

TUM: Junge Akademie

Research Reports 2020



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Partner of





Welcome to the TUM: Junge Akademie



This booklet presents the findings and final results of the *TUM: Junge Akademie* 2020 project groups. Take a look at how the scholarship holders have translated the call "Technology and Art" into a variety of inspiring projects.

What is our idea? First, to bring together talented and creative students from different disciplines to sort and structure ideas under an overarching theme; second, to encourage and guide them to turn these ideas into

concrete projects; and third, to support them with the creation of a result starting from a hypothesis that is tested using scientific methods and discussed based on a concrete application or other tangible outcome. Just as important as the project work are the students' observations of, and reflections on, what is related to inter- and transdisciplinary collaboration: What are the pitfalls of communication across disciplines, where are there unconscious biases that limit cooperation and how to identify them? With the *TUM: Junge Akademie* we want to foster communication and collaboration skills, a sound mutual understanding, and respect for other disciplines.

Our call "Technology and Art" deals with the fusion of different perspectives for the benefit of overcoming possible limitations resulting from too narrow approaches. In terms of the essence of the call, however, one might have expected that the Corona pandemic, with its very limited opportunities for physical presence and exchange, might be a severe showstopper. This was definitely not the case and makes the result achieved by the students – unimpressed by the communications media and perhaps even inspired by the unusual, almost surreal situation at the universities – all the more remarkable. Dear Students: In the near future, your group shall have the responsibility and power to identify and balance the short-, medium-, and long-term challenges facing our societies and the planet Earth, to proactively shape developments for the better, and to work on devilishly difficult problems with unclear solutions. To do this, you need to understand, analyze and balance conflicts of interest, and to be moderators and communicators. We also know that to do this, you will need to communicate, collaborate and work together in a trans- and interdisciplinary way, with a good mutual understanding and respect for other disciplines, ways of thinking and approaches to problem solving. I am convinced that your engagement in these inspiring projects creates valuable building blocks to prepare you for your future tasks. Be ready for your future work to be driven by scientific analysis, creativity, commitment, good communication, and responsibility.

Dear supervisors, tutors and former members who were involved in the projects: Thank you for your generous time, expertise, and kind advice, which was invaluable to the project groups.

Finally, a heartfelt thank you to the TUM Board of Management for supporting the format, to the Managing Director Peter Finger and his team for their invaluable and highly professional guidance, and to the members of the Task Forces and Members Council for their creativity, commitment, and enthusiasm.

Enjoy reading this booklet and exploring the projects!

Yours,

John for

Gerhard Müller Senior Vice President Academic and Student Affairs

Dear TUM filends and associates,



TUMJA is a truly outstanding scholarship program, which over the last decade developed into a success story not just for the exceptionally talented and dedicated students, but also for the university community as a whole. It is further prove that leading universities such as TUM serve as places of systematic reflection as well as engines of progress and are, therefore, prime movers of today's value-creation chain.

The students whose pioneering spirit, talent and creativity fills our university with life are committed to seize the opportunity to tackle the fast-moving challenges of the modern world. They are the future generations of scientists, politicians, managers and decision-makers. Over the last ten years, we were able to witness the professional and personal growth of scholarship holders on their path to positions of responsibility in academia, politics as well as the business world.

The program is now in its 11th year and once again, the current TUMJA student research teams have created an exciting impetus with their projects, with a high benefit for society. Through trans-disciplinary approaches to their projects, the students were set free to enrich their minds and expand their talents, while at the same time learning to stand up for one another, strive to establish debate and develop solutions.

This is what the future holds for the scholarship program: TUMJA is becoming more international by being included in the EuroTEQ initiative. Moreover, through the donations of "Bund der Freunde

der TUM" (Friends of TUM), the academy will receive € 15,000 to further their outreach and impact. In addition, next to athletic events like the running event "Campuslauf", TUMJA is planning an array of extracurricular "culture clubs", offering literature readings and music performances among other activities. These clubs will be a place where leisure is a welcome chance to reflect, get inspired and connect across the university.

We are very proud of the entirety of the TUM family involved, among them our dedicated students, staff, faculty professors and Emeriti of Excellence. My special thanks go to Prof. Dr. Peter Gritzmann, Prof. Regine Keller and Prof. Dr.-Ing. Gerhard Müller, the Senior Vice Presidents for Academic and Student Affairs, responsible for the successful development of this unique scholarship program. Furthermore, I want to thank our extensive interdisciplinary partner network – the HFF / Hochschule für Fernsehen und Film, the HMTM / Hochschule für Musik und Theater and the ADBK / Akademie der Bildenden Künste.

As President of TUM, I would like to wish all TUMJA scholarship holders, alumni, friends and sponsors a high degree of curiosity, determination and most of all continued success!

Yours sincerely,

Thomas F. Hofmann President

"Science does not know its debt to imagination."

Ralph Waldo Emerson (1803-1882)

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Scholarship Holders 2020



Julia **Angerer** Clarify Industrial Biotechnology

At TUMJA I learned a lot about working in an interdisciplinary team and solving very diverse problems. This experience will stay with me for a long time.



Magdalena **Bader** Clarify Brewing & Beverage Technology

During the last two years at TUMJA I learned a lot about teamwork, scientific work, and myself. It was an extraordinary experience!

Laura **Ballentin** Exfluenced Management and Tech<u>nology</u>

The interdisciplinary work presented me opportunities, where I got unique insights, tried out different tasks, learned new skills and made memorable experiences.



Silvia Bergt AppCycle Biochemistry

During the challenging and worthwhile time at TUMJA I have acquired skills in interdisciplinary teamwork and artistry and enjoyed insightful discussions together.





Maren **Bertling** Lacktivity Human Factors Engineering

Working in a highly interdisciplinary team gave me the opportunity to learn and experience problem solving from different perspectives. Thanks to my teammates!



Deniz Avni **Bezgin** Exfluenced Aerospace

Experiencing the transformation of a rough idea into a finished product has been an arduous and challenging yet rewarding journey. Thanks TUMJA!

Len Brandes

Exfluenced Physics (Nuclear, Particle, and Astrophysics)

I look forward to keeping in touch with many smart and interesting people I have met through TUMJA.



En-Hsin **Chung** AppCycle Management and Technology

There were ups and downs in our journey but the best thing is that we learnt to communicate and conquer the obstacles together. That's how we shine.





Ario **Dastmaltschi** AppCycle Informatics

A magical and absolutely indispensable experience since it promotes the freedom of mind in such stressful times.



Monica **Déchène** Lacktivity Vocational Education: Health and Nursing Science, Social Studies

The opportunity to realize a project with enthusiastic scholars has not only provided me with personal growth, but also with many friends and fascinating contacts.

Christian **Faßbender** Lacktivity Engineering Science

Working in an interdisciplinary project has given me many different and valuable perspectives. Also, there was a lot of fun along the way.



Veronika Franz T'UMwelt Brewing & Beverage Technology

Being a part of the TUMJA was a valuable experience that taught me a lot.





Renato Coppi

Exhibition Fish Research on Teaching and Learning

TUMJA gave me the opportunity to work in a interdisciplinary team in which I learned different points of view about life and had an amazing time with them.



Milan **Cupac** Clarify Engineering Science

Teamwork and project management are the most valuable skills I acquired during the TUMJA scholarship program.

Christopher Ebert Exfluenced Health Science

During my time in the JA, I witnessed project work at its best, being interdisciplinary, meaningful, and instructive. In a nutshell: It was an excellent experience.



Omar **Eldeeb** Exfluenced Informatics

It is an enriching academic experience to work alongside like-minded individuals with so many different cultural and academic backgrounds on a mutual goal.





Franz Xaver **Gillmeyer** Exhibition Fish Responsibility in Science, Engineering and Technology

The scholarship program challenged me to work with people from different backgrounds and varying levels of proficiency, an experience I learned a lot from.



Laura **Hoffmann** Lacktivity Architecture

I am thankful for having had a precious experience, working together and connecting ideas across an interdisciplinary team and thereby making an impact on society.



Madeleine **Hotter** T'UMwelt Management and Technology

A stressful but meaningful life experience.



Annalena **Huber** Exhibition Fish Health Science

I had an unexpectedly great time working on a new topic alongside new people with backgrounds different to my own, and I am grateful for the time I had here.

Joel **Jäschke** Lacktivity Environmental Engineering

Our team tackled a many interesting challenges to increase personal fitness during the workday. Teamwork has also greatly improved my communication skills.



Sarah **Kluge** T'UMwelt Political Science

My time at TUM: Junge Akademie was inspiring and fun. There were ups and downs, but as a team, we always found a way to deal with these challenges in a good way.





Aikaterini **Mavroudi** Clarify Mechanical Engineering

TUMJA: New experiences, teamwork, creativity, ambition, research, seminars, evaluations, posters, report. Thank you for these two years and this wonderful journey!



Joshua Sharon **Neumann** Exhibition Fish Cultural and Music Management

As the only TUM: Junge Akademie scholarship holder from a partner university, the University of Music and Theatre, it was particularly exciting to dive into the scientific ecosystem of a technical university.



Florian **Hübler** Lacktivity Mathematics

Besides having loads of fun, working in an interdisciplinary and international group and taskforce enriched my view on research and science in general.



Marie-Theres **Huemer** Exfluenced Sport and Exercise Science

TUMJA was a valuable experience and memorable extension of my time at TUM.

Lena Litzenburger AppCycle Life Sciences Biology

I had an unforgettable experience at the TUMJA: getting to know students from all disciplines, learning to work in a team and overcoming challenges on the way.



Melissa **Lutgardo** T'UMwelt Management

Being part of TUMJA has been an amazing experience full of learning and growth. I am grateful for the challenges, opportunities, and specially for the great team.





David **Noachtar** Exfluenced Physics

TUMJA offered me a unique opportunity to challenge myself, overcome obstacles and meet great people along the way. I am glad for all that I learned during this time.



Maximilian **Passek** AppCycle Physics

Not only working on a meaningful project with a brilliant and interdisciplinary team but also spending time with friends is what TUMJA stands for. Thank you!



Paul Andrei **Sava** Exhibition Fish Informatics

Meeting my team and working on such an amazing project has been for me the highlight of the whole TUM: Junge Akademie Experience.



Jan Luca **Scheerer** Clarify Informatics

Working in a diverse and motivated team on a socially relevant project helped my acquire new knowledge, build new skills, and generally broaden my horizon.

Mohamed **Shoeir** Clarify Health Science

You get to know what being a good researcher is all about: To collaboratively work on a project, to make sense of your results and present them to a wide audience.



Juan Esteban **Suarez** Exhibition Fish Mathematics in Science and Engineering

TUMJA is a rare opportunity to develop self-motivated exciting projects in a unique interdisciplinary atmosphere. It allowed me to meet amazing people while exploring the bridge between science and arts.





Andrea Susanne **Weiller** Exfluenced Engineering Science

Even though the Corona pandemic damped the TUMJA experience, I was allowed to meet a lot of inspiring people and learn much during the evolution of our project.



Jeremias **Widmann** T'UMwelt Biology

Working in an interdisciplinary team and getting to know awesome people truly helped to broaden my perspective how I perceive new topics and surely widened my collaboration skills.



Sophie **Schwarz** AppCycle Health Science

Thinking outside the box and turning ideas into reality has been an incredibly beneficial experience on our journey to contribute to the scientific community.



Maryna **Shcherbak** Exfluenced Informatics

My time in TUMJA has challenged me in the best way possible. I am grateful for all of the incredibly talented people I met during the past 2 years, as well as all the experience I gathered.

Jonas **Unterholzner** T'UMwelt Biology

My time as a scholarship holder at TUM JA I associate with interesting insights into different areas. I am grateful for having been able to work with so many great characters and further develop my skills and personality.



Benedikt Vollmann Lacktivity Management and Technology

Met amazing people, learned a lot & had lots of fun. Thank you for the great time!





Junianna **Zatsarnaja** AppCycle Management and Technology

Every moment here was filled with passion for solving challenges. It was a pleasure to learn about unlimited creativity while combining power of art and technology.



Nina **Zuber** AppCycle Management in Mechanical Engineering

Working in an interdisciplinary team during our 20-month project was an invaluable experience and learning opportunity I am grateful for. Thanks to the best team!

Tutors



Veronika **Bauer** Lacktivity TUM Gov / LMU

Being a tutor gives me the opportunity to share my knowledge and experiences with my team and support them during their own journey at TUMJA.



Eva **Biehl**

Exhibition Fish TUM School of Life Sciences

For me, it was a great pleasure to support the team during the project. It was very exciting to follow the development, progress, and realization of the project.

Christos Gazanis Exfluenced Mathematics

Working with this team was inspiring and fun at the same time. Sometimes, it was even productive.



Bernhard Häfner AppCycle Informatics

TUMJA's approach is exceptional and lets young talents experience a research project in a completely new way. Seeing also their personal growth is very rewarding.





Thomas **Just** Lacktivity Chemistry

It was a great experience to tutor the Lacktivity project group. Sharing ideas with people from various backgrounds is what makes TUMJA such a unique format.



Dr. Matthias **Lehner** T'UMwelt TUM EDU

Being a tutor has given me the unique opportunity to pass on the experiences I have gained in my own time as a scholarship holder to another team.



Yuki **Nojiri** Clarify Physics

I really enjoyed working as a tutor and encouraging the scholars to grow with the challenges during their interdisciplinary projects.



Konstantin **Ritt** AppCycle Informatics

It was great to join TUMJA as a tutor and to support the motivated students in their pursuit.

Jakob Scheffels Exfluenced

Working with a group of motivated students allowed myself to get insights on team work and scientific research, while I was able to meet 9 new friends.



Sabrina **Schwarzmeier** Clarify TUM EDU

Being a tutor has given me the unique opportunity to pass on the experiences I have gained in my own time as a scholarship holder to another team.





Daniel **Schwinger** Exhibition Fish Chemistry

Supporting my diverse team was a pleasure, especially because they worked with great enthusiasm and accomplished so much during their TUMJA time.



Victoria **Treßel** T'UMwelt TUM SoM

It was a pleasure to see team TUMwelt thrive. They showed true skill and drive in developing a meaningful project. I wish them well for their post-TUMJA time.

Supervisors

Prof. Dr. Hans-Joachim **Bungartz** T'UMwelt Informatics

As always: problems make the experience even more valuable.





Prof. Dr. Peter **Gritzmann** Exhibition Fish Mathematics

It was fun to experience the creative work of such a highly motivated team, addressing such an important issue, in such a colorful and multidimensional way which, by itself, constituted art for all senses.



Prof. Dr. Bertold **Hock** Lacktivity TUM School of Life Sciences

I have been lucky to come across the group with the amusing acronym Lacktivity. Since I was aware of my own deficits regarding physical activity, it was a stimulus and an honor for me to become their supervisor.



Prof. Dr. Stephan **Jonas** Exfluenced

Informatics

I enjoyed the exciting exchange with the team and was impressed by the efforts the students put into their project.



Prof. Dr. Helmut **Krcmar** Exfluenced Informatics

I am convinced that the teams' goal to target social media addiction is important and timely.

Prof. Felix **Mayer** AppCycle MCTS

Love the enthusiam of TUM: Junge Akademie and Team AppCycle!



Prof. Dr. Jan **Müller-Wieland** ^{T'UMwelt} HMTM

The TUMJA opened my mind and gave me many new ideas. I learned, like an irish "Learner" (Teacher). Thanks for a good Time.





Silke **Schmidt** Clarify XR HUB Bavaria Munich

I was glad to support TUMJA with their interdisciplinary teams as I believe that this is not only key to developing high quality XR projects but in general to meet challenges of the future.



Prof. Dr. Christopher **Ungemach** T[']UMwelt TUM SoM

TUMJA provides a unique opportunity for students who seek the in-depth experience of conducting applied research, covering the entire process from identifying a relevant problem to writing the report.



Prof. Dr. Michaela Krützen Clarify HFF

What a pleasure to meet a highly motivated project group at the Hochschule für Fernsehen und Film!



tion and how they grew both personally as scholarship holders and as team members.

Prof. Dr.

Clarify TUM EDU

Prof.

Maurice Lausberg Exhibition Fish HMTM

It was a great experience to accompany the highly committed and creative team on this adventure with an uncertain outcome and to experience the surprising and convincing results.

Prof. Dr. Volker Nürnberg Lacktivity Allensbach Hochschule

It has been a great pleasure for me to join the Lacktivity group as a supervisor.



Daniel **Pittich** It was a great pleasure being part of the interdisciplinary Team Clarify and I was impressed by everyone's motiva-



Dr. Susanne Witzgall

It was a great pleasure and quite instructive to support the students at the TUMJA in their interdisciplinary collaboration requiring a lot of staying power and dedication.

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Project Report AppCycle

Team	Silvia Bergt En-Hsin Chung Ario Dastmaltschi Lena Litzenburger Maximilian Passek Sophie Schwarz Junianna Zatsarnaja
Tutors	Bernhard Häfner Konstantin Ritt
Supervisors	Prof. Felix Mayer Dr. Susanne Witzgall

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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 monthlong 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 ^(c) 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!



















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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 gualifications. 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 gualifications (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 fivepoint 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 \in .

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

AppCycle



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 (rs = .15, p = 0.05, 95 % Cl -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 (rs = .26, p = 0.01, 95 % Cl 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).

AppCycle

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	g 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-

AppCycle



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 guo 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.

AppCycle RESEARCH QUESTIONS & INTERIM RESULTS AFTER YEAR ONE

RESEARCH QUESTION

Does the usage of an app for up- and recycling change users' habits and activities towards a more ecofriendly behavior?

WHAT HAPPENED SO FAR

We have created a first prototype of our app, generated first marketing ideas, found a HiWi as a software developer for the iOS version of AppCycle, and concentrated on our two basic features: interactive map and calendar.

WHAT ARE OUR VERY FIRST RESULTS?

We have achieved an active communication with IT consulting company Pixida, created a list of potential partner shops, put our main focus on two basic features, wrote the user stories for supporting the app development, started with developing the Android version of AppCycle, and decided on marketing strategy, which should attract our potential users and inform them about current waste management problems.

ReoCycle θ 1.000 0-----CI.tem 10 D C Tanan 0.7-1-(China) MEMBERS Silvia Bergt, En-Hain Chung, Ario Dastmattschi, Lena Litzenburger, Maximitian Passek, Sophie Schwarz, Junianna Zatkarnaja, Nina Zuber TUTORS Bernhard Hilliner, Konstantin Pitt SUPERVISORS Prof. Folix Mayer, Dr. Jan-Hendrik Passoth, Dr. Susanne Witzgel

HOW WE HAVE ADAPTED OUR **PROJECT APPROACH?**

We have already adapted our plan, since we had too many different feature ideas for our app, which would be too complicated to implement in a short time. Therefore, we carried out a survey during a sustainability seminar at TUM to find out, which features of our future app are the most attractive ones for our potential users.



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AppOyde
                            OCTOBER 2020
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POSTER 2:

Method

ΠΠ

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.

AppCycle

WHAT IS OUR RESEARCH ALL ABOUT?

Our aim is to find how level of education and income influences the eco-friendly behaviour in the consumption of food and clothing in Munich.

WHAT HAPPENED SO FAR

- Completion of data gathering in total 276 survey participants.
- Scientific writing: literature research, methodology and data analysis.
- Journalistic part: planning the interview with an upcycling artist.
- Programming: Implementation of information about shops and events, setting up the real server, interface design.

NEXT STEPS

- First complete draft
- of scientific writing.
- Preparing the first version of journalistic part.
- Server configuration, importing real data onto server, testing.





POSTER 3:

ТШП

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.

AppCycle

SUMMARY

Our project AppCycle is based on the idea of making Munich a more sustainable und eco-friendly city by changing the behavior of citizens (most notably stadents), to be more conscious towards their environment. We planned the creation of a may with all eco-friendly stores (e.g., eecondhand shops, zero weste supermarkets) in Munich as well as upcoming events facued on sustainability. Furthermore, we created an Instagram account Instagram.com/appcycle.mus where we have tips and upcycling (doss. Our research paper was written on the analysis of ecofriendly behavior regarding food and he level of education as well as monthly not-income and the participants' choices regarding eco-friendly perchasing decisions.



RESULTS AND OUTCOME

FOOD AND GROCERIES

- 89.8% of respondents purchasing decision was influenced by whether the product is wrapped is plastic or not (see Figure 1)
 Reasons for still purchasing plastic-wrapped items: sof having an
- alternative (78.5%), lower prices (40.2%) and hygienic aspects (31.3%) as well as convenience (30.0%) (multiple answers possible)
- Three quarters of respondents indicated that whether the product is imported or seasonal influences their purchasing decision

BEVERAGES

- For most bewroges (milk, soft drinks etc.) almost half of the participants (48,8%) proloced glass bettles, while 28,7% used. Tetra Paks and about 20% used recyclable packaging.
- Environmental consciousness (84.9%) and higher product quality (73.1%) were the most stated measure for choosing glass bettles

CLOTHING

 Weak negative correlation between the level of education and the frequency of buying second-band clothing

ΠΠ

- (ns = 15, p = 0.00, 95% GI -2.78 to -0.02) (see Table 1)
 Negative correlation between the participant's monthly net-income and their amount of shopping second-hand
- (rs = 26, p = 0.01, 05% Cl 0.38 % 0.13) (see Table 2) Beators for not buying second-hand clothing: Habits (67.7%) and
- Reasons for net surply second-hand coming, Habes (\$7,7%) and lack of knowledge about second-hand stores (\$0,3%)



IMPACT & SUSTAINABILITY

As the Ap is not finished jet and still is development see impact was mainly through instagram. With internative and contains posts, are were adde to reach more than 100 followers and are hoping to continue to an just do or impact seco the app is released. Sustainability is our highest priority, as the weter project in based to the topic of reducing weets and making new trens the sign project participants of our respired table to be seen in the admost 250 participants of our ensares nurwely.

STAKEHOLDERS / PROJECT PARTNERS

Posida GerbH
 TUM: Junge Akademie
 Poula Pongratz

ACKNOWLEDGEMENT

Finally, we would like to express our graditude to TUM, Junge Akadomin, for always being by our side and accompanying our journey. Dur supprisions, to Wittigell and Pref. Mayer, for their exploit suggestrates and network exportamilies, our talves, Kentaetin and Bernhard, for all the constructive inchosites and support. Paula Porgratz, for incipitual conservations and internove; Thomas Fromit for advice for our grantformative and last but act near Produc, the costalling the top development process. Lastly, we would like to thank reverption which to the first for to fill out our survey!

SEPTEMBER 2021

Inspired by

IEMBERS	Silvia Bergt, En-Hain Chung, Arlo Dastmattschi, Lene Litzenburger, Maximilian Passek, Sophie Schwetz, Janianna Zatsamaja, Nina Zuber
UTORS	Bernhard Hährer, Konstantin Pitt
UPERVISORS	Prof. Felix Mayer, Dr. Jan-Hendrik Pasaoth, Dr. Susanne Witzgall

Final results Our project consists of two main divisions, app de-

POSTER 4:

velopment 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.



Project Report Clarify

Team	Julia Angerer Magdalena Bader Milan Cupac Aikaterini Mavroudi Jan Luca Scheerer Mohamed Shoeir				
Tutors	Yuki Nojiri Sabrina Schwarzmeier				
Supervisors	Prof. Dr. Daniel Pittich				

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Preface by the Supervisors Prof. Dr. Daniel Pittich and Silke Schmidt

Digital Technologies play a predominant role in our work as well as our private and social life. Students today - even the youngest learners - are "digital natives." Technology use, thus, has become an integral part of education in its own right, since everyday practice at all educational levels is no longer possible without it. These technologies include the visualization of 3D data, thus Virtual and Augmented Reality (VR and AR), together: eXtended Reality (XR).

However, this shift to a digitized life presents great challenges not only to youth but also, and mainly, to older age groups. Technology acceptance can be seen as a precondition for all educational stakeholders of integrating smoothly within this new high-tech scenario. In this respect, the topic of VR and AR is at the center of the debate. For a long time, virtual reality was often associated with computer and online gaming and therefore not highly appreciated by many – especially in Germany – and seen as a technology with solely recreational purposes. But this is not the case: Industry

has been using XR technologies for decades to develop new products and environments and to work collaboratively globally. Positive effects in the healthcare sector have been studied and proven for a long time, too. Therefore, it is of great importance that the team Clarify chose virtual reality to study senior citizens' technology acceptance. Putting the focus on this age group is crucial, considering how technology-resistance and age are often related. The way older people could benefit from the use of VR is tremendous, ranging from aspects of health diagnosis (e.g. early detection of Alzheimer's) and health and wellness treatments, to overcoming mobility restrictions by virtual travels, up to enabling communication with family members - to name just a few examples.

We are proud that Team Clarify was resilient enough to overcome many challenges during the project: Gaining access on the field under these unprecedented times, and also approaching the topic from a social science point of view - which was a new field for them. They successfully dealt with the current state of knowledge and have gradually specified and further developed their ideas in an impressive manner on their own. They consistently managed their project in both a goal-oriented as well as a creative way: They even created VR content themselves, which is remarkable, as content creation for VR requires many skills, and is time- and resource-intensive.

In addition, the team found creative solutions to overcome social-distancing restrictions and set as a priority the health of elderly participants.

For the content creation, the team found a wonderful partner from the Bavarian XR community: Granny Vision, who are convinced that "No one is too old for something new." The start-up by Carolina and Daniel Bendlin is driven by the idea of instilling positive emotions within older people through virtual reality. Their innovative and human-centered idea is to enable relatives to create private content in 360 degrees and transfer it to VR glasses. The grandparents can thus experience their great-grandson's first steps or the family vacation up close in VR. Carolina and Daniel explained to the team Clarify possible applications and supported them in the creation of a Munich city tour in VR. Carolina Bendlin was impressed by the team's ideas and energy and highlighted that the team did not actually need support for the conceptual ideas of the tour since they already had a clear vision themselves.

Overall, the Clarify team managed to be agile and creative, involved people from their close environment and at the end of the day this is what is important in this project and in research in general: Bridging the gap between research and everyday life.

You are never too old for something new

Granny Vision GmbH is a young Munich-based company that aims to use Virtual Reality (VR) in order to provide elderly people with adventures that they can no longer experience in real life due to physical or mental limitations. Team Clarify developed its project together with the company; our collaboration primarily focused on creating a virtual tour around Munich.

The two founders Carolina and Daniel Bendlin also shared their expertise in Virtual Reality and senior citizens with us. Julia Angerer and Magdalena Bader interviewed the two of them. Thereby we were able to get some deeper insights into the world of nursing homes, seniors, city tours, forest walks and entrepreneurship.



Carolina Bendlin, the creative head of the company.



Daniel Bendlin, keeps the overview and a clear head.

Magdalena: You founded Granny Vision almost exactly two years ago. Back then, what motivated you to start a company?

Daniel: The basic idea actually came from a hospice. I was a trainee as a volunteer hospice helper here in Munich at the beginning of 2019. There, they had sixteen rooms, eight of them faced the street and eight faced the garden. When people with a room towards the street found out that a garden room had become available, they immediately wanted to move there, just to be able to look out into the green again and not only see cars during their last days. I found that very moving at the time. Simultaneously, I started to get more and more involved with VR and I also talked a lot to Caro about it. At some point we said to ourselves that we had to make something out of that. This is how our idea ultimately was born. We received a lot of positive feedback from the care sector about our project – and then we simply decided to found the company.

Caro: We also have the possibility for relatives to record their own photos and videos so that the seniors can then watch the content on our VR glasses. This also came about because I have a very close relationship with my grandma, but I'm physically far away from her. I would just like to let her participate in my life a little more. And we figured that I'm probably not the only person who feels that way.

Magdalena: Yes, that's true. But did you have any reservations when you founded the company or was it totally easy for both of you?

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Caro and Daniel (both laughing): That depends on whom you ask!

Caro: Well, I'm more of a worrier and Daniel is more of a "just go for it" type.

Daniel: Yes, that's probably true. By that time, I had already accompanied a few start-ups during their founding phase, and I had also founded one by myself. So, I had lost a bit of my shyness about the whole process of starting a business. Still, Caro had some concerns in the beginning, but I think they have become smaller and smaller.

Caro: Now it's okay. (both laugh)

Julia: Basically, you have two mainstays – VR content on the one hand and your digital courses on the other. What projects are you currently working on?

Caro: VR is definitely our main focus. But it's also important that seniors and caregivers know how to use the technology, that's why we offer digital seminars as well.

Daniel: Of course, that was also a bit Covid-related. We had the digital courses ready, and many institutions were really convinced of them, but then Covid came along and that was the end of the digital courses for the time being. As a result, we started to focus more on VR.

Julia: One of your projects was our virtual city tour. Of course, we learned a lot from this collaboration – but why did you take part in our project in the first place?

Daniel: Well, you were a special project with cool components. Especially because of the regional reference, since we are a Munich company. And cooperating with TUM was also great for us, of course.

Caro: Yes, definitely. I had a lot of fun working with you guys. I hope you felt the same way! The TUM: Junge Akademie as a reference is also great for us, of course. It was another exciting project that we had a lot of fun with.

Daniel: We often let people choose for themselves what they want to view, and many of our participants want to see a city tour, especially when we visit facilities in the Munich region. That's a great thing, of course, when people recognize sights, for example. From that point of view, it's a really great project that we're also very happy to be involved in.

Julia: That makes us very happy! But before you can show seniors your VR content, you first need customer contact. How do users usually find out about your company?

Caro: It varies a lot. Sometimes via our website, via contacts, via 'Care for Innovation' ...

Daniel: ... Yes, it's really quite different. In the beginning hardly anyone knew us, and we reached out to many institutions. That has shifted a bit now, because we have a strong online presence, we are in several associations, we participate in contests, and of course we benefit from the classic word of mouth. But in the meantime, we're starting to enter the B2C business, so that people who are at home can also use Granny Vision with their loved ones.

Julia: Unfortunately, we've also had the experience that some seniors got dizzy or nauseous when using the VR glasses. You have mostly told us about positive feedback so far – have you also received any negative reactions?

Caro: Actually, we have only ever had positive feedback. We don't receive a lot of replies when we lend the glasses to facilities because the nurses work with the people there. But we would definitely be informed if dizziness, nausea or something like that occurred. Regarding this, we are in close contact with the institutions.

Daniel: But to be honest, our group of participants is also not entirely representative. You must consider that care facilities are willing and open to a certain extent if they are asking for our services. The organizations know their residents, and they know exactly who is open and willing to participate and who is not. In addition, they know that a headache or something similar is not caused by the glasses per se, but perhaps because they have been used for too long. In this case, the session will be a little shorter next time. Honestly, we have never observed headaches or nausea. Well, some people get a little dizzy, especially when they are not sitting but standing. But then, of course, we tell people to take it a little slower.

Magdalena: This means that you reach many informed and open-minded persons. We ourselves have experienced that some people are totally enthusiastic about the glasses. Do you have the feeling that participants also have a better life outside of Virtual Reality because of this experience?

Caro: Yes, definitely. That's actually the main purpose of this whole thing, that you can escape from everyday life for a short time. In addition, you get other impressions in your head again, there's just more happening around you. Especially in nursing homes, the daily routine is already pretty predefined. And this way you simply have the opportunity to get other input. So, you can actively take part in life again and you have new topics of conversation.

Daniel: I think so, too. We currently have a total of 120 or 130 different contents on the glasses. It starts with individual video or image sequences where people can be out and about and see something new. Then there are also games – people can play virtual chess for example. And the best thing is when participants start talking to each other about it because they simply have more conversation topics through VR. Another very important point is the personal content provided by relatives. If the family decides to bring their relatives in need of care back into the family circle – virtually in 360° – that is of course an insane enrichment for life.

Caro: Exactly, it is actually a product that does a lot with your emotions, regardless of whether your own family is involved or not. And, of course, you carry that beyond the point where you take the glasses off again.

Magdalena: So, the whole project has a very big emotional and social component. But you probably want to pursue your goal of improving self-confidence in dealing with technology in the long term. Do you have any plans for if and how Granny Vision might change in the future?

Caro: In addition to nursing, we are expanding our circles into the private sector, so we are rather getting out of an organized environment. But we always said from the beginning: Who knows where we will end up or how we will develop? But considering the way it has played out over the last two years, it's definitely VR that we will keep our focus on.

Daniel: So, ultimately, Virtual Reality for seniors. That's what Granny Vision already is and that is what it is going to remain.

Magdalena: That means that you are not planning to introduce another new technology either?

Daniel: No, because we really believe that Virtual Reality has a very promising future. If you just look at the last two years, there are huge leaps in what has been happening in terms of technology. And that will continue. And that's why we want to stay with it.

Julia: Well, thank you very much for your time. Not only today for the interview, but also for the fact that you participated in our project and that you were just as enthusiastic as we were!

Clarify

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Abstract

New technologies such as Virtual Reality can be very beneficial to elderly people. Scarce research exists with regards to the adoption of such technologies by older adults. In this study, we applied the Unified Theory of Acceptance and Use of Technology to identify predictors of future VR usage intentions. 72 participants aged 60 to 91 years were recruited for our work. Subjects took part in a VR tour through Munich, Germany, and filled out a questionnaire established in prior research.

48 % of our participants intended to use VR in the future and 76 % enjoyed using the technology. Previous Smart Phone Usage was not shown to predict Intention to Use. The factors Perceived Use-fulness, Social Norms as well as Age and Gender were demonstrated to significantly influence the Intention to Use VR and increased age was negatively related to technology acceptance.

The results of this study support the notion that Perceived Usefulness and Social Norms predict technology acceptance. Close attention should be paid to perceptions of usefulness, encouragement by significant others and age when addressing groups of older adults.

Abbreviations

Abbreviation	Meaning
Н	Hypothesis
IU	Intention to Use
PE	Perceived Enjoyment
PEOU	Perceived Ease of Use
PU	Perceived Usefulness
SN	Social Norms
TAM	Technology Acceptance Model
UE	User Experience
UTAUT	Unified Theory of Acceptance and Use of Technology
VR	Virtual Reality

Introduction

New technologies have many positive effects for the elderly. Virtual Reality (VR), for example, is a technology that is offering realistic experiences in controlled areas with low or no risk. Senior citizens can use it in the comfort and safety of their own homes and can be transferred to new realities. It is an enjoyable, innovative tool that can advance the recollection and retention of the memory as stated by the Virtual Reality Society. According to a Cambridge study (Lin et al., 2018), it has been shown that experiencing and using VR glasses can decrease the risk of depression and the feeling of loneliness among the elderly. This technology seems to have positive effects in the majority of the study's participants, as they appeared to feel more outgoing and less stressed or isolated.

Moreover, latest statistics of 2018 have demonstrated that 78 % of the German population have heard about VR (Statista, 2020) and a growing number of seniors try out the internet, smart phones and video games (C.Gaspar, n.d.). Computer usage in general has been shown to positively affect information processing, reading, comprehension, and the memory in a positive way, resulting in a faster reaction time and an increase in attention span and handeye coordination of the elderly (Oppenauer, 2009). Virtual Reality usage appears to have potential benefits in a variety of health indicators, although research is still inconclusive (Miller et al., 2014). Despite the positive effects and the importance of modern technologies for the elderly, there has been insufficient research on its adoption by older adults. The focus of attention has traditionally been placed on the implementation of e-communication tools for elderly patients in primary care or on software solutions specially designed to fit the needs of elderly users. There is, however, scarce research about the extent to which the elderly, especially in Germany, accept or use new technologies such as Virtual Reality. Motivating this target group to apply VR glasses could increase their enthusiasm and their intention to also use other potentially advantageous technologies. As a result, one would expect acknowledgment of positive effects by the elderly and thus the acceptance of digital technologies.

A related research study (Syed-Abdul et al., 2019) on a group of 30 elderly people aged 60 to 95 years in Taiwan found that Perceived Usefulness, Perceived Ease of Use, Social Norms and Perceived Enjoyment significantly affect the Intention to Use Virtual Reality. Furthermore, participants mostly agreed about Perceived Enjoyment, Perceived Usefulness and their experience of applying VR. It was concluded that this technology is highly accepted among the elderly population.

George Coldham and David M. Cook found a difference between answers on the pre- and post-questionnaires given during their experiment. 63 % of the participants stated that they did not really expect to use VR for anything useful and 79 % held the view that this tool is a frivolous undertaking that provides little benefit. However, after completing the VR exercises, many participants confessed that they could begin to understand the possible usefulness of Virtual Reality. Also, 42 % expressed a "wow" factor once they had applied VR glasses (Coldham & Cook, 2017).

Theoretical Background: Technology Acceptance Model

In efforts to provide an integrated model that can be used to explain information technology adoption, the Technology Acceptance Model (TAM) was proposed (Davis, 1989). This framework has later been validated in empirical work and it is believed to explain technology acceptance as well as actual usage of various technological systems (Venkatesh, Thong, & Xu, 2012). The attitude of people towards using a certain technology depends on the so called "Perceived Usefulness" (PU) and the "Perceived Ease of Use" (PEOU) in addition to other salient factors added into subsequent iterations such as "Perceived Enjoyment" (PE) and "Social Norms" (SN). Those aspects are then hypothesized to predict a user's intention to utilize the technology under consideration.

The Technology Acceptance Model was employed by several researchers over the years since its conception with uses ranging from education and learning (Chao, 2019) to organizational behavior and leadership research (Neufeld, Dong, & Higgins, 2007). The model has also been applied to predict technology adoption in different contexts and across a variety of modalities such as health information technology or smart phone and computer usage (Venkatesh et al., 2012). Nevertheless, TAM lends itself to extension and adaptation to a variety of population groups, which helps researchers to identify the relevance of certain constructs for a specific target group.

The TAM has further been extended to include external determinants of acceptance such as education, health, and psychological needs (Oppenauer, 2009). The model was then specifically adapted to Virtual Reality hardware (Manis & Choi, 2019). A pilot study conducted with older adults and VR glasses in Taiwan added the user experience variable "Interactivity" to the framework, which was found to be associated with behavioral intentions. Current efforts lie in further understanding the influence of User Experience variables (UE) on Intention to Use VR (IU) and how these interact with well-understood variables such as Perceived Ease of Use (PEOU) and Perceived Usefulness (PU).

Although technology acceptance in older adults has been studied in healthcare contexts with usages such as m-health (Hogue & Sorwar, 2017), research with regards to the adoption of VR is still scarce (Syed-Abdul et al., 2019). Furthermore, the demand to expand the theoretical mechanisms underlying UTAUT and adapting them to newer contexts still exists in line with the need to improve the generalizability of the theory which has been highlighted by several authors (Bagozzi, 2007; Venkatesh et al., 2012). In our research project, we aim to use the TAM in a similar fashion. We applied newer iterations of the model to a sample of older adults that integrates relevant variables based on prior research, with the focus on determining the influence of those constructs on Intention to Use (IU), a measure of overall VR technology acceptance. We further intend to identify salient factors in our target group by adding aspects such as previous smart phone usage, paving the way for the development of newer framework iterations adapted to VR acceptance in senior citizens.

In the first part of this work, we describe the methods we used to measure technology acceptance by assessing the relevant constructs and using Intention to Use (IU) as a proxy for overall acceptance levels. Next, we briefly move to the analysis of our results and explain the insights we got from the evaluation of our questionnaires. Finally, we sum up our research on this topic and provide recommendations to producers, practitioners and clinicians who would like to offer VR tools to seniors and to whom predictors of usage intentions will be especially useful.

Goals and Methods

Goals

Our main goals were to expose senior citizens to new technologies and offer an enjoyable experience with devices that are expected to see increased demand in the future. An additional aim was to provide the elderly with relief from the isolating circumstances people experienced during the COVID-19 pandemic. Measuring overall enjoyment was thus also a focus of our project.

The aim of our research study was to investigate the acceptance of VR technologies in older adults and to determine important predictors (through Intention to Use, IU) by applying the framework UTAUT (Unified Theory of Acceptance and Use of Technology, see Figure 4). In our study we tested the hypothesis of the model and added three additional variables, namely Age, Gender and previous Smart Phone Usage. All factors were tested for associations with Intention to Use the technology in addition to the interrelations asserted by the framework. In UTAUT, Intention to Use acts as a proxy for the degree of acceptance as well as strength of motivation and was an important predictor of adoption behavior in prior research work (Venkatesh et al., 2012). We replicated and extended a model resting on a previous study (Syed-Abdul et al. 2019) which proposes the following relationships:

H1: Perceived usefulness influences the intention to use VR.

H2: Perceived ease of use influences the intention to use VR.

H3: Perceived ease of use influences the perceived usefulness factors such

of VR. H4: Social norms influence the intention to use VR.

- H5: Perceived enjoyment influences the intention to use VR.
- H6: User experience has an effect on perceived usefulness of VR.
- H7: User experience has an effect on the perceived ease of use of VR.

We further propose three hypotheses:

- H8: Age influences the intention to use VR.
- H9: Gender influences the intention to use VR.
- H10: Smart phone usage influences the intention to use VR.

Study Design and Participants

Study Design

72 participants were recruited for our study, through the TUM: Junge Akademie network as well as through common friends and advertisements on our website. Subjects were sent VR glasses and given time to use the devices, take part in our VR tour and fill out a questionnaire. Later, as restrictions due to the COVID-19 pandemic were eased, our team also visited elderly care centres, namely ASZ Sendling and ASZ Moosach of AWO Munich, and showed the VR tour to visitors who met our inclusion criteria.

VR Tour

Our VR tour was approximately ten minutes long and showed 360° visual images of Munich as well as auditory voice-overs explaining the relevance of specific sights. The tour included the areas Marienplatz, Odeonsplatz, Hofgarten, Olympiapark, the Thiersch-Turm and the TUM main campus amongst others.

Questionnaire and Translation

The questionnaire consisted of seventeen items measuring the constructs Perceived Usefulness (PU), Perceived Ease of Use (PEOU), Social Norms (SN) and Intention to Use (IU) as well as additional factors such as prior Smart Phone Usage, Age Group and Gender of participants. Question items were based on a provided questionnaire (Syed-Abdul et al., 2019) and were translated from the English language to German by our team. The German translation was then sent to professional translators, as well as native English speakers for a translation back to English. The English questionnaire derived from our German version was then checked for deviance from the original and deemed appropriate by all members of the team.

Statistical Analysis

Statistical analysis was performed using the software JASP (Love et al., 2019). Normality of data was checked applying the Shapiro Wilks test.

Mean response scores, ranging from 1 (completely disagree) to 5 (completely agree) for each construct, were calculated by the software and utilized for subsequent analysis. Reliability of the questionnaire was calculated using Cronbach's Alpha.

Based on the methodology applied by previous authors, simple linear regression was performed for each of the factors Perceived Usefulness (PU), Perceived Ease of Use (PEOU), Perceived Enjoyment (PE), Social Norms (SN) as well as Smart Phone Usage, Gender and Age as independent variables with Intention to Use (IU) as the dependent variable to test the hypotheses described before and which are illustrated in the figure below (see Figure 4). In the case of valid assumptions, a subsequent multiple linear regression was performed using a backward-entry method and the model with the highest fit was chosen.

The degree of acceptance (overall Intention to Use, IU) and overall enjoyment scores (Perceived Enjoyment, PE) were also calculated, displayed in charts and stratified by previous Smart Phone Usage.

Results

Sample Description

72 subjects (n = 62 female; n = 10 male) were recruited for our study and fulfilled the inclusion criteria. The age of our participants ranged from 60 to 91 years. The characteristics of the sample stratified by age groups are shown in Table 1.

Age	60-65	66-70	71-75	76-80	81-85	86-90	91+
Number	5	4	10	46	3	3	1

Table 1: Number of participants stratified by age group.

Descriptive Statistics

The mean score for each of the variables Perceived Usefulness (PU), Perceived Ease of Use (PEOU), Perceived Enjoyment (PE), Social Norms (SN), User Experience (UE) and Intention to Use (IU) as well as their standard deviations are displayed in Table 2. Scores ranged from 1 (completely disagree) to 5 (completely agree).

	PU	PEOU	PE	SN	UE	IU
Mean	2.00	4.46	4.37	1.77	3.84	2.15
Standard deviation	1.27	1.15	1.08	1.13	0.78	1.22
Minimum score	1	1	1	1	1	1
Maximum score	5	5	5	5	5	5

Table 2: Mean score, standard deviation as well as minimum and maximum score for each of the six examined factors proposed by UTAUT.

The percentage scores for each of the variables were calculated and are presented in Figure 1.

- 46 % of subjects thought that VR was useful in their daily life.
- 80 % thought VR was easy to use.
- 76 % thought VR was enjoyable.
- 28 % were encouraged by significant others to use the technology.
- 78 % thought the user experience was user-friendly.
- 48 % agreed that they intended to use the technology in the future.



Figure 1: Summary of the responses by the participants in terms of percentage.

The scores for Intention to Use (IU) and Perceived Enjoyment (PE) are also displayed stratified by previous Smart Phone Usage in the box plots of Figure 2 and Figure 3, with the median values made visible through the lines within the plots.



Figure 2: Score for Intention to Use (IU) VR technology stratified by previous Smart Phone Usage.

Figure 3: Score for Perceived Enjoyment (PE) of VR technology stratified by previous Smart Phone Usage.

Regression Results

Perceived Usefulness ($\beta = 0.832$, p < 0.001) and Social Norms ($\beta = 0.730$, p < 0.001) were shown to significantly predict the Intention to Use VR technology. User Experience influences Perceived Usefulness ($\beta = 0.640$, p < 0.001) and it also influences Perceived Ease of Use ($\beta = 0.333$, p = 0.004).

Perceived Ease of Use was not shown to influence Intention to Use ($\beta = -0.092$, p = 0.442) and the factor also does not influence Perceived Usefulness ($\beta = -0.181$, p = 0.128) in our sample. Perceived Enjoyment ($\beta = -0.050$, p = 0.677) does not influence the Intention to Use VR.

Age (β = -0.485; p < 0.001) and Gender (β = 0.350; p = 0.003) significantly predict the Intention to Use VR. Smart Phone Usage does not influence Intention to Use (β = 0.032; p = 0.788), but it predicts Perceived Enjoyment (β = 0.587; p < 0.001).

The variable β describes the coefficient of the respective regression model, meaning that for every increase in the independent variable (e.g. PU, PE) the dependent variable experiences an increase of β units. The variable p signifies the p-value, whereby a value below 0.050 represents a statistically significant result. The results of our regression model are displayed in Figure 4.



Figure 4: Results of the regression model. Lines represent significant influence of variables on Intention to Use (p < 0.050). Dotted lines signify lack of significant influence of a factor. Thickness of line represents strength of influence.

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Our data did not violate the assumptions for multi-colinearity, and we were thus able to apply a multiple regression model using a backward-entry method in addition to the statistical methods described above.

After adjusting our regression analysis and choosing the model with the highest fit, only Perceived Usefulness ($\beta = 0.395$; p = 0.003), Social Norms ($\beta = 0.255$; p = 0.008) and Age ($\beta = 0.242$; p = 0.041) were shown to influence the Intention to Use VR, a result similar to the one found in our simple regression models.

Discussion

Interpretation of Our Results

While overall levels of enjoyment were relatively high (76 %), Intention to Use Virtual Reality was moderate with only 48 % of users indicating that they would like to work with the technology in the future, which we used as a measure for overall acceptance of VR. It is thus important to further analyze the determinants of technology acceptance in our sample. The results suggest a significant influence of the constructs Perceived Usefulness (PU) and Social Norms (SN) on the Intention to Use (IU) VR technology in a sample of older adults and particularly stable effects of Perceived Usefulness (PU), Age and Social Norms (SN).

Perceived Usefulness (PU) consists of perceptions of utility such as in daily activities, meaning that subjects were able to imagine using the technology in their daily life, and for facilitating the completion of tasks. This notion is also supported in the literature at large and was postulated to be an important predictor for the acceptance of various technologies in the original model (Venkatesh et al., 2012) as well as in previous studies of VR (Syed-Abdul et al., 2019). In the present work, Perceived Usefulness was the most important factor in predicting Intention to Use VR.

Perceived Enjoyment (PE) refers to positive emotions related to technology usage, sometimes referred to as hedonic motivation (Venkatesh et al., 2012). This factor was added in subsequent iterations to the model, and it aims to measure the pleasurable aspects of technology utilization. The effect of enjoyment is not supported by our research in older adults and should receive more attention, as we did not find a significant relationship of PE with Intention to Use, while overall enjoyment levels were very high. This is especially important since Perceived Enjoyment was not included in the original model (Davis, 1989) and was sometimes seen as related to Perceived Ease of Use (PEOU). Moreover, User Experience (UE), the degree to which the user interface was perceived as user-friendly, influences both Perceived Ease of Use and Perceived Usefulness (PU). This demonstrates that manipulations of the User Experience can significantly impact the Perceived Usefulness of VR and thus the Intention to Use is independent of its actual usage in performing important tasks.

Social Norms (SN) measures the extent to which significant others such as family members and friends encouraged our participants to use the technology, and this too was found to influence usage intentions in our research. These results support findings in the literature where Social Norms predicted the acceptance of several forms of technologies in a variety of samples (Yau, H. K., & Ho, T. C., 2015). Social ties were specifically shown to impact acceptance of VR in a similar line of research using the TAM model (Lee, Kim, & Choi, 2019), and it was also demonstrated that social perception was heavily influenced by Perceived Enjoyment (PE).

While Perceived Ease of Use (PEOU), the extent to which subjects did not experience difficulties with using the technology, is an important factor in the Technology Acceptance Model (Venkatesh et al., 2012) and was seen to determine acceptance of technologies

across studies, its relevance was not shown in the present work. Similar results were also observed by others (Sagnier, Loup-Escande, Lourdeaux, Thouvenin, & Valléry, 2020), where no significant influence of Perceived Ease of Use in the acceptance of VR technology was found. This could in part be due to the characteristics of our sample, but also due to the nature of Virtual Reality technology, where most subjects would indeed expect such novel technologies to be difficult to operate and which could have caused them to adapt their expectations. However, more research is needed to determine the role of ease of use among modern technologies such as VR and its relationship to Perceived Enjoyment (PE).

Age and Gender were shown to predict the Intention to Use VR. This assumption is supported by our data, with a negative coefficient for the factor Age, suggesting lower usage intentions among older participants. Longitudinal studies of technology acceptance in older adults, using TAM in a healthcare context, have shown that age influences relevant study outcomes, which is mainly due to the cognitive demands of the technology and psychomotor difficulties related to actual system use (Murugesh-Warren et al., 2015). These mechanisms likely influenced our target group and may be related to the low Perceived Usefulness (PU) of the technology. Research comparing generational effects on technology acceptance has shown that determinants such as effort expectancy may themselves play a substantial role, especially in samples of older adults (Magsamen-Conrad, Upadhyaya, Joa, & Dowd, 2015). Indeed, the influence of effort expectancy may help to explain the missing effects of Perceived Ease of Use (PEOU) and Perceived Enjoyment (PE) in our study. Future research should thus focus on identifying the mechanisms underlying age-related challenges and provide solutions to remedy a possible sense of apprehension. The effect of Gender may also be attributed to Age, as most of our sample was primarily composed of female participants (see sample description). Gender has been largely regarded as a moderator in prior research (Khechine, Lakhal, Pascot, & Bytha, 2014), but it is unclear if it has affected the results of our study independently of the characteristics of our sample.

We further hypothesized that Smart Phone Usage, a factor we applied as a surrogate for prior experience with technology, would influence technology acceptance. Despite our assumptions, Smart Phone Usage did not significantly influence usage intentions in our sample. This indicates that prior experience with modern technologies such as smart phones is not a prerequisite for the acceptance of VR.

Special attention should be paid to Age, Social Norms (SN) and Perceived Usefulness (PU) which, in addition to exhibiting the highest predictive values, were also shown to predict Intention to Use (IU) in our multiple regression model where we have also accounted for the influence of other salient factors.

Limitations

Our study was performed with a large sample of older adults, but due to the pandemic, the number of participants in the age ranges 60 to 70 and 81+ was relatively small. We also have yet to calculate interrelations and thus indirect effects between the factors using structural equation modelling. This study measured the usage intentions of our participants and although these are associated with actual usage, intentions are typically not a perfect predictor of behavior due to the "intention action gap" (Sheeran & Webb, 2016). Future research should investigate VR acceptance in older adults applying a long-term approach to ensure usage intention did translate into future behavior. Researchers could also identify the role of Perceived Ease of Use (PEOU) and Perceived Usefulness (PU) using longer time frames to create situations where the technology could be applied to facilitate daily activities.

Summary and Future Goals

Acceptance of VR is moderate, with 48 % of our sample intending to use the technology in the future, and although enjoyment levels are high, the variable enjoyment itself does not predict users' behavioral intention to apply the technology hereafter. Practitioners and clinicians that intend to utilize the glasses in samples of older adults should think of ways in which VR could improve activities of daily living and be perceived as useful. They can also emphasize its utility for future users by improving the User Experience to increase perceptions of usefulness irrespective of the practical applications, as there is a direct and significant path between User Experience variables such as user-friendliness and the Perceived Usefulness of the technology. Acceptance will also be affected if significant others such as family members, peers and friends support the user's adoption of such devices. Although Perceived Ease of Use and Perceived Enjoyment are important factors in technology acceptance overall, their roles appear to be overestimated with regards to VR. Prior experience with technology such as Smart Phone Usage does not impact the Intention to Use VR and is thus not a requisite factor for its acceptance. Future research should focus on explaining age-related declines in technology acceptance and identify reasons for the absent effects of Perceived Enjoyment and Perceived Ease of Use in our study, perhaps adjusting VR-related adaptations of the Technology Acceptance Model.

Clarify

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Self-reflection

We are now looking back at twenty-three months of an active scholarship program at the TUM: Junge Akademie and being part of Team Clarify. Back in 2019, we started our journey as a team of six students enrolled in diverse fields of study: Brewing & Beverage Technology, Engineering Science, Health Sciences, Industrial Biotechnology, Informatics and Mechanical Engineering. This interdisciplinary environment always helped us to find innovative solutions to very diverse questions that emerged along the way and encouraged us to view problems from different perspectives.

What definitely brought us together at the Kick-off event at Lake Kochel was our initial project idea about science communication and working with children or young adults on common misunderstandings. We started from a joint observation: engagement with and openness towards science and modern technologies is not distributed equally among different groups of citizens in Germany. Our start, however, was a bit bumpy, because we all came up with a lot of diverse, very promising ideas and often shifted between decisions. Maybe we were just a bit overwhelmed by the project itself and all the possibilities that the TUM: Junge Akademie offered us.

During exhaustive research at the very beginning of our project work, we discovered that a lot of studies already dealt with our desired target group. This finding was a huge setback, but we did not hesitate for long and started considered investigating the elderly population instead. Even though some team members were not happy with this shift in our topic, every one of us realized that identifying a research gap was essential for the success of our project. Over time we noticed that understanding technology acceptance in older adults is vital in making the most out of its potential applications and now, at the end of our work, everyone is very happy about the chosen target group. Another issue we had to deal with was the question of how to integrate an artistic component into our project, since our call "Technology & Arts" had to be taken into account as well. Therefore, the idea came up to utilize art as a medium to inform elderly citizens about technology, for example by producing an entertaining video.

Mrs. Schmidt, who supported our work as one of our supervisors, gave us a reference to Granny Vision GmbH in the very early stages of our project. This hint helped us a lot because we were able to establish a cooperation with them, which changed our topic completely. Thanks to our partner company, who is working in the field of providing VR for senior citizens, we found a common ground for our project that every member was very excited about, and we were able to clarify our final research question: Which factors influence technology acceptance in older adults? From that moment on, we had a clear vision about our topic, a goal every member wanted to achieve and a strong partner that assisted us in executing our project.

Unfortunately, by that time, the Corona crisis had come along, and reaching our target group by visiting elderly homes in and around Munich seemed impossible, because senior citizens are the most endangered group of people for a severe disease progression. We even tried to get in contact with some facilities via the phone, but the conversation ended as soon as we mentioned that we would like to talk to the residents to conduct research. One point we learned during that phase is that solving problems and not giving up when obstacles arise is essential to accomplish a project. So, we modified our procedure and decided to contact the network of the TUM: Junge Akademie to acquire participants to whom we could show our VR tour. It turned out that in this way, we were even able to provide relatives and grandparents of scholarship holders with some fun during the hard times of the pandemic and to take them on a virtual adventure. We all found that a very nice side effect of our project!

All in all, we are grateful that our team was able to work together in such a productive way. Every member finished his or her tasks very reliably, and we always found an acceptable compromise if someone had a different opinion about a certain topic. Important points that all of us have learned during the last twenty-four months are how to express problems and opinions clearly and concisely and how to improve time management and become more efficient. This is also linked to very positive and essential aspects of our teamwork: Communication is key! And agendas are very useful! We always respected each other, were understanding and empathetic and every member was intrinsically motivated to bring our project to successful completion. Of course, we could have defined our exact topic a bit earlier, which would have given us more time to concentrate on the execution of the project. Also, deadlines shifted a lot during our work. But in the end, we always reached our goals, and we never had substantial doubt about that point.

Acknowledgments

A very special thank you goes to our tutors, Sabrina and Yuki, who gave us a lot of freedom and who were always there to help us if we were really stuck on something. You answered all our questions at any time – regardless of whether they referred to our project or we just needed some general information. And you even attended our team-building events! We would also like to acknowledge our supervisors, Prof. Dr. Pittich and Mrs. Schmidt. Your input, al-

though (or precisely because) it was critical at times, pushed us to improve the scientific basis of our research, and you always gave experienced advice and feedback when we asked for it.

We say thank you to every participant of our study and we hope you enjoyed our virtual tour around Munich. This was only achievable due to the scholarship holders of the TUM: Junge Akademie who brought us into contact with their relatives, and the ASZ Sendling and Moosach of AWO Munich that added our project to their program for senior citizens.

Thanks a lot to our partner company Granny Vision GmbH. All of this would not have been possible without you. Thank you for the collaboration!

Thanks also to Christoph Reitzle who supported us in taking 360° pictures from the Thiersch tower for our VR tour. We and all our participants had a marvellous view over Munich from TUM's most famous landmark. In addition, we want to thank the TUM Sprachenzentrum, Annalena Huber, Samuel Valenzuela and Robert Kurth for back-translating our questionnaire to English. This was a very crucial step in the scientifically substantiated execution of our research.

Last but not least, we would like to express deep gratitude to the whole team of the TUM: Junge Akademie, especially to Prof. Dr. Gerhard Müller and to Peter Finger, who gave us the unique opportunity to be a part of this extraordinary scholarship program. Thank you!

Clarify

1. PROJECT GOALS

We want to significantly increase the openness towards new technologies of the residents in two retirement homes and facilities for assisted living until January 2021 by presenting artistic content via VR.

- The elderly will be presented artistic content such as painting-classes or tours of different museums.
- The residents will fill in questionnaires about the alteration of their openness towards modern technologies before and after the VR-sessions. We will evaluate these questionnaires to measure the change.

We will also measure constructs related to wellbeing (positive effect, perceived competence or enjoyment) as well as other responses e.g. appreciation of science or art.

We also want to spark engagement with science and technology.

S. TIME SCHEDULE Image: Schedul

2. PROJECT STRUCTURE PLAN

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POSTER 1:

Our first poster presents the initial goals of our project "Clarify", the project structure plan (PSP) we had framed at this early stage of our work, and a time schedule resulting from that agenda. The overall idea of our study was to integrate art or artistic content into the very exciting research field of "Science Communication" to spark engagement with science and new technological approaches. In May 2020, we had already decided on our target group and on the technological instrument we would like to utilize in our project. Since we observed that in this scientific area, children and younger adults are an already closely investigated audience, we were able to identify a research gap in the relative lack of attention to the elderly. We wanted to reach this rather heterogeneous group of people by visiting retirement homes in and around Munich between October and December 2020. During these meetings, our plan was to present different forms of art through Virtual Reality (VR) to increase the participants' openness towards modern technologies. The virtual content was not clearly defined at this time, but we considered formats like videos, paintings, poems, or photos and thought about interactive approaches as well. To measure the impact of our project among our target group, we took the research method of guestionnaires into account, which would be filled out by the participants before and after the intervention.
Clarify

OUR RESEARCH QUESTION

Does the presentation of art through VR media influence technology acceptance in older adults? Which factors affect it the most?

WHERE WE STAND - CURRENT EVENTS AND RESULTS

Our very first results start with the selection of a research direction and cooperation with Granny Vision GmbH, a company specialised in providing VR solutions for senior citizens. We have since designed a VR tour through Munich with Granny Vision GmbH, received several VR glasses and developed a prototype that we can demonstrate to future partners.



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In terms of networking, we presented our project to potential partners at the event Granny Vision Tea Time and intend to appear at the Medientage München, an online event for various Tech initiatives. We have also been in touch with chairpersons from the Faculty of Sport and Health Sciences to establish contacts with nursing homes and have generally received positive responses. We plan to visit the Senior Advisory Board in Augsburg this October. After some initial uncertainty about the research methods, we have found the Usene Tercey or Acceptance we Use or Tercencor by Venkatesh et al. 2012 (UTAUT2) (see Figure 1) to be an appropriate theoretical framework for our project. We are currently translating our questionnaire and preparing the pilot study to validate the instrument.

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ADAPTING OUR APPROACH

It is possible that the current COVID-19 restrictions will impose a significant cap on the number of participants we can recruit for our study. An alternative solution will be to use interviews with a select number of participants and perform qualitative analyses that still fall under UTAUT.



OCTOBER 2020

MEMBERS Julia Angerez Magdalma Baser, Man Cusol, Anaterni Murroud, Jan Luca Scherrer, Mohamed Sholer TUTORS Soberezineer, Yuko Nepr SUPERVISORS Port Dr. Duriel Pittoh, Sile Scherrich, Pot. Dr. Michaela Kristeen



POSTER 2:

The second poster, which was released five months after the first one, presents our latest results at this stage of our work as well as our research question: Does the presentation of art through VR media influence technology acceptance in older adults? To ensure the technically correct implementation of our project, we cooperated with Granny Vision GmbH, a company specialized in providing Virtual Reality solutions for senior citizens. Together, we prepared a VR tour through Munich by taking 360° pictures of the most famous and lovely places of the city that would serve as the artistic content for our events. Furthermore, we recorded audio tracks to intensify the Virtual Reality experience that would be displayed on the seven VR glasses we received. Due to the ongoing Corona pandemic, we kept in mind that reaching our target group could be difficult during the next few months, since elderly people belong to a high-risk group in relation to the disease. Nevertheless, we did not want to change the audience which our project was aimed at, because we saw great potential in our approach. In terms of the research method, we identified the Unified Theory of Acceptance and Use of Technology 2 (UTAUT2) as an appropriate theoretical framework for reaching our defined goals, because this Technology Acceptance Model (TAM) aims to explain the intentions to use technology and the subsequent usage behavior.

Clarify

1. WHAT OUR RESEARCH IS ALL ABOUT

New developments like Virtual Reality (VR) can be applied in clinical settings such as rehabilitation and there is evidence that using such tools can have positive effects on wellbeing. Even though the acceptance of VR has been studied in various groups, technology acceptance among older adults remain largety unexplored.

Our team wants to find out which factors influence techour team varies of and our which accors immence tech-nology acceptance among the elderly and can fluxs predict usage intention. We test the hypotheses of an established framework, the Unexp Tester Acceptor and Usace Technicular (UTAUT) and will examine the effects of additional factors such as Smartphone Usage, Age and Gender

RESEARCH QUESTION:

hich factors influence technology ceptance in older adults?

2. WHERE WE STAND AND WHAT **BROUGHT US HERE**

We finished translating the questionnaire, improved our VR four and sent out the devices to our participants to avoid direct physical contact with them. This allowed us to recruit more than 40 subjects so far and we intend to reach more participants this summer

3. OUR MOST IMPORTANT RESULTS



solgiects thought the technology was useful in their duity life, eggl/ if was easy to use. 62 % Despit it was enjoyable. 30 % were encouraged by others to use the inclinategy 70 % Despit the user experience was over triandy. right the unior experience was unor-friendly. reed that they intended to use the tooknology in the laters



999 B.	

4. NEXT STEPS

We already met with decision makers at the AWO in Moosach who offered to present the isses during social events this summer once the restric-tions are eased. Therefore, it is possible that our results might change a fair bit, since a larger number of participants will lead to higher statistical power and increase the likelihood of detecting an existing effect.



MAY 2021

ТШП

POSTER 3:

In May 2021, we were able to present our third poster, which already includes primary results from our research. By that time, the content for our VR glasses had been finalized and we were ready to show our virtual city tour to senior citizens. Due to the ongoing Corona pandemic, it was impossible to visit residents in elderly care homes, which was our initial means of recruiting participants for our study. Nevertheless, we succeeded in circumventing this hurdle by reaching out to the network of the TUM: Junge Akademie and lending the glasses to active scholarship holders who then introduced their families and friends to the VR technology. Using the information we received from these first 40 subjects, we were already able to test our theoretical framework and familiarize ourselves with the evaluation of the generated data. The most striking results we saw were the facts that 71 % of the elderly thought the VR glasses were easy to use and 63 % found it enjoyable, demonstrating that nobody is too old for trying out a new technology. We were also able to show that Perceived Usefulness, Social Norms and Perceived Enjoyment significantly influence the Intention to Use VR among our participants. This provides an important insight into factors that should be considered when inventing technology specially designed for the use by elderly people. As a next step, we aimed to reach more participants during the summer, hoping to increase the statistical power of our research model.

MEMBERS

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TUTORS

Clarify

SUMMARY

New technologies can confer many benefits to elderly people. Virtual Reality (VR) has many potential chinical applications such as in rehabilitation, in saddition to producing positive effects on well-being and cognitive processing (1). However, scarce re-search exits with regards to the adoption of such technologies by older adults. We applied the Unified Theory of Acceptance and Use of Technology (UTAUT) to identify predictors of future usage intertions of VR is a sample of older adults.

73 subjects aged 60 to 91 years were recruited for our study. Participants took part in a Virtual Reality tour through Munich. Participants tool, par in a virtual rearry too through where, Germany, and filled out a questionnaive hanalated into German how prior research. Single regression was performed for each of the variables with Internton to Use (IU) as dependent variable (see Fig. 3)

The results of this study support the notion that Perceived Usefulness and Social Norms influence technology acceptance. Close attention should be paid to perceptions of usefulness. encouragement by significant others and age when addressing groups of older adults.



ТЛП

Figure 2: Score for Intention to Use (IU) VR technology stratified by previous Smart Phone Usage

Figure 3: Results of the regression model. Lines represent significant influence of variables on Intention to Significant influence of variables on internot of Use (p < 0.060). Dotted lines significant influence of a factor. Thicknoss of line represents strength of influence.

On a scientific level, our results can help to improve the gen-eralizability of the theory (UTAUT) and explain group-specific predictors of facturalizing acceptance, paring the way for new er iterations of the Technology Acceptance Model (TAM) (5). Practitioners such as clinicians and producers of VR glasses for older adults can benefit from our results and put special emphasis on the features social norms (encouragement by sig-inficant others), perceptions of usefulness and user experience

73 % of our participants enjoyed using the technology. The VR glasses and our custom VR tour are still reacify available at the TUMJA office and could potentially be used in larger settings such as elderly homes. We have also met with interested. such as every norms, we never also may with with interested participants after submitting our research results and will likely do so up to the symposium. Moreover, our partner Granny Vision CantoH will contenue to other VB including our tour around Manich to elderly people and may benefit from our findings.

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	SEPTEMBER 2021
kalarini Mavroudi,	inspired by

POSTER 4:

At the Symposium in October 2021, we finally presented our fourth poster including the concrete outcome of our study, a graphic visualization of our research life cycle as well as project partners and stakeholders. During the summer, when the restrictions due to the Corona pandemic were eased, we were able to acquire about 30 additional participants for our work, resulting in 72 subjects in total. We reached this goal by visiting two elderly care centres, namely ASZ Sending and ASZ Moosach of AWO Munich, showing our VR tour to a diverse group of elderly people outside of the TUM: Junge Akademie network. After evaluating our results, we found that the aspects Perceived Usefulness, Social Norms, Age and Gender have a significant impact on the Intention to Use VR technology in our sample. In contrast to that, prior experience with technology such as Smart Phone Usage does not influence the Intention to Use VR and is thus not a requisite factor for its acceptance. As a recommendation for practice, practitioners and clinicians who intend to utilize the glasses among older adults should think of ways in which VR could improve activities of daily living and be perceived as useful. They can also emphasize its utility by improving the user experience to increase perceptions of usefulness irrespective of the practical applications, as there is a direct and significant path between user experience variables and the perceived usefulness of the technology.



Project Report **Exfluenced**

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Preface by the Supervisors

Prof. Dr. Stephan Jonas and Prof. Dr. Helmut Krcmar

Almost one third of the time people spend on social media is unintended, resulting from a lack of self-control.¹ This time, unwillingly spent in front of a screen, could just as well be spent meeting friends, doing sports, doing homework, or studying for university exams, potentially making a difference in people's lives in the real world.

With the increasing reach of social media platforms such as Facebook, Instagram, and TikTok, we have yet to grasp the full extent of negative implications these platforms can have on people's lives. One of the negative implications is social media addiction. In particular, young people are at risk as children, teenagers, and young adults are exposed to social media as early as in elementary school. While the mechanisms are not fully understood yet, increasing social media usage has been linked to loss of concentration, sleep deprivation and decline in school performance, along with a wide range of mental health issues.

When we were contacted by the TUM: Junge Akademie team Exfluenced, we were immediately convinced that their goal to target social media addiction was important and timely. In the course of the project, the team first developed a better understanding of the issues associated with social media usage by conducting interviews with experts from the field. Then, the team focused on Instagram, highlighting, amongst others, the phenomenon of influencers. With their own social media campaign, the team raised awareness for social media addiction and ways social media content can influence our decisions – an issue that becomes even more crucial in the context of the COVID-19 pandemic and related fake news that are omnipresent on social media platforms. Based

1 Allcott, H.; Gentzkow, M.; Song, L. (2021) Digital Addiction. NBER Working Paper 28936, https://www.nber.org/papers/w28936. on their work, the team developed a social media detox training that aimed at educating participants about the risks of social media usage and the importance of being aware of and in control of their social media usage. The team conducted a scientific evaluation of the detox program by implementing a cross-over study mostly among university students.

The project results show that there is no easy answer for the threat that social media poses for the mental health of its users. A detox program such as the one developed by the Exfluenced team might have positive effects when extended and refined. In particular, it could give users more self-control in their consumption of social media. However, a broader strategy is needed to target social media addiction early on and to help children, teenagers, and young adults to become more selfaware with regard to social media consumption. Besides the users, stakeholders such as parents, schools, universities, and regulatory authorities need to be involved to identify the most vulnerable groups and develop strategies on how to mitigate the risks social media consumption poses for these groups.

We are convinced this project contributes to an increasingly important discussion on social media usage. This discussion needs more attention – not the least at TUM, to ensure the wellbeing of our students.

My journey of becoming more exfluenced

Like most 22-year-olds, Mia spends a lot of her time on Instagram to browse for inspiration. By chance, she discovers the project Exfluenced, which raises awareness about unhealthy social media usage on their Instagram account and provides a 7-day detox program to increase users' self-competence regarding Instagram.

Here is Mia's story:

"Brunch is always a good idea!" Choosing a good Instagram caption is an art. Since I have not been active posting on Instagram lately, I need to deliver with my next post and a witty caption is a great start.

I am sitting in a trendy cafe that an influencer recommended to find out what all the buzz about their famous brunch is about. While my friend is talking about some dress she bought which looks similar to what her favorite celebrity wore, I start looking around. At the table right next to us are two girls who seem like they walked straight out of my Instagram feed. Of course, the waiter puts avocado toast and an Instagram-worthy smoothie bowl on their table. Before they even touch the food, they arrange their plates and take pictures. I am sure all of their followers will see these in their Instagram stories with a filter and a pretty caption about meeting their best friend for brunch as well. My friend excuses herself to go to the bathroom after rambling all about her new celebrity crush. I take out my phone to check out his Instagram. After finding out that he is not my type, I catch myself on my explore page. After Instagram shows me another video where someone tells me a lifehack I already know, I see a post from a page called @exfluenced.¹

Maybe, I actually should stop scrolling for today... Thinking that a daily reminder cannot hurt, I check out their account and find that they offer a free 7-day detox program on www.exfluenced.com. Fearing becoming one of the girls on the table next to us, I decide: why not give it a try?

DAY 1: INTRODUCTION

I am welcomed by the words from influencer and author of the book "How Social Media is Ruining Your Life" Katherine Ormerod: "If we continue to use social media the way we have been, we will seriously jeopardize our future health and happiness" (Ormerod, 2018). Wanting to decrease the impact of social media on my life, I am looking forward to the next days.



1 Link: https://www.instagram.com/p/CMZ3za5h8dH/?utm_source=ig_web_copy_link

DAY 2: TESTIMONIALS FROM OTHER USERS

I was always judging myself for spending too much time on social media and failing to get myself out of the endless vortex of content on Instagram. The longer I listen to the words of other Instagram users in the interview series, the more I understand: I am not alone with this, others are struggling as well. Sometimes we do not even notice the impact of Instagram. I realize how the three interviewees deal with reducing screen time and being less controlled by the urge to check their Instagram feed.

DAY 3: A DAY IN THE LIFE OF AN INFLUENCER

Posting pictures of your holiday and getting paid for it? The job of an Influencer sounds tempting, but as most of us know: there is a gap between what we see online and what in reality it really looks like. Did you know that only 14% of posts by Influencers are correctly marked as ads? That's insane! (Geyser, 2021) As I step into the role of an Instagram influencer in an interactive online game and deepen my knowledge about influencer marketing, I realize that money and followers come at the cost of authenticity.

DAY 4: INTERVIEW WITH PROFESSOR HENNINGSEN

I have read articles about the consequences of excessive social media use on mental well-being, but so far, it seemed more like fear-mongering to me. The interview with Peter Henningsen, professor for Psychosomatic Medicine and Psychotherapy at TUM, gave me a new perspective on the complex relationship between the online world and our health.² It seems to me that we often tend to oversimplify the mechanisms at play.

"[Fear of missing out] is a normal thing which has existed before but is now amplified by this technical medium."

Reading this, I realize that even before social media, I was mad when I missed a night out with my girls. However, I regularly check out Instagram to know what others are doing. I understand now the importance of keeping in touch with my friends offline. Don't get me wrong – it is nice to be able to text them at any time, but it is totally different to interact with them in person.

DAY 5: DIGITAL WELL-BEING

I watch the videos explaining fear of missing out, addiction, mental health in connection to social media and productivity. It is fascinating how one small app influences many aspects in our life. The self-reflection questions make me aware of how much Instagram has affected my mental health and productivity. The latter especially always bothered me. Maybe that is why I can't get my seminar paper done...

Hopefully this will change by implementing the helpful tips, especially the one about turning off notifications. Not getting any of these helps a lot with not opening Instagram and finding myself endlessly scrolling afterwards.

I also put a screen-time limit on Instagram. It is easy to bypass, but just that pop-up that I have reached my limit helps me to close the app. Another tip that I really liked was unfollowing all the accounts that do make me feel bad.

DAY 6: INTERVIEW WITH WIENKE STRATHERN

Today provided an interesting change in scenery for me. Wienke Strathern, a Ph.D student and research associate of Computational Social Sciences and Big Data at TUM, talking about the dynamics of social networks showed me a different side to the implications of my own use.³ It used to make me wonder why people would go so far as to insult or threaten another person online. Wienke offered me another look at it: such behavior is often driven and even encouraged by social networks to keep its users constantly involved. It always seemed crazy to me that some of my friends believed in conspiracy theories, but now I see that, through social media, they are often just one click away. And once you are in, there is no going back – echo chambers will keep feeding you similar content. But aren't we all living in our own bubble?

DAY 7: WHAT DO REALLY I KNOW ABOUT FAKE NEWS?

Spending a lot of time online, I - of course - know about fake news and would say that I am able to detect it. At the end of this journey, I find myself in the shoes of a journalist who gets confronted

with mis- and disinformation. The more I embrace this role in the interactive game, the more I learn about recognizing fake news and the algorithms of social media which facilitate echo chambers. It is scary, that a study even confirmed that fake news spreads significantly faster and further than true news (Vosoughi, Roy, & Aral, 2018). I really should be more aware of my own biases and of the fact that I am not immune to misinformation.

A week later, as I walk past the trendy brunch spot, I see a group of friends laughing about something on their phones. I have to smile, wanting to say to them: I know that I am one of you, but I am now aware of it and able to deal with it.

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Exfluenced



Effects of a 7-day social media detox program on Instagram usage: a cross-over study

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Discussion Strengths of the Study Limitations of the Study
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Abstract

We propose a 7-day interactive social media detox program which aims at educating participants regarding the influences of Instagram (psychological well-being, influencer marketing, political fake news).

We evaluate our detox program with a cross-over study. Participants, aged 18–28 years, were randomized into two groups. In the first two-week study period, Group 1 (n = 17) started with the detox program, while Group 2 (n = 21) did not receive the intervention. The allocation of the two groups switched in the second two-week study period. We employed a Wilcoxon test to evaluate differences of the average daily Instagram usage between the detox and no detox period for both groups, respectively. To test changes in eight further outcomes, all targeting experiences with Instagram usage, we carried out Friedman rank sum tests per group.

We observed no significant difference of the average daily Instagram usage between the detox and no detox period for Group 1 and Group 2 (p-value = 0.2091; p-value = 0.0544). Besides, only the variable "I felt I was in control of how much time I have spent on Instagram during the last 7 days" differed significantly in Group 2 between the baseline and the end of the study (p-value = 0.044) as well as between the start and the end of the second study period (p-value = 0.019).

We discuss the implications of our detox program on Instagram usage time and critical self-reflection on the basis of the accompanying study and formulate suggestions for future research based on limitations of the current study.

Introduction

The unprecedented rise of the internet has enabled an age of worldwide connectivity. Social media platforms like Facebook, Twitter, and Instagram have become the de-facto standard for communication – both for personal use as well as for information propagation (Dijck, 2013).

Social media platforms are a group of Internet-based applications that build on the ideological and technological foundations of Web 2.0 and that allow the creation and exchange of user-generated content (Kaplan & Haenlein, 2010).

They have become increasingly important in our lives: Today, the biggest social media platforms share a collective 4.2 billion users worldwide – more than half of earth's entire population (Kemp, 2021). In Germany alone, a reported 79% of the population actively participates in social media – a 13% increase since April 2020 (Kemp, 2021).

Social media networks facilitated the organization of grassroots movements like the Arab Spring (Wolfsfeld, Segev, & Sheafer, 2013), Fridays for Future (Boulianne, Lalancette, & Ilkiw, 2020; Brünker, Deitelhoff, & Mirbabaie, 2019) and Black Lives Matter (Cascante, 2019; Mundt, Ross, & Burnett, 2018). During the recent COVID-19 pandemic, users have relied on social media as a source of information and for a means of staying connected (Tsao et al., 2021). A reported 74% of surveyed users answered that social media helped them stay connected with family and friends during the pandemic (Kemp, 2020).

However, there have been growing concerns about the possible drawbacks of this media revolution. Social media has also enabled the viral spread of misinformation (Gabarron, Oyeyemi, & Wynn, 2021), more explicitly, the phenomenon known as "fake news" (Lazer et al., 2018), which refers to guided and intentional efforts to spread misleading media and information content on social media platforms. This motivated a large body of research investigating the possible influence of fake news on social media during the 2016 US presidential election (Allcott & Gentzkow, 2017).

Several studies have indicated that excessive social media usage is linked to mental health problems such as loneliness, anxiety, and depression (Keles, McCrae, & Grealish, 2020). Moreover, social media use can lead to a lack of sleep (Woods & Scott, 2016) and is associated with a negative body image and disordered eating (Holland & Tiggemann, 2016). Although not formally recognized, social media addiction shares many similarities with diagnoses of recognized addictions, including withdrawal, relapse, and mood modification (Andreassen, 2015). The possibility to continuously engage on social media, connected with the fear of missing out ("FOMO") (Przybylski, Murayama, DeHaan, & Gladwell, 2013), makes it increasingly difficult for users to exhibit self-control when it comes to usage reduction, especially when it conflicts with other goals and obligations, such as academic, career, or social life (Du, Koningsbruggen, & Kerkhof, 2018; Marker, Gnambs, & Appel, 2018; Ward, Duke, Gneezy, & Bos, 2017).

In addition, social media has sparked the rise of so-called influencers, online personas who have gathered a large following on a social media network (Khamis, Ang, & Welling, 2017). This has introduced a novel strategy for the advertising industry, known as "Influencer Marketing," which is based on a more personal and authentic approach to product marketing and is expected to generate \$13.8 billion in market capital in 2021 (Geyser, 2021). Online influencer marketing often blurs the borders between genuine content and advertising, which may increase the susceptibility to these forms of advertising (Lou, Ma, & Feng, 2021). In the past, many influencers have been found to violate existing rules for advertising, which has led to US federal agencies pursuing cases against some influencers (Lou et al., 2021).

Recognizing the possible dangers of excessive and uneducated social media usage, users have become more concerned with their social media usage in recent years. Hence, more than half of millennials and Generation Z individuals think social media does more harm than good. 60% think they would be happier and psychologically healthier if they reduced their interaction with social media. 40% would like to do without social media completely ("The Deloitte Global Millennial Survey 2019," 2019). Another survey finds that out of 4,438 surveyed, roughly 70% have been concerned with reducing their digital consumption (Paisley, 2018). Methods include the deletion of applications, taking short breaks, and switching off notifications.

It has been shown that by limiting social media usage, negative consequences like depression and loneliness can be reduced (Hunt, Marx, Lipson, & Young, 2018). Another study has found that a one-week social media abstinence trial can have a positive effect on perceived mental well-being (Brown & Kuss, 2020). Taking a one-week break from social media has also been shown to lead to an increase in sleep quality (Graham, Mason, Riordan, Winter, & Scarf, 2021). One of the most common practices for social media self-control was found to be modifying a feature on the device,

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such as activating airplane mode (Brevers & Turel, 2019). The authors of this study (Brevers & Turel, 2019) propose that promoting self-control can be a mediating factor for social media usage. A recent study revealed that 22% of students voluntarily disconnected from some social networking platforms for a period longer than one week, but returned to those applications shortly after (El-Khoury, Haidar, Kanj, Ali, & Majari, 2021). Here, Instagram was identified as the most difficult network to limit usage of. Another approach to smartphone detoxification involves the use of dedicated applications, that have been recently developed for this purpose. Most of these programs take the approach of monitoring the users' screen time and limiting access once a certain threshold is met (e.g., ("Flipd App," 2021) & ("Anti Social App," 2021)). The app "Binky" gives its users an environment that is designed to mimic social media apps. but without interacting with other people ("Binky App," 2021). This is meant to act as a pacifier for cravings related to social media. While these apps seem to have gained some popularity, the effectiveness of their approaches in reducing social media consumption amongst users remains unclear. We observed a clear study gap in this regard: None of the investigated apps had published analyses or evaluations on the effects of their respective methods.

The overall results of multiple studies hint towards a positive impact of social media usage reduction on mental well-being – however, not all managed to produce conclusive findings (Brown & Kuss, 2020; Graham et al., 2021; Hall, Xing, Ross, & Johnson, 2021; Hunt et al., 2018; Przybylski, Nguyen, Law, & Weinstein, 2021; Wezel, Abrahamse, & Abeele, 2021). For example, a recent study by Przybylski et al. (2021) found that a single day of social media abstinence did not have any significant positive effect on psychological well-being but rather decreased the level of social relatedness. Hunt et al. (2018) found that a three-week social media abstinence trial can lead to a decrease in depression. However, a study by Hall et al. (2021) indicated that a social media abstinence of up to four weeks did not improve daily well-being.

Recognizing that most previous studies (Hunt et al., 2018; Przybylski et al., 2021; Wezel et al., 2021) have solely focused on pure social media abstinence as a mean of incentivizing a healthier relationship with social media, we aimed to develop and analyze a holistic social media detox program which puts emphasis on educational and self-reflective aspects of social media detoxification in order to close this research gap ("Exfluenced," 2021). Our program is divided into three parts that we identified as significant for our target audience a priori: the concept of influencer marketing, the spread of misinformation, and psychosomatic consequences of Instagram usage. It is based on inoculation theory, which has shown promise in reducing susceptibility towards misinformation in the "fake news" intervention game Get Bad News (Roozenbeek, Linden, & Nygren, 2020). As such, we provided a combination of interactive lessons, useful tips, and expert interviews for the aforementioned topics (see the supplement for more details). In the accompanying study, we aim to investigate the impact of the proposed detox program. This type of intervention has not been studied before in the context of social media use.

Methods



Figure 1: Cross-over design and overall study outline

The study was carried out as a cross-over design with two groups and three time points, in total lasting 28 days. Weighted randomization to compensate high expected dropout rates was performed at baseline, with one-third of participants assigned to Group 1 and two-thirds assigned to Group 2. The study can be divided into two study periods, A and B. Online questionnaires to assess outcome variables were administered at the beginning of period A, between periods A and B, and after period B. In period A, Group 1 completed the detox program for the first seven days, followed by 7 days without intervention. Group 2 had no intervention in period A. In period B, the intervention assignment was reversed, with Group 2 completing the detox program in the first 7 days, followed by 7 days with no intervention, while Group 1 had no intervention (see Figure 1).

Recruitment

For the recruitment of participants, we used several approaches. A few participants could be acquired from the researchers' personal networks. Additionally, advertisements were published on Instagram and emails were sent to all faculties and student representatives of TUM. Other techniques constituted distributing flyers in student accommodations in Munich and publishing an article about the study on the news platform "DeinUpdate" ("DeinUpdate," 2021). To increase the motivation to participate, two forms of incentives were offered. First, a total of four vouchers were shuffled among all participants finishing the study. Second, the first 50 participants, who filled out all three questionnaires, were promised a 20€ reward.

Study population

We recruited 181 participants that took part in the survey. After exclusion of participants with missing data in the first questionnaire, data of 137 participants, aged 18–33 years (53 men, 84 women), remained for cross-sectional analysis. In respect of the longitudinal analysis, initially 90 participants were observed, who participated in the third questionnaire. Due to missing participation or missing data in either the second or the third questionnaire, double participation or wrong declaration of the identification code, data of 38 participants, aged 18–28 years (14 men, 24 women), remained for longitudinal analysis. From the 38 participants, 17 participants were included in Group 1 and 21 participants in Group 2.

Intervention

The web page ("Exfluenced," 2021), which hosted the detox program, was implemented using the JavaScript ("JavaScript," 2021) framework React ("ReactJS," 2021). In total, the detox lasted for seven days. Each day consisted of a 10–15-minute session using methods such as informative videos, interactive games, or expert interviews. A detailed description of the detox program can be found in the supplement. During the detox, participants were not encouraged to restrict their Instagram usage. The goal was that the usage behavior of participants would change automatically in response to an increased self-competence and expanded knowledge regarding the influences of Instagram in form of influencer marketing, psychological well-being, and political fake news.

Questionnaires

The survey consisted of three online questionnaires with two weeks in between each. All guestionnaires were created with the online survey tool LamaPoll ("LamaPoll," 2021). Participants were invited to fill out the questionnaires by receiving emails that included links forwarding them to our survey website LamaPoll. After registering for the detox program on our website, participants received the invitation to the first questionnaire. The invitations for the second and third questionnaires were each sent two weeks after the previous invitation. Only those participants were able to fill out the questionnaires who claimed to be \geq 18 years, assured us of being Instagram users, and agreed to the declaration of consent to the collection and processing of personal data. The questionnaires further consisted of creating an identification code word, which should have been used by the participants for all three questionnaires. Further guestions included the indication of Instagram usage time and eight questions regarding personal experience with Instagram.

Outcomes

In total, nine outcome variables were observed, of which one belonged to the continuous and eight to the categorical level. The continuous outcome was defined as the average daily Instagram usage time over the last 7 days. Participants were instructed to look up the exact time in the settings of their Instagram account. For further analysis, we used the mean change in the average daily Instagram usage for both time periods A and B (period A = 1. follow-up – baseline Instagram usage time; period B = 2. follow-up – 1. follow-up Instagram usage time). Outcomes assessed on a categorical level included the following self-administered items: "I felt I was in control of how much time I have spent on Instagram during the last 7 days"; "I feel good when I use Instagram"; "I feel bad about my life because of what I see on Instagram"; "I feel bad about my body because of what I see on Instagram"; "I use Instagram for procrastination (e.g. avoiding studying/working/ chores etc.)"; "I believe that the information on posts/pictures I see on Instagram is true"; "I believe the content on Instagram has an influence on my opinions on political matters"; "I think critically about the content I see on Instagram". Ratings of the items could be given on a 5-point Likert Scale, structured as: yes, very much; yes, kind of; rather not; not at all; I don't want to answer. In respect to coding, the most favorable outcome was always set to 0 (e.g., "I feel good when I use Instagram" - Yes very much) and to

Exfluenced

the least desirable outcome the value 3 was assigned (e.g., "I feel good when I use Instagram" – Not at all). Participants were excluded in the statistical analysis if they chose the option "I don't want to answer" in any of the eight categorical outcomes, due to low participant number in the respective category.

Statistical analysis

All statistical analyses were performed using R Studio, Version 4.1.0 (R Core Team, 2021). P-values < 0.05 will be used to determine if the conducted statistical tests show significance. In the cross-sectional analysis, we employed Spearman rank correlation tests to assess the correlations between all nine outcome variables derived from the first questionnaire. Due to the large number of statistical tests performed (n = 36), we adjusted the p-values for multiple testing using Bonferroni correction. In the longitudinal analysis, we applied all statistics tests stratified for Group 1 and Group 2. For evaluating differences between the periods A and B regarding the mean change in the average daily Instagram usage, we performed a Wilcoxon signed rank test with continuity correction since the assumptions for the paired t-test were not fulfilled. To test significant differences of the categorical outcomes between the three time points (baseline, 1. follow-up, 2. follow-up), we carried out the Friedman rank sum tests. As a consequence of the large number of statistical tests performed (n = 16), we again adjusted the p-values for multiple testing using Bonferroni correction. For all observed significant differences in categorical outcome

variables, we conducted post-hoc analysis using Nemenyi multiple comparison test.

Results

Cross-sectional analysis: correlation between the outcomes

Out of the 36 Spearman rank correlation tests between the outcomes, solely two tests demonstrated a moderate correlation (> 0.3) with significant p-values after Bonferroni correction. Hereby, the outcomes "I feel bad about my body because of what I see on Instagram" and "I feel bad about my life because of what I see on Instagram" showed a significant moderate correlation (rs = 0.42, Bonferroni corrected p-value = 1.39932e-05). Taking into account the coding of the variables, following direction of correlation applies to the variables: Feeling bad about one's body correlates positively with feeling bad about one's life because of what people see on Instagram.

Also, the outcomes "Average daily Instagram usage of the last 7 days" and "I felt I was in control of how much time I have spent on Instagram during the last 7 days" displayed a significant moderate correlation (rs = 0.43, Bonferroni corrected p-value = 5.0256e-06). Regarding this result, the following direction of correlation is given: A higher average daily Instagram usage correlated positively with feeling less in control of how much time one has spent on Instagram during the last 7 days.

Variable	Group 1 (n = 17)				Group 2 (n = 21)					
	Baseline	1. Follow-up		2. Follow-up	Baseline	1. Follov		2. Follow-up		
Average daily Instagram usage of the last 7 days (minutes)*	44.1 ± 46.8	33.1 ± 38.0		33.1 ± 38.0		44.7 ± 55.1	61.9 ± 36.9	71.6 ± 60.8		53.3 ± 50.0
	1. Follow-up - Baseline (Detox)	2. Follov 1. Follov		w-up - w-up (No detox)	1. Follow-up - Baseline (No de	tox)	2. Follo 1. Follo	w-up - w-up (Detox)		
Mean change in the average daily Instagram usage of the last 7 days (minutes)*	- 11.0 ± 32.8		+ 11.6 ± 40.5		+ 9.7 ± 40.5		-18.3 ± 34.3			

* Continuous variables are presented as mean ± standard deviation

Table 1: Average daily Instagram usage of the last 7 days (minutes) stratified by group

Longitudinal analysis: effects of the detox program on the Instagram usage time

Table 1 and Figure 1 display that the mean values of the average daily Instagram usage of the last 7 days of Group 1 and Group 2 demonstrate distinct differences. Group 2 encompasses a higher average daily Instagram usage of the last 7 days at all three time points. Therefore, we decided not to combine both groups in the further analysis, but to perform stratified analysis for Group 1 and Group 2 to avoid bias due to the high differences between the groups for unknown reasons.



Figure 2: Average daily Instagram usage of the last 7 days (minutes) for all three time points stratified by group. Group 1 participated in the detox between baseline and 1. Follow-up. Group 2 completed the detox between 1. Follow-up and 2. Follow-up.

In Group 1, the average daily Instagram usage of the last 7 days decreases on average for 11 minutes from the first questionnaire to the second questionnaire after all Group 1 participants performed the detox program. Between the second and third time point, the average daily Instagram usage of the last 7 days increased on average for 11.6 minutes. During this time period, the participants

did not perform the detox program. In Group 2, the average daily Instagram usage of the last 7 days increased on average for 9.7 minutes from the first questionnaire to the second questionnaire after all Group 2 participants did not perform the detox program. Between the second and third time point, the average daily Instagram usage of the last 7 days of Group 2 decreased on average for 18.3 minutes after performing the detox program during the first 7 days of the time period (see Table 1 and Figure 3).



Figure 3: Mean change in the average daily Instagram usage of the last 7 days for Group 1 and Group 2 $\,$

The Wilcoxon test revealed no significant difference between the two time periods (detox vs. no detox) for both Group 1 and Group 2 (V = 49.5, p-value = 0.2091; V = 157, p-value = 0.0544, respectively).

Longitudinal analysis: effects of the detox program on critical self-reflection, awareness concerning the influence of social media and influences on a personal level

Participant numbers of the categorical outcome variables can be assessed in the supplement, Table S1.

Variable	Group 1 (n = 17)		Group 2 (n = 21)		
	Friedman chi-squared	Bonferroni corrected p-value	Friedman chi-squared	Bonferroni corrected p-value	
I felt I was in control of how much time I have spent on Instagram during the last 7 days.	4.4	1.787	14.4	0.012	
I feel good when I use Instagram.	1.8	6.485	0.8	10.997	
I feel bad about my life because of what I see on Instagram.	5.1	1.223	6.5	0.606	
I feel bad about my body because of what I see on Instagram.	4.9	1.384	0.9	10.422	
I use Instagram for procrastination (e.g., avoiding studying / working / chores etc.).	2.2	5.416	1.3	1.159	
I believe that the information on posts / pictures I see on Instagram is true.	3.6	2.645	5.3	1.159	
I believe the content on Instagram has an influence on my opinions on political matters.	7.2	0.440	0.8	10.725	
I think critically about the content I see on Instagram.	2.8	3.946	0.5	12.181	

Bold print indicates significant results.

Table 2: Results of the Friedmann tests stratified by group

Referring to Table 2, the results of the Friedman tests of all categorical outcomes displayed solely one significant difference between the three time points (baseline, 1. follow-up, 2. follow-up) of the variable "I felt I was in control of how much time I have spent on Instagram during the last 7 days" in Group 2 (Friedman chi-squared = 14.4, Bonferroni corrected p-value = 0.012). The post-hoc test revealed that the significant differences appeared between baseline and the 3. follow-up (p-value = 0.044) as well as between the 2. follow-up (before detox) and the 3. follow-up (after detox) (p-value = 0.019). There was no significant difference between the baseline and the 2. follow-up (p-value = 0.949).

Discussion

Our study sought to examine the effectiveness of our 7-day detox program in decreasing the Instagram usage time as well as increasing critical self-reflection and awareness concerning the influences and effects of Instagram usage on a personal level.

In the baseline questionnaire two significant correlations were found. Firstly, spending more time on Instagram correlated positively with having less self-perceived control about one's Instagram usage time. Our result is in accordance with previous literature, where participants who scored higher in social media self-control failure used social media more often (Du et al., 2018). Additional studies found a significant negative correlation between self-control and social media addiction (Purba, Istiana, & Wahyuni, 2020) and found that impulsivity (as opposed to self-control) is positively affecting social media usage (Savci, 2016). Secondly, feeling worse about one's body while looking at Instagram correlated positively with feeling worse about one's life while looking at Instagram. This finding is corroborated by previous literature. People who were more satisfied with their appearance and weight reported greater satisfaction with life (Davis, Fowler, Best, & Both, 2020; Frederick, Sandhu, Morse, & Swami, 2016).

The longitudinal analysis revealed that our detox program had a qualitative reducing impact on the average daily Instagram usage time of the past 7 days, i.e., we found a mean change of -11.0 and -18.3 minutes in Groups 1 and 2, respectively. However, the statistical analysis showed that these changes were non-significant. One reason for that might be the high standard deviation in the Instagram reduction time, which could have been caused by the small sample size.

The only ordinal variable that differed significantly between the three points in time was the self-perceived control over one's Instagram usage time in Group 2. Reasons for the missing significant results in the other ordinal variables could be, again, the low number of participants and the possibly high inter-individual differences. Another possible reason could have been the limited intervention time of 7 days. Research indicates that on average 18 to 254 days are necessary to fundamentally change behavior (Lally, Jaarsveld, Potts, & Wardle, 2010).

Furthermore, a possible underestimation of the intervention effect could have occurred due to potential selection bias (e.g., homogeneous education level within participants). The results of the survey on the ordinal variables "I think critically about the content I see on Instagram" and "I believe that the information on posts/pictures I see on Instagram is true" at baseline indicate that participants might have been more critical concerning the content they see on Instagram and more interested in improving their relationship with Instagram compared to the average user to begin with. As a consequence, a major shift in behavior was potentially limited.

Previous research is focused on abstinence for establishing more control over social media usage (Hunt et al., 2018; Przybylski et al., 2021; Wezel et al., 2021), making a relevant positioning of our study difficult. Przybylski et al. (2021) found that one day abstinence from social media did not have any significant positive effect on psychological well-being, whereas another study (Hunt et al., 2018) showed that a three-week social media abstinence trial could lead to a decrease in depression. Thus, an extension of our 7-day detox program might prove to be more effective and yield more conclusive results. In the future, it would also be important to investigate long-term effects on Instagram usage behavior.

It is important to note that it is difficult for researchers to measure the entire screen time associated with one social media account, since devices and services only provide the screen time for a specific device. This means that it is not entirely possible to control whether users access the platforms using other devices. It should also be mentioned that our intervention differs from the previously discussed designs in the way that we did not strictly limit the use of these social media apps. Instead, we based our program on an educational approach, which has not been studied before in the context of social media use. The content addressed multiple topics that we identified as significant for our target audience a priori. It is likely that not all users of our intervention were equally interested in each section of our program, which could explain a weakening in the effects observed, since participants would be more inclined to drop out of the study.

Strengths of the Study

Using the cross-over design, participants act as their own control group, which reduces the necessary amount of study participants. Another advantage of our study is that we surveyed both, categorical and continuous, data. The large sample size of the cross-sectional study is another advantage. Besides, the anticipated higher dropout rate in Group 2 was counteracted by using a weighted randomization technique for allocating study participants. In addition, each participant was instructed to look up their own Instagram screen time through their settings providing us with an objective dependent variable. This was done in accordance with results of a recent study which has shown that users tend to overestimate the duration of their own usage (Verbeij, Pouwels, Beyens, & Valkenburg, 2021).

Limitations of the Study

Our study design does not allow insights into long-term effects of the detox program. Additional follow-up surveys would have been necessary for that. Also, in our study we observed a relatively high dropout rate which is in line with a general trend observed in online surveys (Eysenbach, 2005). Our study did not provide any insights as to why participants dropped out of the detox program. We had no possibility of checking whether participants really completed each section of the detox program. The subconscious knowledge of participating in our study could have induced a bias in Group 2 such that a change in usage behavior might occur before the first follow-up. We cannot generalize our results to other demographics, i.e., the findings are limited to younger adults within an academic setting.

Conclusion

The reduction of the average daily Instagram usage time of the last 7 days and users' increased perceived control of their usage time hint towards a reducing impact of our 7-day detox program. However, the low number of participants did not allow for statistically significant results. Due to the short intervention time and the already critical attitude of the study participants limited the impact on the critical reflection regarding the content on Instagram.

However, the educational approach used in our detox program remains a promising alternative complementary to abstinence trials that are used widely in the literature and should therefore be further studied in future works. Based on the results of this study, it seems crucial that future work uses more participants with more diverse backgrounds who are not already critical about their Instagram usage. The program should last for a longer duration and the active participation of the detox users must be verified. It would be insightful, additionally, to access the long-term impact of the intervention.

Supplement

Detailed description of the 7-day detox program

Day 1 – Introduction to the topic of negative impacts of social media The relevance of the implications of excessive social media consumption is highlighted. This is supposed to provide additional external motivation to the participants.

Day 2 – Testimonials of students and expert interview

Fellow students share their experiences of social media consumption and reflect on their online behavior. Such stories are relatable and induce a self-reflection process in the detox program user. Additionally, the first expert interview with Prof. Sarah Diefenbach from Ludwig-Maximilians-University (LMU) addresses the impact of social media on mental well-being and explains how technology is designed to keep users hooked.

Day 3 – Interactive and educational game "How to be an influencer" This lesson introduces the concept of influencer marketing. Through gamification the decision-making social media influencers go through is laid out. The user has to balance monetary incentives with his/her authenticity and the number of followers. These incentives lead to moral dilemmas, e.g., do I promote a product which I do not wholeheartedly support? The key takeaways are summarized and hands-on tips are provided.

Day 4 – Expert interview

Prof. Peter Henningsen who is professor of psychosomatic medicine and psychotherapy at the Technical University of Munich (TUM) discusses the possible psychological consequences of social media consumption.

Day 5 – Digital Well-being

The topic of digital well-being is explored by discussing the fear of missing out (FOMO), the addictive design of social media, the impact of social media on mental health, and its impact on productivity. Each topic is accompanied by an educational video, multiple self-reflection questions, and practical tips.

Day 6 - Expert interview

Wienke Strathern who is a PhD student in the "Computational Social Science and Big Data" group of Prof. Jürgen Pfeffer (TUM) discusses negative dynamics on social media, e.g. fake news, hate speech, and conspiracy theories.

Day 7 – Interactive and educational game "How to spread fake news online fast"

This game deals with the phenomenon of fake news. The user has to take over the role of a journalist who learns about fake news items, how they spread online, and how to detect them. This sensitizes users to critically question the validity of online news content on social media. Key takeaways are summarized and the user is provided with practical tips.

Variable	Group 1 (n = 17)		Group 2 (n = 21)			
	Baseline	1. Follow-up	2. Follow-up	Baseline	1. Follow-up	2. Follow-up
I felt I was in control of how much time I have spent on Instagram during the last 7 days.						
Yes, very much.	4	6	5	2	0	5
Yes, kind of.	5	7	7	5	6	9
Rather not.	7	2	3	8	11	7
Not at all.	1	2	2	6	4	0
I feel good when I use Instagram.						
Yes, very much.	2	2	2	0	1	0
Yes, kind of.	9	7	6	11	9	12
Rather not.	4	5	8	8	9	8
Not at all.	2	3	1	2	2	1
I feel bad about my life because of what I see on Instagram.						
Not at all.	3	7	6	3	2	5
Rather not.	8	6	8	7	9	9
Yes, kind of.	5	3	2	10	9	7
Yes, very much.	1	1	1	1	1	0
I feel bad about my body because of what I see on Instagram.						
Not at all.	7	7	8	9	8	7
Rather not.	2	8	5	5	6	7
Yes, kind of.	5	1	3	5	5	5
Yes, very much.	3	1	1	2	2	2
I use Instagram for procrastination (e.g. avoiding studying / working / chores etc.).						
Not at all.	2	2	4	1	1	1
Rather not.	4	7	3	1	1	2
Yes, kind of.	5	4	5	8	6	10
Yes, very much.	6	4	5	11	13	8
I believe that the information on posts / pictures I see on Instagram is true.						
Not at all.	3	4	5	0	0	2
Rather not.	12	10	11	11	12	12
Yes, kind of.	2	3	1	10	9	7
Yes, very much.	0	0	0	0	0	0
I believe the content on Instagram has an influence on my opinions on political matters.						
Yes, very much.	4	2	1	2	1	3
Yes, kind of.	6	7	6	13	14	10
Rather not.	4	4	4	2	3	4
Not at all.	3	4	6	4	3	4
I think critically about the content I see on Instagram.						
Yes, very much.	10	8	7	10	9	10
Yes, kind of.	6	8	9	10	10	9
Rather not.	1	1	1	1	2	2
Not at all.	0	0	0	0	0	0

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Self-reflection

While discussing the interplay between Technology & Arts, we found the conversation often drifting to the topic of social media as a technological tool used for influence. How is it, that in the age of information, some politicians manage to abuse this tool and expand their outreach through means of fake news, artificial content, and polarizing hate speech? Could their social media behavior be analyzed and assessed? Could the way politicians present themselves even be seen as an "art form"? Those were the questions we asked ourselves in November 2019 in Kochel am See.

Soon after, more and more scholarship holders joined in on the discourse and our group quickly grew larger in size, eventually reaching a total of nine people, the largest in the TUM: Junge Akademie that year. As the number of participants grew, so did our thoughts and ideas, and we additionally started discussing social media influencers, their marketing strategies, spheres of influence and the psychological effect all of this might bear on avid consumers of social media. As a first goal, we sought to reveal the real influences of social media, often not transparent to its users. And thus, team REveAL came to be.



Initially, we had a lot of trouble communicating with our first supervisors. It seemed that our goals and interests weren't aligned, and there was a difficulty reaching a productive level of mutual understanding. A first goal for us to deal with this was to refine our ideas and reformulate our initial goals.

During meetings, workshops and discussions, we started doing just that. Topics concerning mental well-being, fake news, and consumer behavior soon became the center of our attention. And as a result, our goals slightly shifted, and we decided to focus more on the negative psychological aspects of social media, hoping ultimately to empower users and give them a more conscious and reflective social media experience. Our name changed along with our goal, and after having initially been called REveAL, we renamed our team to Exfluenced[™]. This new focus was also more aligned with our new supervisors, Prof. Krcmar and Prof. Jonas, whose main areas of study include digital transformation and health solutions.

To reach our goal, we came up with two concrete ideas: the first was developing a social media detox platform; a web application, where participants could sign up and complete our curated oneweek program, which was centered around informational lectures, expert interviews, and games that would help users become more aware of the ways they are being influenced on social media. The web page would also serve the purpose of gathering data for our study, as participants would fill out surveys at specific timepoints along the program. The second was a complementary social media awareness campaign, aiming to gather a following on Instagram to promote our detox program.

We quickly realized how much of a challenge it is to achieve clear and transparent communication, as well as division of labor in a team consisting of nine students, especially when one takes into account the effects of different study programs having exams and busy periods at different times throughout the semester. To mitigate these effects, we decided to split ourselves into two teams: Team Awareness, who were responsible for the Instagram page and awareness campaign, and Team Webtool, who were responsible for the development and realization of the online Detox Program.

While this decision simplified the structure and organization of our team, the issue of unequal workloads was yet to be tackled. On top of this, the COVID-19 pandemic that struck the world in early 2020 made it impossible for us to meet in person, forcing us to rely on online meetings for communication and creating a further divide and motivational imbalance within the team. Realizing this, our tutors decided to launch an internal self-reflection round within our team, where they held one-on-one conversations with each member, in order to give a chance for each person to express their

concerns with the project as a whole, discuss goals, values, expectations, and so on. It was clear to see that this effort had great positive effects on the team spirit, and, soon after, team meetings were once again more fully attended than before.

The first phases of our project consisted of much more extensive research than we had initially expected, and actually implementing our detox program took a much longer time than anticipated. We surpassed our initial deadline by several months. But, as the pandemic slowly allowed, we started meeting in person again for so-called "sprints" - dedicated meetings where we would work together to get a certain task done. For this purpose, in a show of great team spirit, some of our team's tutors and members offered their apartments as a workspace. After several such sprints, we kicked off our detox program in April 2021. At this point, our Instagram page was at its peak, reaching over 1200 followers, with posts having upwards of over 250 likes. The detox program gathered a total number of 280 participants, most of whom also signed up for the study. At launch, our program consisted of 3 interactive games, 4 self-reflection questionnaires, 5 expert interviews, and 7 videos as well as 3 surveys.





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While we were very happy with these achievements, we also would have hoped to reach more participants beyond the channels of the TUM: Junge Akademie and our personal groups. As a final note, we would like to thank some people, without whom none of this would have been possible. Firstly, we would like to thank our tutors, Christos and Jakob, for sharing their knowledge and experience with us, always pushing us forward, and helping us reach our full potential as a team. Furthermore, we would like to thank our supervisors for guiding us with their insights and facilitating the connections to partners and interviewees. We are also grateful to our Berlin-based partner "not less but better" who often shared their expertise and first-hand knowledge on the development of an app-based solution to digital well-being with us. And last, but not least, we would like to thank Peter Finger and the entirety of the TUM: Junge Akademie Office Team, for always being there when we needed them with whatever we needed.

exfluenced^o GOAL INTRODUCTION The Telegraph We want to decrease the Social media has fundamentally **Distagram rather** worst social network for young people's mental brafth changed the way we communicate. Instagram screen time of 250 TUM students by Only now people are beginning to 1-14-10 20% over the course of realize the negative connotations TIME a 30-day detox program this entails - ranging from New Social Media Is a Toxic Mirror while changing their aggressive influencer marketing perception of their and negative psychological Psychology local social media feed. consequences to fake news. Social Media and Mental We want to raise your awareness Health: Time for a Digital of how Instagram is influencing you Detox? Sec. 1 subconsciously in an unhealthy in Machington De fashion. For this purpose, we have created an instagram channel How Russia weaponized social media, got promoting the issue. Additionally, raught and escaped consequences we are offering a 30-day social media detox program on our webtool. Our guidance will help you to reestablish a healthy relationship with your Instagram, consciously controlled by you. #breakupwithyourinstagram **#regaincontrol** #checkyourself **PSP & TIME SCHEDULE** June 1" >> Launch of Instagram and webpage June 1" - August 31" ->> Promote campaign, conduct expert interviews, and implement the webtool September 1" - September 30" >>> Test-phase of the Webtool October 1" >> Launch Webtool & On-campus promotion October 1" - December 31" >>> Data collection: Get instagram screen-time information and conduct questionnaires January 1" - February 28" -->> Data analysis March 1" - May 31" >> Write final report MAY 2020

MEMBERS Lucis Balivitis, Denio Bergini, Lan Diandes, Christopher Ebert, Ornar Edeets, Marter Islammi, Dovid Noachta, Maryas Stichertisk, Andres Weiter TUTORS Christics Guarans, Jakob Scheittes SUPERVISORS Prof. Dr. Helenat Kornar, Prof. Dr. Itabel Weipe

POSTER 1:

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At the Kick-Off, our team formed with the goal of creating awareness of the influence of social media. Team REveAL started off with an intense brainstorming phase to find a clear project idea and developed the goal to share our researched knowledge about the influential mechanisms of social media through an interactive exhibition with 1000 participants to raise awareness. At the first seminar weekend in January of 2020, not only did we change our name to Exfluenced, but also reworked our project idea. We first identified as the core problem that users are often not in control of their social media usage and, afterwards, agreed the ambitious goal of making students more aware of their Instagram usage and allowing them to #BreakUpWithYourInstagram and to #RegainControl by decreasing their screen time. To achieve this, we developed a detailed time schedule and Project Structure Plan and split into two groups: Webtool and Awareness. The former did intensive research about the relevant topics for a social media detox program. Meanwhile, the latter developed a concept of an Instagram campaign to reach potential participants.

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RESEARCH QUESTION

How much does the detox program, consisting of the exfluenced Instagram account and the webtool, reduce the Instagram screen time and in what ways does it increase the quality of life of the participants?



WHAT WE DID SO FAR

After an intensive research period, we got to work for the simultaneous launch of ourwebsite(exfluenced.com)

and our Instagram account (@exfluenced). Since then, we have focused on creating content for these two channels – in the form of Instagram posts, interactive games and videos.

HOW WE ARE ADAPTING OUR STRATEGY

To account for the programming on the website, we are pushing the launch of our detox program from October 1" to January 1". We also shifted our intention of interviewing experts on social media and its effects to contacting just the most essential people.

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WHICH GOALS WE REACHED SO FAR

June 1 ^H	>> Simultaneous launch of our Instagram account, that has accumulated over 500 followers, features over 100 posts and reaches over 125 Instagram users that actively engage with us, and our website to represent our project
July 28 th	>> Instagram ad campaigns that reached almost 30 000 interactions
September 10 th	>> Implementation of our first interactive name "How to be an influencer" on website
September 20"	>> Programming of second game under the working title "How to spot Fake News online fast"
October 6*	>> Redesign of our Instagram account based on feedback from our followers >> Production of 4 educational videos on digital well-being
#fri	#friendzoneyourinstagram
CARAMONIA CONTRACTOR	
MEMBERS	Laon Ballerin, Donz Bozyn, Len Brandes, Christopher Ebort, Ornar Elosob, Mann Huener, David Houchtar, Maryna Shchintan, Aerdea Weller
MEMBERS	Laura Ballerin, Denz Borge, Len Brandes, Christopher Ebort, Orner Elosts, Marie Huense, David floodhie, Maryna Shcharbak, Andrea Weiller Christon Gazana, aweb Schertres

POSTER 2:

On June 1, we officially launched our Instagram account @exfluenced and published a landing page on our website www.exfluenced.com, which the team programmed itself. By October, we managed to accumulate over 500 followers with a successful marketing campaign through online ads, posters and flyers and over 100 Instagram posts including interesting facts, statistics and funny memes. The posters and flyers were distributed all over Munich including the Bayerische Landesbibliothek and student accommodations to reach our target audience. Every week, we managed to post four times and included feedback from our followers to revise the content and design of the account in October.

Simultaneously, we started to develop the content for our 7-day detox program, with its launch planned for the beginning of 2021. We based our concept on inoculation theory. Here, the users are exposed to a weakened version of an influence. This theory is usually employed to describe vaccinations, but recently it has shown promise with psychological influences. We created two interactive online games, which we implemented ourselves. The first game, titled "How to be an Influencer," focuses on influencer marketing, while the second tackles the issue of misinformation online. Furthermore, we started the production of educational videos on digital well-being.

During this period, we also contacted multiple experts on the topics of our detox program to conduct interviews with professionals.



WHAT IS OUR RESEARCH ALL ABOUT?

The aim is to evaluate whether our detox programme has a moderating impact on general Social Media usage. Our goal is to analyze if our programme helps the study participants to establish a healthier, more intentional and balanced relationship towards their Social media apps.

CURRENT STATUS OF OUR PROJECT

During the last few months, the design for our website was updated entirely and we created the final content for our detox programme. After a one month testing phase, we successfully launched our programme and the corresponding study. In addition, we managed to surpass over 1.000 followers on our Instagram account. Here, you can take a look at the new design of our website:

Welcome to extuenced Your personal social media detax program MAY 2021 Laura Baltentin, Deniz Bezgin, Lee Brandes, Christopher Ebert, Dinar Eddiet, Marie Huerner, Dovid Noschrar, Maryna Shcharbar, Aodina Weller MEMBERS inspired b TUTORS Christos Gazana, Jakob Schellels SUPERVISORS Prof. Dr. Stachart Jonan, Prof. Dr. Haimut Kromer

THE NEXT STEPS

In the following months, the focus will lie on recruiting study participants via various channels. and evaluating the results of our study. Furthermore, we will conduct additional interviews with experts from various fields

surrounding Social Media. Last but not least, we will invest time into writing the iournalistic and scientific parts of the research report. Be sure to participate in our study! After all, we have an offer for you that you can not refuse:



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OUR MOST IMPORTANT REFERENCES:

For our study, we came up with a unique Crossover design. For this purpose, we consulted our first reference which gives an outline for the deployment of such a design. The other most important sources were helpful for identifying the issues surrounding social networks, especially the rising concerns about disinformation and mental health related problems. Below, you can see the design of our study:



POSTER 3:

In the months after the launch of our instagram page, we updated the design of our website and completed the content creation for the program. Part of it was conducting interviews with students and professors, including Prof. Peter Henningsen, director of the Department of Psychosomatic Medicine and Psychotherapy at the Klinikum Rechts der Isar, about the topic of social media usage. The student interviews were added to the program in the form of videos and the interviews with the experts were transcribed to text. Furthermore, we created a video with the best student answers as part of the first day of the program in order to highlight the most important issues of social media usage.

After a redesign and finalization of the website was completed, we carried out a one-month testing phase and then successfully launched the program and the corresponding study.

For the study, we came up with a unique crossover design, allowing us to compare the influence of our detox program on the behavior and mindset of the participants between two independent groups. In order to gain more participants, we decided to award 20€ each to the first 50 participants who completed the program and all 3 guestionnaires.



SUMMARY

We created a 7-day interactive social media detox program which aims at educating participants regarding the influences of Instagram (psychological well-being, influencer marketing, political fake news) using informative videos, interactive games and expert interviews. We assessed the impact of our detox program on the average daily Instagram usage time of the participants and on eight further variables, all targeting experiences with Instagram usage, with a unique cross-over study (see Figure 1) with two different groups.

RESEARCH LIFE CYCLE



RESULTS

In both groups, the average daily instagram usage of the last 7 days decreased on average for 11.6 and 18.3 minutes respectively after the detox program, see Figure 2. Unfortunately, due to the low number of participants these results were not statistically significant.



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We found that users spending more time on Instagram had less self-perceived control about their usage time. Moreover, users that felt worse about their body while looking at Instagram also felt worse about their life while looking at Instagram.

The variable "I felt I was in control of how much time I have spent on instagram during the last 7 days" increased significantly between the beginning and the end of the study.

IMPACT

- More than 1200 followers with over 250 posts on our Instagram account
- 280 people signed up for our detox program
- with 181 of those participating in our study
- 7 educational videos
- 5 expert interviews with researchers
- 3 interactive games Ongoing detox program for interested users
- Collaboration with TUM4Health to establish
- our program within their app about physical and mental health to continue to exfluence TUM students far into the future

PROJECT PARTNERS

ACKNOWLEDGEMENT

MEMBERS TUTORS SUPERVISORS

Laura Ballentin, Denir Bezgin, Lan Branden, Christopher Ebert, Ornar Elderb Maris Hoerrer, Dovid Noachtar, Maryna Shchartok, Andrea Waller Christion Gazania: Jakob Scheffels Prof. Dr. Stachan Jonan, Prof. Dr. Heimut Kroman



POSTER 4:

To acquire participants for our study, we launched a new marketing campaign. By July, we gained more than 1200 followers with over 250 posts on our Instagram account. We used this platform to promote the launch of the detox program and study. To increase our reach, we contacted other accounts as well as our partners such as the start-ups "not less but better" and "Friendzone app." In addition to participants whom we recruited through our personal network, we distributed flyers in Munich. In total, over 280 people signed up for our detox program with 181 of those participating in our study. We performed an extensive statistical analysis to evaluate whether our detox program had a moderating impact on general Instagram usage and screen time. We analyzed if our program helped the participants to establish a healthier, more intentional, and balanced relationship with their social media apps.

After brainstorming and creative discussion, we designed the comic for the research report. In it, we accompany our readers through the process of completing our detox program and reaching a state of emotional independence towards social media.

Furthermore, after analyzing the results of our study, we sat down together in one of our first meetings in person after a whole year of not seeing each other and wrote the first versions of the journalistic and scientific parts of our research report. After consulting with our supervisors and a journalist we edited our draft and created the final version of the research report.

Finally, we started to organize a collaboration with TUM4Health to establish our program within their app about physical and mental health to continue to exfluence TUM students far into the future and to help you to #FriendzoneYourInstagram.



Project Report Exhibition Fish

Team	Renato Coppi Franz Xaver Gillmeyer Annalena Huber Joshua Sharon Neumann Paul Andrei Sava Juan Esteban Suarez
Tutors	Eva Biehl Daniel Schwinger
Supervisors	Prof. Dr. Peter Gritzmann Prof. Dr. Maurice Lausberg

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Preface by the Supervisors

Prof. Dr. Peter Gritzmann and Prof. Maurice Lausberg

Exhibition Fish: Short Address

When walking in the snow our traces are clearly visible. Our impact on our social environment might not always be as clear but we still have some sense of control. The numerous threads of our digital activities, however, form an impenetrable netting, cryptic to us, but denuded to those who monitor, collect, and interconnect our digital activities. Modern algorithms are unbelievably advanced, and often powerful enough to know us, i.e., predict our future behavior, better than our parents and even we ourselves do. (Welcome to the notorious philosophical discussion of the free will!) Of course, it is easy to believe that this is all to our own good. After all, don't we profit from numerous (relevant and not so relevant) services offered to us free of charge. But should we really suppress the vague sense of a lurking harm of potential abuse of our most private data. No! This is the answer given by the project team: Make emotionally tangible what it means to digitally expose yourself!

When you google yourself most of the displayed information will not disturb you at all since it comes from legitimate websites. More frightening – since beyond our own knowledge let alone control – are the myriads of traces that we leave by using the internet, social media or other tools of mass instruction.

This is indeed a big issue. When you search for data privacy, google shows 7.900.000.000 entries. Of course, by asking for that

subject you left yet another trace in the web. Your search engine knows you, and big brothers are watching you!

In any case, awareness is desperately needed. The project which the TUM:JA team explains in more detail below addresses the apparent discrepancy between the explicitly acted out willingness to share private data and the often only subliminal concern about the mid- and long-term consequences this may have. This privacy paradox is approached from different directions, empirically, followed by a scientific analysis addressing the audience intellectually, but also by means of art. This is in the best tradition of art as a means of fostering and changing consciousness on a powerful emotional level. The project was quite a challenge, and even more so under the regime of the pandemic, but the team succeeded. Of course, there were ups and downs, whenever the ambitious concept faced different aspects of reality. But the team was full of ideas, kept up a good spirit and turned the project into a sustainable activity which is, as we all hope and believe, eye-opening and mind-blowing for a broad audience.

Interview with our artists

In the context of the umbrella topic "Arts and Technology," our team "Exhibition Fish" chose to focus on data privacy and, more specifically, the concept of the "Privacy Paradox." The Privacy Paradox describes the phenomenon that, although many people have the desire to keep their (online) data private, information is nonetheless often liberally shared. This data exchange can take place for example in the context of social media, or by consenting to cookies to access certain websites. Our team was interested in exploring the (perhaps unconscious) motivations, attitudes and emotions that cause people to act in this paradoxical way. Due to the highly personal nature of this topic, we also aimed to find a less scientific and more emotional and creative way to communicate our findings. This led to the development of the HUMAN ALGORITHM.

In the dialogue project HUMAN ALGORITHM, our team developed a musical composition and an accompanying short film in close collaboration with the two participating artists Kilian Sladek (singer/composer) and Laila Bierling (photographer/video artist). Based on our research on the Privacy Paradox among students in Munich, this project aims to draw new attention to the challenges of online behavior in an innovative, personal and emotional way. More specifically, the HUMAN ALGORITHM explores the transaction that occurs when we give away our online data in return for a certain benefit, such as access to a website, and the opportunities and dangers that come with this transaction. The main aspect that the HUMAN ALGORITHM focuses on is the "invisibility" of such processes, meaning that users are often unaware which data they are giving away online, and how this data may be used. The musical composition and short film aim to make viewers more aware of these "invisible" processes, by following a protagonist and her interactions with an artificial intelligence throughout her everyday life.

Here, together with Kilian Sladek and Laila Bierling, the scholarship holders reflect on the joint project and their learnings.

First of all, maybe a short introduction: What do you do in your artistic work and what was the special focus of this project?

Laila: I'm a photographer and videographer from Munich and I take photos in the fashion and beauty sector. In terms of videography, I'm more in the musical field and now, with HUMAN AL-GORITHM, also experimentally in the short film/music combination business. So all in all, I am a photo and video artist with strong connections to music.

Kilian: My name is Kilian Sladek and I studied jazz vocals and am just finishing a master's degree in music management. At the moment I'm working on three band projects: my band, my quartet, then Lauraine, a synth-pop band, where Laila also works with me, and then I'm currently setting up a project together with my girlfriend, which is more in the performative area, called "Amuse". With the composition commission for this project, I've also gone in a more experimental direction musically.

Thank you! Then let's take a closer look at our collaboration, which is something really special for both of us as researchers and you as artists. How did this process work? How did research results become music and a short film?

Kilian: At the beginning, everyone told me very, very precisely and in detail what he or she had found out throughout the scientific work. We did this through very intensive and long workshop sessions. I can remember up to four hours of uninterrupted workshop sessions with you, where everyone was able to contribute with their own topic and their own point of view . Then there was a month or two where we didn't have so much contact, where I could ponder a bit about it and create a story out of the content you gave me. I wrote a lot of post-its and really threw a pile of post-its on the floor and collected everything again, transferred it all into the computer and then put it into meaningful contexts. Important questions were then: Which questions are big? What can I combine and what reappears where and how? That is also the reason why so many meta-levels opened up in this very short time of the composition. It's exciting how much information there is in the end.

Laila: New ideas also kept coming up about the film, we also had many new ideas again during the day of shooting in addition to what we already had. It all came together very organically, with the pictures and the people involved. And yes, it's incredibly nice to see how much everyone enjoys the ideas and has fun implementing ideas and getting involved.

Can either of you give an example of a detail that is now in the film and music that is directly connected to our workshops and Kilian's Post-Its?

Kilian: An important point for me was ultimately this blatant reduction of our unbelievably big topic of the data privacy paradox to the topic of algorithms and how such an algorithm is constructed via an input, a transformation process and an output. The music underlines on many levels that every little input, if you know exactly what the output should be, can be relevant for the system. That's why personal sounds also play an important role, which are not always professionally sung or perfectly intoned. For example, not every note that the singer featured in the HUMAN ALGORITHM sings is perfect - but instead of autotuning her voice. I left her sounds as they were. This underlines that every type of input, even if it isn't perfect or ideal, can be used in an algorithm to generate an output. This is the same way that all of our online data is used for some purpose, regardless of the type and where that data comes from. The important message is: Everything is relevant. Every sound, every clacking in the coffee machine is somehow transposed. Every door opening can somehow be musically transferred into the digital world as well.

Laila: There is also a very significant element in the film, which further underlines that all data is relevant: The smart home camera concept, that you see the actress from the perspective of the coffee machine, from her mobile phone, from her laptop, through CCTV cameras – so she is just being watched everywhere. Stylistically, I also made sure that you notice when you feel closer to her, by making you feel somehow visually closer to her. And when you no longer look at her with eyes which are trying to understand her but rather with eyes which are trying to analyze her, these are completely different camera angles, for example with the surveil-lance cameras.

We are all very excited to see the final work. The workshops were always really cool and the exciting thing was that we also found out completely new levels of the project through them. Thank you for this small foretaste of this unique work of art, the HUMAN ALGORITHM. But we also want to try to go a step further and reflect on this form of project in general. You, Kilian, are also a kind of a coach for us, so you actually helped us in these workshops to find ways to communicate research results in a way that has personal relevance. So, what kind of team are we together? What role did you artists play?

Kilian: I went in with the attitude that I was not going in to explain anything to you or to contribute my point of view, but rather to absorb your insights first. Because it's an absolutely luxurious situation to join a team that has already dealt with the topic very intensively and has illuminated this topic very extensively for me and Laila. Throughout the whole project, it was very important to me to reflect on your insights with you again and again. It's not just about composing music, but it was important to me to convey a lot of the information that you want to convey. I created a symbiosis between your findings and the music and you made this really easy.

Laila: It's extremely valuable that we can exchange our perspectives from different fields and ways of thinking. Research and technology are very logical processes and my creative work is partly the complete opposite. I think it's the most beautiful thing when you can exchange ideas and simply broaden your horizons. This works very well with the project because we all learn from each other!

I couldn't agree more on the value of our exchanges! Thank you, Laila and Kilian, for taking the time today to give us insights into the HUMAN ALGORITHM project ! We look forward to our big online premiere of the HUMAN ALGORITHM in September!

For more information about the artists, see: kiliansladek.com lailabierling.com

Exhibition Fish

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Abstract

Big Data has brought important technological advances in several fields such as medicine, engineering or natural sciences. Together with these advantages, data comes with numerous risks and challenges that affect society in a wide range of aspects, and which raise several concerns on the part of digital users regarding their private data. In this report, we explore the concept of the Privacy Paradox, which describes the contradiction between data privacy concerns and the actual private behaviors of users. In particular, we want to explore to what extent the Privacy Paradox is present among students in Munich, as well as understand some of the factors that could explain this phenomenon. We performed a quantitative analysis in the form of a questionnaire to determine if the Privacy Paradox is indeed present in our target group and if providing a prior bias towards the topic affected the result of the questionnaire. Additionally, we performed a qualitative analysis in the form of interviews, to determine how and if the contextualization of privacy affects behavior towards data disclosure. We found from the quantitative questionnaire that the Privacy Paradox is indeed present among students in Munich and that the prior bias does not have an effect on actual privacy behavior. Additionally, from the qualitative interview, we observed the dependence of the context on the notion of privacy as well as the presence of a coerced participation on the data-requiring platforms. These results give some insights into possible approaches or solutions to the Privacy Paradox.

Introduction

Big data offers great opportunities. Whether it is machine-learning improving cancer detection or recommender algorithms providing us with a never-ending stream of tailored content, data enables us to achieve amazing things. However, it also comes at a cost. From individual risks such as identity theft to large-scale misuse of personal data influencing political elections, sharing data has the potential to do harm. And while most people are aware of and concerned about this, many of us continue to share personal data deliberately. Researchers have called this phenomenon the *Privacy Paradox*, the dichotomy of information privacy attitudes and actual information privacy behavior (Gerber et al. 2018: 2). Luckily, we might be able to overcome this paradox eventually as science
offers various explanations as to what causes this paradox. The most widely accepted one is called the *Privacy Calculus*. It assumes that users trade benefits they might earn by sharing their data off against potential costs.

However, much privacy calculus-based research primarily focuses on the nature and effect of benefits rather than risks (cf. Gerber et al. 2018). Even though the model assumes that users weigh benefits against risks, the notion of risk often lacks thorough consideration compared to benefits. This bias might make sense, considering that risks are commonly less well understood and negative consequences are often delayed or do not materialize at all, while benefits are experienced frequently and immediately by most users (Gerber et al. 2018: 38). However, if we put that assumption into context with Marwick's and Boyd's (2014) research, it loses its merit. In their paper on networked privacy in social media, they demonstrate how privacy behavior is often highly context-dependent. This suggests that understanding the context within which a user makes data privacy relevant decisions is an important determinant for their actual behavior. Therefore, if benefits are a familiar occurrence while negative outcomes are not, we might expect that situations in which users consider data privacy are more easily contextualized in terms of benefits than risks. Following this hypothesis, we argue that if we want to explain the privacy paradox, people not being able to successfully contextualize risks when disclosing data might be just as important to consider as people not taking benefits into account when reflecting on their data privacy concerns.

Starting from this hypothesis, we argue that more research is needed on how users contextualize privacy-relevant situations online and how this process affects their behavior vis-à-vis their privacy concerns. If we can determine how users contextualize these situations, we might better understand not only their behavior but also what factors influence their capacity to contextualize data privacy and, by extension, how we might enable users to reconcile their privacy concerns and their actual data disclosure behavior. In doing so, people could be empowered to make choices that are more informed and a critical discourse around data usage and data privacy could be promoted.

Background

Data in the 21st century has become ubiquitous for most of the world's population. This is because through ever improving technology we can easily gather, store, analyze and interlink massive amounts of data (Crawford et al. 2014). Paired with advances in algorithmic processing and machine learning, we can use these data in order to optimize scientific research, traffic, weather forecasting, health care, manufacturing, advertising, and the entertainment industry to name only a few examples. Because of big data, we are spoiled with only the most relevant content and advertising while unwanted products ads are a relic of the past – or so the well-crafted narrative we hear day in and day out goes.

In fact, there are caveats as well. The application of big data analysis also includes distortion, errors, bias, and misinterpretation, which can be harmful to individuals and reinforce structural inequalities, e.g., when making use of technologies such as predictive policing. In turn, personal marketing and advertising "[...] requires identification, tracking, and predictive analytics [which] should be considered a new and important modality of surveillance" (Bodle 2017: 138). This form of surveillance among other things can lead to online discrimination, coercion, political polarization, the erosion of personal autonomy, and the loss of political freedom (ibid.). A well-known example for such consequences is what Eli Pariser (2011) calls The Filter Bubble, which prevents people from being exposed to competing political, social, economic, or other views. This is problematic in that [a]ccess to a wide range of news and views can encourage an active and informed citizenry and provide the precondi-tions for a vibrant public dialog and debate that is robust, wide open, and uninhibited. (Bodle 2017: 146)

Conversely, the absence of such open dialog is likely to impair the proper workings of our democratic system.

Given these issues, being cautious with our personal data seems paramount and, indeed, people are concerned about what data they share online, how their data is being used, and data privacy in general. Unfortunately, these concerns are often not supported by corresponding actions. People frequently engage in privacy-compromising behavior although they show interest in their data privacy and generally exhibit a positive attitude towards privacy protection (Barth & de Jong 2017). Researchers call this phenomenon the *Privacy Paradox*, a discrepancy between people's information privacy attitude and their actual information privacy behavior. Even though existing privacy concerns should in theory lead to restrictive provision of information, people often share information in exchange for personalized services or retail value (ibid.). This tendency to trade benefits off against potential costs of data disclosure has been investigated by various scholars. Culnan and Armstrong (1999) point out that often for people the perceived benefits [of data disclosure] outweigh the per-ceived risks, which eventually leads to the neglecting of privacy concerns that often results in the disclosure of information in exchange for social or economic benefit. (Barth & de Jong 2017: 1044)

Among the different explanations for the privacy paradox, this *Privacy Calculus Theory* is the most prominent one (e.g. Gerber et al. 2018).

However, the assumption that people are making a conscious effort to weigh benefits against risk every time they disclose information online is guestionable. Barth and de Jong (2017) point out that individuals often experience perceived or actual cognitive limitations regarding privacy concerns, leading to an unwillingness to use all the necessary information to make informed decisions on issues affecting their privacy. Consequently, people often fall back to subpar solutions because rational decision-making is possible only within the limits of cognitive abilities and available time (ibid.). Simon (1982) describes this phenomenon in his Theory of Bounded Rationality. In accordance with this theory, Barth and de Jong (2017) point out that the cognitive processes that are necessary to assess the risks of sharing information online are rather difficult to aggregate and process and, therefore, often seem too costly. Consequently, people tend to rely on simple heuristics rather than accurate information.

Based on this line of argumentation, we argue that investigating which factors influence people's cognitive capabilities in such privacy-relevant settings is crucial if we want to understand how the privacy paradox could be resolved. To this end, Marwick's and Boyd's (2014) research on *networked privacy* in social media might offer valuable insights. In their paper, the authors demonstrate how

privacy behavior is often highly context dependent. This suggests that people's ability to understand the context within which they make privacy-relevant decisions is an important determinant for successful risk assessment. However, the way we contextualize risks can be influenced or impaired by different factors that, in turn, affect the cognitive abilities we rely upon in order to properly carry out such assessments.

Goals and Methods

Taking the existing literature as outlined above into account, we argue that investigating how people's ability to contextualize privacy-relevant situations might offer insights into what factors contribute to the occurrence of behavior in line with the privacy paradox. Consequently, our research questions go as follows:

- 1. To what extent do students that are aware about the topic of the questionnaire regarding the privacy paradox differ from the ones who are not aware of it in self-reporting actions taken to protect their digital data?
- H1: We hypothesize that the experimental group will self-report themselves as more protective with their data in online environments. Since they will be advised on the topic before answering the questionnaire, it is probable that their perceptions of what is socially desirable will play a role.

2. To what extent can the privacy paradox be observed in both groups?

H1: We hypothesize that it will be possible to observe the privacy paradox only in the control group.

3. To what extent do the participants of both groups differ in the amount of optional demographic data given?

- H1: We hypothesize there will be no statistical difference between the groups in this regard, since previous research (Oomen & Leenes, 2008) showed that in general, a higher privacy risk perception does not lead to the adoption of stronger or more protection strategies.
- 4. How do Munich-based students contextualize data privacy when disclosing data online and how does this contextualization affect their risk assessment and subsequent data disclosure behavior?

In order to investigate the first three research questions, we used a quantitative approach. During a period of two months, 87 students from Munich universities answered the Online Privacy Survey (William & Nurse, 2016). The students were randomly divided into two groups. The control group consisted of 36 participants (63.9% male, M_{age} =22.50, SD_{age} =3.33) and most of them were studying a bachelor's degree (55.6%) while the experimental group was formed by 51 students (25.5% male, M_{age} =22.75, SD_{age} =3.36) and most of them were studying a master's degree (41.2%).

The Online Privacy Survey was composed of four parts. The first part consisted of required demographics, in which we added a few questions to the original instrument such as information about in which university the participants were enrolled, field of study and nationality. The second part included three optional demographic questions that contained an option "prefer not to say." In these questions, the participants had a choice to avoid revealing more information about themselves. Next, the third part was the opinions section that was formed by three statements regarding privacy: 1) "Privacy is of importance to me"; 2) "Online privacy is of importance to me"; and 3) "I am private with my data". The participants should rate themselves in each of the statements using a 5-point Likert scale (from strongly agree to strongly disagree). Lastly, the actions section contained a scale formed by statements about actions that online users could take to protect themselves in this environment. Participants rated themselves using a 4-point Likert scale (from always to never), so that lower values represent higher protection in online environments. In addition, in this section was included an option "N/A" and "Unsure" in each of the items.

In a study by Williams and Nurse (2016), the action scale had a Cronbach's alpha of .81, a fact we could not observe in our data. The Cronbach's alpha in our scale was initially .42, which is considered far below the standards for a scale's internal consistency. It was calculated using 48 participants (55% of the total) since cases that participants assigned as "Unsure" and "N/A" were ignored to calculate the internal consistency of the scale. Consequently, in order to increase the reliability of the actions scale, we excluded four items that presented item-total correlation lower than .1. Finally, the action scales were composed of seven items and Cronbach's alpha resulted in .64. This difference between internal reliability coefficients between the studies might be because of the smaller sample size in the present study.

Both control and experimental groups answered the same questionnaire. The difference between the groups was in the message that the participants read before answering the questionnaire. In this message, the experimental group had an extra sentence, underlined in the text below, that aimed to make the students from this group aware of the online data privacy topic. The message was:

"As part of a scholarship program, the TUM: Junge Akademie, our research team is interested in understanding basic online habits, such as social media usage, of students in Munich. Your help is crucial for our investigation.

Furthermore, as concerns about online data privacy are becoming more and more prevalent, the questionnaire also investigates the extent to which students take precautions to protect their personal data online."

Firstly, we analyzed the frequencies of the opinions section of both groups. In the next step, analyzing the items of the actions section, we observed that three items did not meet the normal distribution pattern. Thus, non-parametric methods were used to run the analysis that involved this section. The Mann-Whitney test was used to verify if there was a difference in the self-reported protective actions between the groups and the eta-squared (η 2) as the effect size.

Furthermore, we used Spearman's Rank Correlation Coefficient (p) to measure the correlations between the actions and the opinions statement "online privacy is of importance to me." The presence of the privacy paradox is determined by the positive correlation between these two variables. Lastly, we used independent T-test samples to verify whether the amount of optional demographic data disclosed was different between the groups.

Following this quantitative investigation, we conducted semi-structured guideline interviews to answer the fourth research question. The selection of suitable interview partners was already determined by our research question and the target population of our survey: Munich based students. Participants were chosen randomly from different faculties at TUM and HMTM. In order to conduct the interviews, we used a semi-structured guideline which is particularly well suited to cover narrow topical areas for research interests while still offering enough freedom to uncover structures of relevance and interpretative patterns of interviewees in an exploratory way. The interviews were recorded via recording devices and subsequently transcribed. For analysis, we followed a basic approach for qualitative data analysis as proposed by Strauss (1998). Accordingly, the empirical data was translated into concepts and categories through the application of codes. However, we did not develop a whole theory grounded in our empirical material as this would have exceeded the scope of our investigation. Instead, we focused on uncovering smaller concepts and categories that would allow us to answer the different aspects of our research questions without developing one central key category.

In order to do so, we first opened the raw data through open coding in order to identify concepts that would allow us to create first categories (ibid.). Following that, we created sub-categories through axial coding to form preliminary hypotheses regarding our research question which we then verified against our interview data. This part of the analysis was oriented towards Corbin and Strauss' coding paradigm (e.g. Trübinger 2004). In the following pages, we will present and discuss the findings of our quantitative and qualitative research.

Outcomes and Discussion

Quantitative Analysis

We analyzed the frequencies of the opinions section to verify the extent that both groups agreed with the statements and the results showed that groups behaved similarly. Regarding the first statement of this section, "Privacy is of importance to me," most of the students in both control and experimental groups agreed to some extent with it (88.9% and 92.2%, respectively). As with the first statement, results demonstrated that 88.9% and 92.2% of the control and experimental group, respectively, agreed to some degree with the second statement, "Online privacy is of importance to me." The participants that chose *strongly agree* or *agree* in the third statement, "I am private with my data," were similar but lower than in the first two statements. In the control group 63.9% agreed with the statement and in the experimental group 64.7%.

The results from the Mann-Whitney test showed that there was a significant difference in the self-reported actions between the groups. The control group (Mdn=3.29, SD=.47) self-reported taking fewer actions to protect their online data than the experimental group (Mdn=3.00, SD=.43), U(N_{control}=36, $N_{experimental} = 51) = 673.00$, Z = -2.12, p < .05, as hypothesized, with a small effect size ($\eta 2 = .05$). This fact can be explained by the awareness of the objective of the questionnaire that the experimental group had before answering it, inclining participants to answer according to notions of social desirability. It is important to mention that the difference between the groups was significant, but the effect size was small. A possible explanation for this can be found in the methodology used in the study, since the difference between the groups was only an extra sentence in the beginning of the questionnaire, which might be a weak stimulus to substantially alter the students' actions self-report.

Moreover, we analyzed the correlation between the actions and opinions sections in both groups (Table 1). These results showed that in the experimental group there was a medium correlation between actions and "Online privacy is of importance to me" (ρ =.47, p<.01). However, the same correlation was not observed in the control group, indicating the presence of the privacy paradox only in the control group. This result was expected because it was dependent on the students' self-reported actions, where the participants of this group reported themselves to be less protective with their online behavior than the experimental group.

Lastly, we used independent T-test samples to verify the extent that both groups differ in the disclosure of optional demographic data. In both control and experimental groups, most participants preferred to reveal all the three optional demographic items (94.4% and 90.2%, respectively) instead of choosing the option "Prefer not to say." Moreover, as we hypothesized, there was no significant difference between the groups regarding the amount of data needlessly revealed by the participants. These results indicate that both groups were not worried about needlessly revealing data. It is important to mention that there are possible reasons that would lead the students to needlessly reveal the optional demographic information asked in the questionnaire. Firstly, the students who participated in the survey may have revealed the data because they believed it is protected since the researchers explained in the text before the questionnaire that the research was attached to a project from a well-known university in Germany. Secondly, the participants may not consider data such as relationship status, employment status, and most-used social media as private data or sensitive data they should protect in the online environment.

Qualitative Analysis

Blurred Privacy Status

Whether people share data or not is not solely determined by its privacy status. The interviewees' experiences and reflections indicate that there is a blurred line and disclosing data depends on the situational context. This can be seen in the following sequence:

Mr. G.: And I think, I'm always very critical about health data, because that's something which shouldn't be of importance to anyone except your health insurance, and not even that completely. So if a doctor, if they want to give you a treatment or something like that, they should know about that, of course. But even the health insurance doesn't need to know everything.

At the same time, today's online ecosystem also imposes its logic onto people in that they evaluate their own behavior against this very logic. Data in this context is not necessarily private in itself but only as long as a person keeps it private. Once shared online, the act of sharing renders data's privacy status ambiguous.

Mr. G.: I think the data that was collected about me like when I'm searching for health-related stuff, like I'm still giving it away, even if I'm not conscious about it, so I think it's hard to really draw that line. And like, everything I do online, I have to be aware that this is data that I'm giving away, so maybe there's not much that is really super private.

This shows that people genuinely do consider the context within which they might share personal data and not only potential benefits and risks. Getting health treatment from a doctor merits sharing personal health information while the benefits of that treatment are rather implicit in this case. However, the mere act of sharing data online might cause people to question whether their information is private or not, not because of its inherent privacy status but the imposition of data handling practices in current online environments.

Use context

The interviewees also consider what their data is being used for when contextualizing situations in which they share data online. The following interview sequence illustrates how assessing the merit of what his data is being used for is an important factor for Mr. U's risk perception. **Mr. U.:** What I don't like, and it's also true that just by using the websites, not just by sharing my birthday, people are kind of making money just by knowing my birthday, right, as a representation. This is a little bit I don't know, it's like a bit of a dishonest way to make money.

His considerations go well beyond the fact that websites are using his data to make money from it. He considers these practices not only to be bad or to represent a risk but to be a dishonest way of making money, which is a normative assessment of the situation. This indicates that his assessment of the risks of sharing his personal information is affected by what data is being used for and whether this use context is normatively acceptable. Simultaneously, the interviewees stressed that they do not always know about the ways in which their information is being used and how that might affect them. Mr S .: "[I]n Facebook I have already put in some photos with my friends. Yeah, [...] I have no idea how it can be used." These findings suggest that the ends to which people's data are being used might play an important role in how they contextualize the risks of their data disclosure. This goes beyond clear-cut negative consequences but includes normative evaluations such as whether the data usage is honest or not. At the same time, the interviewees do not always know what their personal information is being used for, making it difficult to assess the merit of such usage and if it poses a risk or not.

Coerced Digital Participation

Another factor influencing the way the interviewees contextualize the risks of sharing personal information is their perception of coerced digital participation. Participating in society means participating in online platforms and the internet in general regardless of whether it puts them at a disadvantage regarding their data privacy or not.

Mr. G.: Let's say I lose my iPhone and I'm not able to access it. I mean, it's very difficult to keep up with what's happening, right? Like how do I get all the content that is there? I'm not going to [...]. But if I really want to be involved in our communication process, I'm just not gonna be part of it. And this obviously is a disadvantage. I think the more you depend on your surroundings and the more you depend on communicating with other people you cannot really choose then I mean yeah, you're kind of screwed when you don't have access to those right[?]

Summary and Future Goals

Considering all the problems and concerns around Big Data, understanding the concept of the Privacy Paradox is of high relevance for developing efficient mechanisms and/or regulations for protecting the user's data. For this, we investigated how the behavior towards data privacy of students in Munich is affected by the contextualization of Data Privacy and whether the paradox presents itself in this target group. We observed in the quantitative analysis that the paradox is indeed present in the target group. Also, the awareness about the topic, prior to the questionnaire, affected the behavior on the self-reported perception of privacy but not on the actual behavior. The prior bias on the questionnaire was not statistically significant on the amount of information disclosed. Additionally, we obtained from the qualitative analysis two hypotheses on how the participants made the risk assessment of their data disclosure. Mainly, we observed that the context in which the data is given away affects the notion of private data, as well as the importance of the notion of coerced digital participation for the participants. With this, we give a first overview on if and how

the *Privacy Paradox* is present in the students in Munich. Further work, from a theoretical perspective, could be focused on realizing a quantitative analysis on the hypothesis from the qualitative study, along with additional theoretical study regarding the factors that affect the *Privacy Calculus*. From a practical perspective, further work can be developed on designing tools or mechanisms that enable the users to regain ownership of their data. This could be done, for example, by making the data transaction process transparent and informing the users abouts its risks and implications, not only from a personal security perspective, but also from an ethical and a political one.

Acknowledgment

The Exhibition Fish would like to thank the DAC Artemis Studentenförderverein e.V which financially supported our project. Moreover, we would also like to thank our supervisors Prof. Dr. Peter Gritzmann and Prof. Maurice Lausberg as well as our tutors Daniel P. Schwinger and Eva M. Biehl for the support throughout the project.

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Self-reflection

At the beginning, we had very little idea how our time as a group in the TUMJA would work out. Our group found each other partially because of a mutual interest in the topic of data privacy, partially at random because the others seemed like nice people to be in a group with. We were happy to see what a diverse group we were, with each member coming from completely different fields of study, several group members coming from different countries and one group member even coming from a university that was not the TUM. We found our tutors and supervisors quickly and naturally, and were excited to embark upon our time in the TUMJA and our topic of data privacy.

As for many groups, we needed some time to figure out what exactly we wanted to focus our project on. After many discussions in and around the field of data privacy, we finally settled on the topic of the Privacy Paradox, a phenomenon that appealed to everyone in the group, and something we felt that everyone could relate to. The more complicated portion came after we had decided on the topic: we were certain from the beginning that we wanted to incorporate art closely into our project. While this decision was clear, it took many discussions to decide how to best combine arts and sciences within our topic. Guided by the cultural management and social sciences backgrounds present in our group, we tried to be very mindful to include artists into our projects as equals, rather than approaching them with a finished project for them to add to artistically. Although we were uncertain for a long time how (and if) our plans would work out, we are all delighted to have found excellent artistic partners in Kilian Sladek and Laila Bierling. Through several intensive workshops, together we managed to combine our ideas, knowledge and inspiration to produce the "Human Algorithm," an artistic reflection on the Privacy Paradox and its implications.

Now, at the end of our time as members of the TUMJA, we are very satisfied with what we have accomplished as a group. Although the COVID-19 pandemic meant that almost all of our meetings had to take place online instead of at a Biergarten as would have been our preference, we are happy to have been part of a great group with great people. We are proud to present the results of our group, including of course the "Human Algorithm," but also a short video documentary about the project process, a virtual exhibit, a website with tips on how to protect your data, and even a brief collaboration with a Bavarian minister, to name a few.

We would like to say a huge thank you to our supervisors Peter Gritzmann and Maurice Lausberg as well as our tutors Daniel Schwinger and Eva Biehl, for being patient with us and helping us so much along the way. Of course, we would also like to thank Kilian Sladek and Laila Bierling for being integral in making the "Human Alorigthm" a reality – this project truly would not have been possible without you. Finally, we would like to thank ProLehre Medien und Didaktik for helping us to create our video documentary, as well as the DAC Artemis Studentenförderverein e.V. for helping us to finance the documentary process. Thank you also to the Bavarian Staatsministerin für Digitales, Judith Gerlach, for taking time out of her busy schedule to support our project as an ambassador.

From Team Exhibition Fish

Exhibition Fish

INTRODUCTION

Over the last few years, researchers have been studying the discrepancies between people's attitudes and their behavior regarding the data they share in online environments. Although users claim to be concerned about their privacy, they undertake very little to protect their personal data. This phenomenon is called "privacy paradox". Scientists have proposed several theories in order to explain this phenomenon but there are still some unresolved questions. The increase in users online interaction renders it important to investigate the privacy paradox and effer information to people, allowing them to make informed decisions.

EXPERIMENT

The second component of our research will be an experiment that uses a questionnaire developed in previous literature. We will hand out this questionnaire to students from the TUM. The questionnaire assesses the attitude of participants towards sharing their data and their corresponding data sharing behavior. By examining whether the participants attitude towards data privacy and their actual behavior matches or not, we will be able to see to what extent the privacy paradox is present among TUM students.

ТЛП



Based on our literature review, we found out that there is a gap between people's concerns about their online data privacy and their actual behavior regarding online data disclosure. A meta-analysis of over 180 scientific studies investigating this phenomenon suggests that one of the main influencing factors is the perceived benefit that people get out of aharing their data despite their concerns. Subnequently, our research question is:

"Which role do benefits of online services play for TUM students when sharing their data online?"

Guided by this research interest, we are going to (1) conduct an experiment in order to determine to what extent this privacy paradox can be found among TUM students and (2) do at least 6 qualitative semi-strucfuerd guideline interviews with TUM students in order to explore this research question. Aspects we will cover in our interviews include what characterizes a benefit of sharing data online and how does context influence these characteristics, to name only two examples. We're going to use arts as means to render this invisible process of sharing data in order to receive benefits visible again. In doing so, we want to raise awareness and offer scientifically backed insights for the public debate around data privacy. Ideally, we would like to include an actual artist in our project in order to treat arts as an equal component in our work. However, we know that finding and including an artist in our project might be difficult. Subsequently, our alternative solution is to offer the abover-mentioned visualization in form of a video, artfully illustrating our research results.

GOAL

The goal of our project is to make people more aware that the privacy paradox exists and that they themselves may be acting this way. We hope that by raising awareness for this issue we will help people to be more conscious of their behavior regarding data privacy, and to be more aware of unconscious processes that may be stering this behavior.

MAY 2020

MEMBERS Hundo Coppl, Friez Xiver Gillineyet, Annalenz Huber, Joshwa Sharon Naumann, Paul Andrea Sava, Juan Estaban Suana TUTORS Eva M. Bent, Daniel P. Scheiniger SUPERVISORS Port Dr. Peter Gritmann, Port Dr. Muurice Lausberg



POSTER 1:

Intermediate Evaluation – May 2020

In this poster, we reached the first convergence point in our definition of the topic of the project. We started from the general topic of data privacy, asking how people perceived this concept, until we became interested in the dichotomy between the concern that people have regarding the disclosure of data and their actual private behavior, which led us to define the privacy paradox as our main topic. From this point, there were several challenges that we needed to tackle such as the formulation of the research question. The initial idea was to investigate the role played by the benefits of online services on the privacy behavior of students in Munich. This following the goal of raising people's awareness of the privacy paradox. The most interesting challenge that we found at this point of the project was how to include an artist into the whole project. Ideally, we wanted them to participate throughout the whole process and not only at the end as a communication challenge of our findings. It was not even clear at this stage if we would be able to find any interested artists. However, our focus at that moment was to continue the progress on the research phase.

ШП

Exhibition Fish

1. RESEARCH QUESTION

There is a gap between people's concerns about their online data privacy and their behavior regarding online data disclosure. A muta-analysis investigating this phenomenon suggested that one of the main influencing factors is the perceived benefit of sharing data. Subsequently, our research question is:

>>> Which role do beyoffts at online seveloes play for stadents in Munick when sharing froir data soline?

2. WHAT HAPPENED SO FAR?

We conducted an experiment with 150 students in Munich to investigate the presence of the Privacy Paradox. This experiment served as a basis for qualitative interview guidelines. We have also contacted artists to include in the development of the DATART Event.

3. WHAT ARE YOUR VERY FIRST RESULTS?

Students were divided into two groups (A and B), Group B was aware of the objective of the questionnaire, group A was not. Group B reported being more protective of their data than group A (Figure 1), ulthough the effect size was small. The privacy paradox was present only in group A (Figure 2). Importantly, there was no diffeence in the amount of needlessly disclosed data between the groups. Accordingly, although group B reported to be more protective with their data, they did not act this way. This suggests that knowing the study objective changed the self-reported data protection behavior, but not the actual behavior shown in the guestionnaire.

Figure [Means of students' self-reported actions in



Figure 2 Correlation table between students' opinions about privacy and their self-reported actions

Opinions	Actions		
	SPine A.	Group 8	
drivery is of unperformed to me	31 (2= 34)	39 (p=.02)	
Order a trany is of incontance to me	2430-340	33 ((=02)	
I give provide with my data	32-p+-054	35-10010	

Figure 3 Two Dimensional representation of the higher dimensional Data, showing the behaviour between group A (Blue) and group B (Orange)

> The plot was generated with I-SNE unsupervised learning algorithm, and gives a qualitative representation of the clustered behaviour of both groups.



4. IF APPLICABLE: WHERE AND HOW SHOULD YOU ADAPT YOUR APPROACH? (CRITICAL REASONING)

The DATART Event will be adapted according to the current Covid-19 situation. Should no in-person event be allowed, the event will be an online interactive experience.

OCTOBER 2020

MEMBERS Renoto Aves Copps, Franz Xaver Gilmoyen, Annakesa Huber, Joshua Shareri Neumann, Yauf Andrei Sava, Juan Estaban Saurer, TUTORS Eva N, Bink, Daniel F Schwinger SUPERVISORS Prof. Dr. Pister Girtamann, Prof. Dr. Maurice Laesberg



POSTER 2:

Symposium Class 2019 – October 2020

By October 2020, we were able to expand our knowledge of the Privacy Paradox through comprehensive literature reviews. The central method of our scientific work was an experiment that we conducted with about 150 students from Munich. The results were extremely significant and can be regarded as a scientific foundation for the view that the Privacy Paradox is a phenomenon that we can observe in our immediate environment. In addition to this research work, after the first relaxation of the pandemic legislation, we had new hope for a physical event with art projects around the topic of data privacy. A few weeks after the poster, however, we realized that we had to find other creative solutions to bring our results into dialogue with the arts.

Exhibition Fish

WHAT IS OUR RESEARCH ALL ABOUT?

Through our research, we have tried to find out the common perception of data privacy among students at TUM, while fo-cusing on the gap between their concerns and their behavior regarding data disclosure – also known as the Privacy Paradox. In order to investigate this phenomenon, we divided our study in two parts.

• UNITED ANY is consisting of a questionnaire that was sent to students in Munich. Participants were divided into two groups, one group that knew that our questionnaire was about data privacy and the Privacy Paradox, and one group that did not. The questionnaire aimed to answer the following ques-

- To what extent do the groups differ in self-reported actions taken to protect their digital data?
- 2. To what extent can the privacy paradox be
- observed in both groups? 3. To what extent do the participants of both
- groups differ in the amount of optional demographic data given?

LLTITE >> consisting of a series of interviews with fellow students, in which we fried to find out in more detail what motivates behaviors like the Privacy Paradox. In particular we touched upon different topics and concepts related to data privacy, such as the transaction of data, privacy calculus, ethical implications of data privacy and the notion of what is private and what is not

UPDATE: WHAT HAPPENED SO FAR:

In the first half of our project, we focused on the research part and conducted an in-depth literature review on the discourse on data privacy. Meanwhile, we determined that our research project should focus on the Privacy Paradox. In the summer of 2020, we were able to gather our own data on the relevance of the Privacy Paradox among students in Munich by means of quantitative surveys and qualitative interviews.

Already during our reseach phase, we had intensive discus shows interrupt and with external experts about how we could integrate arts into our project, integrate, we wanted to figure out how our research on this liphly relevant societal second cal challenge and the arts could work together in the best preside way. The result of these efforts is a series of chalogue its with conceptual artists, that are curated online on our Hub. The first project started in November 2020 with jazz musician and composer Kilan Stadek and the video artist Lalla Bierling, THE HUMAN ALGORITHM was developed in an exten sive workshop phase between Kilian Sladek, his ensemble and our team from December 2020 to March 2021 and will celebrate its premiere in September 2021. We are conducting another dialogue project with a cartoonist from Brazil, whose work will be published online in June-July 2021.

In order to increase the sustainability of our project, we decided to change the focus of the "Exhibition Fish HUB" from the topic of data privacy to the collaboration between technology and arts. This resulted in the creation of the Tech&art HUB*

ТЛП

Our collaboration with Killan Sladek to create a Jazz piece based on the scientific research and discussions with our group evolved to include a short conceptual video that will be realized by Lalla Bierling.



We are very pleased that we could win the Bavarian Minister of State for Digital Affairs, Judith Gerlach, as the first member of our ambassador program. There we will bring together representatives from science, society and outlure to create a network for dialog projects between science and arts.

NEXT STEPS

- Writing the Journalistic Report in the form of an interview with our artists Kilian Stadek & Laita Bierling.
- qualitative and the quantitative analysis of interviews and the qualitative analysis of interviews and writing the Scientific Report, showing the results of the
- Further developing the concept of the "techšart HUB", specifically focusing on the sustainability of the project.
 Creating the storyline for our documentary about the col-
- laboration between science&arts.
- Designing and launching the advertisement campaign for the "tech&art HUB" and the artistic productions of our collaborations.



inspired by

MAY 2021 MEMBERS

Banato Alves Coppi, Franz Xaver Gilmeyer, Annalena Huber, Joshue Sharon Neumann, Paul Andres Sova, Juan Esteban Suam, TUTORS Eya M. Bield, Daniel P. Scheinger SUPERVISORS Prof. Dr. Peter Gritemann, Prof. Dr. Maurice Lausters

POSTER 3:

Intermediate Evaluation – May 2021

This poster represents the first moment in which our whole project showed some tangible development in the artistic phase of our project. This was the most critical milestone at that moment for the aroup in the sense that we managed to materialize a collection of abstract ideas, regarding how to integrate our scientific results with the artists, into an exciting jazz-video composition concept realized by Killian Sladek and Laila Bierling. We had an additional main result regarding the definition of the concept for our website "Exhibition Fish Tech Hub," which was created to guarantee the sustainability of the project, in accordance with the official TUM: Junge Akademie 2020 program. Additionally, we managed to get the Bavarian Minister of State Digital Affairs, Judith Gerlach, for what we planned at the moment to be the ambassador's program of our project. This part of the project was for us probably the most satisfying at that moment, in the sense that we managed to overcome the huge difficulties we had in moving from the abstract initial concept to a tangible one, plus the additional constraints caused by the pandemic on the possible collaboration with the artists. Up to this point, there were still several challenges to overcome, such as finishing the scientific phase of the project and producing a coherent storyline, consistent with artistic cooperation. In addition, we had to formulate a concept for the documentary sub-project which would aim to share our experiences and the process of cooperation with the artists.

ТШ

Exhibition Fish

SUMMARY

We conducted research on the topics of data privacy and the privacy peradox, and, based on our findings, created dialogue projects in close collaboration with srtists.

RESEARCH LIFE CYCLE



In our study, we explored to what extent the Privacy Paradox is present in students in Munich, and conducted interviews to gain an understanding of the motivations behind user

To answer our research questions, we administered a quan-titative questionnaire to see (1) if the privacy paradox was present and (2) if knowledge of our research topic influenced the answers participants gave. We also conducted semi-structured interviews game a deeper understanding of the factors influencing user behaviour.

R dansty in



Renato Alves Coppi, Friez Xaver Gilmeyer, Annaliena Hutser, Joshua Sharon Neumann, Paul Jodna Sava, Juan Esteban Suanu MEMBERS TUTORS Eva M Bield, Daniel P. Schemper SUPERVISORS Prof. Dr. Peter Gritmann, Prof. Dr. Maurice Launberg.

The Privacy Paradox is present among students in Munich and price knowledge of the topic does not influence the actual privacy behavior. Online privacy behaviour is context-depen-dent. There is a general feeling of societal pressure to partici-pate in platforms that isoevitably gathere data.

Our research and journalistic report will be published in the TUMJA yearbook

CONCRETE RESULTS/OUTCOME

Our dialogue projects, most importantly the composition and music video HUMAN ALGORITHM, which will be available on our ExFlut HUB.



IMPACT & SUSTAINABILITY

Through our artistic collaborations, we brought a new emotional and artistic interpretation to the topic of data privacy. To ensure the sustainability of this work, the results are available online.

ACKNOWLEDGEMENTS





POSTER 4:

Symposium Year 2020 – October 2021

At the end of the 20 months of the scholarship, we look back on our time in our team with great gratitude. In the first step, we approached the topic of data privacy and especially the privacy paradox as researchers. looking for insights into how concrete and provable the challenges are that we perceive in our daily lives. The results proved unequivocally that the Privacy Paradox is a phenomenon that is robustly present in our immediate environment at the university. We are particularly proud of the next step, which we took with a lot of work and discussion: We brought our research findings into dialogue with professional artists to find new and personally touching ways to shed new light on this relevant topic. With the opening of our virtual exhibition and the online and live premiere of HUMAN ALGORITHM, we have reached milestones - thanks to the TUM: Junge Akademie - that have greatly enriched us as a team and each of us personally.



Project Report Lacktivity

leam	Maren Berting Monica Déchène Christian Faßbender Laura Hoffmann Florian Hübler Joel Jäschke Benedikt Vollmann
Tutors	Veronika Bauer Thomas Just
Supervisors	Prof. Dr. Bertold Hock Prof. Dr. Volker Nürnberg

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Preface by the Supervisors Prof. Dr. Bertold Hock and Prof. Dr. Volker Nürnberg

The TUM: Junge Akademie has undergone major changes over the past ten years, especially when it comes to the interactions between mentors and scholarship holders. They gradually shifted from a top-down relationship to a guided self-organization. In other words, the scholarship holders now independently form groups and define their own program under the roof of a general topic given by the Advisory Board. The role of supervisors is now seen in the light of cooperation and partnership.

The team with the acronym "Lacktivity" got together during the Kick-Off year 2020 from November 22-24 at Schloss Aspenstein (Georg-von-Vollmar-Akademie) at Kochel above the scenic lake Kochel. The seven student members together with their supervisor are shown in Fig. 1. The background of the members included a wide range of interests, among them Engineering, Education, Mathematics and Architecture.

I have seen my role as a supervisor in the Lacktivity group never in the sense of an overseer or watchdog, as the word suggests in its German meaning. The brilliant performance of the group, its creativity and prudence never made this necessary. It was a great pleasure to join the group as a mentor, answer questions where I was asked, or suggest methods. I suspect the bigger advantage was on my side. Therefore, I would like to thank all members of the group for their perseverance and patience. These qualities were important prerequisites for the success of the project in difficult times. It is a mark of quality that the group never gave up under the restrictions of the pandemic. Rather, they found an intelligent alternative to their original experimental concept. With it, they achieved their goal of suggesting methods to overcome the lack of physical activity. I wish all members good luck and a bright future.



Fig. 1. The Lacktivity group with its supervisors

Bertold Hock

The Scholarship holders of the TUM: Junge Akademie have chosen a very exciting and relevant project with the title "Lacktivity." Due to an increasingly sedentary society, there is more and more lack of exercise and activity, which in turn can lead to lifestyle diseases such as diabetes or high blood pressure. To increase the physical activity of employees, the group analyzed that stair climbing instead of taking a lift would be well suited. This is an appropriate and above all low-threshold approach to reach employees more effectively. The students showed a high level of motivation even though some challenges arose due to the pandemic. It is understandable that the approach could not be experimentally proven because it was not possible due to Covid-19. Nevertheless, the results and findings of the Lacktivity project provide a foundation for further research in the field of nudging.

Overall, it was exciting to accompany the project, as I am involved in health promotion both privately and professionally and struggle with the 10,000 steps myself every day. I wish all TUMJA scholarship holders all the best for their future and continued success!

Volker Nürnberg

Stairs instead of chairs - because your health cares

It is a typical day of work. You just received an urgent note from your boss to step by for a short meeting. So you get up from your desk and walk out to the stairwell as your destination lies two floors higher. And then you see both the inviting comfort of the elevator and the promise of better health contradicted by additional physical effort in the form of the stairs.

You take a look at the clock and see you only have a minute left. "The elevator will surely be faster," you tell yourself while standing in front of the closed metal doors, waiting for them to open.

Think about it, when was the last time that you could have taken the stairs but instead decided to take the elevator? Did a few steps into a healthier life feel like too much of a burden? Did you fear that you would be out of breath by the time you got to your destination and your co-workers would laugh about your fitness?

Fear not, you are not alone. In practice, only few regularly manage to reach the 10.000 steps per day target set by the World Health Organization (WHO). This is the baseline to maintain good health and greatly reduce the risk of many diseases.

This was the main motivation for our team, fittingly called "Lacktivity", to think about how the current situation can be changed. Our motto: We don't want to force you to do anything. As students, we know that as soon as you have to do something, motivation drops to previously unknown levels of low. Consequently, we were looking for a new approach to make physical activity great again. There are huge bodies of research, but one of the latest and greatest techniques is called "Nudging." With Nudging, instead of prohibiting certain activities or directly encouraging them by saying things like "Take the stairs. Do it now!", people are, rather, influenced to think about a topic and come up with measures they see fit on their own. This inverts their motivation from coming from external sources to coming from their intrinsic will.

If you think about it, this makes total sense. Being told to do the dishes is unlikely to get you to do the dishes right now. But what if a friend instead asks you to grab a drink with them later while he adds that there is nothing more annoying than having to do the dishes after coming home after a long night out? As you likely feel the same way, you are more inclined to clean them now instead of afterwards. This example is obviously drawn out of thin air, but it still depicts the basic idea of nudging pretty well.

Now who exactly is "you"? It is very important to set a specified target group in order to be able to better tailor our methods. For example, motivating people in a start-up who regularly run marathons to take the stairs seems a bit pointless. Thus, we tried to sample different companies from a broad spectrum in order to achieve a target group with an average to rather low level of regular physical activity.

After deciding on our strategy to get people moving, we still needed to find ways to nudge them. After a lot of thinking and talking to industry experts, we came up with very different methods which we wanted to compare based on their effectiveness. On the one hand, a more classical approach, utilizing motivational and deterrent posters, which for example contained contents like "Going to the 6th floor is 1% of the Zugspitze" in the motivational case and "A lack of physical activity increases the risk of cardiovascular diseases. Taking the stairs is a step in the right direction." was chosen.

Aside from posters, we also utilized a more novel method that makes taking the stairs itself a fun activity. In other words, we tried to improve the user experience of taking the stairs by fun facts obtainable at different levels. That way, instead of just getting to your destination, you also end up learning new things along the way. Such facts are for example that Humanity still needs to dive to the bottom of the ocean to acquire metal from sunken ships from the pre-World War II era in order to build Geiger counters for radiation detection.

Lastly, competition was brought into the game. This was done by comparing the absolute amount of stairs taken between different companies and showing them on companies' big information screens. This way, participants would always see the score of their competitors first thing in the morning and start their day off in a stair-taking manner. I am sure some of you have asked yourselves how such activities are going to be measured during experiments. And no, even our time as students is too precious to sit in front of a stairway the whole day and count the number of people going up and down. We initially planned to use commercially available light barriers, but were shocked once we found out that the amount we needed would have cost us a fortune. So, back to the drawing board we went. Kind of not knowing what we were getting ourselves into, we decided to just build the sensors we needed from scratch. This meant designing the circuits, ordering them from a manufacturer, assembling them into presentable boxes all while being careful not to make the stairways, which normally have a pretty cold and business-like appearance, look like a laser maze. The sensors were a great success and we were able to dramatically cut down the cost per sensor by building them ourselves. Excited about our progress, we were eager to visit companies and collect data for our experiments.

But then, disaster hit. The original as well as the second time frame in which we had planned to install our sensors at our partner companies' staircases was affected by lockdown restrictions. As it was still unclear at the time of the second deferral if or when on-site projects could be possible again, we decided to test our nudging strategies by conducting an extensive survey.

So, the challenge was then to translate our planned methodology into the purely digital format of a survey as well as possible. We tried to mimic the decision process that would normally happen right at the decision point, the choice of way in front of either the elevator or the stairs. Right there, one of our methods is implemented by a poster or, in the case of competition, by a counter of the stairs taken by the other team.

Then, the participants are asked to rank our different methods depending on which they think would be most effective in order to lure them away from the escalator in favor of the stairs. Furthermore, for each method there are different variants of posters listed that can again be ranked. Additionally, we asked them for their reasoning for why they chose a certain method in order to gain a holistic view about the effectiveness of different implementations.



Fortunately, the last hurdle for successful surveys, finding enough participants, was overcome with the help of our partner companies, who agreed to take part in the survey.

So, we received over 200 responses. Aside from some chronically-lazy participants, an overwhelming majority gave very positive feedback and would appreciate the implementation of our methods in their companies. As one participant fittingly said, "Having motivational posters would often help me to overcome my weaker self and not give in to being lazy and taking the elevator." This was a common occurrence that came up countless times during analysis of the responses and shows that oftentimes, a single nudge is all it takes to live a healthier life. Our deductions from the survey will now be presented in more detail in the following scientific part.



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Summary and Future Goals

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Abstract

Introduction: People hardly meet the recommendations for physical activity in their daily working routines. Sedentary behavior is particularly high and previous interventions trying to increase physical activity have often failed.

Objectives: Therefore, we examine which of the methods (motivation, deterrence, user experience, competition) can most successfully increase the spontaneous physical activity of employees with regard to their stair usage.

Methods: In order to determine which method is most suitable, scenarios were described in a survey in which employees had to decide whether to use the stairs or the elevator. Subsequently, the Situational Motivation Scale (SIMS) was used to capture the specific motivation for taking the stairs.

Results: Our findings strongly indicate that motivational posters are the most effective method. The SIMS reveals that there are dependencies between the chosen method and all types of motivation besides amotivation.

Conclusion: Positive effects of motivational posters in daily working routines regarding climbing stairs were identified. This paper provides a foundation for further research in the field of nudging in occupational health management and the practical implementation of motivational posters in companies.

Background

Hardly any adults meet the WHO recommendations of 10.000 steps per day. These recommendations are designed to encourage an appropriate amount of physical activity on a daily basis and are intended to maintain and promote health benefits (World Health Organization, 2008). Recent studies confirm that the sedentary time of Europeans in everyday working life is currently too high at over 4.5 hours per day and has continued to rise in recent years (López-Valenciano et al., 2020). Physical inactivity represents a major health risk, especially when it occurs over a long period of time, for example, during the workday. Interventions to counteract this trend have so far been rather insufficient, which is also shown by a consideration of occupational health management (OHM). A lack of an overarching occupational health management concept and sustainability, as well as a lack of responsibilities, are most frequently criticized (Arps et al., 2019). Those interventions seem to be less efficient since they often suffer from the effects of variation, caused by lack of access and support from management. Furthermore, the difficulty of passing from knowledge to action is often a problem (Rouat et al., 2021).

Consequently, it is necessary to find an approach to motivate employees to be more physically active in their daily work routine without applying costly OHM concepts and sports courses in their free time. There are several OHM interventions that can help improve the health of employees and make their working routine fitter. For instance, OHM interventions can encourage employees to take the stairs (Titze et al., 2001). Stair climbing is particularly suitable because it can be accumulated during the workday and still make a significant contribution to the recommendation of 30 minutes of daily physical activity. This can be perfectly integrated into the workday, as it does not require additional equipment or encroach upon valuable free time. Previous studies have also shown the effect of climbing stairs during working hours, citing significant decreases in body fat percentage through regular stair climbing (Fardy & Ilmarinen, 1975). The amount of energy burned by stair climbing is approximately 8-11kcal per minute, which is guite high compared to other moderate physical activity (Duke Human Resources, 2021). Therefore, it would take only 5 minutes of stair climbing to burn the calories of an apple. In summary, a weight reduction of up to 3 kg per year can be achieved by only climbing 2 floors per day. Encouraging employees to take the stairs more often during the workday can achieve and maintain a healthy body weight, healthy bones, muscles and joints. The methodological approach to en-



Figure 1: Methods for increasing physical activity and stair usage.

courage people to climb stairs has so far been relatively one-sided in research and has therefore only rarely been able to demonstrate significant benefits. For both stair climbing and other OHM health interventions, experts use a variety of methods to encourage increased physical activity. These are presented in the following.

Motivation

Motivation refers to all motives and reasons for acting or behaving in a particular way, which can be stimulated both internally and externally. In the context of health interventions and stair climbing, motivational posters or installations are considered to motivate people to climb stairs externally and to cause internal motivation for lifestyle changes to get healthier.

Previous research shows motivational stair-raiser banners with slogans such as "Stay healthy, use the stairs" or "Be active!" placed at an appropriate location show positive effects on increasing use of stairs (Kerr et al., 2001a). However, not only motivational banners but also posters in large sizes motivate people to take the stairs more often. Studies in shopping malls and at train stations showed that motivational posters larger than DINA3 with slogans such as "Stay healthy, save time, use the stairs!" significantly motivate people to climb stairs more often according to their gender (Kerr et al., 2001b). The decision to take the stairs at the workplace is a spontaneous one. According to current research results, at the point of decision between elevator and stairs, interrogative slogans on the posters prove to be more effective in motivating people to climb stairs than imperative slogans (Suri et al., 2014). We can thus conclude that the visibility, format or size of the posters and the linguistic design of the messages are of great importance in successfully motivating employees to climb stairs more often.

Deterrence

Deterrence refers to an action of discouraging a behavior or event through instilling doubt or fear of the consequences. Regarding stair climbing in everyday working life, for example, negative health consequences of taking the elevator may be illustrated. These consequences serve as a deterrent and cause employees to decide to climb the stairs more often. In this context, the Protection Motivation Theory, attempts to explain health-promoting behavior on the basis of coping mechanisms and fear (Rogers & Mewborn, 1976). Study results show that 35% of behavioral intentions of the Canadian population and 20% of their actual behavior is precisely influenced by the state of fear and its coping mechanisms (Plotnikoff et al., 2009). Further findings by Russel and Hutchinson (2000) demonstrated in general that the use of signs, either deterrent or motivational, significantly increased the use of stairs. Using deterrent signs at the point of decision with slogans such as "Keep your heart healthy" and "Please limit escalator use to people who are unable to use the stairs" increased stair use by 6.67% regardless of age and gender (Russell & Hutchinson, 2000). Deterrent posters are therefore suitable for encouraging employees to take the stairs more often, as fear of negative health consequences triggers coping mechanisms.

User Experience

User experience refers to the situational context in which a user interacts with a product, system, or service. In this context it is about the perception of the situation with the aim of making the interaction as pleasant and positive as possible. When it comes to motivating people to climb stairs more frequently, aspects that improve the experience within the stair climbing situation are the most effective. Improved user experience can be achieved by using different media. Study results show that the use of gamification methods with mobile fitness apps or email notifications that encourage taking the stairs is most likely to motivate employees to increase their amount of stair climbing and physical activity in general (Andersen et al., 2013; Spillers & Asimakopoulos, 2014). Referring back to the previously mentioned internal and external motivation, we can state that gamification replaces internal motivation with external incentives. Most gamification implementations use a score-based system with rewards to keep up engagement (Zuckerman & Gal-Oz, 2014). Therefore, the user has to be kept in a cycle of continuous reward in order to guarantee lasting change. In order to motivate employees to increase their use of stairs through improved user experience, continuous incentives are necessary. These can be implemented methodically, for example, through fun facts during stair climbing, digitally as a push notification, or analogically in the form of a poster.

Competition

Competition refers to the activity or condition of striving to gain or win something by defeating or establishing superiority over others. When it comes to sports, there is a distinct culture of competition, which can also be applied to such activities as taking the stairs.

The competition between colleagues or between two companies can lead to the fact that one changes its behavior in a way that one would like to climb more stairs than the opposing party. Competitions regarding the daily number of steps taken, represented by social comparison of pedometers and scores on websites, encourage people to increase the number of steps taken by 10% compared to non-competitive conditions (Johannesson et al., 2010). Further research examines the effect on regular participation in sports courses. Social comparison was more effective for increasing physical activity than social support and its effects did not depend on individual or team incentives (Zhang et al., 2016). In addition to successful competition, social support and group membership also play an important role in motivating people to be more physically active. Study results on team-based weight loss approaches show that a high social influence of team members can positively affect the weight loss of the whole group. Additionally, it can promote increased physical activity, which can be applied to taking the stairs more often (Leahey et al., 2012). Therefore, to encourage employees to take the stairs, a mixture of competitive but also team-oriented measures is necessary. Colleagues could compete as a team against other companies in stair climbing and see the score of the leading company live on screens in or in front of the stairwells.

Nudging

As we have already seen, there are various theoretical approaches that can motivate employees to take the stairs and hence exercise more in their daily work routine. One underlying approach is nudging. It describes a subtle and gentle method of influencing people's behavior in a predictable way. Nudging maintains the impression of self-directed behavior and contributes to motivate employees to take the stairs more often (Thaler & Sunstein, 2008). Nudging can decrease sedentary behavior in the workday and increase physical activity through certain walking concepts. There was a study in which employees were subtly encouraged to exercise more by walking directly to their colleagues instead of making redundant calls or sending emails (Gilson et al., 2009). In general, nudging is a popular approach for promoting physical activity in the workplace, including stair climbing. Results from Meiden et al. show that salient nudges such as footprints on the floor had greater success (91.4%) than just posters with motivational slogans such as "Free workouts during work hours? Take the stairs!" (46.3%) to encourage employees to take the stairs more often (Meiden et al., 2019).

Goals and Methods

Goals

To address the previously outlined problem concerning the lack of physical activity in everyday life, we want to analyze promising methods to solve this problem. The scenario of climbing stairs, which has also been described above, is particularly suitable for promoting daily number of steps and physical activity. Instead of looking at methods individually as it has been done in research before, we wanted to look at the overall concept within a comparison of methods.

Therefore, we addressed the following research question in our study: Which of the methods (motivation, deterrence, user experience, competition) can most successfully increase the spontaneous physical activity of employees with regard to stair usage (RQ)? Additionally, we wanted to investigate the dependency between the frequency of taking the stairs and the relation to socio-demographic data such as age, sex, level of education and status of employment. We hypothesized that especially younger and educated people in part-time and full-time employment are most likely to take the stairs, regardless of gender (H1).

Furthermore, we wanted to investigate whether there is a dependency between the frequency of stair use and self-assessment in relation to one's own overall health and physical fitness. We hypothesized that especially employees with a (very) good grade in the categories of overall health and physical fitness are also more likely to take the stairs (H2).

The research question posed, and its associated hypotheses allow for a detailed discussion of methodological approaches regarding incentives to motivate employees to take the stairs more often. Our aim is to provide a valuable methodological contribution, not only as a theoretical basis but also as a scientifically based OHM implementation for future interventions in targeted companies.

Methods and Participants

To assess employees' attitudes toward taking the stairs in their daily work, we conducted a survey. In the period from April to May 2021, employed (187 full-time, 64 part-time, 14 other) adults (n = 265; 74 male, 191 female; mean age = 39.76 years ± 11.74 (SD),

range = 18-70) in various German- and English-speaking companies of different sizes and economic orientations were questioned. When asked how frequently they currently take the stairs during their workday on a 5-point Likert scale (1 always, 5 never), the mean was 1.75 ± 0.85 (SD) with a range of 1-5 (M: mean = 1.57 ± 0.68 , range = 1 - 3; F: mean = 1.82 ± 0.9 , range = 1-5). The participants were informed about the use of their data and agreed to the processing of the data for scientific analysis but could voluntarily and independently discontinue the survey at any time. In addition, the participants were informed that there is no right or wrong when it comes to measuring motivational aspects and that they should therefore answer based only on their initial reaction.



Figure 2: Percentage of people always taking the stairs at work.

Instruments

Our survey captures employees' attitudes in a hypothetical scenario from their everyday working lives, in which they must choose between taking the elevator or the stairs to go upstairs. The use of vignettes as a methodological tool allows us to elicit and capture the subjective sense of action through imagined situations (Barter & Renold, 1999). We used the vignette as a stimulus in our survey, where the respondent is asked to assess the situation and to indicate a course of action appropriate to the situation and to justify it. We then define the respective methods of the scenario and ask respondents to rank them. The order of rank determines which page of the survey will be shown next. The page contains exemplary representations for posters or installations of the method previously selected at position 1 in the ranking. Here the participant was asked to once again rank those 4 posters according to their preferences. All posters were created by the research team, taking into account the aspects of posters for health interventions (visibility, size, nudging, etc.) mentioned above.



Figure 3: Scenario setup between elevator and stairs.

Next, the Situational Motivation Scale (SIMS) was used to assess the motivation to take the stairs, after choosing the most appropriate individual example of the previously selected method (Guay et al., 2000). This scale is widely used to measure motivation for physical exercise. The instrument measured intrinsic motivation (i.e. 'Because I think that this activity is interesting'), identified regulation (i.e. 'Because I am doing it for my own good'), external regulation (i.e. 'Because I am supposed to do it'), and amotivation (i.e. 'There may be good reasons to do this activity, but personally I don't see any'). Each one of these subscales contained four items. Every item was rated on a five-point Likert scale from one (agree) to five (disagree).

There was another part of the survey that was intended to inquire about the feasibility of implementing the methods in the company. These free-text answers were not further qualitatively evaluated within the scope of this study, but rather served as incentives and possible cooperation opportunities for the implementation of the actual methodological TUM: Junge Akademie project.

In the next section of the survey, we collected the participants' socio-demographic data. This includes gender, age, highest level of education, and current employment situation. In order to assess the level of physical activity at work, we also asked about the conditions under which employees get to their workplace (motorized or through their own activity, such as cycling or walking) and how often they use the elevator or stairs during their workday. A five-point Likert scale was used to indicate frequency (always, often, occasionally, rarely, never). In addition, self-assessment of one's own overall health and physical fitness was conducted using school grades. This self-assessment tool is frequently used in

school sports and is therefore valid (Otero-Saborido et al., 2021). In fact, research shows that results of self-assessment strategies can reflect descriptive portraits regarding one's own health and a positive self-perception and more realistic self-assessment.

Interpretation

First, all descriptive data from all variables in the survey were analyzed. Distributions as well as probabilities of the data were determined using R. Then, the SIMS as well as the demographic data was analyzed with Fisher's exact test in R due to the small sample size and nominal data. For data with low sample sizes, the R fisher test with monte carlo simulation ($B=10^5$) was used.

Results and Discussion

Reliability of Measure

Internal Consistency of the SIMS data was chronbach's alpha = 0.8 (IM), 0.85 (IR), 0.76 (ER), 0.88 (AM) where all values pass the 0.7 threshold suggested by Nunally, 1978.

Ranking Results

In the described scenario, the motivational poster was most often (158) chosen as rank 1, followed by UX (54) while Deterrence was chosen the least often (17). This allows us to reject the H₀ hypothesis $p_M \leq 0.5$ with a p-value of 0.001, where p_M denotes the likelihood of motivational posters being chosen for rank 1.

	Motiva	ation	User Experience		Competition		Deterrence	
Rank 1	158	(0.6)	54	(0.2)	36	(0.14)	17	(0.06)
Rank 2	59	(0.22)	106	(0.4)	54	(0.2)	46	(0.17)
Rank 3	41	(0.15)	60	(0.23)	109	(0.41)	55	(0.21)
Rank 4	7	(0.03)	45	(0.17)	66	(0.25)	147	(0.55)
Avg. Rank	1.61		2.36		2.77		3.25	

Table 1: Results of the method ranking.

Note: Rows 1-4 show the number of participants who chose the method in the corresponding rank with the percentage in regard to all participants in parenthesis. Row 5 shows the average weighted rank of the method.



Motivation

Figure 4: Rank 1 poster from each category or method.

Other Results

The data does not suggest a dependency between sex / age / education and stair usage. The exact fisher test rejects the independence of the self-assessed overall health and physical fitness with stair usage with a p-value of 0.004 and 0.001 respectively. The dependency could be described as weakly positively correlated (Health: 0.14, Fitness: 0.2) if the Likert and grade results are interpreted on a numerical scale as it can be seen in Table 2.

	1 very good	2	3	4	5	6 insufficient
Health	1.67	1.7	1.98	2	2.5	-
Fitness	1.43	1.73	1.78	2.04	2.27	1.75

Table 2: Average Likert scale result for stair usage depending on the self-assessed over health and fitness in school grades.

Note: (Health n=(1: 78, 2: 128, 3: 45, 4: 8, 5: 2); Fitness n=(1: 40, 2: 102, 3: 79, 4: 25, 5: 11, 6: 4))

Lastly, intrinsic motivation (p=0.004), identified regulation (p<0.001) and external motivation (p=0.041) can be assumed to depend on the choice of the preferred method. There were however no significant (p < 0.05) signs that the same holds for amotivation.

Discussion

First of all, it has to be mentioned that our results are not based on measurements but rather on a survey. This implies the common limitation when it comes to self-assessment. Furthermore, the majority (72%) of our participants were female. However most results were similar when separated between genders.

The results can however answer our research question with an extraordinary high significance in favour of motivational posters. Not only were we able to derive that motivational posters are the most picked method for rank 1. We were even able to show that more than 50% prefer motivational posters, which implies our hypothesis and answers our research question. Furthermore, the dependency between method and SIMS was expected. Due to the sample size we were however not able to describe the dependency with more details without applying more complex procedures. We might be able to analyze the dependency with a factor analysis for the final report.

While we were not able to supply sufficient evidence for (H1), this phenomenon has already been well documented in recent studies (Akkermans et al., 2009; Akkermans et al., 2013).

On the other hand our expectations were correct for (H2) as the results show. The dependency between self-assessed health and fitness correlate with the participants' stair usage. This trend can even be seen with bare eyes in Table 2. There it has to be noted that the sample size for the health grade 5 and fitness grade 6 (n=2 and 4) are very low, hence they should be ignored. This result implies that by targeting elevator-taking employees the hardest to reach group of self-assessed unhealthy employees can be reached.

Overall we were surprised by the big lead of motivational posters. Here it would be interesting to validate our survey results with measured data in order to erase the self-assessment component.

Summary and Future Goals

In conclusion, motivational posters have the greatest effect in motivating employees to casually engage in taking the stairs during the workday more often and thereby increase the amount of physical activity in everyday working routines, compared to the other methods. The results of the survey further showed that targeting stair usage is a good way to reach otherwise hard-to-reach target groups.

However, several methodological limitations can be identified in the present research design, namely that the assessment of motivation was exclusively captured by the described vignettes and the survey. A measurement of the streams of movement in stairwells on site in companies, before, during and after the methods were installed could have increased the validity and reliability here. Furthermore, the representativeness of the respondents for the total population is difficult to estimate, as the acquisition of survey participants was problematic despite extensive efforts and therefore no further sample restrictions and adjustments could be made. Nevertheless, these research results provide an important contribution to current research. We were able to close gaps regarding the comparison of methods, as we applied the Situational Motivation Scale to all methods and not exclusively to the subjectively best method. Furthermore, this paper provides a suitable approach for further research in the field of motivational posters in occupational health management. Based on our scientific findings, incentives can be created to motivate employees to exercise more in their workday by motivating them to take the stairs more often.

Further research should deal with specific exemplary implementation of the motivating methods and posters. A concept consisting of three intervention studies (pre-intervention, during intervention, long term post-intervention) could be suitable for this purpose, in which the flow of movement is measured in the stairwell, in front of elevators and in front of stairs. This will help to determine whether employees are actually more motivated by the method installed in the stairwell and therefore prefer the stairs significantly more often than the elevator. Further research should also be conducted in the field of nudging in OHM. Our study has shown that especially unobtrusively placed interventions that subtly encourage people to take the stairs have great success. Perhaps this should be an incentive for OHM research to focus on unconscious incentives and nudging and less on classical OHM sports courses, which often fail due to a lack of competent personnel and funding. It also remains to be clarified whether it makes sense to consider and apply methods on their own or to design and evaluate a holistic approach with all the methods mentioned. This approach could help to address the health needs of employees who spend a lot of time sitting and have little free time for physical activity.

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Self-reflection

Our process started at the first seminar weekend in Kochel am See in November 2019, when we first came together as a team of eight students with various study backgrounds. Among these were Human Factors Engineering, Education, Health Sciences and Social Studies, Management & Technology, Mathematics, Architecture, Computational Mechanics and Environmental Engineering. We knew from the beginning that we wanted to work on a theme that had a social focus, particularly on the health and fitness of society. Even though there are already many possibilities and much information on how to exercise and stay healthy, studies show that most people still lack physical activity. After a few meetings, research, and brainstorming, we found that the reason for this is a lack of time, or at least a perceived lack of time. Therefore, we wanted to do a project that would encourage people to incorporate physical activity "sportaneously" into the day of and thereby improving their fitness incidentally.

To figure out the exact implementation, we divided up the topics we thought would be relevant and interesting to do research on. As we were a relatively large group, we came up with a lot of information that had to be sorted. Whenever we arrived at such points, our tutors have been of great help by giving advice on how to move on. Narrowing down the information we had, we figured that the occasions within a workday between sitting at desks, could be an interesting time within which to incorporate more physical activity. Motivating the employees to take the stairs instead of the elevator seemed to us to be the most sensible way to implement exercise into their daily routine. But what is the best method to do so? To find the answer to this research question, we planned on testing different methods for their feasibility. We came up with four main methodologies, these being: Motivation, Deterrence, Competition and User Experience. As splitting the topics within our team proved productive before, we did so once again. In the following period, we found it most effective to work in smaller teams and to check in as a whole group every once in a while, to update and also help each other with the progress.

It was always helpful that we had a lot of different study backgrounds, as we always had different perspectives on the discussed themes. This was also the case when we were looking for a way to measure which method leads employees to take the stairs most often compared to the elevator. With our different knowledge backgrounds, we believed we could prepare a good way to do so using light barriers. Simultaneously, we established contact with many companies. Some were interested and we were able to build up some connections.

Unfortunately, a few months into 2020, Corona came, and so we had to relocate our meetings to online meeting platforms. A pity, as we got along well as a team. But the bigger problem was in fact

that we saw our project drift away. In the beginning we were still optimistic that the situation would improve soon and we could follow our plans for implementation. But as the pandemic kept going on and on, it kept getting more and more unrealistic that we could carry out our project as planned. Our project completely relied on employees being at the office and not in the home office. Due to this, our motivation fell to a low around this point. But with the help of our supervisors and tutors, we managed to get back on track and find a way to keep our main focus but with minimal personal contact. For this reason, we decided to get results by shifting from the real life scenario to conducting a survey. This demanded a lot of flexibility and also creativity of us, but thereby also taught us and prepared us for future projects. Thankfully, some of our initial contacts forwarded our survey to their employees, so we could still get scientific results on the topic.

During our journey at the TUM: Junge Akademie we also had to work around the problem of some people leaving our team and the Junge Akademie during the project period. Even though this was always a surprise at first, it did not hinder us from progressing and instead gave everyone more responsibility and maybe even more motivation to work for our project. Even though our group got smaller and Corona prevented us holding physical meetings, we kept up the team spirit by, for example, creating team Lacktivity t-shirts. Our supervisors Dr. Bertold Hock and Dr. Volker Nürnberg always helped us when we had any questions and when we needed contacts, for example to distribute our survey. We are very thankful for the conversations and the insights they gave us on their work, the wonderful food and beer in Freising and all the advice!

We also want to thank Veronika Bauer and Thomas Just who guided us through the project and gave us the right pushes when we needed them, especially in the beginning! Also a big thank you to the whole team from the TUM: Junge Akademie, especially Peter Finger.



POSTER 1:

Our first contact was at the seminar weekend at Kochel am See. What brought us together, was, besides mutual sympathy, the aim to do good for society. Since we figured the lack of physical activity as one of the biggest health risks in our modern world, we wanted to tackle that exact problem. Despite the fact that there are more than enough opportunities to do sports or exercise in general and, in theory, every citizen knows about the negative impacts of a lack of exercise, people still exercise way too rarely. After great and intensive brainstorming sessions and discussions we identified a lack of time as the main reason for this problem. Consequently, we decided to aim at bringing physical activity into the daily life of employees. As we defined the project goals before the outbreak of the Covid-19 pandemic, we focused on implementing the measures in the buildings of partner companies. In essence, we planned on motivating employees to take the stairs instead of using the elevators.

Afterwards we split responsibilities. One team systematically researched the availability of appropriate partner companies, who had to fulfil several criteria like a certain number of employees and access to elevators. In a second step, those companies were contacted and several meetings were conducted. At the same time, another team was developing methods on how to increase stair usage and how to quantify the results. Our overarching scientific goal was to find out which method is the most suitable to increase stair usage and thus motivate employees to integrate physical activity into their everyday life.



POSTER 2:

At the time of the second poster, we had already made a lot of progress. The four different methods had been defined, scientifically based and also already developed. Furthermore, laser barriers to quantify the stair usage had been built and several companies were willing to let us conduct the experiment at their facilities. Unfortunately, as for most of the teams, the Covid-19 pandemic destroyed most of the hard work. For over one year, only systemically essential employees were allowed to go into the office - the rest were working from home offices. As our original plan was to conduct the study at the office facilities and we figured that was now going to be difficult, we started to implement a backup plan to be more flexible in the event of further disturbances to the pandemic.

For the backup plan, we kept our scientific goal to find the most suitable method to motivate employees to use the stairs. Instead of focusing on real-life stair usage at the location, we decided to get the answers by directly asking the target group which kind of method they would prefer or in other words which kind of method would motivate them the most to use the stairs instead of the elevator.

All in all, the Covid-19 crisis was a big challenge for us as a team. However, we learned to stand together as a unit, be more flexible and to be prepared for all further challenges.



sufficient statistical accuracy, we try to reach further in our networks. Our results will consist of the ranking of methods (Motivation, Deterrence, Fun Facts and Competion) that are the most likely to make the participants of our study take the stairs instead of the elevator. Furthermore, for each method different implementations will be ranked by their effectiveness according to our data Finally, conclusive recommendations will be given. These may then be used to spontaneouosly increase physical activity by the example of taking the stairs over the elevator.

a way to stay connected not only virtually but physically by creating shirts for all team members, tutors and supervisors. That is a great way to represent our commitment to the team and also to represent the project and TUMJA to all stakeholders

and finish our first draft for

the final report. To achieve

that goal, we split our team

into two taskforces. One

is responsible for maintai-

ning and statistically eva-

luating the survey while the

other team is simultaneous-

ly developing the theoretical

framework and conducting

an extensive literature re-

view. This team will build up

on the already finished research that was executed in

the last months. In the end both parts will be merged

and sent to the supervisors.



5 MOST IMPORTANT REFERENCES

We base all our methods on scientific literature. These are our most important references for every single method. Motivation Deterrance Competition



POSTER 3:

As the Covid-19 situation did not improve at all and most employees were still working from home we had to throw away our first plan and switched to the backup plan. Luckily, the contacts we had gained initially for the conduct of the experiment came in handy as we could cooperate with them also for the backup plan and our flexibility was rewarded.

Therefore, to answer our research question, we developed an extensive survey which was based on previous literature and our developed methods. The survey was created both in German as well as English, to also account for non-German speaking participants. It was finally distributed via EvaSys to all different partner companies. In the meantime, we carried on our already conducted research to provide the scientific background to the methods we compared in the survey, and we started working on our research paper.

As we could only meet in online Zoom sessions, we designed our own shirts to keep up the team spirit and show our commitment to the project.

пп lackt vity SUMMARY RESEARCH LIFE CYCLE identify core problem: Our team addresses the initial problem of people being niview Monatore: develop study design: physically inactive in their workday. Recommendations nethods like motivation. theoretical development of experimental setup on site, complementary survey leterrence, user exper ence and competition ack of physical activi-ty during the workday for promoting physical activity are intended to maintain and promote health benefits. With our analysis of different methods, we have identified an approach to encourage people to be physically active in their everyday working the without expensive occupational health management measures or sports courses 111 in their free time. Our comparison of methods was based on a survey in which we described hypothetipresent findings. analyze research. gelber, data cal scenarios in front of the elevator or stairs. Motivaand solutions results tional posters were most effective compared to deterhow companies pose te which method is much out to companie de cevá rent posters, user experience posters and competition health of their employees people to take the stairs **Neults** postars. RESULTS AND OUTCOME STAKEHOLDERS AND ACKNOWLEDGEMENT PASTICIPANTS FURTHER MOTIVATIONAL FINDINGS During a high base above of the state SNS addings (24 matrix, 147 flaministic mean age \sim 38.74 yields a 11.74 (362, single \sim 18-76). The first adding adding a star-185 matrix adding data does not suggest a desendency tertween see / age / education and relations of the second value of 0.004 and 0.001 measurements wells and have constant of the second to 0.24. These Likes and grade results are interpreted on a manetical solds at 3 car to be second the difference on a manetical solds cons that subtly en-people to take the Sor CHAM METHODS Statute 2 31 141 18 Ade - 141 AT 04 1 20 AND 10 10 10 100 100 Bustional motivational scale results; transc motivation (p=0.001; soleClined regulation (p=0.001) to advance and orbitation (p=0.011) can be essueed to depend as the druces of the pailwaved method conserving applicant (p=0.021) signs that the same fields for conserving applicant (p=0.021) signs that the same fields for 144 62. 10. 0.4 11 10.00 IMPACT AND SUSTAINABILITY The conclusion, woldwaterial posters have the grantest effect in motivering employees to assault ranges in taking the data take range the woldship of interview and takes to consider the and the source of the source of the source of the source of provide activity of interview and takes to consider the angesting rate using in a good range to sead, of the source may be applied to the source to sead of the source angesting rate using in a good range to sead of the source. We are able to an import contribution to come insearch. We are able to the paper regularity the source insearch. We are able to the paper regularity the source insearch for the able to the paper regularity the source insearch. The source able to the paper regularity the source in the taket interview. 10.0 ** 82 # 90 425 641 W. #211 A-11 M H-10 M-101 1.00 8.77 1.11 probed scenario. We institutional poster may recent a drogen as rank 1, followed by UV (dr) white Deter-or chosen the lead offers (1). The drag between to to regist sportweets p. Mo33 with a problem of 0.007, where we the illustrood of metalational posters being cho-les the illustrood of metalational posters being chodevice the detailability and matching back to an intercost and catalone to the subjectivity back methods. Furthermore, crede a publicle approach for further research in the faile details and public the scalar public and the sub-traction is a scientific findings, incentifius can be created double employees to exercise more in their workday by million from the state the states more offen. wangetic support at the SEPTEMBER 2021 MEMBERS. Maren Bertling, Monca Dechane, Christian Fallberder, Laura Hoffmann, Florian Hübler, José Jáschke, Benedikt Vollmann inspired by TUTORS Veronika A. Bauer, Thomas Just SUPERVISORS Prof. Dr. Bertold Hock, Prof. Dr. Volker Nümberg

POSTER 4:

Poster 4 describes the work that has been done to finalize our research and evaluate the results. After sending out the survey, we contacted as many additional potential participants as possible to get statistically relevant results. As soon as we had reached a satisfying number of participants, we started evaluating the survey and analyzing the most motivating method. As a final step, we want to distribute our work and help companies to increase the health of their employees by motivating them to exercise in the right way.

In conclusion, we thank every member of TUMJA for the wonderful time we have had and encourage everyone to keep moving, or in other words: Stay Safe and Stay Active!



Project Report **T'UMwelt**

Team	Veronika Franz Madeleine Hotter Sarah Kluge Melissa Lutgardo Jonas Unterholzner Jeremias Widmann	Preface by the Supervisors Journalistic part Scientific part Self-reflection Process description
Tutors	Dr. Matthias Lehner Victoria Treßel	
Supervisors	Prof. Dr. Hans-Joachim Bungartz Prof. Dr. Jan Müller-Wieland Prof. Dr. Christopher Ungemach	

Preface by the Supervisors

Prof. Dr. Hans-Joachim Bungartz, Prof. Dr. Jan Müller-Wieland and Prof. Dr. Christopher Ungemach

On a great idea, severe roadblocks, and "the way is the destination"

Our team's project started with the name EnterTrainment and ended as TUMwelt – which, maybe, already reflects some of the various problems the team encountered and the several re-orientations these problems entailed throughout the last year. The topic is as timely as such a topic can be, and of high societal relevance – the use of appropriate technology to create incentives that foster ecological behavior at large; or, formulated as the team's research question: "What kind of incentives can be successfully delivered via mobile apps that nudge their users towards eco-friendly behavior?" The primary context: local mobility – public transport, cyclists, pedestrians. Now for the problems. Building the project on an app needs someone who can rapidly develop and deliver such an app – all the way down from design to implementation. In particular, the latter became an issue. The first plan – find an informatics student who can do this – did not work. If, as a student, you deliver something for a student initiative, you typically want to be part of it. This holds in general, and it holds in particular for an informatics student who sees only a limited attractiveness in being a coding servant to a team of fellow students. Next, the planned incentive were credits. There were vague plans of designing an "Interdisciplinary Project" – without a deeper understanding of what an IDP is (the module in the informatics master curriculum representing the minor, i.e. a project where the topical context is defined out of the minor). Eventually, a student was hired and paid – who actually delivered something,
but not what was intended; money is not the best incentive – see above. Learning outcome: If coding marks a good part of such a project, at least one team member should bring in coding expertise.

A second challenge for such a project is narrowing down the features and potential nudges to be implemented as part of the app. There are various ways to facilitate behavioral change (e.g., decision signposts, information, financial incentives, gamification ...), but implementing all of them would keep a whole team of developers busy for months. Furthermore, being able to test the contribution of the various nudges empirically requires a detailed consideration regarding the experimental design and a large number of participants. When the circumstances become more restrictive, some decisions make themselves. Another issue is communication. We as mentors found ourselves a bit decoupled from the team's activities, without having shown a lack of interest. That feeling is probably also the reason that our preface is less descriptive and more critical than others. But isn't it such a variety that provides "the salt in the soup"?

Concerning the outcome, there are at least two dimenions: outcome in terms of "the product," and outcome in terms of lessons learned. Even if the first is not (yet) fully convincing, the latter is indisputable. Which brings us to "the way is the destination" in the title of this preface – and with respect to that, the lessons have been learned. By the team members, but also by us. Hence, overall, another great TUMJA experience!

T'UMwelt – let every leaf count.

Have you ever wondered how many CO_2 emissions you could save by walking, biking, or going by public transport instead of the car? As part of our project for the TUM: Junge Akademie, we created the application T'UMwelt which makes your contribution to a more environmentally friendly city visible! After each trip, you will see how many grams of CO_2 you have saved. Thereby, we aim to raise consciousness about mobility habits, awareness about their impact on the environment, and promote eco-friendly behavior.

Knowing that we are not alone in our endeavor for a greener environment, we looked for inspiration from those who are already active and experienced with this challenge. For this, we got in contact with the creators of the platforms GreenApes and MUV. We received important and helpful advice from them about various topics, ranging from how to manage and prioritize the development of features of our final product, what to keep in mind when trying to engage people with our project, and even considerations about making our initiative sustainable in the long term. All these inputs have allowed us to keep moving forward and reach our goal. Are you interested in how we got there? Then join us in a short ride about mobility habits, obstacles for choosing sustainable means of transport, and, finally, experience what it is like to let T'UMwelt accompany your daily trips.

Mobility habits

What impacts people's decisions for or against a means of transport? Regarding cycling, the security aspect has a huge effect on the decision. For a Munich resident, let's call her Marianna, feeling secure due to separated bike lanes, for example, can be an enormous driving force to cycle. In Munich, during the last months, several so-called pop-up bicycle lanes have been created and mirrors have been installed at dangerous crossings to improve visibility for right-turning large vehicles.



How about walking? Apart from being a relatively slow means of transport, why do people walk? First, it is an easy way to get some exercise. Also, in so-called multifunctional neighborhoods which fulfill several functions from shopping to coiffeurs and playgrounds within walking distance, people can be more tempted to walk. For example, when going back from university, Marianna enjoys walking and checking the library and shops that are near the Maxvorstadt. Occasionally she buys groceries before going home. Accessibility and short paths are essential for that. This is also important for the use of public transport. Connections, convenient schedules, as well as comfort and beauty of the stations can affect people's choices.

Experiencing sustainable means of transport

Walking is probably the oldest way to move. Far before the invention of any means of transport, such as bicycles, locomotives, or airplanes, people travelled thousands of kilometres on foot. Over the past centuries, increasing prosperity and the ever-increasing desire of mankind for comfort led to a decrease of distances covered on foot, by bicycle or even public transport. Nowadays, many people want peace and quiet, preferring the comfortable car to other means of transport, so as not to be unnecessarily disturbed by the rest of the population, for example in the subway or bus.

Combined with the ever-increasing frequency of work in the office, modern people are therefore increasingly lacking in exercise, which, in view of ever-improving medical care, is not a cause for concern for them. And although climate change is widely recognized, many people do not like to connect it to their transport behavior if it means foregoing their comforts and being able to get in the car and drive from one's own home to the organic shop in the neighborhood.

Cycling allows for much further traveling distances than walking. Quite easily, you can make about 13 kilometres in an hour. It is also an easy way to do some physical activity, which is – at the same time – an unappealing fact of cycling as you will sweat. That is impractical when cycling to classes, work, or a restaurant. Even worse on hot summer days! Or in the rainy autumn, when damp leaves deceptively cover the little curb between the bicycle path and the footpath. And in the winter months, in freezing cold and on icy roads. But that is not all, we have not even started talking about how to



carry your purchases or travel with children. It can be a challenge to maneuver your way through pedestrians, cars parked on the bicycle path, and on the roads when there is no separate path for bikes. Despite these inconveniences, cycling can be fun. Grab your helmet and pool noodle to indicate the distance cars should respect when passing. Get comfortable clothes and put on a smile. Hop on your bike and enjoy the flow when cruising.

When it comes to larger distances, walking and cycling may no longer be an option. It is in these cases where comfort and flexibility have an even greater importance when choosing between private cars and public transportation; being restricted to specific schedules to initiate a journey, sharing the space with other passengers, and handling luggage from one transport to another represent demotivating factors that drive people away from eco-friendly mobility. Finding ways to overcome these factors or casting a different light on public transport means and their usage, could be an interesting opportunity to convert this behavior. For example, if one has no access to a car (or at least not yet), the cumbersome



endeavor of travelling by bus or train ends up forming part of an individual's routine anyway. We must not waste the chance of finding the key to motivate people towards eco-friendly mobility, precisely during this phase, in which custom and inertia can be very helpful.

Now, let us experience T'UMwelt!

Thousands of people go to work every day in Munich, few of them use environmentally friendly means of transport such as ÖPNV or bicycle. Marianna takes the subway to her office every day. She works for a big electronics company and wants to help protect the environment. Through her circle of acquaintances, she became aware of the app T'UMwelt. An app which, finally, makes her contribution to climate protection visible. Marianna is enthusiastic about T'UMwelt! Every morning when getting on the subway, she swipes the blue bottom in the app to the right, her trip is now recorded! When she arrives at work, she immediately sees the distance traveled as well as how many CO₂ equivalents she has saved by going by ÖPNV instead of her private car. What an emotional morning booster! Now, she is ready to tackle any challenge her workday might bring. Marianna is already excited about how many Leaves of Change she will be able to grow in one week. The Leaves of Change are calculated in accordance with the CO₂ savings and are part of Marianna's tree, which she can grow in the app, and which shows her overall contribution to climate protection. After work when Marianna goes shopping by bike, she swipes the yellow button saying 'Bike' and starts cycling. Although the hill she must climb can be challenging, it is worth seeing her Leaves of Change growing and growing. At night, she drops in on her friends who live five streets away for a barbecue ... swipe the green button ... and let's go. At the party, she compares the collected leaves with her friends, and they even make bets on who will grow more Leaves of Change next week. Also at work, Marianna has already motivated her colleagues to use T'UMwelt. It can be so much fun to do something good and contribute to environmental protection when you see the impact you're having. And, of course, when doing it together with others!



Closure

After finally producing our app T'Umwelt, we dream of being able to make a lasting impact on climate protection. It is not only about nature, but also about maintaining people's well-being. In addition, the app offers users the opportunity to compete with their friends and the community, which is designed to lead to an exciting group dynamic. It is our goal to be able to keep the app alive even after the end of our project, possibly also with partners who will continue the app with us or even take it over. At the end all we have to say is: Become part of T'UMwelt, because we are moving Munich!

Evaluating the potential of the app TUMweltfreund to promote eco-friendly transportation habits

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Abstract

Nudging describes the designing of an environment in which decisions are made to lead the chooser in a certain direction. The effect of a nudge can be increased by gamification, which is including game or fun aspects in the design. Nudging strategies can be applied to benefit eco-friendly behavior. Similarly, TUMweltfreund is an app promoting eco-friendly transportation habits. Comparing it with previous projects, as well as examining the theoretical background, led to the conclusion that the TUMweltfreund is a promising development in this direction, with high chances of nudging people successfully.

Introduction

In Bavaria, 30 to 70 % of distances are still traveled by car (VDW, 2017). While emissions per car have decreased, the purchase, as well as usage of cars, has continued to increase, partially explaining the increase in total CO_2 emissions of 3,7 % since 1995 (Umwelt Bundesamt, 2021). In 2017 an investigation by the German Federal Ministry of Transport and Digital Infrastructure indicated the highest increase in car usage in the rural areas from 20 % in 2002 to 67 % in 2017 due to the increase of commuters. In urban traffic, cars represent 36 % of the modal split (VDW, 2017).

Meanwhile, public transport systems, as the eco-friendlier alternative, make up about 20 % of traffic in German urban centers (VDW, 2017). Although usage of public transportation led to an average saving of 10.5 million tons of greenhouse gas emissions (VDV, 2019), people still often decide to travel by car. According to a study by the Münchner Verkehrs- und Tarifverbund (MVV) examining determinants of the decision whether to use public transport, the most important factors are punctuality and frequency. Large decreases in public transport usage were found for frequencies of 10 minutes and longer. Also important are the price-performance ratio, availability of connections, travel time as well as the availability of general information (MVV, 2007).

For an easier description of target goals and backgrounds, travelers are categorized using a set of different criteria. As already mentioned, there is a substantial difference between the rural and urban population, with different motivations due to a difference in infrastructure (VDW, 2017). Users of the public transport systems can also be divided based on the frequency and their potential to increase usage of public transport (MVV, 2007). Some do not own a car, therefore only travel by eco-friendly means, such as a bicycle or the public transport systems. The other main group consists of car owners and can be further divided by their frequency of taking the public transportations systems. People who tend towards traveling by car can be further divided based on the perceived quality of infrastructure available in their surrounding neighbourhood. Those that do not have good connections but are willing to take the public transportation systems more often represent 23 % of the population of Munich, while those with a good connection and general willingness to use the public transport make up 4 % of the population. This leads to a total of 27 % of the population that could be steered towards public transportation by different means (MVV, 2007).

As shown, people still have different preferences towards various methods of transport, with different reasons and arguments. However, studies have shown many benefits of a modal switch from traveling by car to the usage of public transport in urban areas. Firstly, cars are linked to various health risks from increased mortality rate due to car crashes to increased morbidity due to air pollution (Zhang, 2013). While probably not being obvious at first, noise pollution by increased car traffic can also harm human health, reportedly increasing the risk of myocardial infection, cardiovascular disease, hypertension, reduced sleep quality, and others (Maschke, 2002; Geravandi, 2015). Nonetheless, the most important factor might be the increased temperature rise and climate change due to greenhouse gas emissions, which not only harms biodiversity and health but economics as well, due to high medical costs (Tol, 2009; Haines, 2004; Dantas-Torres, 2015). Furthermore, studies have proven the positive economic, health, and environmental effects of switching to more eco-friendly modes like cycling and walking (Rojas-Rueda, 2012).

Without immediate changes, temperature in Bavaria will rise about 4,8 °C by 2100 (Bayerisches Staatsministerium für Umwelt und

Verbraucherschutz, 2021). However, Bavaria still takes the least action of all the German federal states (DVR, 2020), stressing the urgent need for projects increasing eco-friendly travel behavior. One way to do this is by improving the infrastructure, which has various other positive impacts, like improving the economy of the area leading to so-called accumulated effects, which are synergistic effects increasing the impact (Tricker, 2007). An alternative is the method of nudging and gamification, which can be especially relevant for those who have a good infrastructure but use public transport less frequently (MVV, 2007).

One of these nudging programs is the so-called TUMweltfreund, a mobile app developed by the team TUMwelt of the TUM: Junge Akademie. With this, users track their routes traveled either by foot, by bicycle, or by public transport. The distance of the route is used to calculate the savings of CO_2 equivalents, meaning the effect of all greenhouse gas emissions, the time, and the money savings compared to traveling the same route by car. According to their savings, users will be publicly ranked, therefore competing against each other. The program is available as an app for Android users on the Google Playstore.

The objective of this paper is to showcase different nudging approaches and to critically evaluate the design of the app TUMweltfreund. To achieve this goal, a literature search was undertaken to describe the theoretical background as well as case studies in the field of nudging towards eco-friendly behavior. An additional survey provides further insights into the opinions and wishes of potential users.

Methodology

Literature research

In the literature search for this review, we focused on studies that discussed nudging approaches especially in the context of eco-friendly behavior. Starting in May 2021 and finishing in July 2021, the literature review was conducted using three databases, namely "Scopus," "Web of Science" and "ScienceDirect". As search strings, "nudg*," "gamification," and "intervention" were

used primarily. The search was restricted to English literature more recent than 2000. The results were filtered to fit the specific interest of the field of eco-friendly behavior. The evaluation process of the findings was made independently by three researchers to assure the validity of the results. The screening of the abstracts and full texts resulted in 14 reports that were included in this review. Of those articles, 7 focused on the theoretical background, while 7 focused on field studies. Other articles that were included highlighted the current environmental status of Munich and the health risks that relate to it.

Survey

Design

The survey that provided additional data to the literature review of existing interventions was designed as an online questionnaire. Both closed and open questions were used, where the open questions were used as an addition to the closed questions to add further response possibilities. The wording of the questions was carefully chosen so as not to generate a bias.

The survey was designed and conducted using the platform evasys (evasys GmbH, Lüneburg, Germany).

The questionnaire was divided into four categories, namely "use of public transport," "use of eco-friendly means of transportation," "impact of eco-friendly apps," and "personal data."

Evaluation

For each closed question, the percentage of each possible answer has been calculated, bearing in mind that for multiple-choice questions the percentage is calculated using the number of participants, not the number of answers given. The answers obtained through the open questions were added to the evaluation of the connected closed question.

Theoretical background

Nudging

Theory

There is no set definition of nudging (Vlaev et al., 2016, p. 551), but Thaler & Sunstein define a nudge as "any aspect of the choice architecture that predictably alters people's behaviour without forbidding any options or significantly changing their economic incentives" (Thaler & Sunstein, 2009). The choice architecture is the environment or the surrounding in which the decisions are made. The choice architect aims to create an environment that gently pushes the chooser towards one choice which the architect deems to be in the best interest of the choosing individual (Ferrari et al., 2019, p. 185).

There are believed to be two systems of thinking. On the one hand, system 1 refers to uncontrolled, automatic, fast, and unconscious thinking; and, on the other hand, system 2 refers to reflective, rule-based, slow, and conscious thinking (Dolan et al., 2012). Though nudging is by no means limited to one or the other system, most choice architects focus on system 1 since it is less intrusive, and the choosers do not feel like they are pushed or forced into one direction (Vlaev et al., 2016, p. 551).

One of the best-established frameworks for nudging is the MIND-SPACE framework. It combines the nine "most robust effects on behaviour," namely messenger, incentives, norms, defaults, salience, priming, affect, commitment, and ego (Dolan et al., 2012). The following table shows a short definition for each of these effects.

MINDSPACE cue	Behavior
Messenger	We are heavily influenced by who communicates information to us
Incentives	Our responses to incentives are shaped by predict- able mental shortcuts such as strongly avoiding losses
Norms	We are strongly influenced by what others do
Defaults	We go with the flow of pre-set options
Salience	Our attention is drawn to what is novel and seems relevant to us
Priming	Our acts are often influenced by subconscious cues
Affect	Our emotional association can powerfully shape our actions
Commitments	We seek to be consistent with our public promises and reciprocate acts
Ego	We act in ways that make us feel better about ourselves

Table 1: The effects of the MINDSPACE framework (Dolan et al., 2012, p. 266)

By addressing most if not all of these effects, the effectiveness of a nudge is greatly increased and has been confirmed in laboratory and field studies (Vlaev et al., 2016, p. 552).

Having portrayed an effective way of designing choice architecture we want to highlight that nudging itself is controversially discussed. The main questions in the discussion are: is it morally correct to influence the choices of others? What gives one the right to decide what the best choice is for others? In the term 'choice architect,' which is an invention of Thaler & Sunstein, it is implied that the architect has certain expertise in the field in which the decisions are made, which makes him/her capable of judging what the best choice may be (Sugden, 2009, p. 366). Apart from questioning who is evaluating the expertise of the architect beforehand, what is not addressed is whether the choice that is nudged towards is universally the best for all individuals.

In theory "a choice architect uses the choosers' judgements about what makes them better off, rather than imposing her own" (Sugden, 2009, p. 367). This statement is in line with the 'free choice condition,' that Thaler & Sunstein propose as insurance to prevent manipulation. They describe their approach to choice architecture as 'libertarian paternalism' since certain choices are highlighted or guided towards but not forced upon people (Thaler & Sunstein, 2009). However, many reviews of their work point out that even Thaler and Sunstein themselves, though being the inventors of the free choice condition, show some reluctance in applying it (Leonard, 2008; Sugden, 2009; Thaler & Sunstein, 2009). Overall, nudging can be a powerful tool to increase the chance of someone making the choice the architect has intended, but it must always be used carefully and with the free choice condition in mind.

Case studies

Many consumer apps for a sustainable lifestyle have already successfully implemented nudging in their functionality. In the following section, some of them will be presented in the areas of food, general consumption, and transport.

The app "Too Good To Go" for example offers a marketplace for restaurants and shops that have unsold, surplus food and sell it at a discounted price (Too Good To Go ApS, n.d.). The app uses push messages to inform its users concerning new offers at the appropriate time, e.g. sending reminders concerning lunch offers

between 11 a.m. and 1 p.m. Messages contain texts like "Support our work against food waste. Save delicious meals from being thrown away." The app has already been downloaded more than 500.000 times.

Consumer apps like "Yuka" or "Code Check" use nudging in their functionality. They can be used to scan the barcodes of consumer goods such as shampoos or processed foods to find out exactly what ingredients are in them and which of them may pose a health risk and to what degree. They also provide information about the carbon footprint of many products. Consumers are encouraged to scan the products themselves as well as to actively contribute to the expansion of the product database.

Apps for sustainable mobility again use push messages to regularly inform the consumer of the carbon emissions he or she has already saved and to compare it with that of other users. This should encourage the user to travel even more sustainably.

As far as consumption is concerned, there are multiple apps available. As far as sustainable travel behavior is concerned, however, there is still a lack of beneficial apps. Although there are already initial offers such as "Carbon Footprint & CO_2 Tracker for Travel and Food," which calculate the CO_2 emissions of travel behavior, the calculation method is usually too general and not comprehensible to the consumer (The Capture Club, 2021). Accordingly, the results are not very meaningful. Furthermore, all these apps differ in their calculation method and weighting of the respective mode of transport.

Gamification

Theory

The term "gamification" is gaining importance today in all areas, be it professional or private. Gamification is the inclusion of playful elements in purposeful actions (Deterding et al, 2011). It can be implemented in (private) education as well as in the generation of ideas by employees. The idea behind this is to promote the motivation and long-term engagement of the respective protagonists through playful elements.

Case studies

Companies such as BMW (Silverman, 2011) have already successfully anchored this in corporate processes, enabling the gathering

of points for kilometers driven in electric mode when using their hybrid cars (BMW, 2021). Gamification is also increasingly used in the field of environmental protection, especially in apps (Rosenau et al, 2013).

"GreenMe Life provides users with hundreds of tidbits and tips on how to live a "greener", environmental-friendly life. GreenMe Life includes sections" (Incelligence, Inc., n.d. para. 12) such as clothing or food (Incelligence, Inc., n.d.). The app interface is designed like a calendar with green tiles and every time the user reports a green activity in the app, the respective field of the date turns darker green (Mak, 2015).

The app Eco-Dice, on the other hand, aims to motivate its users to do at least one sustainable deed a day. By tapping the screen, a dice is rolled, and instead of a number, an activity is displayed that the user is supposed to perform within 24 hours. In addition to using the bicycle to get to work, this also includes separating waste or even the suggestion to shower with others to save water. The app "Joule" encourages users to consume electricity more consciously. It sets its users small daily tasks regarding electricity consumption, which in turn can have a major impact on electricity consumption (Mak, 2015). "The app even connects to your home utility account and shows you how much you've saved! You can earn rewards and badges, for each eco-friendly action you take, and you can even win competitions on the leader-board. Share your experience and results on Facebook and get your friends in on the game too!" (Mak, 2015, para. 8-9).

There is a huge number of gamified sustainable apps; however, most of them are aimed at sustainable waste separation and electricity consumption. Gamified consumer and transport apps like GoEco, which promotes eco-friendly transport habits by tracking the number of kilometers traveled by public transport, are still under-represented and less popular.

Unification of Nudging and Gamification

All the apps introduced in the section "gamification" use a combination of nudging and gamification.

They all have in common the use of push messages that educate users about their behavior and contain general service and background information on the respective subject area, e.g., electricity consumption, food waste, etc. Most apps still rely mainly on nudging and the initiative of their users. As a result, they have a reduced reach, since it is mainly people who already have a clear environmental awareness who access such apps. Users who have little interest in the general topic are less likely to be addressed by them (Dolan et al., 2012).

Results of the survey

The survey was taken by 119 participants with an average age of 22 years. 47,9 % of participants were female, 51,3 % male and 0,8 % diverse. For better visualization, the results of the first three categories are displayed in the following bar charts.



Use of public transport

How often do you use public transport?











Why do you use public transport?





Eco-friendly means of transportation













Impact of eco-friendly apps



100% 88% 90% 80% 70% 60% 50% 40% 30% 20% 10% 10% 1% 1% 0% Yes, I have one I Yes, I have several I Sometimes No use regularly use regularly



Which of these apps do you know?

Regarding the convenience of public transport, it was often stressed that a car is not needed in a big city such as Munich. Furthermore, the term flexibility is not only focused on time and destination but also includes not needing a parking slot and being free to consume alcohol. The inconvenience of public transport, as well as the bad connection, was specified to be worse with greater distance from the city centre.

For eco-friendly apps, several (5) participants expressed concerns about the data security of such apps since most operate by surveying the users' actions. Another critique was the unclear structure of many apps as well as the need for several apps instead of one that covers all aspects of an eco-friendly lifestyle.

Discussion

Critical examination of survey results

As seen in the results, there is a relatively even distribution of medium- and low-frequency users of public transport among the participants with the most (37 %) being high-frequency users. While only 36 % own a car, nearly everyone (95 %) owns a bike. It was pointed out several times that in a big city like Munich, cars are often less practical due to limited space and crowded streets. Summing up the overall motivations to use eco-friendly means of transportation for public transport the environment and convenience were the most pronounced, while the bike was seen as convenient and a good way of getting physical activity. Walking was mostly described as suited for short distances and relaxing. The three possibilities of eco-friendly transportation that were compared in this study, therefore, serve different purposes.

What was most striking concerning the category of eco-friendly apps, was that hardly any were known to our participants and very little (2 %) stated they use such apps regularly. The lack of users could be explained by little or ineffective advertisement, since most participants seemed to be generally interested in an eco-friendly lifestyle, indicating no lack of interest in eco-friendly apps. Several participants pointed out that they would appreciate one app that covers all aspects of eco-friendly behavior.

The survey was primarily distributed among TUM students and alumni, inevitably leading to a bias based on age, education and the general mindset. Additionally, partaking in the survey is more likely if there is a general interest in the subject of the study by the person asked to participate (Quick & Hall, 2015). This voluntary and involuntary preselection of participants alters the results, which can therefore not be seen as generally valid for the whole population of Munich or Germany. Given that our project mainly focuses on TUM students, the results are still significant for this specific study.

Critical examination of the TUMweltfreund

To assess the effectiveness of the TUMweltfreund using the MIND-SPACE framework, the survey needed to be considered (Dolan et al., 2012). Afterwards, the impact of the TUMweltfreund could be evaluated by the number of cues in the MINDSPACE framework being fulfilled. As seen in the results, the most important reasons why cars are being preferred were availability (55 % of respondents), longer travel time (55 % of respondents), followed by ticket costs (50 % of respondents).

On the other hand, 70 % of participants stressed the environmental advantages of public transport. This led to the question of whether stressing the already known positive impacts or using nudging to convince people of time or money savings is more successful. However, with these three factors and availability being the most important aspects, it became clear that the app addresses the right cues. With travel time and ticket costs ranking quite similar, the effects could be assumed to be similar.

When considering the reasons for going by bike, it is either the convenience, probably due to short distances, or to do physical activity, leading to the conclusion that the TUMweltfreund is not ideally designed for nudging towards cycling or walking.

As the program is designed for students in Munich, the name TUMweltfreund references the TU Munich leading to a positive impact according to the MINDSPACE framework (Messenger). However, the app does not give any incentives like small gifts or presents (Incentives). The influence of others is considered, when using a ranking, therefore increasing the likelihood of affecting the travel behavior (Norms). As seen in the survey results as well as in the literature research the popularity of mobility behavior apps is still low, needing thorough marketing (Defaults). With Fridays for Future and other initiatives continuing to draw more attention to climate change, the modal switch to public transportation is beoming relevant for an increasing amount of people (Salience). As seen in the survey, the right cues are addressed by the app fulfilling the priming effect. The same can be said for affect and commitments, with more people speaking out against climate change and therefore being especially committed to saving emissions as well as being affected by such savings. These can in turn make them feel good, especially when showing these savings towards others in a ranking (Ego).

Conclusion and outlook

Nudging can be a powerful tool in changing people's behavior towards an eco-friendlier lifestyle, as was shown in the case studies above. Addressing as many key effects as possible of the MIND-SPACE framework can increase the chances of a successful nudge, while including gamification aspects that add to the fun for the nudged person can ensure a long-term motivation to stick with the project.

There is a need for a uniform calculation of the carbon footprint that is comprehensible to the user. At the same time, it must not demand too much information disclosure from the user. On the one hand, this would be too cumbersome, on the other hand, it would be too much of an invasion of privacy. This is a balancing act between too much and too little. Apps should also aim to specifically address users who, so far, have had little knowledge/measurement of environmentally conscious behavior. As already mentioned, this is not yet happening to a sufficient extent. In addition, power consumption should be considered in app development. As in the case of GoEco!, this is often perceived as too high, which is why many users no longer use the apps after a certain time.

The TUMweltfreund includes most of the MINDSPACE effects and joins them with gamification aspects such as ranking and challenges. It, therefore, has a high chance of successfully nudging people to more eco-friendly transportation habits while providing fun and long-term engagement. To prove the effectiveness of the TUMweltfreund further research is needed.

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Self-reflection

As with most project implementations, team TUMwelt had to overcome challenges, starting with the lockdown caused by the global Corona pandemic in 2020. Due to the significant decline in public transport ridership, the members had to ask themselves to what extent their original idea of nudging towards usage of public transport was still possible. Added to this was the difficulty of finding a suitable programmer for the app. There were two possibi lities to involve such a person in the project: via an IDP or a working student position. The team initially wanted to realize an IDP, but then had to hire a student assistant after all. In retrospect, the team has to say that they lost time unnecessarily here in particular because they underestimated the administrative requirements and the associated (time) effort for such an implementation. Believing that all this could be implemented quickly, they accordingly reacted too late and too vaguely to subsequent demands from the faculty administration.

Nevertheless, the team members would not want to have missed this stage of their project because it gave them an insight into how difficult it sometimes is for lecturers to restructure research and teaching projects. Thus, their understanding was further deepened.

With the employment of the programmer, it also became clear to the participants how important it is to keep agreements and communicate regularly. Lack of clear and timely communication led to a delay in the schedule and the results fell far short of the original requirements.

Still, no disadvantage where there is not also an advantage.

It demonstrated to the team the importance to good work progress of contractual conditions such as the agreement of working time documentation.

The TUMwelt team would like to sincerely thank the companies MVV and Pixida for their advisory and supportive role around public transport and app programming.

Special thanks also go to our supervisors Prof. Müller-Wieland, Prof. Dr Ungemach and Prof. Dr Bungartz. Their expertise was an enormous help to the team throughout the whole process.

They would also like to thank their two tutors: Dr Matthias Lehner and Victoria Treßel, who co-supervised the project.

Looking back, it can be said that in the case of team TUMwelt, the journey was the destination. Despite all the hurdles – or precisely because of them – they never discarded their core idea.





POSTER 1:

At the beginning of our journey, we started as the team EnterTrainment, a group of six motivated students who wanted to take a step towards a more eco-friendly Munich. In our initial research, we quickly discovered that Bavaria, despite having the worst air quality in Germany, does the least for eco-friendly solutions. We decided to tackle the problem through increased use of public transport. To do that, our idea was to create an app that combines gamification and nudging strategies to promote the use of public transport systems. As unique features, we planned eco-feedback, a karma point system and partnerships with local shops to provide small gifts for the users of our app. As a measurement of our success, we planned two surveys, one before and one a few months after experiencing the app. By that, we wanted to answer the guestion of how to motivate people to travel in more eco-friendly ways. We had our plan ready to go and went to work.

ТШΠ

Enter Trainment

WHAT HAPPENED SO FAR

We stabilized our partnerships with MVG, GREEN APES, and MUV. In July we started a cooperation with our partner Pixids, who provides us with helpful feedback especially concerning the app development.

In search of coders for our app, we worked on a concept for an interdisciplinary seminar for informatic students, within which they work on practical projects. We are confident to find motivated students and ho start the coding soon!

RESEARCH QUESTIONS

In case the app will not run for long enough to answer our research questions, we added some more questions, that could be interesting to focus on:

- ... What motivated people to download our app?
- ... Are there any savings in time or money when using public transport instead of the car?
- ... How easily do people get discouraged (in case there are no savings in time or money)?



OUR FIRST RESULTS

- Advertise on different social media channels
- Establish cooperations with different pariners
- Create a flyer for advertisement
- Work out a mock-up
- of the app
- Elaborate a concept for an interdisciplinary seminar for informatic students
- Work out a tracking concept for the app



WHAT'S NEXT

The task with the highest priority is the coding of the app. We slightly changed the features and will keep the app more simple. Key features are tracking, ecofeedback, and calculating the karma points.

Apart from that we want to make progress with the cooperation with local shops, which - most likely - will be primarily for mutual advertising.

We are moving Munich!

OCTOBER 2020

MEMBERS Veronika Franz, Madelono Hottor, Sanah Khage, Melsae Latgardo, Jonas Unterhatore, Jovennas Widenam TUTORS Dr. Matthes Lethers Victoria Thele SUPERVISORS Port Dr. Han-Joachim Bungartz, Prof. Dr. Christoph Ungenach, Port Jon Hatter-Weath



POSTER 2:

After a few months we had already achieved great results by establishing partnerships with MVG and PIXIDA and getting valuable feedback from like-minded projects. Through the help of our partners, we created a mock-up of our app and had the first idea of our tracking concept, which would be essential for the flawless running of the finished app. To get our project known we created a flyer and social media accounts. Most importantly, by setting up an interdisciplinary project (IDP), we hoped to acquire a motivated informatics student to be the coder who would implement all our ideas. As the first setback, we had to accept that the partnerships with local shops would be solely based on mutual advertisement instead of discounts or gifts for users of our app.



POSTER 3:

Being already over the half-point mark we had to admit that our project, as we had planned it, would not work out. The IDP did not yield a coder, so, instead, we hired a working student. Having lost a lot of time already the app was not taking shape as fast as we hoped. All things considered. we decided on shifting our focus and changing our name to TUMwelt. Now our project and research were about how to best design and implement a nudging strategy to promote a modal switch towards more eco-friendly travel means like the bicycle, public transport or by foot. Seeing the app not yet working out well enough to include it in the research properly we had to content ourselves with literature research and one additional survey.

ТЛП

POSTER 4:

In the end, few things worked out the way we initially planned them, but nonetheless we have some findings to report. Nudging and gamification have proven to be powerful tools to motivate people to behave in more eco-friendly ways. Our app, the TUMweltfreund, although not being completely finished, is designed well and holds great promise to effectively nudge people. Even though the outcome of our project was not what we hoped for, the process was a valuable experience for us, from which we learned a lot.

T²UMwelt

SUMMARY

The results from our literature research, lossons learned from similar projects, and feedback received from partners and strakeholders wern helpful for creating the mobile application "TUMwelthreund". The results from the conducted survey indicate that the mobile app has the potential to nudge people's mobility behaviour towards more sustainable means of transportation.

RESEARCH LIFECYCLE



CONCRETE RESULTS AND OUTCOME

- Uterature research: Nudging is a powerful tool to increase eco-friendly behaviour
- Cesign of the rudging strategy: the "TUMweithreund" combines many aspects of the MINDSPACE framework
 Implementation: the "TUMweithreund" is a fully operational mobile app for Android, available in Google Play Store
- Survey the "TUMweltImund" mobile app has good chances to nudge successfully Further research is needed to proof the effectiveness of the
- "TUMweltfreund" mobile app.

IMPACT AND SUSTAINABILITY



Research findings could be used by similar projects: a results from literature are relevant for the design of the nucleing strategy a results of the survey are relevant for the interests/ behaviour of a timilar target group No concrete impact of the app itself yet The app always needs a team for maintenance



PROJECT PARTNERS & STAKEHOLDERS

MW. PDIDA

ACKNOWLEDGEMENTS

The team TUMwelt, alias EnterTrainment, would like to sincerely thank the companies MVV, Pixida, GreenApes and MUV for their advisory and supportive role in the area of public transport and app programming.

Special thanks also go to the professors Prof. Müller-Wieland, Prof. Dr. Ungemach and Prof. Dr. Bungartz. Their expertise was an enormous help to the team.

We would also like to thank our tutors Dr. Matthias Lehner and Victoria Trellel, who co-supervised the project, as well as the TUMJA office for the great support.

MEMBERS Wennika Franz, Madeleine Hotter, Sarah Kluge, Meltsea Lutgardo, Jonas Unterholzner, Joramias Widmann TUTORS **Dr. Matthias Lohner, Victoria Trobel** SUPERVISORS Prof. Dr. Hane-Joachim Bungariz, Prof. Dr. Christoph Ungemach, Prof. Jan Müller Weisand



SEPTEMBER 2021

Highlights 2020

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The virtual class - review of a very exceptional time!

Everything was different for this year's class. When the 43 new scholarship holders were invited to the kick-off event at Lake Kochel in November 2019, no one had any idea of the far-reaching challenges they and the world would face.

At the kick-off meeting of class 2020, the scholarship holders of class 2019 were also invited, including their tutors and supervisors. Thus, almost 100 people were present at the three-day face-to-face event at the Vollmer Academy. They got to know each other, celebrated, laughed, and developed their projects further. In January 2020, we held another weekend seminar with both co-horts, this time in Dachau. The modern and spacious building of the Jugendherbergswerk was a perfect place to bring together the members of all 11 student research projects. Photos of the scholarship holders in their blue hoodies document the meeting.

Then the pandemic gripped the world, transforming the grant program with its features of face-to-face meetings and interdisciplinary exchange into a virtual, unfamiliar online program. Worldwide, contact options were reduced from March onwards. Tools like videoconferencing suddenly became the new normal, online learning the norm. As a result, this event also changed TUMJA to an unprecedented extent.

TUMJA became virtual. The office had to be closed, and only the staff could be on-site under strict conditions. Formats like the "TDI -the day of student initiatives," the "Science Hack," the information events, and the selection days of the next cohort – simply all became virtual. The good thing was: it worked!

The scholarship holders of the Taskforce Event, in charge of the official social program, created new formats such as "games and cinema evenings," "Saturday morning workout," "running picnic," "virtual regulars' tables," "book club," "photo club," and much more. All were experiments, driven by the uniqueness of the moment. The ideas were accepted, the cohesion was strengthened, and the scholarship holders came closer together during this challenging time.

To the same extent, the student research teams met regularly, sometimes even more frequently than before, and the taskforces were also very active. The internal TUMJA mentoring program by alumni for the active fellows grew, the TUMJA wiki was tidied up and more efficiently structured. And the Taskforce Members, responsible for admitting new fellows, welcomed over 600 participants to the virtual information sessions and registered almost a doubling of applications. There was a lot to do, which the fellows mastered with flying colors.

In September 2020, after six months of purely virtual collaboration, #class20 came together in person for the first time in the TUM Audimax. Thirty fellows attended, excited to be back on campus and working on their research questions. At this point, we decided to extend the scholarship period of class 2020 from 20 to 24 months, thus putting the official end of #class20 back to October 2021. The weekend seminar ended with satisfied fellows in the Jazzbiergarten Großhessellohe, framed by cool music and a delicious dinner, after a 20 km hike along the Isar river. When the symposium of the outgoing #class19 was live-streamed for the first time at the end of October 2020, it was clear: TUMJA has arrived in the digital age.

On October 30, 2021, exactly one year later, another symposium will take place. This time it is the symposium of #class20, and we are still setting this up virtually. But by now, we have the safety net of double immunization and the necessary precautionary routines in interacting with one another. So, it will be a hybrid event, again with almost 100 people present, this time at the Audimax – and many more interested people on the Livestream – to give the extraordinary class 2020 the recognition which this highly motivated group of talented and curious young people deserves.

Peter Finger Managing director

Kick-Off weekend at Lake Kochel



Science Hack 2019



2019

November

Decembe



Alumni2Newbies-event



Visit of ESO Supernova in Garching

First FutureLab in Dachau

First Evaluation - virtual

.........

Advisory Board electing the call for class 21



new her live and Ann (and

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Deutschland Stipendium ceremony

Meeting at Pixida



Hiking tour at Isar river



2020

ptembe





Intermediate Evaluation 2



Livestream of the Symposium of Class 19

Virtual Chrismas party

Academy Talk with Judith Gerlach and Dr. Hans Pongratz



2021

December







Second FutureLab - virtual



Münchner Initiativen Abend

Science Hack 2021



Comic Workshop with Lisa Frühbeis



2021

Apri





Academy Talk with Verena Osgyan and Prof. Gerhard Kramer



Information Event for Class 2022

Academy Talk with Wolfgang Huang and Prof. Claudia Peus



ust







Intermediate Evaluation 3

TDI goes M!A



For the last couple of years, TUMJA has organized the TdI (Tag der studentischen Initiativen), where student initiatives have been presented and interested students have been brought together to network and get to know each other. Since the first online version of this event in January 2021 did not turn out as well as we had hoped it would, we were looking for other approaches through which to offer this great opportunity for all TUM students. Luckily, both the Student Council of the TUM School of Management and the VMSI (Verband Münchner Studierendeninitiativen) contacted us in March 2021, since they also had their own formats for connecting student initiatives and students. We all came together and thought about how we could arrange an event where all our student initiatives could be represented adequately and acquire new members despite the pandemic. We decided to join forces to create one big student initiative event to connect and reach as many student initiatives and students as possible – the M!A was born.

The M!A – Münchner Initiativenabend, Munich student initiative evening – took place for the first time on April 14, 2021. During the Zoom event, 36 student initiatives were presented in short pitches of about 90 seconds to an audience of around 180 people. Although we had some small difficulties with the breakout rooms in the original session, all the initiative teams adjusted to that problem quickly and created their own Zoom sessions so that interest-

ed students could join them there and get to know them better. All in all, the event was a great success and we decided to do our second M!A on October 20, 2021. Let's hope that M!A will become a regular event in the future and that we'll soon be able to meet the student initiative teams in person!

Magdalena Bader

Our partners of M!A:





Verband Münchner Studierendeninitiativen

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We have something special planned for the TUM Campus Run 2020!



Promise kept: 2,500 'People of TUM' ran in three #virtualTUMrun events in 2020 and 2021 – worldwide.

A message from Alexandros Piatidis reached us from northern Greece after the third virtual run in summer 2021, along with a photo of him and his father: "I took part in the first virtual campus run in 2020, and right after, it was clear to me that I would take part again the next year. I wanted to get 'active' again at TUM. When I told my father (Georgios Piatidis, born in 1940) about it, he immediately wanted to sign up as well, which he did. So two TUM alumni generations ran together!"

At the Campus Run in June 2019, we announced that there would be a more complex and even more awesome run in 2020 with more runners and new categories. The enthusiasm in the TUM community had been so great in 2019 that we could allocate all 1,500 tickets already six weeks before the run. So for the first time, we planned 2,500 runners to take part in 2020.

With new TUMJA scholarship holders in the organizing team, a new format was introduced with a lot of creativity and fun: the #virtualTUMrun in June and November. Altogether, around 1,500 runners joined the two events. The November run was particularly well



Greek dreamteam, summer 2021

Worldwide! TUM Campuslauf







The TUfasteco team, winners of the TUMlinge Challenge 2021.



Handing over the trophies in the Olympic Park to the fastest (female) professor Sonja Berensmeier, the fastest (male) professor Filip Mess and the fastest chair team "EES rapid" of the Chair of Electrical Energy Storage Systems of TUM.

received by new students. Zeyi Wang wrote to us: "I am glad that you took the effort to organize this event at this critical time. I feel even more connected to TUM as a first-year student. Thank you very much for that and also for the running shirt."

Motivated by the positive feedback, it was clear that we would organize another virtual run in 2021 – again with a new organizing team. In advance, we recorded a warm-up with colleagues from the Faculty of Sport and Health Sciences and their student representatives in the Olympic Park. The broadcast was presented on the day of the run itself by our well-known moderation team "Saskia & Christoph", who was present at the joint start of the 52-hour event. This time, a thousand runners participated, including numerous professors, department teams, and TUMlinge teams. This meant that we could include the coveted challenges once again in the standings. The winners were not only fast but also radiant, as the pictures at the trophy presentation show. Congratulations to all participants from over 30 countries for their enthusiasm, fun, and motivation to experience community in the TUM network.

We are very proud to have organized the TUM Campus Run three times in a very exceptional time and go into 2022 with the expectation of finally offering the "real" TUM Campus Run in Garching again. And as we have recognized that TUM students all over the world want to run with us, the #virtualTUMrun will be back at the next TUM Campus Run! Lessons learned!

The organizers of the #virtualTUMrun 20/21: Isabel Aschenbrenner, Magdalena Bader, Milan Cupac, Christopher Ebert, Peter Finger, Juliane Fischer, Daniel Khadra, Lennert Köhnke, Stephanie Kulpe, Nico Michel, Mihyun Park, Matthias Passek, Mohamed Ben Tarfaoui Luis Villa Arevalo

All information about the run and the winners at: ja.tum.de/ja/tumcampuslauf2021/





Science Hack 2021



The TUM: Junge Akademie stands for challenges, not only during the projects that we were working on but also in our taskforces. This is probably especially true for the taskforce CAP (Contacts/ Alliances/Partnerships). Being an important backbone of TUMJA, we wanted to organize a Science Hack in the good tradition of previous years.

To begin with, it felt like an impossible hurdle race, where the hurdles were too high and the finishing line was too far away for us to believe we could ever complete it successfully. Furthermore, the Corona pandemic forced us to change the format of the Science Hack to a hybrid version. This made a couple of organizational things easier but was also new territory for us. Thus, it took us several attempts before we were able to turn onto the home straight. With every attempt, we gathered more forces and were finally successful in organizing the third TUMJA Science Hack. This year's topic was "The New Normal – Sustainable & Inclusive Cities after the Pandemic."

The big showdown took place on a weekend in April. Six companies and five professorships and chairs from TUM set up, in total, eleven different challenges. Over 80 participants divided into sixteen teams worked hard for one weekend to find satisfying solutions to these that were innovative and creative. Initial pitches about the ideas of the teams were presented after half a day. The high degree of motivation and enthusiasm was great fuel for the remaining one and a half days. At the end, the teams demonstrated their results in the final presentations. A diverse jury composed of people with different backgrounds had the difficult task to evaluate the teams' outputs and to agree on the three winning teams, which were announced in a colorful and entertaining award ceremony.

It was both time- and energy-consuming to carry out the Science Hack, but I think we can say that it was a success, even though there is still room for improvement. What makes us especially happy is that the winning team, which worked on visualizing GHG emissions, is planning to set up a start-up based on their result from the Science Hack.

Sarah Kluge
Science Hack organizing team 2020

Julia Angerer Omar Eldeep Peter Finger Franz Xaver Gillmeyer Madeleine Hotter Sarah Kluge Mihyun Park Juan Esteban Suarez

Thanks for being partner of the Science Hack:





Partner Institutions

Partner Universities

TUM: Junge Akademie is an initiative of the Technical University of Munich. In order to increase the interdisciplinary exchange beyond the manifold disciplines of TUM, additional universities from Munich have been invited to join the network since 2016.

"To further develop the academy as a joint program of four very different universities turned out to be a valuable decision. Everybody benefits from the transdisciplinary interaction. Due to the evolved confidence and mutual understanding, we were able to start a new format in 2021: the cross-challenge."

Peter Finger Managing Director, TUMJA AKADEMIE DER BILDENDEN KÜNSTE MÜNCHEN

Academy of Fine Arts Munich (AdBK)

The Academy of Fine Arts Munich is one of the three artistic partner universities of the TUM: Junge Akademie and joined the network in 2019. Approximately 800 students are currently enrolled at the Academy of Fine Arts in Munich. Each student is assigned to a class of his/her choice, selected during the admission process. The Academy of Fine Arts Munich considers itself as an experimental laboratory and includes a total of 25 classes. Training at the academy focuses primarily on the development and practice of artistic skills and abilities in the fine arts. It also offers advanced degree programs in "visual design and therapy", "art and architecture", "interior architecture" and "art and communication". The talents of students are developed according to their major field of study and their personal interests. Curricula and teaching principles are based on self-reliance and personal responsibility.



University for Television and Film Munich (HFF)

Compared to the TUM, the "University of Television and Film Munich" (HFF) is a tiny school with around 350 enrolled students. However, the HFF is one of the oldest film schools in the world, founded in 1966, and is very successful as one of the premier film schools worldwide. The HFF Munich offers eight different degree programs: from directing to camera to script-writing. Emphasis is put on collaborating and storytelling through the medium of film with the help of world-class professors and teachers such as Prof. Julia von Heinz ("Und morgen die ganze Welt") or Maria Schrader (Emmy for "Unorthodox"). The school's illustrious alumni include Caroline Link, Doris Dörrie, Bernd Eichinger, Florian Henckel von Donnersmarck, Wim Wenders and Roland Emmerich. In 2011, the school moved to its newly purpose-built facility in the heart of the Munich art district. It continues to explore the medium of film and pushes the boundaries of the moving image, for example by creating a new VFX study program or researching AI and its possibilities for film.

University of Music and Performing Arts Munich (HMTM)

Hochschule

MÜNCHEN

FÜR MUSIK UND THEATER

The Munich University of Music and Performing Arts is one of the largest universities in the cultural sector in Germany. It was founded in 1846 as the Royal Conservatory of Music and has borne its present name since 1998. The university offers more than one hundred different study programs in all fields of music, dance, and theatre, culture management, or journalism. More than 1.200 students from all over the world study at HMTM. The study programs prepare for artistic, pedagogical and scientific professions. In many fields of arts, tradition plays a very important role. The HMTM wants to keep the strengths of this tradition at the university. At the same time, new areas are developed like digitalization, digital art forms and questions of artistic research. Art develops best in an environment of free-thinking, experimentation, and creativity. Our university intends to be a creative laboratory for the students, professors and researchers, as well for the society.

Industrial Partner – Pixida Group

The Pixida Group turns digital transformation into sustainable success by combining the strengths of its members from strategy consulting to professional services to end2end products and solutions. We create customer value by developing new business strategies, innovating product portfolios, and utilizing cutting-edge technology.

With experience from more than 500 successful projects and 300 experts, we are focused on customer success and eager to shape the digital future together.

The international business scope consists of eight locations in Germany, the USA, Brazil, and China, a multinational team from more than 30 nationalities, and a well-established network of specialists and partners.

Pixida's continuous success is reflected by an average growth of more than 25% per year and multiple top-class awards.







Cooperation TUM: Junge Akademie

Since 2016 PIXIDA GmbH is a cooperation partner of TUM: Junge Akademie. Together with passionate students, our experts in digitalization, Internet of Things (IoT) and mobility exchange knowledge on promising solutions for urban and public challenges.

The relationship has been strengthened since the start of our cooperation in several ways: PIXIDA offers inhouse workshops, supports project teams to develop ideas into applications and has participated in all Science Hacks organized by TUM: Junge Akademie so far.

In 2019 PIXIDA hosted the workshop "Smart Cities and Digitalization" for enthusiastic students. Urbanization has a major impact on society and in the environment. The changes in urban areas cause new challenges and require innovative solutions. The workshop was focused on IoT applications within Smart Cities, an exemplary approach to measure air quality and an evaluation of blockchain cryptography.

The students visualized and discussed several IoT solutions and improvements through Data Analytics dealing with questions such as "Smart Cities and IoT – what does it mean?" or "How to use IoT and the cloud to make a city smarter." The final topic focused on "Blockchain – a broken chain of trust".

At the second edition of TUM Science Hack in December 2019 two student teams worked on the PIXIDA challenge how to promote eco-friendly driving. Both teams developed Web-Apps to visualize the eco-friendliness of trips. The result was very impressive: both teams showcased live map visualizations, online sharing features, detailed trip details and individual recommendations how to improve eco-score.

From August 2020 till March 2021 several PIXIDA colleagues supported two TUM: Junge Akademie project teams in their ambition to develop mobile apps. Team TUMwelt developed an app to track individual urban mobility patterns with the goal to promote eco-friendly behavior among young adult population. The focus of team AppCycle was on the re- and upcycling situation in the city. Shops & events, characterized by environmentally awareness, as



well as the locations of recycling stations were supposed to be centralized within this application. The PIXIDA colleagues offered mentoring in the fields of functional development, architecture, data security and design.

The topic of this year's Science Hack was "The New Normal – Sustainable & Inclusive Cities after the Pandemic". The two PIXIDA student teams developed webapps to visualize the occupancy levels of public transport and pointed out the potential of PI Labs IoT Gateway as prospering business case. The provided data consisting of WiFi probe requests by mobile phones was used to estimate the occupancy levels within public transport vehicles. The final concept for a passenger counting feature was showcased within a dashboard application.

We would like to thank all the students for their high degree of social commitment and performance!

Let's continue our exciting and constructive cooperation in the future!

Projects in Prospect 2021

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Culture

Whereas individuals identify as a member and share values within their in-group, they feel the other way around concerning outgroups (2). Individuals feel more empathy towards their in-group (intergroup empathy bias) (3) and they have a tendency to disassociate themselves from other members of an out-group (4). These phenomena lead to the fact that interaction and discussion within those in-groups comes with a tendency to extremize opinions and to widen the gap between groups (1, 6). In order to counteract the negative consequences of these mechanisms – namely, radicalization and hatred against other groups – we want to promote plurality of opinions based on reflective opinion-forming.

While this concept holds true for all generations of humanity, it becomes increasingly popular – and dangerous – in the modern world. Digitalization enables individuals to share their opinions with a broad mass of people. With the anonymity of the web, radical opinions get shared more easily and the social media oftentimes becomes a place of exchange for one-sided, extreme opinions.

Team Culture believes in plurality of opinions. We believe that we can judge opinions, but that it is crucial to gather an understanding of why people come to more radical conclusions.

We understand very much how furious it can make people to hear about radical opinions on the internet. However, we believe we can reach a more peaceful togetherness if we start to reflect deeper on other opinions and our own.

Therefore, we aim at creating a visual campaign that encourages people to reflect on their opinions and to consider opinions outside their in-group. In our pre-implementation phase, we used surveys and psychological research to find the ideal way of display for our message (please see attached one of our poster prototypes featuring our fictive character John). Our campaign will now be featured via posters at summer events, as well as via social media. Online content will comprise graphics and additional video material. The campaign is not intended to alter opinions, but to create awareness and understanding of opinions outside of one's in-group. While the offline part of our campaign will be crucial to gain exposure for our campaign in Munich, the online part will be particularly helpful to gather relevant data on our outreach. Understanding how our campaign is perceived will be important for our final report. In this report we will assess how visual campaigns can be used to support programs aiming at the reduction of internet radicalization.

We are Team Culture. Eight TUM students, covering the fields of engineering, architecture, business, psychology, maths and computer science. Our common interest in societal topics brought us together during the first TUMJA weekend in November 2020. Since then we have been brainstorming, discussing, prototyping and researching. And we love it.

We are looking forward to presenting you with the final findings of our research. Thank you to the TUM: Junge Akademie for the opportunity to leave our studies' usual playing grounds and dive into new, exciting projects!

Your Team Culture



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Team

Musa Altun Mohammad Hashem Lisa Henicz Adrián Löwenberg Casas Annabel Matz

Eva-Madeleine Schmidt Josephine van Delden Niclas Weddigen (& the Kraken, our mascot)

Tutors

Panagiotis Christou Samuel Valenzuela

Supervisors Prof. Dr. Martir

Prof. Dr. Martin Werner Prof. Dr. Elisa Resconi



Project Goal

Our project *CreaThesis* aims at improving science communication between the students of different scientific domains of TUM. Participants elaborate aspects of their own scientific theses in a creative manner to generate something new: a *CreaThesis*.

There are no limits for the designs, the participants can express themselves freely and use techniques of their choice. *CreaThesis* is not about making professional art but about gaining experience in communicating scientific results to non-specialists and to raise awareness and create passion for research topics.

Background and Motivation

As science communication is a competence currently far too little practiced at university, *CreaThesis* wants to offer students a chance to develop this skill: As they participate, students undergo a process in which they must first select a sub-aspect of their research, express it by creative means and finally share it comprehensively on our website. Importantly, we want to raise awareness of the scientific work conducted by students and show appreciation for their passion.

The schools and departments of TUM benefit from their students' participation, too: The unique form of publishing scientific results creates a high degree of memorability, by which schools and departments can raise awareness of and draw attention to their research topics. Thereby, they can foster curiosity and enthusiasm for their work and recruit future students. Furthermore, this can promote exciting interdisciplinary cooperation.

Research Question and Methods

We want to answer the question of whether the elaboration of a *CreaThesis* increases the science communication skills of the participants. We aim at measuring science communication skills by quantitative online questionnaires consisting of a pre-participation and a post-participation phases ("Pretest-Posttest-Design") and track the attention generated by user metrics.

Project time plan

To give our project a strong empirical foundation, we are collecting data in the form of a literature research and a student survey. In parallel, we are creating the first *CreaTheses ourselves*, which will serve as an example for potential future participants. We expect the launch of our platform before the start of the next winter semester, followed by an adjustment period based on learnings from the launch. The process of submitting a *CreaThesis* to our platform will be constantly monitored internally. A marketing campaign will accompany the platform launch and will continue throughout the subsequent months. This will target both potential participants as well as visitors to the platform. In order to answer our research question, we will then conduct our main study, the results of which we will present at the Symposium of Year 2021 and elaborate on in our final report.



Team

Alix Bertrand Marlon Demandt Theresa Franz Anita Kolmann Nico Michel Andrea Schittenhelm Philipp Strobl Tobias Tiemeier

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Prof. Dr. Ernst Mayr Prof. Dr. Rolf Moeckel

Education

Online lectures and large university courses have one thing in common: it is difficult to find a suitable learning partner. Online lectures lack the necessary daily get-togethers, while most students do not have the opportunity to get to know everybody in large and frequently changing course groups. Neither setting provides optimal opportunities for mutual support, feedback, and motivation. With our platform, we aim to connect students in order to enhance their learning-related social interaction.

Increasing the motivation and efficacy of students' learning drives us to develop our matching platform but it also brought us together at the very beginning. On November 22, we decided that we wanted to support fellow students in the development of their learning by providing a quick and easy way of finding a truly suitable learning partner.

We are all looking forward to supporting fellow and future students in their learning and are convinced of the practical usefulness of our platform. While we can gain new experience in system development during the development and programming of the design and functions of our service, from the initial sketching of ideas to project planning and the implementation of functionalities, the implementation and evaluation opens up the first practical opportunities for marketing and working on a research question.

Hypothesis

Moving beyond connecting students, we plan to research if a higher matching score does result in a higher perceived quality of the matching. The matching score is a number that results from comparing the answers in the questionnaires of two learning partners, respectively, and reflects the similarity between the two. We will evaluate the perceived quality via validated questionnaires. Especially since expert opinions on such a correlation are deeply divided, the results of this experiment might allow interesting insights into collaborative learning.

Methods

After agreeing on creating a matching platform we conducted interviews with fellow students to confirm and refine our goal. From the interviews, we derived three major desires and respective barriers which we now aim to lift with our platform.

For connecting students, we collect and store answers on matching-relevant criteria via a questionnaire to be completed during the sign-up process. These criteria are based on the big five personality model, the Felder-Silverman learning type model, willingness to communicate, and self-efficacy. In October, we will gather test data to examine our evaluation process. After our platform launch in January 2022, we will collect data for our main study during the exam period of the winter semester.

We will measure the correlation between matching score and perceived matching quality using the Spearman rank coefficient, since we cannot assume that our data is linearly correlated.

We also hope to gain insights into which personality types last longer together through small weekly feedback forms.





Before

After

Team

Panarit Jahiri Zoya Kozlova Philipp Patzelt Sara-Luisa Reh Valentin Roth Wolf Thieme Luca Mattes Wiehe

Tutors

Matthias Lehner Elena Tangocci

Supervisors

Prof. Dr. Holger Magel Prof. Dr. Jürgen Pfeffer

elecTUM

We are Team elecTUM - a research group composed of 8 students from 7 different courses and 4 nationalities! Having started as "Team Climate," our goal was always to investigate a disruptive situation that had an impact on the climate. After several weeks of discussion rounds, we decided to focus our project on the effect of different types of lecture on the energy consumption of TUM students. In this context, we are specifically interested in finding out what hybrid format between online and on-site lectures maximizes the energy efficiency of university teaching. To find out the answer to this question, we are going to implement a calculator that predicts the energy consumption of TUM lectures, depending on the way these are taken. Since our calculator is going to be based on real/realistic data, we divided our team into three subgroups, from which two are thought to gather the necessary data for the calculator.

The first subgroup ("data gathering/analysis") is responsible for collecting the fundamental data for the model calculation. Regarding this aim, this subgroup will investigate the electricity consumption of a model lecture hall and a model student apartment, the transportation of students, and the streaming of online lectures. Currently, they are working on gathering the data for the model lecture hall, the model student apartment, and streaming. For the electricity consumption of lecture halls, the subgroup decided to use one of the Interims lecture halls as a representative for a modern lecture hall. As TUM does not monitor the electricity consumption of the lecture halls in detail, the group will manually calculate the electricity consumption of an Interims lecture hall. Regarding the model student apartment, the group uses the Studentenwerk apartments as basis. Since the energy consumption data collected from these apartments are also not detailed enough, they will manually calculate the electricity consumption based on the student's streaming device (to be investigated by survey), internet router, and light infrastructure. For the latter two, the group is in

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elecTUM

We want to develop a model to compare the greenhouse gas enissions of different lecture scenarios (e.g. online vs. offine lectures) based on energy consumption of TUM students to establish lecture formats that are as sustaindel readily available for other universities, we interc to publish this model as a calculator in form of a web



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contact with the dorms to identify the technical details. Lastly, for identifying the energy consumption of the video streaming, the subgroup decided to do an extensive literature research. They are currently defining the different parts that require energy during the streaming process to decide what should be included in our calculation and what questions should be posed to the students by the survey group.

To complement the first subgroup, we created the "survey" group for the purpose of student-based data collection, specifically on student transportation, device use, energy consumption at home etc. Right now, this subgroup is in the first phase of the survey. They have outlined a plan that includes scheduling, preliminary survey design, internal and external review rounds, small group testing, and publication. They have already decided on a platform on which to design the survey (evasys.de) and have been given access to it. Since it is important for data collection to have a representative number of participants, this subgroup is currently working on a plan to reach a substantial range of students and staff. After the first draft, they plan to send the survey to our other group members and our mentors for review while updating the design. Their goal is to make the survey as simple and engaging as possible to encourage more participants to complete it while still providing the necessary data for our calculator. After the first draft is completed, this subgroup will use a small group of participants (each group member should send the survey to around five people she/he knows) to test the survey and provide us with feedback.

Lastly, the subgroup "calculator" was created. To analyze the gathered data, a calculator in the form of a web-application is being developed, which will be made publicly available towards the end of the project. It calculates the overall energy consumption of both online and on-site lectures through a linear model developed specifically for this project, as well as a mix of frequentist inference and linear error propagation to estimate the uncertainties of our results. This model will be made accessible through an interactive web interface, allowing for flexible user input of variable parameters.

Team

Maroua El Asri Alexander Holas Catherine Yngaunis Koch Joachim Leibold Alesia Prendi Sophia Schmid Leonard Schmitt

Tutors

Maryam Tatari Sebastian Zäpfel

Supervisors

Prof. Dr. Peter Annighöfer Prof. Dr. Sara Diana Leonhardt

Proactivation

Team Introduction

We are a team of nine students from various academic backgrounds and a common interest in health. We feel that procrastination is a problem for many students with a significant impact on mental health and wellbeing. Therefore, we came up with the idea to create an anti-procrastination course for students. For this, we will set up a website comprised of short videos and exercises for students who struggle with procrastination.

By helping students reduce procrastination, we want to improve their mental wellbeing.

Status Quo

Before we started our project, we conducted a pilot study in order to identify the status quo of procrastination among students. In an online survey, we asked 786 students from different fields of study about their procrastination behavior and its impact on mental health. In addition, we evaluated which possible interventions would be of relevance to students. Here are our most significant findings:

- Over 70% of students find themselves procrastinating
- 2/3 of students reported that procrastination affects their academic performance
- Over 76% of students said that procrastination affects their mental health

Project

Our website will be a three-week online course, consisting of three sessions each week. These sessions will include short videos, providing information and exercises. In addition, we will create a workbook accompanying the program. Participants will be guided through various short exercises corresponding to the information in our videos.

The PROACTIVATION course will cover three main subjects:

- Understanding procrastination and yourself
- Time management and work efficiency
- Goals and Focus



Research Question

To what extent does our online course PROACTIVATION reduce procrastination in students based on the "Pure Procrastination Scale"?

Subquestions

To what extent is the effect sustained six weeks after the program end? To what extent does the course improve mental wellbeing based on the WHO10 wellbeing index?

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Proactivation

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Hypothesis

Based on our pilot study, we hypothesize that the PROACTIVATION online course significantly decreases procrastination in students.

Methods

In a pre/post intervention analysis, a baseline measurement and a measurement after the three-week online course will be conducted in order to evaluate the efficiency of the PROACTIVATION course. In addition, a follow-up measurement will take place six weeks after the end of the intervention to assess the sustainability of the intervention. Two validated questionnaires, the Pure Procrastination Scale and the WHO-10 wellbeing index, will be used for the data collection, which will be completed online and anonymously by study participants.

Team

Anastasia Asiedu / TUM EDU Daniel Khadra / Electrical and Computer Engineering Leonardo Giannotti / TUM GOV Oliver Schurius / Physics Elisa Rodepeter / TUM SoM Laura Willinger / Sports- and Health Science Genoveva Müller / TUM MED Christian Dietz / Mathematics Dario D'Alò Fonseca / Chemistry

Tutors

Ho Huang Saskia Hutschenreiter

Supervisors

Prof. Dr. Ilona Grunwald Kadow PD Dr. Alexander Zink

TUM: Junge Akademie

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The Academy – Passion for Science

The TUM: Junge Akademie aspires to promote their scholarship holders in an integrated manner. Using the 20 months' duration of the program, the students and doctoral candidates plan and develop a self-chosen project within an interdisciplinary team. Our scholarship holders aim to find solutions for social issues, to enable creative innovations, and to review these in relation to their feasibility. Throughout this process, they are supported by top-class researchers, who guide them, beginning from substantiating their project idea to concluding it as a project report. Various workshops, such as for scientific and journalistic writing or project management, accompany the project work. Not every project is a success, and sometimes it has to be modified along the way. That is also part of learning. However, numerous projects in recent years were so successful that other institutions adopted and continued the successful work.

Eighty fellows and over 500 alumni, supervisors, and professors from four universities are part of the TUMJA community. The creativity of its members and the large community of highly motivated personalities shape the eleven-year history of TUMJA. We look forward to our community growing further over the next few decades.

The Boards of the Academy

Advisory Board

Since the Academy's foundation in 2010, the Advisory Board represents the organizational unit of the TUM: Junge Akademie with decision-making power. The Advisory Board represents the Academy's governing body, whose members meet twice a year. It primarily decides on the medium to long-term strategic and organizational issues of the TUM: Junge Akademie. Since 2016 the President of the University of Music and Performing Arts Munich, Prof. Bernd Redmann, and the President of the University of Television and Film Munich, Prof. Bettina Reitz, have further enriched the collaborative nature of the Advisory Board. The strategic themes include in particular the purpose and direction of the TUM: Junge Akademie as well as its interaction with TUM's several institutions and their programs, such as the Global and Alumni Office, the Corporate Communications Center (CCC), the Legal Office, TUM ForTe or the TUM University Foundation. The Advisory Board also discusses proposals from the Board of Members. Besides, the Advisory Board is responsible for key operational tasks, which include the selection of new scholarship holders or the definition of possible project topics from the wide variety of the submitted project ideas.

Director

Prof. Dr.-Ing. Gerhard Müller, Senior Vice President Academic and Student Affairs

Scholarship holders

Monica Déchène	Stefan Lehner
Saskia Hutschenreiter	Beate U. Neu
Dr. Matthias Lehner	Paul Sieber

Professors

Prof. Dr. med. Pascal Berberat, TUM School of Medicine

Prof. Dr. Sonja Berensmeier, TUM Department of Mechanical Engineering

Prof. Dr. med. (em.) Michael Molls, Spokesperson Emeriti of Excellence

Prof. Dr. Ruth Müller, Munich Center for Technology in Society

Prof. Dr. Bernd Redmann, University of Music and Performing Arts Munich

Prof. Bettina Reitz, University of Television and Film Munich

Board of Members

Giving scholars' inspiration a space to unfold: This is the mission of the members' council of the TUM: Junge Akademie. Each project group and each taskforce sends one representative to the periodical meetings to keep their peers up to date, discuss ideas, give advice, and support each other to improve and further develop the TUM: Junge Akademie. Besides the regular visitors, all members and alumni are invited to join and contribute their experiences and opinions. The meetings are intended to offer a platform to synchronize the different groups and people, and to achieve lively cooperation and synergy.

The Board of Members elects six student representatives to the Advisory Board. By the integration of the Board of Members into

the Advisory Board, the scholarship holders can actively participate in the decision-making process and thereby represent their interests. Proposals for changes in the scholarship program are discussed with the Advisory Board, the director, and the office team. Fellows are encouraged to take action with the Board to implement these decisions.

We consider all scholars' opinions, wishes, and needs to shape life at TUM: Junge Akademie in such a way that every scholar flourishes to their best self.

Speakers

Elena Tangocci Philipp Patzelt

TUM: Junke Akademie



Taskforces

In addition to project work, the scholarship of the TUM: Junge Akademie includes much more: An extensive supporting program with community-forging events, inspiring excursions, and more. What makes this program so special is that the scholarship holders largely design it themselves, contribute their expertise to taskforces, and by doing this, develop their knowledge and personality.

On average, each taskforce meets twice a month to discuss and plan future activities. Besides this, group representatives meet regularly to keep each other updated. To work in one of the taskforces is an essential part of the scholarship program. The scholarship holders acquire skills related to the taskforce they joined, such as event planning, design, project management, and many more. By collaborating with scholarship holders from other projects and years, they expand their network.

Taskforce Contacts, Alliances, Partnerships (CAP) aims to generate funding, and establish and maintain a network of partnerships between scholarship holders, alumni, and companies.

Taskforce Event provides exciting events every semester, offers opportunities to experience a lot of different things, and get to know each other.

Taskforce International wants to create an intercultural exchange amongst students from international universities involved in similar projects as the TUM: Junge Akademie.

Taskforce Marketing aims to increase the brand image and recognition of TUMJA's interdisciplinary scholarship program.

Learn more about each of the taskforces on the following pages.

Taskforce Mentoring designs a one-to-one mentoring program for current scholarship holders with TUMJA alumni.

Taskforce Members is responsible for all issues concerning the active members, alumni, and members-to-be, for instance, the application process.

Taskforce Symposia organizes the final event of each year - the yearly symposium.

Taskforce XP Transfer restructures the TUMJA Wiki, so the project groups and task forces can find and profit from the existing know-how and the experiences of all TUMJA members.

Taskforce CAP

Contacts, alliances, and partnerships, this is what Taskforce CAP stands for. As our name reflects, we are responsible for linking TUM: Junge Akademie and the events it organizes to the corporate world. Mainly, we have two goals:

- 1. Supporting TUM: Junge Akademie through providing funds not covered by the budget set by TUM
- 2. Establishing and maintaining a network between scholarship holders, alumni, and companies through partnerships

Supporting TUM: Junge Akademie through providing funds not covered by the budget set by TUM. As a scholarship program, TUM supports the scholarship holders academically. In other words, TUM provides funding for the academic-related activities like projects of scholarship holders and workshops. However, other expenses, such as for food and accommodation for scholarship holders, are not covered by TUM. This is where Taskforce CAP comes into play. TUM: Junge Akademie hosts on average two seminars each semester, where scholarship holders gather on weekends in locations around Munich to develop their project management and research skills. To allow all students to participate in these seminars regardless of their financial status, we as Taskforce CAP seek to cover those expenses through securing external partnerships and sponsorships. Our major fundraising event is the TUM Science Hackathon.

Establishing and maintaining a network between scholarship holders, alumni, and companies through partnerships. TUM: Junge Akademie is more than just a 20-month scholarship program. In fact, it is an everlasting network created from professionals coming from different backgrounds. To add value to this network, we as CAP further expand it by engaging with a range of companies, turning TUM: Junge Akademie into a unique place for interdisciplinary communication with both alumni and companies. All parties involved in this interconnected network benefit from the exchange of innovative ideas and self-development. Since 2016, TUM: Junge Akademie is proud to have Pixida as a precious partner interested in supporting young talents. Besides keeping close ties, Pixida also sets up workshops for the scholarship holders and helps them with their projects whenever possible. We as Taskforce CAP take care of our partnership with Pixida and aim to establish more partnerships that are similarly formidable.

Science Hack. The Science Hack is a special event gaining increasing attention after each launch. Last April, Taskforce CAP organized the third Science Hack, which we conducted solely virtually and which turned out to be an overwhelming success. In this three-day event, companies and TUM chairs provide participants with challenges and tasks related to a specific theme. Participants from different backgrounds and academic levels team up to solve these challenges innovatively and gain exceptional experience. Moving beyond the Hackathon itself, participants are able to establish initial contacts with possible future employers. Taskforce CAP is in the process of preparing for a further Science Hack in 2021 which will take place from the 26th to the 28th of November. Having previously received very positive feedback from both companies and participants, we look forward to building on this experience and welcoming another highly motivated group of participants.

Team CAP. Currently, Taskforce CAP consists of five members from class 2021. To ensure an improved experience for scholarship holders of the TUM: Junge Akademie, we collaborate with other taskforces, especially Taskforces Marketing and Events. Shout out to previous members who support us with their expertise and best practices and are always there when we have any enquiries.

Class 2020 Julia Angerer Matthias Brucker Omar Eldeeb Franz Xaver Gillmeyer Madeleine Hotter Sarah Kluge Juan Esteban Suarez

Class 2021

Christian Dietz Maroua El Asri Mohammad Hashem Anita Kolmann Philipp Patzelt

Taskforce Event

Who are we and what are we doing?

We, as the Taskforce Event of the TUM: Junge Akademie, are an independent working group that focuses on bringing active scholarship holders, as well as tutors, supervisors, and alumni together. Our aim is to give all members of TUMJA the possibility to connect with people from different disciplines and cultural backgrounds to create networks across project groups and taskforces. By organizing a wide range of events, we provide the possibility to discover new things, broaden your horizon, have fun and enjoy your university life. Unfortunately, the COVID-19 Pandemic made many in-person events impossible and forced us to get creative with online events in order to satisfy our social needs. However, we are excited at the prospect of organizing in-person events again soon and we look forward with great anticipation to meeting all of you there!

How does it work?

As a member of the Taskforce Event, you decide what types of events you want to organize and which of your ideas you want to realize. Let your creativity run free! Moreover, you are in a strong team which organizes recurring events like the Munich's Initiative Evening (M!A) or the TUM Campus Run. Together with your ideas, contribution, and the support of the Academy, everything is possible here.

Here are some insights into what we do regularly or what we have been doing during the COVID-19 Pandemic:

Game Night

One of the first events after the lockdown started was our Online Game Night. Despite not physically seeing each other, we were able to connect and have fun by playing games such as Skribbl.io, 6 Nimmt, Codenames, Secret Hitler, and many more. This recurring event allowed us to get to know each other, stay social during a lonely pandemic, and improve our cognitive skills regardless of our location.

Running Dinner / Sitting Picnic

Usually, the Running Dinner is one of our most popular events. Since the typical procedure of preparing one course and meeting many different people was not possible during the pandemic, we decided to take the party outside and do a "Sitting Picnic" instead! Everyone brought their favorite dish and spent a great Sunday afternoon on their own picnic blanket in the Englischer Garten. We'll definitely do this again!

Bouldering

In order to develop not only academically but also physically over the course of the scholarship, a joint bouldering event was offered at regular intervals as long as the COVID-19 contact restrictions allowed it. Once a month, a session was held at the Boulderwelt Ost at Ostbahnhof. All participants were encouraged to face their fears and challenge themselves on three- to five-meter-high climbing walls.

Secret Santa

It's the most wonderful time of the year – except that it was not, because the pandemic prevented us from seeing each other and celebrating the festive season together. Luckily, the elves of Taskforce Event organized the Secret Santa Event. Everyone could spread Christmas cheer and let out their creativity to make a meaningful present for another TUMJA member. Finally, the gifts were unwrapped at the Christmas Party @ Home, where we enjoyed a delightful and festive evening.

Christmas Party @ Home

After the unwrapping and revealing of the Secret Santas, some of us read "A Christmas Carol" by Charles Dickens to the remaining participants. While listening, everyone interpreted the story differently and found their own intent to change their lives, just as Scrooge in the story itself did. After the reading, the highlight of the evening happened: everybody sang "Jingle Bells" together and with full enthusiasm. As one can imagine, 30 people singing at the same time via Zoom worked out just perfectly. This angelic choir will stay in each participant's memory for a long, long time. The Christmas Party was topped off with breakout sessions on various topics: Some discussed their resolutions for the new year, some played games together, others exchanged ideas for their project groups and so on.

Book Club

The Book Club was founded in the deep lockdown winter of 2020 to cheer up the lonely bookworms with a hot cup of tea, cookies,

and a freshly-picked read. We gather every other Sunday with our highly-praised books, immerse in the world of Saint Exupéry, Orths and other geniuses of literature, and enjoy throwing in our intellectual comments and our broad knowledge of and interest for the typed arts.

Speed Meet and Greet

Having overcome seven long lockdown months, we developed the Speed Meet and Greet as our first event to be held in person again. For this recurring event, the TUMJA members willing to participate are matched among themselves based on where they live, when they are available, and especially on their preferred outdoor activities. Our goal is to form new pairs every other week to encourage TUMJA members to get to know each other and spend some time together outdoors. Until now, it has been a great success!

Class 2020

Magdalena Bader Silvia Bergt Milan Cupac Christopher Ebert Maximilian Passek Maryna Shcherbak Andrea Susanne Weiller Class 2021 Daniel Khadra Nico Michel Valentin Roth Catherine Yngaunis Koch



Taskforce International Cooperation

In times of right-wing populism and increasing isolation of countries, international organizations like the European Union fear inconsistency and decreasing acceptance. It is more important than ever to build transnational connections and look out for partners who are like-minded. This taskforce feels the urge to bring a greater international perspective to the TUM: Junge Akademie in order to exchange ideas, to create connections and to engage in mutual discourse.

Who we are: We are students from different fields of study who are fully motivated to build up networks with other international universities which have similar projects to the TUM: Junge Akademie. History from Year '19: In April 2019, a delegation of Imperial College London visited the TUM Campus in Garching. Three members of the taskforce International attended the meeting and did a guided tour through the entrepreneurship center of TUM and the Makerspace. In a presentation, we explained our goals for a summer school and its program. To foster the relationship, build a network and improve our work, Prof. Buitendijk, the vice provost for education, invited us to the college in London. With this visit we hoped to find other students who wanted to collaborate on a common project – so that our exchange could start as soon as possible. Our delegation traveled from 3rd to 5th of November 2019 to the ICL and had conversations with several interested partners. Among these were:

- Dr. Caroline Clewley: leader of the iExplore program
- Mr. Ashley Brooks: deputy president of the student union
- Mr. Mark Streule: Director of student shapers program



Our "big" summer school goal: We want to create an intercultural exchange amongst students from international universities involved in similar projects as the TUM: Junge Akademie. During this exchange, we will give an interdisciplinary scientific insight into the work of the different TUM Campuses. The students will explore the fields of research at TUM through a variety of organized workshops, guided tours and playful challenges. Needless to say, there will be a leisure program, trips to cultural events and places of interest and

tradition. Regarding the program: the duration of the program will be five days with ten participants from each university, somewhat similar to a normal summer school. The workshops are going to take place in groups and there will be at least one big tour around Munich. The students should have the possibility to propose ideas for events, tasks and improvement. We support a one-to-one-pairing during the exchange, so the TUM-partner can help to look for accommodation, bring the German language closer to the visitor and give insights into German culture. Moreover, we have become increasingly involved in initiating contacts and maintaining relationships with our partner universities as well as in promoting the international exposure of the TUM: Junge Akademie.

Recent progress: The first exchange program with the Imperial College London (ICL) was planned for Summer 2021 with the theme"cities of the future," where students could investigate approaches for architecture of modern buildings or environmentally friendly mobility through a variety of interdisciplinary tasks. However, due to the coronavirus pandemic the program had to be postponed and will hopefully be realized next Summer, 2022. Furthermore, we have begun discussions with the Technion in Haifa, Israel, which also belongs to the network of the EuroTech Universities. The first contact was very positive and we will further expand our partnership in future. We also found online alternatives to the in-person exchange programs and attended the European MIT Career Fair 2021 where we were able to promote the TUM: Junge Akademie. We answered questions MIT students and PhD candidates had about the scholarship program – who also showed keen interest in studying at TUM. More recently, we've organised the "TUM-ICL mini summer school" during the TUM Global Week, an event designed to engage the international involvement of TUM students and researchers. The mini summer school was a short online workshop on Covid-19 vaccines that consisted of a series of questions – both TUM and Imperial College students were asked to discuss these in small groups. After the internal group discussions there was a review of the topics and then a lecture by Prof. Ulrike Protzer, Professor of Virology at the TUM School of Medicine. The event was open to students of all backgrounds and designed to act as a basis for the future TUM-ICL summer school next year, 2022.

Class 2020

Ario Dastmaltschi Paul Andrei Sava Jan Luca Scheerer Mohamed Shoeir Nina Zuber

Class 2021

Alix Bertrand Marlon Demandt Panarit Jahiri Joachim Leibold Genoveva Müller Leonard Schmitt

Taskforce Marketing

As the Taskforce Marketing we are mainly responsible for raising the public profile of TUM: Junge Akademie through strategic campaigns. This requires us to be in close contact with the main office and other taskforces to coordinate our activities. Our ongoing projects include also representation at events like TUM Prelude in Garching.

Simultaneously, we create marketing strategies for TUMJA events like the annual *Science Hack* or the *Symposium* to help them enhance their publicity. Due to the campus closures in the wake of the COVID-19 pandemic, we shifted our main focus to digital advertising, mainly performed through social media. After the success of last year's application phase, we plan to build on these ideas for the marketing campaign for the upcoming application process to reach as many students as possible. For this purpose, we are working closely with task force Members to plan this effort and develop new concepts to appeal to prospective applicants.

Our work also includes the design of TUMJA merchandise: we are already looking into options for TUMJA exclusive items after the success of the hoodies in the last two years. The optimization of the website is another project that we are currently working on.

In addition to this, our taskforce offers help to the group projects and other taskforces of the TUMJA to master the challenge of promoting their work. Hence, this support and commitment is our central responsibility to the interdisciplinary scholarship program. Our work spans a wide range, from designing flyers and posters to contacting partners for advertising opportunities as well as including the creation of marketing strategies. In these efforts, we always collaborate within our team or with the other taskforces.

TUM: Junge Akademie

Do your own thing! ...with others!

The scholarship program for exceptionally talented and motivated students, who are fascinated by the world of science early on.

- ACT: Develop creative solutions on the edge of science and society as part of an interdisciplinary team in a 20-month project.
- LEARN: Improve your project management and soft skills at exclusive workshops with professional coaches.
- CONNECT. Join a network of 80 active students, over 500 alumni, mentors and professors, from 4 universities.
- IMPACT: Choose a taskforce and contribute to the future of the whole program.







In the future, we hope to expand our corporate identity to generate a framework to establish the TUM: Junge Akademie as a prime option for high-achieving students in Munich. gives everybody an opportunity to find a task that best suits their abilities. Students aspiring to join the Taskforce Marketing will thrive by facing these challenges with enthusiasm and creativity.

Our members come from various fields of study – often without a background in marketing. However, this does not impact our performance: together as a team, we come up with creative ideas for promoting the TUM: Junge Akademie. Creating new and exciting solutions is essential to our task.

This includes a high degree of creative freedom for our projects. Therefore, we offer a lot of hands-on experience in the various aspects of marketing to our members. The wide range of our work Class 2020 Laura Ballentin En-Hsin Chung Joshua Sharon Neumann David Noachtar Benedikt Vollmann

Class 2021

Lisa Magdalena Sophie Henicz Eva-Madeleine Schmidt Oliver Schurius Tobias Tiemeier Josephine Van Delden Niclas Weddigen

Taskforce Members

We, the Taskforce Members, are responsible for selecting the most motivated students for a new scholarship year.

To be able to recruit new scholarship holders for the TUM: Junge Akademie (TUM JA) on a yearly basis, our work begins with the nomination of talented students. Therefore, we are in close contact with the individual departments to identify the best 7 to 25 percent of all students. These are the students who are nominated by us and Prof. Müller for the TUM JA.

Another part of the application process involves planning and organizing three information events for interested students. Here, we give the students the opportunity to meet active members and gain firsthand insights into the TUM JA. Due to the current situation, we hold the online information events via Zoom.

We then proceed with the application phase during which we evaluate the incoming applications of potential scholarship holders based on predefined criteria. Here, the applicants' personal motivation and ideas regarding the call are the most important ones. Of course, we always aim to ensure an objective and unbiased evaluation of the applicants. This year we go even one step further: the applicants have to anonymize the letter of motivation, the CV and the essay/video. This should ensure that we can rule out unconscious influences on our decision-making.

Last but not least, we are responsible for organizing the selection days. During these two days, the applicants are asked to participate at various individual or group tasks. For instance, presenting their proposed project ideas described in the essays, as well as having an interview with a supervisor. Last year, we established a score for assessing the applicants' performance, which is revised this year and reused for this year's application process. This score facilitates the comparison of the applicants and helps to assure that the selection process is fair and replicable. Accordingly, based on this performance, about 40 to 50 students are chosen to participate at the TUM: Junge Akademie.

Finally, the winter has come, the die is cast, and we can lean back and bathe in our success ...

Of course, we don't lay low during the winter. We are often in contact with the Taskforce Marketing and try to help where we can.

The greatness of a community is most accurately measured by the compassionate actions of its members. We are proud to be able to contribute with our work to actively shaping the unique and excellent atmosphere of the TUM: Junge Akademie in the future.

Seniors/Mentors	2020	2021
Bauer, Veronika	Bertling, Maren	Giannotti, Leonardo Marco
Huber, Dennis	Hoffmann, Laura	Prendi, Alesia
	Huber, Annalena	Reh, Sara-Luisa
	Huemer, Marie-Theres	Schittenhelm, Andrea
	Déchène, Monica	Thieme, Wolf
	Schwarz, Sophie	Wiehe, Luca Mattes


Roadmap

As every year, we are looking ahead at four major milestones. At this point, the new students have already been nominated and are registering for the information events. Throughout the summer we will accompany them all the way to their final acceptance in the Junge Akademie.



4000 Nomimations from 40896 Total Students

Nomination Percent

In the past years, we decided to give small departments a slight advantage in the name of interdisciplinarity. This year we decided to automate the generation of the percentages to make them more systematic and fair. We nominate 10% on average, 7% as a minimum and 25% as a maximum.



Anonymity

For the first time, we have asked our applicants to provide their applications in an anonymized form. This means that no names or pictures should be provided. Even for the videos we ask applicants to avoid filming or recording themselves, to make the process more objective and fair.

Taskforce Mentoring

The Taskforce Mentoring designs a mentoring program for current scholars of the TUM: Junge Akademie. We strongly believe that mentoring offers great benefits for both parties and is a valuable part of the TUMJA curriculum. Our program offers the opportunity to initiate personal contact between scholars and alumni of the TUM: Junge Akademie. Thus, individual advice and inspiration can be passed on from experienced alumni to younger scholars. At the same time, mentors get a chance to keep in vivid contact with their alma mater and can benefit from the next generation's knowledge and enthusiasm.

We are proud that in the third year of our mentoring program 48 alumni were willing to participate as mentors and provided information about their study background, LinkedIn or XING profile, and certain personal circumstances. Besides that, 20 scholarship holders were interested in becoming a mentee. Since we believe that the mentees themselves know best who they would like to exchange with, they could rank the possible mentors in their preferred order and a matching tool computed the resulting tandems. In May 2021, we organized a virtual kickoff event on ZOOM, which marked the start of this year's mentoring for 19 new tandems. It started with the presentation of the program with its framework conditions, such as the tandem agreement. Here, both parties write down their expectations and organizational agreements. Since the event also

served as the closing event for the last year's tandems, they were able to report directly to the newcomers about their experiences and provide further insights into their interactions. All in all, the event was a great success with lively conversations until late in the evening.

In general, tandems can organize their interaction very individually: While mentor and mentee should meet at least three times during the one-year duration of the program, the frequency, as well as location and topics discussed, are set individually. Academic questions, as well as personal topics, are encouraged to be discussed. As an innovation this year, we offer the possibility for mentors and mentees to evaluate their meetings individually to ensure that potential problems are solved early on.

Apart from that, we are hoping that this summer it will be possible to organize a real-life event for all participants of the program, such as a joint visit to a beer garden. We are also working to involve TUM professors and Emeriti of Excellence as mentors or in other ways.

We are looking forward to undertaking the next steps. Stay tuned!

Your Mentoring Taskforce



Class 2020

Renato Coppi Christian Faßbender Florian Hübler Joel Jäschke Aikaterini Mavroudi

Class 2021

Musa Altun Dario D'Alò Fonseca Alexander Holas Adrián Löwenberg Casas Annabel Matz Laura Willinger

Taskforce Symposium

In ancient Greece, the symposium was a part of a banquet that took place after the meal, when drinking for pleasure was accompanied by music, dancing, recitals, or philosophical conversations. The TUMJA Symposium follows a similar pattern, but instead of a lively gathering of classical philosophers, it serves as the final event that concludes the active time of the TUMJA scholarship holders. The Symposium is held on a yearly basis and brings to a culminating focus the general call every team followed while creating their project.

The main task of taskforce Symposium is to make the event as interesting, fun and special as possible. To that end, we start to gather our first ideas regarding the nature of the symposium about one year earlier. During planning and organizing the final event, it is most important for us to stay in contact with all teams in order to meet their expectations and wishes. Also, the collaboration with other taskforces is a key to a successful result. We actively communicate with Taskforce Marketing, to spread the word about TUMJA and the Symposium as widely as possible, and Taskforce CAP, to make use of and contribute to the valuable partnerships with other universities and institutions. Since the taskforce was founded in 2019 and is therefore very new, it was especially crucial for us to develop all the contacts first, in order to determine the key concepts, goals and expectations for the Symposium in general.

Within one year, we have to divide our team multiple times into subgroups, in order to focus on different tasks. Usually these include finding and contacting keynote speakers, the preparation and designing of the Symposium's location, technical setup, program coordination, moderation and, of course, catering. While performing all these activities, we have a continuous exchange of experience – the scholarship holders of the earlier year support the ones from the new year and the other way around. The most important key here is never to lose creativity and to be always open to ideas, even when they seem to be utopically crazy.

Moreover, our taskforce has the chance to be part of a real event management and to gather experience with the permanent support of professionals. At the time of preparation for Symposium 2020, Markus Walsch contributed to the whole organization process and made our taskforce work in a more structured and professional way. Whereas Jürgen Puls supported the moderators who will conduct the final event and shared his thoughts on how best to carry the message to the wide and curious audience.

Organizing the symposium is a big iterative process, which repeats and adjusts its cycle every year according to the call and the TUM-JA members. We are happy to be part of this taskforce where we are able to learn so much, from setting up the timeline to performing the live stream. The process of brainstorming to find new ideas and solutions has become very common for us, although we are always ready for changes and therefore stay flexible, especially in times of pandemic. We are looking forward to meeting you at our next Symposium, which will be full of surprises. Let's celebrate creativity!

Deniz Avni Bezgin Len Brandes Lena Litzenburger Jeremias Widmann Junianna Zatsarnaja Anastasia Asiedu Elisa Rodepeter Anna Sophia Schmid



Taskforce XP Transfer

Imagine being a time traveler and you travel back to the ancient Roman Empire. Despite being so long ago, you might be impressed by the many achievements they had; well-organized and quite clean cities with sewerage systems, or such seemingly simple things like baking tasty bread. Now, let us travel forward in time by some centuries – we end up in the European Middle Age. We are curios to experience all the progress humankind made within these centuries, but what is this? People pour their drain water just on the streets – do these ways deserve the name "street" at all? And their bread is so hard, it could be used as a hammer.

What has happened? The Roman Empire dissolved, and with it, a lot of knowledge and experiences just disappeared.

Transfer to TUMJA

Let us travel back to the present age and take a look at TUM: Junge Akademie. A group from the current year struggles to create a well-made survey and wonders how to get enough participants. Of course, the group members are smart and search the Project Book of former years, where they see several performed surveys. They even find some people of those groups being still active within Junge Akademie. But ... it is already some time ago and they do not remember the details.

Another group just started to get in contact with partners and want to use their group's shared mailbox. The TUMJA office has sent them a couple-page long instruction and the specific "CN-Funktionsobjekt" they have to use. Nevertheless, they fail a couple of times to include this mailbox to their mail clients. Until one of them figures it out and explains to the others how this works – on half a page.

Time traveler smiles a bit – situation has not changed a lot over the course of history: Still people acquire a lot of know-how and experience, which in turn will be lost to some extent.

Wouldn't it be great to open the TUM: Junge Akademie experience pool and get this half-page tutorial how to set up the shared mailbox? Or, even more awesome, to find another short article about the main lessons-learned by the former groups that created a survey?

Intro and purpose of Wiki

The last-year's founded Taskforce Experience Transfer (XP Transfer) is exactly targeting this issue.

We are aspire to provide a platform, where people search at first to find solutions. This is meant to help people making their tasks better and more effectively within their project groups and taskforces. We use the TUM-wiki as the platform of our choice, which is a wiki system based on Confluence. The wiki is a webpage, where each member of TUM: Junge Akademie can log-in and create new, or edit existing, pages within a tree-like structure. Working with a single page in the wiki is quite easy because the page editor works in a "what you see is what you get" way.

Today, already many groups and taskforces work with the wiki to some extent: A lot of agendas and protocols can be found, several pages where people discussed how to proceed. In addition, many pages where know-how is written down existed in the wiki.

Plans from the TF

Exactly at this point, the Taskforce XP Transfer comes into play. We have created a more sustainable structure within the wiki to have a framework for transferring know-how and experiences.

The first issue we tackled was to create a clear tree-like structure where people know directly where to search for solutions. This is at the top level a division into the project phase, taskforces, tutor experience, TUMJA office and IT. It should prevent mess by too many pages just saved at one point because people were not-knowing where to save a new page properly. Therefore, we introduced a "wiki clean-up day", where the taskforces had the chance to look through their old articles, to sort out the irrelevant ones and to order the others in a sensible way.

As a second step we created easy-to-use templates and guidelines for creating a page. This will make pages more comparable and also lowers the threshold to create a new page. For example, it is often more helpful to have a brief summary of all the relevant points in a bullet point form, than having a many-page long running text; compare this to the above mentioned setup of shared mailboxes.

In addition to the knowledge-management-related tasks, we try to push forward technology which is helpful for TUM: Junge Akademie. For example, we are currently thinking on how to implement an intuitive calendar for the TUMJA wiki.

The third main point is still ongoing: to find new, relevant topics and to write articles addressing these. These should serve as examples for other people to write new pages – and of course the pages should be useful by itself for others. A particular focus of the first articles was the wiki itself; despite many TUMJA members already work with the wiki, the majority just does a limited number of different things. E. g. a lot of users did not know how to create a new page from a template.

We focused on these initial problems at first, because it is extremely important to introduce new tools and ideas properly and to communicate the chances and challenges well. Otherwise, people will experience frustration at a very early stage and will blame the wiki to be a poor system.

To highlight this importance let us take a quick excursus to the Munich townhall. They shifted their IT infrastructure from Microsoft Windows based to Linux based. For the computer affine people this is no big deal, as Thunderbird is very similar to Outlook, Libre-Office Writer similar to Word, and so on. However, for the common user of these programs there is a difference and trying to adapt their used knowledge might fail, because things have different names and are located in a different place within the programs. These are not severe problems, but without proper introduction, hundreds of people have to search for the same things and all get frustrated. This is of course a simplification, but in the end, the general frustration was so high, that Munich shifted back to Microsoft Windows – with again costs for changing a main ingredient for IT infrastructure.

Coming back to the Taskforce XP transfer. After the general structure has been established and first pages are created, we introduced the wiki and the newly created chances to all the other taskforces and groups. At a very early stage, they should experience the benefits of a wiki filled with helpful experiences, and in turn be motivated to share their experiences with the community of TUM: Junge Akademie. Among others, we currently do this by short online workshops, that we plan to record for later classes of the TUM-JA without the need of an experienced teacher.

Outro

Our time traveler is curious how it worked out and travels a bit forward in time. He is quite happy to see that the TF XP Transfer is no longer existing because each members of TUM: Junge Akademie searches first at the wiki in case of problems; and updates the page after their group performed the task – or they even created a new page to save the experiences for the next generation. Thus, making the Taskforce superfluous.

The time traveler realizes, that this wiki-based solution works in this case. Taking a look in a history book he notices that also the ancient Romans had a kind of wiki to save know-how – called "libraries".

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