

**Young Adults' Perceptions of Microplastic and Perceptions of Mitigating Pollution through  
Positive Behaviors**

Bachelor Thesis/Capstone Project

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## Abstract

This study aims to understand young adults' perceptions of microplastic and their perceptions of mitigating pollution through positive behaviors. 125 German high school students from the city of Hamburg were questioned about their perceptions of harmful behaviors in terms of microplastic pollution and their perceptions of the feasibility and impact that positive behaviors can have. Positive behaviors in this case mean the behaviors that can contribute to the mitigation of microplastics. Keywords that were prominent in all parts of the questionnaire and proved to be important for the participants were "Reduction of consumption", "Plastic packaging", "Adequate disposal of waste", "Alternative materials" and "Recycling". These patterns also became evident in the analyses of the feasibility and perceived impact. The characteristics of the answers are backed by the literature that was consulted. Important concepts that explain the result are the media narratives that the students are exposed to, emotional responses to the topic of microplastics, and perceived alternatives. This paper furthermore introduces a framework that can help to take findings generated through this kind of research to the next level. It can be used as a tool to decide how to proceed after the limit of theoretical investigations is reached. *Theory will not be able to save our planet, therefore we need praxis!*

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## Introduction

Microplastic pollution in the environment and the human body has become a topic of global concern. Many claim that the material plastic in itself is not the problem (Grünzer et al., 2023), it is the way we produce, use, and dispose of the material in quantities that exceed our imaginations:

Every week a human ingests an amount of plastic that is equivalent to a plastic credit card (WWF, 2019).

460 million tons of plastic are produced each year and 353 million tons of this produce end up as waste (OECD, 2022), mostly in landfills or in the ocean.

The UN is forecasting that by 2040 we will be adding about 30 million metric tons of waste into the oceans every year (UN, 2021).

These numbers provoke the question, what microplastics are and why they pose such big problems? When talking about microplastics it is usually differentiated between primary and secondary microplastic. The primary microplastic is the one that is produced as tiny particles to be used in cosmetic products for example. Secondary microplastic is created when bigger plastic pieces break apart through extraordinary circumstances (such as erosion through different weather conditions) (García-Vázquez et al., 2021).

According to Grünzner et al. (2023), the source of the problem is as diverse as its effects, therefore it is problematic to speak about "the microplastic". Different chemical compositions have different effects on their surroundings. According to the ECHA, the European Chemicals Agency, the existing evidence on the risks of microplastic in all its forms is enough to declare that "uses of microplastics that result in releases to the environment pose a risk that is not

adequately controlled and should be minimized". In other words: microplastic pollution is getting out of hand and needs to be mitigated and ideally stopped immediately.

Not only experts in the field of environmental pollution and human health are aware of the dangers that microplastic holds. Even the general public perceives them as a risk to health and the environment (Catarino et al., 2021). Still, the researcher felt the need to further study these perceived risks in order to connect them to the feasibility of mitigating behaviors. This public awareness is the perfect building ground for a more sustainable plastics economy (Catarino et al., 2021, Prata et al., 2019). It deserves more attention, even though it is claimed that individual behavior cannot solve the problem and corporate responsibility is needed even more (Schönbauer and Müller, 2021).

There are some existing policies and regulations to combat microplastic pollution, but the progress in adapting and implementing them is rather slow. Examples of this are the microbead ban that was adopted in the United States in 2015 (H.R.1321 – Microbead-Free Waters Act of 2015) (Catarino et al., 2021) or the complete ban on plastic bags in certain countries (e.g. Morocco, Albania, France)(Knoblauch & Mederake, 2021). Once the risk is acknowledged by the public and the government, one would think that an improvement of the situation is in sight. Unfortunately, this is not the case since society and the world are tackling many more problems such as climate change, global warming, and other pollutants that are just as important as the microplastic crises. Many experts claim that the microplastic issue should not take away from the attention that society and politics give the other challenges (Catarino et al., 2021). Only if we work on the problems simultaneously and with joined efforts, will there be holistic solutions. These joined efforts start at the individual level, which is why the investigations should also start there.

This paper will shed light on the perceptions of the feasibility and impact of positive behaviors that can be done to prevent microplastic pollution. It aims to understand how they relate to each other and propose a way to put theory into praxis. To achieve this, the study asks the question "What are the perceptions of microplastic among young adults, and how do they perceive the adoption of positive behaviors to mitigate microplastic pollution?".

Section one of this study dives deeper into the literature to provide a foundation and justification for the decisions that led to the formulation and development of this research. It will shed light on the factors that shape an individual's perception and what significance adolescents have in behavioral research that is focused on pro-environmental behavior. The following section will give detailed insights into the methods of this research, so the design and execution. The analyses of the questionnaire's results will be followed by a discussion that links the outcomes of the questionnaire to each other and the literature. Subsequently, there will be a section that proposes a way to use the findings for the creation of a tool that can help to proceed after the analyses of theoretical perceptions. The conclusion will tie everything together and the paper ends with limitations and suggestions for future research.

## **Literature Review**

### **Factors shaping individual perceptions of microplastics**

#### ***Perceptions and their importance for this research***

Millstein and Halpern-Felsher (2002) argue that perceptions are crucial for human behavior and interactions because of the individual's beliefs about the consequences of their actions, just as much as their perceptions of their vulnerability to those consequences. People also exhibit a greater willingness to perform behaviors that they perceive as effective. An

example of this would be the fact that pro-environmental behaviors are more likely to be done if people perceive them as effective in combating climate change (Wynes et al., 2020).

For this specific study, the perceptions of adolescents are of importance due to the age of the participants which ranged from 16 to 20 years. Historically they were seen as poor risk assessors but recently their competence in decision making has been a focus in policy and legal debates. Perceptions play an important role in motivating their behavior (e.g. pro-environmental behavior)(G. Millstein & L. Halpern-Felsher, 2002), which is why perceptions are the key element of this study.

When talking about the psychological factors that influence the perception of microplastics and mitigating behaviors two things proved to be of great importance during the literature review. The first thing is risk perception and the second thing is the importance of emotional responses to microplastics. They often go hand-in-hand but can also be looked at individually, which will happen in the following sections. As mentioned before, the perception of microplastics are especially important for this study as it aims to understand the perception of feasibility and perceived impact of certain behaviors.

### ***Risk perception***

A study by Catarino, et al. (2021) that investigated people's perception of the risk that microplastics pose to humans and the environment, describes how people are generally more worried about the impact that microplastics have on the environment rather than the impact on the human body. The reason for that might be the fact that humans feel like they have control over their bodies and therefore also have control over the risk to their health. Furthermore, Catarino et al. show how women on average perceive risks higher than men (see also Hampel et al., 1996) and that demographic backgrounds such as income and educational background can



play a huge role. People with lesser social rank and fewer privileges are more likely to be in positions of less authority and control. They "see the world as more dangerous" because they are more susceptible to economic pressures. Despite not being specifically relevant to the research, this does prove a point of differences in perceptions. This can help to understand and explain differentiations in the replies, even if demographic and educational backgrounds were not investigated in the current study. Similar insights could be gained through a study by Kramm et al. (2022), who found that perception varies with socio-demographic factors, but differences are rather small. They argue that it is mainly driven by environmental awareness and the media narratives that people are exposed to (see Media Narratives section).

Another study focuses on the mixed evidence concerning the relationship between environmental risk perception and pro-environmental behavior. They found that an individual's pro-environmental behavior is influenced by his or her cultural worldviews. The study was conducted with young Chinese people so it would be interesting to see whether this finding also becomes evident in other cultures (Zeng et al., 2020).

To conclude the perception of risks it can be said that they are indeed of great importance for this research because they can have a huge influence on the factors that will be investigated. A range of other factors should not be neglected either though, to have a holistic understanding of the reasons behind perceptions in general.

### ***Emotional responses***

Closely related to the previous factor of risk, Li, Zeng et al. (2022) investigated the effect of emotions, specifically the effect that fear has on perception and behaviors. The interesting outcome was that the participants of this study indicated that fear-induced communication is an effective persuasive approach. In other words, if you are scared, you are more likely to act.

Miller (2021) investigated the effect of fear as well as guilt. This study used immersive virtual technology, paired with different emotionally framed messages to make participants experience the impacts of microplastics. Miller concludes that negative emotional appeals have the potential to increase Pro-Environmental Behaviour (PEB) and Environmental Concern (EC) related to microplastic pollution. There is also evidence that proves guilt to be more effective in this study than fear. It can be said that negative emotional appeals generally influence the perception of microplastics and promote behavioral changes. Lastly, research about emotional responses is usually only directed at negative emotions, while investigations into positive emotions such as hopefulness, curiosity, or satisfaction are rare.

### ***Perceived alternatives and carbon numeracy***

The perception of available alternatives is an important factor in the mitigation of plastic pollution. Studies (e.g. Deng et al., 2020) use the example of single-use plastic bags to prove this. Most people know that using them is far from ideal but they continue to do so, simply for convenience. They underestimate the impact and convenience is a higher priority in that moment than care for the environment. In other words, humans are not yet ready to sacrifice their personal interests to reduce emissions (Deng et al., 2020). Another concept that explains these behaviors is "carbon numeracy". The concept is explained by Wynes et al. (2020) as a similar practice to budgeting or calorie counting. If you do/buy/eat one thing, you do not have the capacity for the other thing anymore. Despite the growing attention that carbon emissions of individuals receive, the carbon numeracy of individuals and the public is not well understood yet. Wynes et al. stress the ability to perform trade-offs as a crucial ability to gain carbon numeracy which ties back to the perceived alternatives.

### ***Positive behaviors***

These behaviors are an essential part of the study as they are the ones that are analyzed in the questionnaire. They are referred to as “positive behaviors” because they pose a positive influence on the mitigation of the problem of microplastic pollution. The list of positive behaviors was originally developed by a group of researchers from the university of Groningen and then adapted to fit the scope of this research. The behaviors will be named and explained in detail in the measures section of the methodology.

### ***Media narratives***

The increased frequency of media attention that microplastics received, inevitably influenced the perception of the risks that they pose (Pop et al., 2023 and Schönbauer & Müller, 2021). The study by Pop et al. (2023) argues the need for accurate and balanced media reporting and that the prevention of the spread of misinformation is only then possible. Additionally, it also argues for closer examination of people's perceptions to create appropriate interventions which proves the importance and scientific relevance of the study at hand.

Schönbauer and Müller (2021) investigated the German media landscape. They sectioned the developments into three phases which gives a lot of insights into the importance and attention that the topic received (First Phase: Microplastics—an Invisible Threat in the Ocean (2004-2010), Second Phase: From a Far-Away Problem to Local News (2010-2015), Third Phase: Diverging Risk Assessments and Appeals to Individual Consumer Responsibility (2015-2018)). Despite the media stressing the responsibility of the individual, the researchers concluded the paper by stressing that consumer impacts can only have a limited impact on these major environmental issues. They argue that no matter how much the media emphasizes the importance of individual responsibility and consumer effort, stronger corporate accountability

and policy action are required. A third source interestingly compared the framing of the topic in scientific articles and media reports. While science frames the issues as a new field with many uncertainties and open questions, general media articles imply that all kinds of harmful consequences are very likely (Völker et al., 2019). Media is highly relevant when looking at the factors that influence our perceptions. It needs to be in line with the most recent scientific findings so the public can feel properly informed.

### **Adolescents and their significance for behavioral research**

Adolescents are influenced by a range of different groups. Peers and parents as well as people from their professional environment (e.g. teachers, bosses, colleagues) are part of their daily lives. Meanwhile, they also become more and more independent, form their own opinions, and make their own plans for the future. This explains why this study selected only a certain age group to participate and considers age to be an important factor for the analyses of perceptions. Differing from this, many studies on pro-environmental behavior look at the behaviors and perceptions of college students and/or the differences between younger and older generations (e.g. Grønhøj & Thøgersen, 2017). In a study by Li, Liu et al. (2022) college students were named as the "main source of contemporary and future environmental protection". Furthermore, they concluded that younger generations are generally more concerned about the environment and its crises than older generations are. Young people are globally also seen as the promoters of new environmental movements with the biggest example being the "Friday for Future" movement, starting in 2018.

The studies that were consulted for this literature review mainly focused on college students. A wider range in age groups amongst the participants is always desirable to achieve more applicable results. It became evident that a lot of research focuses on the gap between the

desire to change something and the actual doing, as well as the perception of the risk posed by microplastics.

Research around the perception of microplastics has become more and more relevant to the growing problem of microplastic pollution (Pahl & Wyles, 2017). During the review of the literature, three main areas seemed to be investigated. The perceived danger that microplastics pose (e.g. Catarino et al., 2021)(1), the gap between the desire to mitigate the pollution and the actual behavior that individuals put into practice to achieve mitigation (pro-environmental behavior) (e.g. Li, Zeng et al., 2022) (2) and the severeness of the contamination in various fields (e.g. Katyal et al., 2020)(3).

No studies have investigated the connection between the perceived feasibility of the mitigating behavior and the impact that this specific behavior could have. This study aims to do exactly that and provides a framework that can help to put the gained insights into praxis and develop innovative behavioral interventions. This way the gap between "wanting to do" and "actually doing" will become more narrow. Furthermore, the focus on adolescents from the age of 16 to 20 should enable this study to bring forward the perceptions of that generation. They are the ones who are going to continuously worry about environmental crises in their day-to-day life. Because of this, this age group is very relevant to look at as they should also be the ones that have a say in decisions and plans for tomorrow that are being made today.

## **Methodology**

### **Participants**

All of the participants live and attend different high schools in Hamburg, Germany. In total, 125 students participated and filled out the survey. They were between the ages of 16 and

20. The majority so 66% of the participants were 16 and 17 years old, and 29% were 18,19 and 20 years old. 5% of the participants were outside of the desired age range, most likely 15 or 21 years old. Despite being outside of the age range, a desired but not required criteria, they were still included because they matched the characteristics of being a high school student which is the core component. Regarding gender, proportionally the biggest number of participants were female (65%), followed by male (30%), and 5% declared their gender as non-binary. The survey that was required for participation was distributed to the participants through high school teachers who were contacted by the researcher. The teachers acted as gatekeepers and all students were asked to give informed consent before participation. To ensure the high quality of the collected data, the data screening included two steps. Firstly, attempts in which respondents answered the questionnaire in less than three minutes were removed as well as the participants who did not finish the questionnaire.

## **Procedure**

The participants filled out the surveys on their personal mobile devices after receiving a link or QR-code, provided by their teacher. They received information about the study and some foundational information about microplastics and gave informed consent to participate. After filling out two open questions, they proceeded to rate behaviors on a likert scale. Lastly they were asked to indicate their gender and age. All the data was collected anonymously.

## **Measures**

The questionnaire included two open-ended questions In the first part of the qualitative section of the questionnaire participants were asked to name "Which practices and behaviors can reduce microplastic pollution?". In the second open question, participants were asked to name

"the worst behavior" considering microplastic pollution. Furthermore it included a list of 50 questions that were measured on a Likert scale. The first half of the Likert scale questions concerned feasibility and asked the participants to rank the behaviors, while the second half concerned the perceived impact of the same 25 behaviors (see Table 1).

**Table 1**

*All 25 behaviors that were investigated in the questionnaire*

1 recycle/separate waste	6 Bring your own bottle/cup	11 drink Coffee-to-go etc. from reusable cups	16 not exercising on artificial snow or grass	21 proper ventilation with fresh air
2 not disposing waste in the environment	7 Use bottles made from glass/metal	12 choose restaurants or delivery services that allow sustainable containers	17 using wall paint without harmful materials	22 using an air filter
3 avoid single-use products	8 Microwaving food in glass or porcelain	13 wear clothes made from natural materials	18 use cosmetics without microplastics	23 choose sustainable means of transport
4 avoid plastic and microplastic products	9 use metal, wood or bamboo cutlery	14 textiles in the house made from natural fibers	19 use laundry detergent made from natural ingredients	24 avoid areas with heavy traffic
5 buy unpackaged/sustainably packaged goods	10 use reusable take-away containers	15 vacuum regularly	20 air dry clothes made from synthetic fibers	25 avoid heavy acceleration and braking while driving

Using mixed methods (qualitative and quantitative data) during research often bears some issues. Even if there are problems in methodically comparing different kinds of data, an only quantitative study would not fully take into account each participant's personal experience, and a study that is only qualitative would not be adequately generalizable. Through the mixed methods approach, individual opinions that can give a more personal touch to the data are included, rather than only numerical answers derived from the Likert scale.

## Analyses and Results

### Qualitative Data

In the first part of the qualitative section of the questionnaire participants were asked to name "Which practices and behaviors can reduce microplastic pollution?". From the answers to that question keywords (or their corresponding synonyms) were identified as one can see in Table 2. Some answers included aspects that matched more than one of the keywords so they were added in both categories.

**Table 2**

*Keywords and their distribution in open question 1*

<b>Keyword</b>	<b>Synonyms</b>	<b>Amount</b>
Reduction	Consumption reduction, less plastic, general reduction of plastic, less waste, buy less	27
Packaging	Renounce plastic packaging, less plastic packaging, use of paper packaging, switch to products without plastic packaging, glass bottles instead of plastic bottles	33
Alternative materials	Switch to biodegradable alternatives, use paper, use other packaging materials, environmentally friendly alternatives, more natural materials	17
Recycling	Increased recycling, proper disposal of plastic, waste separation, sustainable behavior, microplastic filters	14
New laws/ Prohibitions	Replace plastic packaging on a bigger scale, introduce laws, plastic tax, ban	10

Through this first question, it can already be said that the participants gave similar answers and were headed in the same direction with their ideas for microplastic pollution



mitigation behaviors. The behaviors and practices catering to "Packaging" and "Reduction" were listed the most. Many times the answers by one student included multiple aspects and therefore were matched to more than one keyword in the table above (see Table 2). Combinations that appeared often were "Reduction and Recycling", "Reduction and Packaging" and "Packaging and Alternative Materials". Some other answers did not fit into the most prominent categories. They showed a certain level of knowledge and concern about the problem of microplastic pollution that was not expected by the researcher such as the following:

*Cradle-to-cradle:* The participant proposed that the cradle-to-cradle principle should be used more frequently. The principle describes the process of a holistic recycling and waste reduction process.

*Minimalism:* This participant thinks that minimalism can be a way to increase the efforts in microplastic pollution mitigation behaviors. The philosophy of minimalism includes making more out of less and therefore also ties into "Reduction".

*Glitter:* This participant stresses the importance of no longer supporting the production of microplastics and refers to the recent "glitter ban", proving that they are well-informed on recent political developments.

*Export of plastic waste to other countries:* This participant is concerned about the effects that the very common behavior of exporting waste to other countries would have on the places that import them. They consider this a very critical issue that needs to be stopped immediately. Again, a clear trend among the answers became visible.

### **Table 3**

*Keywords and their distribution in open question 2*

<b>Keyword</b>	<b>Synonyms</b>	<b>Amount</b>
Disposal of waste in nature	Improper/incorrect waste disposal, throwing trash into the environment/the ocean/nature,	31
Microplastic in cosmetics	Microplastic in care products, body scrub with plastic, cosmetic items, personal care products	5
Plastic packaging	Single-use plastic, use of plastic bags, double plastic packaging	24
Synthetic textiles	Wear and tear of clothes, clothes containing plastic	3

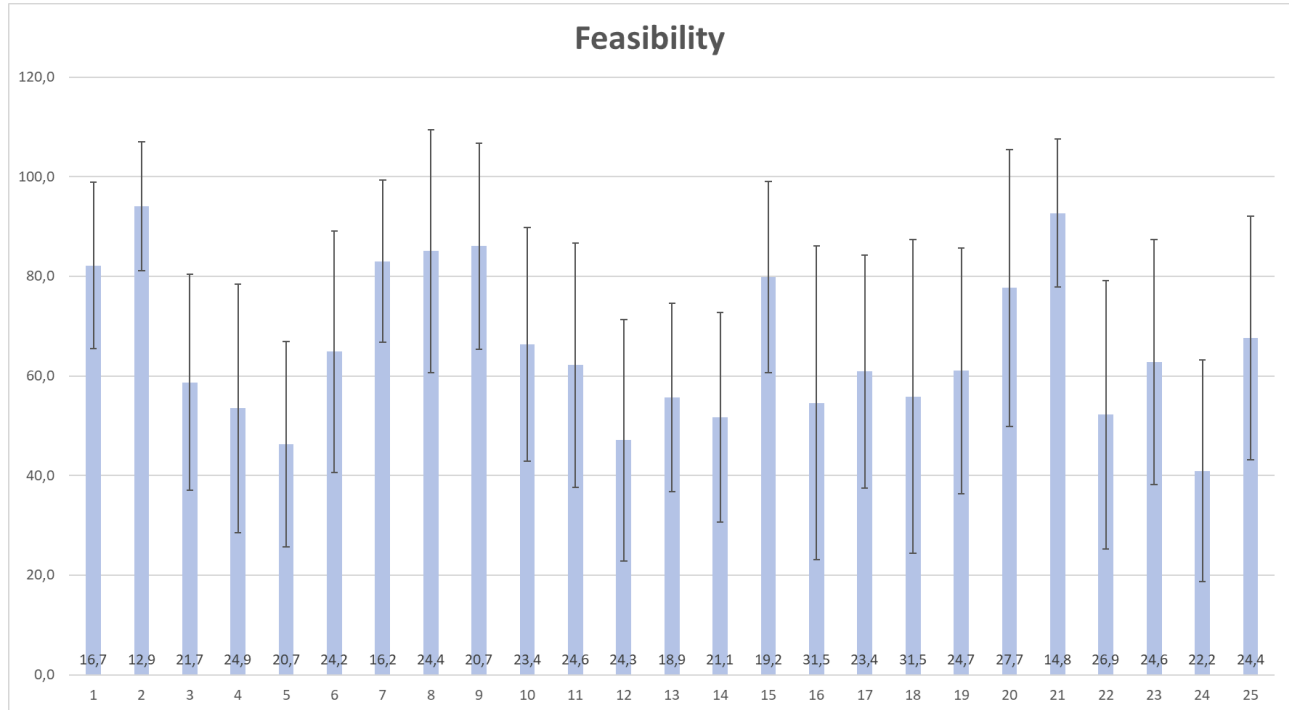
It needs to be said that not all the answers fit in one of these four categories (see Table 3) which is why the amount of answers is not equivalent to the number of participants. From this table, it becomes clear that all behaviors concerning the inadequate disposal of waste and all kinds of "Plastic packaging" are considered very bad. The topics of "Synthetic textiles" and "Microplastic in cosmetics" were also mentioned but not as much as the first two. The students have very similar thoughts about the pollution problem again.

### **Quantitative Data**

The questionnaire was split into a part with questions about the feasibility of certain behaviors and a second part about the perceived impact of the same set of behaviors. The behaviors will be referred to as numbers, which can be seen in Table 1. Firstly the analyses looked at both parts of the quantitative questionnaire separately, afterwards, they were considered in combination. With this approach, the researcher hoped to get an understanding that would allow to proceed beyond the theoretical analyses.

**Figure 1**

*Feasibility of all Behaviors*



- |   |  |  |  |   |
|---|--|--|--|---|
| 1 recycle/separate waste                    | 6 Bring your own bottle/cup              | 11 drink Coffee-to-go etc. from reusable cups                                | 16 not exercising on artificial snow or grass          | 21 proper ventilation with fresh air                  |
| 2 not disposing waste in the environment    | 7 Use bottles made from glass/metal      | 12 choose restaurants or delivery services that allow sustainable containers | 17 using wall paint without harmful materials          | 22 using an air filter                                |
| 3 avoid single-use products                 | 8 Microwaving food in glass or porcelain | 13 wear clothes made from natural materials                                  | 18 use cosmetics without microplastics                 | 23 choose sustainable means of transport              |
| 4 avoid plastic and microplastic products   | 9 use metal, wood or bamboo cutlery      | 14 textiles in the house made from natural fibers                            | 19 use laundry detergent made from natural ingredients | 24 avoid areas with heavy traffic                     |
| 5 buy unpackaged/sustainably packaged goods | 10 use reusable take-away containers     | 15 vacuum regularly  | 20 air dry clothes made from synthetic fibers          | 25 avoid heavy acceleration and braking while driving |

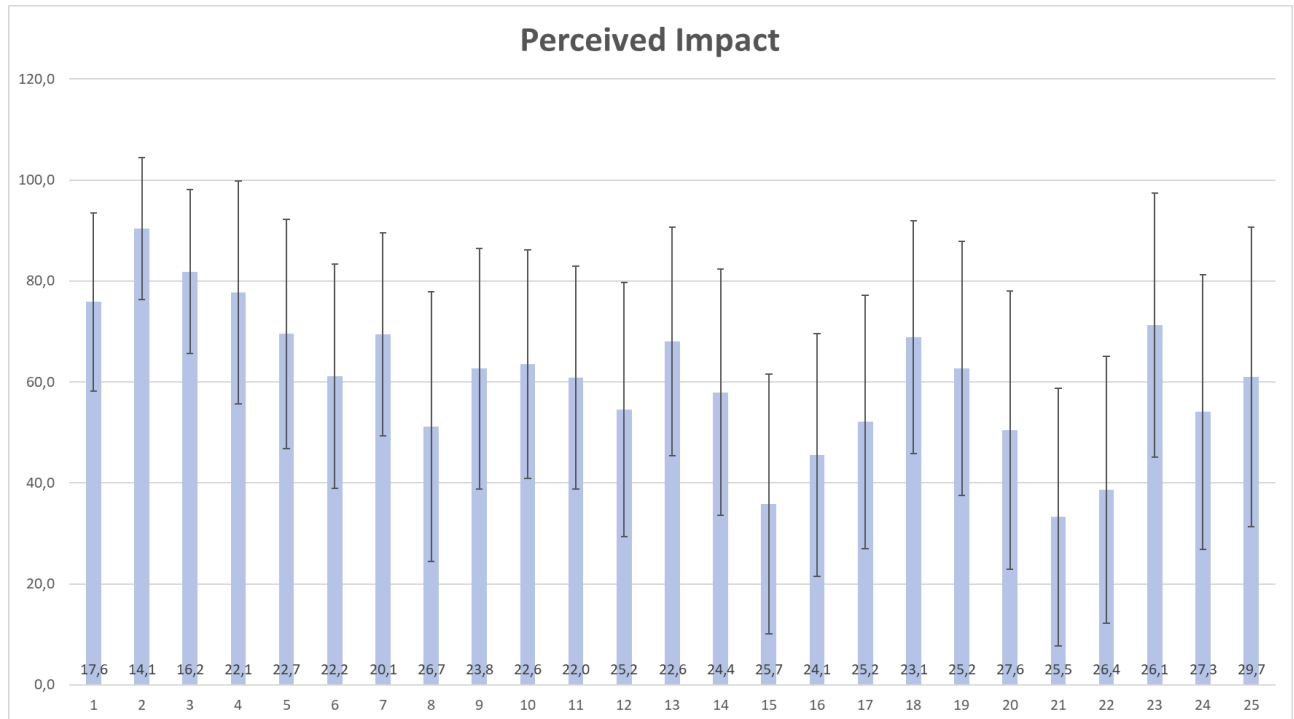
This histogram shows the mean of the answers that the participants gave regarding the feasibility (0 = impossible, 100 = easy) of the individual behaviors that were questioned. We can see that all of the means are above 40 and therefore none of the behaviors are perceived as

impossible to put into practice. Regardless, the behavior that was ranked the "hardest" to implement is "avoiding areas with heavy traffic (24)". This is very reasonable as the participants all live in a big city (Hamburg, Germany). The behavior that received the highest mean and therefore is considered the most feasible was "not disposing waste in the environment (2)". This is the first promising insight that will be further elaborated on in the discussion section.

In addition to the means, this graph gives us insights into the standard deviation of the answers per behavior. With all of them not being considerably big or small, the standard deviations have not created a pattern yet. The things that can be pointed out are the three smallest standard deviations from the mean with the behaviors of "not disposing waste in the environment (2)", "proper ventilation with fresh air (21)" and "use bottles made from glass/metal (7)". For the feasibility of these behaviors, this means that the participants were on the same page.

**Figure 2**

*Perceived Impact of all behaviors*



1 recycle/separate waste	6 Bring your own bottle/cup	11 drink Coffee-to-go etc. from reusable cups	16 not exercising on artificial snow or grass	21 proper ventilation with fresh air
2 not disposing waste in the environment	7 Use bottles made from glass/metal	12 choose restaurants or delivery services that allow sustainable containers	17 using wall paint without harmful materials	22 using an air filter
3 avoid single-use products	8 Microwaving food in glass or porcelain	13 wear clothes made from natural materials	18 use cosmetics without microplastics	23 choose sustainable means of transport
4 avoid plastic and microplastic products	9 use metal, wood or bamboo cutlery	14 textiles in the house made from natural fibers	19 use laundry detergent made from natural ingredients	24 avoid areas with heavy traffic
5 buy unpackaged/sustainably packaged goods	10 use reusable take-away containers	15 vacuum regularly	20 air dry clothes made from synthetic fibers	25 avoid heavy acceleration and braking while driving

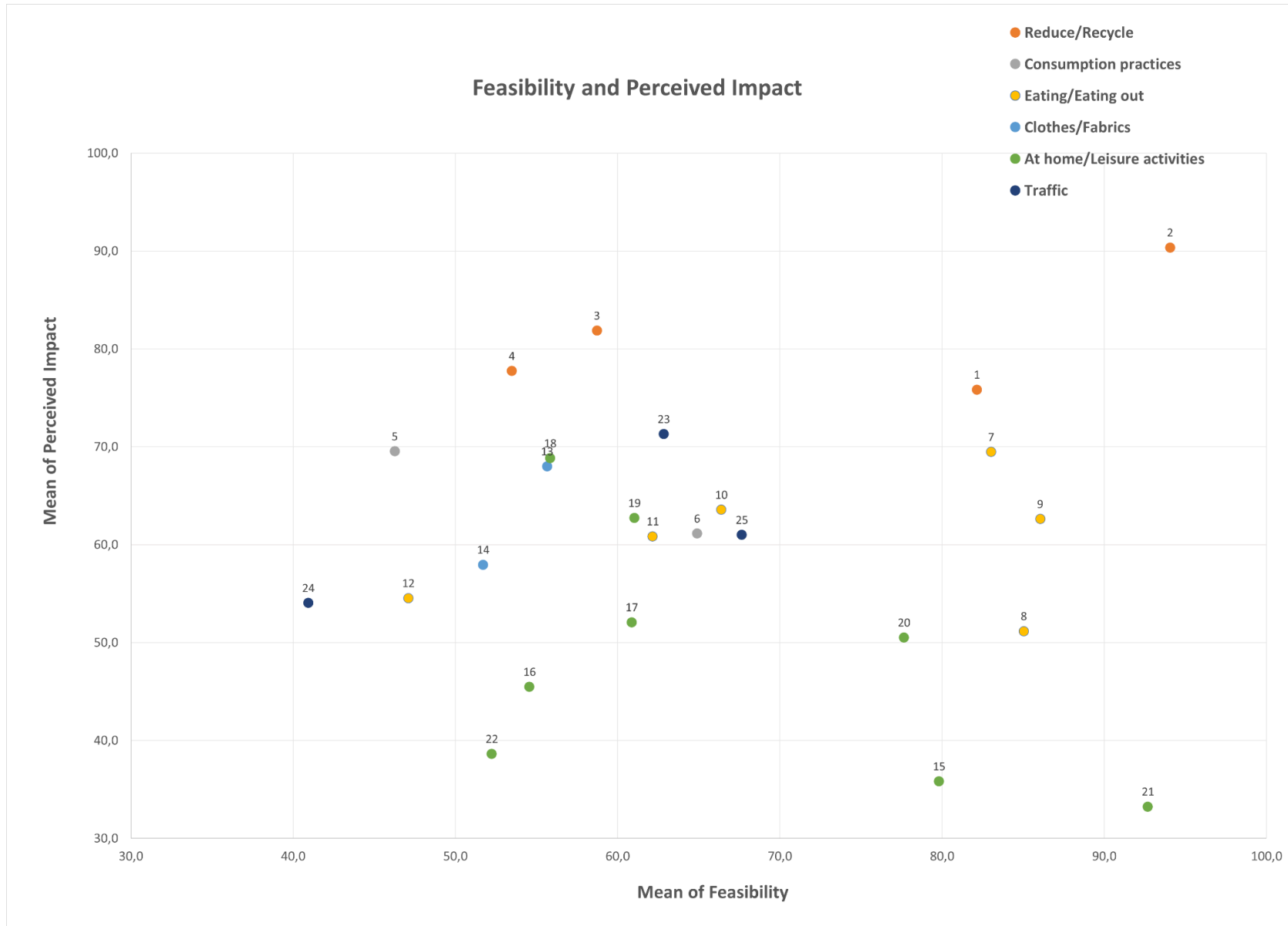
This histogram (Figure 2) has similar characteristics as the one before and portrays the same behaviors. Instead of showing the mean of feasibility, it shows the perceived impact of behaviors (0 = no impact, 100 = very big impact). Contrasting the previous graph, not all

behaviors are above 40. The impact is perceived as rather low or even questionable for these behaviors. These behaviors will be further investigated in the discussion section of the paper. The standard deviation for the perceived impact is higher than for the feasibility. Surprisingly the smallest standard deviation is again for the behavior of "not disposing of waste in the environment (2)". This behavior seems to be worth further investigation.

Despite giving a first layer of information, the previous histograms did not allow to connect the feasibility and the perceived impact yet. To relate them to each other, a scatter plot was created. It allows to make that next step that has been lacking in previous research.

**Figure 3**

*Scatterplot with all behaviors categorized*



Now a whole new layer of information becomes visible. None of the data points fall below 40 in either category (x=Feasibility, y=Perceived Impact). This is why the plot was reduced by the first 30 units on both axes. It also shows how neither of the behaviors was perceived as impossible to achieve or to have no impact at all and creates a sense of positivity in the data.

Behaviors were put into groups that can be identified by the colors of the data points on the plot. This tells us that "Reduce/Recycle" is positioned very high on the perceived impact (all >70), the feasibility varies on the other hand. "Not disposing of waste in the environment (2)" is the behavior that scores highest in both categories. "At home/Leisure activities" behavior has a rather low perceived impact (all <70), also with varying degrees of perceived impact. When looking at the behaviors that belong to this group it becomes evident that these are the ones whose primary reason is to prevent humans from breathing in microplastic particles. This was most likely not clear to the participants, hence the low perceived impact. There might also be a different reason, which will be explained in the discussion section.

All groups seem to have varying feasibility, except "Traffic", where all the behaviors score low on feasibility. The "Clothes/Fabrics" group of behaviors is the one that scores lowest overall (all  $x = >60$ , all  $y = >70$ ). Another interesting behavior to point out is "buy unpackaged/sustainably packaged goods (5)" which has a considerable high perceived impact but its score on the feasibility scale tells us that it is rather hard to be put into practice.

## **Discussion**

The present study used an exploratory methodology to examine the emerging patterns and basic components that impact pro-environmental behaviors. Through the use of an exploratory methodology, this study aims to produce new insights and a deeper understanding of



a field that has not received much attention until now. The connection between feasibility and perceived impact has not been investigated yet. One advantage of an exploratory research design is that it can help uncover new patterns and associations that traditional methodologies would miss. It can provide a basis for more targeted investigations down the road. Furthermore, this methodology facilitates the adaptation of new ideas as they develop (see implications section), resulting in a more all-encompassing and refined knowledge of the numerous dynamics involved. The review of the literature already made clear that the "hows and whys" of pro-environmental behavior are not easy to define. This discussion will relate the findings to each other and link the findings to the literature when possible.

The qualitative data that was generated through the questionnaire was insightful in terms of the topics that the students brought up. They filled in the open questions before they were exposed to the list of behaviors that were investigated through the Likert scale in the second part of the questionnaire. They still ended up naming similar things. Seeing that there were so many similarities leads the researcher to believe that there is a common understanding of practices that are specifically harmful to the environment and a list of behaviors that are believed to be impactful in combating them. The similarities are most likely rooted in similar surroundings (peer groups, education, etc.) but also the media narratives that they are exposed to. It is also interesting to see how both questions lead to answers about similar topics, just from different perspectives. While "Plastic packaging" was considered very harmful, avoiding said "packaging" was also mentioned very often as a mitigating behavior. The same thing happened with "disposal of waste in nature" and the "reduction" of microplastics in general to also reduce

inadequate disposal. Despite very similar answers, the students are aware that there is no such thing as "THE origin" or "THE solution".

The additional topics that were brought up in the qualitative data section and did not match any of the keywords (e.g. cradle-to-cradle) show the relevance of the argument that was made by Millstein and Halpern-Felsher (2002): Adolescents are highly sensitive to the topic of pollution and the environmental crises because of their way of perceiving risk. Their evolving decision-making competence has a big impact on their pro-environmental behaviors.

The scatter plot gave a lot of insights into how feasibility and perceived impact are related. Due to the explorative characteristic of this study, there are no hypotheses that can be proved, which is why this section will further elaborate on the possible reasons behind the specific placement of the data points. The behaviors “proper ventilation with fresh air (21)”, “vacuum regularly (15)”, and “using an air filter (22)” are the ones with the lowest perceived impact. These behaviors are intended to remove microplastic particles from your home environment so you do not breathe them in. Maybe they are not aware of the benefits that these practices have or the argument that Catarino et al. (2021) made can be supported through this finding: The public is more concerned about the impact of microplastics on the environment than the impact that it has on human health. It can be reasoned that low perceived risk leads to low necessity of positive impact. Regardless, this insight of a lack of information about single behaviors shows that the questionnaire should have provided the participants with a justification for each behavior. This way a distortion of the data due to lack of information could have been avoided and the data would have more significance.

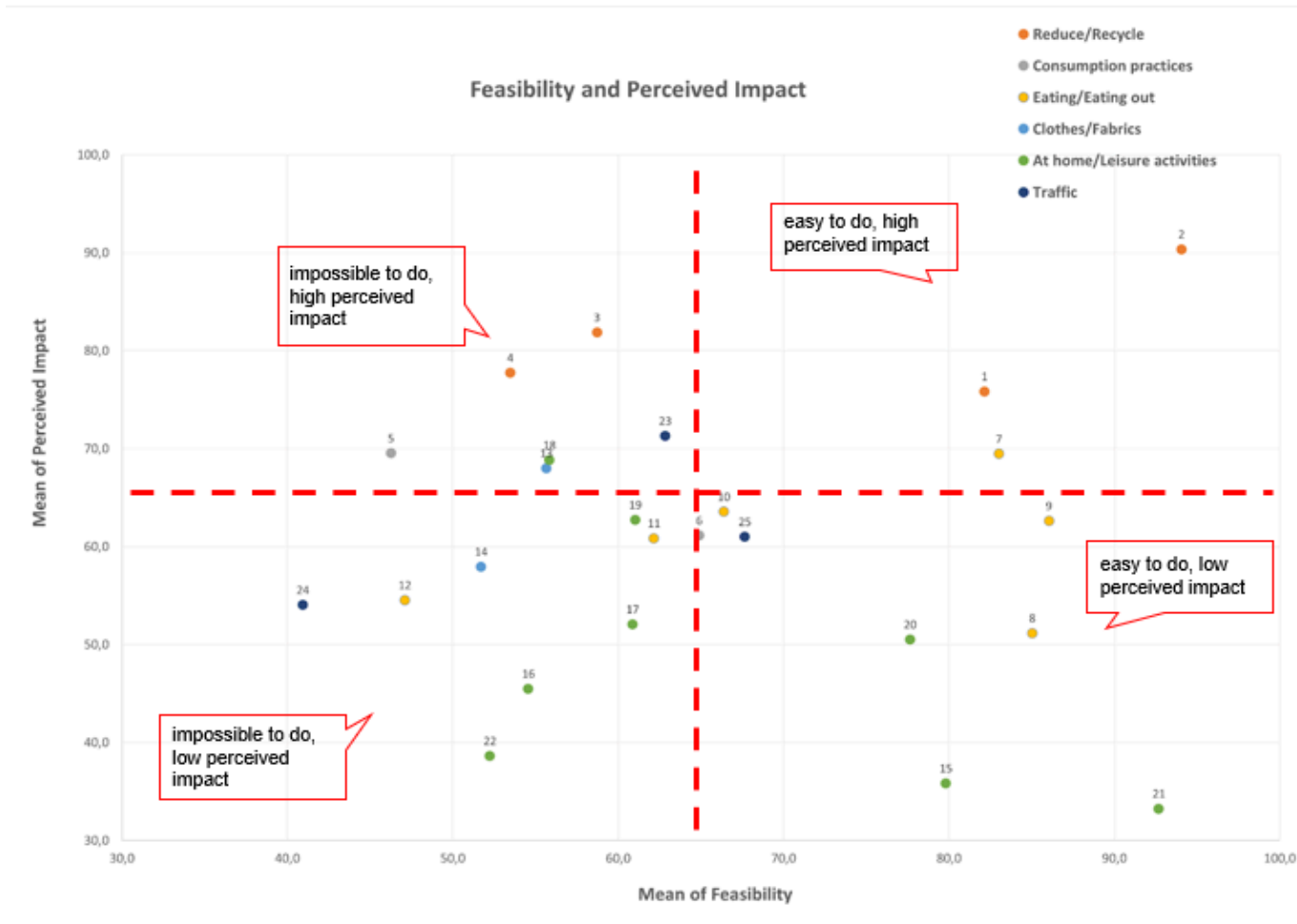
## Implications

### Matrix development

Analyzing the scatterplot and relating it to the literature was the logical step, although it still left the researcher with the question of "What now?". Inspired by many other theories and frameworks (such as the BCG matrix, Eisenhower Matrix, etc.) the researcher developed a new matrix that suggests how to proceed after the investigation of the perceptions. Depending on the placement of the data points along the x and y axis, it can be put into one of the four categories: *Challengers*, *Bullseye*, *Chores* or *Early wins*. The names for the categories were chosen depending on the characteristics that each of the categories has (see Figure 4) which will be further explained in the next section. The first stage of the development (Figure 4) required to apply the framework idea to the generated scatterplot. In a second step the framework was then stripped from the data points and turned into a more refined graphic representation (Figure 5).

**Figure 4**

*Matrix development*



**Figure 5**

*Newly developed matrix*



### *Early Wins*

**Easy to achieve - Low perceived impact.** e.g. Microwaving food in glass or porcelain (8), vacuum regularly (15): As this framework does not investigate the actual impact but the perceived impact, the goal for behaviors that fall into this category is to be perceived as more impactful. How can that be achieved? Because this behavior is so easy to implement, the sacrifice that individuals have to make to do so is rather low. According to the literature, they are already likely to do that behavior (Deng et al., 2020), hence the name, Early Wins. How can the impact be improved, so that this behavior can rank higher on the perceived impact scale? Increasing the perceived impact can happen in various ways. The responsibility can be detached from the consumer (as claimed by Schönbauer and Müller (2021)) so that actions happen in the

production stage of a product for example. Once this behavior is put into practice on a "bigger scale" the perceived impact is also likely to increase.

Example: The behavior "vacuum regularly (15)" is very easy to achieve according to the data that was collected. The reason for this is most likely the fact that it is already a common household practice to vacuum regularly. But why is the perceived impact so low? The participants are most likely not aware of the fact that vacuuming can help reduce the microplastic particles in our homes and therefore reduce the amount of particles that we breathe in. If this was more known it would trigger an emotional response and people would become more cautious of the materials that they have in their home and how they interact with them. In this case the procedure could be a campaign that informs people of the importance of this behavior so the perceived impact increases. In other words, the strategy that is proposed for behaviors like this is education about the impact that this can create.

### ***Bullseye***

**Easy to achieve - high perceived impact.** e.g. recycle/separate waste (1), not disposing waste in the environment (2): These behaviors should be non-negotiable. Their characteristics of easy achievability and a high perceived impact make them the perfect candidates to promote sustainable practices to individuals who are less involved in pro-environmental behavior until now. There should be nothing standing in the way of doing so. It needs to be the normal/default behavior. It should be a priority for producers, institutions, and governments to facilitate these practices.

Example: Many of the "Reduce/Recycle" behaviors fall into the Bullseye category. It is relatively easy to achieve and people perceive it as very impactful. It should be a high priority to make

these behaviors the default. Depending on who conducted the research about the behavior that landed in this category, decisions about the next step can be made. Communities for example could develop information campaigns or create interventions or workshops to kickstart positive behaviors. Strategically this is also education. It will take a different shape than the one that was proposed in the previous section because it is supposed to target a different group of people.

### *Chores*

**Hard to achieve - low perceived impact.** e.g. Using an air filter (22), avoiding areas with heavy traffic (24): These are behaviors that are further away from the ideal scenario than others. A decision needs to be made: is the potential big enough to invest or should the time and effort be used in other places first? Another way to approach this is to re-evaluate the behavior, maybe change it, and then investigate feasibility and perceived impact again. Regardless, this is most likely lower on the priority list than other behaviors.

Example: The behaviors "using an air filter (22)" and "avoid areas with heavy traffic (24)" fell in this category. They are hard to achieve and have relatively low perceived impact. The amount of effort that needs to be put in is doubled for these behaviors because they have potential in two directions. Ease the feasibility or increase the impact. This decision would depend on the resources and on the goal that is supposed to be reached. If feasibility needs to be increased the Challengers can inspire future actions. If the perceived impact is what should be increased the same suggestions as in the Early Wins category can be used.

## *Challengers*

**Hard to achieve - high perceived impact.** e.g. avoid single-use products (3), avoid plastic and microplastic products (4): This should be a point of high interest. The goal is to make these behaviors easier and modify the behavior so that its perceived feasibility becomes more achievable. This could take different shapes. Depending on the positive behavior/practice it could be a support system, new technology, etc. Once that is achieved, there is a whole new pool of behaviors that can be added to the Bullseye list. All the behaviors that fall in the Challengers category require innovation. They are the ones that should be of interest to people, companies, or organizations that are looking for an investment opportunity.

Example: The behaviors "avoid plastic and microplastic products (4)" and "avoid single-use products (3)" are indeed Challengers. Both behaviors are characterized by avoiding something. Avoiding is hard to do if there is a lack of alternatives. Especially after knowing that humans are highly dependent on convenience. They would rather keep reaching for the single-use product, than making the sacrifice of avoiding it. It is widely known that they could have hugely positive impacts on the mitigation of the microplastic problem, putting them into practice is perceived as very hard on the other hand. As a Challenger, they are in desperate need of improvement and innovation. It could look like the following: single-use products made from plastic are made from sustainable materials and the availability of them is increased. Simultaneously the availability of the plastic counterpart becomes lower and lower. This is already happening, but not fast enough. If the process can not be sped up, an alternative reaction needs to be found. A ban for example. As mentioned in the literature review, banning is possible even though it is a big step that seems hard to accomplish.



Overall this matrix should give future researchers from academic and non-academic backgrounds an idea of how they can proceed with their findings. The scale is completely irrelevant. It can be as small as one supermarket wondering how they can encourage people to buy sustainably packaged products. They question a sufficiently large number of customers how they perceive the feasibility and impact of this behavior, calculate the means, and locate the behavior on the developed matrix.

Knowing about environmentally harmful behavior is the first step. Coming up with alternative behaviors that mitigate or avoid pollution is the second. Afterward, the behaviors are evaluated. The theory part is done now. Theory will not be able to save our planet, therefore we need praxis!

### **Limitations and further research**

The limitations of this research include the sampling of the participants as they were recruited through the researcher's network. Furthermore, the sample size should be increased. The sociodemographic background of participants was not considered in this study but according to the literature it proves to be interesting for further research. It is important to note that this study did not investigate the actual behavior of the participants. It simply found the connection between feasibility and perceived impact and used this knowledge in combination with the literature to develop a tool that can give suggestions. The matrix that was developed in the scope of this research creates additional research opportunities. The suggestions that come with the matrix should be investigated to test their success and change or improve the matrix if necessary. A case study of one individual behavior from the development of said behavior until the

implementation after considering the suggestions in the matrix would be of great interest to the researcher.

### **Conclusion**

This paper investigated the connection between the perceived impact and the feasibility of behaviors that can mitigate the microplastic pollution that occurs worldwide. The main findings from the qualitative data that was collected through a questionnaire showed that the participants have similar concerns about behaviors that can specifically be harmful to the environment and beneficial for mitigating pollution. The categorization of the answers showed that the students are well informed, proving the literature that was consulted in the review. Adolescents are very involved in the topic and have high concerns about the environmental crisis. The quantitative data showed how they perceived the feasibility and impact of 25 chosen behaviors. As his study was explorative, no hypothesis could be proven by that data but the insights led the researcher to develop a framework. This should enable the analyses of future data that is collected in the same manner and help different researchers and stakeholders to proceed beyond theoretical analyses.

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## Appendix

### 1. Questionnaire

#### 1.1 Open questions

Zuerst möchte ich dir zwei offene Fragen stellen. Denk nicht zu lang nach, sondern schreibe auf, an was du zuerst denkst. Es gibt keine richtigen oder falschen Antworten. Ich bin daran interessiert, was DU denkst!

Welche Praktiken/Verhaltensweisen können deiner Meinung nach Mikroplastik-Emission und Verschmutzung reduzieren?

Welche Praktiken/Verhaltensweisen hältst du für „die Schlimmsten“ im Bezug auf Mikroplastik-Emission und Verschmutzung?

#### 1.2 Likert scale (example)

Wie leicht glaubst du, kannst du dieses Verhalten übernehmen?

unmöglich                      schwer                      mittel                      leicht                      sehr leicht

Richtig recyceln/Müll trennen

0     100

Müll nicht in der Umwelt entsorgen

0     100

Wegwerfprodukte vermeiden (Einwegtüte, Plastikbesteck etc.)

0     100

Produkte aus Plastik und Mikroplastik vermeiden (z.B. Partydeko, Glitzer...)

0     100