Understanding residence students' motivations to water bottle refilling and reuse at McMaster University

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Abstract

Plastic pollution continues to have a detrimental impact on our environment, and in order to address this problem, it is essential to reduce the amount of plastic waste generated at individual, community, and global levels. McMaster University has implemented strategies, such as the installation of water refill stations and signage, to reduce the amount of plastic waste being generated on campus. The purpose of this study is to understand first-year residence students' motivations and barriers to refilling reusable water bottles on campus. In-person, semi-private interviews were conducted, followed by transcription, coding, and thematic analysis of the recorded interviews. The results reveal three themes of motivation to refill: convenience, water quality, and sustainability. Our findings indicate that the implemented strategies, water bottle refilling infrastructure, and culture of sustainability on campus have resulted in a positive shift in student experiences with reusable water bottle usage and refilling, compared to findings from previous studies. Future studies on this topic could focus on a deeper analysis of motivating factors, along with collecting more information about barriers to refilling and reusable water bottle usage in McMaster residence communities.

Introduction

Plastic waste continues to have a detrimental impact on the environment as it impacts the health of wildlife and poses a public health threat (Nguyen et al. 2022). In between the years 1950 to 2015, 8.3 billion tonnes of plastic products were manufactured, and 6.3 billion tonnes of plastic waste was generated (Li et al. 2021). It is estimated that anywhere between 75 to 199 million tonnes of plastic debris is found in our ocean (UN Environment Programme (UNEP), 2022). Much of plastic waste is single-use plastics, which are intended to be thrown away after one use (UNEP, 2022). Single-use plastics include food containers, plastic bags, and bottles (UNEP, 2022). Approximately one million plastic bottles are purchased every minute (UNEP, 2022).

Canada is a large contributor to the global plastic crisis, as we make up less of 0.5% of the global population, but use 1.4% of all plastic produced (Oceana, 2021). In 2018, Canadians consumed 6323 kiltotonnes of plastic, which was a 23% increase from 2012, where Canadians consumed 5158 kt (Statistics Canada, 2022). In 2018, 34% of plastic products for the consumption of Canadians was packaging materials, which includes bottles and bags (Statistics Canada, 2021). Canada produces over 3.3 million tonnes of plastic waste annually, but approximately only 8% is recycled (Oceana, 2021). 86% of the plastic waste is sent to landfills, and the remainder is incinerated or goes on to pollute our environment (Oceana, 2021).

The strategies to handle plastic waste, such as recycling and incineration, also have their limitations (Li et al. 2021). Recycling is an expensive process, and due to the difficulty of sorting recyclable plastic materials from other wastes, it is difficult to create new products from these materials (Li et al. 2021). Incineration of plastic waste results in hazardous pollutants being released into the atmosphere and the environment (Li et al. 2021). The Single-use Plastics Prohibition Regulations (SUPPR) is a component of the Government of Canada's plan to reduce plastic pollution (Government of Canada, 2022). It went into effect on December 20, 2022, and prohibits the manufacturing, import and sale of six types of single-use plastics including checkout bags, cutlery, certain foodservice ware, ring carriers, stir sticks, and straws (Government of Canada, 2022). SUPPR does not include single-use plastic bottles. As the plastic crisis continues, it is important to reduce the amount of plastic waste being generated on individual, community, and global levels.

Previous studies have shown that at a university, undergraduate students are more likely to consume bottled water compared to staff and graduate students (Choate et al. 2018). Many universities have implemented strategies to reduce the amount of plastic waste being generated on campus, including plastic bottle bans. By 2015, 50 American universities had banned the sale of bottled water on campus, but there is still limited knowledge on the consequences of these bans (Berman & Johnson, 2015).

The University of Vermont implemented a policy in 2012, which states that all campus eatery locations had to ensure 30% of the beverage offerings were 'healthy beverages' (Berman & Johnson, 2015). In 2013, the university banned the sale of bottled water, but still required the 30% ratio to be kept (Berman & Johnson, 2015). A study reviewed shipment data of bottled beverages to campus under the assumption that the university was only ordering beverages that students were purchasing (Berman & Johnson, 2015). The data showed that once the bottled water ban came into effect, the number of beverages with added sugars increased significantly (Berman & Johnson, 2015). Furthermore, the ban did not reduce the number of plastic bottles in the plastic waste being generated on campus, as students were opting to buy other unhealthy bottled beverages rather than

using a reusable water bottle to consume water (Berman & Johnson, 2015). Washington University located in St. Louis implemented a bottled water ban in 2009 and published a report in 2015 of the impacts of the ban (D'Altrui, 2019). Since the ban went into effect, bottled beverages and fountain drink purchases on campus decreased (D'Altrui, 2019). Carbonated drink purchases decreased by 50%, and the ban resulted in decreased recycling costs and student expenditure (D'Altrui, 2019).

Other universities took a different approach to reducing plastic bottle usage on campus by implementing plastic bottle bans, installing water refill stations, addressing concerns about water quality and cleanliness and providing education regarding the environmental impact of plastic waste. A study was conducted at the University of Chicago to understand how water refill stations contributed to reducing plastic waste and promoting a sustainable culture on campus (Piccirillo-Stosser, 2018). The station meter data was collected over the course of two weeks to analyze station usage (Piccirillo-Stosser, 2018). Additionally, a questionnaire was sent to students regarding awareness of water refill stations and usage (Piccirillo-Stosser, 2018). Results from this study indicated that students viewed water refill stations positively and used them frequently (Piccirillo-Stosser, 2018). Results also found that installing additional stations would have a positive impact on reducing bottled water purchases and waste generation (Piccirillo-Stosser, 2018).

Undergraduate students at Allegheny College were surveyed on their perceptions of water consumption and plastic bottle usage (Choate et al. 2018). Survey responses revealed that students were purchasing plastic bottles primarily due to concerns about campus water quality (Choate et al. 2018). They claimed that the water on campus was "disgusting" and "sub-par", and that bottled water was cleaner and safer to drink (Choate et al. 2018). Students stated they would be more motivated to use reusable bottles if there was better water quality on campus (Choate et al. 2018). A few students also said they were concerned about the safety of plastic reusable bottles, as they may contain BPA or other harmful chemicals (Choate et al. 2018). Using this information, Allegheny College installed 11 filtered water bottle refill stations and created a map of their locations, as well as providing incoming first-year undergraduate students with stainless steel reusable bottles (Choate et al. 2018). Overall, these studies demonstrate that when identifying and implementing strategies to promote a sustainable campus culture, it is important to understand the problem and the attitudes of students regarding it (Choate et al. 2018).

A study conducted by a previous SUSTAIN 4S06 student group regarding refillable water bottle usage on campus found that students prefer to drink water from sources that are a close distance to them, and that are affordable and provide clean, filtered water (Barr et al. 2022). A SUSTAIN 3S03 group conducted a textual analysis of survey responses from first-year residence students to a campus wide survey. Results found that students would like more filtered water refill stations across campus to refill their water bottles. (Mahal et al. 2021). The Bring Your Own Bottle (BYOB) initiative was implemented in 2022. The initiative focused on reducing the use of single-use plastic bottles by encouraging staff and students to refill their water bottles at water refill stations across campus (McMaster Okanagan, 2022). This included installing BYOB signage across campus to raise awareness and creating an interactive map of water refill stations around the McMaster campus to make it easier for the community to locate a water refill station and refill their bottles (McMaster Okanagan, 2022). According to the McMaster Sustainability Report (2021), there are approximately 200 water stations on campus, which divert over 20 million plastic bottles from entering landfills. Additionally, filtered water taps were installed in the kitchens of residence buildings in 2021 (Bring Your Own Bottle, 2023).

The purpose of this study is to understand the perspectives of first-year students on refilling reusable water bottles on campus following the installation of filters in all residences and assess the outcomes of the BYOB initiative. We aim to identify motivators and barriers to water bottle reuse so that we can make data-driven recommendations on what can be done to enhance the water consumption experience on campus, motivate more students to shift from single-use plastic bottles to reusable bottles, and ultimately promote sustainability.

Methods

Overview and Participation

In order to analyze the residence student's experiences of water bottle refill and reuse at McMaster University, residence students were invited to participate in an engagement event to promote the BYOB initiative, which was organized by students in the course *SUSTAIN 3S03 – Implementing Sustainable Change*. The BYOB initiative was formed to encourage the McMaster community to reduce the use of single use plastic water bottles and to promote awareness of the water bottle filling stations located throughout campus. The BYOB event was hosted on November 24th, 2022, in the Peter George Centre for Living and Learning residence building, where first year undergraduate students from different residences on campus attended the event. This event presented as a unique opportunity to recruit first year residence students interested in the efforts to promote water bottle refilling and reuse. As such, the data collection process for this study was conducted at the BYOB event in a minimally invasive manner.

Following the ethics approval from the McMaster Research Ethics Board #6100 and SUSTAIN 4S06 course instructor, voluntary participants were interviewed at the event and received a $20 CAD Starbucks gift card incentive upon the completion of the interview. Prior to the interview, participants were presented with the Letter of Information (LOI) outlining the purpose of the study and procedures involved in the research (Appendix A). The LOI required each participant to consent to the research conditions, which included audio recording their responses during the interview process, as well as the anonymous storing and reporting of participant data.

The use of interviews as a primary research tool in qualitative analysis has its benefits and implications. As outlined in McNamara's general guidelines for conducting interviews, the open-ended questions of interviews allow the researchers to pursue in-depth information regarding a particular topic by further investigating the stories behind the participants' experiences (McNamara, 1997). The ability of the interviewers to ask follow-up questions and clarify vague statements in a conversational interview allows a degree of freedom in getting thorough information from the participants, which is imperative for a study aiming to analyze various experiences. Unlike in closed, fixed response interviews, participants are able to elaborate on their behaviors, opinions, values, and feelings, which adds layers to thematic analysis. However, the inherent weaknesses of interviews are that they are prone to experimenter and participant bias. Participants may be inclined to lie or provide incomplete answers in an attempt to say what they believe should be the right or socially acceptable answer (Farnsworth, 2019). For instance, participants might be hesitant to report resorting to single use plastic water bottles at a sustainability event. Moreover, the inevitable reactions from the interviewers could elicit a sense of judgement, and thus affect the degree of honesty in the participants' responses.

In order to minimize the possible biases arising from standardized, open-ended interviews, interview questions were made with caution to avoid being double-barreled or leaning towards a particular response. The participants were also made aware of the confidential nature of the research report prior to the interview, which contributed to the reduction of the social desirability effect. Together, this ensured that the format of open-ended structured interviews with minimal psychological strain could be used to its advantage without having to resort to a sub-optimal data collection method, such as the use of questionnaires, which limits the range of openness and depth in participants' responses.

Interviews

A total of 21 semi-private, in-person interviews, each one being four minutes in duration on average, were conducted at the BYOB event through the use of voice recorders. This number of interviews was sufficient to reach data saturation for subsequent thematic analysis. Participants were asked questions pertaining to their motivations and barriers of water bottle refill and reuse in McMaster residences, as well as feedback for improving the sustainability practices of refilling reusable water bottles on campus (Appendix B). Of the 21 interviews, one was excluded from the thematic analysis as the participant did not reside in a McMaster residence, thus not meeting the participant criteria for this study. Following the interview process, each interview was transcribed into text. The transcripts were manually compared to the recordings and revised for proper punctuation to ensure readability and to allow for the analysis process to proceed smoothly. Upon refinement and confidential naming of the transcripts, the interview audio files were permanently deleted.

Thematic Analysis

The thematic analysis for this study was conducted following guidance from Braun and Clarke's 2006 paper, *Using Thematic Analysis in Psychology.* This study adopted an essentialist-realist epistemological approach to theorize motivations, barriers, and experiences of reusing and refilling in residence and the meaning of participants' responses based on the language they used throughout their interviews. Following the interview process, transcripts were repeatedly read in order to identify recurring ideas and to become actively familiarized with the data set. As this study followed a bottom-up, inductive approach, reviewing previous literature on the topic was avoided to ensure that the themes identified are based on the reported data and not driven by theoretical interest in the research topic. Once every researcher completed the first round of systematic data screening, a consensus was made on the recurring ideas, which led to the formulation of ~10 initial codes. A second round of thorough transcript reading followed to ensure that all relevant data extracts were manually coded, and that each data extract that was coded abided with the standardized definitions of the codes agreed by the researchers.

After all data has been inclusively and comprehensively coded, the codes were sorted into potential themes and sub-themes. As emphasized by Braun and Clarke (2006, p. 96), "themes do not just 'emerge' from the data set". Rather, it was imperative for the researchers to collate all relevant codes into identified themes. The results of this study were grounded on semantic themes that aimed to interpret what the residence students had to say about the experiences of water bottle refilling and reuse at the surface level meaning. For instance, if a participant stated that they are too lazy to find water bottle refilling stations, it could be interpreted as inconvenient for them to go looking for one. As such, codes that were key to the purpose of this research (i.e., pertaining to motivations/barriers) and were identified in five or more transcripts were incorporated into the first

thematic map draft. The next step involved identifying the relationships between different overarching themes and sub-themes within them.

Throughout the revision process, it became apparent that the codes outlining motivators for refilling and reuse were more prevalent than the barriers. As is discussed in further detail in the Discussion section, the data analysis affected the way in which barriers towards refilling and reusing in residence were reported. Broadly speaking, most of the barriers that were stated were in exact opposition to the motivators. To ensure that the final thematic map accurately reflects the keyness of the themes and the meanings evident in the data set, it was decided that the thematic analysis would remain focused on the themes outlining the motivators for refilling and reusing. The resulting set of themes is a rich description of the data set that can be seen in Appendix C. It must be noted that a rich representation imposes limitations in providing a detailed description of each identified sub theme. For the purpose of this paper, each theme was analyzed in reference to its sub-themes, which allowed for the interpretations to be broadly contextualized within the scope of the research question.

Results

Through thematic analysis, the main theme of student experiences of water bottle refill and reuse was 'motivations to refill'. The three sub-themes of motivations to refill and reuse were: 1) convenience; 2) water quality; 3) sustainability. There were several additional codes presented within the themes, such as "optimal locations", "saving money" and "water temperature (see Figure 1). Examples from the themes presented are supported through student quotes seen below.

It is important to note that although students did share their experiences in terms of barriers to water bottle refill and reuse, their descriptions intricately overlapped with motivators. As barriers and underlying sub-themes were not the key themes in this study, they were not included in the final thematic map, as further elaborated on in the Discussion section. Each of the three key themes is discussed below in more detail.
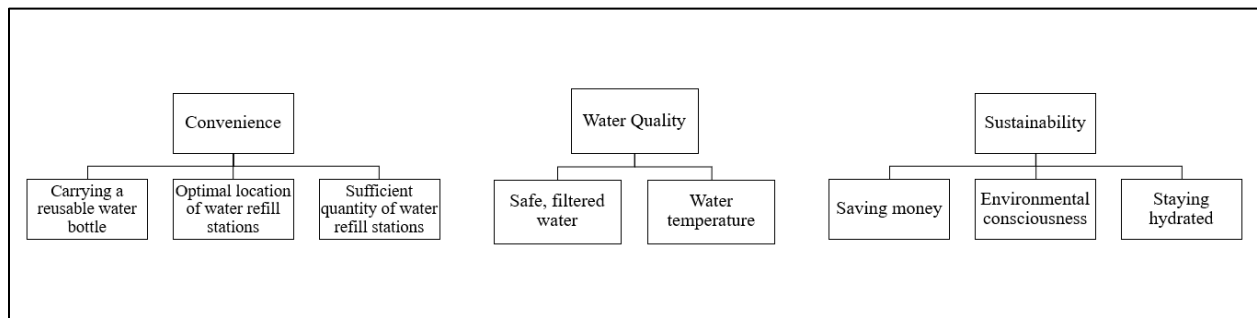

Figure 1. Thematic map of motivations for student usage of reusable water bottles and refilling on campus. The main theme was motivations, and the three sub-themes are: convenience (codes: carrying a reusable water bottle, optimal location of water refill stations, and sufficient quantity of water refill stations), water quality (codes: safe, filtered water, and water temperature) and sustainability (codes: saving money, environmental consciousness, and staying hydrated).

Sub-theme 1: Convenience

Convenience can be defined as a perception held by a user regarding the amount of time and effort that they need to put into completing a task; the lower the time and effort, the greater the convenience (Rowley, 2015).

The theme of convenience was mentioned in all 21 interviews, with 37 references made in total. When speaking about convenience, students referred to reusable bottles as well as water infrastructure, such as water refill stations and taps, that allow them to refill their water bottles. Therefore, this sub-theme was further categorized into three codes: carrying a reusable water bottle, optimal location of water refill stations, and sufficient quantity of water refill stations.

Carrying a reusable water bottle was mentioned in six interviews with a total of six references. Participant #10 describes how keeping their reusable water bottle with them is convenient as it allows them to drink water whenever they need to.

> Um, I definitely use my water bottle a little more [in residence than at home]. Like, if I was at home, I could just go downstairs, like fill my cup, drink it, and then put it back. Mm-hmm. But since I don't, I can't like to go back to the kitchen like every time I need a drink of water. Yeah. So, I'll just keep my water bottle like near me so that if I ever need water, I'll just drink.

Participant #21 shares how carrying a water bottle motivates them to use water refill stations more often than usual.

> I definitely have started like, bringing one around with me every day. I just like to have one always on me and then every couple of days that I forget, I'm like, next day I'm for sure bringing it. Um just because I need it. I've just been like for some reason consuming a lot more water lately and so I've just been constantly looking for like places to refill and all that stuff.

Multiple students mentioned optimal location of water refill stations as a motivator for using a reusable water bottle. This sub-theme was mentioned in 12 interviews, with 15 mentions in total. Participant #6 states they really like the presence of refill stations in their residence building and other popular, big buildings on campus.

> So, I feel that they're great. In my residence, they're in my kitchen and wherever I go in public, they're always there such as the gym and all the big buildings.

Participant #11 shares a similar sentiment, stating that there is typically a refill station at campus locations they often frequent such as their residence building and the library, which makes it easy for them to refill their water bottle.

> I usually use like the refill stations here at PG (Peter George Centre for Living and Learning), so like when I'm going in between classes or like leaving from PG to go to the library. And then I also use the refill stations at Mills [Library] as well.

Sufficient quantity of water refill stations was mentioned in 13 interviews with a total of 16 references. Participant #10 describes how water refill stations are abundant across campus and are easy to locate, which makes refilling an easy process.

> Um, I think like, the fact that there's a lot of refill stations just like everywhere. Like I feel like everywhere I go I see one. And that definitely helps with the convenience of like refilling instead of buying a new [single-use] one.

It should be noted that the three codes were often mentioned together in the same response from students. The response from participant #18 exemplifies this as they speak about convenience

in a manner that correlates the quantity of water refill stations with the motivations of carrying a reusable water bottle around.

> I guess the amount of refillable stations that are accessible to us is I guess, a motivator to have, you know, so you can bring a reusable water bottle around, which is nice.

Participant #1 has a similar response, saying that the abundance of refill stations across campus locations makes it easy for them to refill whenever they need to.

> They're pretty convenient. There's usually no line, and they're pretty much everywhere. Right? You can be in either the library, the gym, anywhere, and you will oftentimes find one. And so it's pretty convenient just to fill up your water when you need to.

Sub-theme 2: Water Quality

Water quality is a complex term which describes the chemical, biological, and physical properties that influence the condition of water and its suitability for a specific purpose, such as the consumption of it (Florida Key National Marine Sanctuary, n.d.). This sub-theme was mentioned in 15 interviews, with a total of 21 mentions. When speaking about water quality, students referred to two main categories, the safety of the water, and the experience of drinking the water. As a result, this sub-theme has two codes within it: safe, filtered water and water temperature.

Safe, filtered water was mentioned in eight interviews, with 11 specific references to it. Many students mentioned that they appreciate that water refill fountains and taps provide filtered water, as it makes them feel more secure consuming it. Participant #16 describes why filtered water is a motivator for reusable water bottle usage.

> Because I am kind of a picky person, I kind of go overboard on the sanitary kind of section. So um, just like making sure that the water is actually safe to drink. And also a lot of these stories that I hear about, like the, lead pipes or something like that. But I think the filter status is just kind of what gives me reassurance on that [safety], yeah.

Students also mentioned that water temperature, specifically cold water, was a motivator for them to use the water refill stations across campus. Cold water as a motivator for using refill stations was mentioned in eight interviews, with 10 specific references to it. Participant #15 states that they prefer using refill stations on campus due to the cold water they provide.

> Oh yeah, it's really useful. Because of the water there, it's usually really cold, so I feel like it's better than the water that you would get in the kitchen. So, I tend to usually use the refill stations...Oh, it's really fast. Because they have a specific section for water bottles, and the water is usually very cold. It's also very fast, I can do it in under a minute…Oh, it's usually really pleasant because it's fast and the water is cold.

Sub-theme 3: Sustainability

Sustainability can be defined in multiple ways, and the definition used for this study is actions and choice that positively contribute to the social, environmental, and economic aspects of an individual's lifestyle and to their community. Within this sub-theme, there are three codes: saving money, environmental consciousness, and staying hydrated.

The code of saving money was mentioned in five, with six total references. Many students explained that keeping a reusable water bottle with them allowed them to save money because

refilling is essentially free. Participant #2 states that refilling their reusable bottle throughout the day saves money that would otherwise be spent on vending machines and single-use plastic bottles.

> I find they're quite beneficial because a lot of the vending machines are pretty expensive. So, if I get a water bottle, or if I have my coffee service, I'll wash it and I'll use that. I'll refill it throughout the day because it's free and it's better than buying plastic water bottles.

Participant #5 shares a similar thought, explaining that refilling is a better option because single-use plastic water bottles cost money, while refilling is a quick process, and they are getting the water for free.

> It's better than getting it from like food places or Centro [eatery] because, well, the plastic water bottles cost money whereas the water from the refill stations is very fast and also the same as the water from plastic water bottles.

Environmental consciousness was mentioned in interviews as a motivator to use reusable water bottles to reduce plastic waste and their negative impact on the environment. This was mentioned across eight interviews, with 10 total references. Participant #6 mentions that they like knowing their choice to refill is helping the environment.

> I like how they're very like convenient and they're very fast too, and I know that I'm helping save the environment by using my reusable water bottle…Just the fact that I'm not using a plastic water bottle so like I know one less bottle is going into the landfills.

Participant #19 explains how learning about sustainability through university lectures, social influencers, and through community drives motivation on water bottle refilling and reuse from an environmental perspective.

> Uh, it's mostly environmental. Like I'm even in a sustainability course right now. So, I'm really intrigued by the concept of like, working together as like a proper community to take care of the world, right? So, like even if it's like something as small as like water bottles, like it would probably make a huge impact if everybody did it, right? Like anything in large quantity can have a significant effect...Since environmental awareness is becoming like a huge thing in our generation even. Yeah. Uh, the majority of people are probably even just motivated to take, take care of the planet for future generations. Right. Yeah. Like I've even seen a lot of the, I don't know if you'd call it lectures, but, uh, by Greta Thunberg and is very motivational because you see such a young girl working so hard to take care of the environment is quite amazing.

Students also expressed the positive impacts the water refill count feature on the refill stations have on their motivations to water bottle refilling. Participant #20 explains the positive reinforcement they gain from viewing the refill counts.

> I just find them, they're super, super convenient. You just like put it under, it also tells you like the amount of, the number, amount of single use bottles you save, which I think is really cool because it kind of just lets you keep in mind that you're doing something good for the environment. So, it gives the incentive to use it.

Staying hydrated was the third code within the sustainability sub-theme and was mentioned by students as a habit that allowed them to support their health and motivated them to use reusable water bottles so they could drink when they needed to. This was mentioned across eight interviews, with nine references in total. Participant #2 explains that they are constantly thirsty, and to ensure

they can drink water throughout the day, they bring a reusable water bottle, which holds a lot of water.

> Well, usually I'm just like thirsty. Also, rather than getting a drink or something, I usually bring a container that holds like a lot, so it'll last me throughout the day, which is kind of my main motivation. It just lasts me longer if you fill it up yourself rather than getting like a tiny water bottle.

Some students, like participant #13, elaborated on their personal hydration goals, and how refilling reusable water bottles helps them achieve their goals.

> Before I used to not worry about like how I'm drinking water, but with a water bottle [I do]. like at home I wouldn't care because it just be a mug. But with a water bottle, I usually like try to set a goal for myself for like 1.5 or 2 liters like that. So, whenever I have, um, the chance to drink water or when I just see a water station, I just convince myself to like, to refill it.

Discussion

As mentioned in the introduction, plastic pollution has a devastating environmental impact. To effectively create a culture of sustainability on campus and motivate students to choose reusable bottles instead of single-use plastic bottles, it is important to implement strategies to address the needs and target the specific barriers that are experienced by the McMaster community. This includes monitoring how the strategies implemented are received and making changes to enhance them. An example of this is McMaster's Bring Your Own Bottle (BYOB) initiative, which was created using the recommendations from the SUSTAIN 4S06 and SUSTAIN 3S03 groups. Previously, student participants in these projects mentioned specific barriers that they have experienced to water bottle reuse, such as inconvenience and accessibility (Mahal et al. 2021). Some participants claimed that the lack of water fountains in the residence building forced them to go further across campus to get water (Mahal et al. 2021). As a result, filtered water taps were installed in residence building kitchens along with signage indicating that the water was filtered. Students were made aware of the infrastructure present that would allow them to easily refill their water bottles through installation of water refill stations, BYOB signage, and accessible water refill stations.

The results from our study indicate that there has been a shift in how students perceive water bottle refilling on campus compared to participants in previous studies. The shift in attitude regarding reusable water bottle refilling can be seen in student discussions about current water infrastructure. In 2018, a discussion thread was made on the McMaster University Reddit page asking if campus tap water is safe to drink, as they heard concerns about lead contamination (ConsultingTimeLord_, 2018). Since then, a McMaster student created a discussion thread asking students about the best water refill station on campus (Humblebltch, 2022). Students responded with their preferred water refill station locations thread, and one student even responded with a ranked list of water refill stations, stating that they preferred those which provided colder water and had a higher pressure, and the stations in newer buildings provide better water (Humblebltch, 2022). These Reddit threads reflect the themes of our research and provides real-world evidence supporting the shift in perceptions. Overall, participants of this study are satisfied with their water refill experience and found the current infrastructure and culture on campus to be motivating. The main theme highlighted in our results is motivators towards refilling reusable water bottles around campus, indicating that the changes that have been implemented were successful in getting students to opt to reuse, and consequently, reduce the amount of plastic waste they generate.

In the past, the lack of convenience in refilling water was a major barrier for students (Mahal et al. 2021). The shortage of on-campus water fountains and the long distances involved made students more likely to obtain plastic bottles from nearby eateries and bring them back to their dorm rooms (Mahal et al. 2021). Currently, and demonstrated by the findings in this study, there are enough water refilling stations and filtered water taps in the kitchen to make it easy to refill water bottles, effectively ameliorating the problem. On the other hand, the safety and cleanliness of water on campus had been one of the concerns of students in the past, with more believing that bottled water was a safer option (Mahal et al. 2021). Our study, however, shows that students trust campus water quality, and have positive experiences consuming water from campus infrastructure with filtration equipment. This suggests that the changes made, and the information provided to students about campus water have been effective in alleviating concerns that once existed. Previous studies also touched upon themes of sustainability, such as the cost effectiveness and environmental impact of single-use bottles, which are internal motivators (Mahal et al. 2021). We found that students are motivated to reuse as it saves them money, allows them to maintain their habits (e.g., staying hydrated), and allows them to continue practicing an environmentally friendly lifestyle. Further research could examine these factors to inform future steps, such as a campus education campaign on sustainable water consumption.

Some barriers to refilling on campus were also mentioned in the interviews, but as we defined key terms as prevalent throughout the dataset, these barriers were not included in the thematic analysis. Not only were the barriers infrequently mentioned throughout the interviews, but the barriers that were mentioned were mostly stated as being the inverse of the motivators, suggesting that the students' main barrier was simply that they could have more of the motivators they mentioned. For instance, although majority of the participants stated that the water refill stations were convenient and accessible in most campus areas, they also mentioned that their convenience could be enhanced if more refill stations were to be installed near lecture halls and libraries. Pertaining to residence buildings, some participants mentioned that they resort to using Brita filters in their rooms so that they could avoid going to the kitchen to refill their water bottles with filtered water. These responses illustrate a never-ending quest for convenience, as participants indicated that taps and refill stations are convenient but could be more convenient if they were in every room. However, there is a saturation point at which strategies to promote sustainability and implement student feedback become unsustainable. Consider the materials needed to create the refill stations, the manufacturing and production of the filters, and the pollution that results from these processes, the transport to campus (more pollution) and the energy used by these refill stations to keep the water cold, and so on. Installing one in every room to maximize the refilling experience would surpass the threshold of sustainability in residence, as it would exacerbate the detrimental impact on the environment.

Through our study, the experiences and perceptions of first-year resident students at McMaster University regarding on-campus water refills were examined with consideration of previous research. The results of the study reveal the achievements of the university in motivating students to practice sustainable bottle refilling; however, there are some limitations to our study. The BYOB engagement event at which the participant interviews were conducted was launched with the goal of raising awareness about the refill stations on campus and to encourage students to reduce their use of single-use plastic water bottles. At this optional event, students could decorate their reusable water bottles and take part in discussions regarding the interactive refill station map, water-bottle habits, and McMaster's BYOB initiative future goals (Muzaffar et al. 2023). As a

result, participants at the event were residence students who were already using reusable water bottles and refilling on campus. Given their interest in promoting sustainability in residence, the participants' answers reflected a positive experience with refill stations with very few barriers. Moreover, the barriers mentioned were in reference to what the participants thought other students would experience when asked about student perceptions on refilling. In addition, McMaster has approximately 3,700 residential students (Faculty of Social Sciences, n.d.). With a sample size of only 20, we were unable to generalize the results to the entire residence community. Future groups are recommended to redo the study conducted by Mahal et al. (2022) by collaborating with McMaster Residence Life staff to analyze qualitative data from the campus wide survey regarding water bottle usage in Fall 2023. Future groups should also conduct the study done by Wong et al. (2023) to assess quantitative data regarding water bottle and refill station usage on campus. This will allow for investigation on whether data from a larger sample size align with the findings from interviewed participants of this current study, to strengthen our data or reveal new information that can inform future action regarding sustainable water consumption on campus.

To further understand barriers, future studies should aim to expand the sample size and recruit interview participants that do not use reusable bottles. A better location for interviews could be a frequently populated student area such as the McMaster University Student Center (MUSC), where students can buy single-use plastic water bottles. Another barrier that was mentioned was the lack of physical accessibility of refill stations. Further research is needed to collect more information about whether these refill stations are accessible to students with physical disabilities, and what can be done to improve accessibility.

Although this study provides a rich representation of the meanings across the entire data set of student responses, further research is warranted to provide a detailed analysis of motivating factors to student reusable water bottle usage and refilling, such as convenience, and what makes a water refill station location optimal. The term 'bright spots' is used to describe situations where research, strategies, policies have been successful and created a positive impact (Cvitanovic & Hobday, 2018). Cvitanovic & Hobday (2018) state that bright spot identification and analysis is essential to environmental science and policy practices, as the documentation of success will inspire optimism and increase the chances of research influencing the strategies implemented to address a problem. While further analyzing the barriers could provide deeper insight into possible solutions of sustainable water consumption campus, diving deeper into the 'bright spots' outlined as motivators towards refilling and reusing could help to advance the culture of sustainability already cultivated in McMaster. Ultimately, we hope that the findings from our study provide valuable insights that can support future studies on this topic and allow for the implementation of strategies that will improve the experiences of using and refilling reusable water bottles for the entire McMaster community.

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References

Barr, A., Hunter, M., Mitra, R., & Minich, S. (2022). Student Perceptions of Water Bottle Refilling on Campus. McMaster's Academic Sustainability Programs Office. https://asp.mcmaster.ca/wp-content/uploads/2022/10/AR-2022.pdf#page=31

Berman, E. R., & Johnson, R. K. (2015). The Unintended Consequences of Changes in Beverage Options and the Removal of Bottled Water on a University Campus. *American Journal of Public Health*, *105*(7), 1404–1408. https://doi.org/10.2105/AJPH.2015.302593

Bring Your Own Bottle. (n.d.). McMaster Okanagan Committee; McMaster University. Retrieved January 29, 2023, from https://okanagan.mcmaster.ca/byobottle/

Bring Your Own Bottle. (2023). *Annual Report: Bring Your Own Bottle Campaign*. McMaster Okanagan Committee. https://okanagan.mcmaster.ca/app/uploads/2023/04/BYOB_2022_AnnualReport.pdf

Braun, V., & Clarke, V. (2006). Using Thematic Analysis in Psychology. Qualitative Research in Psychology, 3(2), 77–101. https://doi.org/10.1191/1478088706qp063oa

Choate, B., Davis, B. Y., & Verrecchia, J. (2018). Campus bottled water bans, not always the solution. *International Journal of Sustainability in Higher Education*, *19*(5), 987–997. https://doi.org/10.1108/ijshe-06-2017-0089

ConsultingTimeLord_. (2018, July 23). Is it safe to drink McMaster's tap water? [Online forum post]. Reddit. https://www.reddit.com/r/McMaster/comments/917ukv/is_it_safe_to_drink_mcmasters_tap_water/

Cvitanovic, C., & Hobday, A. J. (2018). Building optimism at the environmental science-policy-practice interface through the study of bright spots. Nature Communications, 9(1). https://doi.org/10.1038/s41467-018-05977-w

Faculty of Social Sciences. (n.d.). *Living & Commuting | Residence or Off-Campus Living—The choice is yours!* McMaster University. https://futuresocsci.mcmaster.ca/living

Farnsworth, B. (2019, August 29). What is Participant Bias? (And How to Defeat it). iMotions. https://imotions.com/blog/learning/best-practice/participant-bias/

Florida Keys National Marine Sanctuary. (n.d.). *What is water quality?* Floridakeys.noaa.gov. https://floridakeys.noaa.gov/ocean/waterquality.html#:~:text=Water%20quality%20describes%20the%20condition

Government of Canada. (2022, July 13). Single-use Plastics Prohibition Regulations: Overview. https://www.canada.ca/en/environment-climate-change/services/managing-reducing-waste/reduce-plastic-waste/single-use-plastic-overview.html

Government of Canada, Statistics Canada (2022, March 23). *The Daily — Pilot physical flow account for plastic material, 2012 to 2018*. Www150.Statcan.gc.ca. https://www150.statcan.gc.ca/n1/daily-quotidien/220323/dq220323f-eng.htm

Humblebltch. (2022, November 9). Best Water Fountain on Campus [Online forum post].

Reddit.
https://www.reddit.com/r/McMaster/comments/yqsnd9/best_water_fountain_on_campus

Li, L., Zuo, J., Duan, X., Wang, S., Hu, K., & Chang, R. (2021). Impacts and mitigation
measures of plastic waste: A critical review. *Environmental Impact Assessment Review*,
90, 106642. https://doi.org/10.1016/j.eiar.2021.106642

Mahal, G., Dhavantry, N., Ramenthiran, R., & Shang, G. (2021). *Student Perceptions of Water
Bottle Refilling and Reuse on Campus.* McMaster's Academic Sustainability Programs
Office. https://asp.mcmaster.ca/wp-content/uploads/2022/05/Final-Report_Water-Bottle-
Team.pdf

Muzaffar, R., Palparan, J., & Park, J.(2023). *Reducing Single-Use Water Bottle Usage On-
Campus: Bring Your Own Bottle, Student Engagement.* McMaster's Academic
Sustainability Programs Office. https://asp.mcmaster.ca/wp-
content/uploads/2023/01/Reducing-Single-Use-Water-Bottle-Usage-On-CampusBring-
Your-Own-Bottle-Student-Engagement.pdf

Mary D'Altrui, E. (2019). *View of Bottle Water Bans: How can we curb the thirst for bottled
water?* Bc.edu. https://ejournals.bc.edu/index.php/elements/article/view/9614/8847

McNamara, C. (1997). General Guidelines for Conducting Interviews Adapted from the Field
Guide to Consulting and Organizational Development. https://napequity.org/wp-
content/uploads/10j-General-Guidelines-for-Conducting-Interviews.pdf

Nguyen, X. C., Dao, D. C., Nguyen, T. T., Tran, Q. B., Huyen Nguyen, T. T., Tuan, T. A.,
Phuong Nguyen, K. L., Nguyen, V.-T., Nadda, A. K., Thanh-Nho, N., Chung, W. J.,
Chang, S. W., & Nguyen, D. D. (2022). Generation patterns and consumer behavior of
single-use plastic towards plastic-free university campuses. *Chemosphere*, *291*, 133059.
https://doi.org/10.1016/j.chemosphere.2021.133059

Piccirillo-Stosser, C. (2018, June). *The Use and Efficacy of Water Bottle Filling Stations as a
Sustainability Initiative for Reducing Environmental Impact*. Knowledge UChicago.
https://knowledge.uchicago.edu/record/2530

Rowley, J. (2015). The Changing Nature of Information Behaviour. In M. Khosrow-Pour,
D.B.A. (Ed.), *Encyclopedia of Information Science and Technology, Third Edition* (pp.
3955-3961). IGI Global.

UN Environment Programme. (2022). *Visual Feature | Beat Plastic Pollution*. Unep.org.
https://www.unep.org/interactives/beat-plastic-
pollution/#:~:text=Around%20the%20world%2C%20one%20million

Wong, D., Chau, J., Kanth, S., Rajaram, A. (2023). *Assessing Effort to Reduce Single-Use
Plastic Water Bottles.* McMaster's Academic Sustainability Programs Office.
https://asp.mcmaster.ca/wp-content/uploads/2023/01/Assessing-Efforts-to-Reduce-
Single-Use-Plastic-Water-Bottles.pdf

Young, R. (2021, June 22). *Canada's plastic problem: Sorting fact from fiction*. Oceana Canada.
https://oceana.ca/en/blog/canadas-plastic-problem-sorting-fact-fiction/

Letter of information that was shown to student participants in the study

LETTER OF INFORMATION

Investigating Residence Students' Experience of Water Bottle Refilling and Reuse at McMaster University

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Purpose of the Study: To understand residence students' experiences of water bottle refill and reuse at McMaster University

As members of the McMaster Residence Community, we are inviting you to participate in an interview so that we can learn what you think about water bottle refilling and reuse at McMaster. We aim to collect information about motivations and barriers to water bottle reuse on campus and use that information to identify changes that could be made to promote water bottle reuse. The interview is optional but taking part will support our sustainability course work and improving access to reusable and sustainable water consumption options on campus.

Procedures involved in the research:
- We will ask you questions like "What are some barriers of using refillable water bottles?", but we just want to have a conversation to hear your thoughts on the topic.
- The interviews will take place at a semi-private area at the event. While we will aim to remain at a distance so others cannot overhear our conversation, there is a risk that others might hear what is said. If you are concerned about this, we can try to find another spot or stop the interview at any time.
- We will audio record the interview. If you prefer, we will take notes by hand.
- Audio files will be transferred to a secure drive hosted by McMaster called 'OneDrive', and then deleted from the recorder. Hand-written notes will be typed into a file on OneDrive and then shredded.
- Audio recordings will be transcribed into writing within one week of this interview and then the audio recording will be deleted from OneDrive.
- Interview transcripts will be analyzed for key themes, which will be communicated into both a summary report and a research report, which we plan to publish online.

Potential Harms, Risks or Discomforts:
The risks in the study are low. However, you may feel uncomfortable sharing your thoughts and feelings, or you may be worried that what you share with me may impact your relationships in the McMaster Community.

With respect to any concerns you may have about sharing your thoughts with us, we want you to know that your feedback, both positive and critical, is important to us and we value your honest opinions. None of your feedback will negatively affect your reputation at McMaster University because every effort will be made to protect your confidentiality and privacy, as described below.

Confidentiality:
- Your identity will be known to the student researchers, but we will store your data using a unique ID, rather than your name.
- However, we are often identifiable by the stories we tell, and our community is small enough that others may be able to identify you based on what you say. We plan to publish our research findings with some direct quotes, but you can choose not to be quoted.
- Audio recordings can be personally identifying; however, the researchers will delete the recording within one week of your interview. We will store the transcription file on the university's OneDrive platform, which will only be accessible by members of the research team. The transcript file will be deleted from OneDrive on April 6, 2023.
- Only summary results will be published, which will not include any identifiable information.

Participation and Withdrawal:
1) Your participation in this study is voluntary.
2) You can stop the interview at any time, and you can still keep the incentive.
3) You can choose not to have your quotes used in our research reporting.
4) You can withdraw from making your interview available for research purposes for whatever reason, even if you had originally agreed and up until 10 minutes after the interview by speaking to the member of the research team that interviewed you.

Potential Benefits:
This research may benefit you by contributing to creating a more sustainable community at McMaster because we will learn and share the information about thoughts and opinions of students living in residence with the Academic Sustainability Programs Office and Housing and Conference Services. While not benefiting you directly, taking part in this interview will also contribute to our learning as community-engaged and sustainability-minded students, community members, and possible future researchers.

Information about the Study Results:
We expect to have this study completed by approximately March 17ʰ, 2023. Our reports will be available online at https://asp.mcmaster.ca/experiential-learning-projects/past-projects/

Questions about the Study:
If you have questions or need more information about the study itself, please contact our course instructor, Dr. Kate Whalen at whalenk@mcmaster.ca or 905-541-0645.

This study has been reviewed and received ethics clearance from the McMaster Research Ethics Board.

For concerns or questions about your rights as a participant or about the way the study is conducted, contact:
McMaster Research Ethics Secretariat
Telephone: (905) 525-9140 ext. 2406

To be confirmed orally with interview before starting the interview
- **Do you agree to participate in this study?** Yes/No
- **Do you agree for our interview to be audio recorded?** Yes/No
- **Do you agree for my team members and me to select and quotes from this interview, which will NOT be identifiable to you in any way, for use in our research report that we plan to publish online?** Yes/No
- **Have you read the COVID Letter of Information, and understand there remains a risk of exposure to COVID-19 from in-person contact?** Yes/No

Appendix B

Interview questions for this study

1. In this interview, we will be talking a lot about water consumption on campus, specifically using reusable or single-use plastic bottles. To better understand your perspective, would you mind sharing with me how long you've been at Mac?
   a. How long have you lived in residence, and which residence building do you live in/did you live in?

2. Next, would you mind sharing with me about your experience using the refill stations [on campus] [in residence]? (Show picture of specific refill stations)
   a. What do you like about these refill stations?
   b. What are the barriers to using these refill stations?
   c. What do you think other people's experiences are using the refill/spots, how does their experience differ?

3. Tell me, what has your experience been refilling your water bottle on campus?
   a. When you do refill, what are your motivations?
   b. When you don't refill, what are the barriers?
   c. Now thinking of others, what do you think are the opportunities/barriers to refilling their water bottles?

4. I am curious to know more about your experiences with using water bottles, specifically, has it changed since you started living in residence and being on campus more often?
   a. Has there been any change to how often you drink bottled water or from a reusable bottle?

5. When do you choose single-use bottles over refilling?
   a. What would have to change/be different for you to choose to refill?
      i. Is there anything on campus currently that you think helps with using a reusable bottle in campus/residence?

6. Thank you for telling us about your experiences, this information will really help us in identifying what we can do to make refilling and reusing water bottles a more enjoyable experience. Is there something important I forgot to ask? Is there anything else you would like me to know about at this time?