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# "Moments of Change" and Low-Carbon Behaviors: A Multidisciplinary, Systematic Review

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## ABSTRACT

Individual behavior change is essential to reduce greenhouse gas emissions and mitigate climate change. Over the past two decades, significant attention has been given to specific instances when people's habits and routines may be more amenable to change. These instances are referred to as "moments of change" (MoCs). The recent and rapid increase in research in this area warrants a systematic review. We draw on evidence from 130 articles, identified through Scopus and Web of Science, examining the effects of biographical (e.g., relocation) and exogenous (e.g., financial crises) life events on climate change mitigation behaviors (e.g., mobility). Most of the research is focused on the Global North (e.g., UK, USA, and Germany), and comparability is limited due to the use of different methodologies. The results regarding low-carbon behavior change during MoCs are mixed. When behavior change does occur, it is often influenced by contextual (e.g., physical infrastructure), demographic, social, and economic factors. The literature tends to focus more on biographical MoCs (particularly relocation) than exogenous MoCs, and on consumption behaviors (particularly mobility), rather than on social or political behaviors (e.g., activism). Few studies explicitly test theories or models; those that do primarily concentrate on the habit discontinuity hypothesis. Future research could focus on investigating more granular details of MoCs (e.g., habits, planning, and timing) and how interventions might be better targeted to leverage MoCs. This review highlights the importance of considering not only how to foster low-carbon behavior change but also when to do so.

This article is categorized under:

Perceptions, Behavior, and Communication of Climate Change > Behavior Change and Responses

## 1 | Introduction

Tackling climate change requires immediate and drastic action aimed at reducing greenhouse gas (GHG) emissions. According to the Intergovernmental Panel on Climate Change (IPCC), lifestyle and behavior changes, fostered through policy, infrastructure, and technology interventions, can lead to reducing global GHG emissions in end-use sectors by 40%–70% by 2050

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(IPCC 2022a). Changes of this extent can only be achieved if comprehensive policies are integrated at all levels of society, including communities and individual lifestyles (IPCC 2022b). Low-carbon behaviors, defined as actions by individuals or groups that can directly or indirectly cut carbon emissions, include cutting down on driving and flying, switching to a plant-based diet, reducing resource use, and engaging in community action or political activism on climate (Ivanova et al. 2020; Hampton and Whitmarsh 2023).

Many of these are everyday behaviors that people develop over time and may become habitual or routine. Once habits have been formed, they can be hard to break (Verplanken et al. 1997). However, there are certain periods in people's lives that can serve as catalysts for change, as they disrupt routines, habits, and even identities. These are known as "moments of change" and include biographical events (e.g., retirement) as well as exogeneous social disruptions (e.g., pandemics). Research on moments of change highlights that behavior can shift rapidly in response to context change and implies *when* behavior changes can be as important as *how* it changes (Verplanken and Whitmarsh 2021). Here, we present the first systematic review of this literature and how it relates to low-carbon behaviors.

Habits are defined differently by psychologists and sociologists (Kurz et al. 2015) but broadly describe repetitive, everyday actions with a more automatic than deliberative character. This automatisation arises as a result of both psychological and social-material factors that lock in behavioral routines. Psychological research emphasizes the ways in which habits are triggered by cues present in one's physical and/or social environment (Wood and Rünger 2016). These context cues activate a habitual response, such that people act without deliberately making a decision (Wood 2016). Sociological research highlights how everyday practices become routinized as a result of co-evolving cultural meanings and the material context in which action takes place (Burningham and Venn 2020). Multiple social and material developments coordinate interactive practices (e.g., shopping and commuting), resulting in predictable patterns of everyday activity (Shove et al. 2012).

However, in both disciplines, "moments of change" (MoCs) can disrupt routines, habits, and identities. From a psychological perspective, MoCs represent changes in people's environment due to changes in personal, social, or professional circumstances, or in the infrastructural, political, and economic landscape in which their everyday lives are situated. MoCs may lead to the disappearance of contextual "cues" that maintain habitual behaviors (Verplanken and Whitmarsh 2021). Without the familiar cues prompting the behavior, the existing habit is compromised (Verplanken 2018) and individuals may be more open to alternative options. This can offer a window of opportunity for making new decisions about behavior and for new goals and intentions to be implemented (Carden and Wood 2018). This process is known as the Habit Discontinuity Hypothesis (Verplanken et al. 1997). Furthermore, studies suggest interventions implemented during MoCs are more effective than when implemented when habits are stable, highlighting important implications for policy and practice (Verplanken and Whitmarsh 2021).

From a sociological perspective, such as social practice theory, MoCs are pivotal points where shifts in social norms, routines, and interactions can lead to altered behaviors. These moments often arise from disruptions in established practices or the introduction of new technologies and ideas, prompting individuals and groups to reassess and adapt their behaviors accordingly (Spurling and Meekin 2014). MoCs could involve the removal of one or more elements of a set of inter-related practices, leading to the reconfiguration of a practice, or defection to an alternative (Shove et al. 2012). For example, relocating to an area without public transport infrastructure (*material* element of mobility practice) for the school run could increase car use with implications for shopping and commuting practices (Maller and Strengers 2013). Some MoCs may also affect the *social meanings* involved in practices, such as consumption; first-time motherhood, for example, involves a re-patterning of everyday life and schedules, but also a re-prioritization towards caring and thrift associated with the new parental role and identity (Burningham and Venn 2025). As practices are mutually contingent, a change in one practice can result in a change in another. Furthermore, occurrences such as pandemics or wars have wide-ranging effects—altering the social and material context of multiple practices simultaneously, and giving rise to experiences that might permanently transform normative understandings and procedures that shape everyday action (Klitkou et al. 2022).

MoCs can be divided into two categories (Thompson et al. 2011). The first comprises *biographical* events or "life transitions," such as relocation, becoming a parent, starting university, and retiring. The second captures *exogenous* events, such as extreme weather events, infrastructure disruption, economic shocks, or political crises. This binary typology belies considerable diversity within these two categories. Biographical MoCs span career, health, family and relationships; while exogenous MoCs span political, economic, infrastructural, health/security, and environmental disruptions at different scales (from local to global). Moreover, MoCs can be distinguished by characteristics such as degree of pre-planning, motivation and ability to change behavior, stress, and embeddedness/inter-dependencies of practices (Thompson et al. 2011). For our review, we use the simple binary categorization but include diverse MoCs within these categories, drawing out insights on their commonalities and differences.

As noted, MoCs have been theorized in different ways across disciplines. There are also distinct approaches to conceptualizing MoCs within different fields, with terminology including "transformative moments" (Hards 2012), "epiphanies" (Denzin 2001) or "critical moments" (Giddens 2020). Life-course studies (Shirani et al. 2017; George 1993; Baltes 1987) have focused on major developmental changes, such as becoming an adult or parent, or significant changes in work, relationships, group memberships, or finances, that can reconfigure lifestyles (Hards 2012), while work in the clinical domain explored life change inventories focused on negative life events (e.g., Rahe and Arthur 1978). Less work has examined how exogenous events can reshape behavior either directly or via a policy response (e.g., travel disruptions; political unrest; environmental disasters; Birkmann et al. 2010; Thompson et al. 2011). Similarly,

**Sidebar: Moments of Change and Their Diverse Effects on Health Behaviors**

Recent growth in research on the effects of life events on *pro-environmental* behaviors builds on studies of how these events can influence *health* behaviors (e.g., dieting, exercising, and risk behaviors). In a systematic review, Engberg et al. (2012) showed that getting remarried, having a child, starting university, and experiencing a terrorist attack all led to a decrease in physical activity. In contrast, change in employment circumstances, relationship status change, and pregnancy led to an increase in physical activity specifically for young women. The reasons for these changes are not discussed but appear to be linked to changes in the physical environment, available time, and social or economic factors associated with the life events. In another review, Gropper et al. (2020) found similar results and extended the findings by showing that retirement led to an increase in physical activity, while relocation and diagnosis of illness did not lead to any changes. Life events early in adulthood (e.g., starting university) can impact dieting and subsequent weight gain (e.g., Vella-Zarb and Elgar 2009; Wengreen and Moncur 2009; Finlayson et al. 2012). Finally, stressful life events (e.g., losing one's job, relocation, experiencing assault) could lead to an increased risk for suicidal ideation, especially in males and young adults according to a review by Howarth et al. (2020). The multidisciplinary application of life events sheds light on their varied effects on diverse behaviors and on different groups. It also allows for a nuanced exploration of how life events might intersect with mental health, societal dynamics, and overall well-being.

there has long been an interest in how life events shape health behaviors, such as smoking or exercising (see Sidebar). Graham et al.'s (2019) review, for example, found that health behaviors were relatively stable over the life-course, but some did change. For example, breakdown of a relationship was associated with a greater likelihood of starting smoking and binge drinking. However, applying the notion of MoCs to understanding pro-environmental behavior (e.g., energy use and travel) change is more recent.

There is therefore a need to synthesize this growing evidence base in order to understand some of the temporal dynamics of low-carbon behaviors, and how diverse MoCs may provide opportunities to reshape habits and foster more sustainable lifestyles. In the present article, we address this gap by undertaking a systematic review of the empirical literature on the relationship between MoCs and low-carbon behaviors, ultimately to assess the potential for MoCs to contribute toward a transition to low-carbon behavior. The rest of this article is organized as follows. In Section 2, we present the methods we used to identify, select, and analyze the 502 articles identified from a bibliographic search, and narrowed these down to 130. In Section 3, we present the results of our in-depth analysis of the 130 prioritized articles. In Sections 4 and 5, we discuss our findings, then conclude and identify future directions for research and policy.

## 2 | Methods

A systematic review is defined as "a rigorous and comprehensive approach to identifying, appraising, and summarizing all research in a particular area" (Hawker et al. 2002, 1285) with the aim of drawing more solid conclusions than individual studies can do. For our systematic review, we follow the methodology proposed by Uman (2011): we formulated research questions, then defined exclusion and inclusion criteria, developed a search strategy, located the studies, selected the articles, extracted the relevant information, analyzed and interpreted results, and disseminated findings. The resources available for the review and diverse methodologies used in the studies meant we were unable to undertake a formal assessment of study quality, but do nevertheless discuss methodological trends and limitations.

In our review, we address five research questions related to MoCs and their use in the climate change literature:

1. What are the temporal, demographic, and geographic characteristics of the literature published on MoCs and low-carbon behavior? What methods have been used?
2. Which MoCs (if any) lead to increased and/or decreased engagement in low-carbon behavior(s) and in which behavior(s)?
3. What are the pathways/mechanisms through which MoCs exert an influence on low-carbon behavior?
4. Are MoCs linked to any changes in non-behavioral factors (e.g., values and attitudes)?
5. Are there any individual or contextual factors that moderate low-carbon behavior change?

In the next section we describe the steps of the screening process. We discuss the search terms, search techniques, as well as the exclusion and inclusion criteria applied.

### 2.1 | Screening Process

We began by conducting searches using Scopus and Web of Science. Our search terms were divided into two parts: (a) terms specific to MoCs (e.g., parenthood and relocation), (b) low-carbon behaviors (e.g., mobility, energy use). The MoC terms included biographical events (e.g., relocation), exogenous events (e.g., infrastructure disruption), and general terms (e.g., habit disruption and life transition). The MoCs in our review were chosen after discussions during a workshop with experts working in the area of MoCs, and were further refined through preliminary literature reviews to ensure a diverse but searchable range of MoCs. We also focused on a wide variety of low-carbon behaviors covering both consumer (e.g., energy, mobility, food, and material use) and citizenship actions (Hampton and Whitmarsh 2023; Stern 2000). Each of our searches included a MoC combined with a low-carbon behavior using the "AND" operator. For example, we searched for "parenthood AND mobility" or "life transition AND mobility." Applying a diverse search strategy in our review allowed us to capture a wider range of the published literature unlike

previous reviews in the domain which targeted either specific MoCs (e.g., Zarabi and Lord 2019; Sprumont and Viti 2018) or specific behaviors (e.g., Larouche et al. 2020; Nash et al. 2020). See Appendix A for a full list of our search terms.

We conducted these searches within the article title, abstract, and keywords of the journal articles indexed in Scopus and Web of Science. We searched for articles from any subject area, any journal, and any year of publication. We conducted these searches in December 2021; thus, our review does not include any articles published since the beginning of 2022. We limited our searches to journal articles, excluding book chapters, editorials, and conference papers. We also only included articles published in English.

Our initial searches returned thousands of articles; after screening titles, we identified 185 relevant articles, of which 161 were retained after screening at the abstract level. Following this, we conducted backward and forward reference searching, also known as chain searching. Backward searching involved extracting the articles that were cited in each of the 161 articles by examining their reference lists. Forward searching involved identifying the articles that cited each of the 161 articles. During the backward and forward searching, we identified 6021 articles from the former and 3191 from the latter.

The next stage of our review was screening the titles and abstracts of the articles found through the backward and forward searches; this helped us identify 56 papers from the former and 285 from the latter. Taken together with the previous 161, we ended up with 502 journal articles in total. However, we removed 98 duplicate articles and another 204 articles which examined COVID-19 as a MoC. We excluded COVID-19 studies because COVID-19 was ongoing at the time of the review and the literature was still developing. At the end of this stage of the review process, we had 200 articles.

The final step in our screening process included analysis of the full text of each of the 200 articles. The main criterion that we considered was whether the article described an empirical study with data collected on the effects of a MoC on low-carbon behaviors measured at the individual level. Therefore, articles that explored behavioral intentions were not considered in the present review; nor were studies that only presented country-level or aggregate data (e.g., consumption trends). After exclusions, we were left with 130 articles: 91 on biographical MoCs and 39 on exogenous MoCs. These 130 articles form the basis of our review. See Figure 1 for a visual representation of our screening process.

### 2.2 | Text Analysis

We analyzed the 130 articles using a qualitative coding schema that included 15 coding categories. The coding schema was developed to align with our five research questions, building on and extending systematic review criteria which consider sample, phenomenon of interest, research type and design, and study outcome (Cooke et al. 2012). For example, some categories focus on descriptive characteristics of the articles—year of publication, the country where data was collected, and type of research methods used—to help us answer our first question about the characteristics of the published work. The other categories covered information related to the findings of the articles relevant to the other research questions addressed by this review, including behavioral outcomes/changes reported, pathways and mechanisms used to explain any behavior change, and any contextual factors which might have contributed to the results of the study, i.e., factors which served as drivers or barriers of behavior change. See Table 1 for a full list of the 15 categories.

## 3 | Results

Our results are presented in two parts. We begin by discussing the characteristics of the articles related to the biographical MoCs and the exogenous MoCs. We then proceed to discuss the theoretical and empirical findings of the review for each of the biographical and exogenous MoCs separately.

### 3.1 | Descriptive Results

We reviewed 91 articles exploring biographical MoCs and 39 exploring exogenous MoCs. The oldest article in our review was published in 1991, and it was the only paper published in the 1990s. Most articles on this topic were published after 2010, with the last decade (since 2015) seeing an increase in publications (Figure 2). Therefore, the corpus of journal articles in our review is relatively recent. See Appendix B for a full list of the 130 articles reviewed.

Next, we explored the country where the data of these articles was collected (Figure 3). Almost 21% of the articles presented data from the UK, followed by 12% from the USA, and 12% from Australia. Overall, only about 9% of the articles in our review collected data in the Global South (mainly in China). However, our review was limited only to articles published in English, which could have influenced the geographical bias of the articles.

As we discuss below, most articles used quantitative methods, such as surveys and panel data (61%), while fewer used qualitative research methods, such as interviews or focus groups (20%), or mixed-methods approaches (8%). While we did not undertake a formal quality assessment of the evidence, it is notable that most studies relied on self-report measures which are prone to bias (recall errors, social desirability; Kormos and Gifford 2014). This is compounded by some studies relying on "quasi-longitudinal" approaches (i.e., retrospective measures of pre-MoC behavior), for example where MoCs were unforeseen (e.g., pandemics). Relatively few studies tracked long-term behavior change beyond the MoC, so durability of behavior change is not always known. Given the highly diverse nature of the literature, the research designs, measures, populations, and sampling strategies were inevitably heterogenous, making comparisons even within MoC types challenging.

Reflecting the focus on mobility behaviors, the most common journals where articles were published were transport-focused (Appendix C).

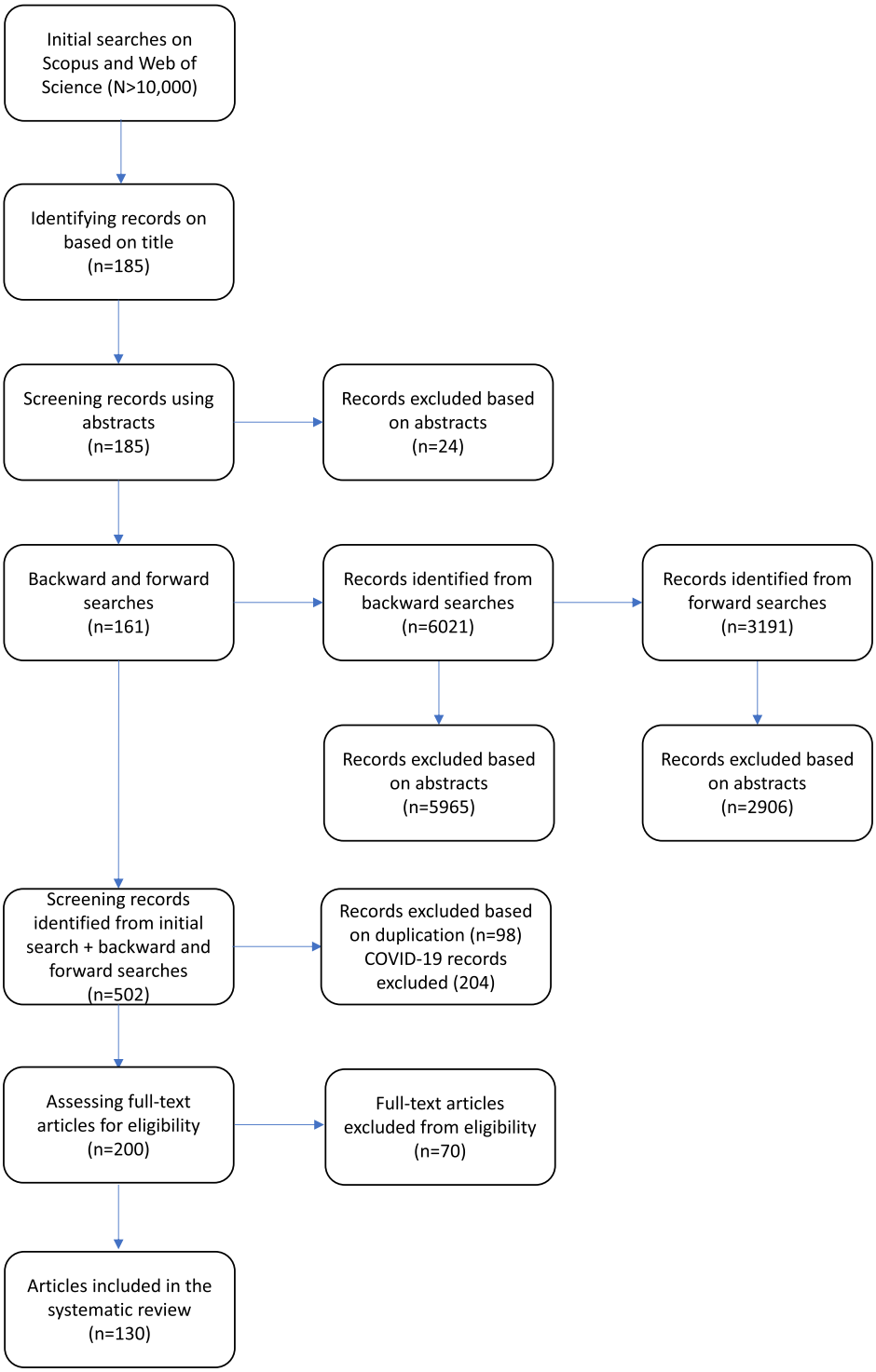


**FIGURE 1** | Visual representation of the screening process for the present systematic review.

## 3.2 | Biographical Moments of Change

Out of the 91 articles on biographical MoCs, 48% presented data on the effects of residential relocation, and in total, 63% of the articles discussed some type of relocation as a MoC, that is, residential/workplace relocation or migration (Figure 4). Almost 19% reported data on parenthood, while 10% explored changes to employment circumstances. Biographical MoCs usually happening earlier in life (e.g., starting university and graduating) were some of the least explored MoCs. Some articles explored multiple MoCs in their design.

### 3.2.1 | Residential Relocation

The MoC that received most attention in the low-carbon behavior domain is residential relocation. We identified 44 articles. All but three explored the effects of relocation on

**TABLE 1** | Qualitative coding categories and link to research questions (RQs).

| RQ | Coding category | Definition |
|---|---|---|
| 1 | When were data collected? | The year the data were collected |
| 1 | Where were data collected? | The country or city where data were collected |
| 1 | What was the population studied? | The characteristics of the sample population (e.g., women, under 18s, Scottish people) |
| 1 | What was the sample size? | The number of people who took part in the study/experiment |
| 1 | What was the design/method used? | The type of research methods for data collection (e.g., surveys and interviews) |
| 1 | How (and when in relation to the MoC) was change measured? | The time of data collection (e.g., before, during, after the MoC) and the method (e.g., longitudinal study, retrospective survey, etc.) |
| 2 | Which MoC(s) was studied? | The types of MoCs studied (e.g., relocation and financial crisis) |
| 2 | Which low-carbon behaviors or carbon-emitting behaviors were influenced by the MoC in question? | The type of low-carbon behaviors studies (e.g., active travel and meat consumption) |
| 2 | What were the behavioral changes/outcomes? | How did behavior change (e.g., 20% reduction in meat consumption)? |
| 2 | Were any other measured behaviors *unaffected*? If so, which? | Any other behaviors that might not have been affected by the MoC |
| 3 | What were the pathways/mechanisms underpinning/explaining the effects (or were pathways/mechanisms based on conjecture)? | The way the authors explain behavior change (e.g., mediation and moderation) |
| 4 | Were there any non-behavioral changes that occurred? | Any other constructs which might have been affected by the MoC (e.g., values and identity) |
| 5 | Were any contextual factors found to facilitate or impede low-carbon behavior change in relation to this MoC? | Contextual drivers or barriers to behavior change during the MoC (e.g., location, infrastructure, and other MoCs) |
| 5 | Were there any differences in terms of the kinds of people who were affected? | Personal characteristics of the samples resulting in differences in the results (e.g., men changed but women did not) |
| — | Other comments/findings of note | Additional information |

mobility behaviors: Groves et al. (2016) and Cho (2019) investigated changes in energy consumption, and Verplanken and Roy (2016) focused on a variety of pro-environmental behaviors. Moreover, 33 out of the 44 articles focused specifically on residential relocation as a MoC, while 11 looked at multiple MoCs in their design, with residential relocation as one of the life events. Since travel behaviors are particularly related to geographical and infrastructural factors (Whittle et al. 2019), this may explain the primary focus on these behaviors in relocation studies.

Out of the 44 articles, 36 used quantitative, four used qualitative, and four used mixed-methods research. Overall, the results showed that moving to a new place was associated with positive changes to low-carbon mobility behaviors in most cases, most likely due to the more common relocation to more urbanized/connected areas. Data from the Netherlands (Oakil et al. 2013) showed that residential relocation led to an increase in bike use, similar to results from the US (Janke and Handy 2019) and the UK (Chatterjee, Andrews, et al. 2013; Chatterjee, Sherwin, et al. 2013). Some studies explored moving from more suburban to more urban areas and found a reduction in car use (Bruns and Matthes 2019; Woods and Ferguson 2014) and an increase in public transport use, walking, and cycling (De Vos et al. 2018; Beenackers et al. 2012). On the contrary, moving to the periphery of a city led to an increase in driving in New Zealand (Buchanan and Barnett 2006) and Shanghai (Zhang and Guan 2016). This indicates the strong role that available infrastructure (e.g., paths and public transport) has on travel-related behavior change (Yang, Wu, et al. 2017; Yang, Day, et al. 2017). Directly testing the effect of active travel infrastructure, one study found that relocating to a walkable neighborhood in Perth, Australia, led to an increase in walking at 12 months (Giles-Corti et al. 2013) and 36 months (Christian et al. 2013) after relocation. Results from the US (Cao et al. 2007) and the UK (Jones and Ogilvie 2012; Aditjandra et al. 2015) indicate that walking increased when the environment was more attractive

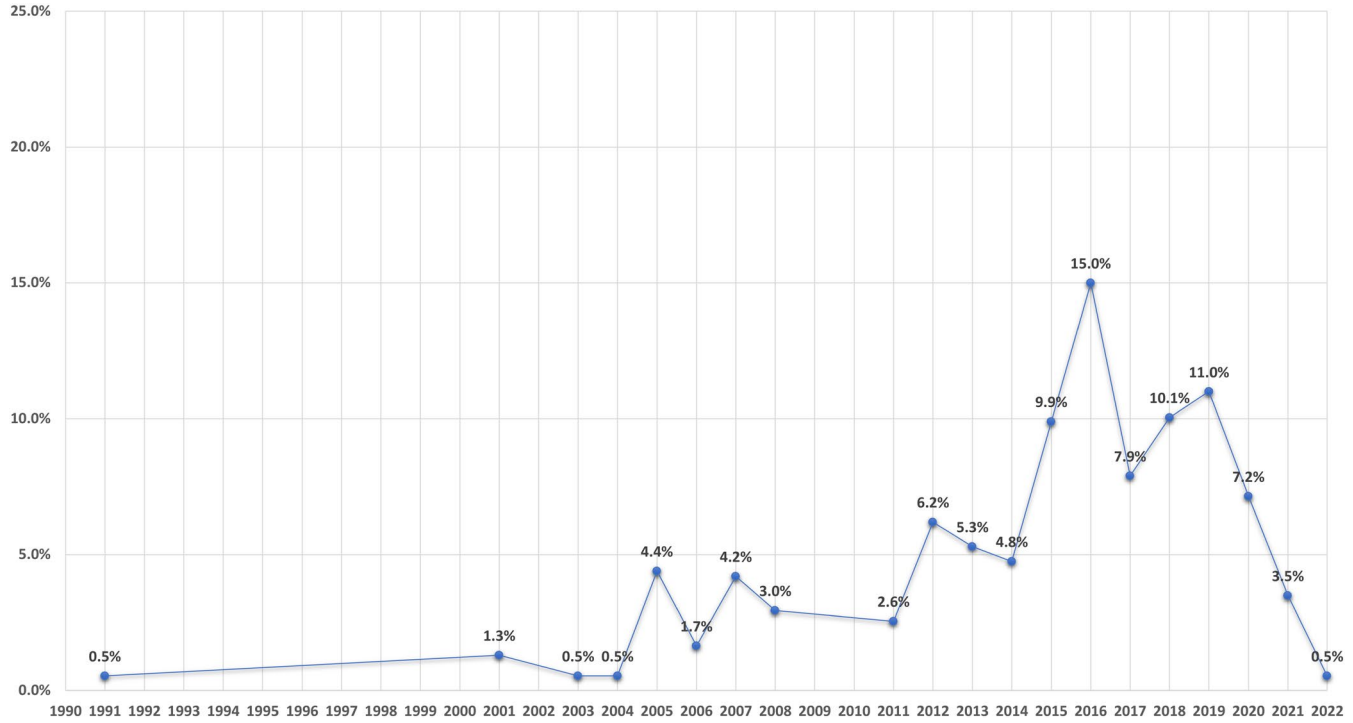


**FIGURE 2** | Percentage of articles according to year of publication for both biographical and exogenous moments of change (The decline since 2019 may reflect the impact of COVID-19 on MoC research).

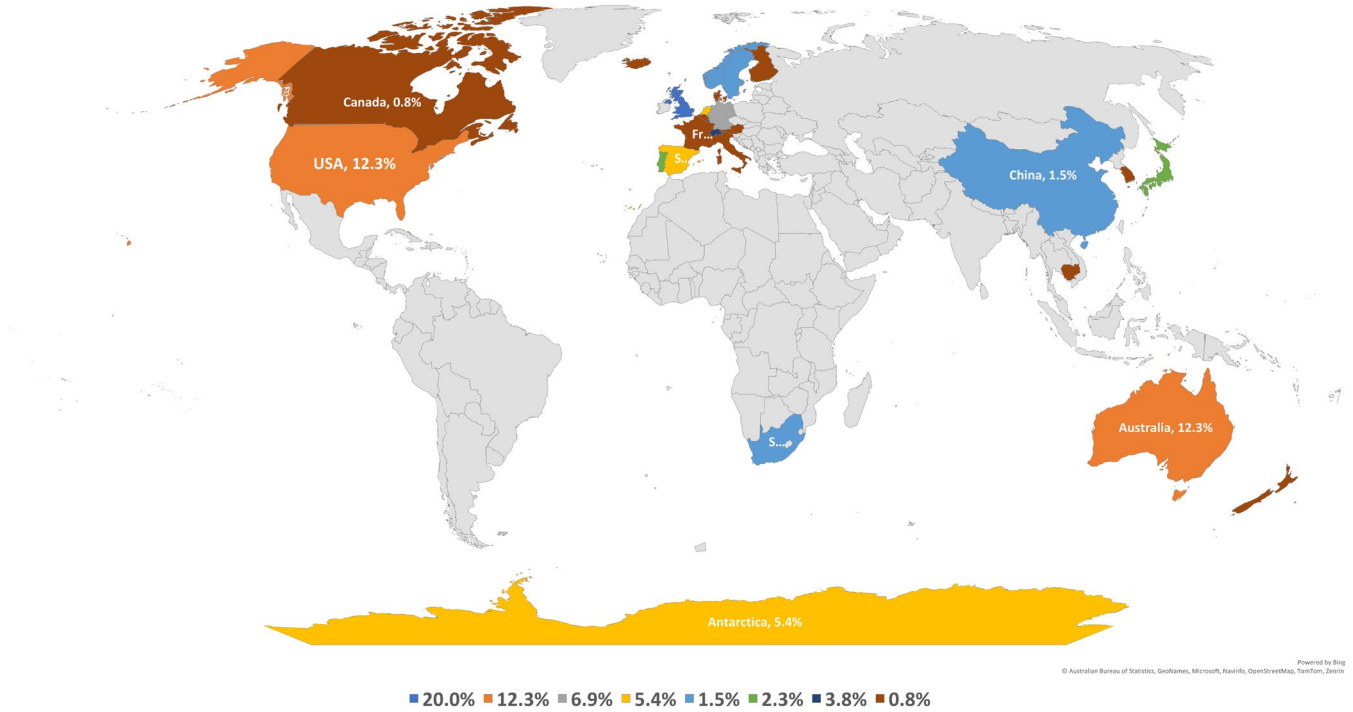


**FIGURE 3** | Percentage of articles according to the country where data was collected for the biographical and exogenous MoCs.

and safer, and driving decreased when amenities became more accessible. Such environmental improvements may lead to attitude change about travel modes, which in turn influence travel behaviors (Ramezani et al. 2021). Relocating also led to an increase in walking when there was an emphasis on its role in health promotion (Hirsch et al. 2014). Relocation also led to people joining a car share scheme given infrastructural constraints (e.g., parking facilities) and ethical as well as financial motives (Priya Uteng et al. 2019).

In addition, several studies which found a positive effect on mobility also provide evidence that relocation weakens existing travel choice habits, facilitating modal changes that are value-led (Fujii and Gärling 2003). Zarabi et al. (2019) showed

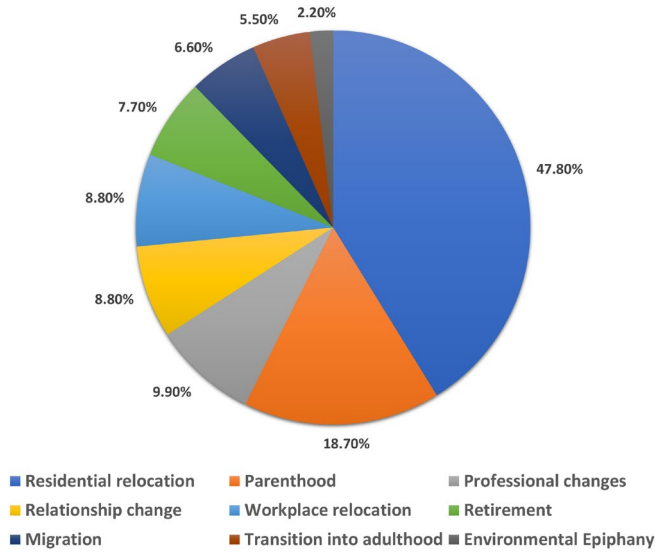


**FIGURE 4** | Percentage of articles according to type of biographical moment of change explored. The percentages in this Figure add up to 116% as articles which explored multiple MoCs were counted more than once, that is, they were assigned to more than one biographical event type.

a positive change in mobility behaviors after relocation. This was associated with habit strength, that is, the change was more pronounced for travelers who had not already formed strong habits. Other research showed values or attitudes may moderate behavior change; both Verplanken et al. (2008) and Thomas et al. (2016) concluded that moving house decreased car use, but the effect was strongest for people with high environmental concern. Haggar et al. (2019) found that relocation led to developing new travel habits, in particular walking or cycling, albeit only for people who engaged in pre-planning the type of transport they were going to use.

Some articles report mixed findings as residential relocation led to no changes in travel behaviors (Zhao and Zhang 2018), to an increase and a decrease in cycling (Bonham and Wilson 2012) and to an increase and decrease in car use and walking (Klinger and Lanzendorf 2016; Klinger 2017; Kamruzzaman, De Vos, et al. 2020; Kamruzzaman, Shatu, et al. 2020). Similar results were reported by Groves et al. (2016) regarding energy use, who pointed out that other factors that played a role in the results included anxiety, which is related to how change is managed, and levels of environmental concern.

Fewer studies reported a negative environmental effect of relocation than a positive one, such as increased car purchases in Australia (Jain et al. 2020), Switzerland (Schoenduwe et al. 2015; Beige and Axhausen 2012), Germany (Prillwitz et al. 2006), the UK (Clark et al. 2014; Clark, Lyons, and Chatterjee 2016) and China (Lin et al. 2018). Furthermore, Oakil (2016) reported gender differences in buying a car after residential relocation as this MoC seemed to affect women but not men, for reasons that are unclear. The same MoC also led to less walking by US women who moved to suburban from denser urban areas (Wells and Yang 2008) apparently due to less walkable environments. In addition, as the length of time since relocating residence increased, so did the probability of commuting by car (Thomas et al. 2016), for reasons that are unclear but may reflect rising household income over time, increasing accessibility to a car, or changes in commuting demands. This is consistent with longitudinal evidence on travel mode shifts in response to life stage and employment transitions (Klein and Smart 2019; Dargay and Gately 1999). Finally, Cho (2019) found that people who had recently relocated used less electricity initially, but this increased over time and eventually plateaued, due primarily to socio-economic factors (e.g., rising income and household size).

### 3.2.2 | Workplace Relocation

In addition to residential relocation, we also identified eight articles that explored workplace relocation as a MoC, six of them used quantitative research methods, one qualitative, and one had a mixed-methods design; all eight focused on mobility behaviors and studied either a specific workplace relocation (i.e., all participants underwent the same relocation in each study) or different workplace relocations in the same study. Three of the papers studying a single workplace relocation reported a positive effect with an increase in cycling and walking (relocation was from urban periphery to city centre; Pritchard and Frøyen 2019), decrease in car use and switch to biking (relocation was from suburb to city centre; Behren et al. 2018), and increase in train use with a switch from cars (relocation was from a small to a large town, with closer proximity to train station; Walker et al. 2015). The main reason for the positive shift described in these papers was the lack of free parking facilities or parking availability at the new workplace location, and improved public and active travel facilities. The findings also shed light on behavioral automaticity: driving habits decayed only gradually for those who had switched modes, indicating the potential to "relapse" to unsustainable modes following this moment of change despite new contextual cues (Walker et al. 2015).

Next, Pfertner et al. (2022) reported on a study of individuals in Munich, Germany, experiencing a workplace relocation in the last three years, and found that when offices were relocated to an urban or central location almost a third of employees reduced their car use and switched to public transport or cycling; however, when offices were relocated from central parts of a city to suburbs or outskirts there was a 25% increase in car use and a 29% decrease in public transport use, especially if the distance between the place of residence and the workplace increased by more than 5 km. Similar results were indicated by Bell (1991) in a study of an office move from central to suburban Melbourne, Australia, showing a 44% increase in car use, a 22% decrease in public transport use, and a 23% decrease in walking with the availability of free parking for employees identified as the main contributing factor for the switch in mobility behaviors. Negative changes were also reported in studies of office relocation from central, well-connected locations to peripheral or greenfield sites by Yang, Day et al. (2017) in Kunming, China; Sprumont and Viti (2018) in Luxembourg; and Rau et al. (2019) in Munich, Germany, all of which found an increase in car use for commuting to the new workplace location. The main factors contributing to the changes included increases in the distance to the workplace and in the total commuting time, also reducing

travel satisfaction and sometimes leading to wider lifestyle changes (e.g., domestic relocation and car purchase). Finally, Peer (2019) explored the effects of relocating an Austrian university campus on students' cycling behaviors and found that 8.4% of the students who did not cycle previously started doing so after the move, while 3.4% who used to cycle before stopped. Positive changes were more likely for male students, those of higher socio-economic status, and those who exercised more regularly.

Overall, workplace relocations can substantially shift commuting habits, often encouraging more sustainable travel modes like cycling, walking, and public transport if the new site is centrally located and lacks free parking. Conversely, moves to suburban areas with greater distances and ample parking can increase car dependence, ultimately dampening pro-environmental travel behaviors. Culture and gender, consistent with known cultural and gender differences in travel mode (e.g., Goel et al. 2023), as well as previous travel habits, moderate MoC impacts on travel behavior. Of the few studies documenting wider lifestyle changes arising from workplace relocation, these show commuting is often linked to other journeys purposes (e.g., caring and shopping), reinforcing the value of MoC research exploring multiple behaviors.

#### 3.2.3 | Migration

Migration is another type of relocation, which is defined as moving to a new country. In this sense, it is distinct from relocation within the same country (see Section 3.2.1). In our review, we identified seven articles on migration; five of the studies used qualitative methods and two used quantitative research methods. In a study of mobility behaviors, Burbidge (2012) followed students who moved countries and found that participants were significantly more likely to engage in low-carbon travel whilst living abroad. Individuals' travel behavior mirrored local counterparts (i.e., more public transport use in Europe and greater numbers of bicycle and walking journeys in South America). However, behavior shifted back to previous norms on return to the US. International students and researchers moving to Portugal similarly reported a decrease in car use and an increase in public transport (Monteiro, de Abreu e Silva, Haustein, et al. 2021; Monteiro, de Abreu e Silva, Ingvardson, et al. 2021). Proximity to a metro station and perceptions of ease of public transport use impacted individuals' use frequency and satisfaction.

In one of the few studies to look at behaviors other than transport, Maller and Strengers (2013) interviewed families who had migrated to Australia and found families adopted local approaches to saving water and energy use but understood these as manifestations of their prior cultural norms not to waste resources. Similarly, Tyers et al. (2019) found that Chinese students who moved to the UK started recycling more and engaged in more energy-saving practices. This was due to supporting infrastructure, increased environmental awareness, and the desire to fit in with the pro-environmental social norms in the UK. Two studies covered thermal comfort. Liu et al. (2020) found that participants migrating climatic zones in China switched to higher insulation clothing and consumed hot drinks for warmth. Fuller and Bulkeley (2013) found that migrating from the UK to Spain resulted in developing cooling behaviors such as wearing cooler materials or less clothing, undertaking heat-producing tasks like ironing and cooking early or late, or waking earlier to complete these and relying on passive mechanisms such as blinds and shutters to protect their homes from heat. Findings suggested that the social and technical flexibility of participants facilitated some of the behavior change. Most participants were older and retired with elasticity in daily schedules. Both studies on thermal comfort described a changing relationship with heat and cold physiologically and psychologically that came closer to matching locals over time through behavioral adjustment.

#### 3.2.4 | Transition to Adulthood

An important developmental stage, but little studied in relation to low-carbon behavior change, is the transition from adolescence to adulthood. This transition often involves relocation, but also changes in relationships, identity, and income; as such, it has implications for a range of low-carbon behaviors (Mitev et al. 2024). In our review, we identified five articles exploring this transition, all using quantitative research methods. Starting higher education resulted in an increase in public transport use for students in the Netherlands, perhaps due to the availability of a free public transport card (de Haas et al. 2018). However, Klein and Smart (2019) reported an increase in car ownership after graduating from university in the US, especially for those with higher socio-economic status, as they have more available capital to buy a car. Similarly, transitioning from university to work led to car users tripling from 7% to 20%, while the use of public transportation decreased from 54% to 45% (Busch-Geertsema and Lanzendorf 2017). Changes in mobility were dependent on whether relocation was present as a factor, as 56% of movers changed their travel mode compared to only 31% of non-movers who did the same. Other factors that influenced the changes were higher levels of car availability, larger commuting distance, and more financial resources.

MoCs early in adulthood also influence sustainable diets; for instance, Butler et al. (2004) found that 5 months after the start of university, first-year female students reported a decrease in meat and milk consumption; Hards (2012) found leaving the parental home resulted in a switch to more sustainable diets due to a newfound freedom to make independent dietary choices.

In sum, the transition into adulthood could critically shape pro-environmental behaviors, with changes such as starting university often encouraging more sustainable travel and dietary choices, while moving into full-time employment often leads to increased car ownership and reduced public transport use due to financial independence. Thus, new freedoms and altered resources that characterize early adulthood can have a significant influence on environmental decision-making.

#### 3.2.5 | Parenthood

Another important biographical MoC is becoming a parent. As noted earlier, this life event can be transformational for identity

and lifestyle, with implications for a range of low-carbon behaviors. We reviewed 16 articles in this category; eight used quantitative, seven used qualitative, and one used mixed-methods research. Overall, becoming a parent seems to be associated with diverse changes to people's everyday pro-environmental behaviors. Research found new parents were more likely to buy a car compared to non-parents, especially if they did not own a vehicle previously (Oakil, Ettema, et al. 2016; Oakil, Manting, et al. 2016; Klein and Smart 2019). New mothers reported using a car more frequently (Wang et al. 2020) and cycling less (Bonham and Wilson 2012; Oakil et al. 2013). The latter was accompanied by a change in values (e.g., increase in the importance of their own health and the safety of the child; Bonham and Wilson 2012). Higher-carbon changes to travel patterns were also reported by Rau and Manton (2016), Thomas et al. (2018), and McCarthy et al. (2021). However, de Goede and Greeff (2016) found that mobility behaviors were positively affected, with car sharing, organizing lift clubs, and using public transport identified as new behaviors after transitioning to parenthood. Having a child also led to more walking according to Gao et al. (2019) and Schäfer et al. (2012). The diversity of findings points to contextual differences in available infrastructure and social connections that likely mediate the effects of parenthood on travel behaviors. In particular, the increased use of cars and reduced cycling among new parents, especially mothers, may reflect concerns about safety, time constraints, and the logistical complexity of traveling with children (Bonham and Wilson 2012).

Studies focusing on other low-carbon behaviors found that new parents switched off lights more often (Thomas et al. 2018) and reduced meat consumption (Moura and Aschemann-Witzel 2020), mainly due to concerns related to saving money and health. The former study also found an increase in environmental concern. The latter collected data from Denmark and France and reported that the change in meat consumption was more apparent in the French sample, suggesting a role for cultural differences in behavior change. On the contrary, both Elstgeest et al. (2012) and Hards (2012) reported higher meat consumption after becoming a parent, for reasons that are not made explicit. It is also interesting to note that in a study by Olson (2005) milk consumption for women increased in the transition to parenthood; however, 2 years postpartum, milk consumption returned to pre-pregnancy levels. Finally, Burningham and Venn (2017) found no consistent shift to sustainable consumption behaviors after parenthood, arguing that the exact point of transition for this MoC is unclear as change is ongoing. However, they did report changes in identity following becoming a parent.

#### 3.2.6 | Relationship Change

Everyday practices are relational and embedded in dynamic social contexts, particularly familial and marital relationships (Shove et al. 2012). We identified nine articles that looked at how a change in relationship (e.g., marriage and divorce) impacts low-carbon behaviors, with six quantitative, two qualitative, and one mixed-methods article. Yu and Liu (2007) found a 53% increase in electricity use and 42% in water use per person per month for households in which the head of the household had divorced. These increases were much greater than for households where the household head remained married. The effects are explained by resource use correlating with household number and size (i.e., individuals living alone consume more per capita than in larger households). Both getting a divorce (Oakil 2016) and finding a partner (Klein and Smart 2019) were associated with increased car ownership, while divorce also led to a shift to car use (Clark et al. 2014; Clark, Lyons, and Chatterjee 2016; Wang et al. 2020). Marriage also led to an increase in meat intake (Elstgeest et al. 2012), while divorce influenced a shift to a more sustainable diet (Hards 2012). Shirani et al. (2017) found an increase in energy use following becoming a carer for family members, and a perceived need to provide a warm home. The reasons for these effects are not always clearly stated in the studies but may reflect shifts in household composition, negotiation of domestic roles, and changes in domestic routines, which have previously been found to influence energy and mobility behaviors during relationship transitions (e.g., Burningham and Venn 2017).

#### 3.2.7 | Professional Changes

People also go through changes in their professional lives, such as changing jobs or employers, with potential implications for travel, consumption, and other practices. Note that this is distinct from workplace relocation (Section 3.2.2) in which the employer decides to physically change where staff work, but job status/type and employer do not change. We identified 10 articles investigating this as a MoC; seven applied quantitative methods, two used qualitative, and one had a mixed-methods design. All examined mobility behaviors, finding mixed effects. Job change predicted a shift in travel mode (Schoenduwe et al. 2015), and according to Clark et al. (2014); Clark, Chatterjee, and Melia (2016b) the shift was towards more car use in the UK, while Wang et al. (2020) found a shift from car use to alternative travel modes in China. Changing jobs also resulted in an increase in car ownership (Beige and Axhausen 2012; Prillwitz et al. 2006), though according to Oakil (2016) the effect was only for women. Active travel was reported to decrease when getting a new job by Rau et al. (2019), though cycling seemed to be influenced both positively and negatively (Oakil et al. 2013). Shirani et al. (2017) found higher engagement in low-carbon travel behaviors due to starting a new job, but this was primarily due to the theft of the interviewee's vehicle (drawing attention to what may be considered a more significant disruptor of travel practices). Most studies do not explain the observed changes in the travel mode following job change. However, such changes may reflect increased income and shifting time demands associated with changes in work routines, which are known to influence commuting preferences and car ownership (Dargay and Gately 1999). In addition, job changes may involve longer or less predictable commutes, further incentivizing car use over active or public transport modes.

#### 3.2.8 | Retirement

Another significant life transition in many countries is retirement from work. This economic, social, and identity change has implications for several low-carbon behaviors. Our review

included seven articles tracking behavior change in retirement, with three quantitative and four qualitative studies looking at changes to diet and mobility. Si Hassen et al. (2017) found that meat and dairy consumption did change around this time, but that these were not directly related to retirement, suggesting age or other factors may be responsible. Burningham and Venn (2017) reported no change in consumption behaviors for new retirees.

On the other hand, mobility behaviors do change with retirement. Siren and Haustein (2016) found a reduction in annual mileage—1114–2729 km—possibly due to a lack of need to commute to a workplace; but the reduction was greater for men than women, since men were more likely to use a car to commute. Berg (2016) found that the purpose of having a car changed after retirement from work to leisure but was still seen as very important. Nevertheless, while Nakanishi and Black (2016) found some retirees increased their active travel or use of public transport, most expected to still be driving in the future, that is, well into their 80s. This persistence in car use may reflect the symbolic and practical importance of driving for autonomy, flexibility, and social inclusion in later life, as highlighted in transport aging research (e.g., Musselwhite and Haddad 2010; Shergold et al. 2012). Cycling also increased after retirement according to Bonham and Wilson (2012) while Berg et al. (2015) also found an increase in both walking and cycling.

#### 3.2.9 | Environmental Epiphany

Another MoC we explored was going through an environmental epiphany, defined as an experience that shifts the relationship between the self and nature (Storie and Vining 2018). Examples include awe-inspiring nature experiences or witnessing environmental degradation first-hand. We identified two relevant articles, one quantitative and one qualitative. Powell et al. (2008) followed a group of tourists who visited Antarctica. At a three-month follow-up, there were no significant changes in tourists' reported pro-environmental behaviors compared with before the voyage, despite a 10% increase in intentions to engage in a range of pro-environmental behaviors when surveyed in the immediate aftermath of the trip. Storie and Vining (2018) recruited participants who had indicated they had experienced environmental epiphany and indicated that 80% of participants reported changes in their behavior towards pro-environmentalism including reduced meat reduction, eliminating hazardous household chemicals, and public-sphere activity such as a career-change. In contrast to Powell et al.'s (2008) findings, changes were persistent with 90% reporting the behaviors to have lasted on average 10-years post-epiphany. The authors argued that the study warrants the provision of public opportunities for access to natural areas with room for "solitary contemplation." This suggests that deliberating over the significance of the experience may be important for durable change (cf. Tasci and Godovykh 2021).

#### 3.2.10 | Summary of Findings on Biographical MoCs

Overall, the findings on biographical MoCs are diverse. Many of the studies focused on disruption to *place*. The evidence from these studies suggested that moving home often resulted in positive changes in mobility behaviors, such as reduced car use and increased use of public transport and active travel, although this change was contingent on supporting infrastructure and may reflect a focus on moves to urban areas rather than the other way around. The effect can also vary by habit strength and environmental concern, highlighting the potential for psychological factors to act as mediators of MoC-induced behavior change (see Section 4). The impact of workplace relocation on mobility behaviors was mixed and similarly depended on external factors like infrastructure, distance to the new location, and commuting times. Moving to a new residence in a different country often led to positive changes in low-carbon behaviors, such as increased recycling and energy-saving practices, due to supportive infrastructure and social norms in the new location. Again, there are relevant intra-individual factors, including prior cultural norms, which can be re-activated in the new culture.

Other MoCs relate to *family*. Becoming a parent changes lifestyles and identity, but has mixed effects on low-carbon behaviors. New parents were more likely to buy cars and use them more but also engaged in some positive behaviors, such as car-sharing and reduced meat consumption. Studies on relationship change found that these MoCs usually had a negative effect, that is, increased electricity and water consumption, car use, and meat intake.

A further set of MoCs focuses on *work*. The transition from university to work or leaving the parental home sometimes resulted in changes in mobility and dietary behaviors, including increased car use and changes in food consumption, at least partly due to increased income, but also due to incentives such as free public transport passes. Professional changes also resulted in mostly negative behavioral shifts with an increase in car ownership and a decrease (but sometimes increase) in cycling. Retirement had different effects on behaviors. While it often led to reduced car use due to changes in commuting needs, it also presented opportunities for unsustainable changes in travel patterns. Dietary behaviors also changed in diverse ways.

A unique MoC is *experiencing an environmental epiphany*, which changes environmental awareness and values but only sometimes leads to more engagement in low-carbon behaviors. As we discuss later, there are some similarities in how environmental epiphanies and natural disasters impact climate mitigation behaviors through increased risk perception or environmental concern.

In conclusion, biographical MoCs, such as residential relocation and parenthood, can have both positive and negative effects on low-carbon behaviors. The evidence from our review suggests that the impact depends on various factors, including infrastructure, habits, culture, and individual circumstances. Demographic factors, such as gender, are sometimes moderating factors in MoC effects on behavior. We should note that a large number of the reviewed papers focused on some kind of relocation as a MoC as well as on exploring changes to mobility behaviors, with other MoCs and behaviors receiving far less attention.

### 3.3 | Exogenous Moments of Change

Out of the 39 articles exploring exogenous MoCs, we found that 42% concentrated on financial crises, while 22% looked at natural disasters, and 20% at infrastructure disruption. There was less focus on events such as terrorist attacks, food safety concerns, and pandemics (Figure 5).

#### 3.3.1 | Financial Crises

Given the significant influence on consumption (and associated emissions) of income and pricing (Poortinga et al. 2004), societal economic disruption can have profound impacts on lifestyles, particularly as a result of changes in employment status and cost of living. We reviewed 15 articles looking into the effects of financial crises on travel, electricity use, meat consumption, and environmental activism. (Note that other studies have examined effects of financial crises on consumption at the aggregate level, but are excluded because they do not include individual-level data).

- *Mobility*. The financial crash of 2007–8 and ensuing financial and economic crises that unfolded around the world had a major impact on mobility and travel-related behaviors. Research conducted in Spain (Marquet and Miralles-Guasch 2016) suggests a shift away from motorized private transport (−7.8%) towards more active travel (+8.8%) except for motorbikes, which saw an increase of 36.2%, and a slight decrease in the use of public transport (Marquet and Miralles-Guasch 2018). Maciejewska et al. (2019) similarly reported a shift away from motorized private and public transport towards more active travel, while Cascajo et al. (2018) showed car purchases also fell. The effect was stronger for men compared to women (Marquet and Miralles-Guasch 2018; Maciejewska et al. 2019), while low-income households were least able to adapt their travel (Cascajo et al. 2018). In two studies with a focus on Thessaloniki in Greece, Papagiannakis and Vitopoulou (2015) and Papagiannakis et al. (2018) found that 49% of people whose main mode of travel before the crisis was the car changed their behavior to other travel modes, mainly public transport (36%). Furthermore, 22% had reduced their car trip frequency explicitly because of the crisis; low-income households were the most likely to have replaced the car with bus travel (Papagiannakis et al. 2018). In Iceland, 27.1% of respondents used their own vehicle less often since the start of the financial crisis, with a shift towards increased walking and cycling (21.0%) and bus use (14.7%; Ulfarsson et al. 2015). Cadima et al. (2020) found that in Portugal the number of students commuting by car decreased substantially from 41.4% in 2006 (before the Portuguese financial crisis) to 29.3% in 2012 (during the crisis), while public transport increased from 38.9% to 51.7%. Walking and cycling remained at about the same level (19%–20%). Many of the studies interpret changes in travel mode choice from a budget perspective—either implicitly or explicitly—whereby the crisis forced people to adopt more economically viable travel (Sobrino 2015). Kamruzzaman et al. (2014) provided evidence of this from Australia, where individuals who became unemployed or experienced financial hardship due to the crisis were more likely to switch to public transport from 2007 to 2009 compared to those who did not. However, from the reviewed literature, it is not clear whether changes in mobility and travel-related behaviors have been maintained beyond the end of the financial crisis, due to a paucity of research tracking travel behaviors over longer periods. Where longer-term data are available (e.g., Kamruzzaman, De Vos, et al. 2020; Kamruzzaman, Shatu, et al. 2020), the authors state that the change could be due to the financial crisis but also due to an increasing emphasis on promoting sustainable transport.
- *Electricity*. Only one study focused on electricity use in the context of the 2008 financial crash (and subsequent economic impacts in the following years). Santamouris et al. (2013) used retrospective data from Greece and reported that energy use in winter 2011–12 was 14.8% lower than in winter 2010–11, despite lower temperatures. Just as for mobility and travel, the effects are explained by lower budgets forcing households to economize on their home heating, although no direct economic evidence was gathered.
- *Meat consumption*. One study in Greece examined diet in the context of the 2008 financial crash, albeit from a health perspective. Kosti et al. (2021) found that self-reported impacts of the crash on food spending were associated with parents consuming fewer servings of fruits, carbohydrates, and legumes. There were, however, no significant differences in meat consumption for either parents or children. While this provides an indication that the financial crisis and following impacts of household finances may have an impact on diet (where healthy foods cost more), its environmental impacts are unclear; it is also not clear whether there were pre-existing differences between the different groups.
- *Environmental activism*. Both Dienes (2015) and Ivlevs (2019) used the Life in Transition Survey II, conducted in 2010 in 35 European and South Asian countries, to examine the impact of the 2008 financial crisis on environmental action and willingness to pay tax to combat climate change. Households that were more affected by the 2008 financial

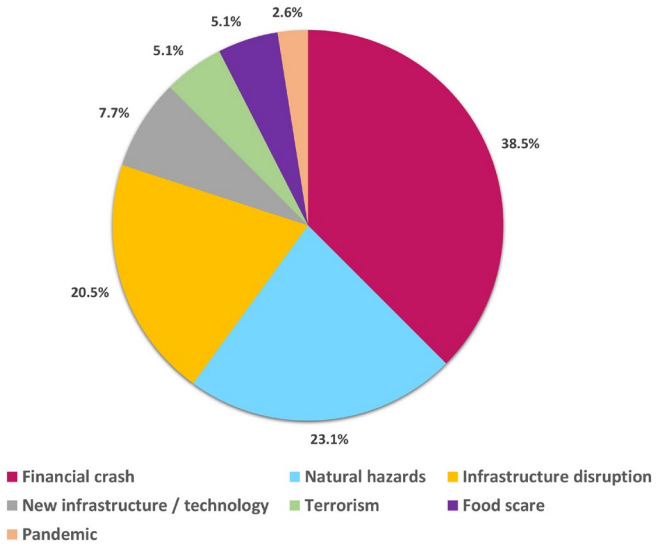


**FIGURE 5** | Percentage of articles according to type of exogenous moment of change explored.

crisis were less willing to pay tax to combat climate change, but more willing to take personal environmental actions to combat climate change. Indeed, Ivlevs (2019) shows that the greatest effects were for so-called curtailment behaviors, such as reduced consumption of water, energy, disposable items, and transport. Again, this suggests financial pressures lead to low-carbon behavior change where these provide cost savings.

#### 3.3.2 | Natural Disasters

Another notable type of exogenous MoC is experiencing a natural disaster, such as a flood or storm, with eight papers identified—three quantitative, two qualitative, and three mixed-methods. The link from this experience to low-carbon behaviors may be via elevated risk perception or environmental concern (i.e., making salient the impacts of human-induced climate change to motivate mitigation or, more likely, adaptation); or it may be more pragmatic, a result of disrupted resource supply systems (e.g., water shortages, blackouts) that lead to changes in practice without changes in attitudes.

Of the studies that focussed on water stress and drought, Chappells et al. (2011) reported that some households experiencing drought adopted new garden-watering practices, a finding echoed by Lindsay and Supski (2017) who found that Australian droughts led to less watering and showering. However both studies highlight the short-term impacts, that is, only during the drought period, and that these events do not necessarily challenge forms of "normality" rather than provoke temporary adjustments to practices that remain in keeping with understandings of what water is for, and the infrastructures that enable supplies into the home. Another Australian survey showed differences according to location (Lindsay et al. 2017). Perth residents were less likely to report personal behavior change during water restrictions, though a higher acceptance of alternative water supplies, while Melbourne residents reported showering, washing clothes and watering the garden less frequently during the drought and Brisbane residents greater uptake of devices in the home, though less adjustment in water-using practices (Lindsay et al. 2017). These findings highlight important difference in water cultures, and the effect of social, infrastructural and policy conditions on both baseline water practices and responses to crisis.

In a mixed-methods study from Cambodia, Ung et al. (2018) reported that people who had experienced floods and storms in the previous 5 years reported lower household energy consumption compared to those who had not, which the authors interpret as being due to elevated concern about climate change and motivation to mitigate it. Whitmarsh (2008) reported few differences in the frequency of, or motivation for, low-carbon behaviors between flood victims and non-victims, although flood victims were more likely to regularly use public transport and to take part in environmental campaigns than non-victims. Since the study did not control for demographic variables, it is possible that these relationships may be explained by other factors (e.g., low-income residents are more likely to live in flood-prone areas and to use transit). Flooding was also the reason for using one's car less often according to Marsden et al. (2020); however, the authors state this was more likely due to road closures than to travelers' desire to mitigate climate change.

Two studies from Japan looked at earthquakes as a MoC. Mochizuki and Chang (2017) showed that after the Fukushima earthquake, disaster-affected communities adopted more solar power compared to the rest of Japan; the effect was even stronger for households who had to relocate or had higher physical damage to their homes. Fujimi et al. (2016) found an increase in the number of Tokyo households reporting energy conservation at home, including increasing air conditioning temperatures by 2°C and reducing the cooling intensity of refrigerators, with the behaviors persisting over the two years studied after the earthquake. A study from New Zealand found that after earthquakes in 2010 and 2011, many businesses were forced to relocate to the suburbs of Christchurch; however, later in 2017, many of these businesses relocated back to the city centre. The latter relocation led to a reduction in car use and an increase in bus use, as well as higher engagement in active travel. This study complements findings reported in the biographical MoC section, highlighting the importance of urban design for mobility practices.

#### 3.3.3 | Infrastructure Disruption

Next, we reviewed eight quantitative articles which looked at the effect of infrastructure disruption (e.g., road closure and strikes) as an exogenous MoC, mostly on mobility behaviors. Again, this focus may be unsurprising given that travel behaviors are particularly infrastructure dependent. (As noted earlier, we restricted our search to studies where individual-level data was collected, rather than aggregate data, e.g., traffic count.) Strikes affecting the London underground increased bicycle trips and their duration (Saberi et al. 2018). However, people reverted to their usual mobility behaviors as soon as the strike was over (Fuller et al. 2012). Underground renovation in Athens led to people switching to cars or buses; women were less likely to travel by car, and low-income individuals had a stronger preference for the bus (Pnevmatikou et al. 2015). Motorway closure in Tokyo, Japan resulted in an 11% increase in using public transport for commuting (Fujii et al. 2001). Reorganization of road and public transport in Florence, Italy caused by the World Cycling Championship did not have a large effect on changing habitual transport behaviors (Lattarulo et al. 2019). Around 60% of the people stuck to their usual way of moving around the city and only 11% changed transport mode (although this rose to 18% among car users). Travel disruptions caused by the London Olympics prompted 11% of participants to switch their mode of transport, while 31% reduced their travel frequency (Parkes et al. 2016). The most significant changes were observed among females, individuals aged 18–34, and those without children. However, once the Olympics concluded, people largely returned to their previous travel behaviors.

Leighty and Meier (2011) showed that the destruction of a main hydroelectric transmission line in Juneau, Alaska led to a 500% increase in electricity prices. However, even before the price increase, electricity demand fell by 25% in the few days after the destruction, and these reductions were sustained for 6 weeks.

Around 10% of respondents changed their appliances to more efficient ones, 18% installed additional insulation in their homes, almost 50% took shorter showers, and 36% took fewer showers. These new water behaviors persisted after the end of the crisis for 21% and 12% of respondents, respectively. Finally, energy rationing after the Fukushima disaster led to a 15% decrease in energy demand, and these levels remained constant for 4 years after the event (Kimura and Nishio 2016).

We reviewed three studies looking at introduction of new infrastructure. Brown and Werner (2007) showed that the introduction of a new light-rail stop led to a 19% increase in ridership, but the increase was not due to people switching from bus to rail as bus use remained constant before. Heinen et al. (2015) showed that those who lived closest to a newly introduced busway in Cambridgeshire, UK were more likely to report a large increase in the proportion of their commute trips that involved active travel than those who lived further away. The new busway also explained a large decrease in the share of commute trips made entirely by car and "prevented" a small decrease in the share of commute trips involving active travel. Finally, Chatterjee, Andrews, et al. (2013) and Chatterjee, Sherwin, et al. (2013) showed that after joining a car share club (a form of transport infrastructure provision), 40% of survey respondents reported a reduction in the number of vehicles they owned, 55% reported no change, 6% an increase. Of those who reported a reduction, 31 individuals went from having a car to not having a car, and 11 went from owning multiple cars to owning a single car. Of the respondents who maintained or increased their car ownership, 37 stayed without a car.

#### 3.3.4 | Pandemics

Pandemic controls typically limit physical movement, so can be disruptive to various low-carbon behaviors. We reviewed one quantitative article which looked at the effects of the Middle East Respiratory Syndrome (MERS) outbreak in Seoul, Korea on mobility behaviors (Kim et al. 2017). One month after the outbreak, there was a 12% decrease in all trips by public transport; more specifically, a 14% reduction in subway use, 37% in circular bus, and around 10% in use of other bus networks. These changes were most apparent among senior people (24%), children (21%), and people with disabilities (14%). Some of the factors driving the change included whether trips were taken to MERS hotspot zones, the number of restaurant businesses in the area, and the number of healthcare facilities in the area. As noted earlier, we excluded the burgeoning literature on COVID-19, which has been more disruptive to lifestyles than MERS; analysis of this literature will shed further light on how pandemics impact low-carbon behaviors.

#### 3.3.5 | Food Scares

Experiencing a food scare can also result in changing diet preferences as described in two quantitative articles we reviewed. Schroeder et al. (2007) showed that after the Bovine Spongiform Encephalopathy (BSE), widely referred to as "mad cow disease," scare, beef consumption in Canada, US, Japan, and Mexico dropped by 19.6%, 20.6%, 55%, and 31.2%, respectively. Around one-quarter of those who reduced their consumption in the first three countries also did it by 80% or more. Similarly, Setbon et al. (2007) reported that 3 months after a BSE event in France, 76% of respondents to a survey had modified their beef consumption; but 14 months after the event, this number had dropped to 68%. Both papers concluded that risk perceptions were positively correlated with a drop in beef consumption.

#### 3.3.6 | Terrorism

Finally, we reviewed two quantitative articles focusing on the effects of terrorist attacks on mobility. After the 9/11 terrorist attacks in the USA, there was a 7.9% decline in domestic revenue per passenger mile in aviation compared to the previous 12 months (Ito and Lee 2005). The terror attacks in Madrid in 2004 led to a small reduction of train use in Spain; however, it was short-lived and did not lead to an increase in car use (López-Rousseau 2005). The author notes that compared to the USA, the Spanish population had experienced more terrorist attacks and thus may have been less alarmed. This highlights the significant role of cultural context in moderating exogenous MoC impacts.

#### 3.3.7 | Summary of Findings From Exogenous MoCs

Like the biographical MoCs, findings from studies on exogenous MoCs are diverse. Evidence from the studies suggests that financial crises had a substantial impact on mobility and travel-related behaviors. During the global financial crisis of 2007–2008, there was a discernible shift away from motorized private transport towards more active travel modes and lower household energy use. There was no impact on meat consumption, and findings on environmental activism were mixed. Taken together, the impacts on low-carbon behaviors can be understood from a budget perspective, where low-carbon behaviors offer financial savings, they become more attractive when resources are constrained. Conversely, although the long-term effects of the crisis were not measured at the individual level, other evidence shows consumption increases with income (Poortinga et al. 2004) so behavioral effects are unlikely to endure beyond the crisis. The results somewhat varied across socio-demographic groups (e.g., gender and income) in ways that are consistent with budgetary and employment impacts of the crisis.

Other exogenous MoCs involve physical disruptions that prevent (or, less often, enable) access to certain types of consumption, particularly travel. Infrastructure disruptions, such as road closures and public transport strikes, shift low-carbon behaviors in predictable ways (e.g., road closures reduce car use), but tend only to temporarily impact travel behaviors. The introduction of new infrastructure, such as light rail stops and busways, positively influences low-carbon travel behaviors. Pandemics and terrorist attacks have led to a temporary decrease in public transport use or aviation, while the BSE outbreak decreased beef consumption in affected countries.

Natural disasters can act in different ways to disrupt behaviors: like infrastructure disruption, they can temporarily limit access to resources; but in contrast to other types of exogenous MoC,

they can also more fundamentally change (risk) perceptions or social meanings in relation to the environment or consumption, with the possibility of more durable change to social practices. Experiencing droughts led some (but not all) to adopt water conservation practices, while some earthquake-affected communities adopted solar power, particularly those who had to relocate or suffered significant damage to their homes. Flooding has also had some positive impacts on low-carbon behaviors, including travel and energy use. In keeping with the wider evidence base on the experience of climate impacts (Hornsey et al. 2016), however, climate *mitigation* behaviors appear to be less likely than adaptation behaviors to result from these experiences unless the event (e.g., flood) is attributed to climate change (Reser and Bradley 2020).

In conclusion, the evidence from our review suggests that exogenous MoCs, encompassing financial crises, infrastructure disruptions, security/health scares, and natural disasters, can indeed shape low-carbon behaviors. These changes are often driven by budget constraints, availability of alternative options, risk perceptions, and policy responses to deal with these issues. In this sense, the effects on behavior may be direct or indirect (e.g., via policy). However, the long-term durability of such behavioral changes, as well as their specific effects on environmental outcomes, requires further exploration and study.

## 4 | Discussion

Our review brings together evidence from 130 studies investigating a wide range of MoCs in a diversity of settings and populations, and using different methodologies. Despite this heterogeneous evidence base, it is possible to provide some broad answers to the review's research questions.

### 4.1 | RQ1: What Are the Temporal, Demographic, and Geographic Characteristics of the Literature Published on MoCs and Low-Carbon Behavior? What Methods Have Been Used?

There has been a growth in interest in MoCs in recent years, with most articles we reviewed published after 2010. Most research focused on the Global North (e.g., UK, USA, and Germany) with far less attention on the Global South. Most articles used quantitative methods (e.g., surveys and panel data) and fewer used qualitative (e.g., interviews) or mixed-method approaches. Most relied on self-report measures of behavior, and some also on "quasi-longitudinal" (retrospective recall) approaches; few studies tracked long-term behavior change beyond the MoC. These methodological limitations are discussed further below.

### 4.2 | RQ2: Which MoCs (If any) Lead to Increased and/or Decreased Engagement in Low-Carbon Behavior(s) and in Which Behavior(s)?

Consistent with sociological MoC studies (Burningham and Venn 2017, 2020), our findings show that the effects of biographical MoCs on low-carbon behaviors are highly diverse and often influenced by contextual and individual factors. Notably, no single MoC consistently drives shifts towards lower-carbon behaviors; the effects differ depending on the specific behavior and situation (Table 2). For example, the effects of physical MoCs (relocation) on mobility behavior tend to depend on the physical infrastructure (parking and walkability) of the new home or workplace. However, since there is usually some degree of choice of home location (albeit constrained by social and economic factors), this may in turn be guided by individual factors such as environmental values (i.e., residential self-selection; Ettema and Nieuwenhuis 2017). Entering the world of work is often associated with increased car ownership, while retirement tends to decrease car use, highlighting the significance of both income and job-related mobility needs. Other life events, such as childbirth, have more mixed effects on different behaviors, such as diet and travel, indicating changing priorities, resources, and schedules.

The effects of exogenous MoCs are equally varied. For financial crises, consumption across categories (energy, travel, etc.) reduces in line with incomes, leading to emission reductions. Experiencing natural disasters has led to certain low-carbon behaviors, such as (temporary) water conservation during droughts; other behavioral changes may be dependent on available options (e.g., relocating offices following an earthquake to where sustainable travel is more viable). Travel infrastructure disruption also impacts mobility behaviors in broadly expected ways, e.g., road closures lead to reduced car use, and new transit links increase transit use. Health-related events, such as pandemics and food scares, similarly affect relevant behaviors (mobility and diet) in low-carbon ways; and terrorist attacks also reduce travel. However, the durability of these changes is under-researched, and in some cases, changes are likely to be only temporary in the absence of accompanying interventions to lock in habit change. This highlights an important opportunity for policymakers to capitalize on disruptions in ways that may foster long-term sustainable habit change.

### 4.3 | RQ3: What Are the Pathways/Mechanisms Through Which MoCs Exert an Influence on Low-Carbon Behavior?

Our review found many papers that did not discuss the reasons for the observed behavior changes post-MoC, but those that did suggest that MoCs involve changes to physical, social, and/or economic contexts (sometimes combined with psychological factors) that shift behavioral patterns. This highlights the important external drivers of human behavior, such as urban design, cultural norms, and income, while psychological drivers tend to be less influential but may moderate the effects of context (Mitev et al. 2023). Few of the papers we reviewed tested theories, and those that did usually drew on biographical or habit approaches. Mobility and energy biographies suggest travel/consumption needs are shaped primarily by physical and social factors and shift at key life transition points such as relocation and childbirth. Habit theory emphasizes that physical and social contexts cue habit, but that psychological variables (e.g., values) can be expressed when contexts change and habits weaken. Taken together, this review confirms the routine nature of much behavior (Verplanken and Whitmarsh 2021; Kurz et al. 2015), but these routines are punctuated in predictable and

**TABLE 2** | Summary of the results for the different MoCs and their effects on low-carbon behaviors (LCBs).

| MoC/LCB | Mobility | Energy | Diet | Material consumption | Activism |
|---|---|---|---|---|---|
| | | | Biographical MoCs | | |
| Home relocation | ± | ± | | | |
| Work relocation | ± | | | | |
| Migration | ± | | | | |
| Transition to adulthood | − | | + | | |
| Parenthood | ± | + | + | | |
| Relationship change | − | − | − | | |
| Retirement | ± | | | | |
| Professional changes | ± | | | | |
| Environmental epiphany | | | + | = | = |
| | | | Exogenous MoCs | | |
| Financial crises | + | + | = | | − |
| Natural disasters | + | + | | | + |
| Infrastructure disruption | ± | + | | | |
| Pandemics | + | | | | |
| Food scares | | | + | | |
| Terrorism | + | | | | |

*Note:* "+" indicates predominantly positive change (i.e., increased engagement in low-carbon action); "−" indicates predominantly negative behavior change (i.e., decreased engagement in low-carbon action) "±" indicates both a positive and a negative change; "=" indicates no change in behaviors.

unpredictable ways that can significantly increase or decrease low-carbon behaviors.

Several studies have applied a social practices approach to investigate how practices evolve during moments of change. These studies highlight that practices are inherently socially and materially embedded. When individuals experience significant disruptions, practices may adapt in a variety of ways: components of practices, such as technologies, may be substituted, reconfigured, or disintegrated entirely. In cases where practices can no longer be enacted, they may "die out." However, such practices can also be revived or "resurrected" if the context or conditions allow (Maller and Strengers 2013). Similarly, if one (material) element of practice is removed (e.g., water supply and during a drought), practice change will be temporary, unless other (meaning, competence) elements also change (e.g., conventions around hygiene and consumption). Conversely, practice change is likely to endure where meanings, competences, and materials shift, such as in the transition to parenthood (Burningham and Venn 2017, 2020).

### 4.4 | RQ4: Are MoCs Linked to any Changes in Non-Behavioral Factors (e.g., Values and Attitudes)?

Our review indicates that few of the papers on MoCs explore how life events might be linked to changes in non-behavioral factors. Where these links were tested and reported, they showed that relocation led to a positive change in attitudes towards travel modes when moving to an urban setting, while migration was sometimes associated with greater awareness of environmental issues or a reactivation of prior cultural meanings around consumption. Studies in the domain of parenthood reported more links with non-behavioral factors, namely a change in identity after becoming a parent with a focus on health and child safety. Some articles also reported higher environmental concerns, as well as higher levels of stress, especially for less affluent parents.

Articles exploring exogenous MoCs similarly tend not to measure psychological constructs, but rather to focus on the external drivers of behavior such as reduced income (due to financial crises), or restricted/increased access to infrastructure (infrastructure disruption, pandemics, and health scares). The exception is natural disasters, which may only temporarily restrict consumption, but may also (in certain circumstances) lead to attitude change and potentially longer-term change in practices. For example, where extreme weather events are conceptually linked to climate change, they may increase environmental concern and motivate action. These findings are very important as they show that MoCs could have an effect not only on people's everyday behaviors but also on various psychological constructs and meanings associated with social practices. However, they also highlight a gap in the current literature and a need for more research in this area which could help reveal more nuanced differences between the various MoCs and mechanisms of change.

Taken together, the findings suggest three possible ways in which motivations may interact (or not) with MoCs (Figure 6). First, MoCs may *activate* dormant values or social meanings in

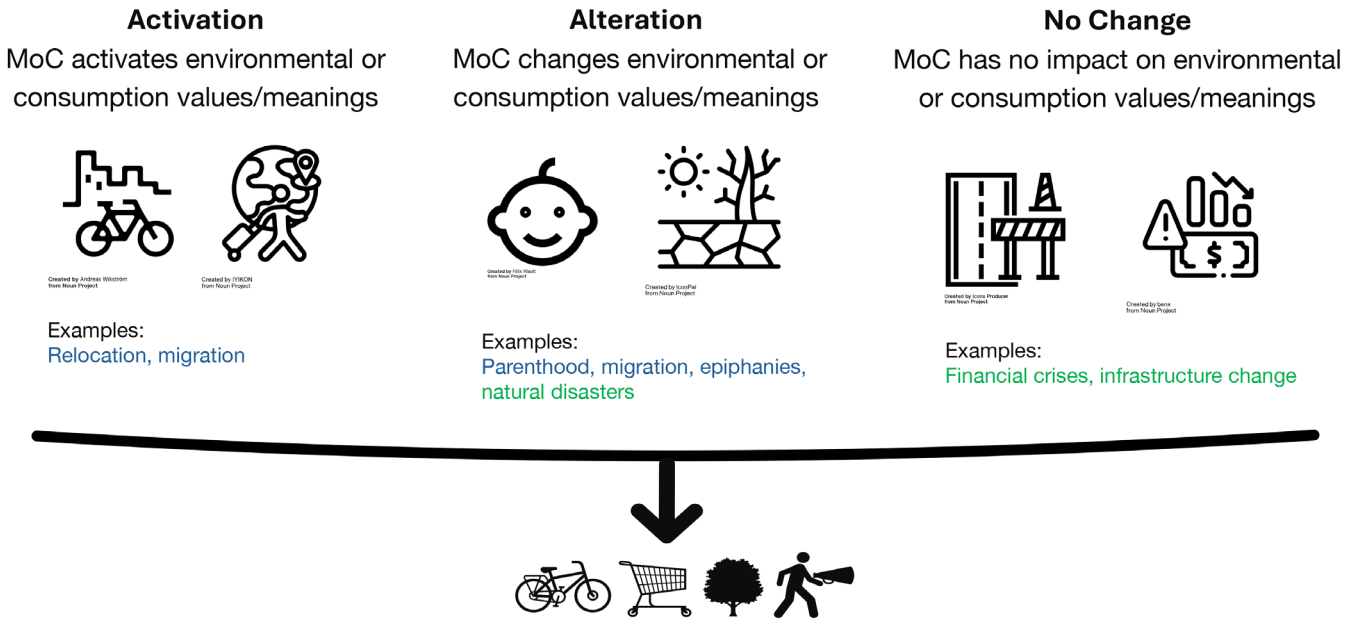


**FIGURE 6** | Options for MoCs to interact with motivations, values, and meanings in relation to environment or consumption: Activation, alteration, or no change. Examples are shown from our review of biographical (blue) and exogenous (green) MoCs.

relation to environmental or consumption. In the case of relocation, the value activation hypothesis has been posited for how pro-environmental values can manifest in behavior change once the context becomes supportive (e.g., moving to an area with cycling infrastructure; Verplanken et al. 2008; Thomas et al. 2016). From a sociological perspective, the "meaning" component of social practices, such as washing, may be reconstituted in a different form in a new context, for example following migration to a new country (Maller and Strengers 2013). Second, MoCs can *alter* values or meanings in relation to consumption or environment. Parenthood changes identity and reorients priorities towards care, but it also leads to temporal rescheduling and frugality which impact (positively and negatively) on low-carbon behaviors (e.g., Burningham and Venn 2020). Experiencing natural disasters or environmental epiphanies can alter environmental perceptions (e.g., highlighting resource scarcity, or human impacts on environment) which can in some cases lead to behavior change. Third, findings for most exogenous MoCs, such as financial crises or infrastructure change, suggest these typically short-lived disruptions *do not impact* on social meanings or values in relation to environment. However, an important caveat is that most studies did not measure psychological/social constructs or the longevity of behavior changes to rule out value change.

### 4.5 | RQ5: Are There Any Individual or Contextual Factors that Moderate Low-Carbon Behavior Change?

Our review suggests that demographic, social/cultural, economic, and physical factors moderate the effects of MoCs on low-carbon behavior. Women and men differ in their response to certain MoCs. For example, childbirth influences women's travel patterns and car ownership more than men's, and women's diets are more affected by cohabitation than men's. For migration, both infrastructure and social norms of the new country appear to influence waste practices. As noted, economic factors are also important for consumption, so economic shocks can have a greater effect on lower-income groups (their consumption may decrease, but also their willingness to pay environmental taxes may decrease). Shifting from car use to more sustainable modes following home or workplace relocation appears to be very dependent on external factors such as infrastructure (more walkable neighborhoods, less workplace parking, etc.), and to a lesser extent (for residential relocators) on an individual's habit strength or environmental values.

Planning may also be important, with some evidence that behavior changes (e.g., travel mode) are predicted by pre-MoC decision-making. This highlights an important difference between biographical and exogenous MoCs, since the former is typically more subject to planning than the latter. It also draws attention to the fact that the start and end point of a MoC can be hard to identify (e.g., a decision to travel sustainably once arriving at university may be made weeks or months before the actual move to campus), leading some to argue that MoCs may not be a helpful construct to understand sustainable lifestyle change in the context of constantly evolving lives (Burningham and Venn 2017).

### 4.6 | Policy Implications

Taken together, our review has three main policy implications. First, by drawing attention to the contextual drivers of behavior, it is in line with the substantial evidence base showing that the most effective behavior change interventions are targeted "upstream," that is, changing the context to make low-carbon actions easier, cheaper and ideally the default choice (Whitmarsh et al. 2021; Mitev et al. 2023), while "downstream" interventions, which focus on individual decision-making (e.g., through information provision), are less effective and may exacerbate inequalities (Nisa et al. 2019; White et al. 2009; Garrott et al. 2024). We

confirmed attitudinal factors were less influential in low-carbon behavior change than contextual factors, but also that behaviors were predicted by multiple factors. This highlights the need for composite interventions that target the various drivers and barriers of behavior, rather than relying on single (e.g., informational) measures (Whitmarsh et al. 2021).

Second, our review highlights the dynamic nature of lifestyle changes and implies that timing matters when trying to intervene to reshape habits. Interventions timed to coincide with a MoC tend to be more effective than when timed to stable contexts, when habits are likely to be a barrier (Verplanken and Whitmarsh 2021; Verplanken and Roy 2016). This has important implications for policy-makers wanting to maximize the efficacy of their interventions. However, the evidence base on this is primarily limited to mobility behaviors, so more evidence is needed to test MoC interventions targeting other low-carbon behaviors. More evidence is also needed on when exactly the "window of opportunity" to intervene is in relation to MoCs; while habits take on average 3 months to form (Lally et al. 2010), critical decision-making may actually precede the MoC.

Third, while targeting moments when habits are more malleable, policymakers should be mindful that individual responses to these moments (and associated interventions) can vary widely, and there is no one-size-fits-all approach to encouraging low-carbon behaviors during such transitions. Interventions should be targeted to the values, needs, and abilities of different groups, including those with high/low environmental concern, men/women, high-income/low-income groups, rural/urban residents, and homeowners/non-homeowners.

## 5 | Conclusions

Our review found the evidence base on MoCs is concentrated in the Global North, and primarily in individualistic cultures (UK, USA, Germany, etc.). Although likely, in part due to our exclusion of non-English articles, the use of WEIRD (White, Educated, Industrialized, Rich, and Democratic) samples is a pervasive problem for social science (Henrich et al. 2010), and suggests our results may not be generalizable to Global South countries. It also represents a challenge when it comes to developing theory on MoCs that may be applicable across cultures with different characteristics (e.g., individualism vs. collectivism). The research on MoCs and low-carbon behaviors is also primarily quantitative, using surveys; for example, far less is qualitative or mixed-methods. More work combining quantitative and qualitative research methods would provide a richer understanding of MoCs and contribute to a greater understanding of the underlying processes that are taking place during life transitions. Moreover, there is little longitudinal research that tracks behavior changes beyond the first few weeks or months after a MoC; more research spanning years would help elucidate the durability of habit change. Future studies should also seek to explain, not merely describe, the effects of MoCs on behaviors; currently, pathways and mechanisms of change remain relatively understudied and undertheorized. One way in which these mechanisms can be explored is through intervention studies. In most studies in the review, researchers observed behavior change as a function of a MoC. Future studies could use interventions that capitalize on a MoC in testing underlying mechanisms, in particular activation and alteration.

Comparability across studies is confounded by different research designs, measures used, and statistical techniques, as well as by highly varying contexts. Our review intentionally adopted a broad scope to explore the boundary concept of MoC, which lies at the intersection of multiple disciplines and encompasses a wide range of disruptions varying in type and scale. For types of MoC with a larger body of literature, such as relocation, we were able to draw stronger conclusions, whereas insights remain more tentative for less-studied MoCs. Future research could undertake meta-analyses of well-studied behaviors or MoCs to quantify changes in more comparable ways. Additionally, drawing on literature that examines MoCs at an aggregate or societal level could complement our focus on individual-level behavior changes. This approach is particularly relevant for exogenous MoCs, such as infrastructure changes, where substantial evidence on observed behavior shifts (e.g., traffic flows) could help triangulate the self-reported data from many studies included in our review.

Almost all behaviors in our review are consumption behaviors, rather than community or political behaviors, such as activism. Yet these non-consumption actions can help influence others and wider social systems (Hampton and Whitmarsh 2023). Moreover, there is a strong focus in the literature on mobility behaviors, while other behaviors (e.g., diet, water use) are less studied. Focusing on a more diverse pool of behaviors would allow for greater understanding of the effects that MoCs could have on a wide range of low-carbon behaviors. This could have important implications not only for scientists working in the area of MoCs, but also for businesses and policy-makers interested in applying this research to their work.

We also found that existing research focuses more on biographical MoCs than exogenous MoCs, particularly relocation. This links to the focus on mobility behaviors, which are more likely to be disrupted during such transitions. We found no papers addressing the impact of serious illness and very few addressing relationship change (e.g., divorce) on low-carbon behaviors, despite these being well studied in relation to health behavior change (e.g., Graham et al. 2019). More generally, our review suggested more interest in the literature on physical disruptions than on social or cultural shifts, despite social context being an important driver of habits (Wood et al. 2005). Within our exogenous MoCs, there was more of a focus on economic crashes than on other societal disruptions; however, a caveat of our review is that we may not have included a comprehensive range of MoCs, particularly exogenous ones, since there is no extant typology of societal disruptions on which to draw (in contrast to the well-established life transition literature; Baltes 1987). Moreover, it can be hard to discern direct effects of these events (e.g., job loss) from indirect effects via policy responses (e.g., fiscal policy). Working towards diversifying research in the various categories of MoCs is important, as each MoC has its own unique characteristics, which might contribute differently to people's actions. More work is needed to identify and distinguish different MoCs in order to consider the specific characteristics of each life transition, as this would offer a deeper understanding of the

problem. This could be crucial for applying behavioral change interventions aimed at tackling climate change.

Our work found that MoCs are often co-occurring; for example, relocation often coincides with a new job, relationship change, or childbirth. Trying to disentangle the effects of a specific MoC can therefore be difficult and highlights the complex nature of routines. Likewise, the studies we found more often focused on a single low-carbon behavior or category of behavior (e.g., driving or travel habits), but behaviors are often inter-connected in "bundles" of practice (e.g., working from home may reduce travel but often impact also on how cooking, cleaning and heating practices; Greene et al. 2022). More work is needed that considers the impact of both intersecting MoCs and multiple intersecting behaviors.

Finally, our review notes, but does not explore, the role of social inequality, including socio-economic disadvantage, gender and racism, in shaping individual responses to MoC. The review's focus is on the overall effects of MoC on those exposed to them, and not on differential exposure and responses to MoCs between those occupying unequal positions in society. Wider evidence suggests that behavior change policies and interventions that require a high degree of personal agency (i.e., rely on the individual's engagement and capacity to act) are less effective than ones that alter the everyday environments in which individual behavior is shaped and reproduced (Garrott et al. 2024). As noted above, these "downstream" and "upstream" interventions also have different equity impacts; the former is more likely than the later to be associated with a widening of inequalities in the targeted behaviors (Adams et al. 2016). An important next step for MoC research is to strengthen the evidence base on how to support low carbon behaviors in ways that are also equity promoting.

### Author Contributions

**Lorraine Whitmarsh:** conceptualization (lead), formal analysis (lead), funding acquisition (lead), methodology (lead), writing – original draft (equal), writing – review and editing (equal). **Kaloyan Mitev:** formal analysis (lead), investigation (lead), visualization (lead), writing – original draft (lead), writing – review and editing (lead). **Nicholas Nash:** formal analysis (equal), writing – review and editing (equal). **Claire Hoolohan:** formal analysis (equal), writing – review and editing (equal). **Wouter Poortinga:** formal analysis (equal), writing – review and editing (equal). **Colin Whittle:** formal analysis (equal), writing – review and editing (equal). **Paul Haggar:** formal analysis (equal), writing – review and editing (equal). **Harriet Dudley:** formal analysis (equal), writing – review and editing (supporting). **Christianne Tipping:** formal analysis (equal), writing – review and editing (supporting). **Louise Turner:** formal analysis (equal), writing – review and editing (supporting). **Daniel Carr:** formal analysis (equal). **Linden Felder:** formal analysis (equal). **Bas Verplanken:** writing – review and editing (equal). **Hilary Graham:** conceptualization (supporting), writing – review and editing (supporting).

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The authors have nothing to report.

### Conflicts of Interest

The authors declare no conflicts of interest.

### Data Availability Statement

Data sharing is not applicable to this article as no new data were created or analyzed in this study.

### Related WIREs Articles

Habitual behaviors or patterns of practice? Explaining and changing repetitive climate-relevant actions

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## Further Reading

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## Appendix A

### List of Search Terms Used in the Systematic Review

MoCs:

- Biographical: Parenthood/childbirth; Retirement; Relocation; Leaving parental home; Job loss; Cohabitation; Relationship Transitions (divorce, marriage, separation); Cultural transitions; Health related changes (accident, serious diagnosis, etc.).
- Exogenous: financial crash; pandemic (COVID, SARS, etc.); extreme weather event; infrastructure disruption (e.g., motorway/railway closure); political disruption (e.g., Brexit); technological breakdown (blackouts; Y2K).
- General: epiphany; transformative moment; life transition; habit disruption; disruptive event; critical juncture; punctuated equilibrium; moment of change.

LCBs:

- General: "low-carbon," "pro-environmental," "environmentally-significant."
- Mobility/transport (fuel efficient vehicles; use vehicles more efficiently; use more sustainable transport modes; reduce travel distance).
- Housing/energy use (energy efficiency behaviors; energy curtailment behaviors; reduce energy and fuel use—heating/cooling).
- Food/diet (increase vegetable intake; decrease animal protein intake; calorie-controlled diet; reduce food waste; increase intake of local, seasonal food).
- Material consumption/waste (material purchasing; material processing; material disposal).
- Political/public-sphere behaviors.

**Appendix B**

**List of the 130 Journal Articles Reviewed**

| Author(s) | Moment(s) of change | Research methods |
|---|---|---|
| | Biographical moments of change | |
| Aditjandra et al. (2015) | Residential relocation | Quantitative (e.g., surveys) |
| Bamberg (2006) | | |
| Beenackers et al. (2012) | | |
| Braun et al. (2016) | | |
| Buchanan and Barnett (2006) | | |
| Cao et al. (2007) | | |
| Christian et al. (2013) | | |
| De Vos et al. (2018) | | |
| Fujii and Gärling (2003) | | |
| Giles-Corti et al. (2013) | | |
| Haggar et al. (2019) | | |
| Hirsch et al. (2014) | | |
| Kamruzzaman, De Vos, et al. (2020) and Kamruzzaman, Shatu, et al. (2020) | | |
| Klinger (2017) | | |
| Klinger and Lanzendorf (2016) | | |
| Lin et al. (2018) | | |
| Monteiro, de Abreu e Silva, Haustein, et al. (2021) and Monteiro, de Abreu e Silva, Ingvardson, et al. (2021) | | |
| Peer (2019) | | |
| Ralph and Brown (2019) | | |
| Ramezani et al. (2021) | | |
| Thomas et al. (2016) | | |
| Verplanken and Roy (2016) | | |
| Woods and Ferguson (2014) | | |
| Yang, Wu, et al. (2017) and Yang, Day, et al. (2017) | | |
| Zhang and Guan (2016) | | |
| Zhao and Zhang (2018) | | |
| Bruns and Matthes (2019) | | Qualitative (e.g., interviews) |
| Jain et al. (2020) | | |
| Jones and Ogilvie (2012) | | |
| Verplanken et al. (2008) | | Mixed-methods |
| Wells and Yang (2008) | | |
| Zarabi et al. (2019) | | |
| Cho (2019) | | Secondary data |

| Author(s) | Moment(s) of change | Research methods |
|---|---|---|
| Bell (1991) | Workplace relocation | Quantitative (e.g., surveys) |
| Pfertner et al. (2022) | | |
| Pritchard and Frøyen (2019) | | |
| Rau et al. (2019) | | |
| Walker et al. (2015) | | |
| Yang, Wu, et al. (2017) and Yang, Day, et al. (2017) | | |
| Sprumont and Viti (2018) | | Qualitative (e.g., interviews) |
| Behren et al. (2018) | | Mixed-methods |
| Burbidge (2012) | Migration | Quantitative (e.g., surveys) |
| Maller and Strengers (2013) | | Qualitative (e.g., interviews) |
| Monteiro, de Abreu e Silva, Haustein, et al. (2021) and Monteiro, de Abreu e Silva, Ingvardson, et al. (2021) | | |
| Tyers et al. (2019) | | |
| Fuller and Bulkeley (2013) | | |
| Busch-Geertsema and Lanzendorf (2017) | Transition to adulthood | Quantitative (e.g., surveys) |
| Butler et al. (2004) | | |
| Olson (2005) | Parenthood | Quantitative (e.g., surveys) |
| Thomas et al. (2018) | | |
| de Goede and Greeff (2016) | | Qualitative (e.g., interviews) |
| McCarthy et al. (2021) | | |
| Moura and Aschemann-Witzel (2020) | | |
| Oakil, Ettema, et al. (2016) and Oakil, Manting, et al. (2016) | | |
| Yu and Liu (2007) | Relationship change | Quantitative (e.g., surveys) |
| Si Hassen et al. (2017) | Retirement | Quantitative (e.g., surveys) |
| Siren and Haustein (2016) | | |
| Berg (2016) | | Qualitative (e.g., interviews) |
| Berg et al. (2015) | | |
| Nakanishi and Black (2016) | | |
| Powell et al. (2008) | Environmental epiphany | Quantitative (e.g., surveys) |
| Storie and Vining (2018) | | Qualitative (e.g., interviews) |
| Beige and Axhausen (2012) | Multiple MoCs | Quantitative (e.g., surveys) |
| Clark, Chatterjee, and Melia (2016a) | | |
| Clark, Chatterjee, and Melia (2016b) | | |
| de Haas et al. (2018) | | |
| Elstgeest et al. (2012) | | |
| Gao et al. (2019) | | |
| Hartmann et al. (2014) | | |
| Marsden et al. (2020) | | |
| Oakil (2016) | | |
| Oakil, Ettema, et al. (2016) and Oakil, Manting, et al. (2016) | | |
| Priya Uteng et al. (2019) | | |
| Qin et al. (2019) | | |

| Author(s) | Moment(s) of change | Research methods |
|---|---|---|
| Rau and Manton (2016) | | |
| Schoenduwe et al. (2015) | | |
| Verhoeven et al. (2007) | | |
| Wang et al. (2020) | | |
| Bonham and Wilson (2012) | | Qualitative (e.g., interviews) |
| Burningham and Venn (2020) | | |
| Butler et al. (2014) | | |
| Chatterjee, Andrews, et al. (2013) and Chatterjee, Sherwin, et al. (2013) | | |
| Groves et al. (2016) | | |
| Hards (2012) | | |
| Janke and Handy (2019) | | |
| Shirani et al. (2017) | | |
| Clark, Lyons, and Chatterjee (2016) | | Mixed-methods |
| Schäfer et al. (2012) | | |
| Clark et al. (2014) | | Secondary data |
| Klein and Smart (2019) | | |
| Prillwitz et al. (2006) | | |
| Exogenous moments of change | | |
| Dienes (2015) | Financial crises | Quantitative (e.g., surveys) |
| Ivlevs (2019) | | |
| Papagiannakis and Vitopoulou (2015) | | |
| Kamruzzaman et al. (2014) | | |
| Maciejewska et al. (2019) | | |
| Cadima et al. (2020) | | |
| Marquet and Miralles-Guasch (2016) | | |
| Santamouris et al. (2013) | | |
| Kosti et al. (2021) | | |
| Marquet and Miralles-Guasch (2018) | | |
| Kamruzzaman, De Vos, et al. (2020) and Kamruzzaman, Shatu, et al. (2020) | | |
| Ulfarsson et al. (2015) | | |
| Papagiannakis et al. (2018) | | |
| Cascajo et al. (2018) | | Time-series data |
| Sobrino and Monzon (2014) | | |
| Ung et al. (2018) | Natural disasters | Quantitative (e.g., surveys) |
| Lindsay et al. (2017) | | Qualitative (e.g., interviews) |
| Chappells et al. (2011) | | |
| Whitmarsh (2008) | | Mixed-methods |
| Frater et al. (2020) | | |
| Lindsay et al. (2017) | | |
| Fujimi et al. (2016) | | Secondary data |
| Mochizuki and Chang (2017) | | Real-world data |

| Author(s) | Moment(s) of change | Research methods |
|---|---|---|
| Leighty and Meier (2011) | Infrastructure disruption | Quantitative (e.g., surveys) |
| Fujii et al. (2001) | | |
| Pnevmatikou et al. (2015) | | |
| Lattarulo et al. (2019) | | |
| Kimura and Nishio (2016) | | |
| Parkes et al. (2016) | | |
| Fuller et al. (2012) | | Time-series data |
| Saberi et al. (2018) | | Real-world data |
| Brown and Werner (2007) | Introduction of new infrastructure/ technology | Quantitative (e.g., surveys) |
| Heinen et al. (2015) | | |
| Chatterjee, Andrews, et al. (2013) and Chatterjee, Sherwin, et al. (2013) | | Mixed-methods |
| Kim et al. (2017) | Pandemics | Real-world data data |
| Schroeder et al. (2007) | Food scares | Quantitative (e.g., surveys) |
| Setbon et al. (2005) | | |
| Ito and Lee (2005) | Terrorism | Real-world data |
| López-Rousseau (2005) | | |

## Appendix C

### List of Journals Where the 130 Articles Have Been Published

| Journal title | Number of articles in % |
|---|---|
| *Journal of Transport Geography* | 10.6% |
| *Transportation* | 6.1% |
| *Transport Policy* | 6.1% |
| *Transportation Research Part A: Policy and Practice* | 4.5% |
| *Transportation Research Part D: Transport and Environment* | 4.5% |
| *Travel Behavior and Society* | 4.5% |
| *International Journal of Behavioral Nutrition and Physical Activity* | 2.3% |
| *Journal of Transport and Land Use* | 3.0% |
| *Geoforum* | 3.0% |
| *Environment and Behavior* | 2.3% |
| *American Journal of Preventive Medicine* | 2.3% |
| *International Journal of Sustainable Transportation* | 2.3% |
| *Transportation Research Record* | 2.3% |
| *Journal of Environmental Psychology* | 1.5% |
| *Transportation Research Part F: Traffic Psychology and Behavior* | 1.5% |
| *Transportation Research Part A-Policy and Practice* | 1.5% |
| *Energy Policy* | 1.5% |
| *European Transport Research Review* | 1.5% |
| *American Journal of Public Health* | 1.5% |
| *Risk Analysis* | 0.8% |

| Journal title | Number of articles in % |
|---|---|
| *Population and Environment* | 0.8% |
| *Energy Research and Social Science* | 0.8% |
| *European Urban and Regional Studies* | 0.8% |
| *Public Health Nutrition* | 0.8% |
| *Case Studies on Transport Policy* | 0.8% |
| *Social Work (South Africa)* | 0.8% |
| *Human Ecology Review* | 0.8% |
| *Plos One* | 0.8% |
| *CICTP 2016—Green and Multimodal Transportation and Logistics—Proceedings of The 16th COTA International Conference of Transportation Professionals* | 0.8% |
| *Proceedings Of the National Academy of Sciences of The United States of America* | 0.8% |
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