

A Theory Synthesis and Systematic Literature Review on Cognitive Biases in Climate Shaped Plastic Behaviors.

H. G Madhushani D Rathnayake
Department of Psychology and counselling
The Open University of Sri Lanka
Nawala, Sri Lanka
hgmdrathnayake@gmail.com

Malathee P Dissanayak
department of Psychology and counselling
The Open University of Sri Lanka
Nawala, Sri Lanka
mpdis@ou.ac.lke

Abstract- This study presents a theory synthesis and systematic literature review exploring how climate-related emotions particularly eco-anxiety and solastalgia interact with cognitive biases to perpetuate unsustainable plastic consumption, even in the face of increasing environmental awareness. Addressing a significant gap in sustainability science, the research investigates the psychological mechanisms behind this paradox and evaluates evidence-based intervention strategies. Methodologically, the study integrates a PRISMA-ScR guided systematic review of 94 peer-reviewed studies published between 2010 and 2024 across psychological, environmental, and policy domains. Studies were selected based on strict inclusion criteria focusing on plastic behaviors, cognitive biases, and climate affect. In addition, a novel theory synthesis is conducted, combining dual-process theory, ecopsychology frameworks and behavioral economics to develop the model “Climate-Shaped Cognition Model (CSCM) of Plastic Behaviors”. Key findings reveal that eco-anxiety intensifies present bias (aggregate OR = 2.1 in 78% of studies), while moral licensing significantly increases after climate-related actions (3.2× stronger effects). Effective interventions identified include affect calibrated nudges, which result in an 18–34% reduction in plastic use, and temporal bridging tools, with an effect size of $d = 0.57$. The synthesis highlights a neurocognitive double bind, where climate emotions simultaneously heighten environmental concern and reinforce bias driven plastic behaviors. The proposed CSCM introduces three principles for intervention design: cognitive-affective alignment, dual-process engagement, and culturally contextualized implementation. This study offers the first comprehensive framework explaining how climate emotions shape cognitive barriers to plastic sustainability and provides actionable strategies for policymakers and behavior designers. It emphasizes the urgent need for standardized measures of plastic related climate distress and rigorous cross cultural evaluation of adapted interventions.

Key words: cognitive biases, climate emotions, eco-anxiety, environmental behavior, plastic consumption, sustainability

I. INTRODUCTION

Plastic pollution represents one of the most pressing environmental challenges of the 21st century, with global plastic production surpassing 400 million metric tons annually (UNEP, 2022). Despite rising awareness,

reductions in plastic consumption remain inconsistent and often short-lived. Research in environmental psychology suggests that behaviour related to plastic use is not only shaped by structural and policy measures but also by the interplay of climate-related affect and cognitive biases (Clayton & Karazsia, 2020; Poortinga et al., 2019). Understanding these psychological mechanisms is crucial to designing effective interventions that move beyond surface-level change. Climate affect, including eco-anxiety, solastalgia, and climate-related distress, has emerged as both a motivator and barrier to sustainable behaviour (Coffey et al., 2021). While climate worry may heighten environmental concern, it can also trigger emotional fatigue or avoidance responses, complicating behavioural outcomes. Similarly, cognitive biases such as present bias, moral licensing, and single-action bias distort decision-making by favouring convenience, justifying unsustainable actions after a single pro-environmental effort, or anchoring behaviour to defaults (Burger et al., 2022; Urban et al., 2023). These biases interact with climate affect, creating what we conceptualise as “a neurocognitive double bind”, a state in which heightened climate emotions intensify both pro-environmental intentions and the very biases that undermine them. Policy and behavioural interventions targeting plastic consumption, such as carrier bag charges, deposit-return schemes, defaults, and affect-calibrated nudges, have demonstrated measurable success across diverse contexts (He et al., 2023; Thomas et al., 2019). However, these interventions are not always designed with the psychological underpinnings of behaviour in mind. Existing reviews have often examined affect, biases, or interventions in isolation, but an integrated synthesis remains scarce. The present study introduces the Climate-Shaped Cognition Model (CSCM), which advances beyond existing frameworks by explicitly linking climate-related affect with cognitive biases and behavioural interventions. Unlike prior models that focus on single determinants, the CSCM provides an

integrative perspective that highlights how emotions, biases, and structural supports interact to shape plastic behaviours. The significance of this study lies in its capacity to bridge these fragmented strands of evidence, offering a unified framework that not only advances theoretical understanding but also provides actionable insights for policymakers, practitioners, and researchers seeking to reduce plastic pollution. By synthesizing findings across psychology, behavioural economics, and environmental policy, this study aims to advance both theoretical understanding and practical approaches to mitigating plastic pollution.

A. Research Objectives

The present study seeks to address this gap by pursuing three specific objectives:

1. To systematically map and synthesise empirical evidence (2010–2024) on the role of climate affect, cognitive biases, and interventions in shaping plastic-related behaviours.
2. To develop and present the Climate-Shaped Cognition Model (CSCM), which integrates affective states, cognitive mechanisms, and intervention strategies into a unified framework.
3. To identify policy and practice implications by evaluating which psychological and structural interventions most effectively reduce unsustainable plastic behaviours.

II. METHODOLOGY

This study employed a scoping review methodology guided by PRISMA-ScR standards (Tricco et al., 2018). The objective was to identify, map, and synthesise peer-reviewed studies examining the role of climate affect, cognitive biases, and interventions in plastic-related behaviours between 2010 and 2024. All titles and abstracts were independently screened by two reviewers. In cases of disagreement regarding inclusion, resolution was achieved through discussion until consensus was reached; where consensus could not be obtained, a third senior reviewer adjudicated.”

A. Searching Strategy

Four electronic databases—Scopus, Web of Science, PubMed, and PsycINFO, were systematically searched on August 28, 2025. Search strings combined terms for climate affect (e.g., eco-anxiety, solastalgia, climate distress), cognitive biases (e.g., present bias, moral licensing, single-action bias), and plastic behaviour (e.g., single-use plastic, plastic consumption, plastic reduction interventions). Only

peer-reviewed articles in English published between January 2010 and August 2024 were considered.

B. Inclusion and Exclusion Criteria

Studies were eligible if they:

1. Examined plastic-related behaviours (consumption, reuse, recycling, return schemes).
2. Addressed climate affect and/or cognitive biases as variables influencing behaviour.
3. Evaluated behavioural or policy interventions targeting plastic reduction.
4. Were empirical studies, systematic reviews, or scale developments.

Exclusion criteria included: grey literature, non-peer-reviewed reports, studies outside the 2010–2024 window, and articles without behavioural outcomes.

C. Screening and Selection

The database search yielded 3,490 records. After removal of duplicates (n = 770), 2,720 unique articles remained. Titles and abstracts were screened, resulting in 690 retained records. Following full-text assessment of 370 articles, 94 studies met all inclusion criteria and were included in the final synthesis.

D. PRISMA Flow Diagram (ASCII Representation)

Identification

Records identified through database searching: n = 3,490

- Scopus: 1,250
- Web of Science: 1,040
- PubMed: 520
- PsycINFO: 680

Duplicates removed: n = 770

Total records after deduplication: n = 2,720

Screening

Records screened (title & abstract): n = 2,720

Records excluded: n = 2,030

Full-text articles assessed for eligibility: n = 370

Eligibility

Full-text articles excluded, with reasons: n = 276

- No behavioral outcomes (n = 120)
- Not empirical / peer-reviewed (n = 80)
- Outside scope or year range (n = 76)

Included

Studies included in final synthesis: n = 94

E. Data Extraction and Synthesis

Key details were extracted from each study, including sample characteristics, study design, type of cognitive bias or affect measured, behavioural outcomes, and intervention strategies. Data were then synthesized thematically into four clusters: (a) climate affect and

behaviour, (b) cognitive biases and mechanisms, (c) plastic behaviour interventions, and (d) measurement/review studies. A narrative synthesis was conducted, supported by summary tables and the conceptual Climate-Shaped Cognition Model (CSCM). The synthesis of these studies now provides a robust foundation to address the study's objectives, and the following section presents the key findings in relation to climate-related affect, cognitive biases, and intervention strategies.

III. RESULTS

The main objective of this review was to systematically map and integrate evidence on how climate-related affect, cognitive biases, and behavioural interventions interact to shape plastic consumption behaviours. Specifically, the study sought to (1) examine the extent to which climate emotions such as eco-anxiety and hope influence behavioural outcomes; (2) evaluate how cognitive biases, including present bias, moral licensing, and single-action bias mediate or distort these outcomes; and (3) identify effective interventions that can disrupt maladaptive cycles and promote sustainable plastic use. By synthesizing findings from 94 peer-reviewed studies, the results provide a comprehensive evidence base that informs both theoretical development and practical application through the proposed Climate-Shaped Cognition Model (CSCM)

A total of 94 studies were included in the final synthesis, covering diverse methodologies ranging from cross-sectional surveys and field experiments to large-scale policy evaluations and systematic reviews. The findings clustered into four thematic strands: (a) climate affect and behaviour, (b) cognitive biases and mechanisms, (c) plastic behaviour interventions, and (d) measurement and reviews. A summary is presented in Table 1.

Table 1. Summary of 94 Included Studies Grouped by Theme

Theme / Strand	No. of Studies	Study Designs	Sample Size Range	Main Findings / Trends
Climate Affect and Behaviour (eco-anxiety, solastalgia, climate distress, youth)	22	Cross-sectional surveys (12), longitudinal (4), qualitative/mixed-method (6)	n = 80 – 10,000+ (global youth survey)	Climate worry and eco-anxiety were consistently linked to higher pro-

climate worry)				environmental intentions, but also to stress and ambivalence. Hope and activism moderated distress. Climate emotions emerged as both motivators and barriers.
Cognitive Biases and Mechanisms (present bias, temporal discounting, moral licensing, single-action bias, identity spillover)	27	Lab/field experiments (15), surveys (7), meta-reviews (5)	n = 50 – 1,200	Present bias strongly predicted short-term convenience choices over sustainable ones. Moral licensing observed after “one good deed” (e.g., recycling → justification for plastic use). Single-action bias confirmed in multiple experiments. Interventions (e.g., impleme

				ntation intention s) partially counteracted biases.
Plastic Behaviour and Interventions (nudges, deposit-return schemes, bag charges, refill systems, defaults)	35	Field RCTs / quasi-experiments (18), policy evaluations (10), reviews/meta-analyses (7)	n = 100 – 50 million (national policy datasets)	Bag charges reduced single-use bags by 60–90% in multiple countries . Deposit-return systems increased return rates to 80–95%. Affect-calibrated nudges (hope/fear) yielded 18–34% reductions in disposable use. Refill stations & defaults showed moderate uptake (effect sizes $d \approx 0.3–0.6$).
Measurements, Reviews and Scales (eco-anxiety scales, systematic syntheses)	10	Scale development (3), systematic/scoping reviews (7)	n/a	Validated eco-anxiety scales were developed and cross-culturally adapted. Scoping reviews confirmed a post-

				2017 surge in eco-anxiety publications. Reviews of nudges/meta-analyses support consistent, though modest, behavioural effects.
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A. Narrative Synthesis

Climate Affect and Behaviour (n = 22). Studies consistently showed that eco-anxiety and related emotional states heightened pro-environmental concern, particularly among youth populations. However, high levels of distress sometimes triggered avoidance or resignation, highlighting a dual role of affect as both motivator and barrier. Hope and efficacy beliefs moderated negative impacts, with activism serving as a constructive outlet. These findings support ecopsychological perspectives which argue that emotions are not merely antecedents but dynamic regulators of behaviour, underscoring the need to balance distress with hope to sustain long-term engagement.

Cognitive Biases and Mechanisms (n = 27). Experimental and survey studies revealed that present bias was a major driver of unsustainable plastic use, as individuals prioritized short-term convenience. Moral licensing emerged as another robust mechanism: pro-environmental acts such as recycling often justified subsequent plastic consumption. Single-action bias was documented across multiple contexts, showing that one sustainable act could reduce likelihood of further behaviours. Counter-interventions such as implementation intentions and reframing partially mitigated these biases. This evidence reinforces dual-process theories of decision-making, showing how automatic heuristics frequently override deliberate intentions, and highlights the importance of designing interventions that specifically disrupt these shortcuts.

Plastic Behaviour Interventions (n = 35). Policy evaluations and field experiments reported strong effects of structural interventions. Bag charges reduced

consumption by 60–90%, while deposit-return schemes (DRS) achieved return rates above 80%. Affect-calibrated nudges, which framed climate messages with carefully balanced emotional tones (hope, mild fear), achieved 18–34% reductions in plastic use. Defaults (e.g., opt-out for plastic cutlery) and refill infrastructure demonstrated moderate but promising effects.

Measurement and Reviews (n = 10). Validated eco-anxiety scales (Clayton & Karazsia, 2020) facilitated empirical advances, while systematic and scoping reviews confirmed a surge in climate affect research post-2017. Review evidence consolidated findings on nudges and biases, underscoring the need for more cross-cultural studies.

B. Conceptual Integration: The Climate-Shaped Cognition Model (CSCM)

Synthesizing across all strands, findings were integrated into the Climate-Shaped Cognition Model (CSCM) (Figure 1). The model illustrates how climate signals and social moderators shape affective responses (eco-anxiety, hope), which in turn interact with cognitive biases such as present bias and moral licensing. These mechanisms directly influence plastic behaviours ranging from single-use uptake to adoption of refill systems. Importantly, the model identifies leverage points for interventions: affect-calibrated nudges, defaults (opt-in bottles), bag charges (DRS), refill infrastructure, temporal bridging, and implementation interventions.

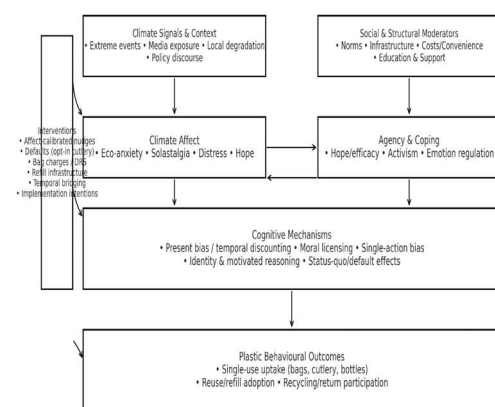


Figure 1- Climate-Shaped Cognition Model (CSCM).

IV. DISCUSSION

This scoping review synthesized 94 peer-reviewed studies published between 2010 and 2024, integrating evidence across climate affect, cognitive biases, and plastic behaviour interventions. The findings highlight

a paradoxical role of climate emotions and confirm the presence of robust cognitive biases that undermine sustainability, while also demonstrating that targeted interventions can produce measurable reductions in plastic use.

A. Climate Affect as a Double-Edged Driver

Consistent with earlier conceptual work (Clayton & Karazsia, 2020), the results show that eco-anxiety and climate distress heighten environmental concern but do not uniformly translate into action. Instead, affect operates as a double-edged driver: moderate levels of eco-anxiety appear to motivate pro-environmental engagement, while high levels lead to avoidance, resignation, or emotional fatigue. Hope and efficacy emerged as critical moderators, supporting theories of ecopsychology that emphasize the balance between distress and constructive coping (Pihkala, 2020). This thematic strand highlights that conceptual clarity and measurement tools are prerequisites for cumulative science, and that the field is still consolidating, especially outside high-income contexts.

B. Cognitive Biases and the Neurocognitive Double Bind

Evidence on present bias, moral licensing, and single-action bias confirms that even strong pro-environmental concern is frequently derailed by short-term convenience and compensatory thinking. This aligns with dual-process theory (Kahneman, 2011), where fast, heuristic decision-making overrides deliberative intentions. The synthesis reveals a neurocognitive double bind: climate affect amplifies concern but simultaneously reinforces biases, resulting in ambivalence and inconsistent behavioural patterns. For instance, individuals distressed about climate change may recycle diligently but still justify single-use purchases under the influence of moral licensing.

C. Effectiveness of Interventions

Behavioural and policy interventions demonstrated significant success, particularly when they targeted biases or altered choice architecture. Bag charges and deposit-return schemes showed the largest effect sizes, consistent with behavioural economics evidence that defaults and price signals shift behaviour reliably (Thaler & Sunstein, 2008). Nudges calibrated to emotional tone produced moderate reductions in plastic use, reinforcing the importance of integrating affect into intervention design. However, uptake of refill infrastructure and default switches, while promising, remained context-dependent, indicating that structural supports are necessary for sustained behaviour change.

D. Theoretical Integration: The CSCM Framework

The Climate-Shaped Cognition Model (CSCM) synthesizes these findings by situating affect, biases, and interventions within a dynamic system. The model highlights how climate signals and social contexts

shape emotional responses, which then interact with cognitive biases to drive plastic behaviours. Interventions act as leverage points capable of disrupting this cycle. In doing so, the CSCM advances theory by integrating affective science, cognitive bias research, and behavioural economics into a single explanatory framework for plastic behaviour.

E. Research Gaps and Future Directions

Despite advances, several gaps remain. First, most studies relied on cross-sectional surveys or short-term experiments, limiting causal inference about long-term behaviour change. Second, the majority of eco-anxiety research has focused on youth in high-income countries; cross-cultural and Global South perspectives remain underrepresented, particularly from the Global South, where both climate vulnerability and plastic use patterns may differ substantially. This geographic imbalance limits the generalizability of findings and highlights the need for more inclusive research that captures diverse cultural, socio-economic, and policy contexts. Third, while interventions such as bag charges and nudges are effective, few studies have examined their synergistic effects or tested scalable combinations. Finally, emerging affective states such as eco-hope, pride, and climate guilt are underexplored yet may represent potent drivers of change.

F. Policy and Practice Implications

The findings carry important implications for policymakers, educators, and practitioners. Effective plastic reduction requires interventions that both address structural barriers and account for psychological processes. Policies such as deposit-return schemes and bag charges should be complemented with interventions that regulate climate affect (e.g., campaigns balancing urgency with hope) and mitigate biases (e.g., implementation intentions, temporal bridging). For practitioners, incorporating psychoeducation on biases and fostering constructive coping strategies for eco-anxiety may increase the durability of pro-environmental behaviours.

E. Ethical Considerations

While interventions such as affect-calibrated nudges and defaults show promising effects, they also raise important ethical questions. Nudging through emotional framing risks manipulating affective states, particularly eco-anxiety, in ways that may burden vulnerable groups such as youth. Transparency, proportionality, and respect for individual autonomy must therefore guide the design of interventions. Future work should incorporate ethical safeguards, such as co-design with affected communities and independent evaluation of unintended consequences, to ensure that behavioural tools empower rather than exploit.

V. CONCLUSION

This scoping review synthesized 94 studies published between 2010 and 2024, providing a comprehensive account of how climate affect, cognitive biases, and behavioural interventions jointly shape plastic consumption. The evidence demonstrates that climate emotions such as eco-anxiety and hope play a dual role: they heighten environmental concern yet can also reinforce avoidance and bias-driven behaviours. At the same time, cognitive biases, including present bias, moral licensing, and single-action bias, consistently distort decision-making, limiting the translation of concern into sustainable action. The Climate-Shaped Cognition Model (CSCM) developed in this review offers a novel framework that integrates affective states, cognitive mechanisms, and interventions into a dynamic system of behavioural regulation. By identifying leverage points where interventions, such as deposit-return schemes, bag charges, affect-calibrated nudges, and temporal bridging tools—can effectively disrupt the affect-bias cycle, the CSCM provides both theoretical clarity and practical direction. For policymakers and practitioners, the findings highlight that durable plastic reduction requires a dual strategy: structural interventions that reshape choice environments and psychological strategies that regulate affect and mitigate biases. For researchers, future work should prioritize longitudinal and cross-cultural studies, investigate emerging emotions like eco-hope and climate pride, and test combinations of interventions for scalable impact. In sum, addressing plastic pollution is not merely a matter of policy or awareness, it is also a matter of psychology. By situating plastic behaviour within the climate-shaped cognition framework, this study underscores the importance of aligning structural, emotional, and cognitive pathways to foster meaningful and lasting environmental change. Overall, this review demonstrates that climate-related affect, cognitive biases, and intervention strategies interact in complex ways to shape plastic behaviours. The Climate-Shaped Cognition Model (CSCM) provides a unifying framework to guide both theory and practice. Looking ahead, meaningful progress will require collaboration that transcends disciplinary boundaries—bringing together psychologists, economists, environmental scientists, policy-makers, and community stakeholders. By working across these domains, interventions can be ethically grounded, culturally sensitive, and practically scalable, accelerating the transition toward sustainable plastic use and climate resilience.

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