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Investigating students' perceptions of single-use plastics at the University of the Witwatersrand, South Africa

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ABSTRACT

Single-use plastics have become interconnected with human populations globally, yet, studies on plastic pollution and practices have predominantly been conducted outside Africa. This study explored perceptions of single-use plastics at the University of the Witwatersrand, with 1398 respondents in an online survey and 18 in a solicited diary during 2019. Despite social media and research exposure amongst university students, only 57% of respondents were familiar with the term single-use plastics. However, respondents displayed considerable pro-environmental attitudes relating to plastic pollution and recycling. These attitudes did not translate into pro-environmental behaviour in daily life, whereby 88% of respondents believed that single-use plastics are used with too many products, yet, only 22% avoid products which incorporate them. Respondents faced constraints in their pro-environmental behaviour relating to recycling infrastructure, re-use and the expense of alternative products. Negative perceptions exist towards single-use plastics in South Africa due to their ubiquitous pollution and presence in daily consumption practices. Increased pro-environmental behaviour provides an opportunity to curb plastic pollution and rethink consumption patterns. However, changing attitudes alone to stem the tide of plastic consumption and pollution will be meaningless without supportive recycling infrastructure from the government and reduced single-use, non-recyclable plastic production.

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Wits University; plastic pollution; pro-environmental behaviour; waste management; South Africa

1. Introduction

Plastic items have become a part of society's daily life and consumption practices (Bashir, 2013). Plastics are inexpensive, durable and lightweight, convenient for manufacturing and everyday use (Bashir, 2013; Bonthuys, 2018; Vegter et al., 2014). Between 1950 and 2021, plastic production increased by 242%, with a market value of $ 584.7 Billion in 2021 (OWID, 2023). The persistence of plastic waste in marine, freshwater and terrestrial ecosystems mirrors the increases in plastic use in society (Khan et al., 2018; Vegter et al., 2014). Global cumulative production of plastics since its introduction in the 1950s was

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approximately 10.3 billion metric tons in 2021, with half of that amount produced over the past two decades (OWID, 2023).

The same attributes which make plastics inexpensive, lightweight and durable pose an increasing threat to the natural and human environment (Bonthuys, 2018; Vegter et al., 2014). The use of plastics as an everyday resource has raised concern over the consumption of natural resources and the toxicity associated with their manufacture and use (Bashir, 2013). The consumption of plastics in South Africa has consistently risen over the past decades to approximately 1.9 million tonnes in 2022 (Plastics SA, 2023). Despite efforts to curb plastic production in industry and reduce consumer consumption in South Africa through bans and taxes, single-use plastics' low cost and effectiveness have ensured their continued market growth (Dikgang et al., 2012; Plastics SA, 2018).

The conventional plastic carrier bag has been referred to as the new national flower of South Africa due to its persistent presence in the urban, rural and natural environment (Knoblauch et al., 2018). Concurrently, the South African government has identified the plastics industry as a priority sector to promote economic growth through the Industrial Policy Action Plan (Bouwman et al., 2018). With this conundrum of continued growth and pollution in mind, this study aimed to explore students' perceptions of single-use plastics across the University of the Witwatersrand (Wits) campuses within Johannesburg, South Africa.

1.1. Background

Plastic items are manufactured from non-renewable resources such as crude oil, natural gases and coal (Bashir, 2013; Mwanza & Mbohwa, 2017). There are seven main types of plastics; these include polyethylene terephthalate (PET), polypropylene (PP), polystyrene (PS), low-density polyethylene (LDPE), miscellaneous plastics (e.g. polycarbonate), Polyvinyl Chloride (PVC) and High-Density Polyethylene (HDPE) (Andrady & Neal, 2009). Single-use plastics can include any disposable plastic item designed to be used only once, such as straws, carrier bags and bottles (Ten Brink et al., 2016). These items are used for packaging, consumer products, water transport, cosmetics and healthcare, among others (Bashir, 2013; Bonthuys, 2018; Ten Brink et al., 2016; Vegter et al., 2014).

Most plastic debris is used and disposed of on land, but it results in extensive pollution of terrestrial and adjacent freshwater environments, often due to human behaviour (Madara et al., 2016). The accumulation rate of plastic in the environment can vary widely due to factors such as proximity to urban settlements, topography, geographic location, shore use, prevailing wind and ocean currents, and waste practices (Barnes et al., 2009). Research by Silva-Cavalcanti et al. (2017) and Lebreton et al. (2017) suggest that urbanization, population density, a lack of or improper waste management and the industrialization of our society are the major factors contributing to the pollution of environments with plastics. Once disposed of or released into the environment, plastics can reach ecosystems in areas considered to have little to no human influence; plastics have reached the deepest parts of the ocean in areas more than 1000 km away from the mainland (Chiba et al., 2018; Windsor et al., 2019). Plastics, like other anthropogenic pollutants, are an economically growing market. Thus, despite their effects on the natural environment and recognition of their issues, the plastics problem will persist for centuries (Barnes et al., 2009).

Globally, governments and private organizations are taking action to minimize the impacts of plastics such as banning single-use plastics, changing from petroleum-based plastics to alternatives and improving waste collection systems (Godfrey, 2019). Over the last two decades, 51 countries and states adopted a ban on the production, sale, or use of plastic bags, and another 39 adopted a tax on the sale (Knoblauch et al., 2018). Strategies such as the Marine Strategy Framework Directive and Water Framework Directive aim to achieve a healthy environmental status for European marine and fresh water bodies, in doing so protecting these environments against the threat of plastic pollution (Dris et al., 2015). At the World Economic Forum in January 2018, eleven global brand owners, retailers and packaging companies committed to making 100% of their packaging reusable, recyclable or compostable by 2025 (Godfrey, 2019). The key driving force for the change of plastic policies in the Global North has been public pressure while in the Global South pressure due to problems caused by plastics has been much more influential (Knoblauch et al., 2018). Industrialized countries have focused their efforts on plastic taxes while developing countries have taken an alternative approach by introducing bans on various types of plastics as well as stringent legislation (Knoblauch et al., 2018). North American and European states have taken less active stances in their response to plastic pollution, typically due to efficient landfill and waste management systems bringing about a reduced visible extent of plastic pollution within the environment despite the high production and use rates within the regions (Godfrey, 2019; Knoblauch et al., 2018).

South Africa has a vibrant and growing plastics industry; however, recycling practices and waste infrastructure are limited, leading to a notable proportion of plastic waste entering the natural environment (Verster et al., 2017). Only 61% of households receive a weekly waste collection service in South Africa; this is linked to the region's broader challenges with solid waste management (Godfrey, 2019). On a countrywide scale, approximately 70% of all single-use plastic products are never recovered for disposal or recycling in South Africa (Verster et al., 2017). Across all plastic products, a low 40% make it to landfill sites where they either degrade or are redistributed in the environment through wind and water transport at open-air sites, while a further 32% across all plastic products are estimated to be disposed of directly in the natural environment (Verster et al., 2017).

Most studies on the sources, perceptions and movement of single-use plastics have been conducted outside of Africa, with limited research across the South African region (Jambeck et al., 2017; Lebreton et al., 2017) (Table 1). Though across South Africa, several studies have been conducted on polyethylene shopping bags, microplastic contamination

Table 1. Perception studies on or relating to plastic pollution in South Africa.

Study	Focus	Study location
Mphaka (2015)	Residents' perceptions of waste management	Johannesburg
Anyasi and Atagana (2017)	Residents' behaviour towards recycling	Cape Town
Thondhlana and Hlatshwayo (2018)	Pro-environmental behaviour amongst student residences at Rhodes University	Makhanda
O'Brien and Thondhlana (2019)	Perceptions, practices and potential interventions for plastic bag use	South Africa
Dalu et al. (2020)	Awareness of plastic pollution at schools	Limpopo
Van Rensburg et al. (2020)	Single-use plastic consumption and impacts on the marine environment	Durban

in freshwater ecosystems, and plastic pollution in coastal and marine ecosystems (Bashir, 2013; Jambeck et al., 2017; Knoblauch et al., 2018; Lebreton et al., 2017) (Table 1)

In a country such as South Africa, in the face of pressing socioeconomic issues such as poverty, corruption and food as well as water insecurity, the protection of the natural environment from plastic pollution receives insufficient attention (Verster et al., 2017). Furthermore, the slow growth of the South African economy has influenced the prioritization and application of capital to stimulate development in the now rather than address issues for the future (Verster et al., 2017). Through increased awareness as well as the persistence of plastic pollution in the environment, manufacturers, retailers, and consumers alike are increasingly using a combination of approaches based on local considerations to stem the flow of plastics into the environment (Bashir, 2013; Godfrey, 2019; Mphaka, 2015).

2. Methodology

This study took place online with 1398 participants from Wits University, Johannesburg, South Africa, between 15 July 2019 and 20 September 2019 (Figure 1). The range of dates used in this study was selected as they coincided with the third teaching block of the Wits academic calendar. This study was approved and awarded Ethics clearance from the Wits Ethics Committee. All procedures relating to this study were performed in compliance with the Wits Ethics Committee and institutional guidelines. Informed consent was obtained from all respondents and participants in this study.

2.1. Study site

Wits have over 30 different schools with approximately 36 500 full- and part-time students across its campuses, with 64% of the student population at the undergraduate level, typically aged 18 to 22, and 36% at the post-graduate level, typically aged 22 to 28 (Wits, 2019b). Approximately 54% of the student population comes from middle-income households, with an increasing number of students from low-income households (Wits, 2018). Most Wits students come from within the Gauteng province and reside in Johannesburg during their studies (Wits, 2019a).

Johannesburg forms part of the largest city region in South Africa and is the provincial capital of Gauteng, the city covers an area of approximately 1 644 km^2, surrounded by an urban landscape (Ballard & Hamann, 2018). Plastic pollution has become a prevalent problem in the Johannesburg region, and plastic pollution can be found along roads and highways, within rivers, conservation and recreation areas (Ballard & Hamann, 2018; Stats SA, 2016). Pikitup is the official waste management service provider to the City of Johannesburg, mandated to provide integrated waste management services to its residents (Ballard & Hamann, 2018; Samson, 2019). The 'Separation @ Source' programme by Pikitup was piloted in September 2009 to encourage households to set aside recyclables and garden waste from general waste, the programme now covers several regions in Johannesburg and deals with 490 000 households (Ballard & Hamann, 2018; Samson, 2019).

The most significant environmental problem experienced by residents of Gauteng, as described by the 2016 Community Survey, was waste removal and littering at 39%,

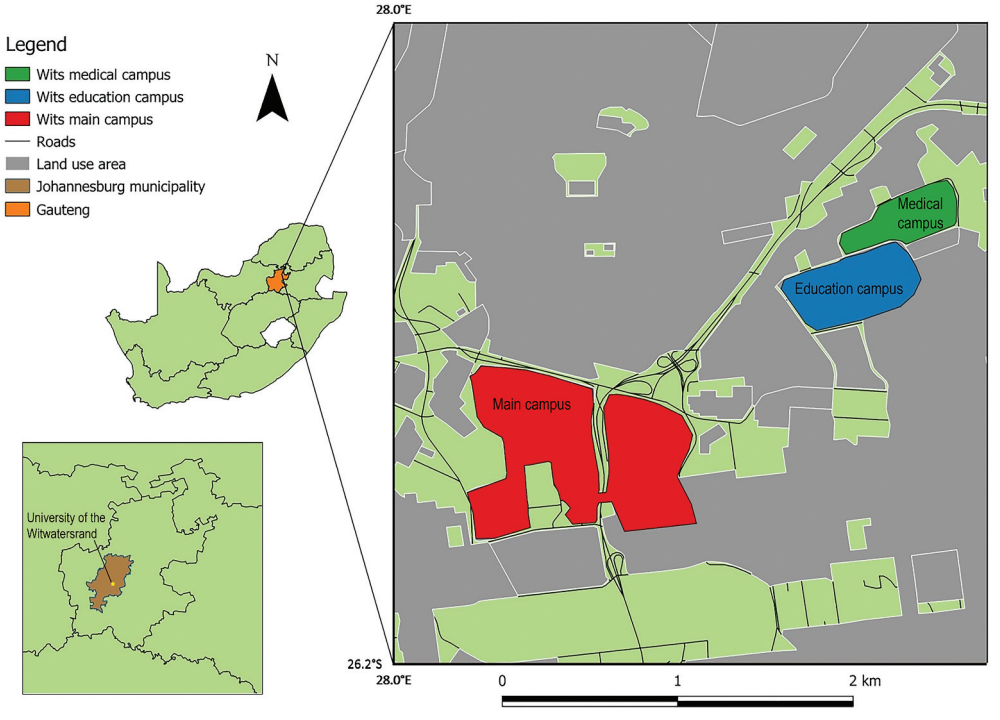

Figure 1. Study site map of Wits University in relation to Johannesburg and South Africa.

followed by land degradation at 36% (Stats SA, 2016). Across Gauteng and its multiple municipalities, there are varying forms and levels of waste management and government participation (Mubiwa & Annegarn, 2015; Peberdy et al., 2017). An example of the varying levels of waste management, according to the 2017/18 Quality of Life survey by the Gauteng City-Region Observatory (GCRO), is evident whereby 83% of respondents in Gauteng reported weekly refuse collection, however, in Emfuleni, only 59% of respondents report weekly refuse collection (Ballard & Hamann, 2018). In the South African context, waste management services are frequently limited to the cities and suburbs, along with a minority of township areas (Ballard & Hamann, 2018; Simatele et al., 2017). A limited number of services are available in the informal and outlying periphery areas, and the lowest levels of refuse removal reported were found within informal settlements (Ballard & Hamann, 2018).

2.2. A mixed methods approach

This study used a mix of quantitative and qualitative data collection and analysis methods to investigate people's perceptions of single-use plastics. These included surveys and solicited diaries for data collection, as well as statistical and thematic analysis, which together triangulated and enhanced the data quality. To enhance the rigour of both methods in design and approach (Halcomb & Hickman, 2015; Neuman & Robson, 2014; Shannon-Baker, 2016), a pilot study was done with the survey questionnaire and solicited diaries. This pilot study was used to clear up any

ambiguity amongst the survey questions and solicited diaries, as well as improve the overall flow of the research tool design. The questionnaire and diary were both created using Google Forms.

The online survey and solicited diary were used in this study to produce the overall raw data set. Surveys were used to: investigate the awareness and knowledge amongst people on single-use plastic items; explore the role of media, research and regulations in forming people's perceptions; investigate whether or not there is a negative connotation towards single-use plastics; explore the role of increasing single-use plastic waste in the environment in forming perceptions. The questionnaire was split into four sections: demographics, single-use plastics, single-use plastic pollution, and lastly, plastic disposal and recycling. Across these four sections, a maximum of 39 questions were asked depending on respondent answers; these were a mix of open and closed-ended questions. Purposive sampling was used for the online survey to identify and limit the sample population group to students enrolled at Wits; further snowball sampling through the use of student mailing lists and the university registrar was used to reach as many individuals as possible during the data collection period.

Solicited diaries refer to an account produced specifically at a researcher's request by informants and written with the full knowledge that the writing process is for external consumption (Meth, 2003). The solicited diaries were used to: explore the role of single-use plastics in daily life; explore the role of media, research and regulations in forming people's perceptions; explore the role of single-use plastic waste in the environment in forming perceptions. Purposive sampling through the use of the online survey was used to recruit diary participants. The final question of the online survey asked respondents if they were willing to participate in further research through a solicited diary. Respondents who indicated an interest in participating in the diaries were asked to leave an email address where they could be contacted at a later stage. The diaries followed a semi-structured format with five questions and an additional section for notes to be answered daily over three days. The duration of a solicited diary can vary based on the purpose and requirements of the study (Meth, 2003). There is no fixed or standard length of time for a solicited diary, as it depends on the specific needs of the study (Meth, 2003). For the needs of this study, a three-day period was decided as sufficient to gain an understanding of the daily interactions between participants and plastic items, keep respondents interested and not interfere with their lives. Solicited diary questions were open-ended, with the length of writing response and writing medium up to the participant. Participants were also informed that the diaries were not spatially delimited and accounts may be produced wherever they interact with single-use plastics.

3. Results

The increasing prevalence of plastics in the human and natural environment and their negative implications have become a global talking point amongst scholars, public stakeholders and the wider population. There is an urgent need to understand people's perceptions of single-use plastics to mitigate their increasing occurrence in the environment, increase recycling practices and direct public policy (Windsor et al., 2019). This study aimed to investigate students' perceptions of single-use plastics to develop a more comprehensive understanding of the interactions between people and plastics within the

Johannesburg region. The results of this study drew upon the perceptions of 1398 respondents who completed the online survey and 18 who completed the solicited diary.

3.1. Online survey

The online survey proved valuable for capturing a large sample population with a wide array of thoughts and opinions (Table 2). For the online survey, with two-thirds (75%) of respondents were aged between 18 and 24, majority female (63%) and African (Table 2). The Wits population is made up of 55% female and 45% male students (Wits, 2019b), and similarly, the respondents of this study were 63% female and 35% male. However, the female population was relatively higher than the general university population. As defined by the Wits census, the largest population group of students is African at 56%, White students at 17%, Indian students at 12%, Coloured/mixed race students at 4% and Chinese students at less than 1%; the remaining 10% of the population are international students (Wits, 2019b). Generally following these trends, the largest student population group in the study sample was African at 47%, followed by White students at 29%. The Indian/Asian student population group made up 18% of respondents, followed by Coloured/mixed race students at 5%. Within this sample, the White student population is overrepresented as compared to the Wits student demographics. Most respondents were students 96%, and Johannesburg was the most common place of residence at 79%.

Reflecting on respondents' familiarity and awareness of single-use plastics, this study found that more than half of respondents, 57%, were familiar with the term single-use plastics, while 18% of respondents were somewhat familiar with it, and 25% were not familiar. Respondents were asked whether they had come across stories on single-use plastics in the media, 57% indicated 'Yes', while 26% of the population had not come across relevant stories in the media, and 17% were 'Unsure'. Respondents who indicated

Table 2. Summary of online survey demographics.

Student or staff	No. of respondents	Age	No. of respondents
Student	1338 (96%)	18–24	1043 (75%)
Staff	5 (<1%)	25–34	253 (18%)
Both staff and student	55 (3%)	35–44	75 (5%)
		45–54	23 (2%)
		55–64	4 (<1%)
Gender	**No. of respondents**	**Population group**	**No. of respondents**
Male	497 (35%)	African	668 (48%)
Female	884 (63%)	Coloured	65 (5%)
Transgender	6 (<1%)	Indian/Asian	246 (18%)
Other	11 (<1%)	White	400 (29%)
		Other	19 (1%)
Level of education	**No. of respondents**	**Place of residence**	**No. of respondents**
< grade 12	1 (<1%)	Johannesburg	1100 (79%)
Grade 12	590 (42%)	Ekurhuleni	186 (13%)
Undergraduate	488 (34%)	Tshwane	49 (4%)
Postgraduate	303 (21%)	Merafong	2 (<1%)
Other	16 (1%)	Mogale	13 (<1%)
		Rand West	27 (2%)
		Emfuleni	8 (<1%)
		Lesedi	3 (<1%)
		Midvaal	10 (<1%)

'Yes' they had come across stories on single-use plastics in the media were asked to indicate all the various media platforms where they had come across these stories, respondents were able to select multiple options (Figure 2). The most common media platform indicated was 'Social media' such as Facebook and Instagram at 35% (761), followed by 'Online news outlets' at 26% (550), 'Television' at 19% (422), 'Newspapers' at 11% (246) and 'Radio' at 9% (207) (Figure 2).

Considering respondents' perceptions of plastics in the environment, this study reveals that when comparing agreement on single-use plastic pollution on the regional, local and global scales, 85% of respondents indicated that they disagreed that single-use plastic pollution is not a problem in Gauteng.While 88% disagreed at the South African scale and 90% disagreed at the global scale. The heightened awareness of global plastic pollution issues over those at home is reflected by a minority of 14% of respondents who were aware of policy relating to single-use plastics in South Africa, while 25% were aware of the policy in the global environment.

When considering respondents' use and interactions with single-use plastics, this study found that respondents most commonly interacted with single-use plastics at home and work. The results suggest that the most common interaction with single-use plastics was related to the packaging and transportation of food (Figure 3).

The most common form of single-use plastic disposal at home and work was reported as a 'general recycling bin', with 44% and 62%, respectively. More respondents noted they use a plastic recycling bin at work (24%) than at home (20%). However, 29% of respondents also noted they re-use plastic items at home, and 12% of respondents keep their plastic items from work to throw away at home. Although technically illegal, 25 (1%) respondents admitted throwing plastic items in the street or veld at home or work. A notable proportion of respondents re-use single-use plastics, highlighting that these items can give value after their initial intended use.

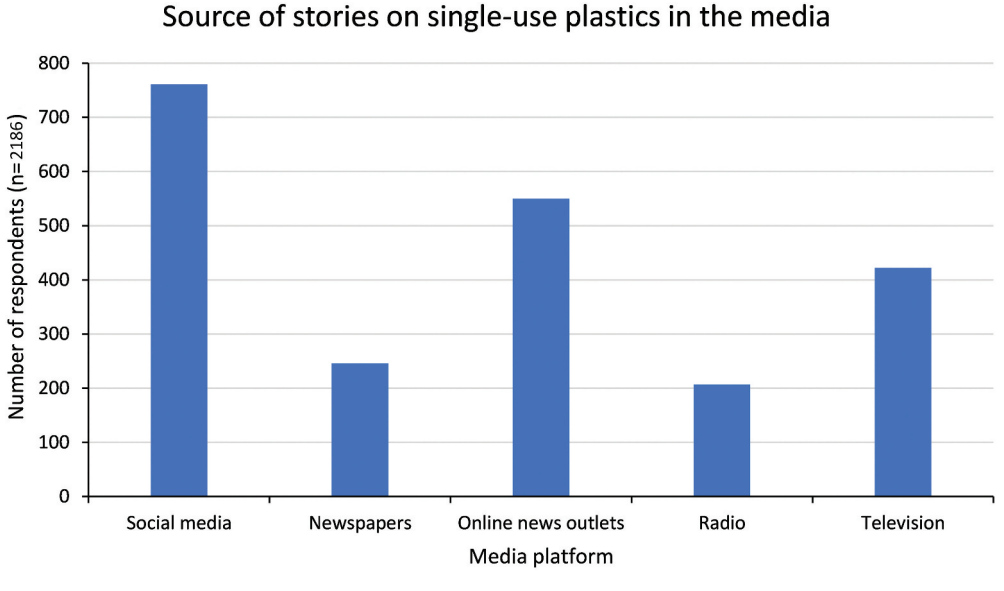

Figure 2. Most common media platforms respondents came across stories on single-use plastics.

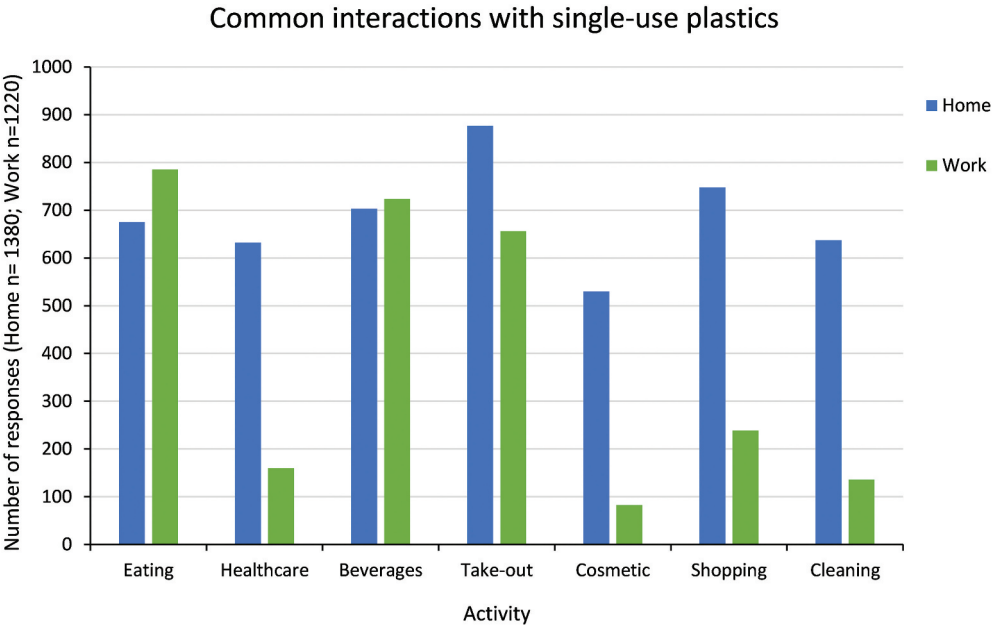

Figure 3. Activities in which respondents commonly interact with single-use plastics at home and work.

Most respondents, 88% (1227), agreed that single-use plastics are used with too many products, while 10% (138) 'Neither agree nor disagree', and a minority of 2% (29) disagree. Conversely, when considering whether respondents avoid products incorporating single-use plastics, the most significant proportion of respondents, 40% (563), indicated they 'Neither agree nor disagree'. The relationship between respondents' agreement on whether single-use plastics are used with too many products and whether they avoid products which incorporate single-use plastics was explored. These were explored to gain insight into the relationship between perceptions and practices. Among the online survey respondents, 1226 (88%) agreed that single-use plastics are used with too many products. However, of those in agreement, the highest proportion (39%) 'Neither agreed nor disagreed' with avoiding products incorporating single-use plastics.

Respondents were asked whether they agree that there has been an increase in the amount of single-use plastic waste in the environment over the last while. The period proposed in this question was purposefully ambiguous to probe the respondent to engage in more profound thoughts on plastic waste in the environment and its increase. Over two-thirds of respondents, 78% (1083), agreed that there had been an increase, followed by 18% (244) who 'Neither agree nor disagree' and 4% (65) who disagreed.

Regarding respondents' recycling and reuse behaviour, 51% (710) indicated that they 'Sometimes' recycle and reuse single-use plastic items. This was followed by 34% (479) who said 'Yes' and 15% (206) who said 'No'. The relationship between recycling behaviour and respondents who indicated 'Yes' they were familiar with the term single-use plastics was examined. Despite respondents' familiarity with single-use plastics, the

majority indicated they only 'Sometimes' recycle at 47% (380), followed by 40% (320) of respondents who do recycle and 11% (890) who do not recycle.

Respondents were asked whether it is worthwhile to recycle the single-use plastics they encounter in their daily life. One thousand two hundred and eight (87%) respondents agreed that the recycling of single-use plastics is worthwhile, while 147 (11%) respondents 'Neither agree nor disagree'. A minority of 35 (3%) respondents disagreed that it is worthwhile to recycle single-use plastics

Respondents were asked whether they knew which single-use plastic items may be recycled and how and where to recycle them. When considering whether respondents were aware of the types of recyclable single-use plastics, 575 (41%) respondents indicated they were 'Somewhat familiar' with which single-use plastics can be recycled. A further 305 (22%) respondents had high familiarity. In contrast, 516 (37%) respondents were unfamiliar with which single-use plastics are recyclable (Figure 4). When considering whether respondents know how and where to recycle single-use plastics, 483 (35%) respondents indicated they were 'Somewhat familiar'. Two hundred and twenty-six (16%) respondents had a high familiarity, while 685 (49%) respondents were unfamiliar with where and how to recycle single-use plastics (Figure 4).

Respondents were asked whether they agree that industry is responsible for making single-use plastics that do not harm the environment and are re-useable, the majority of respondents, 93% (1296), agreed. A further 5% (69) of respondents 'Neither agree nor disagree', and 2% (24) disagreed. Respondents were further asked to consider whom they felt is responsible for reducing single-use plastic consumption in society and the resulting waste in the environment (respondents were able to tick multiple boxes) (Figure 5). 1126 (37%) respondents indicated that it was their 'Personal responsibility' to reduce consumption, while 1036 (34%) believed it was the 'Industries' responsibility' and 876 (28%)

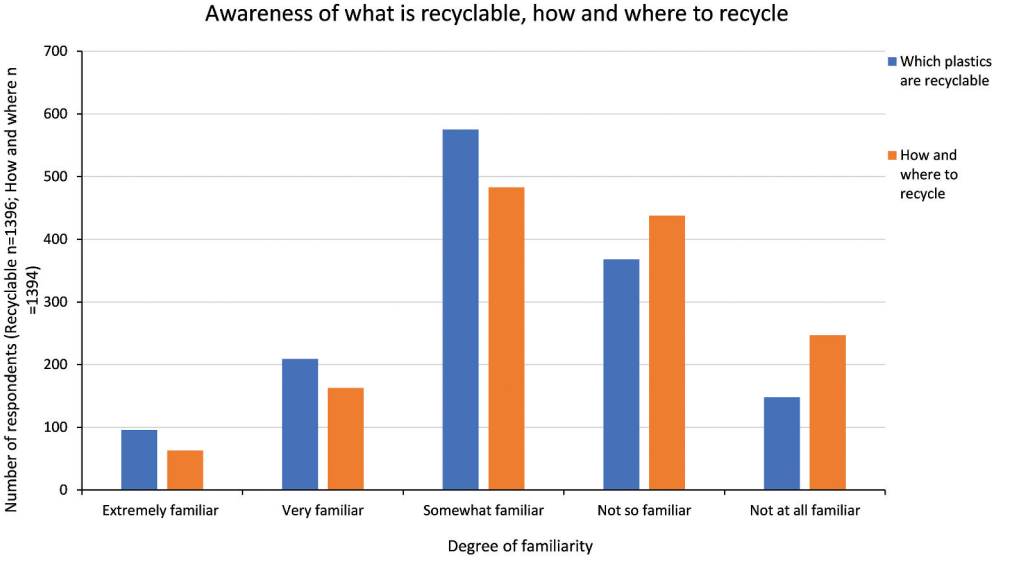

Figure 4. Comparing respondents' awareness of which single-use plastics can be recycled and respondents' awareness of how and where to recycle single-use plastics.

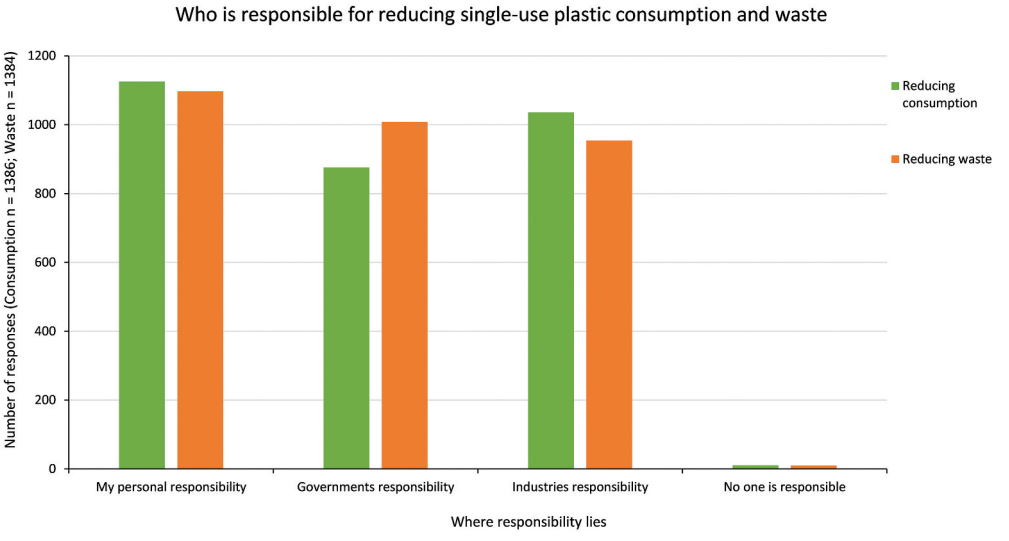

Figure 5. Who do respondents believe is responsible for reducing single-use plastic consumption in comparison to who respondents believe is responsible for reducing single-use plastic waste in the environment.

believed it was the 'Governments' responsibility' (Figure 5). A minority of 11 (<1%) respondents believed 'No one is responsible' for reducing single-use consumption (Figure 5).

Respondents were allowed to share in their own words what they think can or should be done to reduce and eliminate the amount of single-use plastics ending up in the environment. A variety of responses were received. The most common solution to combat single-use plastics in the environment proposed by respondents was to increase recycling efforts and infrastructure to recycle/improve waste management systems at 347 (21%) responses. This was followed by the increased use of alternatives with 278 (16%) responses, and the boycotting of the industry with 271 (16%). A further, 261 (15%) respondents believed that there needs to be increased attention, policy, bans and action by the government, while 232 (14%) respondents believe an increase in awareness and education is the way forward. Increasing upcycling and reuse to reduce single-use plastic pollution was mentioned by 102 (6%) respondents, whereas 99 (6%) respondents see changes in social and individual behaviour as well as lifestyle towards pro-environmental living as the key to reductions. Lastly, the increased use and replacement of single-use plastics for biodegradable options was mentioned 95 (6%) times. Respondents' differences in emphasis on reducing single-use plastic pollution are subjective to their personal biases, levels of awareness and knowledge on single-use plastics, socio-economic standings and connection to the plastics industry.

3.2. Solicited diary

The final question of the online survey asked respondents whether they would like to be contacted regarding participation in a solicited diary. Three hundred and

thirty-six respondents from the online survey indicated they would like to be contacted for participation. A random sample was generated to determine the order of participants to contact; emails went out weekly to groups of participants from 22 August 2019 to 9 September 2019. Diary entries closed on 20 September 2019. Of the 336 respondents who were contacted, 18 completed the solicited diary.

The solicited diary proved valuable for engaging more profound thoughts amongst participants and contributing to a temporal understanding of the relationship between single-use plastics and daily life. Through participants noting their interactions with single-use plastics, interesting and valuable unintended behavioural observations arose.

> I'm sure I did (notice plastic pollution), but have become blind to specific instances given how littered our environment is with these items. (Respondent #1)

Respondents were asked to comment on the amount of single-use plastics they encountered daily. Answers varied greatly from observations while at work to personal notes on awareness and examples of meal preparation. Out of the 18 responses, the most common amount of single-use plastics encountered over the three-day period was minimal to none with 12, followed by a few but not many and a large amount with 9, a disappointingly high amount with 8, a concerningly high amount with 7 and lastly, more than expected with 4. Participants noted an increased awareness of their interactions with single-use plastics, their alarming dependency, and their lack of ability to use alternative products. Participants' dependency and lack of alternatives invoke feelings of obliviousness to plastic pollution due to its prevalence and feelings of conviction through noting the large amounts of single-use plastics participants were interacting with daily.

> Far more than I expected, you only notice it when you are asked to notice it. (Respondent #2)

> Over the past 3 days, I have encountered much more plastic than I would like to have seen. I make a conscious effort every day to avoid plastic, but it is almost impossible to be a conscientious consumer where I live and in today's society. (Respondent #3)

Reflecting on plastic pollution over the three-day diary, 81% of participants indicated they had encountered single-use plastic pollution, most commonly along roads, followed by in a veld/natural environment. Interestingly, respondents noted how they were often viewed down upon when collecting plastic pollution for reuse.

> I went to a sports event today, and in as much as everyone diligently cleaned up after themselves, the bins were full of polystyrene containers, juice and water bottles. I started picking up plastic lids to use as counters for my 6-year-old daughter. I have quickly noticed how society look down on me because I am picking up these lids because most of them are in the bin. As much as I can afford to buy counters, I feel better using the lids for my daughter because it's a few less lids in the bin. (Respondent #4)

Regarding media, research and regulations, most respondents at 67% encountered none over the three days. Among those who indicated 'Yes', they had encountered media, research or regulations, Instagram was the most mentioned platform at 40%, followed by Facebook at 20%, posters and educational boards on campus and around Johannesburg at 20% and within conservation areas at 20% (Figure 6).

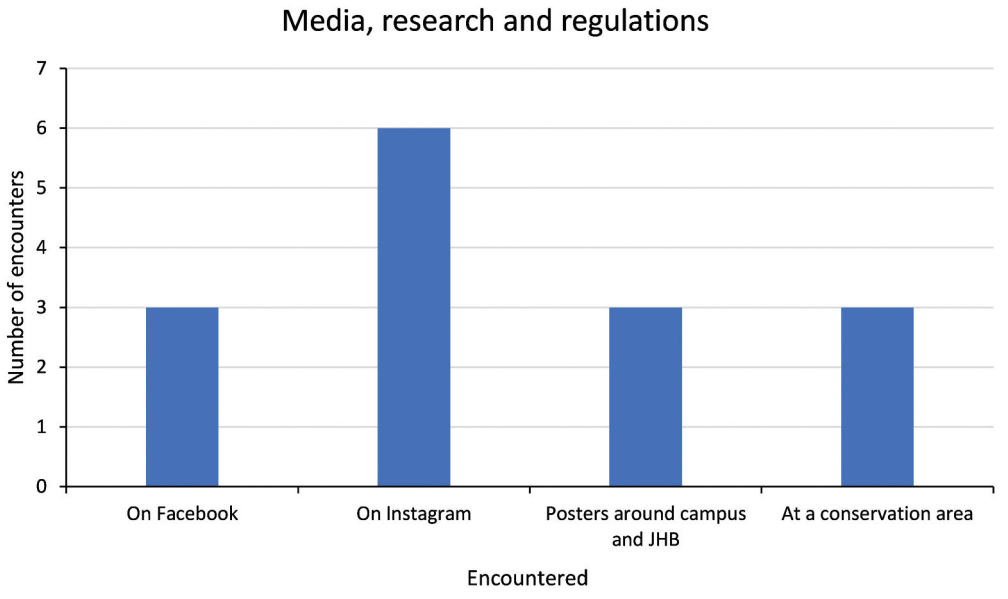

Figure 6. Where participants encountered media, research or regulations to do with single-use plastic over the three days.

Respondents who indicated 'No', they had not encountered any media, research or regulations also took the opportunity provided through the open-ended question format to expand on their thoughts. Responses often displayed passion and anger towards a lack of media on single-use plastics.

> There are hardly any media broadcasts in waste issues and yet literature indicates that littering and illegal dumping are a major environmental and social problem worldwide. (Respondent #5)

> It's really amazing that our media rarely discusses issues of littering and yet it's so rampant. (Respondent #6)

The solicited diary proved valuable for engaging deeper thoughts amongst participants as well as contributing to a temporal understanding of the relationship between single-use plastics and daily life. Through participants noting their interactions with single-use plastics, interesting and valuable unintended behavioural observations arose. Participants noted an increased awareness towards their interactions with single-use plastics, their alarming dependency and lack of ability to use alternative products.

4. Discussion

The results from the online survey and solicited diary have provided valuable insight into the thoughts, knowledge and practices of members of the Wits community when interacting with single-use plastics. The visibility of single-use plastics in urban, rural and natural environments as well as daily interactions through consumption practices, make plastic pollution tangible and relatable to one's daily life (Maguire et al., 2019).

To better understand respondents' perceptions of single-use plastics, there is a need to start with the most basic of questions. Considering whether respondents understood the term single-use plastics and are familiar with single-use plastic items is the most basic and forward approach towards gaining insight into their perceptions, however, these are questions which are often overlooked within the literature (e.g. Hartley et al., 2018). Only 57% of respondents were familiar with the term single-use plastics; surprisingly, 33% indicated that this was the first time they had heard it. Despite the prevalence of single-use plastics in daily life and most consumption practices, the relatively low familiarity with single-use plastics amongst respondents highlights how individuals may be unaware of their consumption practices during daily life. Once individuals are asked to take note of their consumption practices, the prevalence of plastic items in daily life becomes clear:

> Keeping track of plastic items, I've encountered and interacted with over these 3 days has influenced me to make better choices in the products I choose to buy and use. (Participant #7)

This study, as well as the study by Henderson and Green (2020), suggest that public awareness and perceptions towards single-use plastic pollution are highly mediated. Geographical proximity and direct contact with an environmental problem are thought to influence an individual's perception of an environmental issue (Van Rensburg et al., 2020). Despite the prevalence of plastic pollution within the Johannesburg region, only 14% of respondents were aware of policies relating to single-use plastics in South Africa. However, 25% of respondents were aware of the policy on a global scale. This difference in awareness may be attributed to the different ways respondents encounter single-use plastic pollution and information on these issues: 57% of respondents had come across stories on single-use plastics in the media, mainly through social media. Similarly, Van Rensburg et al. (2020) found that the leading platform through which Durban beachgoers gain knowledge about single-use plastics was social media at 27%.

To explore the relationship between perceptions and practices in respondents' daily lives, the relationship between respondents' agreement towards whether single-use plastics are used with too many products and whether they avoid products that incorporate single-use plastics was explored. A majority of survey respondents, 88%, agreed that single-use plastics are used with too many products, yet, interestingly, when considering these respondents, only 19% avoid products which incorporate single-use plastics. These findings describe a gap between perceptions and behaviour, whereby despite negative perceptions towards single-use plastics, this does not translate into behaviour towards avoiding these products. This is similar to the issues around recycling, whereby attitudes towards recycling are optimistic; however, recycling rates are found to be below the number of people who are pro-recycling (Dris et al., 2015; Klöckner & Oppedal, 2011).

When considering who is responsible for dealing with plastic pollution, this study found that 37% of respondents felt it was their responsibility, 28% felt the government was responsible, and 34% felt that industry was responsible. This level of personal responsibility reflects how the relationship between plastics, oneself and the environment can create moral responsibility. For example, moral responsibility to understand and acknowledge plastics' negative implications on the environment, the value of recycling and the misguided business-as-usual approach to plastic pollution – and pursue ethical consumption instead (Barnes et al., 2009; Clarke, 2008; Klöckner & Oppedal, 2011).

Despite having relative knowledge, there persist individuals, <1%, with a sense of nihilism who make the connections between their personal use of plastics and environmental pollution yet feel no need to take any actions towards pro-environmental behaviour or community improvement. For example:

> They are more convenient for us lazy people. It removes the need to wash and carry big plates for takeout etc. Even if it is dangerous to the environment, who am I to sacrifice my own convenience. Plus, we are all going to die anyway. (Respondent #8)

Plastic pollution is neither a new issue for South Africa nor a minor one, as the region ranks within the top 20 countries with mismanaged plastic waste (Khan et al., 2018). An estimated 70% of all single-use plastic products are never recovered for disposal or recycling (Verster et al., 2017). This was highlighted in this study, through 81% of diary participants encountered plastic pollution over three days. Further, only 61% of South Africa's population receives weekly waste collection services (Godfrey, 2019), leaving approximately 23 130 000 citizens without weekly waste collection services in South Africa. The extent of plastic pollution within South Africa may be evident by the high proportion of respondents who believe it is an issue. On the Gauteng scale, 85% of respondents believe plastic pollution is an issue, while on the South African scale, 88% of respondents believe it is an issue; notably, 90% of respondents believe that it is an issue on a global scale. Although slight, the fact that approximately 70 more respondents believe plastic pollution is a global problem rather than a regional and local one lies in the highly mediated space of plastic pollution whereby industry deflects accountably, and social media depicts plastic bags floating in the ocean, often far from land. This is evident in a study undertaken in Europe by Henderson and Green (2020), describing respondents concerned with levels of plastic pollution hundreds of kilometres from where they reside.

On a global scale, attitudes towards pro-environmental behaviour such as recycling are favourable and pro-recycling policies, however, this behaviour does not reflect in daily life, where actual recycling rates are often lower than the number of people who are pro-recycling (Dris et al., 2015; Klöckner & Oppedal, 2011). Results of this study highlight that 87% of survey respondents believe it is worthwhile to recycle single-use plastics. However, 37% were unfamiliar with which single-use plastic items may be recycled, while only 41% were somewhat familiar – only 22% of respondents were familiar with which single-use plastics are recyclable. This unfamiliarity with which items may be recycled is not reflected in respondents' recycling/reuse rates: 51% indicated that they sometimes recycle/reuse, while 34% always recycle/reuse. Only 15% of respondents reported never recycling or re-using single-use plastic products. These results suggest that respondents do not consider whether single-use plastic items are recyclable when disposing of them. Secondly, this sample population generally has a high recycling rate. Respondents who do not note whether single-use plastic items may be recycled could be linked to an act of hope or misguidance, in that if an item is plastic, then should it not inherently be recyclable?

Within South Africa, the recycling rate is debated, varying from plastic lobby groups who estimate the recycling rate at 46% to academics who claim the rate is far lower at 17% (Carnie, 2020). Similar to the recycling rates found in other regions of South Africa, the study by Anyasi and Atagana (2017) in Upper Claremont, Cape Town, revealed that 67% of households did not practice

recycling, with the age distribution of recyclers skewed towards older generations. The study by Morgan and Hughes (2006), which investigated the recycling behaviour of residents in Kentucky, U.S.A., also noted the distribution of recyclers skewed towards older generations. The results of this study contradict the findings by Anyasi and Atagana (2017), Bonthuys (2018), and Morgan and Hughes (2006) with a younger population and higher recycling rates, however, the notable difference in recycling rates and age may be attributed to the high levels of education found within the sample group of this study. The study by Morgan and Hughes (2006) further notes that households and individuals who practised recycling had comparably higher levels of education. Thus, the relationship between high levels of education and recycling explains the significant differences between the levels of recycling and reuse within this study and others in South Africa.

The South Africa scale studies by Anyasi and Atagana (2017), Van Rensburg et al. (2020), Thondhlana and Hlatshwayo (2018), as well as Mphaka (2015), describe a willingness by participants to reduce plastic consumption and pollution in their daily lives. However, they face constraints around limited recycling services, knowledge of recycling, and the overwhelming presence of single-use plastics in daily consumption practices. Survey respondents at home (44%) and at work (62%) most commonly dispose of single-use plastics in a general rubbish bin rather than recycling. The results suggest a recycling infrastructure disjuncture between the home and workplace. At home, 20% of respondents recycle single-use plastics, while 29% reuse them. At work, 24% recycle single-use plastics, while interestingly, 12% keep their single-use plastics to throw away at home. Notably, 43 (3%) respondents reported disposing of their single-use plastics in the street or veld at work and home, and this reveals that a lack of recycling and waste management infrastructure is not the only contributor to plastic pollution. Thus, to reduce plastic pollution, individuals' behaviour and attitudes must be understood and changed to understand the negative implications of incorrect waste disposal practices.

Regarding whether recycling is convenient and hassle-free in respondents' daily lives, only 41% of survey respondents agreed, while a little over one-third of respondents, 34%, disagreed, and 15% neither agreed nor disagreed. Despite low levels of convenience, the high rates of recycling and reuse found within this study depict environmentally friendly behaviour, forming part of respondents' daily lives. One particularly compelling finding in this regard was how respondents would purposefully keep their single-use plastic rubbish to recycle at a later stage or in a different place when possible. Nevertheless, somewhat contradictorily to respondents' high recycling/re-use rates, 49% were unfamiliar with how and where to recycle single-use plastics. The study by Thondhlana and Hlatshwayo (2018) on student residences at Rhodes University in South Africa revealed that over 50% of respondents did not follow waste separation practices in their daily lives due to inconvenience. However, should waste separation bins be made more convenient, they would recycle more (Thondhlana & Hlatshwayo, 2018). A similar sentiment is noted by Anyasi and Atagana (2017) and Nguyen and Lobo (2017), whereby those who did not recycle did so due to inconvenience and an inability to link their daily practices to the issues faced by environmental pollution. To influence recycling rates and, in turn, pro-environmental behaviour, not only do individual attitudes need to be addressed (Dris et al., 2015), but also the convenience of these practices in daily life.

Several studies by White and Hyde (2012), Nguyen and Lobo (2017), and Henderson and Green (2020) reveal that recycling, and in turn, pro-environmental behaviour, is affected and driven by social pressure, high levels of conscientiousness and morality related to environmental degradation and protection. Despite increases in support and leadership towards reducing single-use plastic pollution, consumption and production, action by governments and policy-makers remain stagnant, evidenced by the increasing levels of plastic pollution found on land, within waterways, oceans and even drinking water (Bonthuys, 2018).

The value of single-use plastics lies not only in their recycling and economic value but also in the value individuals give to these items. This study found that 29% of respondents reported reusing their single-use plastic items, most commonly plastic bags and bottles. Further results also revealed a small proportion of respondents (<1%) who are involved in programmes whereby Eco-bricks made at home using old plastic bottles are donated to organizations to construct low-cost housing. The reuse of single-use plastic items has found additional value through creative means:

> Arts and crafts for therapy (Respondent #9)

Respondents also reported re-using single-use plastics for decorative purposes:

> I sometimes recycle bottles by making vases for flowers, by trying to make something creative with the plastics . . . (Respondent #10)

These insights highlight that single-use plastic items can hold value over and above their intrinsic economic value. Pro-environmental behaviour towards reducing and recycling are value- and concern-based; enhancing the value of single-use plastic items as well as highlighting the issues around plastic pollution are seen as valuable ways to relate these issues to oneself and daily life (Clarke, 2008; Dris et al., 2015).

4.1. Limitations

The survey and solicited diary used in this study went through multiple stages of development to ensure the best methodological rigour, with their results clearly and openly shared for the benefit of all. It is important to note that the research's topic and form of voluntary circulation amongst all students may tend to self-select a more environmentally-conscious respondent; this may have the ability to impact the outcome of results. Furthermore, only 16% of Gauteng households have internet access (Stats SA, 2016). Thus, despite the internet access available on campus, the study is limited by respondents who do not have internet access at home and may not have been able to partake in this study.

The online survey data set represents 4% of the Wits student population, while the online solicited diary represents < 1%. This study may be said not to be statistically representative of Wits' whole population. The results of this study are limited in that they are not representative of the broader population found within Johannesburg. Only 11% of the population in Johannesburg and 10% in Gauteng have obtained a degree. Thus the population group that this study reports on makes up less than 10% of the broader population in the region (Stats SA, 2016).

Upon reflection, the data set could have been further enriched by additional questions on students' programmes and faculty of study that could provide valuable insight as to whether certain discipline groups of students are more likely to act pro-environmentally and participate in research regarding plastic pollution. Furthermore, posing questions such as: why respondents recycle, or why it is important to keep the environment clean of plastic pollution, could have provided further valuable insight as to why respondents choose to act in a pro-environmental manner.

5. Conclusion

The role of single-use plastics in daily life varies between individuals depending on their workplace and practices, daily consumption patterns and conscientiousness towards single-use plastics. Ultimately the role of single-use plastics in daily life is ubiquitous in that these items are used in every facet of daily life, from pens to writing, the food we eat, beverages we drink and vaccines we take.

The common perception amongst respondents is negative towards single-use plastics, noting various reasons, such as environmental pollution and lack of recyclability. Respondents aimed to reduce the wastefulness of single-use plastics through reuse, such as through eco-bricks and arts and crafts. The results of this study highlight a willingness amongst respondents to reduce single-use plastic consumption and waste, but constraints around knowledge of recycling, recycling infrastructure, and a lack of recyclable materials within consumption practices exist. The implications of these results would suggest increased levels of information sharing and increased and more widespread recycling infrastructure is needed to allow individuals to recycle their single-use plastic items. In addition, results suggest that claims by industry and government presenting world-class recycling rates and infrastructure within South Africa are misguided.

The disjuncture between pro-environmental attitudes and pro-environmental behaviour revealed by the results of this study is of concern for two reasons. Firstly, and practically, considering this sample population has high levels of education and awareness towards single-use plastics, this is not translated into their behaviour. Secondly and theoretically, this disjuncture challenges the connection between perceptions and behaviour, revealing that it is intermediated by various other factors such as supportive recycling and re-use infrastructure and knowledge on plastics. To reduce single-use plastic pollution and drive consumption and production towards a sustainable circular economic path, emphasis must be placed on improved and more widely available infrastructure, recyclable plastic materials, and increasing pro-environmental behaviour within South African society.

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