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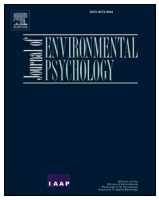

Environments and the experience of flow: A scoping review

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ABSTRACT

Investigations into the impact of natural and built environments on mental health often place greater emphasis on hedonic experience over other meaningful aspects of human wellbeing such as flow. Psychological flow occurs during episodes of deep immersion in intrinsically motivated activities. Giving rise to feelings of fulfilment and self-transcendence, it can contribute to both hedonic and eudaimonic wellbeing. Although individual differences and social contexts can enable or inhibit flow, it is not entirely clear how natural and built environments are associated with flow experiences. The objective of this review is to map existing primary research concerning how environments (natural and built) relate to flow experiences. A total of 60 included sources, published between 1975 and the end of 2022, illustrate that flow is not only impacted by the environment, but also connected to place-based meaning. Four themes reflect the type of source findings, highlighting the importance of 1. contact with nature, 2. person-environment fit, 3. aesthetics and 4. relationship to place. Review findings explore areas for future research and potential implications for nature-based interventions.

1. Introduction

There are many ways in which natural and built environments can promote human health and wellbeing (Hartig et al., 2014; Wilkie et al., 2018). Yet, much of the existing psychological research examining their impact on mental health places greater emphasis on hedonic states, such as affect and cognitive restoration (Beute et al., 2023; Capaldi et al., 2015; Seresinhe et al., 2019) or use indicators of subjective wellbeing in large data sets (e.g. Huebner et al., 2022; Martin et al., 2020). There is growing evidence of their contribution to eudaimonia (e.g. Jagannath et al., 2024), but opportunities remain to identify how individuals actively engage with natural and built environments to create meaningful experiences. Potentially overlooked in this regard, flow describes a state of optimal experience where an individual immersed in an activity feels a deep sense of enjoyment and fulfilment without regard for external validation. It is characterised by nine aspects. Clear goals are present throughout an activity (1) that provides a challenge-skill balance (2) demanding total concentration (3). Actions receive immediate, unambiguous feedback about how to proceed (4) and merge with awareness to allow for effortless engagement (5), giving rise to a sense of control over one's actions (6). Self-consciousness momentarily dissolves (7) and time can feel distorted (8). Importantly, flow is autotelic (9), meaning the activity is intrinsically motivated for enjoyment and not due to external factors (Csikszentmihalyi, 1990).

Activity flow is associated with positive affect (Fullagar & Kelloway, 2009; Rogatko, 2009), life satisfaction (Asakawa, 2010), performance (Harris et al., 2023) and higher emotional wellbeing (Bassi et al., 2022). The PERMA model of wellbeing is a framework for human flourishing stating the importance of positive emotion, engagement, relationships, meaning and accomplishment (Seligman, 2011). As a core component, flow through activity engagement contributes to a developmental process of human flourishing (Delle Fave et al., 2011) and is regularly applied to therapeutic interventions (Carr et al., 2021). Flow can foster a sense of fulfilment (Asakawa, 2004) throughout adult life (Tse et al., 2022) and presents a novel pathway through which to explore how interactions with built and natural environments help to cultivate a sense of meaning in life. Scholars have explored how individual characteristics (Isham et al., 2021; Ullén et al., 2012), activity choices (Magyaródi & Oláh, 2015), family environments (Csikszentmihalyi, 2002) and organisational contexts (Rathunde & Csikszentmihalyi, 2005) support flow. Furthermore, there are two recent scoping reviews on flow research. Norsworthy et al. (2021) reviewed flow constructs,

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measurement and outcomes in scientific disciplines between 2012 and 2019. Peifer et al. (2022) mapped primary data published between 2000 and 2016, illustrating three levels of flow research: individual, contextual, and cultural. While contextual factors are discussed in both, neither review discussed the significance of built or natural environments. Consequently, there is no clear overview of the role natural and built environments play in flow, or how perceptions of them are altered by the experience. Exploring this creates an opportunity to better understand the value that everyday interactions with environments hold in the enrichment of human health and wellbeing.

1.1. Review objective

The objective of this scoping review is to understand how natural and built environments relate to flow experiences and if consequent outcomes for wellbeing and performance are reported. Sources are systematically mapped to assess the extent of literature exploring the relationship between flow and the environments in which they occur. Participant and study characteristics are charted to synthesise a currently disparate evidence base and outline the potential for further research on flow in people-environment studies. By systematically identifying environment types supporting flow, the review findings present subsequent implications for their provision, maintenance and potential contribution to nature-based interventions.

1.2. Review questions

The research questions were developed using a PCC (Population, Concept, Context) framework to align with the objectives of this review as recommended by Peters et al. (2022):

1. What are the study and participant characteristics of research on flow and environments (natural and built)?
2. What types of relationships are identified between flow and environments (natural and built)?
3. If specified, are the consequences of the flow experience for wellbeing and performance suggested to be altered by interactions with the environment?

2. Methods

Conducted March–November 2023, this review followed steps outlined by Arksey and O'Malley (2005) and is documented in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses Extension for Scoping Reviews (Tricco et al., 2018). The review protocol was preregistered on Open Science Framework (Cumming et al., 2023) and developed in advance of source selection, with methodological guidance from the JBI manual for Evidence Synthesis chapter on scoping reviews (Peters et al., 2020).

2.1. Eligibility criteria

2.1.1. Participants

Inclusion of sources was not restricted by population or sample size. Participant characteristics of included sources are reported in the results of this review.

2.1.2. Concept

2.1.2.1. Flow. Source inclusion was based on the measurement of psychological flow as conceptualised by Csikszentmihalyi in 1975 and/or evaluation of at least one of the nine dimensions associated with the experience (Csikszentmihalyi, 1990). Unrelated definitions of flow including but not limited to the fields of physics, chemistry, engineering and material sciences were excluded.

2.1.2.2. Environment. Sources of evidence were required to discuss the physical characteristics of the environment in relation to research outcomes. All environment and building types meeting these criteria were considered. While definitions of the 'natural' or 'built' environment is contested and rooted in culture, for the purpose of this review, the following definitions were used to inform search terms relating to the physical aspects of environments. Nature can be understood as the 'physical features and processes of nonhuman origin that people ordinarily can perceive, including the 'living nature' of flora and fauna, together with still and running water, qualities of air and weather, and the landscapes that comprise these and show the influence of geological processes' Hartig et al. (2014, p. 208). In comparison, built environments are human-made and created to serve human purposes at numerous scales from rooms and buildings to urban civic spaces (OECD, 2023).

This review specifically addresses human interactions with real-world environments. The increasing amount of research assessing flow in computer-mediated environments has been reviewed separately by Valinatajbahnamiri and Siahtiri (2021). Therefore, virtual environments were only included where they reflected real-world environment types (e.g. a virtual forest or mountainous environment). References to human – artefact interactivity were excluded unless studies mentioned the physical setting in which the technology was used.

2.1.3. Context

Sources from all countries and research fields were considered provided the relevant definition of flow is used.

2.2. Types of sources

Included sources were required to report on primary data in peer-reviewed journal articles, conference proceedings, book chapters and PhD dissertations. Non-peer-reviewed journal articles, review articles, opinion papers and commentaries were excluded. There was no systematic search of grey literature and sources were excluded if they could not be accessed through Swansea University Library Services or by contacting any of the authors. To account for the diversity of methodological approach across disciplines, studies using both quantitative and qualitative designs were included provided they were conducted after the conceptualisation of flow in 1975 and before the end of 2022 to ensure a clear cut off prior to the review commencing early 2023.

2.3. Search strategy

Preliminary searches of two databases (APA PsycINFO and Scopus) were conducted using "psychological flow" and "environment" to identify search terms aligning with the eligibility criteria. Following consultation with a research librarian, ten databases were searched. To account for the interdisciplinary nature of flow research, these were APA PsycINFO, ProQuest Psychology, ProQuest Arts and Humanities, ProQuest: Applied Social Sciences Index & Abstracts (ASSIA), Web of Science: Core Collection, Business Source Complete, MEDLINE, GreenFILE, Scopus and British Library EThOS.

The final searches were conducted in March 2023 using the terms outlined in the search strategy (appendix A). References and citations of included studies were searched for further eligible sources; authors were only contacted to retrieve full texts and not to identify additional sources.

2.4. Source of evidence screening and selection

Search results were collated using EndNote May 20, 2023 (Clarivate) and reviewed using Covidence (Veritas Health Innovation, Melbourne). A pilot of the eligibility criteria was conducted on 25 randomly selected sources. Titles and abstracts of all retrieved sources were screened before entering a full-text review. Source selection was carried out by

two independent reviewers. Conflicts were resolved through discussion and agreement with a third reviewer. Additional sources were identified by one reviewer through reference searching and a second reviewer verified their inclusion. Any papers or chapters reporting on more than one relevant study were considered as separate sources. Reason for exclusion at the full-text review was based on the source not assessing flow or the physical environment (natural and built) as outlined by the eligibility criteria, not reporting on primary data or reporting study designs not included in the eligibility criteria (e.g. review and opinion articles).

2.5. Data extraction

Data was extracted by two independent reviewers using Covidence. The final extraction chart (appendix B) was produced following a pilot examination by the three reviewers. Following the charting process, any disputes were resolved during a second meeting with the same reviewers.

2.6. Analysis and presentation of results

Participant and study characteristics (RQ 1), including methodological approach, environment types studied, and the measurement of flow are summarised in tables and figures. An evidence map illustrates the geographic distribution of research settings. A thematic analysis was conducted by the corresponding author on descriptions of the relationship (RQ 2) between flow and the environment (Braun & Clarke, 2006). These findings are reported narratively alongside results concerning performance and wellbeing (RQ 3). To identify areas for future research, this review maps an evidence base not previously synthesised. Therefore, in line with procedural guidance (Tricco et al., 2018), a critical appraisal was not carried out and sources were included regardless of quality.

2.7. Source of evidence selection

The final database searches returned 3308 results. Once duplicates were removed, 2110 titles and abstracts were screened before 512 full texts were assessed. As outlined in the PRISMA flowchart in Fig. 1, a

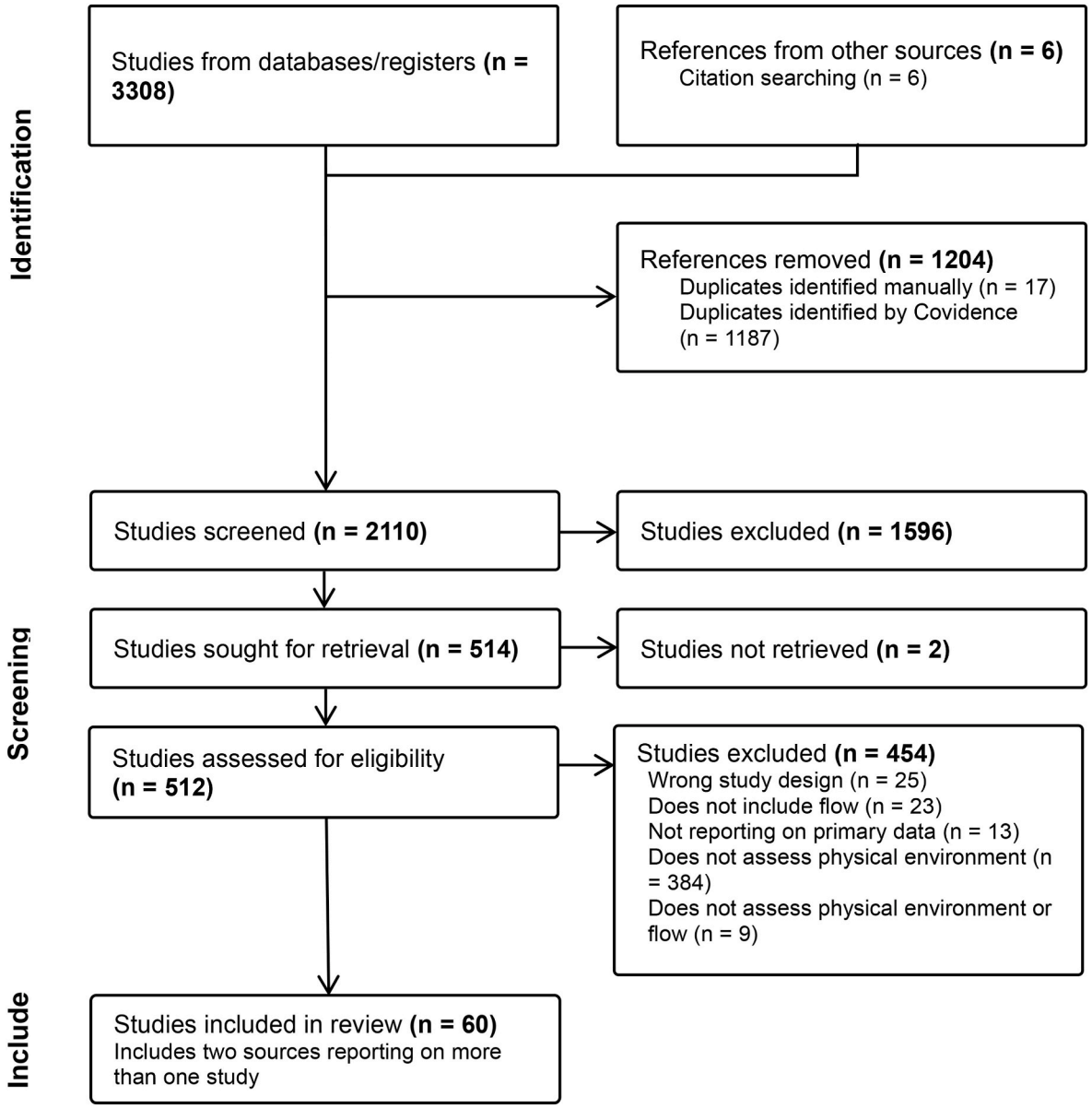

Fig. 1. PRISMA flowchart of included sources.

total of 60 studies were included in the final review. This includes two sources that each reported on two studies. Table 1 gives an overview of included sources. A table included in the supplementary materials reports on all extracted study characteristics.

3. Results

3.1. Research question 1: study and participant characteristics

Table 1 summarises the study and participant characteristics of all included sources. Fig. 2 provides a key to identify the corresponding themes for each source. These are denoted by the shapes included in the final column of Table 1. Out of 60 included sources, 29 employed quantitative methodologies, 17 qualitative and 14 mixed methods. Most (88 %) of included sources concerned real world research settings without the presence of technology. The remaining studies either used virtual technology to recreate real world environments, compare real and virtual research settings or used methods that required interaction with technology within a real-world setting. Fig. 3 shows the geographic spread of countries the sources were conducted in. The highest concentration was in the United States (n = 12), China (n = 9) and the United Kingdom (n = 7), 47 % of the total number of sources. Followed by Taiwan (n = 4), Australia, Ireland, Italy, Norway and South Korea (three sources each), Austria and New Zealand (two sources each). The remaining countries represented by one study reflect 17 % of all included sources.

Fig. 4 shows that flow was applied to research on people-environment interactions across eleven different subject areas, most often psychology, where flow-wellbeing research is most established. Psychological studies reported a range of data collection methods, from experience sampling to surveys and interviews. Leisure and tourism sources mostly surveyed larger samples to assess perceptions of holiday destinations. Across disciplines, ethnographic methods were used by authors studying children or vulnerable populations providing extensive observations of their flow experiences.

In the measurement of flow (RQ 1), only 22 of the included sources assessed all nine dimensions. These studies mostly employed validated flow scales (Jackson et al., 2008; Rheinberg et al., 2003; Waterman et al., 2008). However, scales were often adapted to the research context. For example, by reporting exploratory questionnaire design based on Csikszentmihalyi's (1990) theory (Te Brömmelstroet et al., 2022) or using scale items that assessed the experience of interactions with external factors facilitating flow, like the scientific interpretation at a national park (Tang et al., 2022), rather than the subjective experience of flow dimensions. Qualitative studies also varied in their measurement of flow, with most attention paid to the experiential dimensions like the transformation of time and loss of self-consciousness (Adams & Beauchamp, 2019, 2021; Jones, 2013). However, event and career focused interviews (e.g. Jackman et al., 2015), systematically assessed the presence of all nine dimensions in accounts.

Young adults (18–25) and adults (25–60) were the most studied populations (36 sources), with specific single studies focusing on adolescents (Mackenzie et al., 2018), older adults (Heo et al., 2010) and children under 12 years (Adams & Beauchamp, 2019). Gender distribution was fairly even where gender was not an inclusion criterion (studies of men only: Bassi & Delle Fave, 2010; Jackman et al., 2015; Swann et al., 2012; Swann et al., 2015; women: Allison & Duncan, 1987). Population descriptions can be found in supplementary materials alongside details of the activity and environment type of each source. Most flow activities assessed were sports (in some cases elite) and outdoor recreation, but also making music, performing arts and attending cultural or tourism experiences.

3.2. Research question 2: relationship between flow and environments (natural and built)

All but one source identified a relationship between flow and the environment, illustrating that flow appears to be influenced positively and negatively by natural or built environments. The exception was in a study by Strassmann et al. (2021) who found no difference in measures of flow experience between a virtual sea environment with, and without, plastic pollution. Research mostly concerned natural environments (25 sources), closely followed built environments (22 sources), with some studies involving environments characterised by elements of both built and natural environments (eight sources). The remaining five sources were experience sampling studies and concerned a range of environments. Results of the thematic analysis identified four themes reflecting the type of relationships studied: 1. contact with nature, 2. person-environment fit, 3. aesthetics and 4. relationship to place.

3.2.1. Contact with nature

Being outdoors, attending to scenic views or having contact with nature had a positive influence on flow in numerous physical activities (e.g. Boudreau et al., 2022; Løvoll, 2019; Martinez & Scott, 2016) and outdoor learning (Adams & Beauchamp, 2019, 2021; Mackenzie et al., 2018). Specifically, forests (Williams & Harvey, 2001), manicured gardens (Davis & Gatersleben, 2013) and alpine environments (Bassi & Delle Fave, 2010; Wöran & Arnberger, 2012) but also in the quality and quantity of urban green space (Mao et al., 2022; Peng et al., 2021). Bright, open meadows and tree-covered landscapes evoked flow in the Chinese and Asian practice of Qigong, a moving meditation that includes body-postures and breathing exercises to help balance Qi, the life-force of all beings. The highest flow scores were reported in a semi-open, tree-covered area next to water in an urban park (Hung, Chou, & Chang, 2021).

3.2.2. Aesthetics

Landscape beauty and visual aesthetics was an important factor in participant flow experiences across both indoor (e.g. Ameen et al., 2020; Goddard et al., 2022) and outdoor settings (Frochot et al., 2017; Mykletun & Mazza, 2016; Te Brömmelstroet et al., 2022). Multisensory stimulation, dynamic displays and interactive components contributed to increased flow in a museum exhibit post-renovation (Harvey et al., 1998). However, most sources detailed the influence of natural environments. Rich and diverse soundscapes that include flowing water (Lu et al., 2022), birdsong (Boudreau et al., 2022; Luo et al., 2021) and music (Jackman et al., 2021; Lu et al., 2022) also supported flow. Using images of three different natural biomes, savannah, forests and deserts, Rainisio et al. (2015) developed and tested a 'Flow in Environment Scale'. This measure of 'environmental flowability' assesses the perceived opportunity for flow in an environment. Each participant observed one image for a minute before completing scales for flowability, environmental preference, place attachment and environmental restoration. Significant positive correlations were found between all variables, but flowability predicted environmental preference. This novel finding shows that aesthetic preference for natural environments is at least partially shaped by perceived opportunities for flow.

3.2.3. Person-environment fit

This theme refers to the appropriate level of arousal derived from the natural or built environment to enable flow in an activity. The person-environment fit relative to an activity, or recreationist-environment fit (Wu, 2015) reflects four sub-themes of perceived comfort, safety, freedom and restorativeness, an environments capacity to support recovery from attention fatigue (Kaplan & Kaplan, 1989). Optimal weather and environmental conditions were an important precursor to flow experiences in outdoor activities (e.g. Jackman et al., 2015; Kwon et al., 2022; Swann et al., 2015). Comfort facilitated flow (e.g. Clapp et al., 2021; Ford et al., 2020) through nature contact (Boudreau et al.,

Table 1
Overview of included sources.

Source	Study design	Country of data collection	Population description	Sample size	Age category	Mean age	Male %	Female %	Not specified %	Activity (if described)	Environment type	Theme
Adams and Beauchamp (2019)	QL	UK	Children (ages 7–11) from primary schools in South Wales	187 (34 interviewed)	Children (0–12 years)	N/A	N/A	N/A	N/A	Outdoor learning - making music	Natural environments; woodland; beach; field	● ◆
Adams and Beauchamp (2021)	QL	UK	Children (ages 7–11) from primary schools in South Wales	91 (22 pupils and 4 teachers interviewed)	Children (0–12 years)	N/A	N/A	N/A	N/A	Mindful and sensory nature engagement	Nature reserve; woodland, saltmarsh, grassland; rare birds and wildlife	●
Allison and Duncan (1987)	QL	United States	Professional and blue-collar working women	20	N/A	N/A	0	100	N/A	N/A	Reported flow locations	◆ ▲
Ameen et al. (2020)	QT	UK	Shopping mall visitors (ages 23–38)	553	Young adults (18–25 years); Adults (25–60 years)	N/A	49	51	N/A	Shopping	Shopping mall	◆ ■ ▲
Back et al. (2020)	QT	South Africa	Tourists	468	Young adults (18–25 years); Adults (25–60 years); Older adults (60+ years)	N/A	36.8	63	N/A	Visiting an agritourism attraction	Tourism destination; mountains	◆ ■
Bassi and Delle Fave (2010)	M	India	Male climbers from Northern Italy, experienced but not professional.	6 (780 ESM forms)	Adults (25–60 years)	29.3	100	0	N/A	High-altitude climbing/ mountaineering	Natural environment; wilderness, mountains	● ◆
Bonaiuto et al. (2016)	QT	Greece (GR), Italy (IT)	Residents of Thessaloniki and Rome	287	Young adults (18–25 years); Adults (25–60 years)	28.5 (GR), 31 (IT)	50.7 (GR), 51.6 (IT)	N/A	N/A	N/A	Places of preference	▲
Boudreau et al. (2022)	M	New Zealand	Advanced level rock-climbers aged 18 years old or over	13	Young adults (18–25 years); Adults (25–60 years); Older adults (60+ years)	36.5	69.2	30.8	N/A	Rock-climbing (indoors and outdoors)	Indoor climbing gym; natural environment	● ◆ ■
Chirico and Gaggioli (2018)	QT	Italy	Adults living in the Piedmont and Lombardy regions of Italy.	38	Young adults (18–25 years)	23.01 (female) 23.67 (male)	47.4	52.6	N/A	Experimental task - navigating three virtual reality environments (VREs) using a head-mounted device.	Natural environment; forest, mountains, earth view	●
Clapp et al. (2021)	QT	United States	Undergraduate students	54	Young adults (18–25 years); Adults (25–60 years)	19.6	46.3	53.7	N/A	Experimental task	Office chair	◆
Davis and Gatersleben (2013)	QT	Ireland	Visitors to Sliabh Liag Cliffs in Donegal, Ireland and National Botanical Gardens in Dublin, Ireland	253	Young adults (18–25 years); Adults (25–60 years); Older adults (60+ years)	44.93	43.5	56.5	N/A	Visiting botanical gardens or cliffs	Natural environment; cliffs, botanical garden	● ◆

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Table 1 (*continued*)

Source	Study design	Country of data collection	Population description	Sample size	Age category	Mean age	Male %	Female %	Not specified %	Activity (if described)	Environment type	Theme
Ford et al. (2020)	QL	United States	Undergraduate music students	15	N/A	19	53	47	N/A	Music performance	Stage/performance environment	◆
Frochot et al. (2017)	QL	France	Senior-level students at a tourism university programme	10	N/A	N/A	N/A	N/A	N/A	Skiing and Snowshoeing	Ski resort; mountains	● ◆ ■
Goddard et al. (2022)	QL	Australia	Recreational, semi-elite and elite runners	14	N/A	32.71	42.9	57.1	N/A	Running	Indoor and outdoor environments	■
Harvey et al. (1998a)	M	United States	Museum visitors	443	N/A	N/A	N/A	N/A	N/A	Visiting museum exhibits	Museum exhibits	■
Harvey et al. (1998b)	M	United States	Museum visitors	101	Young adults (18–25 years); Adults (25–60 years); Older adults (60+ years)	N/A	N/A	N/A	N/A	Visiting museum exhibits	Museum exhibits	■
Hefferon and Ollis (2006)	QL	UK	Professional dancers	9	Adults (25–60 years)	N/A	44.4	55.6	N/A	Dancing: ballet and Riverdance	Stage/performance environment	◆ ■
Heo et al. (2010)	M	United States	Older adults from a Midwestern city in the United States.	19 (779 ESM forms)	Older adults (60+ years)	72	31.6	68.4	N/A	N/A	Reported flow locations	▲
Hung, Chou, and Chang (2021)	QT	Taiwan	Qigong course attendees (ages 20 and over)	58	N/A	33.7	N/A	N/A	N/A	Qigong	Urban Park; waterscapes, meadows, trees, plazas	● ◆
Hung, Hwang, and Chang (2021)	M	Taiwan	Qigong course attendees	58	N/A	33.7	67.2	32.8	N/A	Qigong	Urban Park	● ◆
Jackman et al. (2015)	QL	Ireland	Irish professional male Flat jockeys	10	N/A	27.4	100	0	N/A	Horse racing - flat racing	Sport and recreation facility	◆
Jackman et al. (2021)	QL	UK	Recreational and trained runners aged (ages 18 and over)	16	Young adults (18–25 years); Adults (25–60 years)	27.81	50	50	N/A	Running	Outdoor environments	● ◆ ■
Jones (2013)	M	Australia	Education Undergraduate students	114	Adolescents (12–17 years); Young adults (18–25 years); Adults (25–60 years)	N/A	22	76	2	Art workshops in nature	Urban Park; Japanese garden	● ◆
Karasakal and Albayrak (2021)	QT	Turkey	Tourists in Antalya, Turkey	938	Young adults (18–25 years); Adults (25–60 years); Older adults (60+ years)	N/A	37.4	59	3.6	Visiting tourism destination	Tourism destination	■ ▲
Kim and Thapa (2018)	QT	South Korea	Visitors to an eco-tourism destination. Mostly	300	Young adults (18–25 years); Adults (25–60 years); Older	N/A	41	59	N/A	Visiting an ecotourism resort (e.g., wildlife habitat tours,	Tourism destination; natural environment	● ▲

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Table 1 (*continued*)

Source	Study design	Country of data collection	Population description	Sample size	Age category	Mean age	Male %	Female %	Not specified %	Activity (if described)	Environment type	Theme
			leisure and first-time visitors		adults (60+ years)					organic gardening, farm apprenticeship)		
Kim and Kim (2019)	QT	South Korea	Chinese international students resident in South Korea for more than six months	129	N/A	20.8	60.5	N/A	N/A	Restaurant dining	Restaurants	▲
Kim and Ko (2019)	QT	United States	Undergraduate students	247	Young adults (18–25 years); Adults (25–60 years)	N/A	38.5	61.5	N/A	Experimental task - watched an NBA game via either 2-D screen or VR device for 5 min.	Virtual reality vs 2D computer screen	■
Kwon et al. (2022)	QL	South Korea	Experienced football players and golfers	18	Young adults (18–25 years); Adults (25–60 years)	26.5	55.6	44.4	N/A	Golf and soccer	Sport and recreation facility	◆
Ley et al. (2017)	QL	Austria	War and torture survivors in the Movi Kune - Moving Together programme	4	Young adults (18–25 years); Adults (25–60 years); Older adults (60+ years)	N/A	25	75	N/A	90 min sport and exercise intervention	Acoustic environment: music	◆
Li et al. (2022)	QT	China	Elderly adults with Diabolo experience	62	Older adults (60+ years)	N/A	46.7	53.3	N/A	Diabolo	Urban Park; diabolo sound	■
Liu et al. (2019)	QT	Taiwan	Visitors to Taiwan's night markets – students and residents	336	Children (0–12 years); Adolescents (12–17 years); Young adults (18–25 years); Adults (25–60 years); Older adults (60+ years)	N/A	44	56	N/A	Visiting Taiwan's night markets	Public space	▲
Løvoll (2019)	M	Norway	Students at a Norwegian university	26	Young adults (18–25 years); Adults (25–60 years)	23.4	52	48	N/A	5-day introduction course to glacier walking. Nordic outdoor education program (friluftsliv).	Natural environment; glacier	● ◆
Lu et al. (2022)	QT	China	Chinese tourists to Lijiang Town	587	Children (0–12 years); Adolescents (12–17 years); Young adults (18–25 years); Adults (25–60 years); Older adults (60+ years)	N/A	45	55	N/A	Visiting a tourism destination	Acoustic environment; public square with river	● ■ ▲

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Table 1 (*continued*)

Source	Study design	Country of data collection	Population description	Sample size	Age category	Mean age	Male %	Female %	Not specified %	Activity (if described)	Environment type	Theme
Luo et al. (2021)	QT	China	Undergraduate students	71	Adolescents (12–17 years); Young adults (18–25 years)	19.15	39.4	60.6	N/A	Nature-sound mobile application intervention. 30 min every day for 4 weeks when working on academic tasks	Acoustic environment; nature sounds	●
Mackenzie et al. (2013)	QL	New Zealand	Novice white-water river surfing participants	5	N/A	25	60	40	N/A	River surfing	Natural environment; river	● ◆
Mackenzie et al. (2018)	QT	United States	High school students	22	Adolescents (12–17 years)	15.7	59	41	N/A	Five-day snow science program including winter outdoor adventure activities	Natural environment; sport and recreation facility	●
Mao et al. (2022)	QT	China	Residents of urban communities in Chengdu, China	508	Young adults (18–25 years); Adults (25–60 years); Older adults (60+ years)	N/A	46.7	N/A	N/A	N/A	Urban residential area	● ▲
Martinez and Scott (2016)	QT	United States	Ultramarathon, long- distance and short-distance runners	189	N/A	35.93	30.2	69.8	N/A	Ultrarunning	Indoor and outdoor environments; beach, mountains, grass, neighbourhood, city. Indoor running track, gym	● ▲
Mykletun and Mazza (2016)	QL	Chile	Participants of the Patagonian Expedition Race (PER) - "serious sport tourists"	N/A	N/A	N/A	N/A	N/A	N/A	Patagonian Expedition Race (PER) Trekking, kayaking, mountain biking, climbing, and backcountry navigation.	Natural environments; mountains, swamplands, glaciers, native forests, lakes, rivers	● ■
Peng et al. (2021)	QT	China	Residents of urban communities within 13 districts in Chengdu, China	508	Children (0–12 years); Adolescents (12–17 years); Young adults (18–25 years); Adults (25–60 years); Older adults (60+ years)	N/A	46.7	53.3	N/A	N/A	Urban residential area	● ▲
Pitt (2014)	QL	UK	Community gardening volunteers presenting a range of physical and mental health conditions	32 interviews and observations at 3 gardens	Young adults (18–25 years); Adults (25–60 years); Older adults (60+ years)	N/A	N/A	N/A	N/A	Gardening (community allotments)	Community gardens	● ◆ ▲

(*continued on next page*)

Table 1 (*continued*)

Source	Study design	Country of data collection	Population description	Sample size	Age category	Mean age	Male %	Female %	Not specified %	Activity (if described)	Environment type	Theme
Prescott et al. (1981)	M	United States	Academic and healthcare professionals	20	Young adults (18–25 years); Adults (25–60 years)	N/A	50	50	N/A	N/A	Reported flow locations	◆ ▲
Rainisio et al. (2015)	QT	Italy, Algeria	University students in Italy and Algeria	169	N/A	N/A	N/A	N/A	N/A	Experimental task	Natural environment; savannah, forest, desert	◆ ■ ▲
Rathunde (2014)	QT	United States	Young adolescents at Montessori middle schools	Approx 172 students and 2500 signals	N/A	N/A	N/A	N/A	N/A	Morning nature walks	Natural environment; vegetation, trees	● ■
Rau et al. (2017)	QT	China	Undergraduate or graduate students	48	Young adults (18–25 years); Adults (25–60 years)	22	100	0	N/A	Computer gaming, Warcraft 3	Laboratory environment	■
Ruvimova et al. (2020)	M	United States; Switzerland	University students and staff in USA and Switzerland	35	Young adults (18–25 years); Adults (25–60 years)	27.6	48.6	51.4	N/A	Experimental task - Computer game	Office environment; VR beach environment	● ◆
Schmidt et al. (2014)	M	United States	High school students	372	Adolescents (12–17 years); Young adults (18–25 years)	N/A	40	60	N/A	N/A	Reported flow locations	▲
Strassmann et al. (2021)	QT	Germany	Mostly student and employed volunteers	47	N/A	26.09	N/A	36.2	N/A	Experiencing a polluted or non-polluted virtual sea	Virtual reality sea	■ ▲
Swann et al. (2012)	QL	Ireland	Male professional golfers	13	Young adults (18–25 years); Adults (25–60 years)	33.5	100	0	N/A	Golf	Outdoor sport and recreation facility	◆
Swann et al. (2015)	QL	UK	Professional golfers	10	Young adults (18–25 years); Adults (25–60 years)	37	100	0	N/A	Golf	Outdoor sport and recreation facility	◆ ■
Tang et al. (2022)	QT	China	Visitors to Potatso National Park in Shangri-La, Yunnan Province, China.	568	Children (0–12 years); Adolescents (12–17 years); Young adults (18–25 years); Adults (25–60 years); Older adults (60+ years)	N/A	40.1	59.9	N/A	Visiting a national park	National Park; mountains, meadows, lakes, forests, geological relics	▲
Tao et al. (2022)	QT	China	Residents local to urban parks in Beijing, China	771	Children (0–12 years); Adolescents (12–17 years); Young adults (18–25 years); Adults (25–60 years); Older	N/A	49.2	50.8	N/A	Leisure time spent in parks	Urban parks	● ▲

(*continued on next page*)

Table 1 (*continued*)

Source	Study design	Country of data collection	Population description	Sample size	Age category	Mean age	Male %	Female %	Not specified %	Activity (if described)	Environment type	Theme
					adults (60+ years)							
Te Brömmelstroet et al. (2022)	M	N/A	Private, public and active transport users mostly in the Netherlands, the UK and the US	91	Young adults (18–25 years); Adults (25–60 years); Older adults (60+ years)	N/A	53	45	2	Driving, cycling and using public transport	Urban environments	◆ ■
Vasiliou et al. (2014)	M	Cyprus	Post-graduate students and tutors	21	N/A	N/A	38.1	61.9	N/A	Human Computer Interaction (HCI) graduate-level course	Classroom	◆
Vittersø et al. (2001a)	QT	Norway	Norwegian sport fishers	346	N/A	N/A	N/A	N/A	N/A	Sport fishing	Natural environment	● ■ ▲
Vittersø et al. (2001b)	QT	Norway	Recreation area users in southern Norway (85 % canoeists)	305	N/A	N/A	N/A	N/A	N/A	Canoeing	Natural environment; forest, lakes	● ■ ▲
Williams and Harvey (2001)	M	Australia	Individuals who visit, work or live in forests in Victoria, Australia.	131	N/A	N/A	55	45	N/A	Recall transcendence in forest environments	Natural environment; forest	● ◆ ▲
Wöran and Arnberger (2012)	QT	Austria	Hikers visiting huts in the Austrian Salzkammergut	369	Adolescents (12–17 years); Young adults (18–25 years); Adults (25–60 years); Older adults (60+ years)	41.4	N/A	47	N/A	Mountain hiking	Natural environment; mountains	● ◆
Wu (2015)	QT	Taiwan	Tourists	253	Children (0–12 years); Adolescents (12–17 years); Young adults (18–25 years); Adults (25–60 years); Older adults (60+ years)	N/A	66.5	33.5	N/A	Marine sports and recreation	Tourism destination; natural environment	◆ ■
Yang et al. (2022)	QT	China	Tourists	509	Young adults (18–25 years); Adults (25–60 years)	N/A	64.8	N/A	N/A	Tourism experience. Gaoshanliushui toast ceremony	Restaurants	▲

Abbreviations: QT: quantitative, QL: qualitative, M: mixed methods.

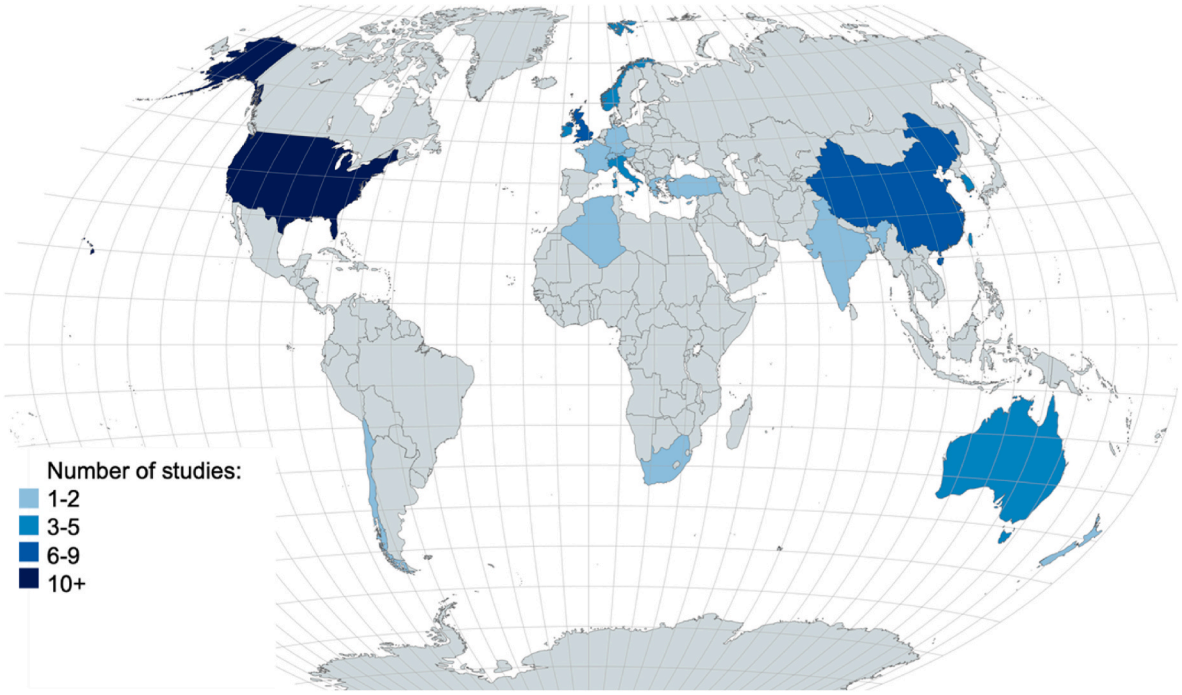

Fig. 2. Number of sources by theme.

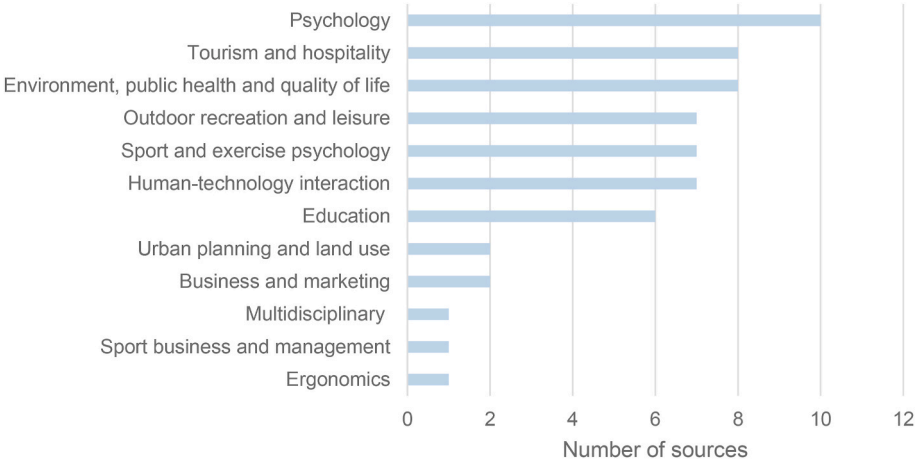

Fig. 3. Geographic distribution of countries where studies were conducted.

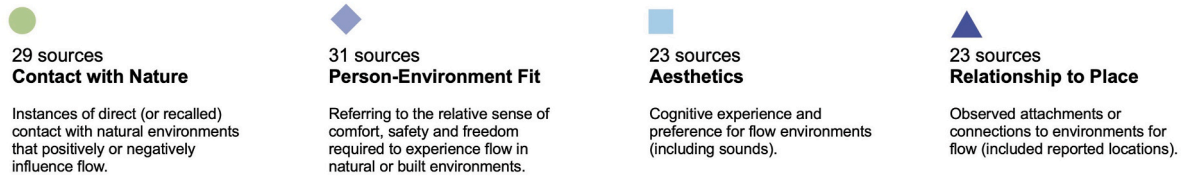

Fig. 4. Overview of sources by journal subject.

2022), familiarity with surroundings (Hefferon & Ollis, 2006; Swann et al., 2012; Wu, 2015) and a sense of safety (Back et al., 2020; Hung, Chou, & Chang, 2021; Ley et al., 2017). Environmental restoration has also been found to correlate with flow (Rainisio et al., 2015; Wöran & Arnberger, 2012) and visits to gardens elicited flow experiences that were associated with low arousal and feelings of calm (Davis & Gatersleben, 2013). Moreover, Williams and Harvey (2001) show that transcendent moments of 'deep flow' in relatively open, familiar areas of forest occurred alongside feelings of relaxation and a sense of belonging. Participants perceived the forest with high compatibility, but also moderate novelty, suggesting that environments for flow do not only need to be safe and calm but cater for curiosity. Novelty and variety in the environment allowed for exploration of stimuli, supporting flow in outdoor activities (Goddard et al., 2022; Jackman et al., 2021; Mackenzie et al., 2013; Vittersø et al., 2001). But comfort also arose from a sense of freedom (Boudreau et al., 2022) or opportunities to freely shape

events and physical environment (Pitt, 2014). Mastery, control, autonomy and freedom were all important for women experiencing flow at home or work (Allison & Duncan, 1987) and musicians felt in flow when they performed on a stage that opened out, giving them more space to move and gesture (Ford et al., 2020).

3.2.4. Relationship to place

This theme refers to findings suggesting that individuals form place-specific relationships with environments in which flow occurs. 'Emplaced flow' (Pitt, 2014) speaks to the relationship between flow and therapeutic landscapes (Gesler, 1992), suggesting that healing experiences in community gardens are inseparable from the socio-spatial context and contribute to a sense of belonging. Findings of included sources also illustrate the association between flow experiences, place attachment (e.g. Liu et al., 2019; Tao et al., 2022), place identity and personal growth (Bonaiuto et al., 2016). Environmental flowability was also found to predict place attachment, providing the some of the first evidence that positive relationships to place are closely associated with their potential to facilitate flow experiences (Rainisio et al., 2015).

3.3. Research question 3: outcomes for wellbeing and performance

Wellbeing outcomes of flow arising from individual-environment interactions were considered in 13 sources in total, but only empirically assessed in four (Clapp et al., 2021; Luo et al., 2021; Løvoll, 2019; Martinez & Scott, 2016). Nature was found to positively influence life satisfaction (Peng et al., 2021), and positive affect (Adams & Beauchamp, 2021; Luo et al., 2021) through flow. Despite natural environments contributing to flow experiences in runners, the activity itself may have a greater impact on their wellbeing than immersion in nature (Martinez & Scott, 2016). Performance outcomes were considered in the discussion of six sources but only measured during experimentally induced cognitive tasks pre and post intervention (Luo et al., 2021) and across conditions in an open plan office (Ruvimova et al., 2020).

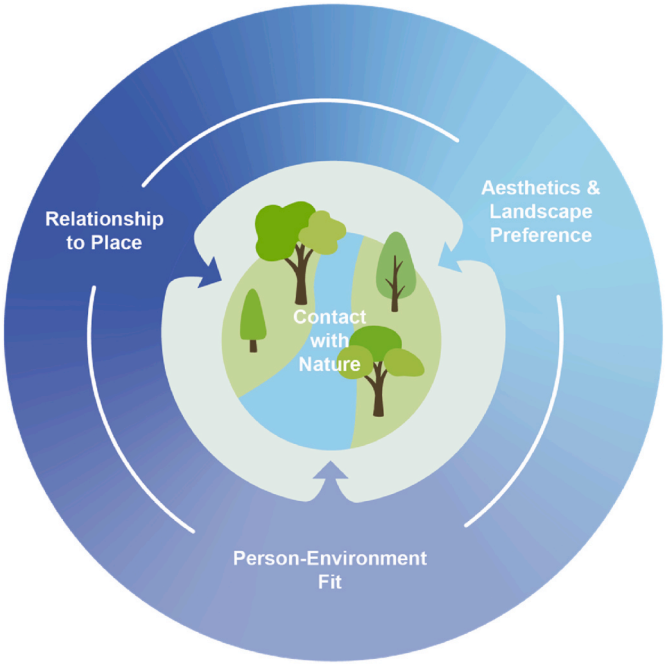

Fig. 5. Illustration of Conceptual Framework for the relationship between flow and the environment (natural and built). Proposed thematic relationships suggest that aesthetic preference, a good person-environment fit and relationships with place, such as place attachment, are associated with flow. Natural environments in particular are considered flow conducive due to their capacity to facilitate these experiences most frequently.

However, it is unclear if any of the observed improvements in performance were a consequence of flow.

4. Discussion

This review sought to map research looking at the types of relationships between flow and environments (built and natural). In response to research question one, review findings provide an overview of both qualitative and quantitative insights across eleven different subject areas, from psychology to tourism and outdoor recreation. Almost half (47 %) of included studies were conducted since the beginning of 2019 and only four prior to 2000, illustrating that flow and environment research is of increasing cross-disciplinary importance. While there may also be an increased interest in people-environment studies more generally, this evidence gives cause for more in-depth analysis into the temporal trends in flow-environment research. Despite this interest, knowledge gaps remain for specific populations including adolescents, older adults or those living in African and South American countries (only three sources in total were conducted in these continents). In alignment with previous scoping reviews (Norsworthy et al., 2021; Peifer et al., 2022), flow measures used were varied and inconsistent. Research going forward must be mindful of methodological differences and commonalities as illustrated by Norsworthy et al. (2021) to reduce theoretical complexity as the field develops. Due to the subjectivity of flow experiences, this could include the clear reporting of flow measurement and more consistent use of validated psychological scales, particularly when investigating causal relationships.

The thematic results (RQ 2) provide an understanding of how flow experiences relate to natural and built environments. Many different indoor and outdoor environments were present in the research, but most concerned natural environments. Rather than identifying the features of flow conducive environments, most sources examined how individuals' perceptions support, disrupt or inhibit flow, through the promotion of behaviour (flow activities), aesthetic experience and emotion. The exception being in studies where flow was compared across types of natural environments (Davis & Gatersleben, 2013; Hung, Hwang, & Chang, 2021).

Further experimental work is required to identify the impact of built and natural environments on wellbeing and performance through flow experience (RQ3). Review results highlight the mostly observational and correlational nature of source findings. Benefits for wellbeing and performance were only empirically measured in a few sources (e.g. Luo et al., 2021). Considering that flow is a key component of wellbeing (Seligman, 2011), studies that systematically measure both could be used to compare the effectiveness of flow and other forms of nature engagement in deriving wellbeing benefits. This is relevant in the evaluation of nature-based interventions. Despite the evident potential for natural environments to support flow, only one included source evaluated the role of flow in a nature-based intervention (Luo et al., 2021). Measures often used to assess the wellbeing outcomes of nature-based interventions tend to focus on hedonic states such as mood, affect and the reduction of adverse psychological states like stress (Reis et al., 2024). Measuring changes in state and trait flow as part of their evaluation could be used to understand the extent activity immersion contributes to eudaimonia.

4.1. Conceptual framework

Based on the thematic findings, Fig. 5 illustrates a conceptual model exploring potential mechanisms for the observed relationships between flow and the environment (natural and built).

4.1.1. Aesthetics and landscape preference

Opportunities for flow are perceived and relate to landscape preference (Rainisio et al., 2015). Therefore, the aesthetics of features (e.g. scenic views, birdsong, water and music) associated with flow could be

interpreted through the lens of Kaplan and Kaplan's (1989) preference matrix. Coherent and legible environments (natural and built), providing the right amount of complexity and mystery could set the necessary conditions for flow. A precursor of flow theory, Berlyne's (1960) work similarly states that exposure to optimal levels of environmental stimuli, and therefore arousal, can account for intrinsically motivated behaviour. Too much novelty or complexity may result in stress, too little in under stimulation.

4.1.2. Person-environment fit

Natural and built environments in which the above balance is maintained may support flow through optimal arousal, relative to the cognitive or physical requirements of an activity. For example, novelty is sought by runners for exploration (Goddard et al., 2022), but a relaxing environment surrounded by trees and water is preferred for Qigong (Hung, Chou, & Chang, 2021). This person-environment fit also relates to Attention Restoration Theory (Kaplan, 1995), with review findings evidencing that fascination, compatibility and sense of being away predicted flow during hiking (Wöran & Arnberger, 2012). Kaplan and Kaplan (1989, p.199-200) note the theoretical differences between a reflective state of compatibility and the highly charged need for a challenge-skill balance in flow. However, it could be that compatibility, or a good person-environment fit, facilitates a state of ease (e.g. comfort and safety) from which to focus attentional resource on the immersive activity. Individual factors such as self-regulation (Jackman et al., 2021) may also have a role in determining person-environment fit through intrinsic and flexible goal setting, meaning that attention is sustained despite potential environmental distractions.

4.1.3. Relationship to place

Regardless of age and gender, flow experienced in a place of preference is positively associated with an individual's place identity (Bonaiuto et al., 2016) and relationships exist between environmental flowability, perceived restorativeness, place attachment and aesthetic preference (Rainisio et al., 2015). This presents several potential bidirectional relationships. For example, do individuals experience flow because of place attachment or does it grow through engagement in flow activities? Place attachment delivers psychological benefits including comfort and security, aesthetic preference, freedom and opportunities for activity engagement (Scannell & Gifford, 2017). Therefore, it could contribute to a person-environment fit for flow where individuals are free to act in the knowledge that they are safe and able to engage with the environment (or an activity in it). Conversely, a pathway to place attachment could arise from a person-environment fit that facilitates a rewarding flow experience, reinforcing positive associations to specific places. Pitt (2014) used 'emplaced flow' to understand the role of community gardening activities in delivering therapeutic benefits of the body in action. A sense of belonging could be developed in gardeners who were free to do activities that brought them to flow.

4.1.4. Contact with nature

Rich in restorative qualities (Kaplan, 1995; Kaplan & Kaplan, 1989) and sites of stress-recovery (Ulrich et al., 1991), it could be that natural environments are more readily supportive of flow by facilitating the cyclical process outlined in Fig. 5. Specifically, forests (Williams & Harvey, 2001), urban parks with vegetation (e.g. Hung, Chou, & Chang, 2021; Mao et al., 2022) and gardens (Davis & Gatersleben, 2013; Pitt, 2014). Whereas wilder, exposed natural environments were associated with higher arousal and a different self-transcendence, awe (Davis & Gatersleben, 2013). However, in a mountainous environment, alongside perceived restorativeness, the likelihood of flow increased with mountaineering experience (Wöran & Arnberger, 2012). While it appears that the public provision of restorative natural environments is important for flow, so too are opportunities to develop mastery in nature-based activities.

4.2. Questions for future research

Based on the results of this review, four questions could be addressed by future research.

4.2.1. Is nature really better for flow?

Flow was not exclusively found to occur in natural environments (Clapp et al., 2021; Harvey et al., 1998), yet most of the research included in this review focuses on physical activity in nature (e.g. Adams & Beauchamp, 2019; Wöran & Arnberger, 2012). Specific findings show that climbing outdoors is better for flow than climbing indoors (Boudreau et al., 2022), but this evidence only exists for one activity. It is therefore unclear whether natural environments in general are better at facilitating flow than built environments or if built environments are currently under researched. This is particularly the case for private indoor domestic spaces. None of the included sources directly assessed how built features impact flow in home environments. Considering the physical health benefits delivered by active visits to natural environments (White et al., 2016), it is important to understand if flow experiences indoors, using technology, delivers the same outcomes for wellbeing as flow outdoors.

4.2.2. How does nature engagement support flow?

The emerging link between environmental flowability and environmental aesthetics is evident (Rainisio et al., 2015). However, research looking beyond visual perception and towards understanding the extent all senses are engaged during immersive activity engagement in nature, could help determine additional pathways through which nature contact can support flow experiences. Recent evidence showing that nature relatedness positively influences flow experiences and in turn, environmental sensitivity (Akçakese et al., 2024), suggests that more could be done to understand the mechanisms underlying the relationship between natural environments and flow.

4.2.3. How do relationships with flow environments change over time?

None of the included sources presented longitudinal findings. Therefore, it is not known how changes in person-environment fit may impact flow over time. For example, elements of natural and built environments, such as the degree of openness or seclusion, appear conducive to developing a sense of safety, whilst affording freedom and autonomy for flow. However, at what point does an environment become safe enough for flow? Preference for places of prospect and refuge (Appleton, 1975) could provide an evolutionary explanation, but the perceived sense of safety could also be relative to the individual, their chosen activity and the environment at any given time. One that potentially evolves with effortful activity engagement, increased familiarity with the environment and curiosity to explore throughout an iterative process. What appears to matter most for flow in creative tasks is that an individual feels in harmony with the environment and free to move in and shape the surroundings (Csikszentmihalyi, 1997). Studies that follow the development of new skills in new environments could ascertain when unfamiliar environments become unthreatening enough to support flow, learning how individuals expand into both activity and environment to satisfy the psychological conditions for immersion.

4.2.4. Are there barriers to accessing environments for flow?

Sources using experience sampling methods were among the first studies to illustrate variation in locations of flow depending on age, gender and employment status (Allison & Duncan, 1987; Prescott et al., 1981). While location is a poor predictor of flow (Schmidt et al., 2014), across a population it can highlight the places flow is catered for better than others. What is not known however, is why individuals choose specific natural or built environments for flow activities. For example, determining if older adults experience flow more at home than outside the home (Heo et al., 2010) out of choice or due to limitations in accessibility could have implications for encouraging flow for wellbeing

in later life. Particularly when visits to nearby nature support recreation for healthy aging (Levinger et al., 2022). Considering the important relationship between flow, place and personal growth (Bonaiuto et al., 2016), identifying barriers in accessing places for flow from the perspective of specific populations could have meaningful consequences for their physical and mental health.

4.3. Limitations

This review focused on flow as a concept of western psychological science. Therefore, a potential limitation is not accounting for various non-western conceptualisations of activity immersion. The inclusion of sources only reported on in English perpetuates this inequality. Future reviews could continue to explore if co-existing understandings of flow, like Qi as illustrated by Hung, Chou, and Chang (2021), provide insights into the influence of different cultural understandings of environments supporting flow. Secondly, by not including terms for specific natural features like 'water', 'ocean' or 'woodland', sources that referred to the specific physical element rather than an environment or landscape may have been missed. However, the objective was to understand the types of relationships between flow and environments rather than the role of specific features. Finally, as this is a scoping review, critical appraisals of research quality were not included alongside the thematic analysis.

5. Conclusion

Despite the wealth of flow research in Positive Psychology, little attention has been paid to the impact of natural and built environments. A total of 60 included review sources highlights the emerging potential for flow research in relation to environments (natural and built) across multiple research areas, from tourism and psychology to urban design. Set out within a novel conceptual framework, the review results suggest that under a good person-environment fit flow could lead to meaningful experiences that foster feelings of fulfilment. Open and bright areas close to plants, trees and water potentially offer prospect and refuge from which relationships with place are formed through flow experiences. As familiar environments and soundscapes low in arousal supported feelings of calm, the physical and psychological safety of restorative environments could create space for individuals to engage in flow activities. In future research, the activity and environment should be considered simultaneously and account for individual perspectives to ensure environments for flow are accessible for all.

CRediT authorship contribution statement

Megan Cumming: Writing – review & editing, Writing – original draft, Formal analysis, Conceptualization. **Birgitta Gatersleben:** Writing – review & editing, Supervision, Conceptualization. **Jason Davies:** Writing – review & editing, Supervision. **Aïsha van Buuringen:** Formal analysis. **Amy Isham:** Writing – review & editing, Supervision, Formal analysis, Conceptualization.

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Appendix A

Search strategy

The following search string was adapted to search all databases except British Library EThOS:

("flow experience" OR "psychological flow" OR "flow state" OR "optimal experience*" OR Csikszentmihalyi) **AND** (environment* OR setting* OR surrounding* OR indoor* OR outdoor* OR nature OR interface* OR architectur* OR place* OR space* OR building* OR spatial* OR landscape*) **NOT** ("cerebral blood flow" OR "work-flow centrality" OR "blood flow" OR oxygen OR liquid OR fluid OR "data flow" OR "flow chart" OR turbine OR "lateral flow" OR "cash flow" OR "surface flow" OR "optical flow" OR "patient flow" OR "optic flow")

Table A.1
Database search terms.

Database	Search terms	Number of sources
Scopus	(TITLE-ABS-KEY ("flow experience" OR "psychological flow" OR "flow state" OR "optimal experience*" OR csikszentmihalyi) AND TITLE-ABS-KEY (environment* OR setting* OR surrounding* OR indoor* OR outdoor* OR nature OR interface* OR architectur* OR place* OR space* OR building* OR spatial* OR landscape*) AND NOT TITLE-ABS-KEY ("cerebral blood flow" OR "work-flow centrality" OR "blood flow" OR oxygen OR liquid OR fluid OR "data flow" OR "flow chart" OR turbine OR "lateral flow" OR "cash flow" OR "surface flow" OR "optical flow" OR "patient flow" OR "optic flow")) AND PUBYEAR >1975 AND PUBYEAR <2023 AND (LIMIT-TO (DOCTYPE, "ar") OR LIMIT-TO (DOCTYPE, "ch") OR LIMIT-TO (DOCTYPE, "cr")) AND (LIMIT-TO (LANGUAGE, "English"))	1197
EBSCOhost: APA PsycInfo	("flow experience" OR "psychological flow" OR "flow state" OR "optimal experience*" OR csikszentmihalyi) AND (environment* OR setting* OR surrounding* OR indoor* OR outdoor* OR nature OR interface* OR architectur* OR place* OR space* OR building* OR spatial* OR landscape*) NOT ("cerebral blood flow" OR "work-flow centrality" OR "blood flow"	Total: 824 (731 minus duplicates) 442
MEDLINE	OR oxygen OR liquid OR fluid OR "data flow" OR "flow chart" OR turbine OR "lateral flow" OR "cash flow" OR "surface flow"	214
GreenFILE	OR "optical flow" OR "patient flow" OR "optic flow") Limiters - Publication Year: 1975–2022; Peer Reviewed; English.	19
Business Source Complete	Search modes - Boolean/Phrase Expanders - Apply equivalent subjects	168
Web of Science: Core Collection	TS= (("flow experience" OR "psychological flow" OR "flow state" OR "optimal experience*" OR csikszentmihalyi) AND (environment* OR setting* OR surrounding* OR indoor* OR outdoor* OR nature OR interface* OR architectur* OR place* OR space* OR building* OR spatial* OR landscape*) NOT ("cerebral blood flow" OR "work-flow centrality" OR "blood flow" OR oxygen OR liquid OR fluid OR "data flow" OR "flow chart" OR turbine OR "lateral flow" OR "cash flow" OR "surface flow" OR "optical flow" OR "patient flow" OR "optic flow")) and English (Languages) and Article or Proceeding Paper or Book Chapters (Document Types) and Retracted Publication (NOT-Document types) Timespan: 1975-01-01 to 2022-12-31 (Publication Date)	1, 192
ProQuest	(noft("flow experience" OR "psychological flow" OR "flow state" OR "optimal experience" OR csikszentmihalyi) AND noft (environment* OR setting* OR surrounding* OR indoor* OR outdoor* OR nature OR interface* OR architectur* OR place*	188

(*continued on next page*)

Table A.1 (*continued*)

Database	Search terms	Number of sources
	OR space* OR building* OR spatial* OR landscape*) NOT noft("cerebral blood flow" OR "work-flow centrality" OR "blood flow" OR oxygen OR liquid OR fluid OR "data flow" OR "flow chart" OR turbine OR "lateral flow" OR "cash flow" OR "surface flow" OR "optical flow" OR "patient flow" OR "optic flow") AND peer(yes) AND la.exact("English")) AND (pd (19750101–20221231) AND PEER(yes)) Date: From 1975 to 2022 Language: English Databases: Applied Social Sciences Index & Abstracts (ASSIA) Arts & Humanities Database Psychology Database	
British Library EThOS	flow OR Csikszentmihalyi AND environment	10

Appendix B

Data extraction instrument

Table B.1
Data extraction instrument.

Publication details
Title:
Year of publication (in journal, not online):
Author names:
Publication type:

☐ Journal article☐
☐ Conference proceeding
☐ PhD dissertation
☐ Conference abstract
☐ Book chapter
Journal title:
Country in which the study was conducted:

☐ United States
☐ UK
☐ Canada
☐ Australia
☐ Taiwan
☐ China
☐ Other
Notes (e.g. Study funding sources and possible conflicts of interest for study authors if relevant):

Characteristics of included studies

Aim of study:
Study design:
☐ Quantitative research
☐ Qualitative research
☐ Mixed method
☐ Other
Method of data collection:
☐ In person self-report survey
☐ Online self-report survey
☐ Semi-structured interviews
☐ Focus groups
☐ Observation
☐ Other
Methodology:
☐ Lab experiment
☐ Case study
☐ Experience sampling
☐ Field experiment
☐ Natural experiment
☐ Quasi-experiment
☐ Ethnography
☐ Phenomenology
☐ Grounded theory
☐ Multiple studies

(*continued on next page*)

Table B.1 (*continued*)

Characteristics of included studies
☐ Other Activity (if described): Method of data analysis:
Participant characteristics
Population description: Age category: ☐ Children (0–12 years) ☐ Adolescents (12–17 years) ☐ Young adults (18–25 years) ☐ Adults (25–60 years) ☐ Older adults (60+ years) ☐ Not specified Mean age: Total number of participants (sample size): Sex of participants (percentage and count): ☐ Male ☐ Female ☐ Not specified Gender Identity: ☐ Women ☐ Men ☐ Transwomen ☐ Transmen ☐ Non-binary/gender queer/agender/gender fluid ☐ Not specified Nationality (if specified): Ethnicity (if specified):
Key Findings
Environment type: ☐ Real ☐ Virtual ☐ Real and virtual Description of physical environment: How were features of the physical environment measured or assessed? (If specified): How was flow measured? For quantitative studies include the scale used. For qualitative studies include details of interview questions or techniques (i.e. experience recall). Dimensions of flow assessed: ☐ Challenge-skills balance ☐ Action-awareness merging ☐ Clear goals ☐ Unambiguous feedback ☐ Concentration on the task at hand ☐ Sense of control ☐ Loss of self-consciousness ☐ Transformation of time ☐ Autotelic experience Is the main aim of the study to measure flow? If flow is the only focus of the study select yes. If, for example, it is assessed alongside mindfulness select no. ☐ Yes ☐ No Details of other variables measured (if applicable) Is there an association between flow and the physical environment? ☐ Yes ☐ No Details about the strength of flow-physical environment relationship (Include key statistics if quantitative): Do findings concern human relationships with nature? i.e. connectedness to nature, biospheric values, sustainable wellbeing, pro-environmental behaviour? ☐ Yes ☐ No Details about the strength of flow-connectedness to nature relationship (Include key statistics if quantitative)
Description of key findings
Relationship between the physical environment and flow experience (include details of what physical environment features influence flow and how they affect, support or prevent it): Influence of physical environment on wellbeing (including key statistics or details about the strength of relationship): Influence of physical environment on performance (including key statistics or details about the strength of relationship) Practical and theoretical implications (as described by authors): Study limitations (as described by authors)

Appendix C. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.jenvp.2025.102605.

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