Project Report **AppCycle**

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Preface by the Supervisor

Prof. Felix Mayer

For me as a supervisor, it is highly interesting and instructive to watch and accompany a team of young students in their month-long discussions, self-organization and intense work on their project-idea. Substantiating this idea, finding solutions to many challenging problems, working creatively and innovatively, and last but not least: working *together respectfully* is of great value for them and is exemplary for our society.

The actual team I had the pleasure to learn from is Team AppCycle. They had the very convincing idea of developing a useful tool for Munich inhabitants to help them change their daily consumer habits to more eco-friendly and eco-sensible ones. Creating such a tool, such an application, is connected to the most intriguing and fundamental issues of our time. The team had to ask and – if possible – find answers to some of the hardest and most difficult questions, questions which are important to all of us.

So, I was forced during the time accompanying Team AppCycle to reflect, myself, on my own consumer habits. This was eminently rewarding for me.

I hope the result of the team's more than twenty months of work and struggle will reward us all with an App, which is *used*. And when it's used, that will be the proof that it's helpful and it will have a *valuable* effect.

Preface by the Supervisor

Dr. Susanne Witzgall

The different ecological crises of the present – among them climate change, global plastic pollution and species extinction – challenge our Western way of life, our patterns of production and consumption. We all know that to avoid the sixth mass extinction not only bold political decisions are needed but that we also have to radically change our everyday habits. A constantly growing ecological awareness bears witness to this fact but doesn't often lead to a corresponding behavior modification. The "automatic force of habit" seems quite persistent, compelling us "to repeat previous modes of action again and again" (Pedwell).

Team AppCycle set itself to investigate the motives of and obstacles to eco-conscious purchase decisions in regard to groceries and shopping for garments and to develop an app for the cell phone to support and encourage the consumption of bioproducts, nonpacked food or re- and upcycled items in the region of Munich. The results of the survey conducted by AppCycle as part of this very ambitious enterprise can't be generalized due to the very restricted and largely homogeneous group of survey participants (mostly students). They nevertheless provided the quite unexpected insight that the reason for non-eco-friendly purchase decisions isn't first and foremost a small income (at least not in every case) but rather a lack of alternatives or not knowing about them. Hence, one of the app's objectives is to lead the way to such alternatives. If this is actually achieved and AppCycle manages to launch the app, the use of this app can make a difference. It might provide new ways and venues that can step-by-step merge into a map of embodied processes of eco-friendly habituation! And for those still lacking the power of imagination as to how a transformation of our everyday habits might look, the journalistic part of AppCycle provides a radical blueprint describing the day of a zero-waste artist.

A day in the life of a zero-waste artist

Today I did not need an alarm to get out of bed, since I had planned a lot of activities for this lovely Saturday in autumn. Quickly, I put on some new old clothes, which I had bought a few days ago in a small second-hand shop in Munich, before taking the bike to a café, which offers tasty vegetarian and vegan breakfasts. There, I met up with some friends and enjoyed the cosy atmosphere with a delicious breakfast. While we were talking, they complimented me on my clothes and we started a discussion about second-hand shops. We wondered why many people prefer fancy new clothes from well-known brands even though they cause more pollution to the environment, and whether these people ever thought about donating their old clothing instead of disposing it. We concluded that it would be very interesting to gain more insight into people's habits and thoughts regarding those questions.

After the breakfast, I biked to the train station and took the S-Bahn to go northwest of Munich to a so-called "Solidarische Landwirtschaft" (SoLaWi). The members of this association – of which I am a part – rent a field to grow their own vegetables together. We share the harvest based on how much effort each individual puts into the field and what share of the rent and seed he or she holds. As a result, I receive self-grown organic vegetables throughout the whole year on the one hand, and, on the other, I have the possibility of learning how to farm. But the best part of this experience is that it is loads of fun to get out of the hustle and bustle of city life and to work on the field with the community. Today we harvested potatoes and planted garlic, which will be ready for harvest next summer. The work is exhausting but rewarding, because I really see an outcome in the end. Moreover, I stay fit without going to a gym ☺ After we had finished the work, we stayed a little longer, ate some apples from the trees, carrots from the ground and drank lots of water from a spring. On the train back to Munich, Anna, another member of the SoLaWi and I decided that we should cook dinner together this evening with the freshly harvested potatoes from the SoLaWi.

Repairing instead of purchasing

Upon collecting my bike at the train station, I suddenly found that it had a flat tire. It was frustrating and I had no choice but to walk

home while pushing the bike with me. Fortunately, it came to my mind that a nearby repair café in Westend is open on Saturday afternoons. A repair café is a place where people meet and repair broken items together, or, let's say, at least try to repair them. Normally there are some tools and always people around who are able to help you with basic repairing knowledge. Luckily enough, I found a woman there, who also had a punctured tire and a repair kit but seemed to be confused about how to use the kit. Together we managed to repair the two tires and were both satisfied with our work! That was such a great exchange experience, as the woman learnt how to fix a flat tire and I was able to use her kit for my own tire in return. Before leaving the café, I had a quick glance at a corner for non-repairable goods, which everybody is welcomed to take home. I found an old keyboard with missing keys, which I would love to use for making some jewellery later on.

About sustainable shopping, cooking and jewellery

On my way home with the fixed bike, I stopped by the packaging-free supermarket, where I normally shop for my groceries, and by a plastic-free cosmetic shop for shampoo and toothpaste in glasses.

When I finally arrived home, it was already quite late, and Anna came by for dinner just a few minutes later. We decided to make a potato gratin with our fresh potatoes, for which we used cheese and milk, which Anna brought with her from a milk filling station from a farm close to the SoLaWi. Once again, we were impressed by how tasty and fresh self-grown vegetables are and were happy to have the opportunity to enjoy those. As both of us were worn out after this long and exhausting day, Anna left soon after dinner. Before going to bed, I tinkered a little bit with the broken keyboard and made an earring and a necklace out of the keys. I thought they looked stylish and were for sure unique on this planet. I will definitely wear them very often! Before falling into my sweet dream, I suddenly realised that apparently the flat tire was a blessing in disguise: I found the keyboard and by upcycling it, I made myself some one and only jewellery!

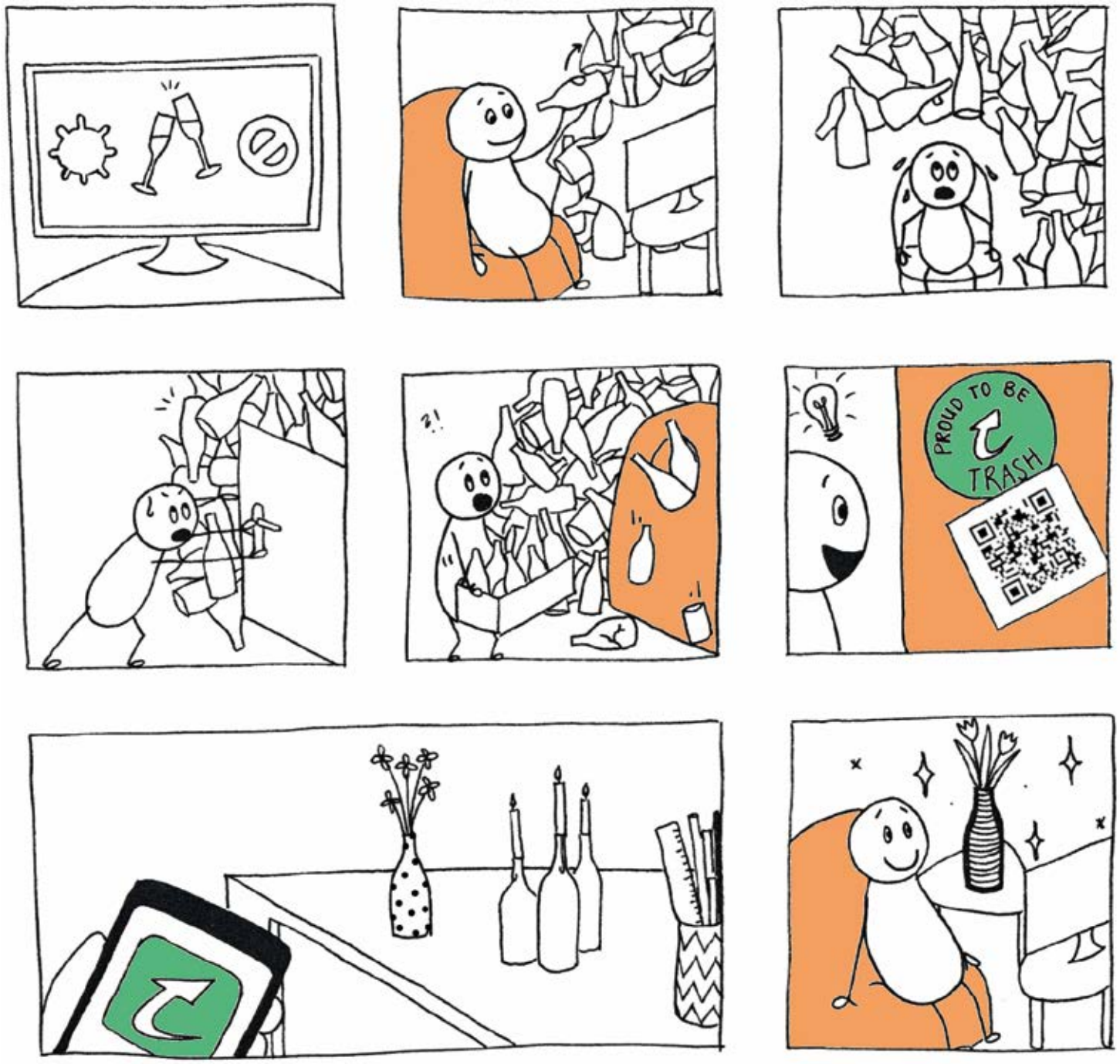
This story is inspired by conversation, in early December 2020, with Munich-based Paula Pongratz, who is known for creating post-apocalyptic jewelry from disposed goods. Living according to her principles of waste reduction, she has been using disposed materials as the resources for her artwork. From delicate accessories to necessities, she is dedicated to preventing waste production in every action in daily life. Being experienced in re- and up-cycling, she mentioned that a little planning beforehand is the key to the success of a zero-waste lifestyle. Once the habit is adapted to, we will be surprised at how both timely and economically efficient it actually is to live a zero-waste life. "We should struggle for the preservation of mother nature in solidarity. No one is out of the fight," said Paula at the end of our conversation.

Our role in making a zero-waste lifestyle more accessible

Helping Munich citizens seamlessly adapt to the zero-waste lifestyle is the main goal of our project. The majority of people are fully aware of the issue of excessive waste in the city and are willing to take actions to change the status quo, yet they have no concrete idea of how to go about this. Inspired by Paula's conviction that planning is the key to success in a zero-waste life, we decided to provide easier access to relevant information for the citizens. The "information" is an aggregate of the everyday actions from grocery shopping, goods repair, gift selection, and recycling, to workshops and events. In this way, we hope to create a guide to a zero-waste lifestyle that is easy to follow.

Considering smartphones as a necessity in the age of digitalization, our lifestyle guide is designed in an app format. Our app, AppCycle, serves as the information hub, which consists of two main functions: Map and calendar. The map includes eco-friendly stores in Munich while the calendar records related events held by local initiatives. With little storage in the smartphone, people are able to know within a click, where and how to go whenever the need arises.

To end up with Paula's plea that everyone should be involved in caring for the environment, we take part in this action with our app. We hope to make an impact on our beloved city by providing the zero-waste lifestyle guide and thereby enlisting the participation of even more residents in this community. Our journey starts in Munich, yet we are optimistic to see how far it will go!


PROUD TO BE
TRASH

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Abstract

The climate crisis and related environmental issues are becoming increasingly severe, which makes people question their lifestyles and consumption behaviors. It is widely acknowledged that there is a need for radical changes in our conduct. Despite rising ecological awareness, however, corresponding eco-friendly behavior is not always registered. This research report aims at discovering the motives for and obstacles to environmentally friendly consumer behavior, focusing on the consumption of groceries and clothing in particular. To answer the research question of which socio-economic factors influence such eco-friendly consumption in Munich, an online survey was distributed among Munich residents. The results indicate that education and income were linked only to quite special environmentally aware buying decisions, but not to all of them. A frequently stated obstacle for eco-minded purchasing was the lack of alternatives and knowledge. Team AppCycle of the TUM: Junge Akademie aims at addressing these challenges by providing information about eco-friendly stores and events in Munich via an accessible app.

1. Background

1.1 Motivation

In recent years, the environment has received greater attention and has become a major social issue. Due to a multitude of environmental problems – such as climate change, global warming, deforestation, ozone depletion, pollution and acid rain – there is an urgent need for action. One main cause of these environmental issues is overconsumption in industrial countries.

Food consumption, for example, is responsible for one third of a household's total environmental impact. Hence, changing households' consumer behavior might be a possible way to reduce the use of natural resources and thus decrease the environmental impact and increase eco-friendly behavior as well as environmental awareness (Vlaeminck et al., 2014). However, several studies have shown that there is a gap between the intention to make a pro-environmental purchase and the actual purchase (Grimmer & Miles, 2017). Therefore, it is important not only to trigger the intention to be more eco-friendly, but also to try to change the actual routine of people's consumption.

Next to food consumption, clothing also plays an important role regarding the environment. The textile chain forms a complex construct of globally located production steps which entail cultivation of raw materials as well as processing, finishing, packaging, use and recycling (Piegsa, 2010). During these steps emissions are caused by transport, but also by the high use of chemicals, energy and water which cause emissions via soil pollution, wastewater or exhaust air (Eberle & WWF Deutschland, 2010; Piegsa, 2010). In particular, the use of pesticides in cotton cultivation leads to approximately three million cases of poisoning among cotton workers yearly (Perschau & PAN, 2009) as well as to the release of toxic substances into the soil and water body (Eberle & WWF Deutschland, 2010).

1.2 Environmentally friendly behavior – motives and obstacles

The content of the following paragraphs is focused on studies which target students and their ecological behavior. This is due to the fact that mainly students of Munich city participated in AppCycle's research, the results of which are presented in Section 3. The research studies we drew on were performed in diverse countries with different sample sizes but help to represent the overview of recent as well as basic research and act as a foundation for analyzing our own study results.

Interestingly, there are some factors that can predict ecologically friendly behavior among students. Dahm et al. released a study which showed that eco-friendly attitudes indicate eco-friendly behavior of students (Dahm et al., 2009). According to their results of the study performed with the students at a mid-sized Southern university in the U.S., positive attitudes towards organic products and beliefs in eco-friendly behavior are indeed correlated with their actual behavior. Furthermore, they found that 49 % of students possess factual knowledge about ecological products and even 64 % felt positive about the availability of organic food options both on campus and elsewhere. It was mostly the high quality of the taste and lower price levels that motivated the purchase of such foods (Dahm et al., 2009). Although, most students were definitely in favor of increased consumption and availability of eco-friendly foods, a correlation could be measured to suggest that those students who already tend to follow a healthy and active lifestyle are willing to have and consume more organic food products on campus, whereas students with lower levels of physical activity and healthy eating habits were rather neutral for such products (Dahm et al., 2009).

In general, the younger generations often have further reasons for being more eco-friendly. The results of a study by Fu and Liang, which was performed with undergraduate students majoring in consumer sciences in a south-eastern university in the United States, indicated that millennials' ecological and social consciousness also positively influenced their purchase intention and willingness to pay more for eco-fashion (Fu & Liang, 2018). Furthermore, their results showed that due to the millennials' need for variety there is a positive relationship between social consciousness and willingness to pay more. With this knowledge, manufacturers and designers can create and produce a greater variety of styles of eco-fashion products to strengthen millennials' willingness to pay more for eco-fashion, and retailers can emphasize features of eco-fashion products such as the use of natural plant dyes and fabrics to strengthen millennials' willingness to pay more for eco-fashion (Fu & Liang, 2018).

The results of a study by Halimatussadiah et al. show that education can increase students' awareness about environmental problems and their solutions (Halimatussadiah et al., 2017). They researched over 700 students of three high schools in the city of Bekasi in Indonesia and found that a student's environmental concern does not have any relationship with the level of eco-friendly behavior. An interesting finding was that students with higher daily expenditure behave in a less eco-friendly way compared to students with lower daily expenditure. At the same time, they observed that a higher educational level regarding waste management along with school courses with an environmental focus correlated with more conscious environmental behavior (Halimatussadiah et al., 2017). Therefore, it is important to support the provision of more knowledge about eco-friendly consumption and waste management in high schools, when students start to form their own opinion and habits as consumers.

In general, it can be recognized in many countries that students tend to be more eco-friendly and have higher incentives for consuming environmentally friendly products than older generations. Therefore, this could be an important target group for organic food

suppliers and sellers, who should explore ways to make their products more accessible despite of the high prices.

According to another study by Kumar and Jha, which was also performed with over 700 people in Kerala State in India, different social and economic factors can play a role regarding environmental awareness in other socio-demographic groups, too. Their results have shown that the socio-economic profile of consumers has a significant influence on their attitude towards eco-friendly products (Kumar & Jha, 2017). Kumar et al. observed that the higher the education level of the consumer, the lower their attitude towards ecological products. Although the research did not provide any further discussion why higher educational and income level have a negative effect towards ecological consumption, we might assume that it is rather related to the age of different social groups. As mentioned earlier, students have more interest and incentives to buy organic food and clothing, but they have also a lower income as well as educational level than people who have already started to work. Hence, it could be rather a question of a generation gap in the attitude for eco-friendly consumption.

1.3 Eco-friendly consumption and behavior in Germany and Switzerland

Since our research is focused on Munich (Germany) it is relevant to provide a more detailed overview about the studies which have focused on the situation of eco-friendly consumption and behavior in Germany. The Humboldt University of Berlin released a study about environmental behavior in grocery shopping by means of an investigation of shopping behavior and supply structures in six residential areas of Berlin (Weiß, 2006). Among other aspects, the study investigated the allocation of eco-friendly food in Berlin and its ecological effects. According to the research, the environmental impact of food products can be divided along their supply chain which can be segmented into agriculture, processing and packaging, transport, and consumption. The environmental relevance of these areas differs depending on the product group and the study method. Overall, however, based on the results of the study, packaging is of comparatively minor importance, while the relevance of the type of agriculture is disputed. From differentiated results regarding the environmental impact of individual food products, simple indications are developed for consumers: labels, guiding principles or shopping guides with simplified reproduction of the results of life cycle assessments (Weiß, 2006).

Additionally, according to Weiß there are various motives for buying organic goods. Studies in recent years have concluded that health aspects are the most important motives for buying organic products in Germany, and that they are more important than the motive of environmental protection and nature conservation. The triggers that lead to initial purchase of organic goods do not necessarily coincide with subsequent motives for purchase. They can be divided into personal triggers (illness, birth of a child, change of diet), social events (food scandals, reports in the media) and the social environment (friends, relatives). In addition to the positive effects, there has been a lot of discussion about the expensiveness of eco-friendly products. The comparatively higher prices of organic products are not only caused by higher production costs and the differentiation of supply structures, but also by small-scale distribution. Therefore, supermarkets and discounters can offer organic products at lower prices by cost savings in distribution, especially through their wide range of organic private labels. Compared to the average monthly cost of a food basket, when buying conventional goods (154 €), the average cost of buying organic products (303 €) is almost twice as high (Weiß, 2006).

Being ecologically friendly can furthermore be expressed within one's lifestyle but is often influenced by social factors. For example, the purchase of seasonal vegetables is related to household income. In addition, both the customers of the special organic food shops and the buyers of organic products are characterized by their high school qualifications. Some studies find that especially people with higher incomes are organic buyers (Kropp & Sehrer, 2004; Kuckartz & Rheingans-Heintze, 2004). In a survey in Berlin, a particularly high number of high earners (net monthly income over 3000 €) were among the regular organic buyers (Weiß, 2006). People with higher education (A-levels or university degrees) buy organic products much more frequently than people with lower school qualifications (Kropp & Sehrer, 2004; Schade et al., 2002) and spend more on these products (Michels et al., 2004). According to Visschers et al., the price represents an important factor in environmental purchasing behavior. Still, consumers' price perceptions do not always match actual costs. Consumers are more willing to pay for technical measures than to change their behavior or forego comfort. Moreover, income and the associated household budget have different effects on environmentally compatible consumption behavior. On the one hand, a high income is associated with higher energy consumption for housing and everyday

mobility. On the other, a higher income has a positive effect on recycling behavior (Visschers et al., 2010). At the same time, families with a lower monthly income are more suspicious regarding organic labels in supermarkets. Additionally, low financial status of a person was considered as a main factor for why people do not think about buying seasonal and regional products but are rather price-oriented in the first place. It is one of the main challenges for the government, how to support consumers to motivate them to buy ecologically friendly products, and suppliers who often find less expensive ways of producing their food without concerns about the environment (Weller et al., 2010).

According to Visschers et al., environmental concern shows a positive influence on environmentally friendly consumption behavior in the areas of everyday mobility, housing, food consumption and recycling, whereas the degree of specificity of the measured attitudes and behavior determines the relationship between them. The more specifically the attitudes are measured, the greater the correlation with the corresponding behavior. For example, specific attitudes toward buying environmentally friendly clothing may predict buying behavior better than general environmental attitudes or environmental concern (Visschers et al., 2010).

The German Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU) also surveys environmental awareness in Germany every 2 years (Federal Ministry for Environment et al.). The team, consisting of Rubik et al., described three different dimensions in their study: the affective, cognitive and conative component. In other words that means emotional participation (affective), rational assessment (cognitive) as well as active action (conative). On a scale of zero to ten, their study showed rather high approval values of 7.2 and 7.9 for the affective and cognitive component, respectively. The conative dimension, however, received a lower value of 4.6 points. This implicates again the attitude gap between the willingness to act pro-environmental and actually acting in an eco-friendly behavior. The team also studied if there were differences regarding gender and found out that females showed higher average values than male respondents. In terms of mobility, 89 per cent of those surveyed perceive the reduction of transport-related environmental problems (noise, particulate matter, exhaust gases) as important, but still 70 per cent of the respondents use their car daily or several times a week. One of the main reasons for that is time saving or combining several necessary trips in daily life. Regarding agriculture, more than 90 per cent of the participants consider the decline in species diversity among plants and animals as well as the environmental pollution caused by pesticides to be a very serious or somewhat serious problem. Hence, the respondents attach value to high-quality and healthy foods, provided by agriculture.

2. Goals and Methods

Based on the previously mentioned insights of past research projects on this matter, the TUM: Junge Akademie team AppCycle has set itself the task to further research the fundamentals of environmental friendliness in Munich. Specifically, Munich was chosen due to the lack of knowledge about eco-friendly behavior of Munich residents as well as due to the main focus on this city in the app developed by the team.

2.1 Goals

The following hypotheses were based on several studies examining the impact of different variables on eco-friendly behavior. Education has shown to positively influence a person's pro-environmental behavior, with an increase in schooling years having a positive impact on eco-friendly behaviors (Blankenberg & Alhusen, 2019; Khare, 2015; Tripathi & Singh, 2016). Furthermore, an individual's income level can influence pro-environmental behavior, however findings diverge and some relationships in terms of income and eco-friendly behavior have turned out to be non-linear (Blankenberg & Alhusen, 2019; Khare, 2015; Tripathi & Singh, 2016). To answer the research question of which socio-economic factors influence eco-friendly consumption of food and clothing in Munich, this study tests the following null hypotheses:

- There is no association between the level of education as well as monthly net income and the participants' choices in regard to buying plastic-wrapped, imported or seasonal products.
- There is no correlation between the level of education as well as monthly net-income and the amount of sustainable clothing owned, the frequency of shopping second-hand and the sum of money willingly paid for a sustainable T-shirt produced in Germany.

2.2 Methods

The following two subsections describe the gathering of data and its evaluation.

2.2.1 Data collection

The study was conducted in Munich, Germany, in March 2021. Data was collected exclusively using an online survey, developed by the research team (AppCycle) and distributed mainly via email. It was also promoted on various social-media platforms and the research team's website, to reach different populations, hence making the sample largely opportunistic.

The questionnaire was provided in both English and German and consisted of 43 items in 27 sub-categories, which covered the following topics: groceries and food, beverages, clothing, and socio-demographic as well as socio-economic factors. The format included single- and multiple-choice questions assessing self-reported behavior regarding the above-mentioned topics and personal information including age, gender, level of education, occupation and monthly net-income. Most questions were evaluated with multiple answer opportunities and the option for free text input, while the majority of other questions were assessed on five-point Likert scales.

2.2.2 Data analysis

Data analysis was conducted using SPSS Statistics Subscription (IBM Company). Descriptive statistics were used to report the participants' demographic and socio-economic characteristics and to display frequencies of responses to survey items.

To analyze associations and correlations between the variables, non-parametric tests were chosen, since the variable scales were either nominal or ordinal and the distribution within the population was unknown. While non-parametric tests make no assumptions for normality, equal variances and outliers, they are not as powerful as standard parametric tests (Whitley & Ball, 2002). Nevertheless, this method is appropriate in the present study, since the aim was geared toward testing hypotheses rather than estimating certain effects (Whitley & Ball, 2002).

Like all non-parametric statistics, the Chi-square is robust with respect to the distribution of the data. Specifically, it does not require equality of variances among the study groups or homoscedasticity in the data. Hence, Chi-squaretests were used to determine associations between categorical variables of interest. This included the association between the level of education as well as monthly net income and the participants' purchasing decisions concerning whether the product is wrapped in plastic, imported or seasonal. The participants' answers with yes or no were coded into dummy variables and subsequently analyzed with Chi-square tests. Additionally, Phi Coefficients and Cramer's V Correlations were calculated. These tests provide a measure for the strength of association between categorical variables in a contingency table and are based on the Chi-square test (3). They are interpreted between 0 and 1, with 0 meaning no association.

Whether education or net income correlated with the ordinal variables was analyzed using Spearman correlations. A Spearman's rank correlation coefficient assesses the monotonic relationship between two continuous and/or discrete ordinal variables (Schober et al., 2018). The strength and direction of association can vary between -1 and +1 with zero meaning no association (Akoglu, 2018). The present study analyzed whether the level of education and/or monthly net income correlated with the level of eco-friendly behavior in terms of the amount of sustainable clothing owned, the frequency of second-hand shopping and how much money the participant would be willing to spend on a T-shirt which was sustainably manufactured in Germany, if a comparable T-shirt made from synthetic material produced in a developing country cost 15 €.

Those analyses with a p-value less than 0.05 were considered statistically significant and are reported in the following results section.

3. Outcome and Discussion

3.1 Outcome

3.1.1 Demographics and Socio-Economic Variables

The sample (N = 246) was 46.1 % male and 53.1 % female, while one participant identified asdiverse, and another chose not to answer. Almost three quarters of participants were between 18 and 25 years old, 14% and 11%, respectively, between the ages of 26 to 35 and 26 to 70. Only 3 respondents were over the age of 70. 66 % of participants were students, while 17 % indicated they were working full-time. More than half of the respondents' highest level of education was a high school degree, while 20 % had received a bachelor's and another 20 % a master's degree.

About one third of the respondents earned less than 450 € per month. 22 % and 23 % received a net income of 450 to 1000 € and

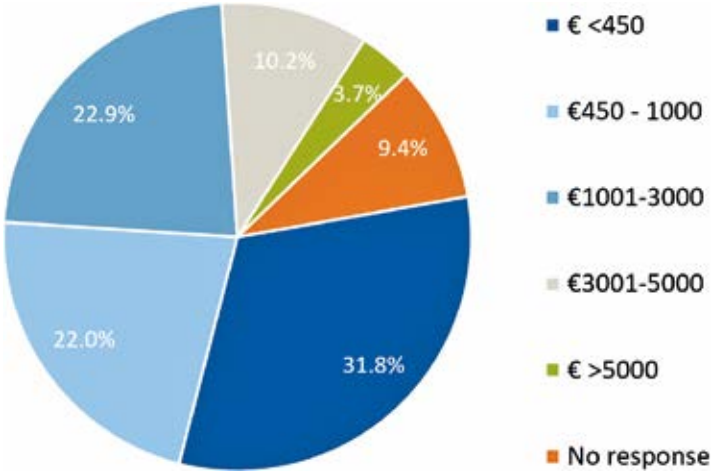

Fig. 1: Distribution of monthly net income.

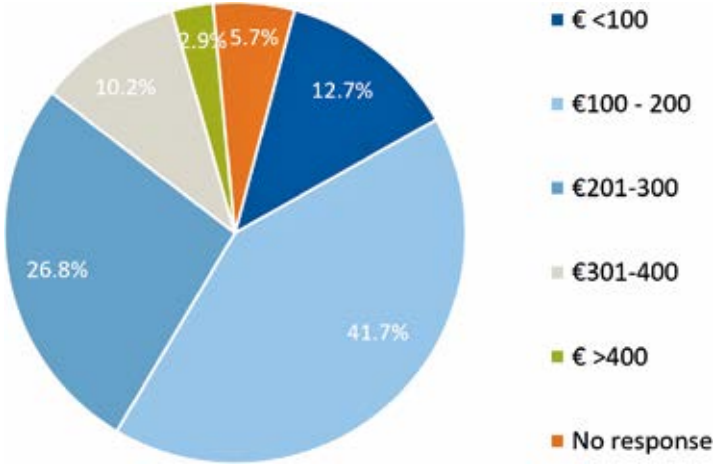

Fig. 2: Monthly spending on groceries per person.

1001 to 3000 €, respectively. 14 % of survey participants earned more than 3000 € and 9.4 % wished to not disclose (see Fig. 1).

41.6 % of the participants indicated spending between 100 to 200 € per month and person on groceries. 66 respondents (27 %) usually buy food for 201 to 300 €, while 12.7 % disclosed spending less than 100 € per month and person. Only 13 % revealed spending more than 301 € and 14 participants preferred not to answer this question (see Fig. 2).

3.1.2 Food and Groceries

Almost half of the respondents (48.4 %) did not follow any particular diet, while one third considered themselves to be vegetarian and 14.2 % as vegan. A few participants stated they seldomly consume meat. When asked about their usual grocery stores, 63 % stated they buy their food at a conventional supermarket and 23.3 % indicated they go to a discounter. Only 6.5 % of respondents buy organic ingredients or receive their groceries directly from a farmer, while 15 participants (6.1 %) shop at organic supermarkets.

Neither level of education, nor monthly net income were associated with the purchasing decision in regard to plastic-wrapped, imported or seasonal groceries. However, 89.8 % of respondents stated that their purchasing decision is influenced by whether the product is wrapped in plastic or not (see Fig. 3). Reasons for still purchasing plastic-wrapped items were claimed as not having an alternative (78.5 %), lower prices (40.2 %) and hygienic aspects (31.3 %) as well as convenience (30.9 %) (multiple answers possible).

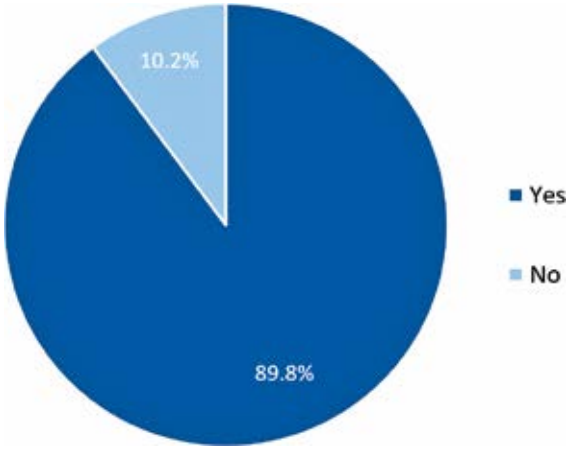

Fig. 3: Is your purchasing decision influenced by the amount of plastic wrapping?

Almost all respondents carry their groceries in their own bag or use no bag (99.5 %), while only 1 person (0.4 %) indicated the use of plastic bags. However, this one person said they used their plastic bags multiple times.

Three quarters of respondents indicated that whether the product is imported or seasonal influences their purchasing decision. 63.4 % of participants said they would still buy an imported product for reasons of convenience and 145 people (58.9 %) stated that this was because there is no alternative, or the selection is greater. 193 respondents (78.8 %) answered they are still buying non-seasonal products, because the selection of seasonal products is small or there is no alternative (32.7 %)

3.1.3 Beverages

90 % of respondents indicated that they prefer tap water over bottled water and are using refillable bottles. For other beverages (milk, soft drinks etc.) almost half of the participants (48.8 %) prefer glass bottles, while 30.7 % use Tetra Paks and about 20 % use recyclable packaging.

Environmental consciousness (84.9 %) and higher product quality (73.1 %) were the most stated reasons for choosing glass bottles. Opting for Tetra Paks was justified most often with convenience (60.8 %) and easy disposal (59.5 %). Recyclable packaging was also preferred for reasons of convenience and 42.2 % of participants mentioned the bottle deposit as a reason.

3.1.4 Clothing

Two thirds of respondents said they wear their clothing items very often before disposing or passing them on and 26.5 % wear them often. A garment was most commonly passed on because it was damaged or dirty (68 %), it did not fit any longer (57 %) or the amount of clothing owned was too high (37.3 %). Almost half of the respondents (46.9 %) passed their clothing on to the old clothes collection or second-hand stores. 16 % gave them to relatives, while 9 % sold them online and 7.8 % upcycled their old clothing items.

Both level of education and monthly net income, were statistically significant regarding the frequency of shopping clothing second-hand. The level of education had a weak negative correlation with the frequency of buying second-hand clothing ($r_s = .15$, $p = 0.05$, 95 % CI -2.78 to -0.02) (see Table 1). Furthermore, the participant's monthly net income also correlated negatively with their amount of shopping second-hand ($r_s = .26$, $p = 0.01$, 95 % CI 0.39 to - 0.13) (see Table 2).

Interestingly, 48 % of respondents said they never buy second-hand, while 18.3 % and 9 % of participants shop second-hand occasionally or very often, respectively (see Fig. 4). Eco-friendliness (88.5 %) and lower prices (55.2 %) were the most common reasons for buying second-hand, while habits (67.7 %) and lack of knowledge about second-hand stores (50.3 %) kept people from purchasing clothing in such shops.

When asked about the importance of a clothing item's ecological footprint, 71 respondents (28.9 %) answered rather not relevant, while 52.4 % thought it to be rather relevant or relevant. This is mirrored in the participants' amount of sustainable clothing. 34.4 % and 15.2 % indicated having few to very few sustainable clothing items, respectively, while 89 respondents (36.5 %) possess a medium amount and 14 % a high to very high amount of sustainable

Frequency of shopping clothing second-hand			
Spearman's Rho	**Level of education**	Correlation coefficient	-.147**
		Significance (2-tailed)	.021
		N	246

Table 1: Spearman correlation level of education and frequency of purchasing clothing second-hand. * Correlation is significant at the 0.05 level (2-tailed).

clothing. 62.5 % of respondents did not like to purchase sustainably produced clothing due to a small selection of items and more than half stated their reason as high prices and few suitable shops. Lastly, respondents were asked how much money they would be willing to pay for a T-Shirt which was sustainably produced in Germany, if a comparable item but made of synthetic materials and produced in a low-income country would cost 15 €. Only 7 participants would pay the same price, while one third would spend between 15 and 25 €, 115 (46.7 %) participants would lay out between 25 and 35 € and 17 % would spend more than 35 €.

3.2 Discussion

We aimed at analyzing whether the level of education and the monthly net income influenced eco-friendly behavior in the consumption of food and garments in Munich. Especially, we examined how these two factors affect the participant's choices in regard to buying plastic-wrapped, imported or seasonal products, but also the amount of sustainable clothing owned by them, the willingness to pay for that, and the habit of shopping second-hand. On the one hand, therefore, we conducted a survey asking about the demographic and socio-economic data of participants. On the other hand, the consumption behavior was assessed and the respective underlying reasons were identified. The questionnaire was analyzed both descriptively and inductively.

The null hypothesis was that there is no correlation between the educational level as well as the monthly net income and the buying decision relating to plastic-wrapped, imported or seasonal groceries. The statistical analysis of the survey data did not yield any significant correlations between those factors. Hence, we cannot reject the first null hypothesis, as no meaningful correlation could

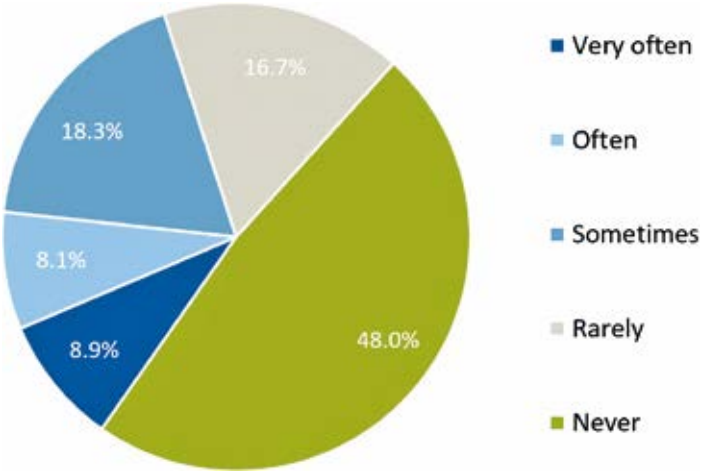

Fig. 4: Frequency of shopping clothing in second-hand stores.

be found. Nevertheless, it was striking that the buying decision of most participants was influenced by plastic packaging of a product. The main reason for still purchasing plastic-wrapped goods was the lack of alternatives followed by financial aspects.

In addition to the purchase of food we analyzed the influence of socio-economic and demographic factors on the consumption of clothing, as shown in the second null hypothesis: There is no correlation between the educational level as well as income and the amount of sustainable garments owned, the frequency of shopping second-hand and the price they are willing to pay for a sustainable, regionally produced piece of clothing. The only cor-

Frequency of shopping clothing second-hand			
Spearman's Rho	**Monthly net-income**	Correlation coefficient	-.249**
		Significance (2-tailed)	.000
		N	222

Table 2: Spearman correlation monthly net income and frequency of purchasing clothing second-hand. ** Correlation is significant at the 0.01 level (2-tailed).

relations of statistical significance we found were firstly between education and second-hand shopping and secondly between income and second-hand shopping, which were both negative. In past research no relation could be detected between the educational level and motives for shopping second-hand except for one negative correlation (Roux & Guiot, 2008), which is relatively in line with our conclusion. Roux et al. also reported that income and motives for second-hand shopping were linked. Unfortunately, age did not allow for inductive analysis in our case, which is why we could not reproduce the significant positive correlation between age and motives for purchasing second-hand goods (Roux & Guiot, 2008). Apart from environmental consciousness, possible reasons for buying second-hand clothing are economic, recreational and social (Roux & Guiot, 2008; Yan et al., 2015). While we can reject the null hypothesis assuming no correlation between education as well as income and second-hand shopping, it is not possible to deduce eco-friendly behavior. Still, environmental intentions could be a contributing factor to the frequency of purchasing used clothing.

Furthermore, the meaning of the results of the study is limited by the sample. Despite the almost even gender distribution, age and educational level were not represented reflecting the general population of Munich. Firstly, the majority of respondents were students and young adults. Secondly, the analyzed collective did not contain any participants with a level of education below a high school degree. The sample should be larger and more diverse in order to be representative of Munich's population enabling generalization so that the research questions could be answered more satisfactorily. In addition, potential biases during the data collection in the survey could have occurred, for example biased self-reporting of the participants' environmentally friendly consumption behavior.

Since we were not able to identify further statistically significant relations between socio-economic factors and eco-friendly behavior regarding food and clothing consumption, we could not reproduce the influences of age, gender, income, or education on different aspects of environmentally aware actions. Nonetheless, we gathered some information about the reasons for purchasing certain products. For instance, a frequently stated reason for buying goods with a deleterious environmental impact was the lack of alternatives. In addition, more than half of the participants reported that they did not shop at second-hand stores because they do not know about any. We concluded that information about shops could facilitate people visiting these more, which could result in an improvement of people's consumption behavior by purchasing more eco-friendly products.

4. Summary and Future Goals

We conducted an online survey among Munich residents to evaluate how socio-economic factors such as educational level and monthly net income influence eco-friendly behavior and buying decisions in relation to certain groceries and garments. While we did not find that education or income were linked with choosing products that were imported, seasonal or in plastic packaging, two significant negative correlations were found between education or income and the frequency of shopping in second-hand stores.

Furthermore, the reasons for specific buying behaviors were determined among the examined collective. Many respondents stated a lack of alternatives or lack of knowledge causing them to choose products that are rather harmful for the environment. Consequently, providing the residents of Munich with information about local stores offering eco-friendly goods could improve their consumption in a more environmentally friendly direction. This, precisely, is the aim of the research team AppCycle from the TUM: Junge Akademie. We have designed and implemented an app which contains detailed information about stores in Munich selling eco-friendly products: packaging-free shops, organic grocery stores, second-hand shops and many more. Additionally, the app includes a calendar with local repairing, upcycling or flea market events, which people in Munich can participate in to reduce their ecological footprint. To our knowledge such an app focusing on Munich has never been launched before. By collaborating with the environmental student representation of the two main Munich universities, who are currently working on a similar project, we already have a basis of potential users in the future.

The application AppCycle will be an accessible way of quickly providing users with the information that is preventing them from buying and purchasing more sustainably. Another objective of the app is to motivate users to reduce waste by upcycling or repairing, which could be the first step of establishing eco-friendly habits among the residents of Munich. We are convinced that every action matters in the fight for the conservation and protection of our environment.

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Self-reflection

It still feels like yesterday, when we all met each other for the first time in Kochel. Looking back at the past twenty months, eight students with diverse backgrounds united as a team and created an interdisciplinary project together. We were faced with many challenges; nevertheless, together as a team, we overcame all obstacles.

How the journey started

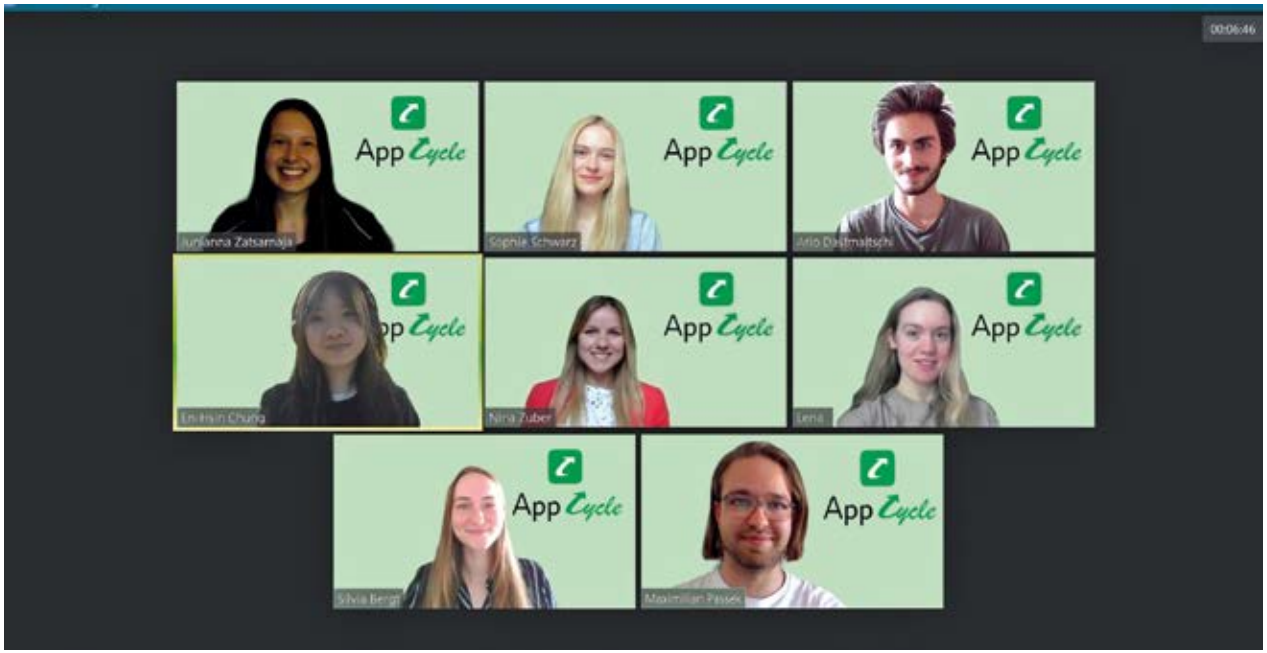
The initial emergence of our group project was full of surprises. Given all the fascinating topics available to us at the start, most of us were thrilled about all the possibilities, and therefore indecisive. It was not until the last minute that our group united around one topic. With the same vision of transforming Munich into an eco-friendlier city, AppCycle was born. We are a big group consisting of eight students from diverse backgrounds, both academically and culturally. While looking for the supervisors, we determined that we would love to build an eco-friendly community. The first generation of our plan was to create an app with the following functions: a map for eco-friendly shops, an interactive calendar for related events, a forum for users to connect and to share their upcycling ideas, and a reward system to encourage the users to change their behavior. An App for Upcycle ideas, that is how AppCycle started!

Challenges confronted along the way

Nevertheless, our project has not been running smoothly ever since, as several challenges have presented themselves along our way. We were lucky enough to have supervisors from artistic backgrounds, Dr. Witzgall and Prof. Mayer, with us. The first challenge emerged after our very first meeting. Our ambitious first-generation plan was a formidable undertaking, resource-wise and time-wise. Thereafter, we made the first big change to our plan. Out of all the features in the app we chose the map for eco-friendly shops and the interactive calendar to be our core features; hence, the second generation of our plan came out. The decision of focusing on the core features of the app and shifting the community idea to Instagram was wise and it allowed us to work in parallel subgroups, where each of us was able to contribute their specialty. Accordingly, the task for each one became clearer, and the working efficiency of the whole group escalated.

As the whole world was unprepared for the outbreak of Covid-19, so were we. The pandemic undoubtedly disrupted the workflow we had just established and it posed a major challenge for us. At the beginning, everyone was satisfied with online meetings, and they were essentially efficient. Yet, we soon found out how frustrating the never-ending lockdown was. Our productivity was stunted in online seminars, and it was hard to always engage everyone to participate in online meetings. Decisions were hard to make under the collective will as proposed in our code of the conduct due to limited participation at times. It was arduous to balance the commitment of each team member and to avoid relying on a disproportionate amount of effort from individuals. Luckily, with feedback from the tutors, we were able to adopt new ways of working by, for example, always predefining the meeting schedules, giving explicit tasks to everyone, and having a virtuous reward (cookies!) for the member who contributed most.

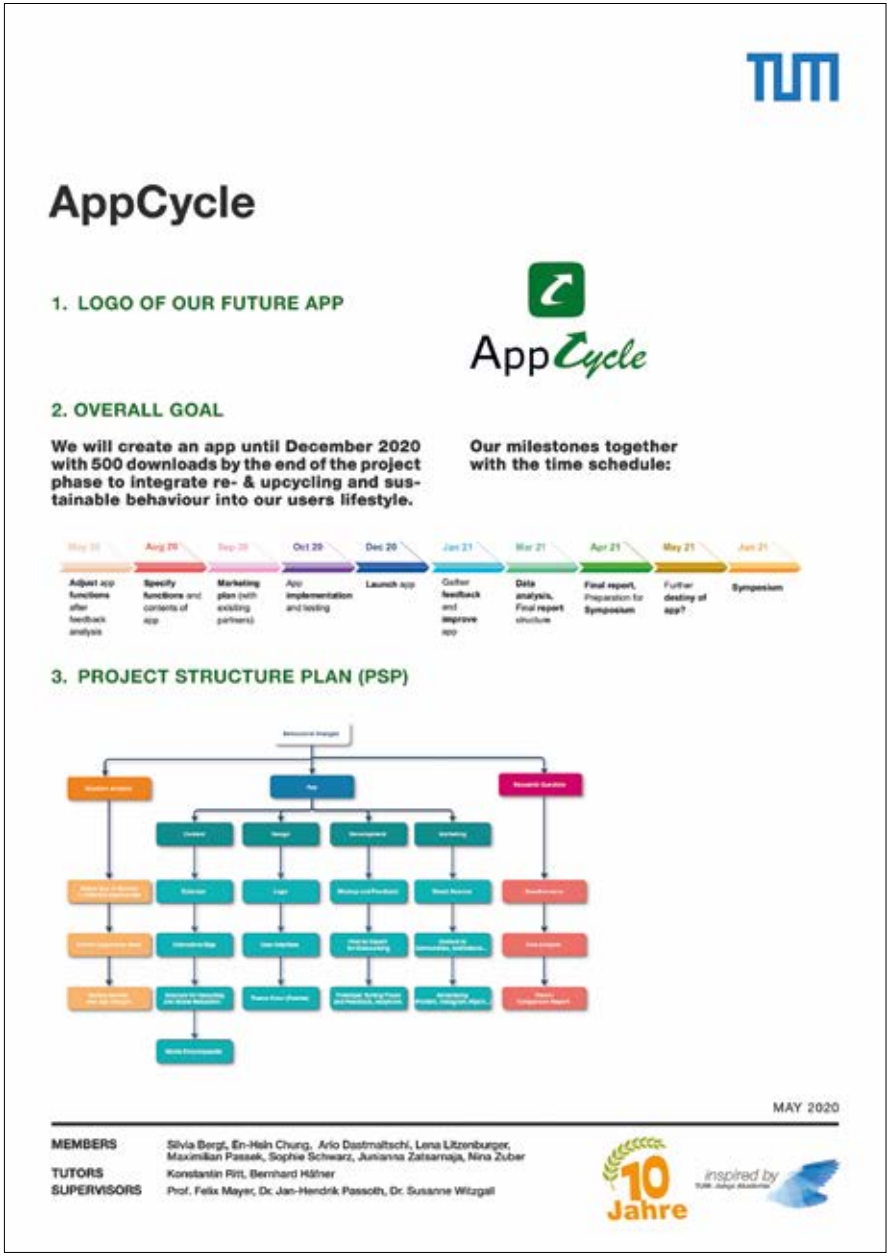
While the end of the project phase approached, we struggled with the scientific report as none of us was experienced in the field of social science. The period of deciding the topic and formulating the survey was long, although we did our best with our extant experience. The findings of our report were regrettably not scien-



tifically significant considering the method of sample choice and data collection. Still, we have learnt a lot during the process and we knew where to improve henceforward. Meanwhile, another unexpected challenge popped up as our HiWi for the development of an iOS version of the app quitted abruptly. It caught us off our guard but, eventually, the problem was solved when Ario decided to buy a MacBook and agreed to take over the remaining tasks.

Acknowledgement

The past twenty months were more than just a project to us. We are delighted that each of us gained seven supportive friends, whom we not only work with but also share the moment of life with. Despite of all the challenges, we conquered them and grew together along the way. Last but not least, we would like to express our gratitude to the TUM: Junge Akademie, for always being by our side; our supervisors, Dr. Witzgall and Prof. Mayer, for explicit suggestions and networking; our tutors, Konstantin and Bernhard, for all their constructive feedback and support; Paula Pongratz, for insightful conversations and interviews; Thomas Fromm for advice for our questionnaire; Pixida, for advising on the app development process. Thank you all for joining hands on our journey: AppCycle would not have made it here without each one of you.



POSTER 1:

Hypothesis

As all the other stories, it is hardest to take the first leap. 8 of us shared the same love and concern for Munich, our beloved city, despite the diverse cultural composition of our team. After the first seminar in Kochel, it was our goal to ease the excessive waste in Munich and transform it into a greener city by stirring changes of public behavior. In the first project management workshop, our target is addressed in three approaches: situation analysis, App, and research question. We decided to build a community for people with the awareness of eco-friendly lifestyle, either currently living to it or not taking actions yet. As one of the three pillars in our project, we launch situation analysis to get a full picture of the status quo in Munich – what measures are taken, what the main struggle is, and what upcycle ideas could be realized, with the highlight featuring a market survey aiming at potential users. We would like to understand what hindered them from taking actions and what incentivized them to change their behavior towards an eco-friendlier lifestyle. This is the inherent measure prior to app develop, the core component of our project. Accordingly, the app is the medium to engage the public for its accessibility and usability. We further broke the app component into four concurrent tasks: Content, Design, Development, and Marketing. Lastly, inspired by Junge Akademie, scientific research is the basis of our project. Our research was based on a questionnaire and by analyzing the data gathered, and we would like to find out the factors that influence people upon decision making.

POSTER 2:

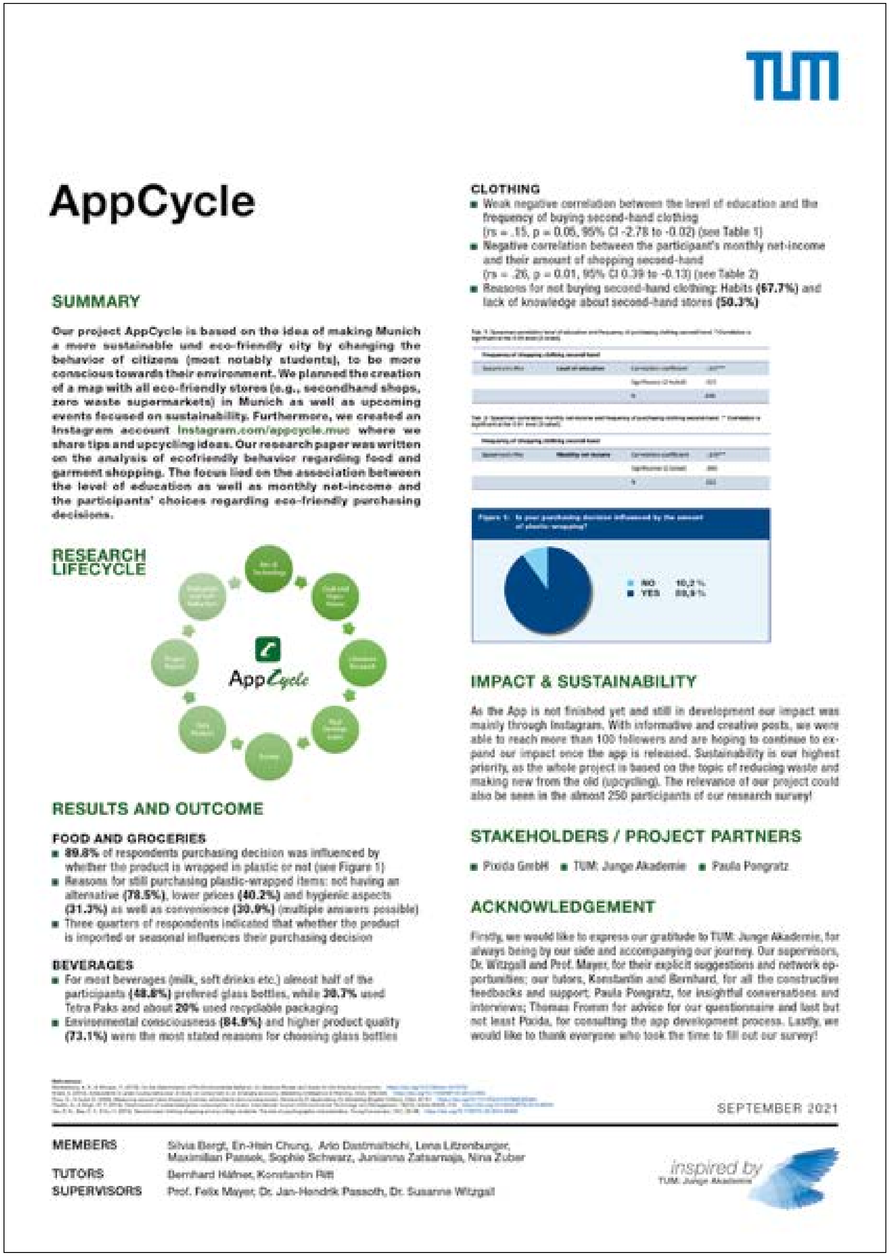
Method

Up to this point, three tasks had been accomplished. As the core of our project, the first prototype of our app was successfully established, thanks to our developer, Ario. More specifically, we had narrowed down the focus of functionalities of the app and decided to focus on the two basic features: the interactive calendar and the map for eco-friendly shops. The community engagement and upcycling features would be achieved via our Instagram account instead. Secondly, the app development team received substantial support. We established the communication channel with our external consulting partner, Pixida, and gladly had a HiWi joined our team for the development for iOS. In this way, Ario can focus on his ongoing work with Android system while our HiWi was focusing on iOS one. In additional to the progress of app development, marketing ideas are generated. It featured the awareness raising contents, interactive Q&As, and upcycling ideas.

POSTER 3:

Process & team

As the end phase of the project approached, our team was working harmonizingly with the new structure of three sub-tasks. Ario continued his devotion to app development along with the HiWi, Salmon. Marketing campaigns are charged by Lena, Nina, and Veronica while Max, Juna, Silvia, and Sophie can focus on our scientific research. The objective of our research is to ascertain how the level of education and income influences the eco-friendly behavior in food and clothing consumption of consumers in Munich. Gladly, 276 participants filled out our survey and we were able to conduct the analysis with collected data. Lastly, Paula, the upcycle artist in Munich, joined our writing in journalistic parts. As of May in 2021, we finished the drafts for both scientific and journal parts and were at the last phase of our app development. Remaining tasks for the last step in our project are the server configuration and testing for our app, and finishing our project report.



POSTER 4:

Final results

Our project consists of two main divisions, app development and scientific research. Our app ended up with the two basic features, a map for environmental friendly shops and an interactive calendar for events. The app is available in Android version at the moment. On the other hand, we conducted the scientific research on the relation between education and income level and the eco-friendly behavior. More specifically, the behavior is captured in the aspects of food and groceries, beverages, and clothing.