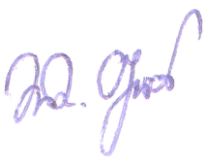
Master Thesis
Summer Semester 2021

CAMediaid: Multimethod approach to assess Cognitive-Affective Maps in mediation – A quantitative validation study

Name:	Wilhelm J. Gros, B.Sc.
Matriculation no.:	3907222
Contact:	0761 / 61 25 70 93, hildvgh@gmx.de
	Güterhallenstraße 13, Ap. 2-148, 79106 Freiburg i. Br.
Reviewers:	Prof. Dr. Andrea Kiesel; PD Dr. Roland Thomaschke
Supervisors:	Dr. Michael Stumpf; Sabrina Livanec, M.A.; Lisa Reuter, M.Sc.; Julius Fenn, M.Sc.
Course:	M.Sc. Kognitionspsychologie, Lernen und Arbeiten
Institution:	Albert-Ludwigs-Universität Freiburg, Allgemeine Psychologie and Cluster of Excellence *liv*MatS
Submission date:	13.08.2021
Signature:	

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Acknowledgement

I'd like to thank the Psychological Institute of the Albert-Ludwigs-Universität and especially the department of Allgemeine Psychologie for the enablement and supervision of this master thesis.

I'd like to thank several other departments of the Albert-Ludwigs-Universität, the Uniseum, the IGPP and the Marienberger Seminare for promoting me to think out of the box.

I'd like to thank my family for the enablement of my studies and the backing.
I'd like to thank my partner for enduring many bad and causing many good moments.

I'd like to thank my Rennererer, Limburger and Freiburger workmates, fellow students and companions for the ongoing addition to my point of view as well as for countless adventurous and cheerful moments.

At least, I'd like to thank everybody out there, whose action stays in hiding but is significant to me and this work.

Zusammenfassung

Mediation ist eine Methode der Konfliktlösung, in welcher ein unparteiischer Mediator die Streitparteien durch die Förderung gegenseitigen Verständnisses zusammenbringt. Eine Kognitiv-Affektive Karte (CAM) ist ein neuartiger Konzeptgraph, der sowohl Kognitionen als auch Affekte der Sichtweise einer Person zu repräsentieren im Stande ist. CAMediaid ist ein Kofferwort aus den Bestandteilen CAM, mediieren und helfen. Es soll ausdrücken, dass CAMs womöglich besonders hilfreich in der Mediation sein könnten. Um dies weiter zu untersuchen, zeichneten unsere Versuchspersonen eine CAM bzgl. eines kontroversen Themas. Eine Woche später elaborierten die Teilnehmer, welche zum ersten Messzeitpunkt eine positiv valente CAM zeichneten, eine negativ valente CAM und umgekehrt. Danach zeichneten sie eine weitere CAM. Eine Kontrollgruppe elaborierte ihre erste CAM. Zusätzlich wurde eine modifizierte Version des Technology Acceptance Model 3 (TAM3) zwecks Validierung verwendet. Unsere erste Hypothese konnte angenommen werden: Die Prä-Post-Differenz der mittleren CAM-Valenz war größer in der Experimentalgruppe als in der Kontrollgruppe. Auch unsere zweite Hypothese konnte angenommen werden: Die Prä-Post-Differenz des mittleren TAM3-Scores war größer in der Experimentalgruppe als in der Kontrollgruppe. Das bedeutet, dass die Elaboration einer CAM gegenläufiger Valenz in der Lage war, die Sichtweise unserer Versuchspersonen in der Experimentalgruppe zu verändern. Das TAM3 lieferte einen ersten Hinweis auf die Validität von CAMs für den Zweck der Meinungsänderung. Zusammenfassend empfehlen wir die weitere Untersuchung von CAMs im Kontext der Mediation.

Abstract

Mediation is a method for conflict resolution in which an impartial mediator reconciles the conflicting parties by fostering mutual understanding. A Cognitive-Affective Map (CAM) is a novel concept graph that is able to represent cognitions and affects of somebody's point of view. CAMedaid is a portmanteau consisting of the words CAM, (to) mediate and (to) aid. It's meant to express, that CAMs perhaps are a helpful method in mediation. To examine this further, our participants drew a CAM on a controversial topic. A week later, participants who drew a CAM of positive affective connotation at the first measurement time point elaborated a negative CAM and vice versa. After this, the participants drew a second CAM. A control group elaborated their first CAM. In addition, a modified version of the Technology Acceptance Model 3 (TAM3) was used to validate our findings. Our first hypothesis could be accepted: The pre-post difference concerning the CAM's average valence was greater in the experimental group than in the control group. Our second hypothesis could be accepted as well: The pre-post difference concerning the TAM3's aggregated score was greater in the experimental group than in the control group. This means, that the elaboration of a CAM of opposite affective connotation was able to change the point of view of the participants in our experimental group. The TAM3 questionnaire provided a first hint at the validation of CAMs for the purpose of opinion change. All in all, we highly recommend the further examination of CAMs in mediation.

Table of contents

1 Theoretical background

"AVDIATVR ET ALTERA PARS" is an ancient proverb in Latin and means "let the other side be heard as well". Since ancient times it's furthermore a principle of fundamental justice, whereas conflicts are probably as old as mankind itself. Until today, conflicts are present in our everyday life, be it in our families and neighborhoods or in job, school and politics.

The German Mediation Law from 2012 is just one out of many indications, that there is an ascending interest in constructive and sustainable conflict resolution, which not just saves money and relieves courts, but satisfies every conflicting party as well as possible instead of stigmatizing a winner and a loser.

In general, mediation lacks of a systematic method for exploring the belief system of the conflicting parties (Homer-Dixon, Milkoreit, Mock, Schröder & Thagard, 2014). The purpose of this master thesis is to assess a new method of inquiry, Cognitive-Affective Maps, in mediation.

1.1 Introducing Cognitive-Affective Maps

A Cognitive-Affective Map (CAM) is a concept graph first introduced by Paul Thagard (2010), who expanded existing cognitive mapping models by an affective component (emotions, moods and motivations) to obtain a kind of a sophisticated mind map. A CAM concerns a certain topic and consists of arbitrary concepts connected to each other in a network. These concepts are cognitive elements, e.g. a goal, argument or person. In many cases, there is a central concept in the middle of the CAM with the most connections of all concepts. But a central concept is not mandatory. A CAM can be drawn like a flow chart, like sun rays around a central concept or like clusters – just as it may best please the CAM drawer.

Furthermore, these concepts can be emotionally marked as positive (green ovals), negative (red hexagons), both of them (this is ambivalent, displayed as purple ovals within hexagons) or neutral (yellow rectangles). As mentioned before, the concepts are in relation to each other. This relation can be of supportive (solid line) or inhibiting (dashed line) nature. For example, achieving a goal can allow or prohibit a related goal. In addition, the relation can be one-sided (represented by arrows on the connecting lines showing the direction of influence) or both concepts can influence each other (no arrows on the connection line). Positive and negative concepts as well as relation-lines can be weighted in three degrees (represented by the thickness of the lines or frames of the concept shapes). Please see Appendix A for an example, how a CAM can look like. Altogether, this is a very fine-grained method to define and to show one's point of view considering both, cognitions as well as affections.

CAMs can be drawn digitally via the software Valence (Rhea, Reuter & Piereder, 2020). Furthermore, this software is accessible online, which enables to flexibly include participants from every place that has access to the internet. Not only does this software make it easy to draw an optically pleasing CAM but also delivers all CAM data in a *.csv file and thereby facilitates the subsequent quantitative analysis of CAMs.

1.2 Introducing mediation

Mediation is a method for conflict resolution in which an impartial mediator reconciles the conflicting parties by helping to find a consensual solution (Proksch, 2016). Unlike in court, mediation is based on voluntariness, own effort of the conflicting parties and a mediator, who just helps fostering mutual understanding. Mediation shifts the focus from justice and injustice to interests and needs. This is done via a multitude of discussion and questioning techniques, especially Nonviolent Communication (Rosenberg, 2001). A professional mediation has rather less to do with intuition. In fact it requires a specific

training and is structured by seven well-defined phases (Proksch, 2016). These phases provide a helpful framework by giving orientation: no phase will be missed out, no phase will be applied unless other important antecedent phases are passed through.

The Mediation Phase Model (Proksch, 2016) looks as follows: The (1) pre-mediation phase is reserved for one-on-one preliminary talks (e.g. 'What are common interests?'), conflict analysis (e.g. 'Is a mediation the best fitting conflict resolution method?') and implementation planning (e.g. 'Which room offers a beneficial environment?'). The quality of the preparation will make or break the success of a mediation. The (2) parameter definition phase consists of a transparent discussion of the conflicting parties. The task is to work out a goal, e.g. improving mutual respect. The mediator assumes the role of an impartial moderator. Within the next phase of (3) issue compilation, the conflict should be separated to a list of solvable individual problems. This will structure the following mediation process. The next (4) conflict discussion phase is meant to reveal the underlying needs and interests of each conflicting party. Based on the issue compilation, every party now can express thoughts and feelings on each individual problem one by one. The task of the mediator is to help switching the point of view and keeping focus on a future-orientated solution rather than past-orientated blaming. Now starts the phase of (5) search for a solution. This can be initiated by a creative brainstorming where every idea is allowed. By a subsequent discussion inappropriate and unfeasible solutions can be filtered out. Maybe some solutions can be combined for a better fitting. In phase (6), agreement, the chosen solution will be examined conscientiously for a last time. Once every party is satisfied, a binding agreement will be signed. The last (7) post-mediation phase is kind of a quality management follow-up. To foster the attachment of the conflicting parties to the agreement, either the agreement can be adapted if necessary or the success of an appropriate agreement can be communicated (Proksch, 2016). In most of these phases, CAMs conceivably are of good use, be it as inquiry

tool in phase 1, as growing basis for the open discussion in search of a solution in phase 5 or as vivid representation of the agreement in phase 6, for example.

A mediation as described above is applicable in many conflict scenarios: within a company, school, neighborhood or family. Out of these areas, family and divorce mediation is the fastest growing one (Proksch, 2016). But mediation is used at a higher level as well. For example, the UN try to mediate in Libya, Syria and Yemen via drawing up a power-sharing agreement (Asseburg, Lacher & Transfeld, 2018). At this level, mediation helps to improve international security and therefore improving mediation means saving human lives.

1.2.1 Three exemplary problems of mediation and the role of CAMs

Firstly, international mediation often lacks of a significant contribution to peace and security. Asseburg, Lacher and Transfeld (2018) indicated three major problems. One of them concerns the agreements as not being mandatory enough. They became unfeasible or obsolete due to changing conflict parties or third parties undermining sanctions, for example. How could CAMs improve international mediation? A steadily updated CAM representing the issue could help to lucidly keep track of multifactorial international developments: Are the conflicting parties still representative or has a person in charge to be changed? Are the goals still common sense or do recent events require an adjustment? Is it still possible to implement these goals or did new obstacles emerge? If new parties enter the negotiations, CAMs represent the current state of previous negotiations. In this way, CAMs might improve the commitment of the conflicting parties.

Secondly, Seaman (2016) attested one big problem of mediation: the impartiality of the mediator. Despite the fact that this impartiality is a cornerstone of mediation, it is rather an ideal than achievable to its full extent. The mediator is meant to bring conflicting parties together, observe conversation rules and focus on a common solution which is generated by the parties on their own. But in reality, the mediator often exerts – be it conscious or

unconscious – effect on the parties. Just by asking certain questions or showing certain facial expressions he can prompt solutions that rather are his own favorites but not necessarily the favorites of the conflicting parties. This undermines the fundamental goal of mediation that a solution shall be created by the conflicting parties on their own. The mediator must not judge this solution.

The questionable mediator impartiality is especially relevant in business mediation, where the mediator often is an in this subject trained employee or even superior of the same company as the conflicting parties (Proksch, 2016). While mediation is meant to be open-ended, an in-company mediator might constrain an agreement, which puts pressure on the conflicting parties and, at worst, rather is in the purpose of saving money or another company goal, than in the purpose of the conflicting parties (Seaman, 2016). To mandate an external mediator may mitigate the problem of impartiality, but it is unlikely that it can remedy this problem as a whole.

In psychology, similar effects are known as Rosenthal effect or Pygmalion effect. The former describes how expectancies of an experimenter can influence the results of an experiment just by inconspicuous utterances while giving the treatment, for example. The latter describes how the performance capability expectancies of teachers can yield a self-fulfilling prophecy: preferred pupils are unconsciously encouraged more than others, for example. One suggestion to mitigate these effects in experimental designs is to let experimenters come less into contact with participants (Shadish, Cook & Campbell, 2002).

CAMs might be a possible way to minimize this contact between experimenter / mediator and participant / conflicting party. Drawing a CAM substitutes dialogues between mediator and conflicting parties. Once the CAM is drawn and accessible to all parties, the point of views become manifest and possibly less prone to unconscious influences. Everything lies written down in front of the conflicting parties and to change a concept needs a conscious

attempt at least. Therefore, CAMs might be helpful to mitigate one of the biggest problems of mediation by the substitution of the preliminary talks in phase one, for example.

Thirdly, another problem in mediation is stated by Proksch (2016): Once the mediation starts, the conflicting parties often are insufficiently aware of their needs and interests. This is true all the more for the knowledge of a conflicting party regarding the needs and interests of the other conflicting parties. Furthermore, conflicting parties know better what they don't want, but less of what they do want in many cases. On top of that, Proksch (2016) ascribed the importance of this knowledge of needs and interests to the mediation success.

CAMs might be of support for mediation in this regard as well: Drawing a CAM forces to address one's own point of view in depth. It's a little bit like the proverb "I have to say what I think, to hear what I opine". People elaborate their opinion while drawing a CAM, they can clarify what's especially important for them and the other conflicting parties or even the CAM-drawer himself might be surprised at the results. Therefore, CAMs may not only mitigate another mediation problem, but also support a more sustainable or faster agreement.

1.3 Cognitive-Affective Maps in conflict management

The idea of using CAMs in conflict management is not a completely new one. In fact, already in 2010 Thagard named conflict resolution as primary application of CAMs. He suggested, that the conflicting parties draw two CAMs each, concerning their own point of view and what they think the point of view of the other party may look like. These CAMs could then be used for further conflict exploration.

More precisely, CAMs have already been applied in mediation scenarios as well (Homer-Dixon et al., 2014). The authors attested a need for new methods, which are able to represent a conflict in a holistic manner (cognitions and affections) and nominated CAMs for this job. In several conflict areas (national policies, international policies and religion), CAMs

performed well in terms of quickness of implementation, clarity of description or understanding of the conflict.

Nevertheless, the authors determined a lack of emotional representation, which are important to a deeper understanding of a conflict. Missed are activity (in terms of arousal) and potency (in terms of perceived self-efficacy). In the worst case, CAMs could cause hardened fronts, e.g. as a result of highlighted differences, though providing an explanation for this development. If a CAM can't facilitate the finding of a solution, it delivers an assessment of causes for this stalemate, at least.

As the CAM reveals a point of view, similarities and overlaps become salient and point at the best suitable agreement. If there aren't any overlaps, CAMs could serve as a kind of conceptual intervention (Homer-Dixon et al., 2014), i.e. changing concepts, values or links via dialogue for the purpose of finding an agreement. In this case, CAMs could be a diagnosis tool for choosing the next step, e.g. psychoeducation. And again, at the very least, if there isn't any agreement possible at all, CAMs can show the causes of this.

At the bottom line, CAMs are appraised as applicable to mediation and more in-depth CAM-related conflict research is encouraged (Homer-Dixon et al., 2014). Despite this, very little is known of the feasibility to use CAMs in mediation. Neither was a CAM ever evaluated in an actual mediation process, nor was it evaluated *as* mediation itself. This master thesis wants to fill this gap.

1.4 In search of an adequate mediation scenario

To assess CAMs in mediation, we first needed to provoke a controversial scenario with at least two conflicting parties. Eventually, we found the topic of technological implants to suit best. More precisely, we created a scenario of a fictional implant, which is to be placed in the brain, controls the sleep-wake cycle and is controllable via an app. It receives energy from its

environment (blood flow, blood heat or vibrations), repairs itself autonomously if necessary and can be metabolized at the end of its lifetime.

Such an implant could be used for good (e.g. mitigating sleep disorders, optimizing energy balance, replacing drugs) or bad (surveillance, class division, abuse by employers) as well. It could be imagined in almost every area: medicine, education, job, military, politics, leisure time and much more. Every participant should find an area, which is important to him which probably leads to many concepts for the CAMs. Furthermore, this implant was described as to be introduced in the near future. This made the implant within one's grasp and therefore imaginable, while leaving space for speculations concerning good and bad – just like our participants wanted. Thus, we stretched a wide spectrum of possible points of view, out of our participants chose a stance: between a socially accepted cochlear implant and a dystopian cyborg everything was imaginable (Pelegrín-Borondo, Reinares-Lara & Olarte-Pascual, 2017). In addition, there a several ethical sources attesting the controversy potential of implants (Baumgartner, 2008; Berger, Gevers, Siep, & Weltring, 2008; Siep, 2008). Therefore, imagining a technological implant should provide potential for both, cognitions from convincement to concerns as well as for emotions from hope to fear – the ideal hotbed for rich and controversial CAMs.

Altogether, the topic of implants should likely lead to a sample of implant supporters on the one hand and implant critics on the other hand. In multiple iterations, our team designed a scenario text introducing a fictional technological implant, describing a few technical aspects and mentioning some good and bad possible outcomes of this technology to inspire our participants. The final scenario text was then proof-read by an English native speaker. Please see Appendix B for our scenario text.

1.5 Technology Acceptance Model

In this master thesis, we want to assess CAMs in mediation. To strengthen the construct validity, we added a second dependent variable in form of a questionnaire. Already in 1959, Campbell and Fiske explained how measuring errors and systematic properties of measurement methods can bias the results of a study. By now, the mono-method bias is well known in experimental design and describes, how one single measurement method becomes rather a part of the construct to be studied, than being an independent operationalization (Shadish, Cook & Campbell, 2002). But if the CAM-method and a questionnaire showed similar results of opinion change, this would be a first hint at a decent convergent validity and with that for a decent construct validity.

The first Technology Acceptance Model (TAM) was introduced by Davis in 1989. In 2000, Venkatesh and Davis presented a revised TAM, called TAM2. The latest revised, extended and empirically tested version is TAM3, which provides a thorough nomological network of the determinants of acceptance of new information technology (Venkatesh & Bala, 2008). TAM3 is the latest peak of an integration of the rich TAM research between 1989 and 2008. As of August 2021, Google Scholar listed over 6,300 citations to the article of Venkatesh and Bala (2008), indicating the frequent discussion and usage of TAM3. Furthermore, an augmented version of the TAM has already been successfully applied to a comparable scenario of technological implants (Reinares-Lara, Olarte-Pascual, Pelegrín-Borondo, & Pino, 2016).

Originally, the TAM was meant for assessing and predicting employees' acceptance and use of new information technology. This knowledge helps managers to choose adequate interventions aiming for a greater acceptance of new information technology. However, we considered the TAM3 suitable for our purposes as well: This questionnaire represents the

point of view on a technological topic, it is well-established and it already has successfully contributed to research on technological implants.

1.6 Integration, hypotheses and preregistration

While mediation is a method, which concentrates on subjective points of view, and a CAM is a tool, which is able to show somebody's point of view, it's obvious to combine them in synergy. In fact, CAMs have already been used in conflict research. But as it's a rather novel tool, there's just little literature on CAMs in mediation and still a lot of foundational research is to do.

CAMedaid is a portmanteau consisting of the words CAM, (to) mediate and (to) aid. It's meant to express, that CAMs are a perhaps especially helpful method for mediation. The idea is to change somebody's point of view just by elaborating an opposing CAM of someone other. This would be decent evidence in favor of the use of CAMs as a mediation tool. Many conflict solving processes suffer from dysfunctional communication and a lack of insight in the opponent's point of view. CAMs could mitigate these problems via elaborating an opposing point of view.

In this study we will assess the CAM-method less as part of a mediation rather than as a mediation itself. The participants will commit their point of view concerning a fictional technological implant as a CAM. After that, they will elaborate a CAM of opposing valence and then they will draw a second CAM, which might show an opinion change. This possible opinion change will be validated with the TAM3 questionnaire as second dependent measurement.

This leads to the hypotheses of this master thesis: (1) The pre-post difference concerning the CAM's average valence is greater in the experimental group (EG) than in the control group (CG). (2) The pre-post difference concerning the TAM3's aggregated score is greater

in the EG than in the CG. Please view chapter 2 (method) for a description of intervention and groups.

The preregistration of this study can be viewed at the Open Science Framework (https://osf.io/k2tw9). Preregistration means, that hypotheses and methods of analyzing are announced officially before the actual data acquisition starts. A preregistration not only facilitates the progress of experimental designing, it further guarantees, that hypothesis generating and hypothesis testing don't take place in a single study and thereby mitigates hindsight bias (Nosek, Ebersole, DeHaven, & Mellor, 2018). Thus, a preregistration is a great approach in terms of open science and transparency.

1.7 Funding and research team

This study is funded by the interdisciplinary Cluster of Excellence Living, Adaptive and Energy-autonomous Materials Systems (*liv*MatS), which aims to create new materials systems combining both, nature and technology (Albert-Ludwigs-Universität, 2018). Within one research area of this cluster, an interdisciplinary team consisting of philosophers and psychologists examines, how to describe and predict the acceptance of these new materials systems. An innovation might be of enormous improvement, but it will fail if nobody wants to or can use it. This master thesis contributes to this aim via assessing the CAM-method as a tool for inquiring and predicting somebody's technology acceptance in order to support a timely and transdisciplinary exchange for improving both, acceptance by potential users as well as customer-oriented research.

If there is talk of 'we', this means our interdisciplinary *liv*MatS-sub-team, which processed the underlying study: Mia Dörr, Julius Fenn, Andrea Kiesel, Sabrina Livanec, Lisa Reuter, Michael Stumpf and the author of this master thesis, Wilhelm Gros. Please note, that the underlying study involves a lot more ideas and measurements, thus, supplying several theses. This master thesis is just an excerpt of a greater study.

2 Method

The experimental design was as follows: At first, the participants read a brief overview of the study and signed the informed consent followed by the generation of an individual ID, which linked questionnaire data with Valence data. After that, our participants read the scenario text concerning a fictional technological implant, which can be viewed in Appendix B. Now, the participants answered several questionnaires, of these the modified TAM3 is important to this master thesis. The sequence of questionnaires was fixed, the order of sub-dimensions and items was randomized. The questionnaires came first in the hopes that this lead to more sophisticated CAMs as the participants were elaborating the topic while answering the questionnaires. Subsequently, the participants read an instruction on how to use Valence and then had to answer several comprehension questions which were iterated so long as they weren't answered correctly. Please visit the preregistration of this study at the Open Science Framework as described in chapter 1.6 for full instructions. This was followed by the task to draw a CAM concerning their point of view on the fictional technological implant. Eventually, the participants answered final questions, gave demographic information, signed an honesty contract and gave feedback.

After this first measurement time point, all participants were assigned randomly to either the EG or the CG. Then, we rated each drawn CAM in the EG as either positive (mean valence > 0) or negative (mean valence < 0). Now we created a positive prototype concerning the fictional technological implant as well a negative prototype. For this purpose, we chose CAMs out of our data, which already were very sophisticated and added further nodes, so that every concept drawn by our participants was represented at least in a super category. By doing so, we created a semi-natural CAM, which is controllable on the one hand and on the other hand is less biased by us researches than a completely artificial CAM would be. We added some striking negative and ambivalent arguments to the positive prototype and vice

versa to improve the credibility of our prototypes. Super categories got a higher degree than sub categories. We refrained from the usage of arrows and dashed lines, as we know from experience, that participants need very specific instructions to understand them correctly. In this case, we preferred accessibility over complexity. Finally, we cleaned up the positions of concepts to improve accessibility and look of the prototypes. Please see Appendix A and Appendix C for our prototypes.

At the second measurement time point a week later, participants read a brief overview of the study and signed the informed consent once more, followed by the re-generation of their individual ID, which linked questionnaire data with Valence data. The participants were able to read the scenario text and view their first CAM again. Now, participants with a positive pre-CAM were told to elaborate the negative prototype and vice versa. Participants with a neutral pre-CAM (mean valence = 0) got allocated randomly. The elaboration was prompted by two questions which had to be processed for at least two minutes each. Both CAMs, the own CAM from the first measurement time point and the allocated prototype, were visible at the same time. The CG just elaborated their CAM from the first measurement time point and by this, helped to rule out regression to the mean (Shadish, Cook & Campbell, 2002). After that, the participants could read the instructions for Valence again and were then told to draw a second CAM concerning the fictional technological implant. Finally, they did the questionnaires a second time. At the second measurement time point, the order of CAM and TAM3 were reversed compared to the first measurement time point, because the treatment (i.e. elaborating the CAM of opposite affective connotation) should be in more dense temporal connection to the dependent variable (i.e. post CAM).

We therefore had a mixed design with a within factor ‘time’ (two measurement time points) and a between factor ‘condition’ (EG and CG). The two independent variables were (1) the presentation of an opposing CAM and (2) the pre-post time point. For this master

thesis, two dependent variables are relevant: Opinion on a fictional technological implant measured by (1) average valence of the CAM and (2) aggregated score of the questionnaire TAM3.

2.1 Sample

We used the software program G*Power (Faul, Erdfelder, Buchner & Lang, 2009) to conduct a power analysis. Our goal was to obtain .80 power to detect a medium effect size of .30 at the standard .05 alpha error probability. For our design, we calculated a sample size of 68 participants. Our experience value in terms of dropout for prolific.co totals 20%, which leads to a required sample size of 82. As we don't know yet, how sensitive CAMs are as a measuring instrument, we adjusted upward to 90 participants.

To estimate this expected effect size of mediation equivalent to .30, we did a literature research: Several meta-analyses reported average overall effect sizes for victim offender mediation equivalent to .34 (Bradshaw, Roseborough & Umbreit, 2006), for divorce mediation equivalent to .36 (Shaw, 2010) and for mediation in schools equivalent to .26 (Garrard & Lipsey, 2007).

Our participants were recruited at prolific.co. They were paid an expense allowance at the level of the German minimum wage of converted 8.50£. Single inclusion criterion was English as first language, since we used a demanding scenario text and difficult items. The participants predominantly answered from the United Kingdom (N = 56), the United States of America (N = 6) and South Africa (N = 4). Two participants each answered from Canada and Spain. One participant each answered from Australia, Hungary, Ireland, South Korea and Poland.

Out of 90 participants at the first measurement time point, we managed to keep 75 participants at the second measurement time point resulting in a dropout rate of 16,6%. 18 participants of the EG (N = 35) drew a positive CAM, 17 participants drew a negative CAM

and the CG consisted of 40 participants. The mean age was 32.69 years (*SD* = 12.14), while ranging from 19 to 72. We had 46 male participants, 28 female and one intersex. The participants predominantly stated, that their religious faith was not important to them (*N* = 48), while nine participants each stated, that their religious faith was somewhat important, important or very important to them. Two participants stated experiences regarding technological implants, which indicates an unprejudiced sample without foreknowledge, which otherwise could have biased the results. At both measurement time points, every participant agreed to the informed consent and affirmed the honesty contract.

The elicitation of the first measurement time point took place between 2021.04.30 and 2021.05.05. The elicitation of the second measurement time point took place between 2021.05.12 and 2021.05.31.

2.2 Modification and preparation of the TAM3 questionnaire

We modified the TAM3 in two ways for our needs: (1) deletion of items which didn't fit the fictional technology and (2) renaming items to fit our scenario. In the first case, we deleted the subscale 'perceived ease of use', for example, and several other items, which aren't applicable on a technology that is yet to be released. In the second case, we replaced the original term 'system' with 'technological implant', for example. All renaming was proof-read by an English native speaker. We added three new items to the TAM3. Please see Appendix D for the items we used.

We inverted eight items of the TAM3 for further statistical analyses. Please see Appendix E for a correlation plot of all TAM3 items prior to inversion. The eight negatively correlated items matched to a contentual test indicating the same eight items as to be inverted. Please see Appendix F for a correlation plot of all TAM3 items posterior to inversion. All inverted Items are evident from Appendix D.

We deleted eleven low correlated items by face validity using the correlation plot. Maybe these items were too hard to imagine within a fictional scenario or the participants didn't understand them correctly. However, it is obvious that they lowered the internal consistency and therefore had to be deleted. All deleted Items are evident from Appendix D. Appendix G shows the correlation plot posterior to inversion and deletion.

Eventually, we computed the mean score of the TAM3. This was done via adding the value of all items and dividing by the total number of items.

2.3 Statistical analyses

Within this master thesis, we are interested in the potential of CAMs to change a point of view. Therefore, we computed pre-post differences of both, the CAM's average valence and the TAM3's mean score. Considering this work as exploratory, we were less interested in the direction of this opinion change rather than in the basic potential of CAMs to change an opinion in any direction. Thus, we used absolute pre-post differences. Furthermore, our EG consisted of both, positive and negative pre CAMs. At worst, the effects of positive CAMs becoming more negative and negative CAMs becoming more positive could counterbalance themselves to zero. To counter that, we computed one-way ANCOVAs for each dependent variable with the pre-value as covariate to be partialed out.

As inference criteria, we used the standard $p<.05$ criteria for determining if the ANCOVAs suggest that the results are significantly different from those expected if the null hypothesis were correct. Since we applied a two-sided confirmatory hypothesis testing for two dependent variables (average CAM-valence and aggregated score of TAM3), we didn't adjust the alpha level. All analyses of other dependent variables weren't adjusted, too, and are explicitly marked as explorative for the purpose of generating further hypotheses.

We excluded data of each participant who drew a CAM of less than four nodes. In addition, we conducted a plausibility inspection: A participant who drew a CAM consisting

of neutral nodes only maybe misunderstood the task, for example. As part of a consistency check we had a look on answering patterns to check insufficient effort responding. Since no participant was able to proceed if not all items were answered, no participants had to be excluded due to missing data.

All statistics were computed by using R (R Core Team, 2020). Please see Appendix H for the applied packages and versions.

3 Results

3.1 Descriptive statistics

Table 1

Descriptive Statistics for CAM Mean Valence

Group	Time	*N*	*M*	*SD*	*Mdn*	*Min*	*Max*	Range	Skew	Kurtosis
Control	1	40	-0.11	0.58	-0.13	-1.33	1.20	2.53	0.17	-0.24
Experimental	1	35	-0.10	0.65	0	-1.89	1.10	2.99	-0.70	0.41
Control	2	40	0.08	0.62	0	-1.64	1.33	2.97	-0.07	0.26
Experimental	2	35	-0.08	0.67	0.06	-1.33	1.38	2.71	-0.14	-0.54

Note. Time = measurement time points; the CAM mean valence value could range from -3 to +3.

Table 2

Descriptive Statistics for the pre-post difference of CAM Mean Valence

Group	*N*	*M*	*SD*	*Mdn*	*Min*	*Max*	Range	Skew	Kurtosis
Control	40	0.41	0.37	0.28	0	1.33	1.33	0.96	-0.01
Experimental	35	0.66	0.57	0.51	0	1.96	1.96	0.87	-0.32

Table 3

Descriptive Statistics for TAM3 Mean Score

Group	Time	*N*	*M*	*SD*	*Mdn*	*Min*	*Max*	Range	Skew	Kurtosis
Control	1	40	4.03	1.23	4.31	1.42	6.58	5.15	-0.24	-0.75
Experimental	1	35	3.93	1.14	4.00	1.81	6.42	4.62	0.06	-0.47
Control	2	40	4.11	1.14	4.06	1.77	6.92	5.15	-0.06	-0.15
Experimental	2	35	4.13	1.09	4.15	1.77	6.38	4.62	-0.08	-0.39

Note. Time = measurement time points; the TAM3 mean value could range from 1 to 7.

Table 4

Descriptive Statistics for the pre-post difference of TAM3 Mean Score

Group	*N*	*M*	*SD*	*Mdn*	*Min*	*Max*	Range	Skew	Kurtosis
Control	40	0.41	0.30	0.31	0	1.23	1.23	0.94	0.07
Experimental	35	0.74	0.90	0.46	0.04	4.58	4.54	2.69	7.93

3.2 Hypothesis testings

Concerning the ANCOVA of CAM mean valence, four out of five assumptions were violated: There was no linear relationship between pre-value and pre-post difference of the CAM mean valence for both groups, as assessed by visual inspection of a scatter plot. There was homogeneity of regression slopes as the interaction term was not statistically significant, $F(1, 71) = 0.82$, $p = .37$. The Shapiro Wilk test was significant ($p < .05$), so we couldn't assume normality of residuals. The Levene's test was significant ($p < .05$), so we couldn't assume homogeneity of the residual variances for all groups. There was one outlier in the data, as assessed by one case with standardized residuals greater than 3 in absolute value. After adjustment for pre-value of the CAM mean valence, there was a statistically significant difference in pre-post difference of the CAM mean valence between the groups, $F(1, 72) = 5.30$, $p < .05$.

Table 3

One-Way ANCOVA Statistics for CAM Mean Valence

Effect	df_{Num}	df_{Den}	*F* ratio	*p*	η^2_G
Covariate	1	72	1.43	.236	.02
Group	1	72	5.30	.024*	.07

Note. $N = 75$. ANCOVA = analysis of covariance; covariate indicates the pre value of the CAM's mean valence; df_{Num} indicates degrees of freedom numerator; df_{Den} indicates degrees of freedom denominator; η^2_G indicates generalized eta-squared.

*p < .05.

Concerning the ANCOVA of TAM3 mean valence, four out of five assumptions were violated: There was no linear relationship between pre-value and pre-post difference of the CAM mean valence for both groups, as assessed by visual inspection of a scatter plot. There was homogeneity of regression slopes as the interaction term was not statistically significant, $F(1, 71) = 0.75$, $p = .39$. The Shapiro Wilk test was significant ($p < .05$), so we couldn't assume normality of residuals. The Levene's test was significant ($p < .05$), so we couldn't assume homogeneity of the residual variances for all groups. There were two outliers in the data, as assessed by two cases with standardized residuals greater than 3 in absolute value. After adjustment for pre-value of the TAM3 mean score, there was a statistically significant difference in pre-post difference of the TAM3 mean score between the groups, $F(1, 72) = 4.82$, $p < .05$.

Table 4

One-Way ANCOVA Statistics for TAM3 Mean Score

Effect	df_{Num}	df_{Den}	F ratio	p	η^2_G
Covariate	1	72	0.63	.431	.01
Group	1	72	4.82	.031*	.06

Note. $N = 75$. ANCOVA = analysis of covariance; covariate indicates the pre value of the TAM3's mean valence; df_{Num} indicates degrees of freedom numerator; df_{Den} indicates degrees of freedom denominator; η^2_G indicates generalized eta-squared.

*p < .05.

3.3 Exploratory analyses

As mentioned before, the study contained further analyses. Some findings of interest will follow in this section. These deliberations are explicitly marked as exploratory and meant for hypothesis generation.

Table 5

Exploratory Statistics for CAM Concept Number

Group	Time	*N*	*M*	*SD*	*Mdn*	*Min*	*Max*	Range	Skew	Kurtosis
Total										
Control	1	40	13.45	4.12	13.50	6	24	18	0.34	-0.08
Experimental	1	35	13.63	4.47	15	6	26	20	0.57	0.31
Control	2	40	13.57	4.62	13	6	27	21	0.57	0.01
Experimental	2	35	18.43	5.65	19	7	31	24	-0.06	-0.67
Positive										
Control	1	40	4.78	2.58	4	1	11	10	0.68	-0.13
Experimental	1	35	5.37	2.68	5	1	13	12	0.49	-0.01
Control	2	40	5.32	2.49	5	1	12	11	0.37	-0.41
Experimental	2	35	7.54	3.39	8	1	14	13	0.01	-0.85
Negative										
Control	1	40	5.22	2.34	5	2	11	9	0.48	-0.31
Experimental	1	35	5.40	2.88	5	1	14	13	0.97	1.14
Control	2	40	4.90	2.38	5	0	12	12	0.46	0.50
Experimental	2	35	7.60	3.41	7	3	15	12	0.79	-0.40
Ambivalent										
Control	1	40	1.50	1.57	1	0	8	8	1.84	5.03
Experimental	1	35	1.00	1.03	1	0	4	4	0.94	0.36
Control	2	40	1.60	1.55	1	0	7	7	1.35	1.92
Experimental	2	35	1.97	1.93	2	0	7	7	0.68	-0.41
Neutral										
Control	1	40	1.95	1.60	1	1	8	7	2.27	5.07
Experimental	1	35	1.86	1.24	1	0	6	6	1.34	1.66
Control	2	40	1.75	1.21	1	1	6	5	1.81	2.80
Experimental	2	35	1.31	1.11	1	0	6	6	2.17	6.85

Note. Time = measurement time points.

Table 6

Exploratory Statistics for CAM Mean Valence and TAM3 Mean Score with three groups

Group	Time	*N*	*M*	*SD*	*Mdn*	*Min*	*Max*	Range	Skew	Kurtosis
CAM										
Control	1	40	-0.11	0.58	-0.13	-1.33	1.20	2.53	0.17	-0.24
Negative	1	17	-0.61	0.52	-0.46	-1.89	0	1.89	-1.17	0.38
Positive	1	18	0.38	0.31	0.33	0	1.10	1.10	0.62	-0.59
Control	2	40	0.08	0.62	0	-1.64	1.33	2.97	-0.07	0.26
Negative	2	17	0.02	0.71	0.12	-1	1.38	2.38	0.17	-0.97
Positive	2	18	-0.17	0.64	0.05	-1.33	0.78	2.11	-0.60	-0.87
TAM3										
Control	1	40	4.03	1.23	4.31	1.42	6.58	5.15	-0.24	-0.75
Negative	1	17	3.46	1.12	3.65	1.81	5.92	4.12	0.26	-0.66
Positive	1	18	4.38	0.99	4.13	2.54	6.42	3.88	0.21	-0.48
Control	2	40	4.11	1.14	4.06	1.77	6.92	5.15	-0.06	-0.15
Negative	2	17	3.87	1.30	3.77	1.77	6.38	4.62	0.20	-1
Positive	2	18	4.38	0.81	4.35	2.73	6.23	3.50	0.22	-0.12

Note. Time = measurement time points; negative indicates participants who drew a CAM with valence < 0 at the first measurement time point; positive indicates participants who drew a CAM with valence > 0 at the first measurement time point.

Table 7

Exploratory Statistics for a Dichotomous Opinion Survey at the End of Each Measurement Time Point

Group	Time	*N*	N_{Yes}	N_{No}	*M*	*SD*
1. Would you use the technological implant based on moral/ethical considerations?						
Control	1	40	21	19	0.52	0.51
Experimental	1	35	16	19	0.46	0.51
Control	2	40	21	19	0.52	0.51
Experimental	2	35	14	21	0.40	0.50
2. Do you think that the technological implant should be paid by the health insurance company?						
Control	1	40	18	22	0.45	0.50
Experimental	1	35	18	17	0.51	0.51
Control	2	40	22	18	0.55	0.50
Experimental	2	35	17	18	0.49	0.51
3. Should research into the development of such implants be supported with public funds?						
Control	1	40	18	22	0.45	0.50
Experimental	1	35	17	18	0.49	0.51
Control	2	40	18	22	0.45	0.50
Experimental	2	35	14	21	0.40	0.50
4. Should research into the development of such implants be prohibited?						
Control	1	40	10	30	0.25	0.44
Experimental	1	35	7	28	0.20	0.41
Control	2	40	5	35	0.12	0.33
Experimental	2	35	10	25	0.29	0.46

Note. Time = measurement time points; 0 = “No”; 1 = “Yes”.

4 Discussion

In the following, we will discuss, how the findings could be interpreted. This is followed by discussion of limitations regarding the experimental design and statistical analyses. After that, we want to share our experiences from this study to improve further research. Eventually, we discuss some suggestions for the implementation of CAMs.

4.1 Interpretation

The ANCOVA shows a statistically significant group difference regarding the CAM mean valence after controlling for the pre-value. Accordingly, our first hypothesis can be accepted: The pre-post difference concerning the CAM's average valence is greater in the experimental group than in the control group. This means, that the elaboration of a CAM of opposite affective connotation (i.e. our prototypes) is able to change a point of view. As soon as a conflicting party begins to shift its point of view, compromises become more likely. We therefore highly recommend mediators to consider the CAM method in terms of a conceptual intervention suggested by Homer-Dixon et al. (2014) for the purpose of finding an agreement.

Furthermore, the second ANCOVA shows a statistically significant group difference regarding the TAM3 mean score after controlling for the pre-value. Accordingly, our second hypothesis can be accepted as well: The pre-post difference concerning the TAM3's aggregated score is greater in the experimental group than in the control group. Thus, the opinion change caused by the elaboration of a CAM of opposite affective connotation (i.e. our prototypes) is not only measurable by the second CAM. Beyond that, it is measurable by a well-evaluated questionnaire. This indicates the robustness of the effect. All in all, our modified TAM3 questionnaire provides a first hint at the validation of the CAM method for the purpose of opinion change.

To further understand the effect mechanisms underlying these findings, we want to discuss four related effects: (1) priming (e.g. Carruthers, 2016), (2) grounding (Clark & Brennan, 1991), (3) social desirability (Edwards, 1953) and (4) cognitive dissonance (Festinger, 1957). (1) The choice of words is a very important priming in mediation affecting both, emotion as well as behavior. For example, if the more neutral ‘finances’ is used instead of the emotionally laden ‘retrenchment’, this can improve emotional well-being and cooperation of the conflicting parties. In our study, the word choice of the scenario text or prototype could have contributed to the results. (2) Grounding is a process of discussion and cooperation of two persons. The goal is to foster mutual understanding and therefore is directly linked with mediation. By elaborating the CAM of opposite affective connotation, our participants potentially understood an alternative point of view, found common concerns or confidence and integrated them in their own point of view, thus causing a more moderate post CAM. (3) When participants answer to questions in a way that they think it would be desired by others rather than in their own way, this is called social desirability. Maybe our prototype made such a view of someone other salient and therefore influenced the post CAM. (4) Cognitive dissonance describes a condition of inner tension that arises, when cognitions (e.g. a perception and an attitude) don’t match each other. A participant, who decided to draw a negative pre CAM, read many positive arguments. These advantages are compelling alternatives to the point of view this participant chose at the first measurement time point and they probably caused cognitive dissonance. Likely, this participant tried to reduce his cognitive dissonance by adding new cognitions to his point of view, which may have caused a more moderate post CAM. Further research is needed to determine, whether and to which extent these effects are involved in the findings of this study. Anyhow, every effect named is less a matter of differential diagnosis of our findings. Since the named effects have crucial overlaps with mediation or at least are beneficial for conflict resolution, they should rather be

considered as components of mediation. Of course, this is a mere suggestion and has to be confirmed by further studies examining the construct of mediation.

Considering the exploratory statistics for CAM concept number in Table 5, we noticed an increase of about five concepts between the two measurement time points in the EG but no increase in the CG. The number of positive and negative concepts increased equally (about two concepts each). As with an increasing number of concepts a more balanced CAM becomes more likely, this is another indication in favor of CAMs as a mediation tool. The finding that the elaboration of a CAM of opposite affective connotation yields CAMs with more concepts might be of interest for educational purposes, too, since knowing more about a topic or a more interconnected knowledge is beneficial for learning processes. Furthermore, the CAM method could serve as assessment of training success.

As can be seen in Table 6, the greatest difference occurred within the group of participants, who drew a CAM of negative affective connotation at the first measurement time point. This is true for both dependent variables, CAM mean valence and TAM3 mean score. On the one hand, this indicates the reasonableness to divide the EG into sub groups according to the mean valence of their first CAM in further studies, to examine CAMs more fine-grained. On the other hand, this suggests a possible difference between different kinds of prototypes or that different point of views have to be treated different. Moreover, CAMs of extreme valence may only be mitigated by an extreme prototype. To know more about this would help to generate prototypes of suitable credibility, since we believe that too extreme prototypes wouldn’t be taken seriously or could reveal the purpose of the study. These findings should be starting points for new hypotheses, to understand CAMs in mediation further.

As can be seen in Table 7, there are some small developments between the measurement time points in political questions. There was a shift in the frame of question 3 (‘Should

research into the development of such implants be supported with public funds?') towards the response 'No.', indicating a possible usefulness of CAMs in the process of opinion formation. Further research could examine this to generate instructions, which can be used by governments, insurances, institutes and so on to use CAMs for the purposes of enlightenment, opinion formation or advertisements, for example. Surprisingly, the greatest shift was observable in the frame of question 4 ('Should research into the development of such implants be prohibited?') within the CG. Apparently, some participants reconsidered their point of view just by elaborating their own CAM from past a week. In mediation, maybe just to draw a second CAM on the same conflict issue after a certain time period can motivate the conflicting parties to reconsider their point of view and to stagger a stalemate. This is also a hint at a possible usefulness of CAMs in the development of ideas. Everyday, the designer has overview on the present state of his ideas, can easily recognize possible links and is motivated to reflect the project as a whole.

4.2 Limitations

In the present analysis, we decided to compute ANCOVAs despite the fact that four out of five assumptions concerning both ANCOVAs were violated. In the case of the outliers we decided to keep them in. Extreme positions will definitely occur in mediation, so keeping the outliers means strengthen external validity. In a simulation study, ANCOVA was not robust when the assumption of the homogeneity of variances was violated (Ateş, Kaymaz, Tekindal, & Erdoğan, 2020). In another simulation study, ANCOVA was robust when both assumptions of normality and homogeneity of regression coefficients were violated but the group sizes were equal (Papanastasiou, 1982). In our study there was an imbalance in group size of five participants due to dropout. All in all and considering this as a first exploratory study, we still stick with our hypotheses and encourage further research considering the use of CAMs as a mediation tool.

In the very beginning, we planned a CG without treatment to assess the temporal stability of CAMs over the period of a week. However, in this design the EG does an additional CAM task (i.e. elaborating a CAM of opposite affective connotation) and therefore a group difference could be caused by fatigue effects or practice effects (Shadish, Cook & Campbell, 2002) and not sure enough solely by the elaboration task. Thus, to increase comparability of the groups, the CG was told to elaborate their first CAM as a surrogate task. On the other hand, this could persuade our participants to remember and stick with their original CAM and therefore yields an unrealistically high temporal stability of CAMs. Another surrogate task in further studies could be a CG, which elaborates a CAM of the same affective connotation. As this is rather unrealistic for a mediation scenario, we refrained from this type of CG. A further surrogate task could be given in terms of a CAM concerning a completely different topic. This topic, however, has to be chosen very thoroughly because at worst, it could bias the post CAM by a contentual priming effect, for example. Moreover, the mere drawing of a CAM could be considered as a treatment and therefore causes pre-post differences. Further research could find more evidence for the type of CG fitting best in CAM research.

Concerning the TAM3 we have to admit, that it wasn't constructed and validated to be applied on a fictional scenario. Furthermore, we used a variant that was not previously validated by deleting some items and renaming the items left for the purpose of our scenario. However, we thoroughly discussed every modification and did not more than necessary. At the first measurement time point, our participants answered the TAM3 before drawing the CAM in the hopes that this lead to more sophisticated CAMs as the participants were elaborating the topic while answering the questionnaires. A study similar to ours could reverse or randomize this order to see how a precedent drawing of a CAM affects a subsequent TAM3. In our study, the precedent TAM3 likely primed the subsequent CAMs, which therefore can't be assumed as unbiased or spontaneous.

Regarding the scenario text concerning the fictional technological implant one could ask whether this topic was open-ended enough or too specific. While textbooks prefer a neutral introduction, we added some drastic outcomes and the number of good and bad outcomes wasn't balanced. Despite we never conducted a pilot study on our scenario text, it yielded a satisfying distribution of positive and negative CAMs in our sample. An alternative approach could be the presentation of two scenario texts, one in favor of and one against technological implants. Regarding the instruction, it could be discussed, whether a real opinion change was encouraged or just a recall of more arguments. Since the latter should not be underestimated in terms of a conflict resolution process, we don't consider this point as of high importance.

To date, there still are a few bugs left in Valence. These caused our participants errors and crashes which in turn led to frustration and multiple attempts to finish the CAMs. This might had an influence on the results. But since the software is constantly patched, it's just a matter of time until it will run bugless.

In general, we have to submit that we possibly overcharged our participants. They read a demanding scenario text, studied a taxing CAM-instruction, used a novel method and answered several questionnaires. Hence, we can't eliminate fatigue effects or order effects (Shadish, Cook & Campbell, 2002).

4.3 Suggestions for further research

In this master thesis, we used a questionnaire as validation for the CAM method. The other way round, CAMs might serve well in the field of questionnaire construction. Maybe a CAM will show concepts relevant to a construct, which weren't considered in the construction of the questionnaire and therefore contributes to the completion of a questionnaire. In addition, a central response to an item can have several causes: Is the participant undecided or is his opinion ambivalent? Does the participant know too little or doesn't it matter to him? If a participant likes the mitigation of sleep disorders but at the same

time fears an abuse by hackers, he is forced to response at the middle of the scale treating the question on how he likes technological implants in general. CAMs are likely to determine these causes and therefore might contribute to both, construction of questionnaires as well as interpretation.

In addition, we recommend further research on the comparability of CAMs and questionnaires. Questionnaires are answered rather mechanically, which might less encourage to elaborate one's own point of view, possibly leading to less identification of a participant with the questionnaire results regarding their point of view. A CAM offers more ways to express an opinion, the participants invest more time in drawing a CAM than ticking a questionnaire and last but not least, participants are able to design the look of their CAM. We suggest, that this might elicit intrinsic motivation and encourages to elaborate one's own point of view deeper, possibly leading to more identification of a participant with the final CAM result regarding their point of view. Hence, CAMs could have a better sensitivity for assessing a point of view, than questionnaires. But this is a mere presumption and has to be examined further.

No psychotherapy is conducted, if the client is unwilling or not compliant. Likewise, mediation is based on the voluntariness of the conflicting parties (Proksch, 2016). Maybe it would be useful to develop a screening tool for assessing the willingness or aptitude for mediation. This could be done on the basis of existing conflict management scales (e.g. Austin, Gregory, & Martin, 2009). A cut-off could define the applicability of mediation in general or mediation with CAMs in particular and thus save money, effort and time. However, it's a legitimate question whether an unwilling conflicting party is willing to do this screening anyway.

"I have to say what I think, to hear what I opine" – further studies could examine whether this proverb is true for CAMs. Do participants notice this effect while drawing a CAM? Does

the CAM differ from a brief estimate the participants gave on a certain topic prior to drawing a CAM? And again, even drawing a CAM could cause an opinion change.

Educational psychologists could examine CAMs compared to texts regarding educational and opinion-forming purposes. Maybe it turns out that CAMs outperform texts but are inferior as the topic becomes more complicated. Moreover, prompting techniques could be assessed to improve the usage of CAMs in the educational area. A simple prompt (e.g. 'What are the differences between this CAM and your CAM?') could promote elaborating the point of view of someone other. Referring to socratic questioning (Paul & Elder, 2006), crucial parts of a CAM could be highlighted (e.g. 'Why is there a link between these two concepts?'). A more therapy-like prompt could look like 'What has to be changed in your life, so that the valence of this concept can change as well?'. These findings could be of interest for both, education and mediation.

Further mediation research could examine whether conflicting parties feel comfortable with the use of CAMs in conflict resolution or whether it's rather difficult to transform a point of view into a CAM. Despite this, we want to encourage research on the prototype: Is a natural CAM of the opposite conflicting party able to change a point of view or does it need a well-structured prototype like in our study? Currently, the generalizability of prototypes is unclear. The answer to this question might have crucial influence on the process of mediating with CAMs in terms of whether a prototype has to be generated or natural CAMs could be used. If a prototype has to be used, a pre-test validation prior to implementation could turn out useful.

Further CAM research could focus on the visual perception of CAMs. Does it matter whether the CAM is designed radial, vesicular or like a flow chart? How does the exhaustive usage of position, size or thickness of the concepts for the purpose of hierarchization influence comprehensibility? Another interesting research approach could investigate the

temporal stability of CAMs staggered by hours, days, weeks, months or years. This would help assessing the reliability of the CAM method. Likely, the topic measured by CAMs is important to that matter, too. Someone's mood is by nature less temporal stable than his political attitude, for example. This has to be considered before assessing the reliability of CAMs.

A third measurement time point could serve as follow-up, indicating whether the opinion was sustainably changed or just factual learning was encouraged and hence assessing the long-term effect of CAMs as mediation tool. If a conflicting party is able to mention more arguments concerning a conflict, this might already be a conflict solving success, but is not necessarily the same as a deeply change of interests and needs. This is an important difference and to understand these coherences better could help improving the mediation process.

In this master thesis, we decided to use the well-established TAM3 to validate the CAM method. But this questionnaire only represents the cognitive aspect of CAMs. We suggest to consider the usage of the Cognitive-Affective-Normative (CAN) model which is a combination of parts of the TAM with affective variables (Pelegrín-Borondo et al., 2017). Another suggestion is the usage of the Multidimensional Ethics Scale (Reidenbach, & Robin, 1990) which was already combined with the TAM by Olarte-Pascual, Pelegrín-Borondo, Reinares-Lara and Arias-Oliva (2021). Such a combination of questionnaires could be able to represent both aspects of CAMs, i.e. the cognitive and the affective one.

In international mediation, there might not always be one ambassador to draw a CAM. In some cases it might be necessary to aggregate multiple CAMs of a group. Further research should examine how the elaboration of a prototype of opposite affective connotation influences a group (or a representative sample out of this group) compared to a single person. Within an aggregated CAM score there might be individuals with a rather positive or

negative point of view. It is unclear, how a single prototype will affect multiple individuals and how this will influence the post value of the aggregated CAM mean valence. Furthermore it could be cross-culturally assessed, whether the CAM method is a cultural fair one or if there should be specific instructions for specific cultures.

4.4 Implications

A CAM is a very advantageous communication tool. A CAM offers a brief and easy accessible representation of a point of view in which the concepts are displayed together which belong together, while providing several mechanics for making a complex statement. Whereas a communication via dialogue or text – intentionally or unintentionally – may lead to long, hypotactic and unapproachable messages, a CAM drawer is forced to be precisely and concisely. In many cases, drawing a CAM promotes development and knowing of one's point of view in the first place. A CAM surely isn't able to display an issue as profound as a text, we grant, but this is a trade-off between complexity and accessibility. So there will be cases in which CAMs fit and there will be cases in which they don't. However, CAMs mitigate split attention effect (Tarmizi, & Sweller, 1988), because a concept and its valence are integrated at the very same location. All in all, CAMs invite us to integrate, elaborate and understand a point of view. This opens a large field of possible implications.

The usefulness of CAMs in business mediation was already addressed. But this usefulness might not be limited to cases, in which a conflict already broke out. Maybe CAMs could serve as a kind of an early-warning system as well. Many stores already ask their customers at the exit, whether they were satisfied or not (e.g. via smileys). Imagine a workshop, in which every employee constantly draws a CAM concerning his job satisfaction. A foreman could assess the overall satisfaction of his workshop on the basis of the aggregated CAMs of his journeymen and therefore is able to timely react on unfavorable trends. Zooming into the original CAMs prior to aggregation allows him to analyze the

emerging problem further. To save working time, the journeymen could draw a complex CAM once and then just update it in periodic intervals. Moreover, a CAM could serve as basis for complicated personal reviews. Every prevented conflict is a good and cheap one.

To date, CAMs in science often are used just to analyze and visualize data, like Luthardt, Schröder, Hildebrandt and Bormann (2020) recently did in the field of early childhood education. After all, Homer-Dixon et al. (2014) suggested the usage of CAMs as teaching material in conflict education. Thagard (2015) presents CAMs of different political ideologies which promise to be helpful in history lessons. In this study we showed, that CAMs aren't just a kind of imaging technology for dependent variables but furthermore are a possible treatment to influence a dependent variable as well. We therefore want to encourage the usage of CAMs in other teaching subjects besides history, in adult education, in psychoeducation of a psychotherapy and so on.

CAMs aren't a promising tool only in scientific and conflict management areas. Imagine for example an economical context: A costumer wants a suspended scaffold to clean a communication tower. Via a CAM he could express every factor which is meaningful to him or which could endanger the project. Furthermore, he can express what is especially important to him (e.g. time) and what is less important (e.g. costs). All this is shown in an accessible graphic without tedious and inefficient email or telephone exchange. The engineer can recognize a potential ignorance of the customer in no time and deliberately address problems. Therefore, CAMs could serve as a useful negotiating basis. In addition, a CAM of the project could be constructed by customer and engineer together and in this case serves as a tool for project design. In future, a digital modular assembly system could be used by the customer on his own in his planning phase. Once he marks the node ‚low costs' as very important, an inhibiting connection to the node ‚quality' appears, for example. There might

be a high potential of CAMs for economists to lower costs of inefficient negotiations and to optimize the negotiation process in general.

A very progressive idea would require a lot of subsequent research but looks equally promising. Two conflicting parties each draw a CAM concerning their point of view within their conflict. Then, these two CAMs get entered into an algorithm, which connects the concepts of both CAMs. If both CAMs contain the same concept ‘making money’ that has the same valence and degree, it’s to 100% connectable and represents an unanimity, for example. If one CAM contains a positive concept ‘making money’ at highest possible degree and the other CAM contains a negative concept ‘making money’ at the highest possible degree, then this would be to 0% connectable and represents an issue. The clue could be, to add the new CAM component ‘range’. Additional to his concept of a certain valence at a certain degree, the CAM drawer can state a range of valence and degree that he is willing to accept in the extreme. Now, for each CAM component, the combination of valence, degree and overlaps permits to find a common ground for negotiations. In turn, this common ground indicates opportunities of least resistance on the way to an agreement. Furthermore, flow graphs could illustrate different ways to possible solutions (which concepts or valences have to be adjusted by both conflicting parties to enable or facilitate this or that solution). The only task left to conflicting parties would be to choose one flow, that both like the most.

5 Conclusion

The aim of this master thesis was to assess CAMs as possible mediation tool, which can change the point of view of the conflicting parties. Despite some concerns regarding the experimental designs and statistical methods, CAMs are very auspicious for mediation and we highly want to encourage further research in this area.

In 155 BCE, Carneades, representative of the Academic Skeptics, was sent from Athens to Rome among two representatives of other important ancient Greek schools of philosophy

(Zetzel, 2017). Their mission was to mediate in a political issue. On one day, Carneades gave a speech on justice and the Romans were excited about his statement and rhetorical skills. On the next day, Carneades gave a speech against justice by masterly refuting every point he stated the day before. This time, the Romans hated his point of view and he was expelled back to Greece, but his rhetorical performance stayed.

This is very old evidence for a world, which never was just black and white. As a rule, there are good reasons for both sides, even if one side might not see them straight away and even a generally accepted topic like justice can be disputed. While courts stigmatize a winner and a loser, mediation is more likely to yield sustainable solutions in these complicated issues or ethical dilemmas, for example. A CAM can represent two opposite but yet well justified points of view, improves mutual understanding and helps to find overlaps. With an authentic evident CAM, an agreement becomes rather a matter of a puzzle than a struggle and maybe one day – with a lot more research to come – a computer software might facilitate this process by computing possible compromises.

There still are many questions to be answered, guidelines to be formulated and mediators to be trained but as reward, CAMs could play an important role in our families and neighborhoods, in job and school and on international level they might save lives. In short, CAMs could be a great revitalization of the ancient Latin proverb “AVDIATVR ET ALTERA PARS”.

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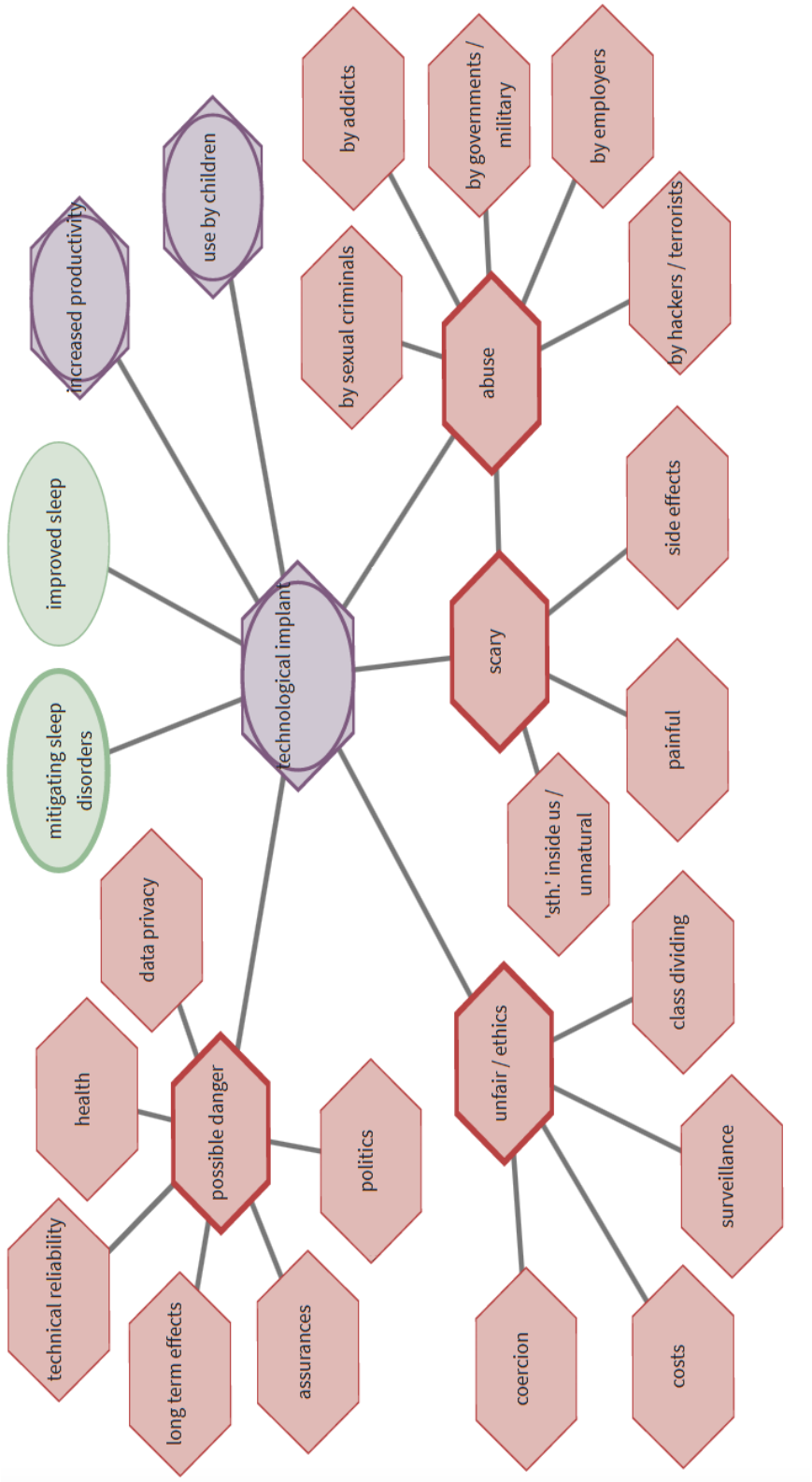
7 Appendix

7.1 Appendix A

The Negative Prototype that was Presented to Participants who Drew a CAM of Positive Affective Connotation at the First Measurement Time Point



7.2 Appendix B

Our Scenario Text Concerning a Fictional Technological Implant

For your subsequent task imagine the following fictional scenario in the near future:

A team of interdisciplinary scientists recently created a small technological implant. This technological device can easily be implanted into the brain and can be controlled via an app on your mobile phone. Once the implant is in the brain, it does not require any maintenance because it gets its energy from its' surroundings (using multiple energy sources like moving blood, temperature and vibrations). It can also repair itself in case of small damages. If the user does not want it any longer or in case of major damage, the implant will be decomposed and automatically metabolized. The implant can help to regulate the sleep-wake cycle of humans.

While everybody might profit from such an implant that enables the regulation of sleep and wake phases via an app, it could also be used for patients with sleep disorders. Sleep disorders occur frequently and are often associated with many severe physical and psychological impairments. Currently they are treated with medications, but sleeping drugs have serious side effects and can potentially lead to addiction.

Besides the medical field, the military is also interested in such an implant. For example, special forces could be on a mission for multiple days without sleep, which eminently increases the chance of accomplishment. However, some generals fear that the implant could alter the mentality of the soldiers leading for example to an excess of preparedness to kill.

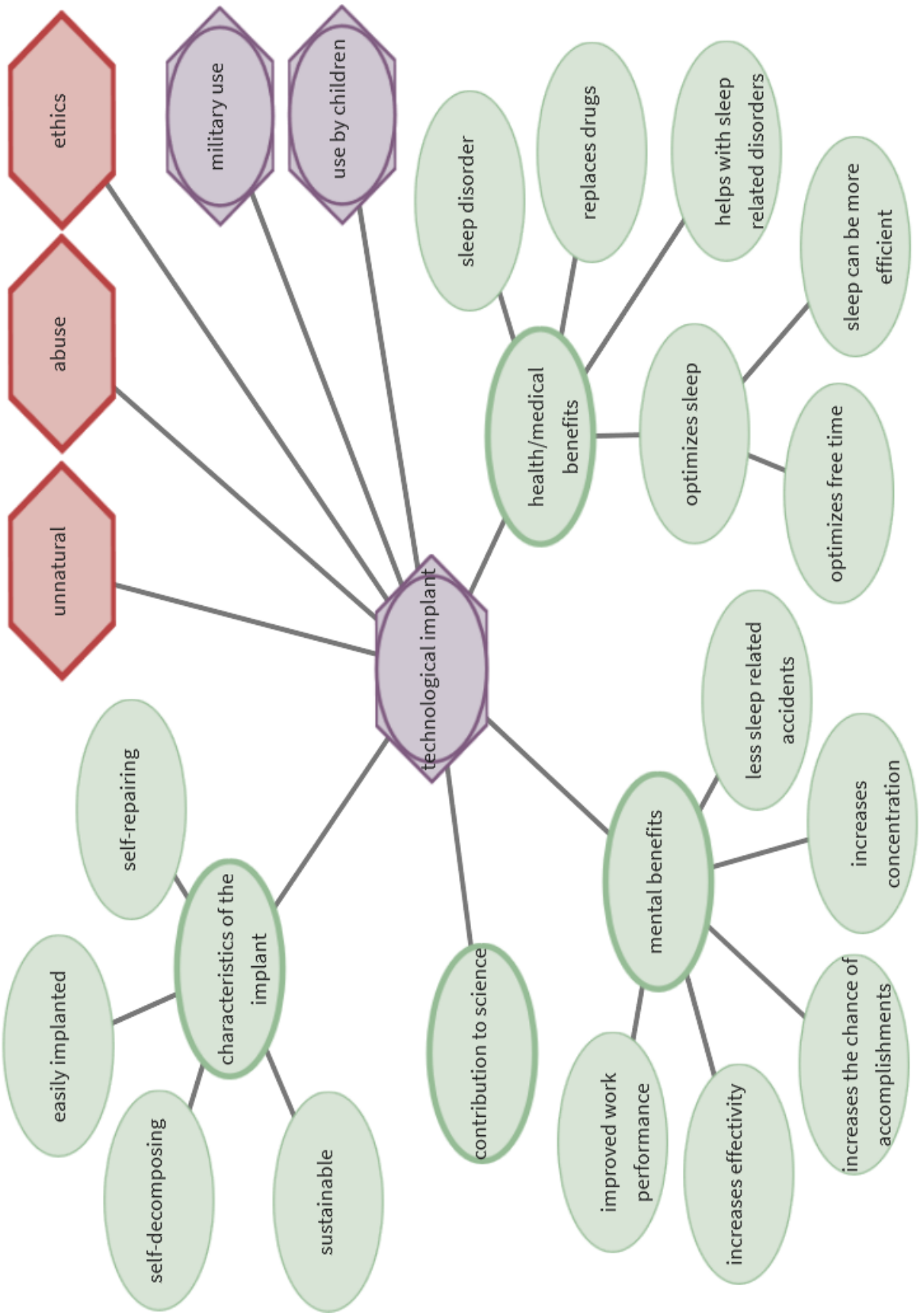
In addition, this implant is of interest to economists, too. While it could lower the risks of accidents as a result of fatigue, some people fear an exclusion of applicants without such an implant, effectively creating a have and have-not class system. This bears the risk that people might feel coerced to get such an implant.

Finally, the implant affects our daily lives by regulating our sleep-wake cycle: adolescents could party three days in a row, undergraduates could optimize their learning curve and the elderly could have a guaranteed afternoon nap, people could work more efficiently and sleep at the touch of a button on days off.

The data privacy is unclear in all of these cases, and research on the risks is still in its beginnings. And how about hackers who assume control over the implant, putting people to sleep? Therefore, the list of possible outcomes could be heavy. Overall, do you think that the benefits outweigh the costs for society? Please also consider ethical and societal implications when making this assessment.

7.3 Appendix C

The Positive Prototype that was Presented to Participants who Drew a CAM of Negative Affective Connotation at the First Measurement Time Point



7.4 Appendix D

Modified Version of the TAM3 Questionnaire we Created to fit the Scenario

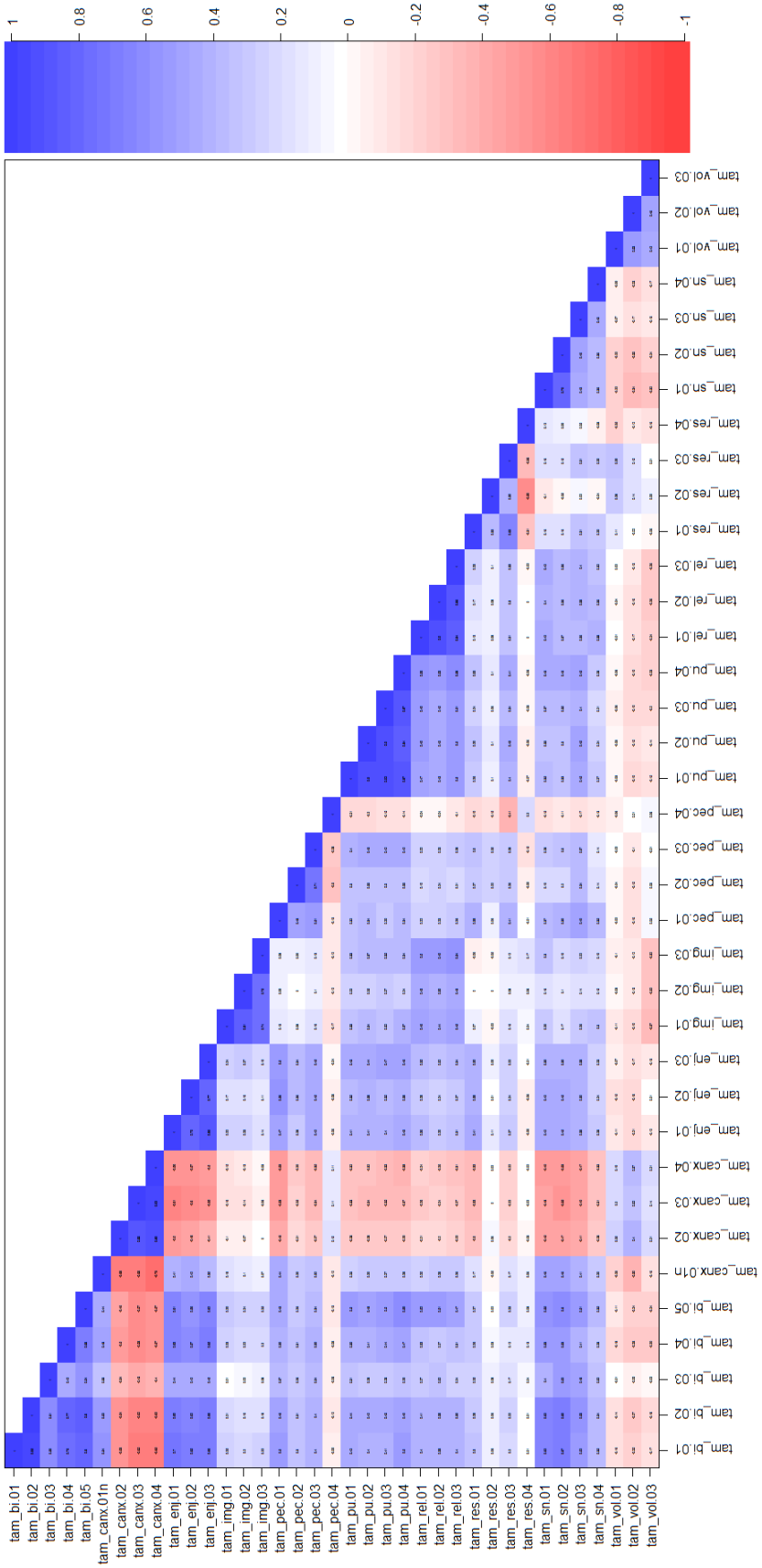
Constructs	Code	Items
Perceived Usefulness	PU1.	Using the technological implant would improve my performance.
	PU2.	Using the technological implant would increase my productivity.
	PU3.	Using the technological implant would enhance my effectiveness.
	PU4.	I would find the technological implant useful to perform my activities.
Image	IMG1.[d]	People in my working area who use the technological implant would have more prestige than those who do not.
	IMG2.[d]	People in my working area who use the technological implant would have a high profile.
	IMG3.[d]	Having the technological implant could be a status symbol in my working area.
Job Relevance	REL1.	The technological implant could be important for my job in the future.
	REL2.	The technological implant could be relevant in the future for my job.
	REL3.	The use of the technological implant could be pertinent in the future to my various job-related tasks.
Result Demonstrability	RES1.[d]	I would have no difficulty telling others about the usefulness of the technological implant.
	RES2.[d]	I believe I could communicate to others the consequences of the implementation of the technological implant.
	RES3.[d]	The usefulness of the technological implant is apparent to me.
	RES4.[i,d]	I would have difficulty explaining why using the technological implant may or may not be beneficial.
Computer Anxiety	CANX1.	The technological implant would not scare me at all.
	CANX2.[i]	To use the technological implant would make me nervous.
	CANX3.[i]	The technological implant would make me feel uncomfortable.
	CANX4.[i]	The technological implant would make me feel uneasy.

Perceived Enjoyment	ENJ1.	The idea of using the technological implant is enjoyable to me.
	ENJ2.	The actual process of using the technological implant would be pleasant to me.
	ENJ3.	I would have fun in using the technological implant.
Perceptions of External Control	PEC1.	I would have control over the use of the technological implant.
	PEC2.	I would have the resources necessary to use the technological implant.
	PEC3.	Given the resources, opportunities and knowledge it takes to use the technological implant, it would be easy for me to use it.
	PEC4.[i,d]	The technological implant is not compatible with other electronical systems I use.
Subjective Norm	SN1.	People who influence my behavior would think that I should use the technological implant.
	SN2.	People who are important to me would think that I should use the technological implant.
	SN3.	The societal support of the technological implant would be helpful to use it.
	SN4.	In general, the society would support the use of the technological implant.
Voluntariness	VOL1.[i,d]	I would prefer that the use of the technological implant should be voluntary.
	VOL2.[i,d]	I would prefer when the use of the technological implant is not mandatory.
	VOL3.[i,d]	Although it might be helpful, using the technological implant is not going to be compulsory in my job.
Behavioral Intention	BI1.	Assuming I had access to the technological implant, I would intend to use it.
	BI2.	Given that I had access to the technological implant, I predict that I use it.
	BI3.[n]	I predict I would use the technological implant for my leisure activities.
	BI4.[n]	I predict I would use the technological implant for medical purposes.
	BI5.[n]	I predict I would use the technological implant for my professional activities.

Note. All items were measured on a 7-point Likert scale (where 1: strongly disagree; 2: moderately disagree, 3: somewhat disagree, 4: neutral (neither disagree nor agree) 5: somewhat agree, 6: moderately agree, and 7: strongly agree); [i]inverted items; [d]deleted items; [n]new items.

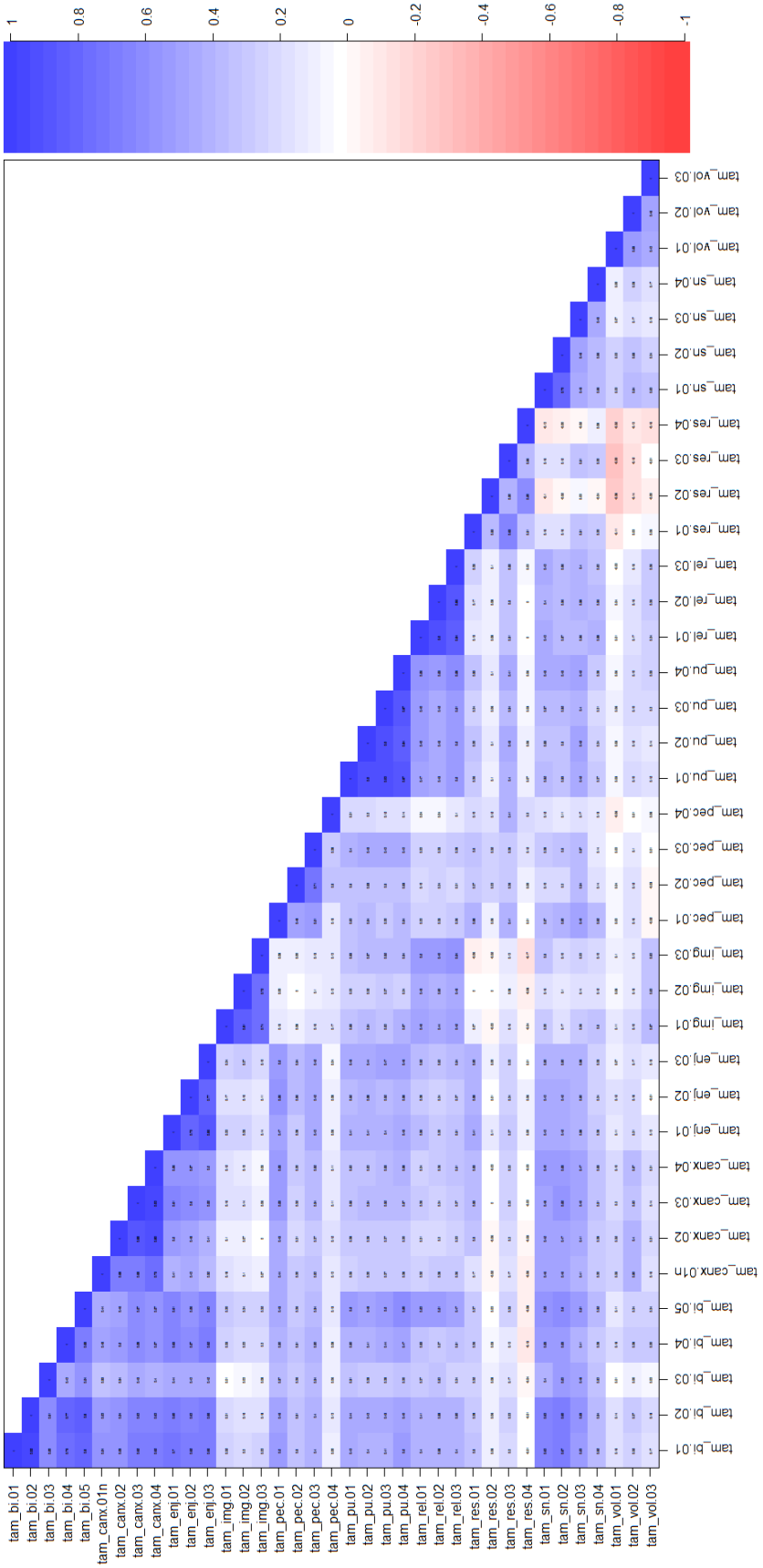
7.5 Appendix E

Correlation Plot of All TAM3 Items Prior to Inversion



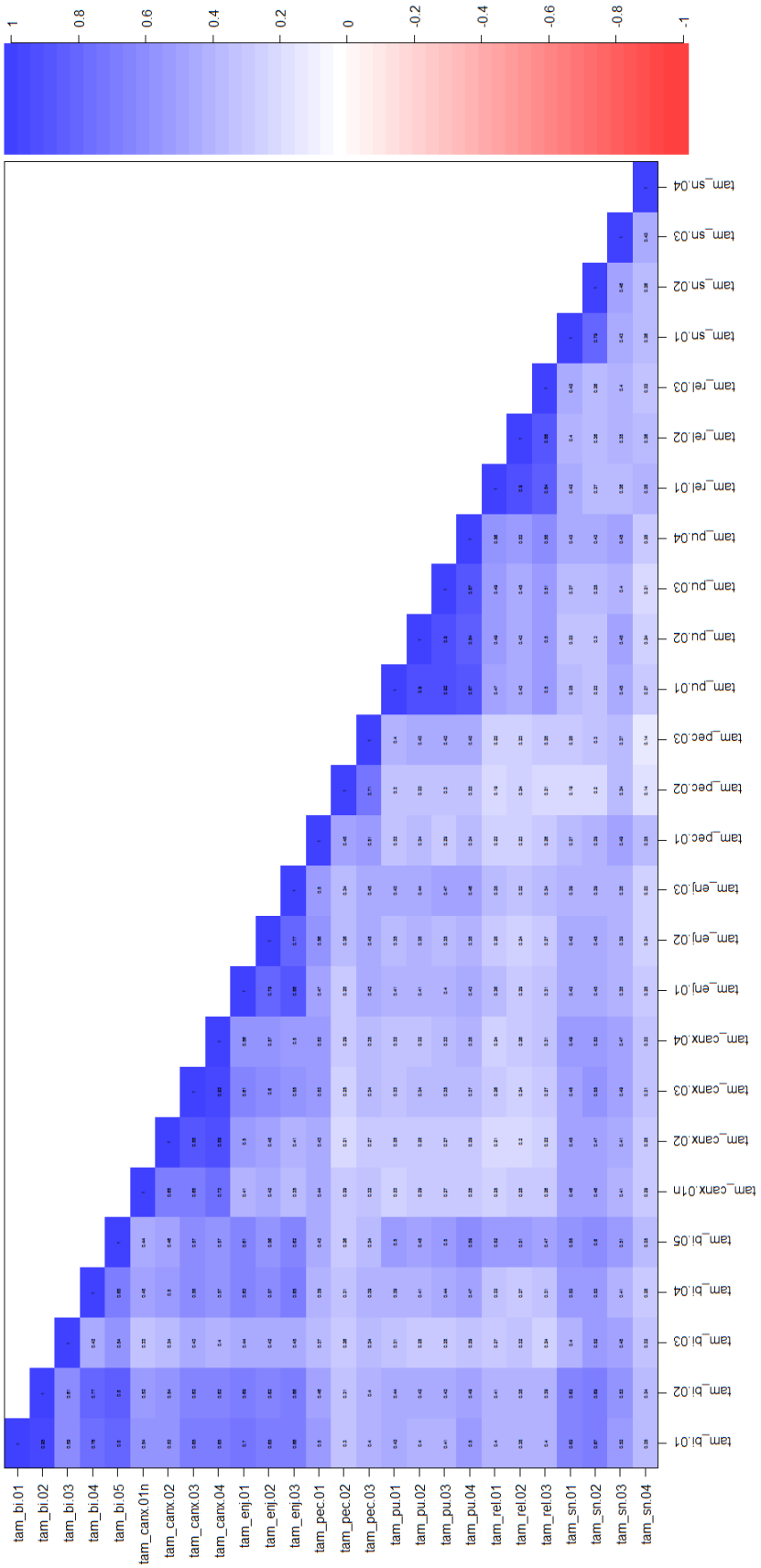
7.6 Appendix F

Correlation Plot of All TAM3 Items Posterior to Inversion



7.7 Appendix G

Correlation Plot of All TAM3 Items Posterior to Inversion and Deletion



7.8 Appendix H

Applied Packages and Versions of the Statistical Software R

```
> devtools::session_info()
- Session info -------------------------------------------
 setting  value
 version  R version 4.1.0 (2021-05-18)
 os       Windows 8.1 x64
 system   x86_64, mingw32
 ui       RStudio
 language (EN)
 collate  German_Germany.1252
 ctype    German_Germany.1252
 tz       Europe/Berlin
 date     2021-08-13

- Packages -----------------------------------------------
 package      * version    date       lib source
 abind          1.4-5      2016-07-21 [1] CRAN (R 4.1.0)
 afex           0.28-1     2021-01-12 [1] CRAN (R 4.1.0)
 assertthat     0.2.1      2019-03-21 [1] CRAN (R 4.1.0)
 backports      1.2.1      2020-12-09 [1] CRAN (R 4.1.0)
 boot           1.3-28     2021-05-03 [2] CRAN (R 4.1.0)
 broom        * 0.7.8      2021-06-24 [1] CRAN (R 4.1.0)
 cachem         1.0.5      2021-05-15 [1] CRAN (R 4.1.0)
 callr          3.7.0      2021-04-20 [1] CRAN (R 4.1.0)
 car            3.0-10     2020-09-29 [1] CRAN (R 4.1.0)
 carData        3.0-4      2020-05-22 [1] CRAN (R 4.1.0)
 cellranger     1.1.0      2016-07-27 [1] CRAN (R 4.1.0)
 checkmate      2.0.0      2020-02-06 [1] CRAN (R 4.1.0)
 cli            2.5.0      2021-04-26 [1] CRAN (R 4.1.0)
 coda           0.19-4     2020-09-30 [1] CRAN (R 4.1.0)
 colorspace     2.0-1      2021-05-04 [1] CRAN (R 4.1.0)
 crayon         1.4.1      2021-02-08 [1] CRAN (R 4.1.0)
 curl           4.3.1      2021-04-30 [1] CRAN (R 4.1.0)
 data.table     1.14.0     2021-02-21 [1] CRAN (R 4.1.0)
 DBI            1.1.1      2021-01-15 [1] CRAN (R 4.1.0)
 dbplyr         2.1.1      2021-04-06 [1] CRAN (R 4.1.0)
 desc           1.3.0      2021-03-05 [1] CRAN (R 4.1.0)
 devtools       2.4.2      2021-06-07 [1] CRAN (R 4.1.0)
 digest         0.6.27     2020-10-24 [1] CRAN (R 4.1.0)
 dplyr        * 1.0.6      2021-05-05 [1] CRAN (R 4.1.0)
 ellipsis       0.3.2      2021-04-29 [1] CRAN (R 4.1.0)
 emmeans        1.6.2-1    2021-07-08 [1] CRAN (R 4.1.0)
 estimability   1.3        2018-02-11 [1] CRAN (R 4.1.0)
 fansi          0.5.0      2021-05-25 [1] CRAN (R 4.1.0)
 farver         2.1.0      2021-02-28 [1] CRAN (R 4.1.0)
 fastmap        1.1.0      2021-01-25 [1] CRAN (R 4.1.0)
 forcats      * 0.5.1      2021-01-27 [1] CRAN (R 4.1.0)
 foreign        0.8-81     2020-12-22 [2] CRAN (R 4.1.0)
 fs             1.5.0      2020-07-31 [1] CRAN (R 4.1.0)
 generics       0.1.0      2020-10-31 [1] CRAN (R 4.1.0)
 ggplot2      * 3.3.3      2020-12-30 [1] CRAN (R 4.1.0)
 ggpubr       * 0.4.0      2020-06-27 [1] CRAN (R 4.1.0)
 ggsignif       0.6.1      2021-02-23 [1] CRAN (R 4.1.0)
 glue           1.4.2      2020-08-27 [1] CRAN (R 4.1.0)
 gtable         0.3.0      2019-03-25 [1] CRAN (R 4.1.0)
 haven          2.4.1      2021-04-23 [1] CRAN (R 4.1.0)
 hms            1.1.0      2021-05-17 [1] CRAN (R 4.1.0)
```

```
htmlTable      2.2.1      2021-05-18 [1] CRAN (R 4.1.0)
htmltools      0.5.1.1    2021-01-22 [1] CRAN (R 4.1.0)
htmlwidgets    1.5.3      2020-12-10 [1] CRAN (R 4.1.0)
httr           1.4.2      2020-07-20 [1] CRAN (R 4.1.0)
igraph         1.2.6      2020-10-06 [1] CRAN (R 4.1.0)
jsonlite       1.7.2      2020-12-09 [1] CRAN (R 4.1.0)
knitr          1.33       2021-04-24 [1] CRAN (R 4.1.0)
labeling       0.4.2      2020-10-20 [1] CRAN (R 4.1.0)
lattice        0.20-44    2021-05-02 [1] CRAN (R 4.1.0)
lifecycle      1.0.0      2021-02-15 [1] CRAN (R 4.1.0)
lme4           1.1-27     2021-05-15 [1] CRAN (R 4.1.0)
lmerTest       3.1-3      2020-10-23 [1] CRAN (R 4.1.0)
lubridate      1.7.10     2021-02-26 [1] CRAN (R 4.1.0)
magrittr       2.0.1      2020-11-17 [1] CRAN (R 4.1.0)
MASS           7.3-54     2021-05-03 [2] CRAN (R 4.1.0)
Matrix         1.3-3      2021-05-04 [2] CRAN (R 4.1.0)
memoise        2.0.0      2021-01-26 [1] CRAN (R 4.1.0)
mgcv           1.8-35     2021-04-18 [2] CRAN (R 4.1.0)
minqa          1.2.4      2014-10-09 [1] CRAN (R 4.1.0)
mnormt         2.0.2      2020-09-01 [1] CRAN (R 4.1.0)
modelr         0.1.8      2020-05-19 [1] CRAN (R 4.1.0)
munsell        0.5.0      2018-06-12 [1] CRAN (R 4.1.0)
mvtnorm        1.1-2      2021-06-07 [1] CRAN (R 4.1.0)
nlme           3.1-152    2021-02-04 [2] CRAN (R 4.1.0)
nloptr         1.2.2.2    2020-07-02 [1] CRAN (R 4.1.0)
numDeriv       2016.8-1.1 2019-06-06 [1] CRAN (R 4.1.0)
openxlsx       4.2.3      2020-10-27 [1] CRAN (R 4.1.0)
pillar         1.6.1      2021-05-16 [1] CRAN (R 4.1.0)
pkgbuild       1.2.0      2020-12-15 [1] CRAN (R 4.1.0)
pkgconfig      2.0.3      2019-09-22 [1] CRAN (R 4.1.0)
pkgload        1.2.1      2021-04-06 [1] CRAN (R 4.1.0)
plyr           1.8.6      2020-03-03 [1] CRAN (R 4.1.0)
polynom        1.4-0      2019-03-22 [1] CRAN (R 4.1.0)
prettyunits    1.1.1      2020-01-24 [1] CRAN (R 4.1.0)
processx       3.5.2      2021-04-30 [1] CRAN (R 4.1.0)
ps             1.6.0      2021-02-28 [1] CRAN (R 4.1.0)
psych        * 2.1.3      2021-03-27 [1] CRAN (R 4.1.0)
purrr        * 0.3.4      2020-04-17 [1] CRAN (R 4.1.0)
R6             2.5.0      2020-10-28 [1] CRAN (R 4.1.0)
Rcpp           1.0.6      2021-01-15 [1] CRAN (R 4.1.0)
readr        * 1.4.0      2020-10-05 [1] CRAN (R 4.1.0)
readxl       * 1.3.1      2019-03-13 [1] CRAN (R 4.1.0)
remotes        2.4.0      2021-06-02 [1] CRAN (R 4.1.0)
reprex         2.0.0      2021-04-02 [1] CRAN (R 4.1.0)
reshape2       1.4.4      2020-04-09 [1] CRAN (R 4.1.0)
rio            0.5.26     2021-03-01 [1] CRAN (R 4.1.0)
rlang          0.4.11     2021-04-30 [1] CRAN (R 4.1.0)
rprojroot      2.0.2      2020-11-15 [1] CRAN (R 4.1.0)
rstatix      * 0.7.0      2021-02-13 [1] CRAN (R 4.1.0)
rstudioapi     0.13       2020-11-12 [1] CRAN (R 4.1.0)
rvest          1.0.0      2021-03-09 [1] CRAN (R 4.1.0)
scales         1.1.1      2020-05-11 [1] CRAN (R 4.1.0)
sessioninfo    1.1.1      2018-11-05 [1] CRAN (R 4.1.0)
stargazer      5.2.2      2018-05-30 [1] CRAN (R 4.1.0)
stringi        1.6.1      2021-05-10 [1] CRAN (R 4.1.0)
stringr      * 1.4.0      2019-02-10 [1] CRAN (R 4.1.0)
tableHTML    * 2.1.0      2021-03-21 [1] CRAN (R 4.1.0)
testthat       3.0.4      2021-07-01 [1] CRAN (R 4.1.0)
tibble       * 3.1.2      2021-05-16 [1] CRAN (R 4.1.0)
tidyr        * 1.1.3      2021-03-03 [1] CRAN (R 4.1.0)
tidyselect     1.1.1      2021-04-30 [1] CRAN (R 4.1.0)
tidyverse    * 1.3.1      2021-04-15 [1] CRAN (R 4.1.0)
tmvnsim        1.0-2      2016-12-15 [1] CRAN (R 4.1.0)
usethis        2.0.1      2021-02-10 [1] CRAN (R 4.1.0)
utf8           1.2.1      2021-03-12 [1] CRAN (R 4.1.0)
vctrs          0.3.8      2021-04-29 [1] CRAN (R 4.1.0)
withr          2.4.2      2021-04-18 [1] CRAN (R 4.1.0)
xfun           0.23       2021-05-15 [1] CRAN (R 4.1.0)
xml2           1.3.2      2020-04-23 [1] CRAN (R 4.1.0)
xtable         1.8-4      2019-04-21 [1] CRAN (R 4.1.0)
zip            2.2.0      2021-05-31 [1] CRAN (R 4.1.0)
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