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PROMOTING GREEN LIVING AREAS

NUDGES

1.1.1 State of the art analysis of cultural nudges to pro-environmental behaviour

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Interreg Euro-MED

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Executive Summary

Deliverable 1.1.1, titled “State of the Art Analysis of Cultural Nudges to Pro-Environmental Behaviour,” is part of the Work Package 1 (W.P.1) and offers a comprehensive systematic review of nudging interventions aimed at encouraging behaviors that can help combat climate change, particularly in the Mediterranean region and Europe. The findings from this systematic review analysis, along with the outcomes of Activity 1.2, serve as a foundation for Activity 1.3, by providing key insights into the effectiveness of different strategies and policies and feeding the methodological framework for the NUDGES pilots. Nudging, a concept rooted in behavioral economics, leverages cognitive biases and decision-making heuristics to guide individuals toward choices that are beneficial for both themselves and society, without restricting their freedom of choice. The review highlights the most effective nudging strategies, underscores the influence of cultural factors on the success of interventions, and integrates insights from various geographical and cultural contexts throughout the European Union (EU).

1. Introduction

1.1 Overview of Nudging Theory and Its Application to Behavioural Economics

Nudging theory, as an integral component of behavioral economics, influences the behaviour of the individual through subtle, non-coercive interventions, or "nudges", rather than direct regulations. Introduced by Thaler and Sunstein (2008), nudges demonstrate how minor adjustments in choice architecture can significantly shape the decision-making process by leveraging cognitive biases and heuristics (Kahneman, 2011). The goal is to guide individuals toward decisions that benefit both themselves and society while preserving their freedom of choice. For example, placing healthier foods at eye level in grocery stores encourages healthier eating habits without restricting other available options (Thaler & Sunstein, 2008; Van Gestel et al., 2020). Nudging interventions align with the concept of "libertarian paternalism," promoting welfare-enhancing behavior while allowing individuals to opt out (Sunstein, 2014). By exploiting biases like the "status quo bias," these interventions foster positive change with minimal resistance, as seen in the increased savings from default enrollment in pension programs (Benartzi & Thaler, 2004).

Recent studies underscore the effectiveness of nudges across a plethora of sectors, including health, finance, and environmental sustainability. Interventions like automatic reminders and default settings have increased participation in medical check-ups and improved dietary choices (Kazemian et al., 2023), boosted savings rates (Beshears et al., 2021), and encouraged green energy adoption (Dur et al., 2021). Despite this success, critiques highlight limitations in the consistency of nudging outcomes across different populations and contexts, with some interventions yielding mixed results (Szaszi et al., 2022). Nevertheless, nudging remains a powerful tool for driving positive behavioral change across a range of fields.

1.1.1. Context of Environmental Sustainability and Climate Change Mitigation

Climate change presents a significant challenge, demanding coordinated action at individual, community, and governmental levels. While policies often focus on large-scale industrial or regulatory efforts, individual behavior change is essential for sustainability. Encouraging environmentally sustainable actions-such as reducing energy use, minimizing waste, and choosing sustainable products-is increasingly recognized as vital in mitigating climate change. Traditional methods, like information campaigns or financial incentives, have limitations, as individuals may not act on information due to cognitive overload, and incentives may not be sustainable long-term. Nudging offers an alternative by subtly steering individuals toward sustainable choices without requiring drastic lifestyle changes or financial penalties (Schubert, 2017). For instance, default options like setting renewable energy as the standard for household electricity plans have been shown to increase participation in green energy programs (Momsen & Stoerk, 2014).

1.1.2 Importance of Behavioral Interventions, Specifically Nudges, in Influencing Environmentally Responsible Behavior

Nudging has emerged as an effective tool for promoting pro-environmental behaviour, offering scalable, cost-effective interventions without requiring legislative changes. By targeting determinants like habits, social norms, and framing effects, nudges influence how people engage with environmental issues (Sunstein, 2014). Small adjustments, such as setting paperless billing as the default or positioning recycling bins conveniently, can increase sustainable practices (Lourenco et al., 2016). In energy consumption, real-time feedback via smart meters has proven effective in reducing usage (Allcott & Rogers, 2014). Nudges reduce decision-making friction, using insights like loss aversion and status quo bias to prompt action. “Opt-out” systems for green energy demonstrate the power of default settings in encouraging sustainable choices (Pichert & Katsikopoulos, 2008). Overall, nudging provides a non-intrusive, cost-efficient method to drive behavioural change. This deliverable provides a comprehensive analysis of nudging

interventions aimed at promoting climate change mitigation behaviours. By reviewing existing literature and examining cultural factors, this report highlights the effectiveness of these behavioural strategies across different regions in the EU. The following chapters present the key findings, methodologies, and implications for future policy design.

2. Methodological Approach for the Review of Nudging Interventions for Climate Change Mitigation

2.1. Methodological Approach

A systematic review methodology was employed to ensure a rigorous and comprehensive search of the literature (Figure 1.). The search strategy involved querying multiple academic databases (e.g., PubMed, Scopus, ScienceDirect) for studies published between 2014 and 2024. Studies were included based on their relevance to climate change mitigation, their use of nudging interventions, and their focus on populations within the EU. Data extraction focused on intervention types, target behaviors, cultural factors, and outcomes.

The research question guiding this review - “How effective are nudges in promoting environmentally sustainable behaviours related to climate change mitigation?” - was developed to explore the growing interest in behavioral interventions for encouraging pro-environmental actions. By focusing on the subtle influence of nudges, which steer decisions without restricting choice, this review aims to assess their effectiveness in fostering behaviors that support climate change mitigation. This inquiry provides a foundation for understanding the mechanisms behind nudges and their potential application in addressing the critical challenge of climate change underscoring the influence of cultural factors.

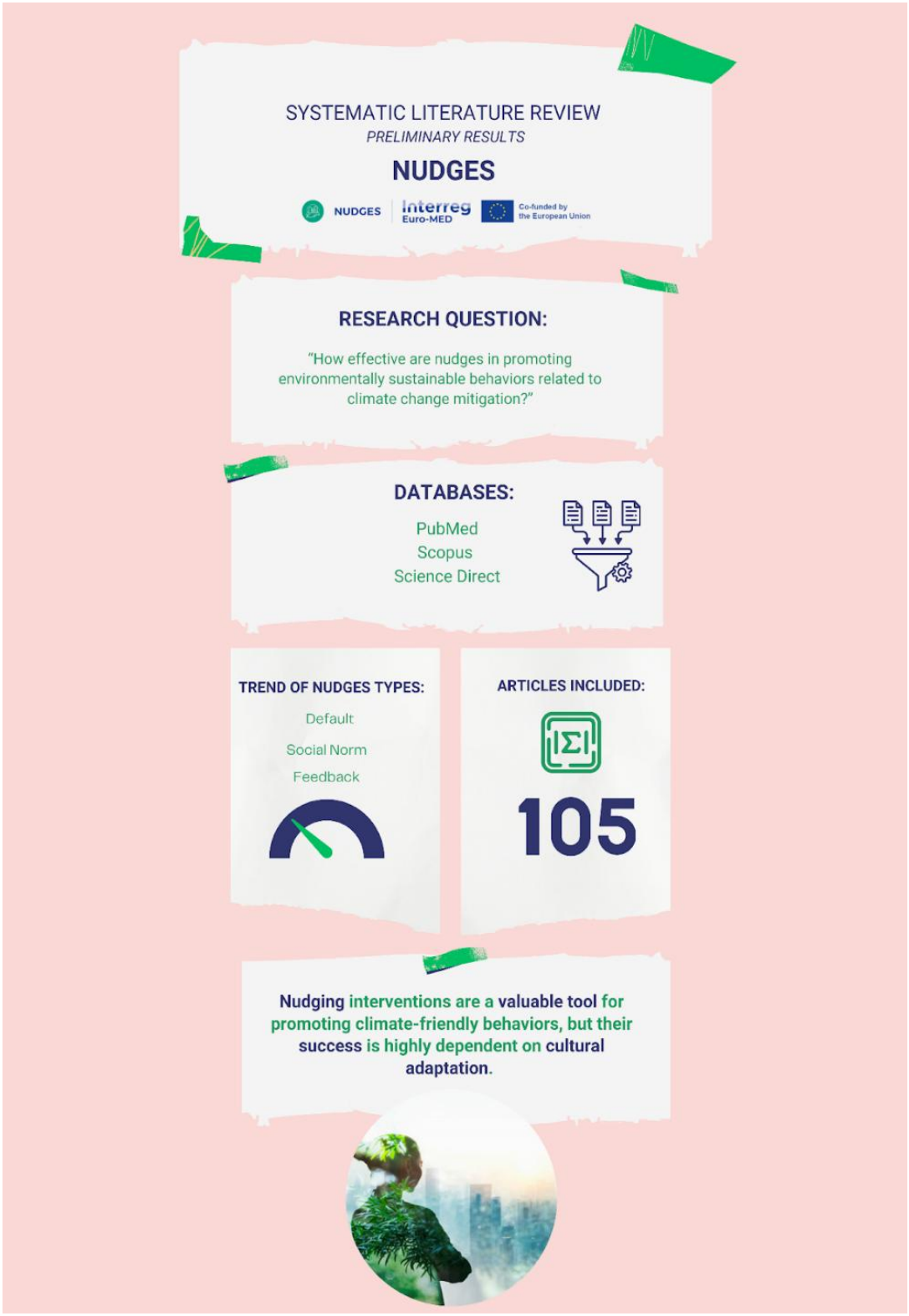

Figure 1. Overview of the methodological approach for the systematic review of Nudges for Climate Change Mitigation

2.1.2 Objectives of the Review

The primary objective of this review is to analyse and summarise existing literature on the effectiveness of nudging interventions in promoting sustainable behaviors related to climate change mitigation. This includes examining how different types of nudges-such as default options, social norm nudges, and reminder nudges-impact behavioral outcomes across various cultural contexts within the EU. A key component of the review is the exploration of cultural factors that influence the effectiveness of these interventions, particularly in Mediterranean countries where community values and social norms play a significant role in decision-making.

2.1.3 Search Strategy

The search strategy for this systematic review was meticulously designed to capture a comprehensive and representative set of studies on nudging interventions for climate change mitigation. The choice to conduct a systematic review stem from the need for a rigorous and objective assessment of the existing evidence base. Systematic reviews allow for an organised and replicable approach to synthesising large volumes of literature, ensuring that conclusions drawn are based on all relevant data, not just a selective sample. This is particularly important in the field of behavioral economics and climate change, where interventions can vary widely in terms of methodology, outcomes, and target behaviors.

The review process encompassed a targeted search across multiple databases, including:

- PubMed
- Scopus
- ScienceDirect.

These databases were selected for their extensive coverage of high-quality, peer-reviewed literature in the fields of behavioural sciences, economics, public health, and environmental science.

2.1.4 Key Concepts and Search Terms

To ensure a comprehensive search, the following three core concepts were used:

- **Nudges:** The term "nudge" refers to interventions that subtly influence behavior without restricting choice. Search terms included "Economics Behavioral"[Mesh], "Nudge Theory", "Nudging", "Nudges", and "Green Nudges".

This ensured that all variations of nudging interventions were covered.

- **Sustainable Behaviors:** Since the focus of the review is on behaviors that contribute to climate change mitigation, terms such as "Choice Behavior"[Mesh], "Sustainable Behaviors", and "Environmental Behaviors" were used.

These terms allowed us to capture a broad range of studies addressing various pro-environmental behaviors.

- **Climate Change:** The impact of nudging on behaviors related to climate change mitigation was the core outcome of interest, so we included terms like "Climate Change"[Mesh], "Global Warming", and other related keywords to encompass the relevant scientific discourse.

Each search string was configured to retrieve studies published within the last 10 years (2014-2024), reflecting the most recent developments in nudging interventions and policy frameworks. The search was also limited to English-language articles to ensure consistency and comparability in data interpretation. Furthermore, we included filters to focus on empirical studies, case studies, randomised controlled trials (RCTs), reviews, and meta-analyses, ensuring a robust evidence base for synthesis.

The systematic approach, with predefined search strings and inclusion/exclusion criteria, guarantees objectivity in study selection, minimising biases that can arise

from selective reporting or publication bias. By including multiple databases and using comprehensive search terms, we aim to ensure that the review captures the

Distribution of Studies by Year

The number of studies increased notably from 2018, peaking around 2020, and slightly tapering off afterward (Figure 2.). This trend aligns with a growing research interest in fields such as behavioral science, where "nudges" became increasingly prominent. The surge in studies, particularly from 2018 to 2020, could be linked to the rise of nudging techniques in policy and decision-making frameworks, reflecting a heightened focus on applying these insights across various domains. The subsequent decline may indicate either a saturation in the field or shifts toward other emerging areas of research.

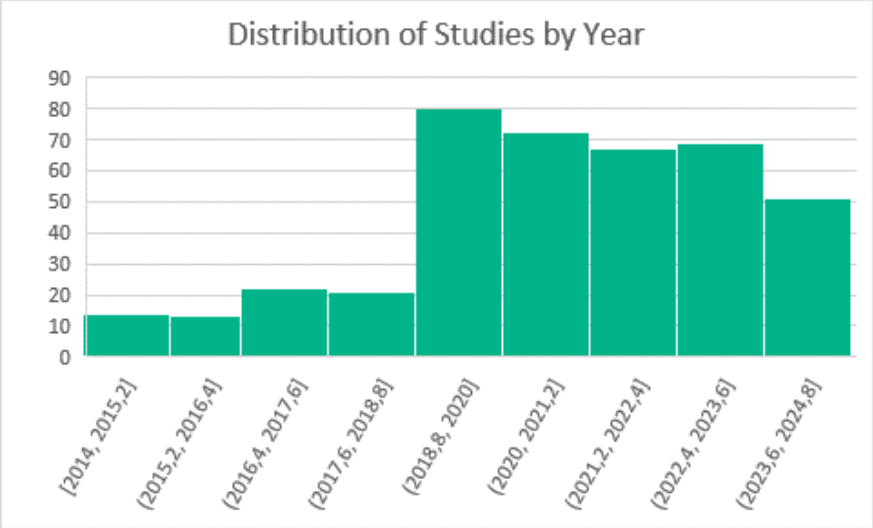

Figure 2. Distribution of Studies by Year

2.1.5 Selection Criteria

The selection criteria were carefully designed to ensure that the review captures only high-quality, relevant studies that provide insights into the effectiveness of nudges for climate change mitigation. The use of a systematic review ensures that

all relevant studies are evaluated rather than cherry-picking studies that support a particular viewpoint, thus strengthening the validity of the findings.

2.1.5.1 Inclusion Criteria

Population: Only studies involving adults aged 18+ were included, as adults are typically the primary decision-makers in behaviors impacting climate change (e.g., energy consumption, transportation choices). This criterion ensures that the interventions studied are relevant to the target population most capable of enacting change.

Interventions: We focused on studies that examined nudging interventions aimed specifically at climate change mitigation behaviors. Nudges are subtle, non-coercive interventions that alter behavior by changing the way choices are presented, without restricting freedom of choice. This is a key area of interest, as nudges represent a potentially powerful tool for encouraging environmentally sustainable behaviors in a way that is socially acceptable and economically efficient.

Geographical Focus: Studies conducted within the European Union (EU) context were prioritized. This decision was made because of the EU's strong regulatory and policy frameworks on environmental issues, which may influence the effectiveness of nudging interventions. It also allows for more meaningful comparisons across studies due to shared legal, economic, and cultural contexts.

Study Designs: Only empirical studies, including randomised controlled trials (RCTs), case studies, reviews, and meta-analyses, were included. This decision reflects the desire to base conclusions on rigorous, well-controlled studies that provide high levels of evidence regarding the effectiveness of nudging interventions.

Language: Only English-language publications were included to maintain consistency in data extraction and interpretation. The exclusion of non-English studies was deemed necessary due to resource constraints and potential challenges in ensuring consistent interpretation across languages.

Publication Date: The review is limited to studies published in the past 10 years (2014-2024), reflecting the evolving nature of behavioral science and policy measures related to climate change. The recent focus ensures the review reflects the most current evidence and interventions relevant to today's climate and policy challenges.

2.1.5.2 Exclusion Criteria

Population: Studies involving populations under the age of 18 were excluded, as behaviors in children and adolescents are often influenced by factors different from those in adults (e.g., parental guidance, schooling environments).

Interventions: Interventions that do not use nudging principles or that target behaviors unrelated to climate change mitigation (e.g., health behaviors) were excluded. This ensures the review remains focused on the intersection of nudging and environmental sustainability.

Study Type: Non-peer-reviewed articles, grey literature, and reports were excluded to maintain a high standard of scientific rigor.

Publication Date: Studies published before 2014 were excluded, as older studies may not reflect the latest advancements in behavioral science or the current urgency of climate change issues.

2.1.6 Selection of Studies

The selection of studies followed a rigorous two-step process, adhering to best practices for systematic reviews (Figure 3.). This method ensures the review's comprehensiveness, transparency, and replicability, providing objective and unbiased evidence on the impact of nudging interventions.

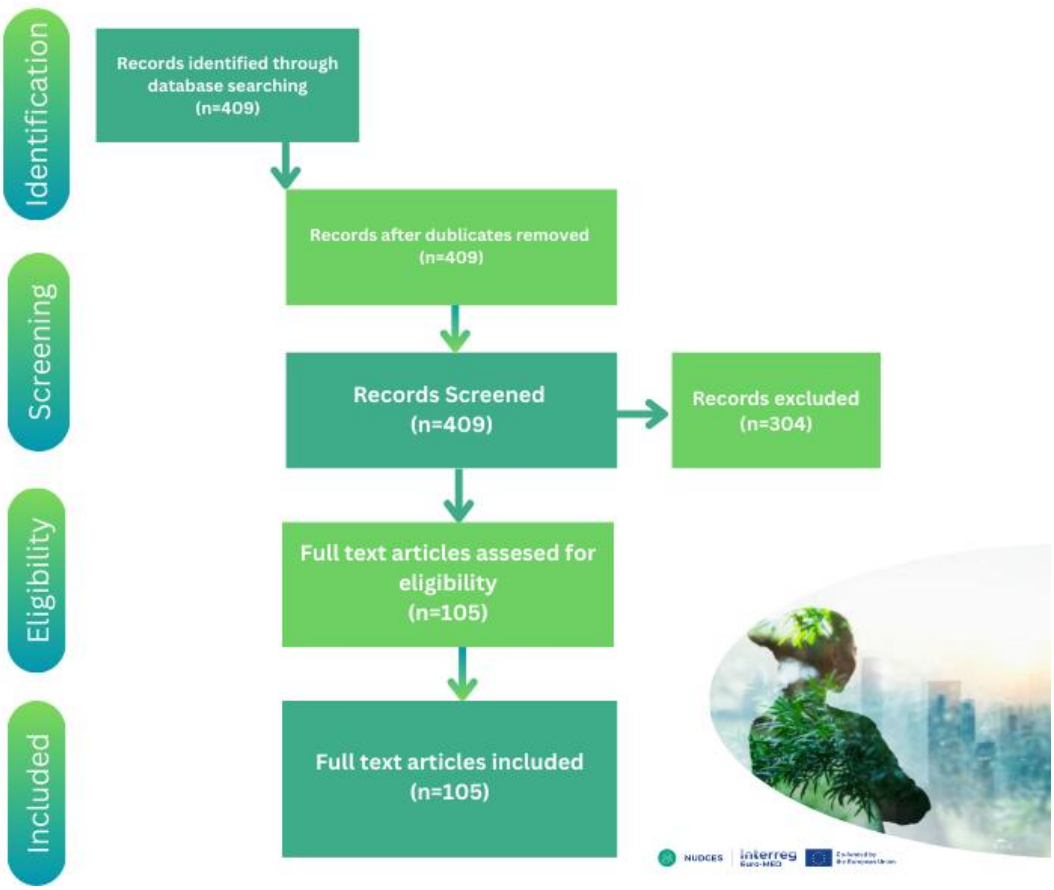

Figure 3. Flow diagram of study Selection Process for Systematic Review

Step 1: Title and Abstract Screening

The first step involved screening titles and abstracts of all retrieved studies against the inclusion and exclusion criteria. This preliminary screening was conducted independently by two reviewers to minimise bias. Each study's title and abstract were carefully assessed to determine relevance based on the study's population, intervention type, and outcomes related to climate change mitigation.

Objective: This step aimed to narrow down the pool of studies to only those that were most relevant to the research question, eliminating studies that were clearly outside the scope of the review (e.g., non-nudging interventions, non-climate-related studies).

Step 2: Full-Text Review

In the second step, all studies that passed the initial screening underwent a full-text review. During this stage, the full content of each study was evaluated to ensure that it met all inclusion criteria. Particular attention was given to the quality of the study's methodology, the type of nudging intervention used, and the outcomes related to climate change mitigation.

Objective: This stage ensured that only methodologically sound studies were included (ANNEX, p32.), thereby enhancing the reliability and validity of the review's findings.

Disagreements between reviewers were resolved through consultation with a third reviewer. This process helps maintain rigor and objectivity in the selection process.

2.1.7 Data Collection and Charting

Data collection and charting were conducted using a standardised data extraction form. This form was developed to ensure consistency in how data were extracted from each study, allowing for easy comparison and synthesis.

Data Extraction Variables:

Study Characteristics: Information such as author(s), publication year, sample size, and study design (e.g., RCT, case study) were extracted. These variables provide context for interpreting the study's findings and understanding how different geographical, temporal, and methodological factors might influence results.

Nudge Interventions: Details on the type of nudge employed (e.g., defaults, social norms, framing effects), the targeted behavior (e.g., energy conservation, recycling), and the underlying theoretical framework (e.g., Mindspace Framework, TDF) were recorded. This allows for analysis of which nudging techniques are most effective in promoting sustainable behaviors.

Outcome Measures: Both primary outcomes (e.g., reductions in energy consumption, increased recycling rates) and secondary outcomes (e.g., shifts in behavioral intentions or attitudes) were captured. This ensures that the review considers not only immediate behavioral changes but also longer-term impacts and attitudinal shifts.

3. Results

3.1. Data analysis

The data analysis phase was designed to extract meaningful insights from data, allowing for a comprehensive understanding of the effectiveness of nudging interventions aimed at climate change mitigation. A systematic review was chosen as the methodology because it enables the integration of findings across multiple studies, providing a robust synthesis of evidence that is more powerful and reliable than individual studies in isolation. This approach helps in identifying patterns, trends, and gaps in the literature, contributing to both academic knowledge and practical applications in policymaking.

Quantitative Analysis:

The average success rate of nudging interventions across all studies was generally moderate in the preliminary data extraction process. Default nudges were particularly effective in Northern Europe, achieving significant success, while social norm nudges led to a notable reduction in resource usage in Southern Europe.

Qualitative Analysis:

Preliminary thematic analysis revealed that cultural norms, such as the importance of community in Southern Europe and environmental consciousness in Northern Europe, significantly influenced the outcomes of nudging interventions. Tailoring nudges to fit local cultural contexts is critical for maximising their effectiveness.

Implications for Policy and Practice:

The preliminary findings from this systematic review underscore the importance of considering cultural and regional factors when designing and implementing nudging interventions. Policymakers and stakeholders across the EU can use these insights to develop targeted nudging strategies that address specific behavioral and cultural contexts. For instance, in regions where social approval and community values are strong, interventions that encourage peer comparison and social cohesion may be more successful, while in areas with high environmental awareness, default options that align with sustainability goals can lead to significant behavior change.

3.1.1. Key Preliminary Findings

Effectiveness of Nudging Interventions:

The review highlights the effectiveness of nudging interventions in promoting climate-friendly behaviors such as:

- Energy conservation, sustainable food choices, and water usage reduction.
- Default nudges (e.g., automatic enrolment in green energy plans) emerged as the most effective intervention type, particularly in Northern European countries like Germany and Sweden, where public trust in institutions and environmental responsibility are high.
- Social norm nudges (e.g., comparing energy or water usage to neighbours) were found to be highly effective in Southern European countries (e.g., Spain, Italy), where community cohesion and social approval strongly influence behavior.

3.1.2.Cultural Factors

Cultural factors play a crucial role in determining the success of nudging interventions. In collectivist cultures like those in Southern Europe, social comparison and community-based nudges were more effective, while in individualistic cultures (e.g., Northern Europe), default nudges aligned with personal responsibility and trust in authority yielded better outcomes.

The conducted review emphasises the need for culturally tailored nudges that align with local values, social structures, and cultural norms. For instance, in Mediterranean countries, nudging strategies that leverage community ties and collective responsibility were more successful in driving behavior change.

Regional Differences:

Nudging interventions in Northern European countries benefited from high levels of environmental awareness and institutional trust, resulting in greater adoption of sustainable behaviors through default options and social comparisons.

In contrast, in Mediterranean regions, where social interactions and community engagement are more pronounced, nudges that foster social connections and peer influence showed higher efficacy.

3.2 Integration with Theoretical Frameworks

The findings from the analysis were interpreted and contextualised using established behavioral change frameworks, which helped explain the mechanisms through which nudging interventions influenced behavior.

These frameworks included:

- **Theoretical Domains Framework (TDF):**

This framework provided insights into the specific behavioral determinants targeted by nudging interventions, such as motivation, decision-making processes, and external influences. The TDF helped to identify which domains (e.g., social influences, knowledge, beliefs) were most frequently and successfully targeted by effective nudges.

- **Behavior Change Techniques (BCT) Taxonomy:**

The BCT taxonomy was used to classify the specific techniques employed in the nudging interventions, such as feedback mechanisms, default settings, or

reminders. This categorization allowed for a systematic comparison of which techniques were most effective in promoting sustainable behaviors across different studies.

- **Mindspace Framework:**

The Mindspace framework, which outlines key psychological principles (e.g., social norms, priming, and incentives), helped interpret the underlying cognitive processes that made certain nudges successful. For example, interventions that leveraged emotional triggers or framed choices in a way that appealed to individuals' sense of identity were found to have significant impacts on behavior.

3.2.1 State-of-the-art Review of Literature

The growing environmental crisis, marked by challenges such as climate change, resource depletion, and ecosystem degradation, has driven increasing interest in leveraging behavioral science to promote sustainable actions. In this context, nudging, a behavioral intervention technique that subtly influences individuals' decisions without restricting choices, has become a widely explored approach. The current body of literature reflects a multidisciplinary integration of psychology, behavioral economics, environmental science, and public policy, offering a diverse range of insights into how nudges can be utilized to encourage pro-environmental behaviors.

This state-of-the-art chapter presents a systematic and integrated understanding of how nudging and behavioral interventions can effectively promote sustainability across a wide range of contexts. The following sections synthesize the review's preliminary key findings, according to the behavioural frameworks, adopted to analyse the data extracted from the literature.

Behavior Change Techniques (BCTs) and Environmental Sustainability

A significant portion of the literature has focused on the application of Behavior Change Techniques (BCTs) in promoting sustainable behavior. BCTs, as codified in

Michie et al.'s BCT Taxonomy (2013), provide a framework for categorizing the interventions aimed at modifying behavior. Several studies have systematically applied BCTs to encourage pro-environmental actions, such as reducing energy consumption, promoting sustainable food choices, and encouraging recycling.

Action Planning (BCT 1.4): Many interventions use action planning to help individuals structure specific, actionable steps toward sustainable behavior. Whittall et al. (2023), for instance, highlight the importance of action planning in shifting public dietary behaviors toward sustainability.

Self-Monitoring (BCT 2.3): Studies like Panzone et al. (2023) emphasize the effectiveness of self-monitoring tools, such as carbon footprint calculators or energy use trackers, to increase individual awareness and commitment to sustainable behavior.

Feedback on Behavior (BCT 2.2): Several studies, including Korteling et al. (2023) and Van Dessel et al. (2022), underline the role of feedback in reinforcing positive environmental behaviors by making the consequences of actions (e.g., energy savings or carbon reduction) more salient to the individual.

The literature supports the efficacy of BCTs in structuring interventions that align with both conscious decision-making and unconscious behavioral drivers.

Habit formation (BCT 8.3) and **restructuring of the physical environment (BCT 12.1)** are further highlighted as pivotal strategies to create long-lasting behavioral change by embedding pro-environmental actions into daily routines and making sustainable choices easier to access

A. Nudging: Subtle Behavioral Interventions for Sustainability

Nudging, as popularized by Thaler and Sunstein (2008), has become a key strategy in the field of behavioral public policy. The core premise of nudging is to influence decision-making in ways that improve outcomes for individuals and society without coercion. **MINDSPACE**, a behavioral framework developed by Dolan et al. (2012), outlines several key factors - such as **norms, salience, and incentives** - that are central to nudging individuals toward more sustainable choices.

Norms and Social Influence: Numerous studies, including Vesely et al. (2022) and Van Der Zee et al. (2024), demonstrate the power of social norms in nudging behaviors. These studies show that making sustainable behaviors visible and socially desirable significantly increases participation, particularly when individuals see their peers adopting similar behaviors.

Salience and Feedback: Haggar et al. (2023) found that providing real-time feedback, such as information on water or energy consumption, increases the salience of environmental behaviors and leads to more sustainable outcomes.

Commitment Devices: Studies like Panzone et al. (2023) highlight the use of commitment devices and symbolic rewards, such as badges or public pledges, which reinforce long-term adherence to pro-environmental behaviors.

The literature suggests that nudges are effective because they align with automatic, intuitive decision-making processes rather than relying on sustained effort or willpower. By modifying the decision-making context - whether through changing defaults, providing timely reminders, or leveraging social norms - nudges have been shown to significantly increase the uptake of sustainable behaviors with minimal friction.

B. Theoretical Domains Framework (TDF):

Understanding Behavioral Determinants:

The Theoretical Domains Framework (TDF) provides a comprehensive lens for understanding the psychological, social, and environmental determinants of behavior. Studies like Cleveland et al. (2020) and Capstick et al. (2014) emphasize that for sustainable behavior change interventions to succeed, they must address not only the individual's intentions and capabilities but also the broader social and contextual factors.

Beliefs about Capabilities: Research by Cleveland et al. (2020) highlights the role of self-efficacy in determining whether individuals engage in pro-environmental behavior. Individuals who believe that their actions can have a meaningful impact on the environment are more likely to adopt and sustain these behaviors.

Environmental Context and Resources: Van Dessel et al. (2022) underline that behavior change interventions must ensure that individuals have access to the resources and infrastructure needed to act sustainably, such as recycling facilities or public transportation.

Social Influences and Norms: As with BCTs and MINDSPACE, the TDF highlights the importance of social norms. Studies consistently find that when sustainable behavior is seen as the social norm, individuals are more likely to engage in it.

By addressing these multiple behavioral domains, the TDF framework helps ensure that interventions are comprehensive and target all potential barriers to sustainable behavior.

Affordance-Based Approaches to Sustainable Behavior: Building on the work of Gibson (1979), recent research by Kaaronen & Rietveld (2021) has explored affordance-based interventions that restructure the physical environment to naturally guide individuals toward more sustainable behaviors. Affordances refer to environmental features that invite or facilitate specific behaviors without requiring conscious decision-making.

Environmental Restructuring: Studies like Garnett et al. (2019) and Van Der Zee et al. (2024) demonstrate how restructuring physical environments - such as increasing the availability of vegetarian meal options or placing recycling bins in prominent locations - can subtly nudge individuals toward more sustainable actions.

Prompts and Cues: Environmental cues, such as clear labelling or strategically placed reminders, serve as non-intrusive prompts that encourage individuals to make sustainable choices. Gottselig et al. (2023) highlight how discrete choice experiments show consumers are more likely to value sustainable food when provided with green nudges in the form of cues.

Affordance-based approaches align with findings from the MINDSPACE framework and BCTs by focusing on making sustainable behaviors easy and convenient, thereby reducing the cognitive load associated with decision-making.

C. Cultural Factors in Nudging and Behavior Change:

A recurring theme across the literature is the importance of considering cultural context in designing and implementing behavior change interventions. As noted by Capstick et al. (2014), Cleveland et al. (2020), and Eker et al. (2019), cultural values and social norms heavily influence how individuals perceive environmental responsibility and engage in sustainable behaviors.

Collectivist vs. Individualist Cultures: In collectivist cultures, interventions that emphasize communal responsibility and collective action, such as community recycling programs, are more effective. In contrast, individualistic cultures may respond better to interventions that emphasize personal benefits, autonomy, and self-interest.

Cultural Norms and Values: Garnett et al. (2019) show that dietary interventions in countries with strong meat-eating cultures may face resistance unless they are designed to align with cultural values around health and nutrition. Similarly, Whittall et al. (2023) note that understanding public perceptions of sustainable diets is critical to designing interventions that resonate with cultural attitudes toward food. The literature highlights that behavior change interventions cannot take a one-size-fits-all approach. To be effective, nudges and other behavior change strategies must be tailored to reflect the cultural values, social norms, and environmental realities of the target population.

D. Summary of Insights from the Literature:

The preliminary findings and state-of-the-art literature on nudging and sustainable behavior change reveals several key insights:

Behavior Change Techniques (BCTs) provide a structured and evidence-based approach for designing interventions that encourage pro-environmental behaviors. Techniques like **action planning, feedback, and habit formation** have been proven effective across various domains.

Nudges that leverage **social norms, salience, and commitment** can significantly influence sustainable behavior with minimal resistance or effort from individuals.

These interventions work by altering the decision-making context in ways that favor pro-environmental choices.

The Theoretical Domains Framework (TDF) offers a comprehensive understanding of the psychological and contextual factors that must be addressed to facilitate lasting behavior change, highlighting the importance of addressing beliefs about capabilities, social influences, and environmental resources. **Affordance-based approaches** that **restructure physical environments** can create contexts that naturally guide individuals toward sustainable behaviors without requiring conscious effort (Kaaronen & Rietveld, 2021). **Cultural sensitivity** is critical to the success of behavior change interventions, with cultural norms and values shaping both the design and the effectiveness of nudges and other interventions (Capstick et al., 2014; Cleveland et al., 2020; Eker et al., 2019).

As the literature evolves, **future research** should focus on exploring the scalability of these interventions across **diverse cultural and socio-economic contexts**, while also examining the **role of digital technologies** in providing real-time feedback and reinforcement for sustainable behaviors.

4. Discussion

This systematic review highlights the pivotal role that nudging interventions can play in promoting climate change mitigation behaviours across different regions and cultural contexts in the European Union. Nudging, a key concept in behavioural economics, offers a non-coercive, cost-effective way to subtly influence individual behaviours towards pro-environmental actions, such as reducing energy consumption, adopting sustainable food practices, and minimising waste. Through the preliminary findings of the review, we have gained valuable insights into the effectiveness, adaptability, and limitations of nudging strategies in fostering sustainable behaviours.

One of the central preliminary findings is the effectiveness of nudges, particularly those that utilize default settings, social norms, and real-time feedback. Default nudges, such as automatic enrolment in green energy programs, have consistently

shown the highest success rates, particularly in Northern European countries where public trust in institutions is notably high. Social norm nudges, which rely on peer comparison, have proven effective in Southern European countries, where community values and social cohesion are prominent. These nudges are successful because they may align with regional social dynamics and tap into widely held values.

A critical takeaway from the review is the importance of **cultural sensitivity** and **adaptation** in the success of nudging interventions. The effectiveness of these strategies varies significantly across different regions and cultural contexts. For instance, **collectivist cultures** are more **responsive to social norm nudges,** while **individualist cultures**, where personal responsibility is emphasized, tend to show **stronger responses to default nudges**. This finding highlights the need for **policymakers** to design **nudging interventions** that are **tailored** to the specific cultural norms of the **regions they aim to impact**, thus maximizing the effectiveness of these interventions.

However, despite the promising potential of nudging, several **challenges and limitations were identified.** One challenge is the **variability** in the long-term effectiveness of nudges, with some studies indicating that the behavioural changes induced by these interventions may diminish over time. Additionally, the **generalizability** of nudging interventions can be limited by socio-economic factors and cultural diversity, suggesting that a one-size-fits-all approach may not be suitable for all regions or populations. This emphasizes the need for more nuanced and context-specific strategies.

The implications for policy and practice are clear. **Policymakers must consider culturally adaptive nudges that are aligned with local social and cultural values to enhance their effectiveness.** Furthermore, nudging interventions should be **integrated into broader environmental policies** to complement existing regulatory measures and financial incentives. This integration will create a comprehensive and multifaceted approach to encouraging sustainable behaviour on a larger scale.

Looking ahead, there are several **future research directions** that need to be explored. **Future studies should focus** on evaluating **the long-term sustainability of nudging interventions** to ensure that the behaviours they promote endure over time. There is also a pressing need for more **research in underrepresented regions**, such as Eastern Europe, to understand how nudging strategies can be adapted to different cultural and socio-economic contexts. Additionally, combining nudges with other behavioural interventions - such as financial incentives or educational campaigns - could further enhance their impact and should be an area of further empirical investigation.

Building on the findings of this review, the next phase of the project will involve the design and implementation of culturally tailored nudging interventions across six Mediterranean countries. These pilot studies will test the effectiveness of various nudges in real-world settings, with the goal of scaling up successful interventions to promote widespread climate-friendly behaviors across the region.

5. Conclusion

In conclusion, **nudging offers a powerful and practical tool** for influencing pro-environmental behaviours and **mitigating the effects of climate change**. However, the **success** of these interventions **depends on their careful adaptation to cultural and regional contexts** and a clear understanding of their limitations. As the global challenge of climate change intensifies, nudging provides a scalable solution for encouraging sustainable behaviour at both individual and societal levels. Policymakers and researchers must continue to refine and adapt these strategies to maximize their impact, ensuring that nudging remains an essential component of global climate change mitigation efforts.

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ANNEX

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Victoria Y. Martin, Betty Weiler, Arianne Reis, Kay Dimmock, Pascal Scherrer	‘Doing the right thing’: How social science can help foster pro-environmental behaviour change in marine protected areas	2017
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Mark Cleveland, Jennifer L. Robertson, Victoria Volk, Helping or hindering	Environmental locus of control, subjective enablers and constraints, and pro-environmental behaviors	2020

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Roope Oskari Kaaronen, Erik Rietveld	Practical lessons for creating affordance-based interventions for sustainable behavior change	2021
Marleen C. Onwezen, Hans Dagevos	A meta-review of consumer behaviour studies on meat reduction and alternative protein acceptance	2024
Hoi-Wing Chan, Alina Mia Udall, Kim-Pong Tam	Effects of perceived social norms on support for renewable energy transition:	2022
Pascal Frank, Katrin Heimann, Viktoria Kolbe, Carolin Schuster	Can guided introspection help avoid rationalization of meat consumption? Mixed-methods results of a pilot experimental study	2022
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Jan M. Bauer, Simon C. Aarestrup, Pelle G. Hansen, Lucia A. Reisch	Nudging more sustainable grocery purchases: Behavioural innovations in a supermarket setting	2022
Ghina ElHaffar, Fabien Durif, Laurette Dubé	Towards closing the attitude-intention-behavior gap in green consumption: A narrative review of the literature and an overview of future research directions	2020
Jeanine Kirchner-Krath, Benedikt Morschheuser, Nevena Sicevic, Nannan Xi, Harald F.O. von Korflesch, Juho Hamari	Challenges in the adoption of sustainability information systems: A study on green IS in organizations	2024
Vanessa Schöller, Clara Ulmer	Can monetized carbon information increase pro-environmental behavior? Experimental evidence	2023
Michelle Berger, Theresa Lange, Bastian Stahl	A digital push with real impact – Mapping effective digital nudging elements to contexts to promote environmentally sustainable behavior	2022
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Philip J. Vergragt, Leonie Dendler, Martin de Jong, Kira Matus	Transitions to sustainable consumption and production in cities	2016

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Gianluca Grilli, John Curtis	Encouraging pro-environmental behaviours: A review of methods and approaches	2021
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Stefan Hoffmann, Wassili Lasarov, Hanna Reimers, Melanie Trabandt	Carbon footprint tracking apps. Does feedback help reduce carbon emissions?	2024
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Marius Alt, Hendrik Bruns, Nives DellaValle, Ingrida Murauskaite-Bull	Synergies of interventions to promote pro-environmental behaviors – A meta-analysis of experimental studies	2024
Sari R.R. Nijssen, Martijn Pijs, Alicja van Ewijk, Barbara C.N. Müller	Towards more sustainable online consumption: The impact of default and informational nudging on consumers' choice of delivery mode	2023
Claudio Soregaroli, Elena Claire Ricci, Stefanella Stranieri, Rodolfo M. Nayga, Ettore Capri, Elena Castellari	Carbon footprint information, prices, and restaurant wine choices by customers: A natural field experiment	2021

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Astrid Dannenberg, Eva Weingärtner	The effects of observability and an information nudge on food choice	2023
Olivier De Schutter, Nick Jacobs, Chantal Clément	A 'Common Food Policy' for Europe: How governance reforms can spark a shift to healthy diets and sustainable food systems	2020
Anna-Louisa Peeters, Ellen van der Werff, Nynke Tromp	Designing for value-behaviour consistency: ethical choice architecture to stimulate sustainable meat purchase	2022
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Lisa Boenke, Miriam Panning, Anika Thurow, Jacob Hörisch, David D. Loschelder	Who can nudge for sustainable development? How nudge source renders dynamic norms (in-)effective in eliciting sustainable behavior	2022
Stefan Vögele, Lisa Hanna Broska, Sebastian Otte, Dirk Rübbelke	Why the trend towards gas-guzzlers? A closer look at the complex effects of social norms on German car buyers	2021
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Rebecca J. Hafner, David Elmes, Daniel Read	Promoting behavioural change to reduce thermal energy demand in households: A review	2019

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Meike Morren, Jantsje M. Mol, Julia E. Blasch, Žiga Malek	Changing diets - Testing the impact of knowledge and information nudges on sustainable dietary choices	2021
Sanneke Kloppenburg, Aarti Gupta, Sake R.L. Kruk, Stavros Makris, Robert Bergsvik, Paulan Korenhof, Helena Solman, Hilde M. Toonen	Scrutinizing environmental governance in a digital age: New ways of seeing, participating, and intervening	2022
Stephen Axon, John Morrissey, Rosita Aiesha, Joanne Hillman, Alexandra Revez, Breffní Lennon, Mathieu Salel, Niall Dunphy, Eva Boo	The human factor: Classification of European community-based behaviour change initiatives	2018
Matthias Lehner, Oksana Mont, Eva Heiskanen	Nudging – A promising tool for sustainable consumption behaviour?	2016
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José-Luis Vázquez, Ana Lanero, Juan A. García, Xavier Moraño	Segmentation of consumers based on awareness, attitudes and use of sustainability labels in the purchase of commonly used products	2023

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Angela Santangelo, Simona Tondelli	Occupant behaviour and building renovation of the social housing stock: Current and future challenges	2017