**Article**

# Framework for understanding public pluralities in greenspace design and consultation

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Public participation underpins contemporary governance, facilitating discourse, enhancing decision legitimacy, and improving outcomes. In urban greenspace planning, however, persistent barriers, including cultural disparities and tokenism, impede effective engagement. Traditional assumptions of a homogeneous 'public' and uncritical endorsement of participation's merits overlook group heterogeneity. Acknowledging public plurality is essential for authentic involvement. Within environmental science, scant research addresses public segmentation to devise bespoke, inclusive strategies. This study innovatively integrates Situational Theory of Public and Self-Determination Theory to examine diverse public segments in green space consultation and design. A UK-based survey classified four segments (active, aware, latent, non-public) and linked them to motivational drivers: trust, recognition, cohesion, employing ANOVA and PCA. Results reveal uniform approaches are inadequate. Autonomy-supportive contexts and community bonds outweigh generic incentives. Extrinsic rewards prove secondary to intrinsic factors. This framework offers practitioners a tool to tailor engagement, optimising greenspace outcomes across diverse populations.

Urban green spaces offer ecological, social, and economic benefits such as flood mitigation, physical and mental health improvement of communities and fostering social inclusion[1]. The discourse surrounding urban green spaces is often intertwined with concepts of environmental justice and equitable access[2,3]. In urban contexts marked by social disparities, limited access to local green spaces can perpetuate gaps in economic and social well-being, disproportionately affecting marginalised communities[4]. For instance, in England, the wealthiest 20% of administrative areas own five times the amount of green space relative to the most deprived 10%, highlighting a stark equity gap[5].

Participatory opportunities in urban green space design are perceived to address these equity challenges and are key to good governance[6–8]. A participatory approach enables the effective harnessing of values and opinions of diverse communities and can support the development of contextually-sensitive and culturally-embedded interventions[9]. It also contributes to capacity building of stakeholders and social learning[9,10]. Many local authorities have used participatory approaches such as focus groups and workshops to consult with the communities and gather information that can improve local green spaces[11,12]. Despite widespread advocacy for public participation in urban green space planning, multiple barriers impede genuine involvement. These include tokenism, stigma and cultural differences[13,14]. The concept of 'public participation' has been criticised for prioritising compliance over autonomy, with individuals frequently finding their views dismissed when

they diverge from professional perspectives[14–17]. In addition, increased participation has been perceived as inherently beneficial, but not all individuals participate at the same level[17,18]. Individuals typically determine their participation based on their abilities and interests, rather than conforming to predetermined expectations that disregard individual strengths and concerns[17,19].

Compounding these challenges, in many domains, including urban planning/greening, stakeholders are often referred to as 'the public', 'civics', or 'communities'[20,21]. This traditional concept of a singular public sphere often overlooks the reality that there are many different types of publics, each with distinct needs, interests, and characteristics. Treating the public as a homogenous entity also risks neglecting the diverse and nuanced ways in which people interact with and respond to information[16]. Rather than a monolithic 'general public', it is crucial to recognise the plurality of the 'publics' and their associated characteristics to develop precise and effective engagement strategies[15,16,22,23]. Many studies have recognised and emphasised the importance of segmenting the population into groups to enable more meaningful participation and ensure multiple voices are heard[19,22,24], yet this remains underexplored in green space contexts[9]. Grunig's Situational Theory of Publics (STP) framework, which has been widely used in fields such as public relations, communication studies, political science, and organisational behaviour[22,23], recognises the multifaceted nature of public identities and seeks to explain and predict how different groups of people, or 'publics,' will behave in response to various issues or situations. Despite its

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potential, STP's application to urban planning and green spaces is limited, leaving a gap in systematically analysing behaviours and motivators of diverse publics, here defined as individuals with varying degrees of interaction with green spaces, from frequent users (e.g., those visiting parks 'most days' or 'weekly'), occasional users (e.g., those visiting parks 'monthly'), and non-users (e.g., those selecting 'never' in response to park visitation frequency). These categories were established based on responses to the survey question, "How often do you visit/use urban green spaces?" with options 'most days,' 'weekly,' 'monthly,' 'very occasionally,' and 'never,' aligned with frequency thresholds from Natural England's Monitor of Engagement with the Natural Environment (MENE) survey[25] to ensure consistency with national benchmarks. To the best of our knowledge, no known study has fully explored these intersections, underscoring the need to acknowledge the diversity of publics who perceive and engage with surrounding landscapes in distinct ways[17,26]. Particularly, understanding non-participants whose disengagement often sustains inequitable outcomes and crafting tailored strategies to bridge these gaps remain especially critical challenges. This is particularly salient when considering the environmental justice implications, as the health benefits derived from natural spaces should be equitably distributed across all societal groups. Disengagement, however, may prevent certain populations—often those already marginalised—from accessing these benefits, thereby exacerbating existing inequities. For example, studies in the UK show that Black, Asian, and minority ethnic (BAME) groups and lower-income communities often face barriers such as limited proximity to quality green spaces, cultural disconnect, or safety concerns, which reduce their engagement[27,28]. Furthermore, the root of this disengagement may lie not in a lack of interest, but in procedural shortcomings within the research process itself, such as inaccessible survey methods, limited outreach, or insufficient accommodation of diverse needs. Addressing these procedural barriers is thus essential to ensure that engagement efforts are inclusive and that the distribution of environmental benefits aligns with principles of justice[27–31], aligning with Sustainable Development Goal (SDG) 11 (Sustainable Cities and Communities), target 11.7, for universal green space access, and SDG 10 (Reduced Inequalities), target 10.2., for social inclusion.

Against this backdrop, our study addresses the critical problem of inequitable participation in green space design and consultation, in which structural barriers, unsegmented approaches, and a lack of motivational insight hinder inclusive engagement. We aim to understand the types and distribution of publics involved in green space design and consultation initiatives, from active to disengaged, using STP to explore the enabling factors facilitating their involvement across this spectrum, without presupposing uniform participation levels. For data collection, we conducted a United Kingdom (UK)-focused survey from March to May 2023 to capture a broad range of public opinions and behaviours and analysed these data using STP-based segmentation and statistical techniques to identify participation patterns and motivators. The UK provides an ideal context for this study as it has many community involvement initiatives and concrete frameworks for public participations. Nationwide surveys have previously explored public perceptions and their degree of engagement with nature and environmental issues. Notably, Natural England's Monitor of Engagement with the Natural Environment (MENE) survey[25] and its successor, the Public Attitudes to Nature and Conservation Survey, (PANS)[32] have gathered data from adults (16+) across England using an online panel. These, however, do not have a focus on segmenting the public and identifying factors relevant to increased participation in green spaces, leaving a knowledge gap that this work fills. This research thus makes a novel contribution to the field of public engagement and green space studies in offering analysis of public segments and providing recommendations on strategies to enhance the involvement of each.

## Results
### Descriptive analysis
The survey oversampled by 10% (423 responses compared to the targeted 385 responses) whose demography closely aligned with that of the UK government's data on ethnic groups although there were minor over-and under-sampling across groups (Table 1). The sample was dominated by White British individuals (78.3%) with other ethnic backgrounds also appropriately represented, including Indian (3.1%), Pakistani (2.1%), Chinese (1.9%), Caribbean (1.2%), White & Asian (0.7%), White & Black Caribbean (0.5%) and several other smaller groups.

The gender of the respondents closely mirrored that of the adult UK population: 53.2% identified as female, 46.1% as male, 0.5% as non-binary and 0.2% as another gender, reflecting minor diversity not typically captured in national binary data. The age distribution was slightly skewed toward younger adult and middle-aged groups. Specifically, 9.9% of the participants were in the 18–24 age category when this is 8.0% nationally. This was followed by 30.5% in the 25–39 category, 46.1% in the 40–65 category, 12.8% in the 65–75 age category and a mere 0.7% in the 75+ age category (vs. 11.7% nationally). This indicates an overrepresentation of 25–74 age categories and an underrepresentation of those over 75.

Most participants reported never taking high commitment actions such as writing to management authorities (n = 383, 90.5%), joining a 'friends' group' (n = 330, 78%), answering consultations on green spaces (n = 235, 55.6%), or thinking that their voices/ opinions matter (n = 233, 55.1%) (Fig. 1). Most, though, mentioned talking with people or their friends sometimes about their ideal green spaces (n = 231, 54.6%). Overall, the number of people chose 'never' or 'sometime' for all five actions/ thoughts was substantially higher than those who chose 'often'.

The degrees of actions/thoughts related to green spaces did not vary systematically across respondent and gender, age, income, and ethnic background. Frequency of use, however, was influential (p < 0.001); those using green spaces often were more likely to conduct actions related to green spaces or thought their actions would matter. These participation patterns suggest frequency of use as a key facilitator, explored further in the context of enabling factors below.

### Factors facilitating engagement in public consultations
Prior to looking at the segment-specific patterns, there was some identifiable variation in overall respondent perspectives regarding the enabling factors that would encourage them to voice their opinions on green spaces.

A perceived valued contribution was the most important enabling factor, followed by trust and comfort in people involved and tangible rewards such as gift cards, vouchers, or money (Fig. 2). Knowing other people participating and intangible rewards such as recognition or praise were considered of lesser importance by most people (M = 4.87 and M = 3.46 respectively).

### Public segmentation
Most respondents were categorised to non-public (n = 202, 47.8%), followed by latent public (n = 140, 33.1%). The percentage of aware public was 13%, while that of active public was only 6.1% (Fig. 3).

### Variation in factors of influence among segments
The results, detailing the mean differences from pairwise contrasts of influential factors across public segments along with inferences from post hoc Tukey's HSD tests, are provided in Table 2.

There was no evidence that the public segments varied in their scores for tangible rewards (EF1) (F = 0.58, p = 0.63) suggesting a consistent perception of this factor's importance. Variation was identified among means of EF2 - intangible rewards (F = 12.58, p < 0.001), EF3 – Feeling your opinion matters (F = 13.93, p < 0.001), EF4 – Trust in people involved (F = 14.14, p < 0.001), and EF5 – Knowing people involved (F = 5.20, p = 0.002) among the different segment types, suggesting these enabling factors are perceived differently across groups.

Non-public participants scored intangible rewards (EF2), lower than all other segments: latent public (MD = −0.82, p = 0.037), aware public (MD = −1.81, p < 0.001), and active public (MD = −2.88, p < 0.001). The active public also scored this higher than the latent public (MD = −2.05, p = 0.003).

**Fig. 1 | Degree of actions/thoughts related to green spaces.** Mean values (M) of construct scales are expressed on a three-point Likert scales indicating degree of participation from 1 (never), 2 (sometime), to 3 (often).
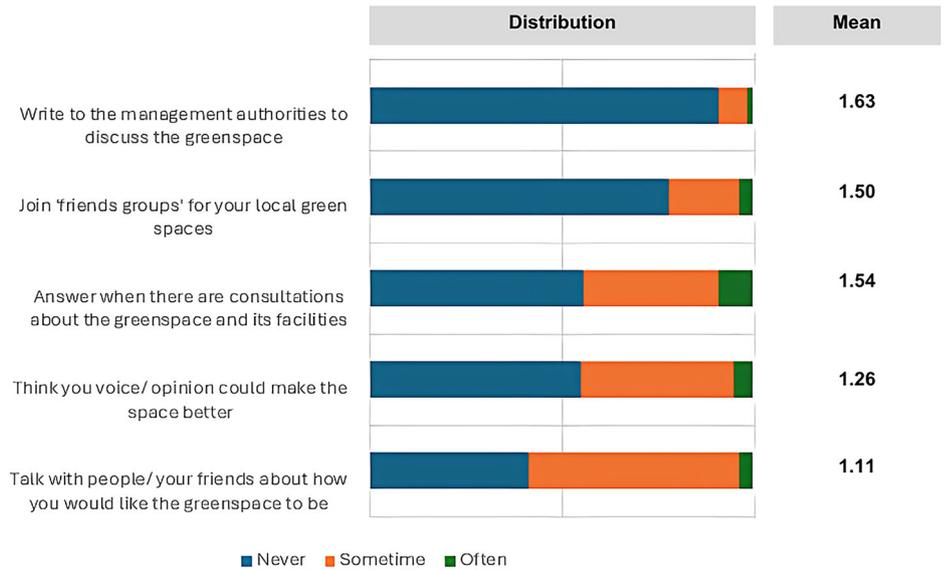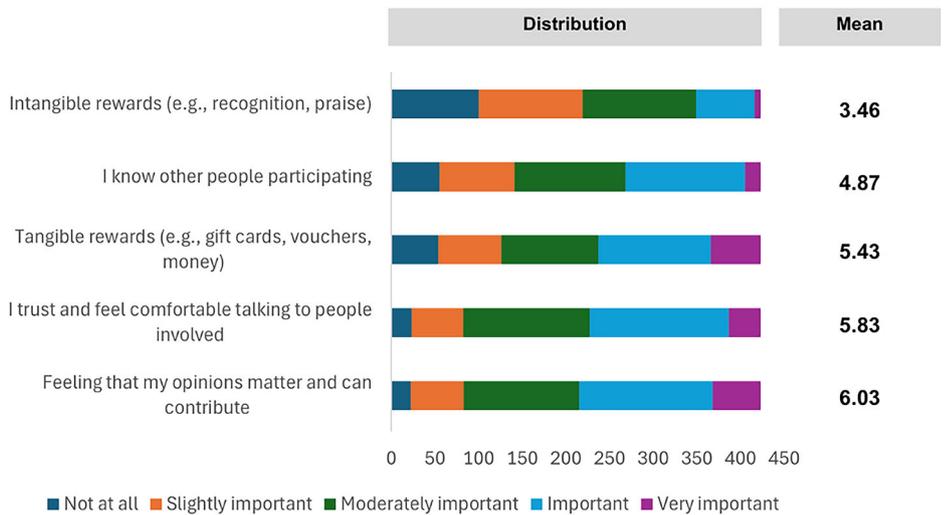


**Fig. 2 | Distribution of factors facilitating engagement.** Mean values (M) of construct scales are expressed on a ten-point ordinal scale indicating degree of participation from 1 (not at all important) to 10 (very important).

Non-public individuals felt their opinions mattered less (EF3) than those in the latent public (MD = −1.42, $p = 0.000$), aware public (MD = −1.99, $p = 0.000$), and active public (MD = −2.22, $p = 0.001$). There was a similar pattern with the trust of the people involved (EF4) as the non-public individuals' scores were lower than those of the latent public (MD = −1.22, $p < 0.000$), aware public (MD = −2.18, $p < 0.000$), and active public (MD = -1.94, $p = 0.002$).

The influence of knowing others involved (EF5) varied between the Active Public who indicated a stronger sense of encouragement from knowing other participants compared to Non-public (MD = −2.11, $p = 0.004$).

### Correlation and principal component analysis (PCA)

Pearson correlation showed negligible link between segment progression and tangible rewards ($r = 0.057$, $p = 0.24$). All other influential factors revealed slight positive correlations ($r = 0.29$, 0.28, 0.29, and 0.19 respectively; $p < 0.001$ in all cases) suggesting that the value (score) placed on these rises with the level of green space participation engagement.

PCA results showed variation in the number of components emerging across the different public segments (Fig. 4), underscoring the distinct ways in which each group perceived and/or engaged with consultation on green
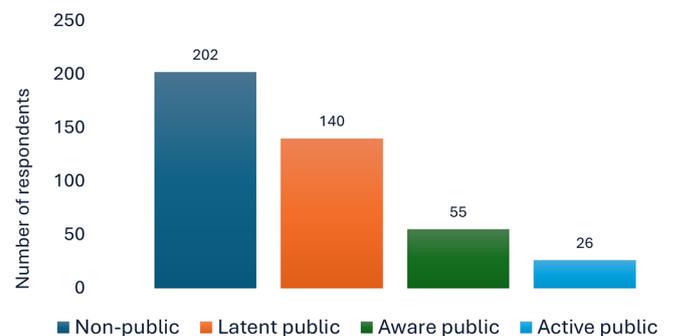


**Fig. 3 | Number of participants divided by type of public segments.** The figure shows the distribution of survey participants according to public segmentation categories derived from their engagement with green space design and consultation.

spaces. For the non-public and active public groups, a single principal component accounted for most of the estimated variance, with all factor loadings being positive. This indicated a strong, cohesive set of attitudes toward the issues. Notably, Perceived Contributions (E3) exhibited a strong

## Table 1 | Demographics characteristics of survey respondents compared to UK population

| Demographic category | Survey proportion (%) | UK population proportion (%)[a] | Difference (%)[b] |
|---|---|---|---|
| **Ethnicity** | | | |
| White: British/English/Welsh/Scottish | 78.3 | 76.1 | +2.2 |
| White: Irish | 1.2 | 1.0 | +0.2 |
| White: Any Other Background | 5.2 | 6.8 | −1.6 |
| Asian/Asian British: Indian | 3.1 | 3.1 | 0.0 |
| Asian/Asian British: Pakistani | 2.1 | 2.2 | −0.1 |
| Asian/Asian British: Bangladeshi | 0.2 | 0.9 | −0.7 |
| Asian/Asian British: Chinese | 1.9 | 0.8 | +1.1 |
| Asian/Asian British: Any Other Background | 0.9 | 1.6 | −0.7 |
| Black/Black British: African | 1.2 | 2.2 | −1.0 |
| Black/Black British: Caribbean | 1.2 | 1.1 | +0.1 |
| Black/Black British: Any Other Background | 0.5 | 0.3 | +0.2 |
| Mixed/Multiple: White & Asian | 0.7 | 0.5 | +0.2 |
| Mixed/Multiple: White & Black Caribbean | 0.5 | 0.6 | −0.1 |
| Mixed/Multiple: Any Other Background | 1.7 | 0.8 | +0.5 |
| Other Ethnic Group: Arab | 0.5 | 0.6 | −0.1 |
| Other Ethnic Group: Any Other Background | 0.9 | 1.6 | −0.1 |
| **Gender** | | | |
| Female | 53.2 | 51.6 | +1.6 |
| Male | 46.1 | 48.4 | −2.3 |
| Non-binary | 0.5 | N/A | N/A |
| Another gender | 0.2 | N/A | N/A |
| **Age group** | | | |
| 18–24 | 9.9 | 10.5 | −0.6 |
| 25–39 | 30.5 | 25 | +5.5 |
| 40–64 | 46.1 | 40.3 | +5.8 |
| 65–74 | 12.8 | 6.4 | +6.4 |
| 75+ | 0.7 | 11.7 | −11 |

[a]UK population proportions (%) were calculated based on Office of National Statistics' 2021 Census (England and Wales adjusted for UK) and mid-2023 estimates[58,59,67], %s are those of the adult population, excluding under 18 s, as they fall outside the scope of this study.
[b]Difference (%) = Survey % – UK Population %. Positive values indicate oversampling; negative values indicate undersampling.

loading in the first component for the non-public group but was the least loaded in the active public group.

Unlike the active and non-public groups' one-dimensional PCA results, the latent and aware public groups, which were in the intermediate stages of engagement, revealed a more complex, multidimensional picture with a greater number of emergent components explaining their views and attitudes. While the first component in both groups displayed positive loadings across all enabling factors, negative loadings were observed in the second and third components, suggesting the presence of potential conflicts or trade-offs perceived by these segments.

## Discussion

The distribution of public segments in green space design and consultation initiatives highlights significant variation in perceptions and engagement levels, reinforcing the concept of public heterogeneity. Both ends of the engagement spectrum, whether disengaged or fully committed, tend to exhibit single-axis dominance in their views, while the latent and aware segments show greater complexity, reflecting transitional stages of engagement where individuals reconcile competing concerns or values. As people move from no engagement to limited engagement and then to active participation, their cognitive frameworks evolve from one-dimensional to multidimensional, and often back to more streamlined or unified structures. We advocate for the lens that reframes public engagement as dynamic and adaptive; participation is not a linear progression but a cyclical process of expansion and refinement, driven by iterative interactions with green space issues. This underscores the need for tailored approaches in consultation and policymaking to enhance participation and inclusivity.

Nearly half (48%) of participants in the non-public segment indicate a broad lack of awareness or interest, representing a significant opportunity for targeted campaigns and information dissemination to increase their involvement. The term 'Non-public' may be counterintuitive, particularly when the context is not explicitly defined. This large group of people are part of the public and we advocate using more intuitive or appropriate terms such as 'disengaged public' or 'disinterested public' for clarity, recognising their latent potential. For the latent and aware publics, addressing the underlying conflicts or trade-offs in their multidimensional perspectives could strengthen their involvement. The latent public (33%) has potential for greater engagement if mobilised effectively through demonstrating tangible benefits, providing clear involvement pathways, and reducing participation barriers. The aware public (13%) is knowledgeable but not fully participatory; empowering them with information, decision-making opportunities, and recognition can enhance their advocacy. The active public, though the smallest (6%), is the most engaged and invested; supporting this group with resources and leadership opportunities can sustain their participation and amplify their impact.

We identify both commonalities and observable disparities in the enabling factors of green space engagement across different public segments. While tangible rewards, such as gift cards and money, do not seem to

**Table 2 | Mean differences arising from pairwise contrasts of the scores given for the influential factors among public segments and the inference from the *post hoc* Tukey's HSD tests**

| Public segment | | | Mean difference (I–J)[a] | Std. error | Sig. | 95% confidence interval | |
|---|---|---|---|---|---|---|---|
| | | | | | | Lower bound | Upper bound |
| EF2 – Intangible rewards | Non- | Latent | −0.82 | 0.31 | 0.04 | −1.61 | −0.03 |
| | | Aware | −1.81 | 0.42 | <0.01 | −2.89 | −0.71 |
| | | Active | −2.88 | 0.58 | <0.01 | −4.37 | −1.38 |
| | Latent | Aware | −0.98 | 0.44 | 0.12 | −2.12 | 0.16 |
| | | Active | −2.05 | 0.59 | <0.01 | −3.58 | −0.52 |
| | Aware | Active | −1.07 | 0.66 | 0.37 | −2.78 | 0.63 |
| EF3 – Feeling that my opinions matter and can contribute | Non- | Latent | −1.42 | 0.30 | <0.01 | −2.19 | −0.64 |
| | | Aware | −2.00 | 0.42 | <0.01 | −3.07 | −0.92 |
| | | Active | −2.22 | 0.57 | <0.01 | −3.68 | −0.75 |
| | Latent | Aware | −0.58 | 0.44 | 0.54 | −1.7 | 0.54 |
| | | Active | −0.80 | 0.58 | 0.52 | −2.3 | 0.71 |
| | Aware | Active | −0.22 | 0.65 | 0.99 | −1.9 | 1.46 |
| EF4 – Trust and comfort in engaging with participants | Non- | Latent | −1.29 | 0.29 | <0.01 | −1.96 | −0.47 |
| | | Aware | −2.18 | 0.40 | <0.01 | −3.2 | −1.15 |
| | | Active | −1.94 | 0.55 | <0.01 | −3.35 | −0.53 |
| | Latent | Aware | −0.96 | 0.42 | 0.10 | −2.03 | 0.12 |
| | | Active | −0.72 | 0.56 | 0.57 | −2.16 | 0.73 |
| | Aware | Active | 0.24 | 0.62 | 0.98 | −1.37 | 1.85 |
| EF5 – Participant acquaintances | Non- | Latent | −0.64 | 0.33 | 0.21 | −1.49 | 0.21 |
| | | Aware | −1.09 | 0.46 | 0.08 | −2.26 | 0.09 |
| | | Active | −2.11 | 0.62 | <0.01 | −3.72 | −0.5 |
| | Latent | Aware | −0.44 | 0.48 | 0.79 | −1.67 | 0.79 |
| | | Active | −1.47 | 0.64 | 0.10 | −3.12 | 0.18 |
| | Aware | Active | −1.03 | 0.71 | 0.47 | −2.87 | 0.81 |

Green boxes indicate where there is some evidence the means are not the same at the 0.05 level.
[a]The sign indicates which segment had scored higher in this question.

play a substantive role in motivating engagement, intangible factors such as a person's perceived contribution, their trust and comfort with others involved, and the social connections inherent within small, passionate population sub-sets emerge as more influential. Our analysis reveals that these factors form a motivational hierarchy, with perceived contribution as a foundational driver that unlocks the potency of trust and social ties, a pattern overlooked in prior green space studies. Variations in how different groups perceive these enabling factors suggest that certain elements, particularly perceived contribution, resonate universally, while others, such as trust in individuals and intangible rewards, may vary in importance between segments. These insights illustrate the need for segment-specific tailoring of communication and engagement strategies to ensure these resonate with the characteristics of each segment.

Perceived contribution consistently emerged as the most influential factor across segments, with individuals being intrinsically motivated when they view their involvement as personally meaningful and impactful. This is especially important for less-engaged segments but remains relevant for more engaged aware and active publics. The belief that one's opinion can contribute is tied to cognitive efficacy, or the confidence in one's ability to think critically, analyse situations, and generate meaningful ideas[33]. Those who feel undervalued or disenfranchised often experience self-doubt and a lack of control, leading to disengagement. In contrast, individuals with higher levels of perceived contribution are more likely to participate, believing they can effect change.

We propose that perceived contribution acts as a critical motivator, supported by our PCA results, where it showed strong positive loadings (0.82 for non-public, 0.75 for latent public) across all segments, suggesting its universal relevance (Fig. 4). However, while perceived contribution strongly correlates with engagement ($r = 0.29$, $p < 0.001$), the exponential acceleration of participation requires further longitudinal studies to confirm, as our cross-sectional data limit causal inferences. Enhancing perceived contribution requires strategies that build confidence in one's ability to influence outcomes and recognise their capabilities. Participants engage when they perceive their contributions as aligned with broader civic and cultural values and when they have a personal stake in the outcomes[34,35]. The sense of contribution and agency is strengthened when participants can autonomously apply their skills, receive direct feedback, and achieve tangible outcomes, boosting intrinsic motivation and encouraging proactive behaviours.

Here, trust and comfort in engaging with other participants emerged as an enabling factor for engagement across different public segments, particularly for the central latent and aware segments. In other studies, responsive trust is fundamental for democratic participation[36] as it facilitates collective action, lends credibility to any initiatives and policies, and legitimises institutions across public and private sectors and civil society. A trust deficit, often marked by scepticism and lack of confidence in people involved, can hinder effective participation. This distrust might stem from power dynamics, perceived or actual failures of the facilitators/ organisers[37,38] in acting transparently and in the public's best interests, compounded by an environment that does not respect or appreciate engagement.

We propose that trust acts as a relational catalyst, amplifying the effect of perceived contribution, a synergy not fully explored in environmental contexts. Improving trust requires deliberate and sustained efforts. An inclusive, respectful, and transparent decision-making process that
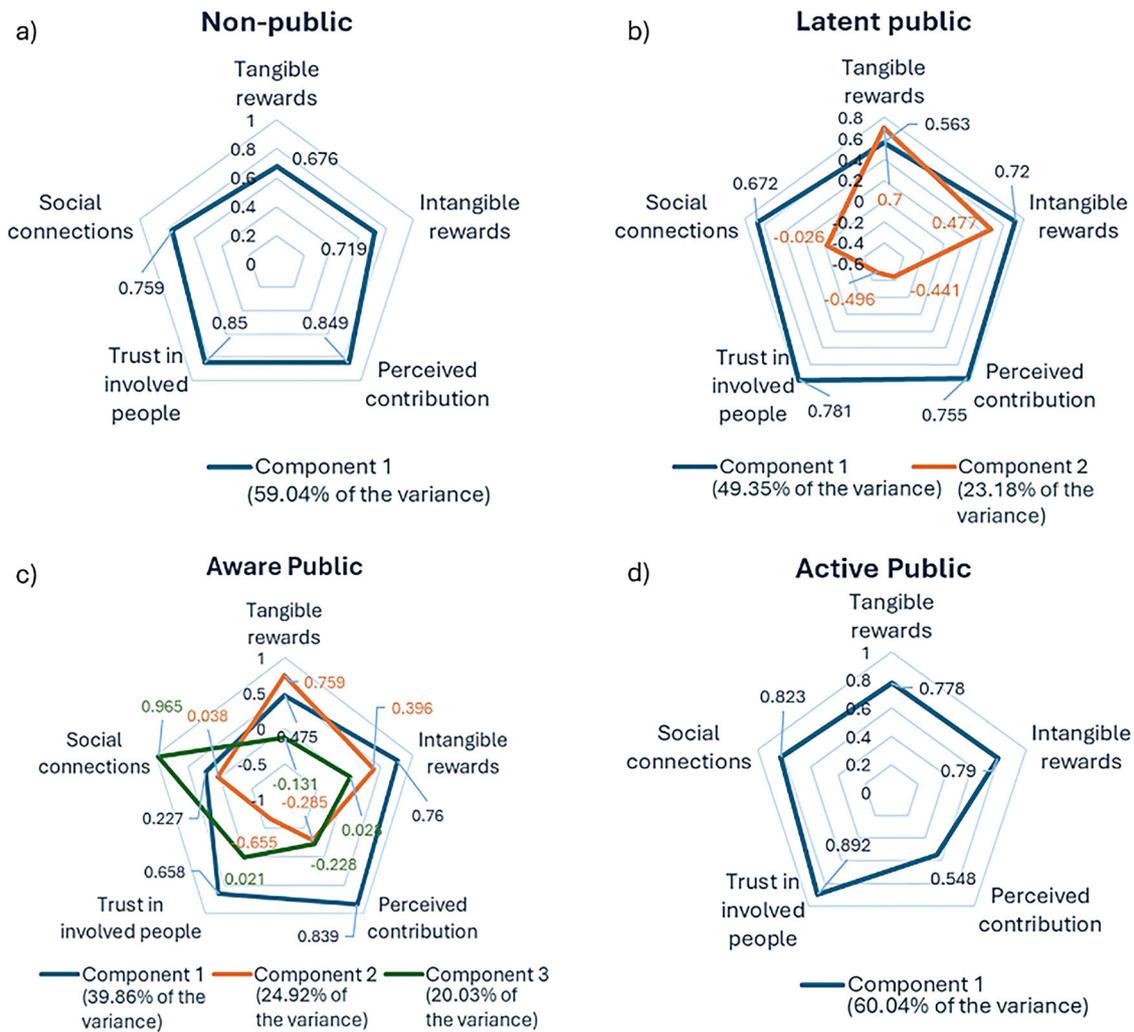
**Fig. 4 | Principal component analysis loadings of the motivational factors associated with the different emergent public segments. a** Non-public, **b** Latent public, **c** Aware public, and **d** Active public. The radar charts illustrate the factor loadings of key motivational variables, including tangible rewards, intangible rewards, perceived contribution, trust in involved people, and social connections. Different colours represent distinct principal components, with variance percentages indicated in the legend.

cultivates relationships among stakeholders is crucial. With trust often being tied to competence, professional identity, and respect[39], it is important to provide stakeholders with opportunities to interact and collaborate to foster mutual respect and understanding and to develop feeling of comfortable and confident in engaging with each other.

For many, their reluctance to join green space initiatives might also stem from their own perception of their competency. When perceived as competent and acknowledged through intangible rewards such as praise and recognition, people are more likely to engage actively. Such intangible rewards, however, were generally less influential relative to the other enabling factors, particularly for the less-engaged groups. Non-public, disinterested groups have no awareness or connection to the issue, while latent groups, despite being aware, do not see it as relevant to their personal lives (Grunig, 1989). Without a strong connection or perceived personal benefit, these groups are unlikely to find intangible rewards motivating. We highlight that recognition and praise are more effective when the recipient already values the activity and understands its significance, suggesting a staged motivational sequence. According to the SDT framework, intrinsic motivation, which intangible rewards aim to enhance, is more potent among individuals already interested or engaged in an activity (aware and active public segments).

Participant acquaintances play a crucial role in fostering engagement and trust across public groups. People are more inclined to participate in civic activities when they perceive a sense of familiarity or connection with other participants[40]. Social connections often serve as the primary means of recruitment for green space design and consultation initiatives, both formally and informally, with individuals joining through personal connections or as official representatives. The presence of affective ties, or emotional connections, within these networks strengthens commitment to participation by providing emotional support, a sense of belonging, shared purpose, and identity, especially within the non-public segment[17]. These connections also mitigate power dynamics and expertise concerns, as participants feel less intimidated among familiar faces with shared goals and values. Established participants rely on networks to sustain involvement and collective action, with social ties fostering trust, motivation, and a collaborative environment conducive to achieving shared goals.

Improving public engagement in green space initiatives requires addressing various barriers linked to bureaucratic constraints, a lack of systematic approaches, inadequate public administration systems, and personal and interpersonal factors that limit equitable involvement. For instance, our survey identified that 55.6% of respondents never participated in green space consultations, with non-public segments citing barriers such as lack of awareness (47.8%) and distrust in organizers (M = 3.12), highlighting procedural shortcomings. The public's lack of knowledge about participation, complex planning issues, and technical reports further affect their ability to comprehend the decision-making process, thereby
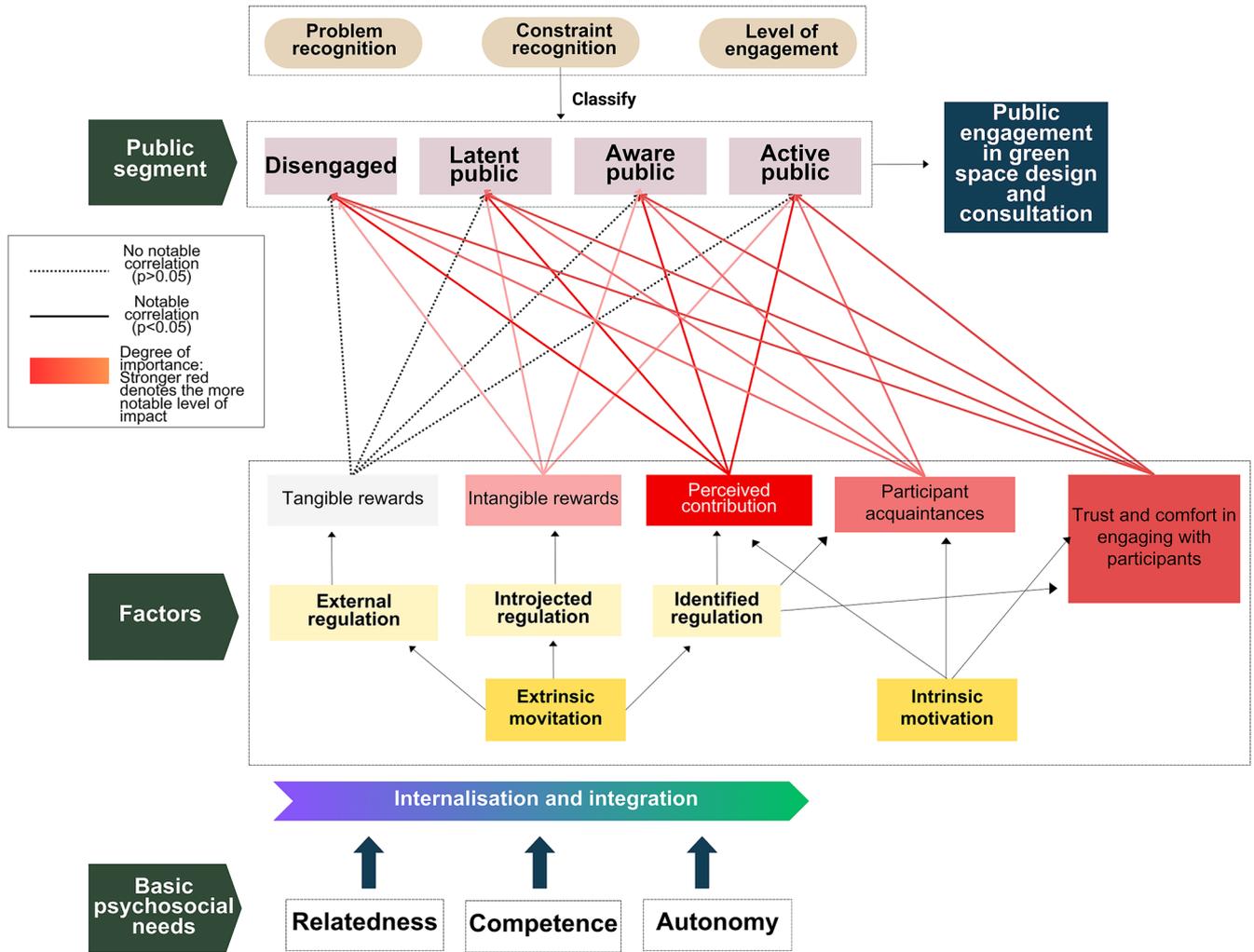
**Fig. 5 | Framework of motivations influencing public engagement in green space design and consultation.** The original term 'Non-public' has been renamed as 'Disengaged' to be more intuitive. Public segments (Disengaged, Latent Public, Aware Public, and Active Public) are classified based on problem recognition, constraint recognition, and level of engagement. Arrows indicate the influence of different motivational factors, categorised as extrinsic and intrinsic motivation, on public participation. The degree of importance is represented by colour intensity, with stronger red denoting a higher impact. Dashed lines indicate non-notable correlations ($p > 0.05$), while solid lines indicate statistically significant correlations ($p < 0.05$). The framework is grounded in the Self-Determination Theory, highlighting the role of basic psychosocial needs: relatedness, competence, and autonomy.

diminishing their participation efficacy[41]. Issues of community capacity, institutional capacity, organisational cultures, and regulatory frameworks also present barriers to achieving community empowerment essential for inclusive urban spaces. Trustworthiness, influenced by social bonds and interrelationships, plays a crucial role in initiative acceptability and legitimacy. Studies have shown that the public's intention to participate in environmental activities is influenced by attitudes, subjective norms, and perceived behavioural control. According to the Theory of Planned Behaviour, these factors influence an individual's intention to engage in specific behaviours[42]. Our findings propose that attitudes, norms, and control evolve cyclically across publics; fostering positive attitudes towards green spaces (e.g., valuing parks), promoting supportive social norms (e.g., communal green spaces), and enhancing perceived behavioural control through accessible participation pathways (e.g., clear consultation invites) can effectively increase engagement among various public segments. But notably, these factors are influenced by a complex interplay of social, cultural, and psychological dimensions, affecting how community members perceive their roles and responsibilities in environmental decision-making processes[17].

The survey analysis enabled a revision of our analytical framework (Fig. 7 in the Methods section) to better reflect the strength of influence and

specific factors influencing public engagement in green space design and consultation. The updated framework (Fig. 5) now elucidates the interplay of each factor (e.g., trust, contribution) and its direct impact on participation of each segment, thus theoretically advancing participation models. These factors should be recognised as interrelated and transactional, and their influence can vary across public segments, from daily visitors to those who 'never' engage, especially when considered in combination. This variation underscores the need for tailored approaches that can effectively address the specific factors affecting participation of different participants. We highlight here the need for a paradigm shift from uniform policies to adaptive, practical, and evidence-based strategies that respect and support public autonomy and resonate with diverse community needs and preferences in urban greening efforts worldwide. Most importantly, we develop a practical approach integrating STP and SDT to reveal the motivations affecting public engagement in green space design and consultation (Fig. 5). Future studies and practical applications could use these to explore the relevant publics and develop tailored engagement approaches not only in urban greening but also in other fields. Beyond the UK, our framework's emphasis on universal drivers such as perceived contribution, trust, and social connections, coupled with segment-specific adaptations, suggests broad applicability to diverse global contexts, such as urbanising regions in Asia or

community-led initiatives in North America, where green space engagement faces similar motivational and structural challenges, contributing to sustainable cities and reduced inequalities (SDGs 11, 10). To test its global relevance, future studies could apply our framework in varied socio-cultural settings, adjusting for local governance and community dynamics. In addition, given the complexity of factors facilitating engagement in green space initiatives and the range of emergent publics, qualitative research would serve to complement this quantitative study and provide greater richness of understanding of what constitutes public segments and the contextual factors that might influence the relationship between enabling factors and segment types. This could enrich our framework by testing its predictive validity across diverse contexts.

## Methods

Public participation is a broad concept with no unified definition. Adler and Goggin (2005) identified four definitions, including community service, collective action, political involvement, and social change. Ashley and Roe portray public participation as a spectrum, ranging from passive involvement to active engagement and full local participation, where the community takes an active role and ownership in initiatives[43]. Our research acknowledges the evolving definition of public participation and defines it as a deliberative process in which diverse stakeholders such as citizens, governmental actors, and social organisations engage in consultation.

Arnstein's "Ladder of Citizen Participation" (1969) is a seminal eight-rung framework that illustrates different levels of citizen participation in the decision-making processes and associates these with the spectra of authority and power[44]. The eight rungs are categorised into three main groups: nonparticipation, tokenism, and citizen power and as citizens move up the levels of participation, they gain greater power to influence government decisions and outcomes. Whilst the framework has been used extensively to investigate power within decision-making contexts, some research has suggested that the ladder oversimplified the intricate dynamics of participation by categorising participation into a linear hierarchy and failing to capture the nuanced and multidimensional nature of diverse citizen involvement. The ladder has been said to assume a one-size-fits-all approach to participation that might not be pertinent in different contextual settings and for different types of publics[19,24]. This critique inspires our theoretical aim: to refine participation models by segmenting publics and uncovering their motivational drivers.

Understanding who constitutes a 'public' and 'public segments' is crucial to build relationships and increase participation. Generally, 'public' is understood as a social concept that requires social spaces in which dialogues might be facilitated[45]. Dewy defined a public as a group of people who perceive themselves as having a common interest concerning an organisation and who strive to act through suitable structures for oversight and regulation. This organisation-centric definition has provided a foundation for further taxonomic approaches that differentiate among publics[46]. A common method to identify different types of publics is to use the 1968 STP framework proposed by Grunig[22,23]. It categorises publics into four segments, including active, aware, latent, and non-publics. Non-publics are individuals or groups who are not aware or affected by a specific issue. They do not perceive themselves as stakeholders and do not engage in discussions or actions related to the issue. Latent publics are those aware of an issue but not acting or engaging actively or publicly to solve it. Aware publics are people with heightened recognition of the issue. They might participate in activities related to the issue, albeit not consistently or extensively. Active publics are those actively taking action to address the problem and engaging in the issue. According to STP, three variables – level of involvement, problem recognition, and constraint recognition – play a crucial role in understanding the varying degrees of public engagement and influence different public segments exert in relation to an issue or organisation. We apply STP to green spaces, an underexplored domain[17,26], extending its predictive power beyond communication studies.

The STP framework, however, has limitations; it primarily focuses on external triggers, problem recognition, level of involvement, and constraint

recognition, as determinants of public formation and behaviour. While these variables are critical in understanding when and how publics arise, the theory does not sufficiently address the internal processes or the antecedent variables such as culture and perceived shared experience that enable publics to respond differentially to similar situations[47,48]. This limitation suggests a gap in understanding the motivational drivers behind public engagement and the nuanced factors that influence public behaviour beyond mere situational responses. In addition, by treating publics as entities that exist and act only in reaction to organisations, the framework overlooks the proactive aspects of public engagement and the internal dialogues that contribute to collective recognition and action. This perspective limits the theory's ability to explain how publics generate their own understandings and motivations independent of organisational stimuli[49]. To address these limitations, it is essential to integrate an analysis of enabling factors into the study of publics. These enabling factors might encompass trust, perceived contributions, access to rewards or any other resources. Understanding these would also provide practical insights on how to foster more effective and inclusive public participation. This is why Jeong-Nam Kim built-on the STP framework and developed the Situational Theory of Problem Solving (STOPS) to explore the motivations and communicative actions of the publics when they face problematic situations[50].

This research followed closely the STP framework to define the different public segments (non-public, latent public, aware public, and active public) based on the three variables: problem recognition, level of involvement, and constraint recognition. Problem recognition refers to the extent to which individuals become aware that a situation or issue exists and perceive it as problematic. Level of involvement measures the degree of relevance or significance the issue holds for them, while constraint recognition reflects how capable or empowered people feel to address the problem. How each group is categorised based on the three mentioned variables is visualised in Fig. 6. Overall, the STP theory is useful in understanding how different publics form and react to situations.

To determine the enabling factors that facilitate further participation from different public segments, we referred to the self-determination theory (SDT) by Edward Deci and Richard Ryan, a widely adopted framework in psychology explaining the motivation behind human behaviours instead of the STOPS framework by Jeong-Nam Kim. STOPS is more narrowly focused on explaining communicative actions and with only one inclusion of 'situational motivation'[50], may not offer the same depth in understanding a wide range of human motivations as SDT. This framework posits that individual motivations are innately driven by three fundamental psychological needs: autonomy, competence, and relatedness. Autonomy refers to the desire to feel in control of one's actions and decisions, and to act in accordance with one's values and interests. Competence involves the need to experience effectiveness and mastery in interactions with the environment, while relatedness pertains to the need for meaningful connections with others and to feel cared for and connected in social contexts[51].

Central to SDT is the differentiation between various types of motivation along a continuum from amotivation, extrinsic, to intrinsic. Amotivation refers to a lack of motivation or intention to act. This aligns with STP's non-public concept that refers to those lacking interest or awareness in a particular issue or initiative. Since this research concerns with the enabling factors for participation, we will not include amotivation in the analytical framework. Within extrinsic motivation, SDT further distinguishes between identified regulation, where behaviours are driven by personal goals and values, and introjected and external regulations, which involve more controlled forms of motivation driven by internal pressures or external contingencies. Intrinsic motivation arises when individuals engage in activities purely for the inherent enjoyment, interest, or satisfaction they provide. In contrast, extrinsic motivation stems from external factors such as rewards, recognition, or pressure to avoid negative outcomes[52]. Description of different types of motivation and associated factors within the Self-Determination Theory is shown in Table 3.

We have developed a novel analytical framework based on the concepts of the two frameworks to direct this research and to provide an overview of
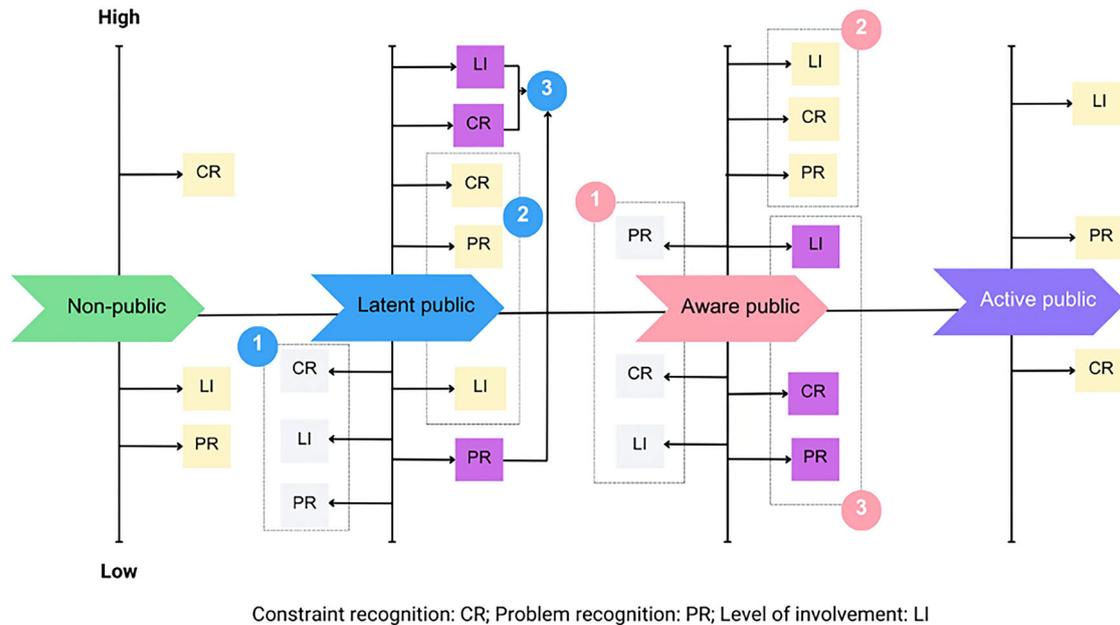
**Fig. 6 | Categorisation of different public segments based on constraint recognition (CR), problem recognition (PR), and level of involvement (LI) according to the Self-Determination Theory (STP) framework.** Different colours represent the different groupings.

**Table 3 | Description of different types of motivation and associated factors within the Self-Determination Theory**

| Type of motivation | Enabling factor (EF) | Description |
|---|---|---|
| Extrinsic motivation | External regulation | The least autonomous form of extrinsic motivation and is driven solely by external demands, rewards, or punishments. |
| | Introjected regulation | Motivation driven by internal pressures, such as avoiding guilt or seeking approval. The behaviour is not fully self-endorsed. |
| | Identified regulation | When individuals recognise and accept the underlying value of a behaviour, leading them to internalise it and see it as personally important. |
| | Integrated regulation | The most autonomous form of extrinsic motivation, where behaviours are fully assimilated with oneself and values, though initially driven by external factors. |
| Intrinsic motivation | Intrinsic regulation | Engaging in activities for their inherent satisfaction and enjoyment, rather than for some separable consequence or external reward. |

public engagement in green space decision-making (Fig. 7). This framework creates a dynamic model that bridges behavioural prediction with psychological drivers, addressing both STP's gaps while refining participation paradigms.

As demonstrated in the framework, STP categorises individuals into different types of awareness based on their problem recognition, constraint recognition, and level of engagement. To understand the motivational factors (both extrinsic and intrinsic) that influence their engagement levels and how they influence each public segment, we incorporated the SDT framework to provide a foundation on the psychological needs and individuals' motivations.

We conducted a UK-focused survey to explore the public's perspectives on community engagement in green spaces and the factors that would encourage them to participate in green space design and consultation initiatives. The survey was designed based on the following:
- Analytical framework, grounded in the STP and SDT concepts
- Gaps in relevant and existing literature
- Gaps in national surveys, including the Monitor of Engagement with the Natural Environment (MENE) and the People and Nature Survey for England by Natural England (PANS) which do not investigate public differentiation and segmentation as mentioned in the Introduction section
- Discussions with experts (*n* = 5 academics, 9 laypeople)

We included in our survey items that measured participants' degree of actions or thoughts related to green space initiatives (e.g., consultation responses) and the factors that could facilitate their engagement further (e.g., trust). The survey included 25 closed-ended questions (multiple-choice, Likert-scale, and 0–10 slider scales) and two open-ended questions on preferences and barriers to giving opinions. The key questions asked in the survey that provided crucial information for this research, and how types of motivation and associated factors (intrinsic motivation and extrinsic motivation such as external regulation, introjected regulation, and identified regulation), according to SDT, are explored within the scope of the study are shown in Table 4.

Prior to the launch of the survey, we pilot-tested it to validate the contents with five academic and nine lay people. The refined survey targeted UK residents over 18 years old to scope and understand their general perceptions of community engagement in green spaces and factors affecting participation in design and consultation initiatives. To determine the sample size, we employed Cochran (1977)'s sample size formula for estimating proportions, a widely accepted method in survey-based research for determining adequate sample sizes when the population is large or effectively infinite, such as the UK population[53–57]. The formula is as follows:

$$n = \frac{Z^2 \cdot p \cdot (1 - p)}{e^2} \tag{1}$$

Where:
- $n$ = sample size,
- $Z$ = Z-score corresponding to the confidence level (set at 1.96 for a 95% confidence level)
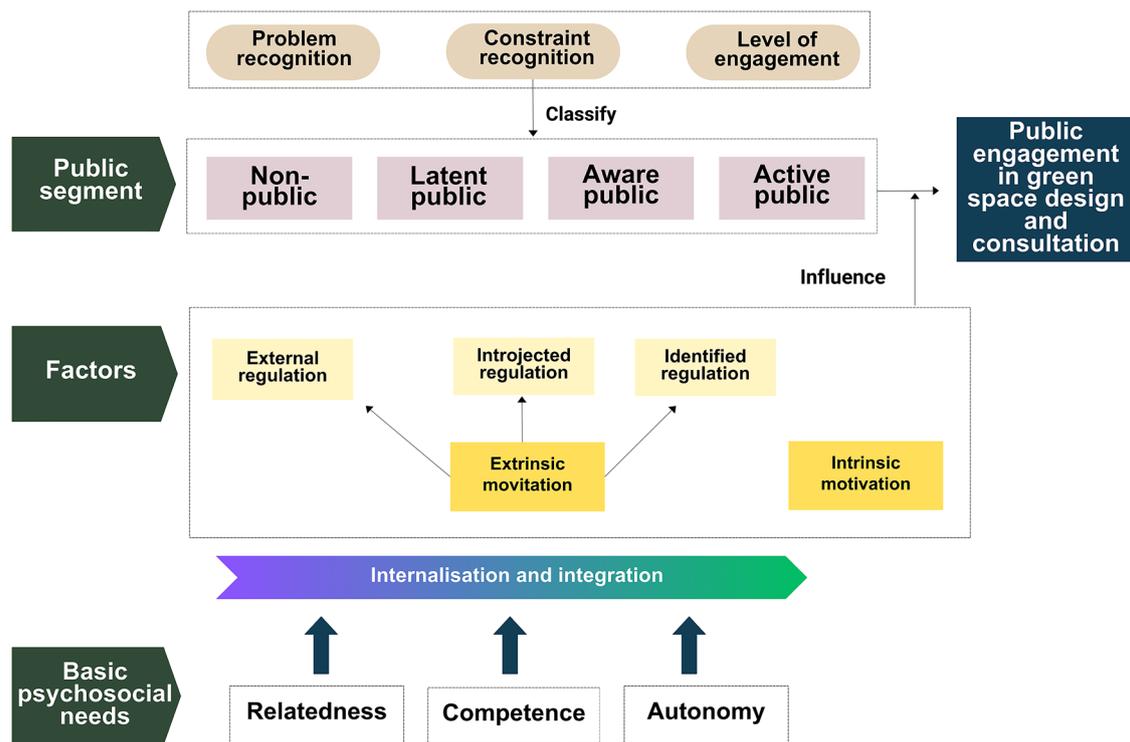
**Fig. 7 | The analytical framework used based on the situational theory of publics and the self-determination theory frameworks.** The framework categorizes public segments (Non-public, Latent Public, Aware Public, and Active Public) based on problem recognition, constraint recognition, and level of engagement. Motivational factors are classified into extrinsic motivation (comprising external regulation and introjected regulation) and intrinsic motivation (including identified regulation). The process of internalization and integration bridges external motivations with intrinsic motivations, influenced by the fulfillment of basic psychosocial needs: Relatedness, Competence, and Autonomy. The model illustrates how different motivational processes shape public engagement in green space design and consultation.

- $e$ = margin of error (set at 0.05, or 5%, to balance precision and feasibility)
- $p$ = estimated proportion of the population exhibiting the characteristic of interest (set at 0.5 to maximise variability, as prior UK-specific data on green space engagement were limited)

Using these parameters, we calculated a minimum sample size of 385, which ensures statistical reliability at a 95% confidence level with a ± 5% margin of error. We acknowledge that 385 is a small fraction of the UK population of ~68.3 million[58]; however, this size aligns with standard survey research practices for detecting statistically significant trends in large populations without requiring infeasible resources[57]. Cochran's formula assumes an infinite population, making finite population corrections unnecessary here, as the sample is well below 5% of the total. In addition, this sample provides adequate power to detect moderate effect sizes in descriptive and inferential analyses (e.g., ANOVA, Pearson correlation).

The choice of 385 reflects a balance between the advantages and drawbacks of small versus large sample sizes. A smaller sample offers cost-effectiveness, manageability within our data collection period (March to May 2023), and reduced risk of respondent fatigue, which can degrade data quality in larger surveys[59]. It suits this exploratory study's focus on broad public segmentation (non-publics, latent, aware, and active publics) and identifying enabling factors, delivering statistically significant findings with moderate precision. Nonetheless, drawbacks include limited precision for detecting small effect sizes or nuanced subgroup differences (e.g., urban vs. rural residents)[60]. Larger samples enhance power and subgroup analysis capability but escalate costs, time, and risks of non-response bias if recruitment falters[33,59]. Given our emphasis on establishing a baseline for UK green space engagement, where prior specific benchmarks are scarce, and resource constraints, 385 strikes an effective compromise.

To maximise representativeness, we used Prolific's representative sampling tool, which stratifies samples by age, sex, and ethnicity to match closely UK Office for National Statistics (ONS)'s 2021 census data. The sampling strategy ensured proportional representation of ethnic groups (e.g., White British: 78.3% vs. 80.5% nationally), with slight oversampling of younger adults (18–24: 9.9% vs. 8.0%) and undersampling of those over 75 (0.7% vs. 11.7%), as detailed in the Results section. The survey was published from March to May 2023, with data collected and managed using Qualtrics. This sampling approach and size provide a foundation for generalising findings to the broader UK context, though we note that oversampling specific subgroups, especially in terms of regional diversity, could refine future analyses if resources permit.

The project received ethics approval from Imperial College's Research Governance and Integrity Team on 8 February 2023. The Science Engineering Technology Research Ethics Committee's reference number is 6481813.

The survey process involved four stages: development, validation, implementation, and data preparation, leading to a fifth stage focused on data analysis using descriptive and inferential statistics (Fig. 8).

Data analysis used IBM's Statistical Product and Service Solutions (SPSS), version 26.0. The analysis only included fully-completed surveys ($n = 423$) and statistical significance was set at $p < 0.05$. The specific steps and tests we conducted are as follows:

- **Step 1. Descriptive analysis:** Mean, standard deviation, and frequency distributions summarised key data features, including demographic information, green space usage, and engagement frequency related to green space activities.
- **Step 2. Reliability assessment:** We evaluated the internal consistency of measurement scales for participants' degree of actions/ thoughts related to green spaces and factors facilitating engagement to ensure

**Table 4 | Questions to address the objectives of the research**

| No. | Objective of the research | Foundational concept | Question in the survey | Type of question |
|---|---|---|---|---|
| 1 | Understanding the distribution of various types of publics involved in specific green space initiatives and activities | Situational Theory of Public | Do you… <br> - Talk with people/your friends about how you would like the greenspace to be <br> - Think you voice/opinion could make the space better <br> - Answer when there are consultations about the greenspace and its facilities <br> - Join 'friends groups' for your local green spaces <br> - Write to the management authorities to discuss the greenspace | 3-point Likert scale question (never, sometimes, often) |
| 2 | Exploring the enabling factors that facilitate their involvement. | Self-Determination Theory | On a scale of 1–10, how much would these encourage you to give your opinion about a green space project? <br> - Tangible rewards (e.g., gift cards, vouchers, money) <br> - Intangible rewards (e.g., recognition, praise) <br> - Feeling that my opinions matter and can contribute <br> - I trust and feel comfortable talking to people involved <br> - I know other people participating | 10-point ordinal scale question ('not at all' to 'very important') |

reliability. Acceptable α thresholds are ≥0.7 generally, ≥0.6 in exploratory research, with classifications: very low (α ≤ 0.30), low (0.30 < α ≤ 0.60), moderate (0.60 < α ≤ 0.75), high (0.75 < α ≤ 0.90), and very high (α > 0.90)[61,62]. Our α values are 0.674 (moderate) for actions/ thoughts and 0.788 (high) for enabling factors, thus confirming reliability for exploratory purposes. CA assumes unidimensionality, potentially masking multidimensionality, which PCA (Step 7) later addresses.

- **Step 3. Public segmentation**: We used the summation method of public segmentation to categorise participants into different public segments in accordance with their STP constructs, including problem recognition, constraint recognition, and level of engagement[63]. We first developed different Likert scale questions exploring people's awareness, perception, and action regarding green space design and consultation activities, and aligned the questions with the three mentioned STP constructs. For these questions, responses were recoded as follows: never = 1, sometimes = 2, and often = 3. We calculated average scores for each situational perception characteristics and then dichotomised them based on the mid-point of the three-point scale: low engagement (average ≤ 1.5) = 0 and high engagement (average > 1.5) = 1. Based on the dichotomised scores, participants would then be segmented into four groups of publics: non-public (0), latent publics (1), aware publics (2), and active publics (3).

- **Step 4. Analysis of variance (ANOVA):** One-way ANOVA was used to detect variations in enabling factors (EF1-EF5) among public segments, identifying overarching patterns and distinctions in engagement across groups.

- **Step 5. Post hoc test:** Where ANOVA suggested variation in score among groups, Tukey's HSD was used to explore where these differences lay. The mean difference (MD) quantified how much one group's mean value differs from the others. A negative MD implies that the first group perceives the measure as less important or less favourable relative to the second group.

- **Step 6. Pearson correlation:** This was conducted to explore the systematic relationships between enabling factors and progressive engagement levels within each public segment, providing insights into systemic associations (e.g., r values).

- **Step 7. Principal component analysis (PCA):** This was used to reduce dimensionality of enabling factors (EF1-EF5) and identify underlying factors influencing public engagement in green space design and consultation initiatives. This informs the strategies for enhancing public participation for each public segment. We considered loadings above 0.7 or −0.7 to be strong and indicative of a clear trend between the variable and the component. Loadings between 0.3 to 0.7 or −0.3 to −0.7 suggest a moderate relationship. Loadings below 0.3 or −0.3 indicate a weak relationship. Positioned last, PCA integrates prior findings to refine our framework, a common exploratory approach in environmental behaviour studies[64–66].

In terms of limitations, our sample ($n = 423$) is small relative to the UK's 68.3 million population, with stratification (age, sex, ethnicity) approximating ONS 2021 data but underrepresenting children (<18, excluded), the elderly (e.g., >65, ~10% vs. 18% nationally), and some ethnic minorities (e.g., Asian British, ~5% vs. 9%). Online sampling via Prolific may overrepresent digitally literate, engaged adults, skewing toward aware/ active publics. Lack of geographic data (e.g., urban/rural, city scale) limits analysis of spatial influences on STP segments or SDT factors (e.g., rural access affecting relatedness). This constrains statistical power for fine-grained subgroup comparisons (e.g., urban vs. rural autonomy). Additionally, the cross-sectional design limits causal inferences about engagement dynamics, which would require longitudinal studies to validate. The survey's reliance on self-reported data may also introduce recall bias, particularly for frequency of green space use, and the absence of qualitative data limits deeper insights into contextual barriers (e.g., cultural disconnect for BAME groups).
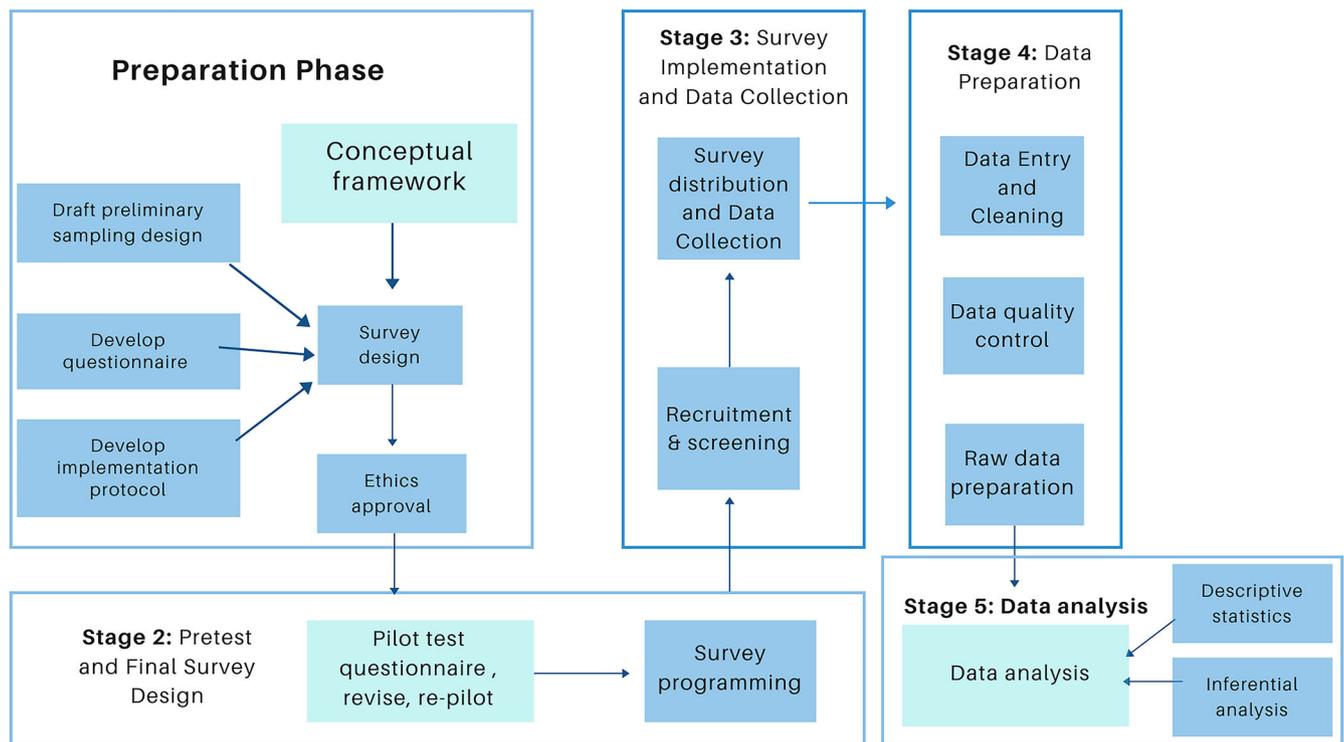
**Fig. 8 | Flow of survey development, implementation, data collection and analysis.** This figure illustrates the sequential stages in the survey research process, designed to ensure methodological rigour, ethical compliance, and high-quality data for analysis. The process is divided into five main stages, starting with a comprehensive Preparation Phase, where the Conceptual Framework guides the development of a draft sampling design, questionnaire, and implementation protocol. These components converge in the Survey Design, which is then subjected to ethics review and approval.

Future studies could oversample underrepresented groups (e.g., quotas for elderly, minorities) and use mixed-mode methods (e.g., postal surveys) to reduce digital bias and capture geographic variability, testing how context shapes motivation (e.g., competence in rural settings). Applying the STP-SDT framework in diverse socio-cultural contexts (e.g., non-UK) could validate its generalisability, adjusting for governance or community norms. Complementary qualitative research could deepen insights into segment-specific drivers (e.g., trust for latent publics), enhancing the framework's predictive utility.

## Data availability

The data generated and analysed in this study are not publicly available due to confidentiality agreements with participants. However, summary statistics and relevant findings are included in this article.

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## Acknowledgements

## Author contributions

N.T.N. contributed to conceptualisation, data curation, methodology, software, visualisation, formal analysis, writing – original draft, and writing – review and editing. A.C. provided support in conceptualisation, validation, analysis, supervision, and writing – review and editing. C.M.T.C. contributed to validation, analysis, supervision, and writing – review and editing. All authors (N.T.N., A.C., C.M.T.C.) have read and approved the final manuscript.

## Competing interests

The authors declare no competing interests.

## Additional information

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