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People, plastic, and behaviour change – a comment on drivers of plastic pollution, barriers to change and targeted behaviour change interventions†

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There are many studies considering the use and waste management of plastics but these are primarily focused on recycling. While studies of human interaction with plastics provide some insight into current waste creation and recycling choices, studies on behaviour change and the human relationship to plastic are limited. In this perspective, we pose that understanding individual and community behaviour change is key to determining effective and sustainable drivers of change in the use of plastics. A review of contemporary literature highlights this as a knowledge gap, with only a few studies undertaken which have primarily focused on the theory of planned behaviour and plastic waste. To help support more sustainable and effective plastic use and waste management policy, it is recommended that future research focus on behavioural aspects of the plastic–people relationship with a focus on the Behaviour Change Wheel and the Capability, Opportunity and Motivation model (COM-B), to advance current understanding of individuals' behaviours relating to plastic use and waste. It is suggested that understanding the behavioural elements of the people–plastic relationship is fundamental to identifying effective and sustainable changes in behaviour and the guidance, policies, opportunities, and restrictions that can help achieve change.

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Environmental significance

The challenge of addressing the creation of plastic waste and plastic pollution is complex and is routed in people's relationship with plastic. Plastic still follows a linear economy at present; hurdles in shifting to a more sustainable and circular economy include difficulties changing people's behaviour. However, the factors driving people's plastic behaviour are understudied, especially through a human behaviour change lens. This perspective paper presents a focused literature assessment identifying that knowledge gap in plastic pollution and the confrontation of the plastic waste problem using behaviour change theories and tools. Specifically, it identifies the potential beneficial implementation of the behaviour change wheel and COM-B tools in identifying plastic behaviour factors and future targeted intervention design.

Introduction

Impacts of plastic pollution on environmental and potentially human health are well-reported.[1–3] Both larger items (macroplastics) and smaller plastic particles or microplastics (MPs) are becoming more of a public concern due to increasing media attention and public policy.[4–6] Although systemic change is needed to address the current plastic waste problem and its consequences, complementary individual action is also necessary to reduce waste, prevent pollution and decrease exposure to potentially harmful MPs. Efforts to change individual behaviour have been focused on distributing information about plastic, raising awareness of its impact, or introducing restrictions.[7] The implementation of behaviour change models and methods to date have resulted in only a small step rather than a systematic change or significant individual shift in people's relationship to plastic. The significant changes needed to tackle the growing plastics problem have been slow and increasing awareness of the issue has not been found to result in action. A large shift in a broad range of plastic-related behaviours is needed. To implement individual level behaviour change in relation to plastic use, it is logical to understand the science of behaviour change, an understanding that has been predominantly missing in the plastic pollution discourse.

To simplify the use of behaviour change theories in designing behaviour change interventions, various behaviour change tools have been developed. These tools are used

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extensively in the context of public health (*e.g.*, to examine the drivers of vaccine hesitancy) and therefore hold promise for potential effective use in addressing the plastic pollution problem. One prominent behaviour change framework is The Behaviour Change Wheel (BCW)[8,9] (see Fig. 1). This model is based on the synthesis of 19 existing behaviour change frameworks and provides a comprehensive and systematic meta-approach to designing behaviour change interventions.

At the centre of the BCW is the Capability, Opportunity and Motivation model (COM-B) model[8,9] (see Fig. 2). The COM-B model describes behaviour as the interaction between an individual's capability, opportunity, and motivation to engage in the behaviour with six components that drive behaviour (*i.e.*, physical capability, psychological capability, physical opportunity, social opportunity, reflective motivation, and automatic motivation).

These COM-B components are linked to intervention functions (*i.e.*, education, persuasion, incentivization, coercion, training, enablement, modelling, environmental restructuring, restrictions) through which an intervention can change behaviour, and seven broad policy categories (*i.e.*, guidelines, environmental/social planning, communication/marketing, legislation, service provision, regulation, fiscal measures). Intervention functions are then linked to behaviour change techniques (BCTs), which are the observable, replicable, and irreducible active ingredients of an intervention[9,10] (see Fig. 1). While we know that these tools have been used extensively in the health field to achieve positive and effective behaviour changes towards behavioural health issues (*e.g.* language development, rehabilitation participation, behaviour change for disease prevention through exercise and diet change, vaccine acceptance and uptake, see ESI†), the current paper will explore their use within the context of plastic-related behaviours.

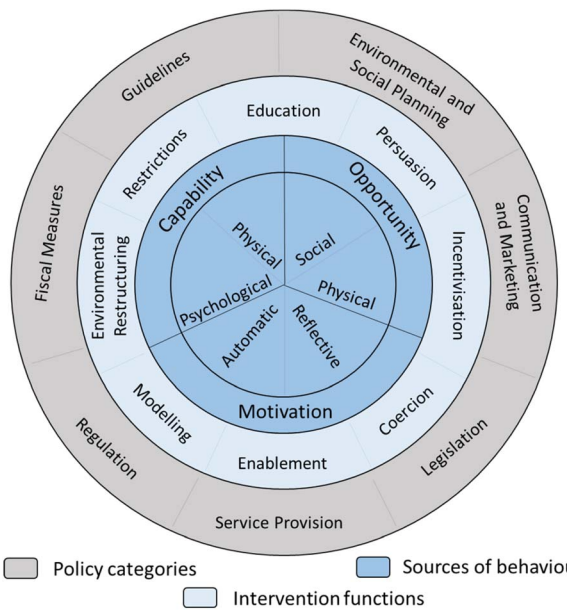

Fig. 1 The Behaviour Change Wheel (modified from Michie *et al.* 2011).

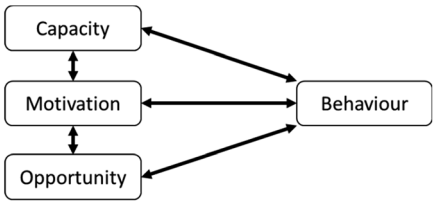

Fig. 2 COM-B System of Behaviour Change (modified from Michie *et al.* 2011).

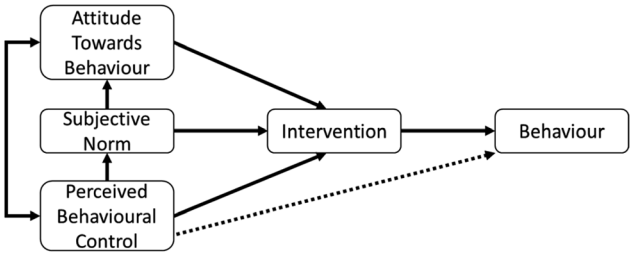

Fig. 3 Ajzen's Theory of Planned Behaviour (Ajzen 1991).

One theory that has been used within the literature on pro-environmental behaviour is Ajzen's theory of planned behaviour (TPB).[11] Although this theory and its constructs can easily be subsumed within the BCW and COM-B approach it is worth considering it separately because of its predominance within the field. TPB posits that engaging with a behaviour can be predicted by one's intention to engage in that behaviour. Intention is determined by interaction of three variables: attitude; subjective norms; and perceived behavioural control (PBC)[12] (see Fig. 3).

This perspectives paper aims to explore the extent of the contemporary literature on behaviour change and plastic-related behaviours and highlight the opportunity to consider behaviour change models such as COM-B, BCW and TPB in addressing the plastic pollution problem. This study makes a tentative step towards identifying what behaviour change concepts and theories have been used to study the use of individual plastic consumption, the use of plastic and waste behaviours. A non-exhaustive literature review was conducted to establish the extent of the literature that has been published on this matter to-date and to identify gaps in knowledge which could form the basis for future research in this area.

Methodology

A keyword search was completed using SCOPUS, employing a range of terms relating to plastic and behaviour change (Fig. 4). The aim of the high-level scoping literature search was to identify relevant contemporary studies on behaviour change elements, plastic, and general pollution. Results are shown in Table 1, presenting the numbers of papers with titles, abstract or keywords associated with the 'main' and 'sub category' keywords entered into the SCOPUS keyword search. A Scopus search for each individual combination of main and sub

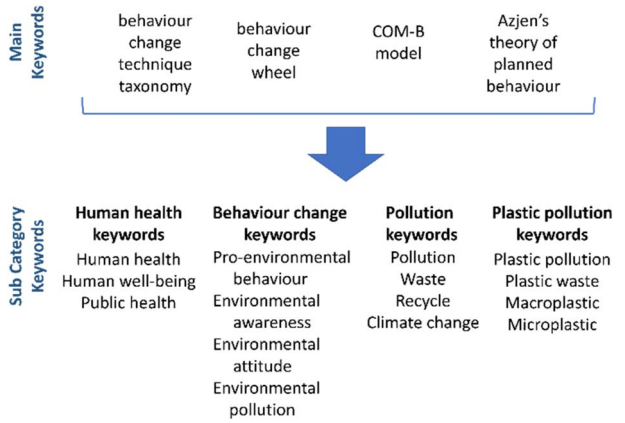

Fig. 4 Flow diagram showing keywords and resulting subcategory words from SCOPUS search.

category keywords was conducted and the resultant papers recorded (see ESI†) to determine the current use of these four main behaviour change models and tools relative to both plastic specific (plastic pollution keywords) and pollution, behaviour and human health research. The search was completed on 16/03/2022 and included all results published in peer reviewed journals up to this date. The studies found during this search were checked manually to ensure they were relevant, peer-reviewed studies.

As can be observed, most of the literature is biased towards the use of Ajzen's TPB across all subcategories investigated, with only a few papers utilising other behavioural change models and theories, such as COM-B and BCW in relation to plastic, waste management or pollution (Table 1). The literature search identifies a knowledge gap and research need for plastic pollution studies to address the human–plastic relationship from a behaviour change lens to identify why people use and waste plastic and what creates or potentially can change this relationship.

There are more papers published that have included behaviour change principles in the context of environmental awareness and pollution (*e.g.* Barker *et al.*'s discussion on consumer behaviour change for food waste prevention,[13] Kolodko *et al.*'s assessment of the BCW method to modify UK littering behaviour,[14] or Lasrado and Zakarina's examination of BCW organisational factors that influence environmental attitudes and self-initiated green behaviour[15]) than directly focus on plastic pollution, and although there will be relevant discussion to plastic-related behaviours within these topics, for the purposes of this initial review, only papers specifically associated with plastic and plastic waste have been included in the plastic pollution publication counts. The general litter and pollution based behaviour change research can provide useful lessons and insight into the potential success of implementing the BCW, COM-B and TPB models to the plastic pollution problem. Potential early translatable findings include the identification that awareness does not translate to action of behaviour change effectively and that incohesive small reward driven interventions do not consistently result in long-term significant behaviour change.

Although the literature on this subject to date is not extensive, there have been interesting observations and findings from the existing studies on behaviour change and plastic-related behaviour.

Plastic, waste management and behaviour change

Plastic-related behaviours

It is known that plastic is closely related to many aspects of modern life and therefore there are many behaviours that may encourage or modify the use of plastic. Therefore, plastic-related behaviours encompass a range of actions from waste reduction, waste management and responsible consumption through to individual and societal valuation of the product or

Table 1 Results of Scopus keyword search based on publications up until 16/03/2022, provided in the ESI

		Main keywords			
Category keywords	Sub category keywords	Behaviour change technique taxonomy	Behaviour change wheel	COM-B model	Azjen's theory of planned behaviour
Plastic pollution	Plastic pollution	0	0	0	9
	Plastic waste	0	6	1	28
	Macroplastic	0	0	0	0
	Microplastic	0	2	0	0
Pollution	Pollution	3	20	7	171
	Waste	5	23	6	389
	Recycle	0	0	69	127
	Climate change	13	37	2	183
Environmental behaviour	Pro-environmental behaviour	0	3	1	275
	Environmental awareness	4	13	12	244
	Environmental attitude	12	37	20	1050
	Environmental pollution	2	9	4	122
Human health	Human health	298	373	317	3474
	Human well-being	12	16	10	78
	Public health	72	104	87	699

material. Most of the studies found during this scoping literature search published to date that examine behaviour change in relation to plastic focus on waste management behaviours and recycling. For example, 196 (11 of these with 'recycle' in the title) out of 4932 studies (the total identified through the Scopus search for all main + sub category searches) focused on recycling as the subject of their study (Table S1, ESI†). Although this is an important part of preventing plastic mismanagement, waste management and recycling are only a fragment of the behaviours which need to be addressed to reduce plastic waste, plastic pollution and plastic environmental and human exposure. Behaviours which reduce the production, purchase, use and waste and behaviours which promote the move towards a more circular economy are also to be encouraged. However, there is a large gap in knowledge about what is known about behaviour change and current plastic-related behaviours.

Ajzen's theory of planned behaviour

Ajzen's TPB is one of the most utilized behaviour change theories in relation to plastic and pollution. Despite a general agreement on the applicability of the TPB in predicting plastic-related behaviour change,[16–23] there was is a lack of consensus on which of the elements of TPB – PBC, subjective norms or attitude – have the most influence on plastic-related behaviour change. For some studies the findings suggested PBC was the most important in plastic behaviour change,[24–27] for others it was subjective norms,[28,29] and others it was attitude.[29,30] However, these studies took place in a range of locations with varying cultural approaches to waste management, and varying access to recycling facilities. This cultural and facilities inconsistency could explain the varying degrees of influence of these elements of the TPB, or it could be said that the TPB is too linear in single element focused in its approach. It is expected that different cultural and societal norms will play into plastic-related behaviour change, therefore a model with a more variable and flexible approach might be better applied to plastic-related behaviour change research.

Other studies used extended versions of TPB and included elements such as environmental awareness,[22,24,25] habit[17,31] and social norms,[16,31,32] which were all found to be significant in predicting behaviour change. This further emphasises the need for a more extensive model to examine plastic behaviour change. Habit is defined as a "response automatically triggered by the perception of relevant context cues" (Wood, 2017: p. 389).[33] Therefore, relevant social and cultural cues are important for influencing individual behaviour change, especially if the behaviour change is to become more permanent and automatic, and should be factored into considerations on plastic-related behaviour change.

COM-B model

The COM-B model consists of three conditions necessary to complete a behaviour. These include capability, which consists of psychological or physical ability; opportunity, which comprises the physical and social environment needed; and motivation, which includes reflective motivation.[8] Only one study was identified during this scoping search that utilised this model to assess plastic-related behaviour, Allison *et al.* (2021) (Table 1, main keyword = COM-B, category keywords from the plastic pollution list).[34] Allison *et al.* (2021) surveyed participants on their willingness to purchase bio-degradable compostable plastic packaging (BCPP) to identify barriers and enablers. Survey responses were then organised according to the COM-B model.[34] For example, psychological capability included understanding the terminology of plastics and their labelling and understanding the plastic problem; physical opportunity consisted of access to the correct waste management and shopping environment; and social opportunity included social norms. Finally, automatic motivation and reflective motivation included environmental concerns and believes about the impacts of biodegradable plastics. The focus on biodegradable and compostable plastic may be inconsistent with current thinking on the importance of the circular economy rather than replacing one waste problem with another, but this paper provides valuable insights. For example, this paper highlights the conditions that affect individual-level behaviour change in relation to plastic. This study identifies the main barriers and enablers in terms of psychological capability are understanding terminology and awareness of the plastic waste problem; within physical opportunity: the shopping environment, access to products, and access to waste management; and within social opportunity: social norms; and finally, within reflective motivation: environmental beliefs and concerns, and beliefs about capability. This tells us that to influence willingness to change behaviour there needs to be access to an environment where alternatives are readily available, the social norms need to be aligned with this change, and their needs to be an environmental awareness and capacity for the individual to make the change.

Perceptions and attitudes towards plastic

Understanding individual perceptions of plastic is a useful starting point in understanding and potentially changing people's relationship and behaviour associated with plastic, as it indicates whether plastic is viewed as a convenient part of modern life or if the increased attention on the environmental impact and human health consequences have altered perceptions. Heidbreger *et al.* (2019) reviewed 187 studies focused on relevant 'plastic pollution' and 'pollution' and found that the perception of plastic had changed, especially in relation to its impact on health with people becoming more aware of the plastic problem.[35] However, as found in many studies including Heidbreger *et al.* (2019) behaviour does not always follow awareness and this is definitely true with regards to the plastic pollution problem. It appears most individuals consider the impact of packaging at the point of disposal rather than pre-purchase despite education and awareness campaigns.[35] This is consistent with research on consumer preferences for bio-degradable packaging.[34] Most recently the COVID-19 pandemic and its associated health and safety concerns have changed the function and perception of many plastic and single-use plastic (SUP) products. The increase in awareness of

public health and viral transmission, combined with the many restaurants offering more takeaway services during the international lockdown, and the temporary rejection of reusable items by some retailers due to safety concerns, has resulted in both an increase in use of SUPs and shift in public perception of plastic towards a hygienic and healthy product rather than a pollutant, thus limiting an individual's opportunity to make a change to reduce their use of plastics.[36]

Food hygiene and environmental awareness have been highlighted as important but opposing views influencing plastic behaviour. Studies have identified food hygiene as a priority and an associated willingness to pay for biodegradable alternatives,[37] reflecting the importance of motivation, while other studies suggest environmental concerns are more pertinent and that participants are less willing to pay for alternatives, but participants would still prefer this to outright bans.[38] Behaviours associated with single-use items are not seen as the focus of SUP reduction but rather the material itself, and that despite a high level of awareness participants are not willing to change their purchasing behaviours to reduce plastic.[39] Similarly, ease of access to recycling information has not been shown to directly relate to appropriate disposal of plastic waste or recycling actions.[40] Awareness and information are not the sole drivers of plastic-related behaviour change, but merely a starting point.

Social patterning

There is a general consensus within published research regarding the influence of sociodemographic factors on the behaviours and attitudes associated with plastic. This consensus identifies that sociodemographic factors such as age, gender, marital status, education and income determine the uptake of anti-plastic behaviours and attitudes, and also the implementation of plastic reduction policies.[41–45] Similarly, the influence of education on plastic and related behaviours suggests individuals of a younger age will have a more effective long-term impact and participate in anti-plastic behaviour, given the importance of socialisation in the attitudes we form.[42]

Many of the studies utilising TPB also investigated the role of gender, but there was no consensus or consistency in inclusion of the gender element. Although it can be argued that examining the differences in gender may lead to a gendered approach to behaviour change,[46] in order to produce targeted behaviour change interventions the role of gender and factors like ethnicity and income may be important to consider. Such targeting logic could also be applied to a wider range of variables (including class, ethnicity, income) to help advance the understanding social patterning, individual or community–plastic interaction and production of targeted interventions. To effectively unpick the influential elements on plastic pollution and use behaviour and identify potential intervention strategies there is a need for individual and multiple factor analysis.

Drivers, obstacles and potentials for research and policy

Convenience culture is one of the main drivers of plastic-associated behaviours. This was most apparent in the literature on the perceptions of plastic and in relation to the increase in takeaway culture with COVID-19. Within behaviour change literature, it is known that the ease by which a behaviour can be changed affects the success of interventions. Therefore, successful behaviour change interventions associated with plastic will need to ensure that accessing reusables or sustainable alternatives is just as easy, if not easier than using traditional (single use, SUP) plastic. Ideally, circular approaches (a shift from produce-use-dispose to reduce, reuse, repair, remanufacture, recycle,[47] potentially incorporating elements such as upcycling of plastic waste[48] and implementation of production/waste management policies and regulations[49]) would be the most accessible and affordable option. Additionally, socio-demographic factors were also identified in the literature, although the degree to which this drives plastic pollution is not established. However, it appears that targeted behaviour change interventions (*e.g.* by gender, ethnicity, income) are recommended by most studies and this is an interesting avenue for future research.

One of the main obstacles to reducing use of SUP during COVID-19 related to food safety and hygiene concerns, leading to increased SUP use of personal protection equipment (*e.g.*, masks, gloves hand gel, and visors), and food and drinks containers. This is considered an obstacle, as many individuals still perceive a risk with reusable items, and the COVID-19 situation will continue the use of several SUP items for a considerable period. Habit was also identified as an obstacle. This is closely related to our current convenience culture and has been considered as a barrier. Finally, money is another major obstacle in terms of plastic behaviour change, in relation to both the costs associated with behaviour change (by the individual, producers and industry, waste managers and governance bodies) and the policy change required (*e.g.* the increased cost of plastic construction if regulations require circular economy future reuse/repair/remanufacture to be incorporated in product design; implementation of a plastic levy on plastic use or tax to cover end-of-life costs).[49,50]

However, despite these drivers and obstacles, there are some opportunities for change. COVID-19 could also be an opportunity for change. As the COVID-19 situation continues to evolve, there are opportunities for regime and habit change to be introduced. Also, it is hoped that as the health and safety situation improves this will provide more opportunities for single-use items to be reduced. Education is also another theme which arose within the literature. Many of the papers reviewed here recommended education to individuals of all ages. This is especially pertinent as there appears to be situations of misinformation in relation to plastic and the sustainability of biodegradable alternatives. Part of this education could involve de-marketing. This is when a company uses negative messages to discourage demand for a certain product, and has been used for health behaviours, such as tackling obesity.[51] It has also been included in work on behaviour change in relation to antibiotic misuse[52] and sustainable tourism[53] (behaviour changes identified using one of the 3 behaviour models; BCW, COM-B, TPB). Raab *et al.* (2022) found that it was successful in motivating a reduction in SUP consumption amongst tourists in

Canada. This was especially true for those with a stronger recycling attitude, individual commitment, and responsibility.[54] Future research could look to the use of negative messaging within other contexts as it may be more suited to individuals that already have a sense of responsibility for their plastic consumption. Although this review did not focus on pro-environmental behaviour elements of it appeared in the literature, for example, the importance of social norms and locus of control in motivations behind behaviour change.[55] Future research could look at what lessons can be learned from pro-environmental behaviour change for potential tranfer or insight into positive change in the people–plastic relationship and individual plastic behaviour.

Limitations

This paper acknowledges that this review is not systemic or extensive. As stated in the methodology, this search was limited to papers mentioning 'plastic' but this subject area is related to pollution, waste, recycling and litter or specific consideration of 'micro-' or 'macro-' plastic. This may have resulted in some relevant papers being missed or excluded during the search. In addition, only studies published in the English language were included which will have limited the scope of this search and will have caused some bias in the selection of studies covered in this article. A full systemic review is recommended, including an extended selection of terms and investigating papers not directly associated with plastic.

Conclusions

There needs to be multi-level and systemic change to alter our relationship with plastic. Fundamentally this must include individual change. Clarity regarding a range of new behaviours to be adopted must be central moving forwards. Although recycling is important for the public, more focus needs to be placed on specifying, understanding and promoting circular behaviours, detailing waste reduction behaviours, and for manufacturers, providing reusable alternatives, rather than biodegradable ones. The creation of new habits, routines and social norms based around these diverse behaviours will help facilitate a cultural move away from plastic. Previous literature has focused too much on behaviours associated with plastic after it has been purchased and used, rather than behaviours at the beginning of the plastic life cycle. This paper acknowledges that to create individual-level behaviour change individual facing interventions are required. However, it is important to acknowledge that not all individuals are the same and that the barriers and facilitators to individual behaviour change are socially patterned (*e.g.* by gender, class and ethnicity).

There are many drivers and influences of plastic-related behaviour, including habit, convenience, and culture, and therefore a nuanced approach is necessary (*i.e.* not considering individual drivers, obstacles or the effectiveness of individual opportunities or actions in isolation). The BCW system with the COM-B model at its core, provides such a nuanced approach and could help identify and guide effective interventions that include mechanisms and policies that could help generate or positively influence behaviour change.

The SCOPUS search shows that there is a lack of research on the BCW in relation to plastic and this needs to be expanded in future research. It is also clear that raising awareness of the plastic problem is not sufficient on its own in instigating behaviour change. Future research should seek to investigate which targeted interventions would work best in different cultural and demographic contexts. Policy also needs to ensure there is a physical environment where access to reusables, alternatives and waste management is easy, so the convenience of SUP is shifted. A social environment also needs to exist where social norms and culture dictate that reducing plastic waste is a norm to be upheld.

Author contributions

LW, DA and AM: conceptualization, resources, methodology, data curation, investigation, writing – original draft, all authors: writing – review & editing.

Conflicts of interest

There are no conflicts to declare.

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