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Review

# A systematic literature review of voluntary behaviour change approaches in single use plastic reduction

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ABSTRACT

Plastic waste is a leading contributor to climate change due to its build up in landfill and oceans, releasing harmful greenhouse gases and causing harm to ecosystems. The past decade has seen a rise in the number of policies and legislative regulations surrounding the use of single-use plastics (SUP). Such measures are needed and have shown effectiveness in the reduction of SUP's. However, it is becoming apparent that voluntary behaviour change efforts, which preserve autonomous decision making are also needed to further reduce demand for SUP. This mixed-methods systematic review had three aims, 1) synthesise existing voluntary behavioural change interventions and approaches aimed at reducing SUP consumption, 2) assess the level of autonomy preserved in interventions, and 3) assess the extent of theory use in voluntary SUP reduction interventions. A systematic search was executed across six electronic databases. Eligible studies were peer-reviewed literature published in English between 2000 and 2022 reporting on voluntary behaviour change programs aimed at reducing the consumption of SUPs. Quality was assessed using the Mixed Methods Appraisal Tool (MMAT). Overall, 30 articles were included. Due to the heterogenic nature of outcome data in included studies, meta-analytic analysis was not possible. However, data were extracted and narratively synthesised. Communication and informational campaigns were the most common intervention approach with most interventions taking place in community or commercial settings. There was limited theory use among included studies (27% used theory). A framework was created using the criteria outlined by Geiger et al. (2021) to evaluate level of autonomy preserved in included interventions. Overall, level of autonomy preserved in included interventions was low. This review highlights the urgent need for more research into voluntary SUP reduction strategies, increased integration of theory in intervention development, and higher levels of autonomy preservation in SUP reduction interventions.

## 1. Introduction

The proliferation of plastics over the past few decades has now culminated into a global issue that threatens the well-being of various ecosystems and human society (Chen et al., 2021; Heidbreder et al., 2019). Growing plastic use and waste are issues requiring immediate attention through a coordinated multidisciplinary effort that involves advances in technology and science that are coupled with behaviour change interventions and policies (Heidbreder et al., 2019). Advancements in science have been made to aid in curbing plastic pollution. These range from discoveries of water-resistant cardboard (ESCAP, 2018) to plastic-eating bacteria (Cornwall, 2021). The efforts of scientists and engineers need to be complemented by behaviour-based efforts that aim to change consumer consumption and disposal of plastics. Behaviour-based efforts to reduce SUP consumption have primarily taken the form of public campaigns, education programs, policies, legislation, and government regulations (Geiger et al., 2021; Heidbreder et al., 2019; Macintosh et al., 2020; Schnurr et al., 2018). Excell et al. (2018) found that at least 127 out of 192 countries in the world have enacted some form legislation to regulate plastic bags. These range from

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full and partial bans on plastic bags to imposing fees for the use of plastic bags. Some countries' legislations extend past looking solely at plastic bags to also include other single-use plastic items such as plastic cutlery, plates, and stirrers. Bans and levies attempt to control human behaviour (Deci and Ryan, 2012; Geiger et al., 2021). Controlled motivation implies that an individual's behaviour occurs due to external pressures or forces. The implementation and effectiveness of approaches using controlling elements dominate academic research and practice (Heidbreder et al., 2019; Macintosh et al., 2020; Wang et al., 2022). Extant literature provides mixed support for the effectiveness of interventions with controlling characteristics such as plastic bag bans and levies (Jehangir et al., 2022; Kish, 2018; Ritch et al., 2009). Interventions which aim to control behaviour increase extrinsic motivation. Extrinsically motivated behaviour can have many unintended consequences, including a decrease in intrinsic motivation (Deci, 1971; Kruglanski et al., 1971; Lemos and Veríssimo, 2014; Lepper et al., 1973), higher likelihood of negative community reactance and negative spillover effects (Geiger et al., 2021). While coercive efforts will always be required and are proven to deliver reductions in SUPs, it is becoming apparent that less controlling behaviour change approaches are also needed (Geiger et al., 2021; Isbanner et al., 2021). Autonomy preserving interventions that allow for voluntary behaviour change provide a viable solution.

According to Self-determination theory (SDT), autonomous behaviour is self-determined and stems from internal goals and outcomes (Deci and Ryan, 2012). Interventions that support autonomous motivation preserve a sense of choice, provide an explicit rationale, involve perspective-taking, or use non-controlling language (Bartholomew et al., 2009; Bradshaw et al., 2021; Deci et al., 1994). SDT suggests that individuals acting from autonomous motivation are more likely to initiate and persist with behaviour when compared to those acting due to controlled motivation (Geiger et al., 2021). Autonomy preserving interventions can complement and aid in addressing some of the drawbacks of interventions with controlling characteristics (Jehangir et al., 2022). While there are obvious benefits to using voluntary behaviour change interventions, understanding and use of voluntary behaviour change interventions are limited (Borg et al., 2022; Geiger et al., 2021). Behaviour change interventions are more effective when their development and implementation are grounded in relevant theory (Manikam and Russell-Bennett, 2016; Pang et al., 2017; Rundle-Thiele et al., 2019; Willmott et al., 2019; Willmott and Rundle-Thiele, 2021). Yet, theory application in behaviour change interventions is scarce (Dietrich et al., 2022; Rundle-Thiele et al., 2019; Willmott et al., 2019; Willmott and Rundle-Thiele, 2021). To decrease plastic waste, a blueprint for creating and implementing effective interventions must be created, agreed upon, tested, and used. However, first, a deeper understanding of voluntary behaviour change approaches to plastic reduction must be gained. This systematic literature review consolidates current understandings of voluntary SUP consumption behaviour change interventions.

The existing literature offers numerous studies and evaluations on the efficacy of regulatory measures, such as plastic reduction levies, to control plastic waste (Jehangir et al., 2022; Kish, 2018; Muposhi et al., 2022; Nielsen et al., 2019; Ritch et al., 2009; Xanthos and Walker, 2017). However, research on voluntary approaches, including those related to single-use plastic (SUP), is limited. Heidbreder et al. (2019) conducted one review that analysed public perceptions, behaviours and interventions related to SUP. The authors split current approaches to solving the plastic issue into two categories, regulatory and economic policy instruments to reduce plastic use and psychological interventions and included interventions targeting the 'Three R's' of waste management (recycle, reuse, and reduce). They found that while regulatory and policy instruments effectively reduce SUP use, they may not be politically feasible in every context. Their review further determined that educational approaches, gaming strategies, public commitments, and the introduction of role models were effective in raising awareness and partly effective in creating behaviour change. While Heidbreder et al. (2019) provided good insight into a broad range of factors related to the SUP issue, their reporting on reducing consumption, specifically through behavioural interventions, was limited.

To date, only one review has been conducted on voluntary behaviour change programs aimed at reducing the consumption of SUPs (Borg et al., 2022). Borg et al. (2022) found that interventions with controlling characteristics were effective in the short-term and that autonomy supporting interventions were moderately effective. The rapid review noted poor evaluation and short-term monitoring as shortcomings and established that multiple stakeholders partly facilitate individual behaviour change. While the work by Borg et al. (2022) presents valuable insights into voluntary behaviour change in SUP reduction, the review was limited to studies conducted in developed countries over the past five years. While Borg et al. (2022) included theory in their data extraction process, their findings regarding levels of theory use were limited and a clear understanding of theories used was not provided.

Given that the literature is restricted to evidence from the past five years in developed countries with a limited focus on voluntary SUP reduction interventions, there is a need for a systematic evidence review with an extended focus. This review has three aims: 1) synthesising existing voluntary behavioural change interventions and approaches aimed at reducing SUP consumption, 2) assessing the level of autonomy preserved in interventions and, 3) assessing the extent of theory use in voluntary SUP reduction interventions. The current review aims to uncover how voluntary behaviour change can reduce SUP and asks.

RQ1 What methods are employed to create voluntary behaviour change to address SUP consumption?

In addressing RQ1, a focus is placed on intervention approaches.

RQ2 In what contexts do voluntary behaviour change interventions addressing SUP consumption take place?

In addressing RQ2, a focus is placed on countries where studies are conducted, the settings where interventions are implemented in, and the type of single-use plastic(s) that interventions target.

RQ3 To what extent is theory applied in voluntary behaviour change interventions aimed at reducing SUP consumption?

In addressing RQ3, a focus is placed on specific theories reported in voluntary SUP reduction campaigns, and an assessment of the extent of theory use is provided.

RQ4 What was the level of autonomy preserved in included studies?

In addressing RQ4, the criteria for autonomy supporting interventions, as outlined by Geiger et al. (2021) is considered.

## 2. Method

The preferred reporting items for systematic reviews and meta-analyses (PRISMA) (Moher et al., 2010) were followed in the review. The PRISMA method provides a comprehensive set of guidelines for conducting systematic reviews (Paul et al., 2021; Sajid et al., 2020; Willmott et al., 2022). PRISMA outlines four key stages: identification, screening, eligibility, and inclusion. These were followed in the current review.

### 2.1. Systematic review

This review applies the theories, contexts, and methods (TCM) framework (Paul et al., 2017), and the theory coding framework (Pang et al., 2017), and it considers the criteria for autonomy supporting interventions as outlined by Geiger et al. (2021) to answer the outlined

research questions. This study focuses on theory application and autonomy preservation in voluntary SUP reduction programs reported in peer-reviewed literature.

### 2.2. Eligibility criteria

Eligible studies included peer-reviewed literature published in English between 2007 and 2022 reporting on voluntary behaviour change programs aimed at reducing the consumption of SUPs. Evaluative and formative research papers using qualitative, quantitative, or mixed methods research designs were included. Studies were excluded if they reported on SUP bans, levies, or policy. These types of interventions altogether remove any level of autonomy. Furthermore, extant literature is saturated with reviews on the impacts and effectiveness of SUP bans, levies, and policy (Bezerra et al., 2021; Macintosh et al., 2020; Muposhi et al., 2022; Nyathi and Togo, 2020; Xanthos and Walker, 2017). Studies were excluded if they reported on the provision of biodegradable plastic alternatives or technological advancements in SUP alternatives. These items are also considered single-use, and the disposal behaviour related to biodegradable items is like that of single-use plastics. Studies were assessed for eligibility by two independent reviewers. Any conflict in inclusion and exclusion decisions were highlighted and resolved through consultation between the two reviewers and the wider research team.

### 2.3. Search strategy and information sources

The search strategy was adapted from Borg et al. (2022). Search terms comprised four related categories: (1) behaviour; (2) outcome; (3) intervention; (4) plastic (broad) and (5) plastic (specific). It was necessary to separate the two plastic terms with 'AND' as the term 'plastic' on its own spanned across multiple irrelevant fields (e.g., engineering, medicine) (see supplementary file 1). The systematic search strategy was completed in March 2022 and executed across six databases (see supplementary file 1). Database searches were limited to the past 22 years. The context in which consumers interact with plastic has changed drastically over the past few decades. There have been many advancements in technology, science, and policy and both expert and public understandings of single-use plastic have changed over the past decade. Due to these reasons, including studies published before 2000 would not yield results relevant to the present-day context. Backward and forward searches were performed to identify additional studies for inclusion.

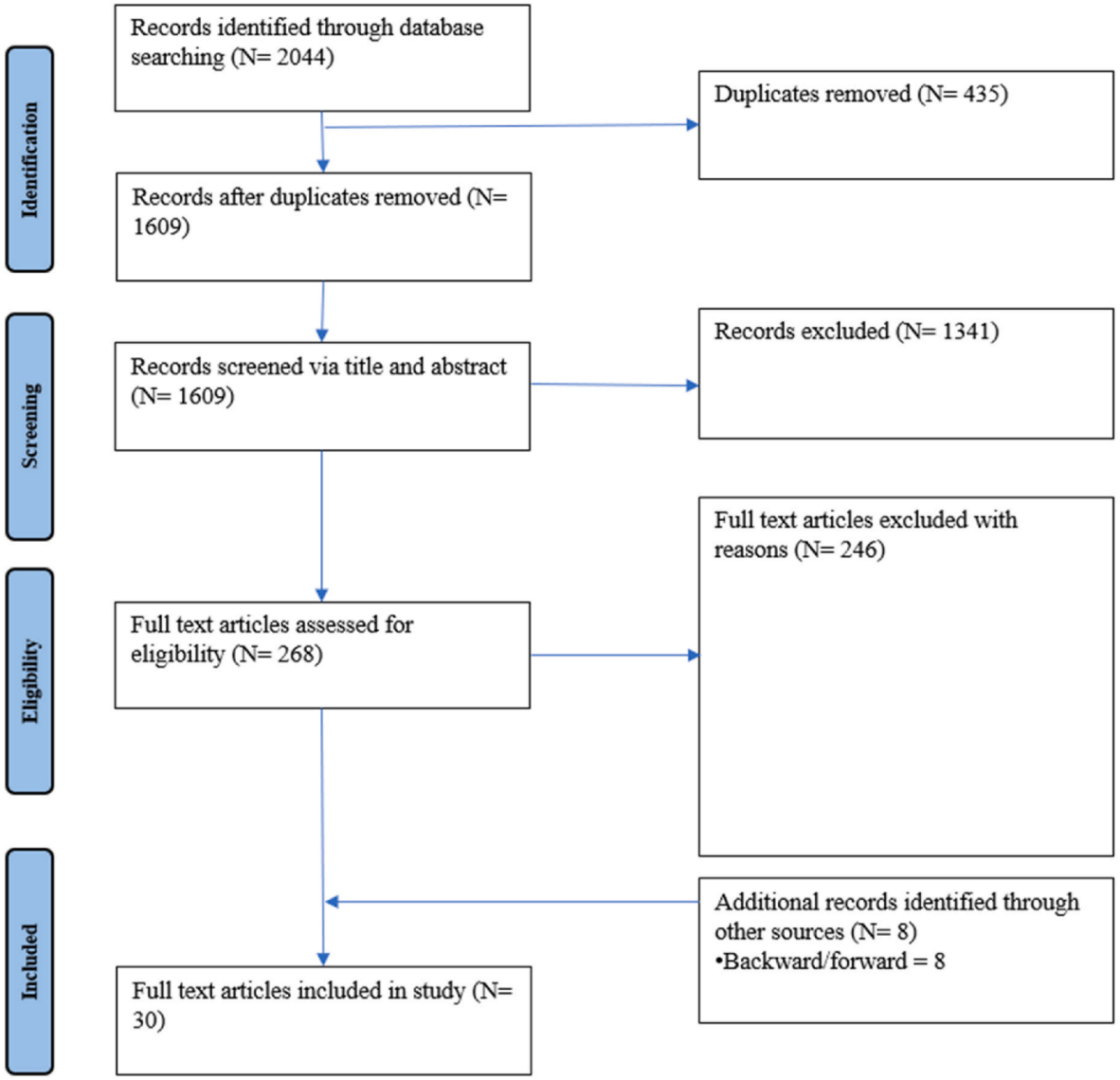


**Fig. 1.** Prisma flowchart.

### 2.4. Data management and selection process

All records retrieved were downloaded to Covidence. Once records were imported to Covidence, duplicates were removed, and the remaining studies were assessed for eligibility by two independent reviewers. Records were screened via title and abstract and organised into (1) papers appearing to meet inclusion criteria and (2) excluded papers. The full text of papers appearing to meet inclusion criteria were then obtained, and the text was assessed for eligibility by two independent reviewers (refer to Fig. 1 for PRISMA flow diagram). These papers were further categorised according to their eligibility. Any discrepancies were identified by Covidence. All identified conflicts were resolved through discussion between the two reviewers.

### 2.5. Data collection process

The findings suggest that data reporting and outcomes in the included literature are largely heterogeneous. The data extraction component of Covidence is not well suited to manage this heterogeneity. Therefore, Excel was used for data extraction. A PRISMA-informed data extraction spreadsheet was developed to extract the following data: publication details, research type, and research design; sampling methods and participant characteristics; data collection methods; intervention/program details; evaluation and outcomes; and key details on theories used. The data extraction was also guided by the TCM (Paul et al., 2017) and theory coding frameworks (Geiger et al., 2021; Pang et al., 2017). Two independent reviewers extracted data from the full-text articles.

### 2.6. Quality assessment

Quality and risk of bias were assessed using the Mixed-Methods Appraisal Tool (MMAT) (Pluye et al., 2009). MMAT allows for the critical appraisal of methodological quality across research designs, including qualitative, quantitative, and mixed-methods studies (Hong et al., 2018). Two independent reviewers assessed the quality of included studies according to the appropriate MMAT criteria. All discrepancies were resolved via discussion between the two reviewers to achieve 100% agreement for each study. Following the process undertaken by Willmott et al. (2022), an overall rating was assigned to each study (yes = 1, and no or cannot tell = 0) by summating the total score out of the five criteria for each category.

### 2.7. Data extraction and analysis

#### 2.7.1. Data extraction: guiding framework

This review used the TCM framework to extract, analyse, and synthesise extant literature. The TCM framework looks at theories, contexts, and methods. Theories refer to the academic perspectives researchers rely on to guide their research, context refers to the circumstances in which the research is conducted, and methods are concerned with the process through which empirical evidence is gathered (Lim et al., 2021; Shirolkar and Patil, 2021).

This review places focus on theory use in autonomy supporting SUP reduction efforts. A theory coding framework by Pang et al. (2017) was used to best capture the current use of theory in SUP reduction interventions. Theory can be used at various levels when engaging with behaviour change programs (Hurley et al., 2019; Pang et al., 2017; Rundle-Thiele et al., 2019; Willmott et al., 2019; Willmott and Rundle-Thiele, 2022). Pang et al. (2017) used a framework consisting of four levels of theory when analysing the extent of theory use in behaviour change interventions promoting active travel to school. The four levels are 1) Informed by theory, where theory is identified, however, its use and application are limited, 2) Applied theory, where several components and measures of the theory are applied, 3) Testing theory, where more than half of the theoretical constructs are explicitly measured and tested, or theory comparison exists, 4) Building theory, where theory is revised or created by measuring, testing, and analysing constructs (Glanz and Bishop, 2010; Pang et al., 2017; Webb et al., 2010). This framework has also been used by Hurley et al. (2019) and Schmidtke et al. (2021) in their review of parent-based programs aimed at reducing alcohol consumption in adolescents and social marketing intervention approaches in low- and middle-income countries.

To assess the level of autonomy of included interventions, a basic measurement framework was created using the criteria outlined by Geiger et al. (2021), which classifies an intervention as autonomy supporting. Interventions support consumer autonomy if they preserve a sense of choice, provide an explicit rationale, involve perspective-taking, or use non-controlling language (Bartholomew et al., 2009; Bradshaw et al., 2021; Deci et al., 1994; Geiger et al., 2021). Interventions were given a score out of four, where a score of 4/4 indicated high levels of autonomy support and a score of 1/4 indicated low levels of autonomy support.

#### 2.7.2. Data analysis

Emerging fields of literature are often characterised by inconsistency and proliferation of constructs, a scattered or fragmented collection of knowledge, a lack of a universal language, and an absence of coalescing and binding theories (Adams et al., 2017; Burgess et al., 2006). In such instances, synthesis techniques which hail from a constructivist research paradigm are useful as the goals of synthesis of such literature are interpretation and integration (Adams et al., 2017). As such, data were inductively analysed using a narrative evidence synthesis approach, allowing for a nuanced understanding of included studies (Gurevitch et al., 2018). Findings from data extraction and analysis are reported in a narrative structure descriptively summarising the salient characteristics of included studies.

## 3. Results

A total of 2044 records were retrieved from the systematic database search. Following duplicate removal, 1609 records were screened via title and abstract. Following title and abstract screening, 268 full-text articles were retained and further assessed for eligibility, including eight additional studies identified via backward and forward searching. Of these, 30 articles reporting on 29 interventions met inclusion criteria (see Fig. 1 for a completed PRISMA flowchart of the study selection process).

### 3.1. Study characteristics

Of the 30 articles included in this review, 60% (n = 18) were published from 2020 onward. Most studies were conducted in the United States (27%, n = 8) and Germany (13%, n = 4). Two studies (7%) did not

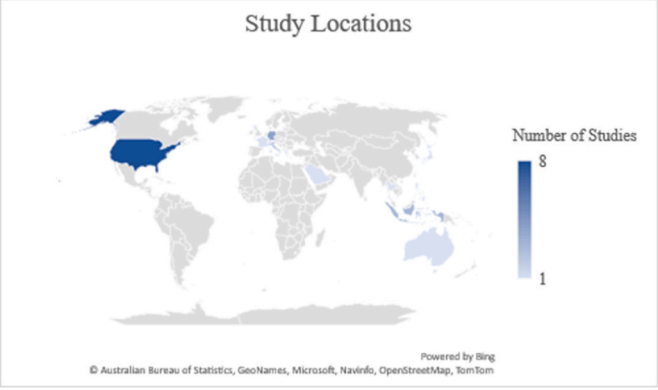


**Fig. 2.** Map of study locations.

report the country and the remaining studies were conducted in various countries across the globe (refer to Fig. 2). The majority (70%; n = 21) employed a quantitative design, 10% (n = 3) used a qualitative approach, and 20% (n = 6) applied a mixed methods design.

There was limited homogeneity in reported measures among included studies. Most papers (61%, n = 19) report behaviour (use of a targeted SUP item). Those papers which did not report on actual behaviour collected data on other measures such as behavioural intention (Baechler et al., 2020; Baek et al., 2022; Ohtomo and Ohnuma, 2014), social media metrics (Heidbreder et al., 2021), identity (Bruchmann et al., 2021; Rapada et al., 2021; Wang and Arpan, 2021), commitment (Wang and Arpan, 2021), social norms (Spranz et al., 2018), and motivation (MacDonald et al., 2021; Ohtomo and Ohnuma, 2014). As nearly 40% of papers did not report actual behaviour, comparing the efficacy of interventions in reducing SUP consumption is not possible'

### 3.2. Quality assessment

All 30 included articles were assessed using MMAT criteria (see Supplementary File 2 for MMAT results). The overall quality of included studies was high. Two (6.6%) out of the 30 articles assessed using MMAT criteria were rated as low (47%), five as moderate (16.6%), and 23 as high (76.6%).

### 3.3. RQ1: what methods are employed to create voluntary behaviour change to address SUP consumption, and what is their efficacy?

Various types of interventions ranging from communication campaigns to serious games were employed to attempt to influence SUP consumption behaviour (refer to Table 1).

**Table 1**
Intervention types.

| *Intervention Type* | *Reference* |
|---|---|
| Communication and Informational Campaigns | |
| | Baek et al. (2022) |
| | Barkela et al. (2021) |
| | Bruchmann et al. (2021) |
| | Heidbreder et al. (2021) |
| | Heidbreder and Schmitt (2020b) |
| | Heidbreder et al. (2020) |
| | Jiang (2016) |
| | Latinopoulos et al. (2018) |
| | Nelson et al. (2021) |
| | Rapada et al. (2021) |
| | Rubens et al. (2015) |
| | Truelove and Nugent (2020) |
| | Wang and Arpan (2021) |
| Multi-faceted Interventions | |
| | Adestika (2021) |
| | Hardy and Bartolotta (2021) |
| | MacDonald et al. (2021) |
| | Santos and van der Linden (2016) |
| | Thongplew and Kotlakome (2019) |
| Physical Changes to the Environment and/or provision of reusable goods | |
| | Bethurem et al. (2021)[a] |
| | Mundt et al. (2020) |
| | Saleem et al. (2019) |
| | Willis et al. (2019) |
| | Zorpas et al. (2017) |
| | Spranz et al. (2018) |
| Charitable Donations | |
| | Lange et al. (2021) |
| | Romano and Sotis (2021) |
| Voice Prompts | |
| | Ohtomo and Ohnuma (2014) |
| Informational Exhibits | |
| | Baechler et al. (2020) |
| Serious Games | |
| | Panagiotopoulou et al. (2021) |

[a] Choate et al., 2018 has not been included in the table as it is a formative study informing the intervention outlined in Bethurem et al. (2021)..

Campaigns were primarily either conducted in controlled experimental conditions (Barkela et al., 2021; Truelove and Nugent, 2020; Wang and Arpan, 2021), in the field (Nelson et al., 2021; Siyavooshi et al., 2018), or online (Baek et al., 2022; Heidbreder et al., 2020, 2021; Heidbreder and Schmitt, 2020a; Rapada et al., 2021). Most campaigns included mostly informational elements, educating consumers about various SUP-related facts and issues. For example, Barkela et al. (2021) presented participants in one intervention group with a short media report outlining the damage caused by plastic pollution and the other intervention group with the same information with the additional report of a couple who took part in the plastic-free challenge. Their approach attempted to educate the participants and use role models to attempt to influence SUP waste reduction behaviour.

Heidbreder and Schmitt (2020a) engaged participants on the topics of plastics waste related to environmental impacts, injustice, and responsibilities (intervention group 1) and action steps for reducing plastic waste (intervention group 2). They used question prompts, visual aids, and written information. Some campaigns informed participants about the damage caused by SUP while also attempting to influence participants' emotions and attitudes. For example, Truelove and Nugent (2020) presented participants in their study with an informational video of scientists removing a plastic straw from a turtle along with written information about SUPs and tips on reducing SUP usage. Nelson et al. (2021) presented participants with informational posters that were positively (intervention 1) and negatively framed (intervention 2). Other campaigns were larger in scale. For example, Heidbreder et al. (2021) reported on the Plastic Free July campaign. The Plastic Free July campaign is a worldwide campaign that brings together people through social media and online platforms such as their website to challenge people to reduce their plastic consumption during the month of July.

A change in physical surroundings and/or provision of a reusable good was the next most common approach to addressing SUP consumption behaviours. For example, Willis et al. (2019) installed water refill stations, and Saleem et al. (2019) installed water purification systems in households to improve water availability and quality. The provision of a SUP alternative (non-single-use item) was another common method adopted in interventions. Bethurem et al. (2021) installed water refill stations and distributed reusable water bottles to students in a college setting. Zorpas et al. (2017) provided stainless steel water bottles to students in a school to reduce the use of disposable plastic bottles. All interventions in this category were supplemented with some communication to either showcase the environmental and economic benefits of reducing SUP consumption (Bethurem et al., 2021; Zorpas et al., 2017), highlight the negative impacts of waste generation (Saleem et al., 2019), or increase awareness of intervention (Willis et al., 2019).

Multi-faceted interventions were also a common approach. Multi-faceted interventions typically include multiple aims, engage several stakeholders, and involve various components. Multi-faceted interventions extend beyond the provision of information and the use of communication approaches, and often involve more than just single environmental changes. For example, The Princeton Drink Local Program (Santos and van der Linden, 2016), launched in 2009, included three major, complementary components: provision of reusable goods, change in physical environment, and education. Undergraduate students received a full "Sustainability Survival Kit", which included a reusable bottle, a durable plastic spork and information about getting involved in sustainability initiatives on campus. These efforts were complemented with the replacement of outdated sinks and water fountains. The implementation of the program required a co-ordinated effort from multiple university stakeholders.

RQ2: In what contexts do voluntary behaviour change interventions addressing SUP consumption take place?

Most studies were conducted in community (27%, n = 8) (Adestika, 2021; Barkela et al., 2021; Heidbreder et al., 2020, 2021; Heidbreder and Schmitt, 2020b; Panagiotopoulou et al., 2021; Willis et al., 2019) commercial (27%, n = 8), (Hardy and Bartolotta, 2021; Jiang, 2016; Lange et al., 2021; Nelson et al., 2021; Ohtomo and Ohnuma, 2014; Romano and Sotis, 2021; Rubens et al., 2015; Spranz et al., 2018), and educational settings (30%, n = 9) (Bethurem et al., 2021; Bruchmann et al., 2021; Choate et al., 2018; Panagiotopoulou et al., 2021; Saleem et al., 2019; Santos and van der Linden, 2016; Thongplew and Kotlakome, 2019; Wang and Arpan, 2021; Zorpas et al., 2017).

The remaining studies were set in online contexts (10%, n = 3) (Baek et al., 2022; Rapada et al., 2021; Truelove and Nugent, 2020), at an aquarium (3%, n = 1) (Baechler et al., 2020), and one at both a university and in the community (3%) (Mundt et al., 2020). Plastic bags were the most targeted type of plastic. Approximately, one-third 37% (n = 11) of included studies targeted plastic bags through their interventions (Adestika, 2021; Hardy and Bartolotta, 2021; Jiang, 2016; Lange et al., 2021; Latinopoulos et al., 2018; Mundt et al., 2020; Nelson et al., 2021; Ohtomo and Ohnuma, 2014; Romano and Sotis, 2021; Rubens et al., 2015; Spranz et al., 2018; Truelove and Nugent, 2020; Wang and Arpan, 2021). General plastic waste (23%; n = 7) (Baechler et al., 2020; Baek et al., 2022; Heidbreder et al., 2020, 2021; Mundt et al., 2020; Panagiotopoulou et al., 2021; Rapada et al., 2021) and plastic bottles (23%; n = 7) (Bethurem et al., 2021; Bruchmann et al., 2021; Choate et al., 2018; Saleem et al., 2019; Santos and van der Linden, 2016; Willis et al., 2019; Zorpas et al., 2017) were the next most commonly targeted SUPs.

RQ3: To what extent is theory applied in voluntary behaviour change interventions aimed at reducing SUP consumption?

The theory coding framework used by Pang et al. (2017) and Schmidtke et al. (2021) was used to assess theory application (refer to Supplementary file 3) Only 27% (n = 8) of included studies reported theory use (Baek et al., 2022; Bruchmann et al., 2021; Heidbreder and Schmitt, 2020b; Heidbreder et al., 2020; Ohtomo and Ohnuma, 2014; Rapada et al., 2021; Thongplew and Kotlakome, 2019; Wang and Arpan, 2021). Of the eight studies which reported using theory, rates of theory application were high. Thongplew and Kotlakome (2019), Heidbreder et al. (2020), and Rapada et al. (2021) all built theory (level 4). For example, Heidbreder et al. (2020) developed the Integrative Theoretical Framework by selecting and combining key factors from various theories (Theory of Planned Behaviour, moral choice model, habit model) that have previously been shown to encourage pro-environmental behaviour. The experimental group were invited to reduce their single-use plastic consumption during July in line with the 'Plastic Free July' campaign. Heidbreder et al. (2020) used a survey and path analysis to measure, test, and analyse the theoretical constructs.

Ohtomo and Ohnuma (2014) and Heidbreder and Schmitt (2020b) both tested the theory (level 3). For example, Heidbreder and Schmitt (2020b) used key constructs from The Theory of Planned Behaviour and the Norm Activation Model to develop three interventions to reduce plastic consumption. Chosen constructs from both models were measured and tested through a survey and path analysis. Wang and Arpan (2021) and Bruchmann et al. (2021) applied theory (level 2). For example, Wang and Arpan (2021) applied self-affirmation theory to develop communication interventions to influence SUP consumption among university students. They utilised the idea of in-and-out groups from self-affirmation theory by showing students images of either their university or a nearby university. Finally, Baek et al. (2022) had the lowest level of theory use and reported on an intervention informed by theory (level 1).

The Theory of Planned Behaviour (TBP) was used in half of the eight studies (Heidbreder and Schmitt, 2020b; Heidbreder et al., 2020; Ohtomo and Ohnuma, 2014; Rapada et al., 2021), making it the most used theory in the included set of studies, which is consistent with other voluntary behaviour change contexts (see Brennan et al., 2014; Luca and Suggs, 2013; Truong, 2014; Truong and Dang, 2017). Half of the studies utilised more than one theory (Heidbreder and Schmitt, 2020b; Heidbreder et al., 2020; Ohtomo and Ohnuma, 2014; Rapada et al., 2021). Half of those studies reporting theory use (Baek et al., 2022; Bruchmann et al., 2021; Rapada et al., 2021; Wang and Arpan, 2021) did not measure change in actual behaviour. 37% (n = 3) reported a reduction in consumption of SUP (actual behaviour) (Heidbreder and Schmitt, 2020b; Ohtomo and Ohnuma, 2014; Thongplew and Kotlakome, 2019) and 12% (n = 1) reported mixed results (Heidbreder et al., 2020).

RQ4 What was the level of autonomy preserved in included studies?

Multiple studies in this review tested more than one intervention approach. As such, the level of autonomy is assessed for each intervention instead of each study. Fifty intervention approaches from 30 studies were assessed. Overall scores for level of autonomy were low. Most interventions scored one or two out of four points (refer to Supplementary file 4). All intervention approaches preserved a sense of choice in their approaches. 76% (n = 38) of the interventions used non-controlling language. 40% (n = 20) provided an explicit rational. For example, Zorpas et al. (2017) provided stainless steel water refilling bottles to primary school children to reduce plastic bottle use. The benefits of plastic prevention activities, the social and environmental impacts of plastic bottle use, and the economic benefits of reusable bottle use were explained to the parents' council as part of the intervention. Only 12% (n = 6) of interventions involved perspective-taking. For example, Baechler et al. (2020) engaged participants in interactive activities that required participants to prioritise conservation issues, including plastic pollution, climate change, ocean acidification, sustainable fisheries, and illegal wildlife trafficking. Most participants ranked plastic pollution as a top conservation priority. Baechler et al. (2020) then provided further information on plastic pollution and presented ways to tackle the issue.

## 4. Discussion and conclusion

This evidence review provides an assessment of voluntary behaviour change approaches that have been applied, considering context, study quality, the extent of theory use and levels of autonomy preserved. The following discussion considers the contexts the studies were set in, the methods and theories utilised in interventions, and the level of autonomy the included interventions preserved.

### 4.1. Context

Consideration of context is vital when discussing SUP reduction efforts. On a macro scale, context can include the specific countries' interventions and studies conducted (Molthan-Hill et al., 2020). The rates of plastic waste production, the roles SUP plays in society and culture, and waste management infrastructure and societal knowledge on waste management vary considerably across countries. These factors are important to consider when designing and implementing SUP reduction strategies. The dominance of research based in the USA is also not surprising or novel, as this is a common trend across research disciplines (Witze, 2016). There were limited studies conducted across the Asian continent. This poses a possible concern as countries such as India and China have been flagged as major contributors to the plastic waste crisis (Ritchie and Roser, 2018). As such, there is scope in the literature to consider voluntary SUP reduction interventions conducted across the Asian continent. On a meso-scale, context can refer to the specific settings within countries in which the interventions are conducted (e.g., schools, communities, workplaces) (Ali et al., 2022). Most interventions included in this review were in communities, commercial environments such as stores, or educational institutes such as colleges. This reviewed suggested that SUP reduction strategies are taking place in a variety of

settings, reaching a broad spectrum of audiences. The review did, however, highlight a lack of interventions set in the workplace. With employees spending about one-third of their time in an office, workplace settings can be an ideal context through which pro-environmental behaviours can be encouraged (Blok et al., 2015). More research is urgently needed in varying contexts to extend the evidence base delivering approaches that can be confidently applied by organisations and communities across the globe to reduce SUPs voluntarily.

### 4.2. Method

This review discusses how interventions were delivered and draws attention to the levels of autonomy preserved through intervention approaches. Communication only campaigns were the most common intervention approach. Due to the limited number of studies measuring behavioural change, it is not possible to draw clear conclusions regarding the success of specific approaches in reducing SUP consumption. However, extant literature suggests that behaviour change is more likely when approaches extend beyond communication only approaches (Carins and Rundle-Thiele, 2014; Xia et al., 2016). As such, reliance on communication only campaign approaches may limit voluntary SUP reduction efforts.

The review revealed low levels of autonomy preservation across the various SUP reduction intervention approaches and no pattern between intervention approach and level of autonomy preserved. All included evaluative studies preserved a sense of choice and most used non-controlling language. Few studies provided an explicit rationale or involved perspective-taking. Individuals acting from autonomous motivation are more likely to initiate and persist with a behaviour when compared to those acting due to controlled motivation (Geiger et al., 2021). Higher levels of autonomy may increase levels of intrinsic motivation, which has been shown to result in longer-lasting behaviour change (Geiger et al., 2021).

### 4.3. Theory

Evidence supports theory use with greater rates of behaviour change observed in studies reporting theory use (Kim et al., 2019). This evidence review identified that theory application in voluntary SUP reduction efforts is low. Only 27% of studies in the present review mentioned, applied, or built theories and only half measured behaviour change. Of the studies reporting theory use and measuring behaviour change, voluntary SUP reductions were reported in all four studies, with one reporting mixed outcomes. Lack of theory use is concerning, however, not surprising given that theory application in other voluntary behaviour contexts is also limited (Hurley et al., 2019; Pang et al., 2017; Rundle-Thiele et al., 2019; Willmott et al., 2019). Theory should be an integral part of designing, implementing, and evaluating behaviour change interventions (Willmott et al., 2019). In contrast to findings from other reviews assessing theory use in different contexts (Hurley et al., 2019; Pang et al., 2017; Rundle-Thiele et al., 2019; Willmott et al., 2019), the present review found that there was an overall high level of theory application among those studies which applied theory. This finding is interpreted with caution due to the small number of studies that reported theory use. Moving forward a testing of application of voluntary behaviour change theories is recommended. Commonly used voluntary behaviour change theories are summarised in Brennan et al. (2014), Luca and Suggs (2013), Truong (2014), Truong and Dang (2017) and Anibaldi et al. (2021).

Very few studies in this review measured actual behaviour. Studies using behavioural proxies, such as behavioural intentions, are limited in their validity, given that intentions do not directly correlate with behaviour (Holdershaw et al., 2003). After a close inspection of the studies which reported theory use, it was found that the theory of planned behaviour (TPB) was the most used theory. While the use of TPB has been shown to facilitate behaviour change (Masser et al., 2009; Sheeran et al., 2001; Veldhuizen et al., 2011) intentions are not always clearly linked to behaviour (Holdershaw et al., 2003). Consideration of a wider range of voluntary behvaiour change theories is also indicated (Rundle-Thiele et al., 2019). For example, theories that expand the focus of interventions beyond individuals ensuring social and institutional factors are considered are recommended (Bergman et al., 2019). Plastic consumption is impacted by factors that extend past just the individual (Heidbreder et al., 2019). As such, reliance on theories focused on the induvial may not be the best suited to encourage a reduction in SUP consumption.

## 5. Future research directions

Three key recommendations are made for future SUP reduction behaviour change research. Firstly, there is an urgent need for research on voluntary SUP reduction interventions. The review uncovered limited voluntary SUP reduction studies and narrow geographical focus. Two countries (USA and Germany), which are the world's largest plastic producers dominated in this review. This review has also highlighted a lack of studies conducted in workplace settings. Considering the time individuals spend at work each day, research should be conducted in such settings.

This review makes two key implementation recommendations. First, future interventions should adopt more elements of the marketing mix, extending beyond just promotion or communication. While promotion and communication are important drivers in creating behaviour change, the adoption of a greater range of elements from the marketing mix has been shown to result in more successful interventions (Carins and Rundle-Thiele, 2014). Secondly, it is recommended that future studies provide explicit rationale for engaging with promoted behaviours and incorporate perspective-taking. For example, Baechler et al. (2020) highlighted the need for plastic reduction through their informational exhibits. They facilitated perspective taking by engaging participants to critically consider the relative importance of various conservation issues, including that of plastic waste generation. Increasing levels of autonomous motivation will encourage longer-lasting behaviour change.

Three key recommendations are made for future research to advance theory application in voluntary SUP reduction efforts. Firstly, there must be greater adoption of theory in intervention design, implementation, and evaluation. This review has highlighted a serious lack of theory application across SUP reduction interventions. Future studies should incorporate theory into intervention design, implementation, and evaluation. Secondly, it is recommended that future studies use theories that extend past the individual and consider external factors such as social and institutional factors. Theory should be selected based on its relevance to the specific characteristics of a target behaviour, context, and population, not simply because it is widely used in literature (Davis et al., 2015; Willmott et al., 2019). Future studies could consider the use of theories such as social cognitive theory (Bandura, 1989), social norms theory (Berkowitz, 2003) or Capability, Opportunity, Motivation, Behaviour (COM-B) (Michie et al., 2011). Finally, it is recommended that future studies measure actual behaviour instead of just behavioural antecedents. This would require that future studies clearly define target behaviour and employ data collection methods appropriate to measuring defined behaviour.

## 6. Limitations

The present study is the first to review voluntary behaviour change approaches to reducing SUP consumption. While this study has provided important insights, there are limitations. Firstly, there are a limited number of studies, and there is considerable heterogeneity in study reporting ($n = 30$). As such, a meta-analysis of data is not appropriate. Moving forward standardised reporting in outcomes is recommended to support future meta-analytic studies. The low number of studies reflects

the relative infancy of academic literature reporting on voluntary approaches to SUP reduction. Considering the urgency of the current plastic waste crisis; there is a substantial requirement for more voluntary behaviour change research in this field. Secondly, only peer-reviewed articles in the English language were included. Grey literature was not included. While academic literature may be lagging in their engagement with voluntary approaches to SUP reduction, industry, practitioners, and community may be better engaging with this issue, and evaluation must extend to non-English reporting. A grey literature review focused on voluntary SUP reduction interventions is recommended to extend understanding. Finally, this is the first time the autonomy preservation framework was used to evaluate voluntary behaviour change interventions. There is scope for this framework to be tested in varied contexts with larger data sets.

## 7. Conclusion

This review reveals an over-reliance on communication campaigns for reducing SUP consumption, which are not theoretically guided. This evidence review highlights the need for more research on voluntary approaches preserving the highest levels of autonomy that are conducted across a wider range of settings (e.g. workplaces and countries). Voluntary behaviour change approaches offer a key strength given that the approach "sells" rather than "tells" people what to do. These efforts require coordinated input from multiple parties and financial resourcing. Complex environmental problems, such as SUPs, result from free individual choice and market trade-offs governed by self-interest. The current SUP waste crisis is a reminder that when self-interest and market forces are left unchecked, they deliver tragic consequences for people and our planet. From a policy standpoint, approaches that place responsibility of disposal costs and recovery of single use products are indicated as a mechanism that can change the supply system for the benefit of all.

## Novelty and significance statement

Addressing the over-reliance on plastics, especially single-use plastics is a key step in combating climate change. Current research efforts have focused on forced or regulatory approaches to reducing single-use-plastic (SUP) consumption. While such measures are important, they must be coupled with voluntary behaviour change interventions to create enduring change. This review brings together current literature on voluntary SUP reduction interventions. It goes beyond the limited existing reviews looking at SUP reduction interventions by placing a focus on theory use in such interventions – a factor that extant literature highlights as a key component to effective behaviour change interventions. The present review also puts forth a framework, adapted from existing literature, that can be used to evaluate the voluntary nature of interventions.

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## Data

Data available on request.

## Authors' contributions

AM conceived and designed the systematic review protocol and was responsible for its execution and reporting and was actively involved in all stages of research. YX worked with AM to conduct screening, data extraction, quality analysis, and edit of final manuscript. SI and SRT Provided critical feedback on and assisted in drafting the manuscript and provided advice and assistance in research design. GL worked with AM in conducting database searches and inclusion and exclusion screening. PD assisted in developing search strategy, running database searches, and provided feedback on initial drafts of the manuscript. DL contributed to conceptualisation of the SLR search strategy and provided feedback and guidance during initial stages of screening.

## Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper..

## Data availability

Data will be made available on request.

## Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.jenvman.2023.117582.

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