments reflecting stereotypes, such as vertical, linear, and solid structures like skyscrapers symbolizing masculine rationality and power (Bondi, 1992; Bondi & Rose, 2003; Lico, 2001), whereas women's needs for access, safety, and transport continue to be overlooked (Burgess, 2008; Navarrete-Hernandez et al., 2021). Recent evidence confirms these inequalities. A study in Barcelona found persistent gendered patterns in public space use (Valera & Casakin, 2022). Public areas remain contested, maintaining inequalities in gender relations (Vera-Gray & Kelly, 2020). Women and minorities often experience them as hostile, fearing crime or harassment (Pain, 2000; Valentine, 1990), which fosters feelings of vulnerability, objectification, and mental health risks (Davidson et al., 2016; DelGreco & Christensen, 2020; Johansson & Haandrikman, 2023; Szymanski et al., 2021; Tandogan & Ilhan, 2016). Women may perceive to have less right than men to occupy public urban spaces or even assume responsibility for their own protection, ultimately deciding to restrict their use of public space (Bastomski & Smith, 2017; Fairchild & Rudman, 2008; Wesely & Gaarder, 2004), especially in more traditionalist societies (Jalalkamali & Doratli, 2022; Lata et al., 2020). Public urban spaces can also be understood as "panoptic" environments, where architectural layouts increase social visibility and thus the salience of monitoring and normative control. Drawing on Foucault's (1977) account of panopticism, regulation would not depend solely on external surveillance but also on its internalization: women may anticipate being observed and evaluated and therefore would adjust their conduct accordingly. From a gendered perspective, this is consistent with the idea that women's presence in public space is often subject to heightened scrutiny and a sense of being positioned as "the Other," whereas men are more readily treated as the default users of these settings, dynamics which can constrain women's behavior (de Beauvoir, 1949/2010).

3. Space-focused stereotypes: how social group beliefs shape perceptions of places

Scholars have argued for moving beyond social categories to include socio-cultural and physical contexts when studying social phenomena taking place in and mutually constituting macroenvironments (Cikara et al., 2022; Glasford, 2021; Meagher, 2020; Oishi, 2014; Reis, 2008). Recent theorizing suggests that stereotypes extend to physical spaces, linking places with stereotypical traits generally associated with the social groups that inhabit or frequent those areas. As a consequence of this *space-focused stereotyping* process (Yantis & Bonam, 2021), individuals' preconceptions about certain social groups can also influence how they perceive and interact with areas related to social groups. Bonam and colleagues (2016; 2017) showed how "Black Space" stereotype, rooted in historical segregation and resource deprivation (Grigoryeva & Ruef, 2015), lead to negative evaluations, distancing, reduced property values, greater tolerance of harm (Bonam et al., 2016, 2020; Yantis & Bonam, 2021), and increased criminalization (James et al., 2023) of U.S. black neighborhoods. Similar findings emerged for immigrant neighborhoods in Germany (Essien & Rohmann, 2023) and communities of people with HIV/AIDS in China (Wen et al., 2022).

Despite the pervasiveness of stereotypes, social psychology has rarely examined their implications for the perception of physical environments (Meagher, 2017). Most social-cognitive research has focused on how contexts shape stereotyping and target perception (Brambilla et al., 2024; Casper et al., 2010; Cheryan et al., 2009; Gosling et al., 2002; Lawrence & Leather, 1999; Sng et al., 2024; see also studies on racial biases: Correll et al., 2011; Kahn & Davies, 2017; Niemann et al., 1998; Williams, 2023; Williams et al., 2016; Wittenbrink et al., 2001). By contrast, far fewer studies have investigated how stereotypes shape perceptions of inanimate stimuli or the physical world, with some notable exceptions concerning gendered objects, brands, and shapes (Gal & Wilkie, 2010; MacPhee & Prendergast, 2019; Meagher, 2017; Zhang et al., 2022).

Empirical research linking gender categories to perceptions of space remains limited as well. While social and environmental psychology have documented gender differences in relations to urban environments, such as spatial abilities, perceived safety, and place attachment (Bartlett & Camba, 2023; Coluccia & Louse, 2004; Dasgupta et al., 2022; Jiang et al., 2017; Schmitz, 1997), they have largely overlooked the dominant cognitive association between cities and masculinity and its potential implications. Addressing this gap, Sacchi and colleagues (2025) provided first quantitative evidence that urban spaces are stereotypically linked to masculinity and are attributed more masculine than feminine traits, based on both direct and indirect measures. Although

these findings support the hypothesis of a widespread city-masculinity stereotype, its downstream consequences for socially relevant outcomes in urban settings remain to be clarified.

4. Gendered environmental behavior: stereotypes and social roles in public space

Pro-Environmental Behavior (PEB; Lange & Dewitte, 2019) refers to actions that protect or minimally harm the natural environment, while harmful actions are classified as Anti-Environmental Behaviors (AEBs). Gender stereotypes and roles significantly shape environmental habits (Bloodhart & Swim, 2020; Zhao et al., 2021). Studies across psychology, sociology, and marketing show women express stronger environmental concern, display more positive attitudes and intentions for green consumption, and engage more in PEBs than men (Briscoe et al., 2019; Dzialo, 2017; Gifford & Nilsson, 2014; Hunter et al., 2004; Kennedy & Kmec, 2018; Macias & Williams, 2016; Takahashi & Selfa, 2015; Witek & Kuźniar, 2020; Xiao & McCright, 2012; Zelezny et al., 2000). Women are more likely to buy organic foods, reuse products, and reduce household energy use (Bulut et al., 2017; Radman, 2005; Rainisio et al., 2022). These trends extend beyond Western countries and appear to be a global phenomenon (Eisler et al., 2003; Pisano & Lubell, 2017; Xiao & Hong, 2018).

Various theories may explain this gender gap. Hypotheses range from women's socialization into altruism and prosocial values (Dietz et al., 2002; Strapko et al., 2016), to higher empathy and care for others (Milfont & Sibley, 2016; Xiao & McCright, 2012), personality traits such as conscientiousness and agreeableness (Desrochers et al., 2019; Luchs & Mooradian, 2012), income inequality and lower possibility of consumption (Segal & Podoshen, 2013), and ecofeminist critiques linking patriarchy, gender, and environmental exploitation (Echavarren, 2023). Additionally, a mix of socio-cultural factors has been suggested (Chan et al., 2019).

The gap is also linked to gender stereotypes. Individuals engaging in PEBs are often attributed more feminine traits (Swim et al., 2020), and greater concern for climate change is associated with an increase of perceived femininity (Swim & Geiger, 2018). The green-feminine stereotype is so pervasive that it can even be triggered by packaging colors and cause stigmatization of the goods on sale (Felix et al., 2022).

This association has important consequences for men's and women's self-perception and behavior. Men tend to avoid green choices to preserve their masculine image (Brough et al., 2016), while affirmations or threats to masculinity influence their environmental engagement (De Backer et al., 2020; Gal & Wilkie, 2010; Pinna, 2020). Considering the prescriptive nature of stereotypes, it would be common to expect women to be more attentive to environmental issues and men to be more disengaged (Swim & Geiger, 2018; Swim et al., 2020).

Environmental behaviors can be performed in both private (e.g., household management) and public spheres (e.g., policy support, activism; Stern, 2000). The gender gap is stronger in the private domain, whereas it is less consistent for public behaviors (Hadler & Haller, 2011; Hunter et al., 2004; Kennedy & Kmec, 2018; Newman & Fernandes, 2016; Tindall et al., 2003; Xiao & McCright, 2012; Yates et al., 2015Yates et al., 2015). Trelohan (2022) explains women's engagement in PEB through the lens of social role expectations within the public sphere. If environmental behaviors are conceptualized not in terms of the content of the action, but rather in terms of the space in which they are performed (see for this argument Stacheli, 1996), then in publicly accessible spaces both PEBs and AEBs have greater potential to socially signaling group status and identity than behaviors performed in the private context of domestic space (Brick et al., 2017; Griskevicius et al., 2010). More broadly, gender itself, and the social prescriptions attached to it, can be understood as constituted through continuous performative acts (Butler, 1988), with public urban spaces serving as a salient stage on which appropriate behaviors are enacted and judged.

5. The present research

Building on the empirical evidence and theoretical frameworks introduced above, this research has two general aims. First, it extends work on space-focused stereotyping (Bonam et al., 2017, 2020) by examining gendered attributions to urban space. In particular, it provides further quantitative evidence for the cognitive association between urban space and masculinity (Sacchi et al., 2025) which has been long theorized within feminist geography (Bondi & Rose, 2003). Second, it investigates the social consequences of perceiving cities as masculine by bridging space-stereotyping research with environmental psychology, considering the interplay between psychological processes and urban geography (Götz et al., 2025). In doing so, it contributes to understanding the gender gap in pro-environmental behavior (Briscoe et al., 2019) by accounting for how the physical setting of environmental actions is itself subject to stereotypical evaluation. Specifically, we test whether gendered perceptions of urban space influence expectations about pro-environmental and anti-environmental behaviors performed by women and men in private and public contexts (Stern, 2000; Trelohan, 2022).

Three key hypotheses guided the research. Based on prior findings, we predicted PEBs would be more associated to femininity and AEBs to masculinity (Hypothesis 1; Bloodhart & Swim, 2020; Brough et al., 2016; Swim et al., 2020). We further anticipated that perceiving urban space as gendered would intensify gendered judgments of PEBs and AEBs performed in urban environments (Hypothesis 2). Finally, we hypothesized that this eco-gender gap could be driven by gender role norms in public settings (Hypothesis 3). We reasoned that men, feeling more compatible with masculine spaces, may act consistently with agentic traits, displaying greater autonomy and less regard for norms. In contrast, women may tend to conform to communal traits, displaying more protective attitudes toward the environment, but also feeling to be more constrained in a space that is not “theirs”. These speculations are consistent with person-environment fit models (see Schmader & Sedikides, 2018), for which social groups that are more compatible with their environment feel high autonomy in their actions and strong social validation, whereas less fitting groups are more socially constrained by norms and strive to meet others’ expectations to avoid negative social outcomes. Relatedly, research on social power suggests that norm-violating behavior arises from higher self-determination and reduced concern for others (Galinsky et al., 2006, 2008; Guinote, 2007; Van Kleef et al., 2015). Thus, women may be more likely to navigate public space while anticipating scrutiny and potential sanction, which can foster greater self-regulation of environmental behavior. By contrast, men who perceive urban space as “theirs” may experience greater legitimacy and freedom of action and may be more motivated to enact control within these settings rather than prioritize environmental protection.

Three studies tested these predictions. Study 1 investigated how environmental behaviors performed in urban public (vs. domestic) spaces by men and women are judged in terms of valence and gender, and how these judgments can be affected by the gendered view of urban space assessed though a direct measure. Study 2 replicated the results using an indirect measure. Study 3 experimentally manipulated gender-space associations through priming and tested gendered norms in public contexts as a possible mechanism for the effect of the spatial stereotype on the expectations about the typical gender associated with environmental behaviors.

All studies were conducted in accordance with the Declaration of Helsinki, applicable national and European data protection legislation, and the relevant institutional policies of the University of Milano-Bicocca. The study procedures were reviewed and approved by the internal Ethics Committee of the Department of Psychology, University of Milano-Bicocca, operating under the University Ethics Board. No significant risks to participants’ physical or psychological wellbeing were identified, and the study did not involve deception, invasive procedures,

or stimuli expected to induce distress.

5.1. Analytical plan

The quantitative analyses relied on general linear (mixed) modeling to examine multivariate relationships among experimental manipulations and psychological constructs primarily assessed via psychometric Likert-type scales. To test Hypothesis 1, we fitted linear mixed-effects models to account for the multilevel structure of the data, with repeated scores (Level 1) nested within participants (Level 2). These models allowed us to estimate the effects of the experimental variables, including type of environmental behavior, on the gendered perception of those behaviors. To test Hypothesis 2, we conducted moderation analyses for repeated measures designs to examine whether stereotypical perceptions of space predicted differences in the stereotypical attributions to environmental behaviors. To test Hypothesis 3, we estimated mediation models to assess whether gender-role norms in public contexts could account for the moderation pattern observed in Hypothesis 2.

All analyses were executed on SPSS 28.0 and Jamovi 2.3 software. Supplementary Analyses including careless responding detection procedures are available on the Open Science Framework (https://osf.io/k3nv7).

6. Study 1: how gendered urban space stereotypes shape judgments of environmental behavior

The first objective of Study 1 was to measure the cognitive association between gender and urban spaces as an explicit construct. As this is the first attempt in social psychology to quantify this association using a psychometric scale, we designed an ad-hoc scale based on materials of recent studies on the topic (Sacchi et al., 2025) examining its factorial structure and internal consistency.

As a second aim, we tested whether PEBs were perceived as more typically feminine while AEBs were seen as more typically masculine. Additionally, we explored whether the gender of the agent may have an effect on how PEBs and AEBs are perceived as gendered, respectively as even more feminine and masculine, and whether these judgments could be moderated by the private or public context where the behaviors are performed.

We then examined whether the gender of the agent performing environmental behaviors affected the appreciation or the reprobation of PEBs and AEBs respectively. Considering the literature on person-environment fit outcomes (Kandler et al., 2024; Van Vianen, 2018), we predicted that in case of mismatch between the gender of the agent and the stereotypical gender associated with the space (i.e., men-domestic places, or women-public places), PEBs would be more admired (extremely positive) and AEBs would be more condemned (extremely negative) than the cases in which the gender of the agent is matching.

Finally, we investigated the effects of the gender-space cognitive association on the social judgments about environmental behaviors performed in gendered spaces. We expected that PEBs could be seen as more typically feminine and AEBs more typically masculine as levels of stereotypical beliefs on gendered spaces increase. We also explored whether this influence might be stronger in public settings compared to private ones.

6.1. Design and participants

Study 1 was an experimental study consisting of a mixed design 2 (Behavior: PEB vs. AEB, within participants) x 2 (Space: Domestic vs. Public, within participants) x 2 (Agent: Woman vs. Man, between participant).

We planned an a-priori power analysis for the effect of the gendered space perception on the differential gendering of PEBs (perceived as more feminine) versus AEBs (perceived as more masculine) which constitutes our primary effect of interest. Previous studies have shown that greenness is perceived as feminine, with effect sizes of $d = 1.13$, and $d = 0.969$ (Brough et al., 2016; see Studies 1 and 2). Additionally, urban public spaces are associated with masculinity, $d = 1.02$, and $d = 0.66$ (Sacchi et al., 2025; see Studies 1a and 1b). Given these findings, we adopted a conservative estimate of $d = 0.50$ to represent the moderation effect. Having established the use of a moderation model in a two-instance repeated measures design (Montoya, 2019), we employed the "Linear bivariate regression: One group, size of slope" command in G*Power (Faul et al., 2009). After setting the H1 slope as $r = 0.25$ (approximately $d = 0.50$) and fixing the variables standard deviations to 1, the software returned a sample size $n = 120$ (H0 slope $r = 0$, 1 - $\beta = 0.80$, $\alpha = .05$).

The study was implemented and delivered via Inquisit Web software. We relied on convenience sampling as a cost-effective strategy to recruit adults from the Italian general population with varied sociodemographic backgrounds. Participants were recruited by distributing the study link via informal networks and social media platforms. Potential risks of adverse publicity were considered minimal. Similarly to Study 2 and 3, the recruitment message presented the study in neutral and non-sensitive terms, avoiding statements that could be misleading or stigmatizing.

The sample consisted of 130 Italian individuals including 68 women, 59 men, and 3 non-binary, aged 20 to 65 years, $M_{age} = 31.5$ years, $SD_{age} = 10.34$ years. Eighty participants (61.6%) had a bachelor's degree or higher education, and the sample was on average politically oriented toward the left ($M = -2.04$, $SD = 2.01$). Seventy respondents were randomly assigned to the Woman Agent condition and the other 60 to the Man Agent condition.

6.2. Procedure and measures

Before taking part in the study, all participants provided digital informed consent and accepted the data-treatment policy in the first pages of the online survey, similarly to Study 2 and 3. Then participants were randomly assigned to experimental conditions and proceeded to the completion of a questionnaire including the following scales.

Environmental Behaviors (gender & valence). The scale comprised 20 ad hoc items inspired by prior measures (Kaiser, 1998; Lange & Dewitte, 2019; Markle, 2013; Truelove & Gillis, 2018). The item list was designed to provide a comprehensive set of common, clearly observable environmental behaviors in both domestic and public urban spaces, so that they could be readily evaluated by hypothetical observers. Here, *public* refers to publicly accessible spaces where behaviors occur, rather than the traditional "public sphere" of environmental action (Stern, 2000). The item pool was developed from 28 pre-tested behaviors, with the 8 most gender-extreme items removed to maintain a conservative test of the experimental effects (see Supplementary Analyses in Data Availability subsection). The items described ten PEBs and ten AEBs, each attributed to fictional man or women agents (between-participants design). For both behavior types, five items referred to private domestic settings and five to public urban settings (i.e., streets and squares). Participants were asked to imagine an agent performing the behavior in the specified environment and to evaluate, in their view, how others would judge that action. Each behavior was evaluated on two dimensions: the Gender perception was assessed by a bipolar, 7-points scale (1 = typically masculine - 7 = typically feminine); the Valence perception was assessed using three bipolar, 7-points scales (1 = extremely negative/despicable/unrighteous - 7 = extremely positive/admirable/righteous).

Commitment to the Environment. This validated scale (Davis et al., 2009; $\alpha = .941$, $\omega = 0.945$) was made of 11 items describing the sense of personal connection, affiliation and interdependence with the natural environment. Items were assessed on a 7-points Likert scale (1 = strongly disagree - 7 = strongly agree). The scale served as a control measure.

Gendered Space. This scale ($\alpha = .835$; $\omega = 0.842$) comprised 7 ad hoc items, developed based on the only quantitative study examining the association between space and gender (Sacchi et al., 2025). Their work asked participants to rate images rather than item statements, so we adapted the underlying conceptual approach into an item-based measure. The items assess beliefs about the association between gender and urban spaces, in particular the masculinity-public space association (e.g. "Typically, men think that the street and the square are their places par excellence") and the femininity-domestic space association. Items were assessed on a 7-points Likert scale (1 = strongly disagree - 7 = strongly agree).

Sociodemographic characteristics. Last, participants were asked about sociodemographic characteristics including gender identity (Woman, Man, Non-binary, Prefer not to say), age, education level, and political orientation (from −5 = far left to +5 = far right).

6.3. Results

First, we ran an explorative factorial analysis (EFA) on the 7-items Gendered Space scale. The analysis was conducted with the principal axes factoring and no rotation and displayed Bartlett's Sphericity χ^2 (21) = 338, $p < .001$, KMO = 0.812. One single eigenvalue (3.09) greater than 1 and the scree-test based on parallel analysis suggested a mono-factorial structure, with a good internal consistency (α = .835; ω = 0.842).

We then built a series of general linear mixed-effect models. Random intercept regression models were run with the maximum likelihood estimation approach (GAMLj Jamovi package, Gallucci, 2019a). For all the following mixed-effect models, independent continuous variables were centered to the total sample mean, and Satterthwaite approximation of degrees of freedom was used to compute significance tests of the effects (Luke, 2017). The random slopes for the predictors were not computed since the models would not converge when including interaction terms. All post-hoc comparisons were Bonferroni corrected.

To examine the effects of the experimental conditions on the gendered view of environmental behaviors, we built a model including the Gender of Environmental Behaviors as a dependent variable predicted by type of Behavior, type of Space, type of Agent, their two-way and three-way interactions, and the random intercept.

The model revealed a marginal $R^2 = 0.269$, a conditional $R^2 = 0.275$, and a small ICC = 0.00735. The following statistically significant fixed effects were observed: the main effect of type of Agent, $F(1, 130) = 28.22$, $p < .001$, for which behaviors performed by women ($M = 4.09$, $SE = 0.03$) were perceived as more feminine than behavior performed by men ($M = 3.89$, $SE = 0.03$); the main effect of type of Behavior, $F(1, 390) = 159.02$, $p < .001$, for which PEBs were perceived more feminine ($M = 4.22$, $SE = 0.03$) than AEBs ($M = 3.76$, $SE = 0.03$); and a significant interaction effect of Behavior x Space, $F(1, 390) = 3.89$, $p = .049$. All other effects were not significant, F's < 0.31 and p's > 0.578. See Table 1 for fixed effect parameters estimates, and Fig. 1 for Behavior × Space interaction representation.

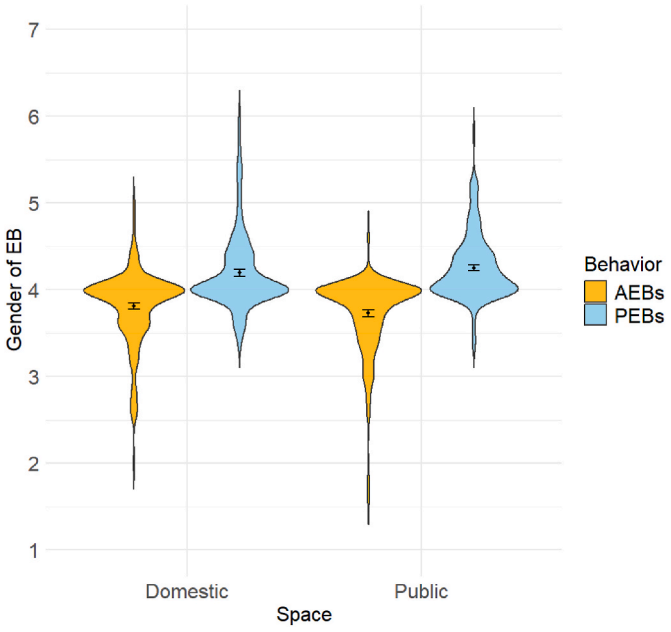

Fig. 1. Perceived gender typicality of pro-environmental and anti-environmental behaviors performed in domestic and public spaces.
Note. PEBs = pro-environmental behaviors; AEBs = anti-environmental behaviors; EB = environmental behavior. Higher scores indicate greater perceived femininity of environmental behavior, whereas lower scores indicate greater perceived masculinity. Violin plots show the distribution of responses; points indicate estimated means and error bars indicate 95% confidence intervals.

Consistently with Hypothesis 1, the post-hoc comparisons of the Behavior × Space interaction suggested that PEBs were seen as more feminine ($M = 4.19$, $SE = 0.04$) than AEBs which were perceived as more masculine ($M = 3.81$, $SE = 0.04$) in domestic space, $t(396) = 7.46$, $p < .001$. One sample t-tests against the neutral values of the measurement scale ($\mu = 4$) confirmed the genderization of domestic PEBs, $t(129) = 5.01$, $p < .001$, $d = 0.439$, and AEBs, $t(129) = -4.87$, $p < .001$, $d = 0.427$. The difference between gendered environmental behaviors was wider between PEBs ($M = 4.25$, $SE = 0.04$) and AEBs ($M = 3.72$, $SE = 0.04$) that are performed in public space, $t(396) = 10.23$, $p < .001$, meaning that PEBs were considered as even more feminine, $t(129) = 7.77$, $p < .001$, $d = 0.681$, while AEBs were viewed as even more masculine, $t(129) = -7.05$, $p < .001$, $d = 0.618$.

A second model testing whether the gender of the agent influenced the positive or negative evaluation of PEBs and AEBs respectively, yielded a non-significant three-way interaction effect, $p = .391$. Refer to Supplementary Analyses for further details, including the negligible effects of Commitment to the Environment and Political Orientation, which were considered as potential confounds in the models.

Table 1
Fixed main and interaction effects predicting the perceived gender typicality of environmental behaviors as a function of behavior, space, and agent types.

Names	Effect	Estimate	SE	Lower	95% Confidence Interval		t	p
					Upper	df		
(Intercept)	(Intercept)	3.991	0.018	3.955	4.027	130	218.345	<0.001
Behavior	AEBs - PEBs	−0.454	0.036	−0.525	−0.383	390	−12.610	<0.001
Space	Public - Domestic	−0.011	0.036	−0.082	0.058	390	−0.325	0.745
Agent	Women - Men	0.194	0.036	0.122	0.265	130	5.313	<0.001
Behavior ✻ Space	AEBs - PEBs ✻ Public - Domestic	−0.142	0.072	−0.283	−0.001	390	−1.971	0.049
Behavior ✻ Agent	AEBs - PEBs ✻ Women - Men	0.028	0.072	−0.113	0.169	390	0.388	0.698
Space ✻ Agent	Public - Domestic ✻ Women - Men	−0.040	0.072	−0.181	0.101	390	−0.557	0.578
Behavior ✻ Space ✻ Agent	AEBs - PEBs ✻ Public - Domestic ✻ Women - Men	0.042	0.144	−0.239	0.325	390	0.296	0.768

Note. PEBs = pro-environmental behaviors; AEBs = anti-environmental behaviors. Positive estimates indicate that environmental behaviors were perceived as more feminine, whereas negative estimates indicate that they were perceived as more masculine.

6.3.1. The effect of gendered urban space perception on gendered environmental behavior

To investigate whether the gendered perception of urban space affected the differences in gendered perception of PEBs compared to AEBs in domestic and public space, we conducted moderation analyses for two-instance repeated measure designs using MEMORE 2.1 macro for SPSS software (Montoya, 2019). We employed the percentile bootstrap method with 5000 resamplings to compute 95% confidence intervals.

In the first model (Model 2 of MEMORE) we included gendered PEBs and AEBs in domestic places as dependent variables and Gendered Space scores as the moderator. The model revealed a significant moderating effect, $b = 0.223$, $SE = 0.05$, $t(128) = 4.55$, $p < .001$, 95% CI [0.13, 0.32], $d = 0.805$. Consistently with Hypothesis 2, for lower levels of gendered space perception (−1 SD) there was not a significant difference in gendered perception of PEBs and AEBs, $b = 0.142$, $SE = 0.08$, $t(128) = 1.89$, $p = .06$, $d = 0.335$, whereas for higher levels of gendered space perception (+1 SD) environmental behaviors were perceived as more extremely gendered, $b = 0.624$, $SE = 0.08$, $t(128) = 8.34$, $p < .001$, $d = 1.475$.

In the second model, after including PEBs and AEBs in public places as dependent variables, the model yielded significant results and a similar moderation effect, $b = 0.225$, $SE = 0.05$, $t(128) = 4.52$, $p < .001$, 95% CI [0.13, 0.32], $d = 0.799$. For lower levels of gendered space perception (−1 SD) the difference in gendered perception of PEBs and AEBs was already significant, $b = 0.280$, $SE = 0.08$, $t(128) = 3.69$, $p < .001$, $d = 0.652$. For higher levels of gendered space perception (+1 SD), environmental behaviors were perceived even more extremely gendered, $b = 0.767$, $SE = 0.08$, $t(128) = 10.09$, $p < .001$, $d = 1.783$, providing further support for Hypothesis 2. See Fig. 2 for a visual representation of moderation effects.

6.4. Discussion

Study 1 investigated whether women and men engaging in environmental behaviors were judged differently depending on the types of space in which the behaviors were performed, and which are stereotypically linked to the (mis)matching gender category - namely, the femininity-associated domestic settings and masculinity-associated public settings.

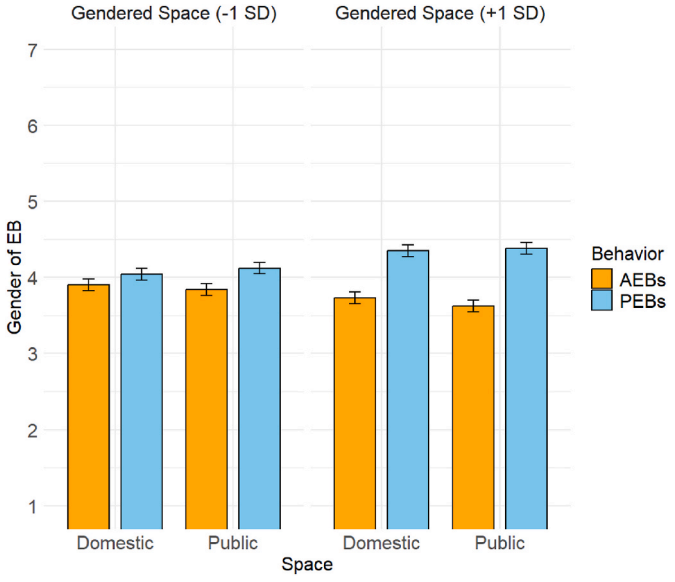

Fig. 2. Simple slopes of behavior and space types predicting the perceived gender typicality of environmental behaviors at low and high levels of gendered space stereotypes.
Note. Gendered space stereotypes were plotted at low (−1 SD) and high (+1 SD) levels. Bars show estimated means of perceived gender of environmental behaviors, and error bars represent 95% confidence intervals.

Confirming our Hypothesis 1 and previous findings (Brough et al., 2016; Swim & Geiger, 2018), PEBs were seen as more feminine than AEBs, which in turn were considered masculine. Our results indicate that environmental behaviors enacted by women were judged as more typically feminine than the same behaviors enacted by men. This pattern is consistent with work showing that environmentalism is associated with communal, care-oriented prescriptions that are culturally perceived as feminine, and that gender identity is closely tied to expectations about appropriate conduct (e.g., Koenig & Eagly, 2014; Swim et al., 2020). From this perspective, observers may use the actor's gender as a salient interpretive cue when assigning gender-typical meanings to environmental actions, reading women's pro-environmental conduct as more norm-congruent with feminine role expectations.

Contrary to our expectations, results did not reveal any significant interaction of the gender of the agent with the type of spaces when testing their effects on the perceived gender and valence of environmental behaviors. The statistical equivalence of these effects suggests that women and men agents are not differently judged for their behavior on the basis of space-related expectations. This pattern is compatible with the idea that gender stereotypes may function as broad, readily accessible evaluative frameworks that shape interpretations even when environmental cues are present (Casper et al., 2010; de Lemus er al., 2014). Further analyses including in the models the binary gender of respondents (see Supplementary Analyses) revealed a Behavior x Participants' Gender interaction effect on the gendered perceptions of environmental behaviors, for which women showed more extreme evaluations of PEBs than men. This suggests that the stereotypical process is driven by the representation of culturally widespread stereotypes, which are particularly assimilated by the disadvantaged group (Latrofa et al., 2010; Simon & Hamilton, 1994).

Additionally, we found that on average the public behaviors were more extremely evaluated on the valence dimension than domestic behaviors. This may be attributable either to the ad-hoc selection of behaviors (given that the same difference emerged in the items' pre-test) or to the fact that public behaviors are more readily and extremely evaluated in social contexts governed by shared expectations (Cialdini et al., 1990; Trelohan, 2022)

In Study 1 we also showed how the Gendered Space scale had a good internal reliability and a monofactorial structure. The scale scores effectively moderated the gendered perception of PEBs and AEBs, making them perceived as respectively more feminine and masculine as the gendered perception of urban spaces increased. This moderating effect appeared to be consistent across contexts, with no significant variation between public and domestic environments. These findings, supporting our Hypothesis 2, suggested that the gendered perception of space may reinforce stronger stereotypical beliefs about individuals who engage in behaviors within those spaces.

7. Study 2: indirect evidence of the urban-masculine association and its implications

Study 1 provided evidence for a stereotypical association between gender and urban spaces that can affect people's expectations on environmental behaviors performed in those spaces. The main objective of Study 2 was to support these findings using an indirect assessment instrument of gender-space association. In particular, we designed a Face Gender Recognition task to test the facilitated accessibility of face gender construct when paired with public space representations. We anticipated that men's gender would be more easily identified when faces with masculine traits, rather than feminine traits, were superimposed onto an urban background. Thereafter we tested the effects of the indirectly measured gendered space stereotype - conceptualized as the ease of recognition of men faces on urban versus natural

backgrounds - on the gendered view of environmental behavior to replicate the findings of Study 1.

7.1. Design and participants

Study 2 was planned with an experimental within-participants design, 2 (Behavior: PEB vs. AEB) x 2 (Space: Domestic vs. Public). Similarly, the Face Gender Recognition task involved a within participants design, 2 (Face gender: Man vs. Woman) x 2 (Background: Urban vs. Natural).

In line with Study 1, we conducted an a-priori power analysis for the effect of the gendered space perception on the differential gendering of environmental behaviors. Following the approach of Anderson and colleagues (2017), we computed the necessary sample size to reach desired power for a single regression coefficient by adjusting the effect size observed in Study 1 to account for uncertainty. Inputting in the accompanying Shiny App the effect size of the moderation of public environmental behaviors ($t = 4.52$, $d = 0.799$, $n = 130$) along with a desired assurance level of 95%, the analysis indicated that a sample size of $n = 146$ would be required ($1 - \beta = 0.80$, $\alpha = .05$).

The study was conducted using Qualtrics XM online software. Participants were recruited by sharing the link to the online survey via social media networks. We recorded 352 responses, then we excluded participants who did not fully answer at least the environmental behaviors scale. The final sample comprised 170 Italian individuals, of which 113 women, 54 men, and 3 persons who did not answer, aged 19 to 79 years, $M_{age} = 50.9$ years, $SD_{age} = 13.5$ years. In this sample, 102 participants (61.1%) had a bachelor's degree or higher education, and on average they were politically oriented toward the left ($M = 2.97$, $SD = 1.28$).

7.2. Procedure and measures

Face Gender Recognition Task. Participants completed a task designed to indirectly assess the cognitive association between urban spaces and masculinity. They were instructed to morph virtual faces from a gender-neutral appearance until they could confidently determine the depicted gender. Stimuli consisted of 3D face models superimposed on background images, with participants using a slider (from 0 = neutral, to 10 = extreme masculine/feminine) to autonomously morph the gender traits with gradual adjustments.

For the face stimuli, we selected five male and five female faces from the Chicago Face Database (Ma et al., 2015), excluding models with makeup or facial hair. Using FaceGen Modeller demo, we generated 3D virtual faces, rendered them with a gender-neutral appearance, and created 11-step morphing sequences toward extremes of masculine and feminine traits, for a total of 20 sliders and 210 face model stimuli. Backgrounds consisted of 5 urban (streets, squares) and 5 natural (parks, forests) images, sourced from copyright-free databases and free of people or animals. Each of the 10 face models was paired with both urban and natural scenes, generating a total of 420 stimuli later imported in Qualtrics to run 40 randomized slider tasks per participant. Participants were instructed to drag each slider (from step 0 to step 10) until the point they felt confident in identifying the gender (randomly masculine or feminine) of the virtual face in each picture.

The task aimed to analyze the ease of gender recognition by determining the number of steps required for participants to confidently identify the face identity as masculine or feminine when superimposed on an urban or natural background. We calculated a Space Facilitation Index for Men (SFI-M) by subtracting the recognition scores of men faces superimposed on urban backgrounds from the recognition scores of men faces superimposed on natural backgrounds. Higher scores reflected easier identification of men faces in urban versus natural contexts. An analogous SFI-W for women faces served as a control.

Gendered Environmental Behaviors. This scale consisted of the same 20 items as in Study 1, with participants no longer asked to imagine an individual deciding to engage in environmental behavior. The subjective evaluation of the gender of behaviors was assessed on a bipolar, 7-points scale on the Gender dimension (1 = typically masculine - 7 = typically feminine).

Commitment to the Environment. The scale ($\alpha = .870$, $\omega = 0.908$) was used as a potential confound to control for, as in Study 1.

Sociodemographic questions. They included gender identity, age, education level, and political orientation (1 = far left - 7 = far right).

7.3. Results

We built a general linear mixed-effect model adopting the same modelling choices as those employed in Study 1. To test the effects of urban space on the gendered view of environmental behaviors, we run the model with the Gendered Environmental Behaviors as a dependent variable predicted by the type of Behavior, the type of Space, their two-way interaction, and the random intercept. The model revealed a marginal $R^2 = 0.179$, a conditional $R^2 = 0.268$, and an ICC = 0.109, and yielded the following statistically significant fixed effects: the main effect of type of Behavior, $F(1, 510) = 133.66$, $p < .001$, and the interaction effect of Behavior x Space, $F(1, 510) = 30.02$, $p < .001$. The main effect of the type of Space was not significant, $F(1, 510) = 2.29$, $p = .130$. The post-hoc comparisons (Bonferroni corrected) of Behavior × Space interaction suggested that PEBs were seen as more feminine ($M = 4.21$ $SE = 0.06$) than AEBs which were perceived as more masculine ($M = 3.90$, $SE = 0.06$) in domestic space, $t(513) = 4.29$, $p < .001$. One-sample *t*-tests against the neutral midpoint of the scale ($\mu = 4$) confirmed the gendered perception of PEBs, $t(169) = 3.74$, $p < .001$, $d = 0.287$, and AEBs, $t(169) = -1.96$, $p = .052$, $d = 0.150$. In line with findings from Study 1, the same difference was even more pronounced when PEBs ($M = 4.42$, $SE = 0.06$) and AEBs ($M = 3.54$, $SE = 0.06$) were framed as occurring in public spaces, $t(513) = 12.01$, $p < .001$. Specifically, PEBs were judged as even more feminine, $t(169) = 6.91$, $p < .001$, $d = 0.530$, and AEBs as even more masculine, $t(169) = -9.29$, $p < .001$, $d = 0.712$.

7.3.1. Face gender recognition

We proceeded to analyze the Face Gender Recognition Task by running a mixed-effect model with the recognition scores as a dependent variable predicted by the type of Face, the type of Background, their two-way interaction, and the random intercept. The model yielded a marginal $R^2 = 0.06$, a conditional $R^2 = 0.68$, and a relevant ICC = 0.660. Only the main effect of type of Face was significant, $F(1, 510) = 126.86$, $p < .001$, for which men faces ($M = 4.29$, $SE = 0.12$) were easier to identify than women faces ($M = 5.29$, $SE = 0.12$) when morphing neutral-gender faces. The main effect of Background, $F(1, 510) = 0.66$, $p = .416$, and the Face × Background interaction effect, $F(1, 510) = 0.14$, $b = 0.066$, $SE = 0.18$, $p = .708$, were not significant.

7.3.2. The effect of indirect gendered urban space perception on gendered environmental behavior

Similarly to Study 1, to investigate whether the indirect association between men and urban space - represented by SFI-M scores - affected the differences in gendered perception of PEBs vs AEBs in domestic and public space, we computed a moderation model for repeated measure designs using MEMORE 2.1 (Model 2, percentile bootstrap 95% CI, 5000 resamplings). We inputted the PEBs and AEBs in domestic places as dependent variables and SFI-M scores as the moderator. The model did not reveal a significant moderation effect, $b = 0.086$, $SE = 0.09$, $t(168) = 0.96$, $p = .339$, 95% CI [-0.09, 26], $d = 0.148$. However, the model yielded significant results when including PEBs and AEBs in public places as dependent variables, $b = 0.27$, $SE = 0.09$, $t(168) = 2.72$, $p = .007$, 95% CI [0.07, 0.47], $d = 0.419$. For lower levels of space facilitation (−1 SD) there was a significant difference in gendered perception of PEBs and AEBs, $b = 0.647$, $SE = 0.12$, $t(168) = 5.35$, $p < .001$, $d = 0.826$; and for higher levels of space facilitation (+1 SD), environmental behaviors were perceived as even more extremely gendered, $b = 1.11$,

$SE = 0.12$, $t(168) = 9.2$, $p < .001$, $d = 1.419$ (see Fig. 3). Refer to the Supplementary Analyses for further details on the SFI-M moderation effect, which was significantly greater for public settings, and the SFI-W, which did not yield a significant moderation effect.

7.4. Discussion

Confirming the findings of Study 1, we successfully replicated the effects of the types of space and environmental behavior on the gendered judgment of these behaviors. Specifically, PEBs were perceived as more feminine and AEBs as more masculine, as predicted by Hypothesis 1, particularly in the public context.

Building on the Face Gender Recognition Task, we showed that the Space Facilitation Index for Men (SFI-M), which reflects the ease of recognizing men faces in urban backgrounds compared to natural ones, influenced the gendered perception of PEBs and AEBs, confirming again Hypothesis 2. The results exhibited a pattern similar to those of Study 1 regarding the moderating effect of the explicit gendered space scale. However, the impact of this indirectly assessed gendered space perception was found to be more pronounced in public contexts, an effect that did not reach significance in Study 1. This discrepancy may be attributed to the nature of the SFI-M index employed in Study 2, which specifically targeted perceptions within public urban contexts, in contrast to the broader Gendered Space scale used in Study 1, which included associations between femininity and domestic space.

Moreover, the effects on gendered behaviors were specific to men faces, as the Space Facilitation Index for Women faces (SFI-W) did not prove to be a significant moderator. Consequently, SFI-M may be a promising indirect measure of the association between masculinity and public urban space, warranting further investigation.

Last, we did not observe a significant background effect that facilitated the recognition of masculine faces compared to feminine faces. Unexpectedly, a significant gender effect emerged, with men's faces being easier to recognize than women's, regardless of the background. This finding may be explained by studies indicating an androcentric bias (Bailey et al., 2019), where digital avatars are more often perceived as masculine, even when designed to be explicitly gender neutral. Consistently, when asked to identify a prototypical human, people tend to select men more frequently than women (Bailey & LaFrance, 2016, 2017).

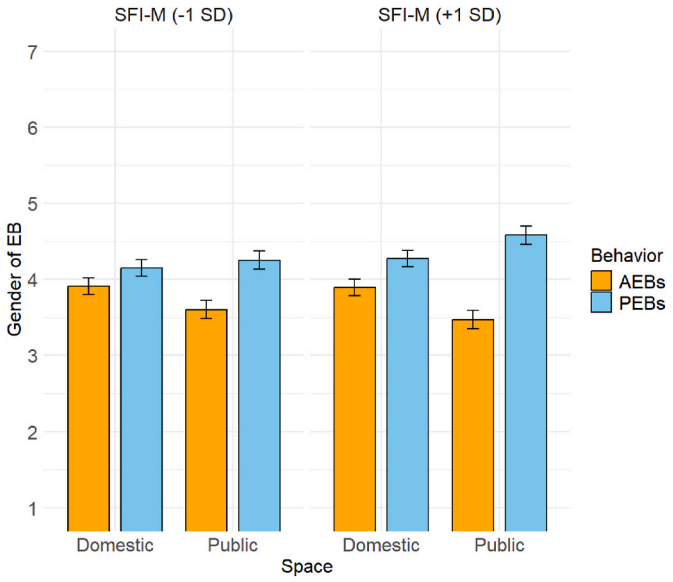

Fig. 3. Simple slopes of behavior type and space predicting the perceived gender typicality of environmental behaviors at low and high levels of SFI-M scores.

Note. SFI-M = Space Facilitation Index for Men, representing easier identification of men faces in urban versus natural contexts. SFI-M scores were plotted at low (−1 SD) and high (+1 SD) levels. Bars show estimated means of perceived gender of environmental behaviors, and error bars represent 95% confidence intervals.

8. Study 3: manipulating gender-space associations and testing their effects on gendered environmental expectations

The purpose of Study 3 was to provide insights regarding the mechanism of the impacts of the gendered view of urban space on the gendered perception of environmental behaviors reported in Study 1 and 2. First, we experimentally manipulated the cognitive accessibility of gender-space association to provide evidence for its causal effects. In particular, we leveraged a priming procedure to make more accessible the masculinity-public space association or the counter-stereotypical femininity-public space association through the repetition of sentences with (counter-)stereotypical content. As a result, we expected to successfully increase, via the stereotypical condition, and decrease, via the counter-stereotypical condition, the perceived masculinity of urban spaces compared to a control condition.

Secondly, according to Hypothesis 3, we investigated whether the beliefs about adherence to social norms related to gender roles in public spaces could serve as a mechanism driving the influence of the gendered view of spaces on expectations regarding men and women engaging in environmental behaviors within those spaces. We first examined whether the manipulation affected the endorsement of gender role norms. Then we hypothesized a statistically significant indirect effect in a model where gender role norms beliefs acted as a potential mediator of the impact of the manipulated gendered space stereotype on the gendered perception of environmental behaviors.

8.1. Design and participants

Study 3 consisted of a one-way design including three between-participants manipulation conditions (Stereotypical vs. Counter-stereotypical vs. Control). We ran an a-priory power analysis for a one-way ANOVA with three groups using G*Power software.

One study employed counter-stereotypical pictures as a strategy for reducing gender stereotypes (Finnegan et al., 2015; see Study 1), finding significant effects of the counter-stereotypes in affecting the accuracy $d_z = 0.61$, and $d_z = 1.16$, and response times, $d_z = 0.77$, and $d_z = 1.61$, of judgments about gendered words pairs. Given these findings, we adopted a conservative estimate of $d = 0.50$ representing the effect of a gender stereotype manipulation procedure. Using the one-way ANOVA command of G*Power, the software computed a required sample size $n = 159$ (three groups, 1 - $\beta = 0.80$, $\alpha = .05$)

We also conducted a Monte Carlo power analysis simulation for a mediation model with two parallel mediators (Schoemann et al., 2017, p. 5000 replications). We set all path coefficients to $r = 0.25$ (approximately $d = 0.50$), except for the direct effect, which was set to $r = 0.05$ to reflect the assumption of full mediation. Standard deviations for all variables were fixed at 1. Based on these parameters, the analysis estimated a required sample size of $n = 200$ (1 - $\beta = 0.80$, $\alpha = .05$).

The study was run with Qualtrics XM online software. The link to the online survey was shared on social media networks. A total of 402 responses were recorded; incomplete responses of persons who did not fully answer at least the gendered space scale were excluded. The final sample consisted of 204 Italian individuals, of which 138 women, 58 men, 1 non-binary and 7 who did not answer, aged 18 to 79 years, $M_{age} = 44.1$ years, $SD_{age} = 17.2$ years. The sample was on average politically oriented toward the left ($M = 3.04$ $SD = 1.21$), and 98 participants (49.5%) had a bachelor's degree or higher education. Seventy-one respondents were assigned to the Stereotypical condition, 64 to the Counter-stereotypical condition, and 69 to the Control condition.

8.2. Procedure and measures

Scrambled Sentences Task. At the start of the study, participants completed a scrambled sentences task adapted from Bargh et al. (1996) to prime constructs by increasing their cognitive accessibility. Three sets of 20 sentences were created. In the stereotypical condition, sentences described men in public urban spaces, aiming to reinforce the masculinity-public space association. The counter-stereotypical condition used identical sentences but with women as protagonists, designed to weaken the stereotype. The priming sentences addressed four dimensions potentially underlying the gendered construction of public space: frequentation of urban settings (e.g., "Squares are largely frequented by men/women"), legitimacy of behaviors (e.g., "Men/women do whatever they want in the streets"), feeling of ease (e.g., "Men/-women feel confident in public spaces"), and the extent to which the environment is tailored to gendered needs (e.g., "Urban spaces are designed for men/women"). In the control condition, sentences provided neutral descriptions of urban scenes to avoid activating gender-related associations (e.g., "A cat rests on the wall in the square"). Each sentence comprised 7-9 words in Italian, including articles. Once completed the task, participants answered the following questionnaire.

Masculine Space. This scale (α = .574; after dropping the reversed item, α = .778, ω = 0.786) was a short and adapted version of the scale from Study 1 serving as a manipulation check. Four ad-hoc items portrayed traditional masculine stereotypes associated with urban spaces, except for one reversed item concerning the counter-stereotypical beliefs related to women ("When in the streets and squares, women are more legitimized to do whatever they want than men"). Items were assessed on a 7-points Likert scale (1 = strongly disagree - 7 = strongly agree).

Gender Roles Norms. Given the lack of suitable measures in literature, we developed two ad hoc scales, each comprising 7 items, to assess beliefs endorsing gender differences in adherence to norms in public settings. Specifically, the items described social expectations about the roles men and women are expected to fulfill when they are in public spaces under the social scrutiny of others. For men role expectations, we designed the Norms Disregard scale (α = .821, ω = 0.823; e.g., "Men can express their opinions in public without caring about others"), which reflects the perception of greater freedom and disregard for others' judgments among men. For women role expectations, we created the Norms Adherence scale (α = .766, ω = 0.773; e.g., "When in public, women often try to avoid the attention and judgments of others"), which captures the heightened concerns and self-awareness women are believed to exhibit in public settings.

*Public Gendered Environmental Behaviors***.** This scale included the 10 items already used in Study 1 describing PEBs and AEBs performed in public urban spaces only.

*Sociodemographic questions***.** Data was collected including gender identity, age, education level, and political orientation.

8.3. Results

We performed a one-way ANOVA to test the effect of the experimental manipulation conditions on the Masculine Space manipulation check. The analysis yielded a significant effect, $F(2, 201) = 5.98$, p = .003, d = 0.487 (see Fig. 4). Contrary to our expectations, post-hoc comparisons (Bonferroni corrected) indicated that masculine urban space ratings in the Counter-stereotypical condition (M = 4.08, SE = 0.18) were significantly higher than those in the Control condition (M = 3.22, SE = 0.17), $t(201) = 3.46$, p = .002, d = 0.600. Additionally, in the Stereotypical condition (M = 3.65, SE = 0.17) masculine urban space ratings did not differ significantly from those in the Control condition, $t(201) = 1.79$, p = .223, d = 0.303, nor from those in the Counter-stereotypical condition, $t(201) = 1.72$, p = .261, d = 0.297.

Then we performed two one-way ANOVAs to test the effect of the experimental manipulation conditions on the Norm Adherence and Norms Disregard scales. The analyses did not yield a significant effect for adhering to norms, $F(2, 195) = 0.05$, p = .950, d = 0.063, nor for disregarding norms, $F(2, 195) = 0.25$, p = .770, d = 0.110. This is a case where the manipulation produced a significant effect only on the manipulation check (see Gruijters, 2022).

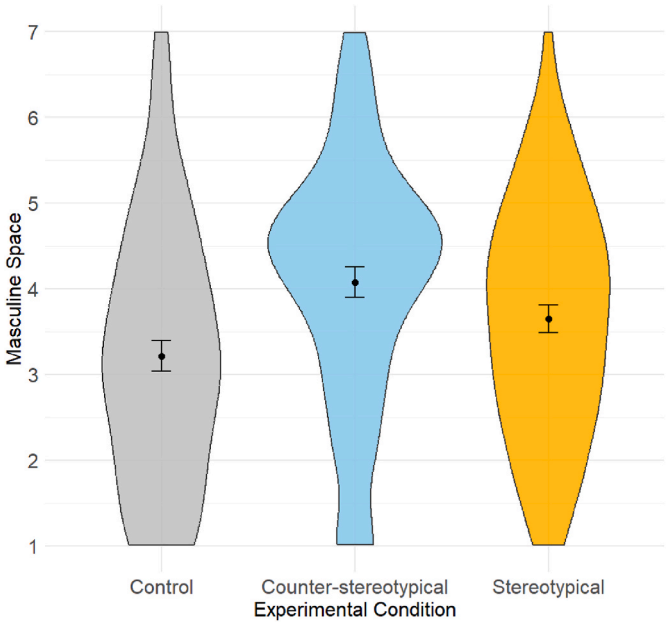

Fig. 4. Distribution and estimated means of perceived masculinity of space across the control, counter-stereotypical, and stereotypical experimental conditions.
Note. Experimental conditions were manipulated through the Scrambled Sentences Task. Higher scores indicate greater perceived masculinity of space. Violin plots show response distributions; points indicate estimated means, and error bars represent 95% confidence intervals.

Before conducting further analyses, we calculated a differential score (Public Gendered EBs) between PEB and AEB ratings to represent the amplification of gendered perceptions of environmental behaviors, with higher scores reflecting a perception of PEBs as more feminine and AEBs as more masculine. Refer to Supplementary Analyses for correlational analyses among Study 3 variables.

We then conducted a sequential mediation analysis to examine the indirect effect of the experimental conditions on the gendered perception of environmental behaviors. The model tested whether this effect was mediated by the endorsement of beliefs about gendered urban spaces and gender-related norms adherence and disregard. The manipulation of the stereotypical beliefs impacted only the intended focal construct - the gendered perception of urban space; thus, we incorporated the manipulation check into the mediation model (see Lench et al., 2014). We used the jAMM module for Jamovi (Gallucci, 2019b; percentile bootstrap 95% confidence intervals, 5000 resamples). In this model (see Fig. 5 and Table 2) the experimental conditions were the independent variable, Masculine Space was the first mediator, Norms Adherence and Norms Disregard were the second and parallel mediators, and Public Gendered EBs was the dependent variable.

Conditional on assuming gender role norms as potential mediators, the indirect effect via Norms Adherence proved to be significant, b = 0.06, SE = 0.03, 95% CI [0.01, 0.14]. In more detail, the counter-stereotypical manipulation condition led people to confirm the belief that urban space is masculine. This belief was positively associated with the beliefs about women adhering to social norms, which, in turn, predicted more extreme stereotypical beliefs about the gender associated with public environmental behaviors. Conversely, the indirect effect via Norms Disregard was not statistically significant, b = 0.01, SE = 0.02, 95% CI [−0.03, 0.05].

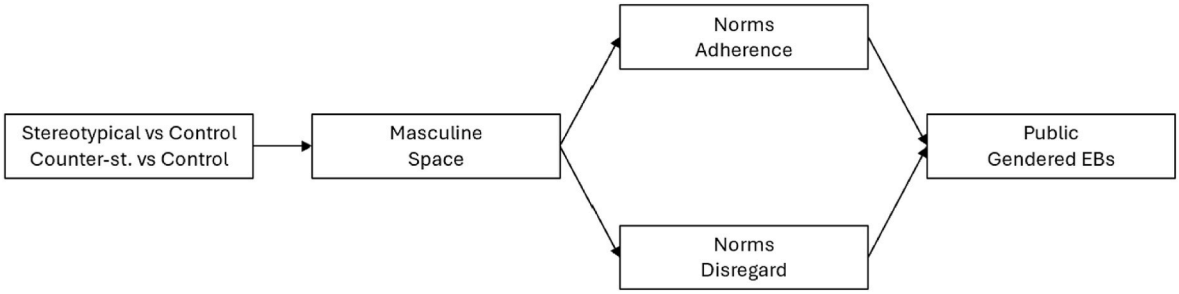

Fig. 5. Conceptual mediation model linking experimental condition, perceived masculinity of space, gender-role norm beliefs, and public gendered environmental behaviors.
Note. Stereotypical = stereotypical condition in the Scrambled Sentences Task; Counter-st. = counter-stereotypical condition. Experimental conditions were dummy-coded by comparing the stereotypical and counter-stereotypical conditions with the control condition. Public gendered environmental behaviors (EBs) refer to the perceived gender typicality of pro-environmental and anti-environmental behaviors performed in public spaces.

Table 2
Path estimates for the mediation model testing the effects of gender-space stereotype manipulation on public gendered environmental behaviors through perceived masculinity of space and gender-role norms beliefs.

Type	Effect	Estimate	SE	95% C.I. (a)		β
				Lower	Upper	
Indirect	Stereotypical ⇒ Norms Adherence ⇒ Public Gendered EBs	−0.031	0.040	−0.114	0.045	−0.017
	Stereotypical ⇒ Norms Disregard ⇒ Public Gendered EBs	−0.004	0.017	−0.039	0.029	−0.002
	Stereotypical ⇒ Masculine Space ⇒ Public Gendered EBs	−0.025	0.029	−0.100	0.025	−0.014
	Counter-st. ⇒ Norms Adherence ⇒ Public Gendered EBs	−0.045	0.044	−0.144	0.029	−0.024
	Counter-st. ⇒ Norms Disregard ⇒ Public Gendered EBs	−0.005	0.020	−0.059	0.030	−0.002
	Counter-st. ⇒ Masculine Space ⇒ Public Gendered EBs	−0.048	0.051	−0.164	0.040	−0.025
	Stereotypical ⇒ Masculine Space ⇒ Norms Adherence ⇒ Public Gendered EBs	0.030	0.021	−0.001	0.082	0.016
	Stereotypical ⇒ Masculine Space ⇒ Norms Disregard ⇒ Public Gendered EBs	0.006	0.012	−0.016	0.034	0.003
	Counter-st. ⇒ Masculine Space ⇒ Norms Adherence ⇒ Public Gendered EBs	0.057	0.032	0.008	0.133	0.030
	Counter-st. ⇒ Masculine Space ⇒ Norms Disregard ⇒ Public Gendered EBs	0.012	0.020	−0.030	0.054	0.006
Component	Stereotypical ⇒ Norms Adherence	−0.124	0.149	−0.430	0.160	−0.063
	Norms Adherence ⇒ Public Gendered EBs	0.251	0.093	0.067	0.438	0.272
	Stereotypical ⇒ Norms Disregard	−0.079	0.169	−0.413	0.247	−0.035
	Norms Disregard ⇒ Public Gendered EBs	0.052	0.085	−0.107	0.218	0.065
	Stereotypical ⇒ Masculine Space	0.431	0.240	−0.018	0.908	0.140
	Masculine Space ⇒ Public Gendered EBs	−0.059	0.055	−0.170	0.052	−0.099
	Counter-st. ⇒ Norms Adherence	−0.182	0.150	−0.456	0.122	−0.089
	Counter-st. ⇒ Norms Disregard	−0.103	0.180	−0.451	0.240	−0.044
	Counter-st. ⇒ Masculine Space	0.806	0.271	0.249	1.342	0.255
	Masculine Space ⇒ Norms Adherence	0.281	0.048	0.186	0.371	0.437
	Masculine Space ⇒ Norms Disregard	0.294	0.056	0.176	0.393	0.398
Direct	Stereotypical ⇒ Public Gendered EBs	0.127	0.155	−0.169	0.428	0.069
	Counter-st. ⇒ Public Gendered EBs	−0.010	0.147	−0.277	0.288	−0.005
Total	Stereotypical ⇒ Public Gendered EBs	0.103	0.161	−0.222	0.406	0.056
	Counter-st. ⇒ Public Gendered EBs	−0.039	0.149	−0.3323	0.241	−0.0211

8.4. Discussion

In Study 3, we manipulated the cognitive accessibility of stereotypical beliefs regarding the gendered perception of urban space. However, contrary to our expectations, emphasizing counter-stereotypical contents that associated women with public urban spaces resulted in participants reporting an even stronger association between masculinity and public spaces, rather than a reduction in this belief. This inverse effect could be comparable to "boomerang" effects of attitude change (Byrne & Hart, 2009) or "backfire" effect of misinformation correction (Swire-Thompson et al., 2020) and could be the result of a reactance phenomenon in response to the explicit rejection of a belief widely held by participants, which ultimately reinforced the stereotype of the masculine urban space. In fact, to ensure an allegedly stronger manipulation, we did not ask participants to engage in an interfering task (such as retaining a 6-digit number in mind, Würtz et al., 2022) which would reduce their awareness of the sentence content they were unscrambling. This made the primed content more explicit for participants, who may have answered the masculine space scale motivated to emphasize their disagreement with the counter-stereotypical content. Alternatively, if participants felt compelled to disregard their prior stereotypical beliefs, another explanation could be a failure in selective attention processes. These processes may have unintentionally focused on the masculine space cognitive representation, making it even more accessible than in the stereotypical condition (see the "white bear" effect, Tsal & Makovski, 2006).

The results of a model hypothesizing the mediation of role norms associated with genders provided supporting evidence for a possible mechanism of the effect of gendered space stereotypes on gendered environmental behaviors, consistently with Hypothesis 3. The mediation analysis suggested that stronger beliefs in masculine urban spaces may be associated with equally strong beliefs that women feel judged in public spaces perceived as more suitable for men. This perception may lead women to self-regulate in masculine environments and appear respectful of social norms. Consequently, these beliefs may reinforce stereotypical views of gender roles in environmental behaviors, resulting in expectations that women should act sustainably, whereas men, being in "their" space, are granted greater freedom to engage in environmentally harmful behaviors.

9. General discussion

Research has repeatedly shown a gender gap in environmental concern, attitudes, and behaviors, as women tend to engage more in sustainable practices (Briscoe et al., 2019; Echavarren, 2023). This research aimed to provide an alternative explanation for these differences by examining the stereotypical association of urban spaces - where environmental behaviors are potentially performed - with masculinity, extending work on space-focused stereotypes (Bonam et al., 2020; Yantis & Bonam, 2021)

Feminist geography has long argued that cities were historically shaped by men, reinforcing gender inequalities (Bondi & Rose, 2003; Spain, 2014; Vera-Gray & Kelly, 2020). Recent findings confirm that stereotyping processes extend to places, with public urban spaces predominantly perceived as masculine (Sacchi et al., 2025). The present studies examined how such perceptions influence gendered expectations and judgments surrounding PEBs and AEBs. The multi-study approach (Studies 1 and 2) provided converging evidence across different operationalizations of gendered space, using both direct and indirect measures, while the experimental design in Study 3 enabled causal inferences by testing the effects of inducing a gendered view of urban space.

Study 1 showed that, whether in domestic or public urban settings, and regardless of the performer's gender, PEBs were consistently judged as feminine and AEBs as masculine. Such findings corroborate evidence on the stigmatization of green behaviors among men (Bloodhart & Swim, 2020; Brough et al., 2016; Swim et al., 2020), underscoring the need to examine how societal norms influence individual behavior in gendered contexts. Importantly, participants who strongly endorsed gendered space stereotypes rated PEBs as even more typically feminine and AEBs as more typically masculine. This pattern suggests that space-related expectations can shape how gender roles are perceived in relation to sustainable behavior.

Study 2 introduced the newly developed Face Gender Recognition Task as an indirect measure of the masculinity-urban space association. The Space Facilitation Index for Men (SFI-M), which captures the ease of recognizing men faces in urban (vs. natural) backgrounds, moderated the gendered evaluations of environmental behaviors, replicating Study 1 patterns, and suggesting that the effect of gender-space association is more pronounced in the public sphere. Notably, this effect was specific to the recognition of men's faces, as the corresponding index for women's faces (SFI-W) did not influence the evaluation of gendered PEBs and AEBs.

Study 3 primed participants with scrambled sentences emphasizing either stereotypical (men-urban) or counter-stereotypical (women-urban) associations (Bargh et al., 1996). The manipulation was effective, but the counter-stereotypical priming produced a backfire effect reinforcing the masculine space stereotype, possibly due to motivational (Byrne & Hart, 2009; Swire-Thompson et al., 2020) or attentional mechanisms (Tsal & Makovski, 2006). A mediation analysis suggested that gender role norms in public contexts, particularly women's expectation of being judged and needing to self-regulate, may explain how masculine space perceptions shape gendered expectations of PEBs and AEBs. These findings are consistent with person-environment fit and social power theories (Galinsky et al., 2006; Guinote, 2007; Schmader & Sedikides, 2018). Men, fitting better in masculine spaces, would experience autonomy and empowerment, and may not prioritize environmental protection or feel constrained by shared social expectations. Women, as a less fitting group, may feel restricted and compelled to protect their social identity (Kaiser et al., 2006), thus conforming more strictly to social rules to avoid negative consequences. From a sociological perspective, these interpretations resonate with Foucault's (1977) analysis of power and panopticism, insofar as the heightened visibility of public settings may produce stronger self-monitoring among women when they are positioned as non-normative occupants of masculine-coded space. They also align with de Beauvoir's (1949/2010) account of women as "the Other" relative to a default masculinity. In this context, gender can be understood as enacted through repeated performative acts that signal norm adherence and manage social evaluation (Butler, 1988). Importantly, our findings should not be interpreted as evidence for inherent differences between women and men in environmentalism. Rather, they are consistent with the view that people ascribe gendered meanings to urban spaces, and that gendered expectations and stereotypes shape how behaviors are evaluated across different normative spaces.

9.1. Limitations and future directions

While this work offers new insights on how gendered spaces reinforce gender-role expectations and differences in environmental behavior, several limitations should be noted. As one of the first quantitative studies on gendered urban spaces, we relied on newly developed instruments without prior validation. The items assessing perceptions of gendered space in Studies 1 and 3 were developed ad hoc; although internal consistency indices were satisfactory, more comprehensive psychometric validation is needed. This is particularly important for the potentially multidimensional facets of masculine space implied by the Study 3 manipulation, which may capture distinct but related components. Likewise, the Face Gender Recognition Task requires further validation, as it did not directly capture associations between masculinity and public space. Still, the distinct effects of the SFI-M (vs. SFI-W) index suggest a promising direction for future refinements.

A second limitation concerns the priming manipulation. The Scrambled Sentences Task produced a backfire effect, inadvertently reinforcing the masculinity-public space stereotype. Stronger procedures, such as repeated negation of stereotypes and affirmation of counter-stereotypes (Gawronski et al., 2008; Kawakami et al., 2000), may be more effective. Moreover, our evidence for causal effects was limited to the manipulation check assessing masculine perceptions of space (Ejelöv & Luke, 2020; Lench et al., 2014). Given that the other links in the mediation model were correlational, alternative mediating variables or causal paths should also be considered (Fiedler et al., 2018). It should also be noted that our outcomes capture evaluative responses rather than observed behavior; thus, we cannot draw direct conclusions about behavioral consequences. Future research should test whether these perceptual patterns translate into enacted behavior using behavioral measures such as experiences sampling methods.

A further limitation is that our quantitative approach cannot capture the richness of individual narratives and lived experiences in gendered urban spaces. Given our aim to provide initial quantitative evidence on socio-environmental psychological outcomes associated with perceiving public space as masculine, our conclusions should be interpreted as identifying general, testable patterns in perceptions and evaluations. Future research could complement these findings with qualitative designs to examine how gendered meanings of space are constructed and negotiated in everyday life and to identify contextual factors that may qualify the observed effects (see as an example of discursive approach, Di Masso & Dixon, 2015).

Another limitation concerns our recruitment strategy, which relied on convenience sampling and included only Italian participants. Although this approach was not intended to achieve population representativeness, it is suitable for an experimental design aimed at testing internal validity and causal effects through random assignment; nonetheless, it may constrain the external validity and generalizability of the findings.

In line with the sample's background, we operationalized urban space (e.g., through the Study 2 stimuli) primarily as publicly accessible city settings such as streets and squares consistent with typical Italian/European urban environments. Because feminist geography has theorized a division between a masculine-coded city center and a feminine-coded suburban sphere, principally in relation to white, affluent Anglo-American contexts (Bondi & Rose, 2003), this points to two

complementary directions for future research. First, studies should more directly differentiate among urban spaces (e.g., U.S. downtown skylines with skyscrapers vs. suburban residential landscapes) and test whether distinct gendered categories and trait attributions emerge across them. Second, it remains uncertain whether the present findings generalize cross-culturally; future work should therefore replicate these effects using culturally grounded stimuli and extend investigation beyond WEIRD samples.

Future research could also extend the current framework by adopting an intersectional perspective (Cho et al., 2013), recognizing that gender may interact with other social categories and structural inequalities (e.g., ethnicity, social class, migration background, age, disability) in shaping experiences of public urban spaces. Accordingly, the meaning of gendered spaces and the perceived legitimacy of behaviors may vary across groups; examining intersectional factors and related space-focused stereotypes (Essien & Rohmann, 2023; Yantis & Bonam, 2021) would help identify boundary conditions of our effects.

10. Conclusion

The present research seeks to provide new insights into the gender gap in environmentalism by examining how gendered perceptions of urban spaces influence the expectations regarding environmentally responsible behavior. Our findings provide a quantitative foundation for addressing the critique of feminist urbanism, which highlights the traditional distinction between men's spaces, predominantly public, and women's spaces, largely relegated to the domestic sphere. This gender-space association may play a significant role in shaping gender roles and sustainable behaviors in public urban environments. Our results suggest that environmental behaviors are more strongly gendered in public spaces, where women, perceiving these areas as masculine, may feel more constrained. This sense of constraint could drive women to adhere more closely to social expectations regarding pro-environmental behavior. In contrast, men may feel less compelled to engage in sustainable actions or even perceive doing so as a threat to their masculine identity. While the gendering of public space may influence how individuals feel constrained or empowered in these environments, future research should also emphasize the importance of promoting PEBs not merely as compliance with prescriptive norms, but as a genuine commitment to environmental care. Incorporating and prioritizing a gender perspective in urban planning is essential to ensure equitable access to urban spaces for both women and men (Beebeejaun, 2017; Day et al., 2003; Huning, 2020), thereby advancing both social and environmental sustainability.

CRediT authorship contribution statement

Giulio Faccenda: Writing – original draft, Methodology, Investigation, Formal analysis, Conceptualization. **Federica Spaccatini:** Writing – review & editing, Supervision. **Daniela Ruzzante:** Writing – review & editing, Supervision. **Chiara Sparascio:** Writing – review & editing, Investigation. **Simona Sacchi:** Writing – review & editing, Supervision, Methodology, Formal analysis, Conceptualization.

Informed consent statement

All studies were conducted in accordance with the Declaration of Helsinki, applicable national and European data protection legislation, and the relevant institutional policies of the University of Milano-Bicocca. The study procedures were reviewed and approved by the internal Ethics Committee of the Department of Psychology, University of Milano-Bicocca, operating under the University Ethics Board.

Participants were recruited through convenience sampling from the Italian adult general population. Recruitment took place by sharing the link to online surveys through social media platforms and informal networks. No vulnerable groups were targeted or included. Potential risks of adverse publicity were considered minimal. The recruitment message presented the study in neutral and non-sensitive terms, avoiding statements that could be misleading or stigmatizing. Any public communication of the findings was presented in aggregate form, without identifying participants or specific individuals.

The study was classified as minimal risk. No significant risks to participants' physical or psychological wellbeing were identified, and the study did not involve deception, invasive procedures, or stimuli expected to induce distress. Similarly, no significant risks to the health or wellbeing of the research team were identified, as data collection was conducted entirely online.

Before taking part in the study, all participants provided digital informed consent and accepted the data-treatment policy. Data was collected through an online survey platform without collecting identifying information. Datasets were stored in password-protected, University-managed cloud storage and were accessible only to members of the research team. Data were not shared with unauthorized third parties.

In line with Open Science practices, datasets containing no direct identifying information were shared through the Open Science Framework repository.

Declaration of generative AI in the writing process

During the preparation of this work the authors used ChatGPT-5 to improve the readability and language of the manuscript. After using this tool, the authors reviewed and edited the content as needed and take full responsibility for the content of the published article.

Funding sources

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

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.

Appendix A. Supplementary data

Supplementary data to this article can be found online also at https://doi.org/10.1016/j.ssaho.2026.103015.

Data availability

Datasets, materials and supplementary analyses are available on the Open Science Framework: https://osf.io/k3nv7.

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