Shared Mental Models for Better Virtual Collaboration

Is there Potential for Adaptation?

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Abstract. *Background and Relevance*: Virtual and hybrid work redefine expectations for video meeting systems (VMS), which should enable seamless collaboration. Users of VMS face challenges such as reduced engagement, lack of trust, and inefficient coordination. Further, virtual teams in organizational settings are regularly confronted with social dilemmas, where personal goals conflict with collective objectives. In these situations an individual's Social Value Orientation (SVO) has shown to significantly influence decision-making and team behavior. Unlike face-to-face interactions, trust-building processes are less explicit in virtual environments. To address this, we propose two intervention elements to strengthen the teamwork-related Shared Mental Model (SMM) of virtual teams.

Proposal and Methods: We introduce a graphical recall of personality by examining the relationship between the SVO Slider Measure and low-order constructs of the Portrait Values Questionnaire (PVQ) with 42 students. Additionally, we propose the Mental Contrasting for Collaboration Rules (MCCR) method, which applies a Socratic approach to foster a collaborative mindset via mental contrasting, tested in a preliminary think-aloud study with six researchers.

Results and Discussion: Our findings identify six PVQ constructs (achievement, power-resources, face, universalism-concern, universalism-tolerance, and conformity-rules) that are suitable for enhancing transparency about trustworthiness, but also raise discussions about Schwartz's conceptual distinction into personal-focus and social-focus. Moreover, while MCCR was perceived as useful, further iterations are needed to improve comprehensibility.

Future Work: We will refine the intervention elements and conduct a controlled laboratory experiment to assess their impact in social dilemmas (e.g., Weakest Link Game) and their effectiveness in improving team coordination across different team compositions.

Keywords: Virtual Meeting Systems, Goal Alignment, Adaptive Systems, Team composition, Social Value Orientation, Mental Contrasting, Portrait Values Questionnaire, Shared Mental Models

1 INTRODUCTION

Effective collaborative processes are pivotal for organizational success, particularly in the post-pandemic era, where virtual work structures have become the new norm. However, users of *video meeting systems* (VMS) face several challenges such as a lack of engagement, reduced accountability, trust, and productivity, among others, as summarized in a literature survey by Morrison-Smith & Ruiz 2020 [24]. These challenges often arise from a lack of contextual information, highlighting the need for advancing VMS designs that (i) consider the users' context and (ii) support individuals in collaborating and functioning effectively as a team.

In organizational collaboration, individuals who come together to operate as a team often experience conflicts in mixed-motive situations, because they pursue multiple goals [1]. For instance, team members may prioritize projects that enhance personal reputation over those that benefit the organization as a whole. These conflicts arising between short-term self-interest and long-term collective interest, and can be viewed as *social dilemmas* [49]. Such situations frequently leading to suboptimal decision-making and according to Bogart et al. 2008 [7] are driven by an individual's stable social behavior preference, the *Social Value Orientation* (SVO) [22]. In such situations, team members may deliberately withhold information [50] or face *coordination failures* [35], hindering the team from effectively synchronizing its activities and efforts to achieve a common goal.

The larger scope of this project is to address these challenges of organizational virtual collaboration. Since the context (e.g. team composition, corporate culture, incentives) influences our cooperative behavior, and static video meeting systems are not suited to consider the collaboration context, we orient to the conceptualization of adaptive systems [4]: systems that intelligently adjust their behavior or configuration based on real-time feedback from both the environment and user inputs. For this purpose, we plan to model a social dilemma situation with the *Weakest Link Game* (WLG) [8] to test whether different adaptive VMS elements, which intervene in virtual meetings when teams struggle to reach consensus, contribute to better collaboration depending on the teams' overall SVO.

To this end, in this work in progress paper, we propose two adaptation strategies for VMS based on literature. With the goal to enhance virtual collaboration, we extended the theoretical model by Bogeart et al. 2008 [7] with normative influence [2] as additional contextual factor and argued, that these moderators are suited to address the teams' shared understanding of teamwork, which can be referred to as teamwork-related *Shared Mental Model* (SMM) [12, 21, 47, 44].

RQ1: Based on which strategies should VMS adapt to support collaboration in teams with heterogeneous SVO?

We suggest, based on theory as presented in Section Two of this paper, that adaptive VMS elements should target the individuals' collaborative goals and expectations of others. To archive this we designed elements that either recall an

existing collaborative SMM or alternatively align the team to a new collaborative SMM. The developed adaptive elements are presented in detail in Section Three of this paper.

The first element recalls personality characteristics with a graphical visualization to signal trustworthiness. In order to display meaningful personal values in the context of collaboration, we conducted an online study with 42 participants to reveal the distribution of Schwartz's [43] personal value constructs in the population and their relation to SVO by Murphy et al. 2011 [27].

RQ2: Which six personal values are most suited to be recalled in a graphical visualization, to provide insights into teams' trustworthiness?

The second element we designed is an adaptation of the goal-pursuit method *Mental Contrasting with Implementation Intentions* (MCII) [18] for virtual teams. We leverage the underlying technique of goal pursuit via mental imagery to create a shared understanding of social norms with regard to collaboration [25, 16]. The team formulates together rules for normative behavior (*collaboration rules* (CR)) to foster agreement with this new collaborative SMM. To test whether the novel method *Mental Contrasting for Collaboration Rules* (MCCR) works as expected we tested a preliminary version with six fellow researchers in a think-aloud approach [45].

RQ3: Does employing the MCCR lead to a shared collaborative goal?

We present the methods in Section Four and the results in Section Five of these two investigations. Afterwards we point out in the discussion, Section Six, the personal values we believe are most suited for signaling trustworthiness, but also highlight that the distinction of these values by Schwartz et al. 2013 [39] into personal-focus and social-focus needs more validation. Further, we conclude that the overall conceptualization of the MCCR is promising, but that the design needs more iterations of adjusting and piloting before applying the method to a larger sample.

2 THEORETICAL BACKGROUND

In social dilemma situations [49], according to Bogaert et al. 2008 [7], an individual's inclination for cooperation includes the general (un)willingness to cooperate and the general expectations of others' behavior. Further, it depends on an individual's SVO, an individual's fundamental and stable personality trait of social behavior tendencies [22]. Applying the Goal-Expectation-Theory [31], the relationship between an individual's SVO and an individual's cooperative behavior is mediated by his cooperative goal (Figure 1 arrow 1) and his expectations of others' cooperative behavior (Figure 1 arrow 2). Further, according to the model by Bogert et al., which we extended for our research in Figure 1 (additions in blue), the context moderates the goal and the expectations. It is hence suggested in the original model, that an incentive to cooperate moderates

the context-specific cooperative goal (Figure 1 arrow 4) and a signal of trustworthiness moderates the context-specific expectations of reciprocity (Figure 1 arrow 3).

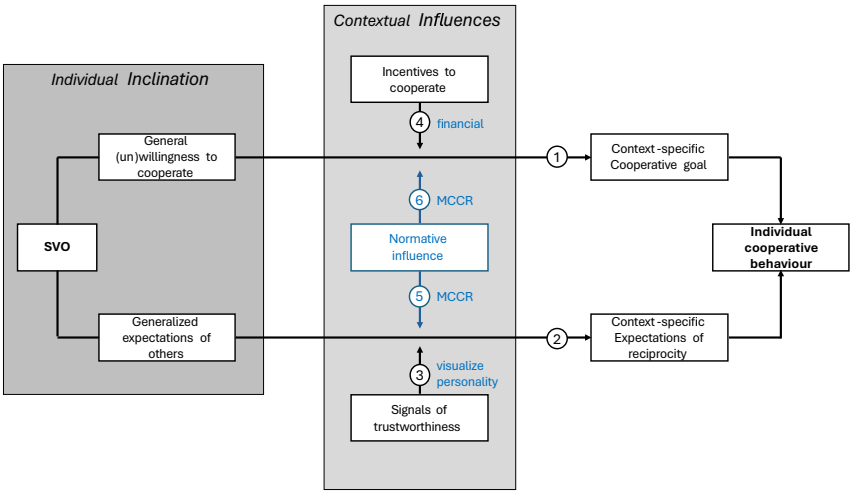

Fig. 1. original theoretical model by Bogaert et al. 2008 [7] in black and white. Extension for virtual collaboration and adaptive VMS in blue.

Prior studies of social dilemma situations leveraged the WLG, where individuals work as a team to decide on how many hours in a work-week should be allocated to their own projects versus a team project, have investigated how manipulating financial incentives affect the individuals collaborative behavior. Brandts et al. [8] found on the one hand that increasing the financial incentive increases cooperative behavior, and that the effect sustains in the same team to a certain degree, when the higher financial incentive is taken away again. On the other hand the authors demonstrated that with pure financial incentives the coordination failure [35] is not too overcome. With regard to the model (Figure 1) this means that altering only the context specific expectations with (financial) incentives (arrow 4) is not sufficient to guarantee collaboration. Therefore more nuanced considerations and further research is necessary.

An other study has revealed [33] that when teams come together with complete freedom in choosing their members, coordination failures are minimal in the WLG - even leading to fully efficient coordination. Based on that, we expect in the context of the theoretical model, that teams that come together on their own free choice, choose a context where they have a cooperative goal and expect others to cooperate. In organizational collaboration, however, individuals typically cannot select their team members and often come together in temporary

virtual teams where they have to build trust and a collaborative goals before becoming a team.

In virtual environments are team-forming processes are limited, because trustworthiness which is according to signaling theory [11, 32] often communicated by non-verbal cues such as gesture, body language, subtle voice inflection or facial expression, providing valuable personal context, is easily overlooked. For this reason Morrison et al. 2020 [24] recommend that VMS should be explicitly designed to assist in the development of trust. The authors also give the design recommendation that VMS should support building a sense of shared goals and expectations - since having a common ground (e.g. vocabulary, mental models) - makes collaboration in virtual teams easier. This is in line with other design recommendations for VMS, pointing out that such systems should allow for the development of SMMs because they are harder to build in virtual teams [21] and also differ from those in face-to-face collaboration [36]. Further, such teamwork-related SMMs are positively associated with virtual team effectiveness [24] and significantly influence team processes and performance [20]. In conclusion, more explicitly recognizable signals of trustworthiness (Figure 1 arrow 3), showing the team members' personality, are needed in VMS to build collaborative SMMs.

Turning back to the SVO, due to individuals' differing levels of SVO, based on the composition of its team members, a teams' SVO differs. We expect that collaboration could be increased in more pro-social oriented teams by visualizing the team's SMM, to build trust due to transparency, altering the context-specific expectations of reciprocity [7]. However, visualizing personality in more pro-self oriented teams may also alter the expectations of reciprocity, but not in a way that contributes to better collaboration.

These prior works point in the direction that VMS need to be equipped with different adaptive strategies to target the SMMs within a team depending of the team's SVO. As stated above, for pro-social teams we intend to build intervention elements that signal trustworthiness more explicitly. But is the team predominantly pro self, we intend to give a context-specific collaborative goal extrinsically and design an adaptive element the way that it accounts for (i) supporting the individual in pursuing an extrinsically given collaborative goal (Figure 1 arrow 6) and (ii) shaping the individual's context-specific expectations of reciprocity (Figure 1 arrow 5) in a positive way.

To define and pursue the cooperative goal we leverage the underling technique of *Mental Contrasting with Implementation Intentions* (MCII) [18], combining mental contrasting [46, 29] for goal setting with goal striving [14]. To adapt this method for teams and to address the individual's context-specific expectations of reciprocity, instead of if-then-plans, we utilize rules, in this paper referred to as *Collaboration Rules* (CR), to build commitment with the collaborative goal and the team. The CR are expected to induce social norms within the team to enhance collaborative behavior [5, 25, 16], leveraging the theory of normative social behavior [34, 13].

3 PROPOSED ADAPTIVE INTERVENTION ELEMENTS

3.1 Personal Values as Signals of Trustworthiness

According to signaling theory [11, 32], non-verbal communication - often less explicitly recognizable in video meetings - plays a crucial role in building trust [17], which is necessary for a positive expectation of reciprocity [7]. In the intervention element design to signal trustworthiness (represented as arrow 3 in Figure 1), we artificially model personality by displaying individuals' personal values that are strongly associated with SVO. By creating transparency between team members, these personality values are expected to influence the expectations and strategies formed within the teams [7].

Graph-based visualizations have proven to be useful in visualizing multi-criteria information, such as varying preferences or information about team members [23]. To signal transparency and foster trust in more pro-social teams, we propose a design of a spider graph visualization, displaying six personality values and representing the shared understanding due to two graphs, one showing the own personality values and one the averaged personality values of the team members. With three personality values within the graph that represent a pro-social orientation and three personality values that represent a pro-self orientation, the individual will receive information about their team members, and indirectly, a signal whether the team is expected to behave cooperatively or not (see Figure 2).

A well-established construct of personality values (see Figure 2 and Appendix, Table 4), measured indirectly through portraits (descriptions) of fictitious persons, is provided by the refined version of the *Portrait Values Questionnaire* (PVQ) [43], which has been validated with a large sample across several cultural groups and in a variety of countries [42]. Schwartz showed the relation of the personal values he originally introduced [38] with individuals' social- and personal-focus [40, 41], as well as the relation to behavior in the dictator game [37]. A growing body of research emerges to reveal the relation of personal values and behavior in different settings. Recent work by Nezlek 2024 [28] showed in a sample of 1655 participants that the personal values *Benevolence*, *Universalism*, and *Conformity* are related to pro-social SVO and *Hedonism*, *Achievement*, and *Power* are related to pro-self SVO. However, as in Nezlek 2024 [28], the research is mainly dominated by the earlier 21 item version of the PVQ [39] and/or SVO-measurements that only allow for categorical distinction into competitor, individualist, and pro-socials [48].

An alternative approach to measure the SVO, which is more suitable for research focusing on the SVO-level within a team, is provided by the slider-measure [27, 26], allowing to express the SVO as an angle (from -16.26° to 61.39°) in a continuous manner. Some preliminary evidence indicates that the high-level construct *Self-Transcendence* of the refined PVQ version is strongly correlated with this SVO-angle [15].

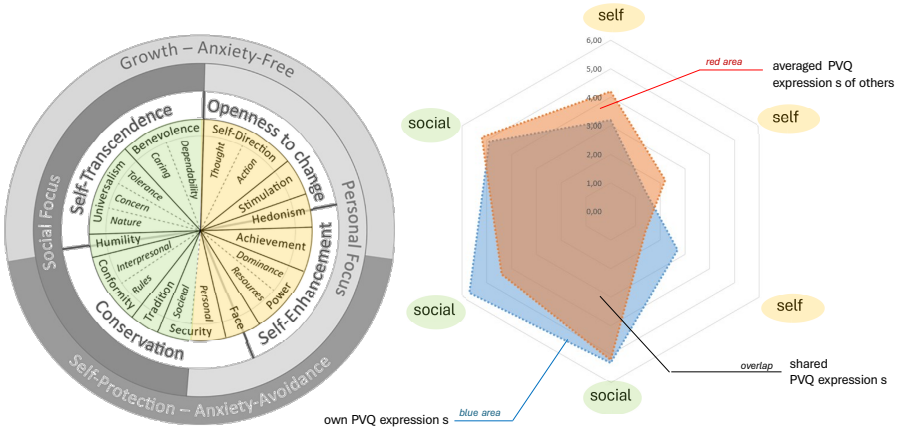

Fig. 2. The left side shows Schwartz's Portrait Values in the theoretical construct of Social Focus and Personal Focus [43]. The right side visualizes the planned Spider Graph with placeholders for pro-self and pro-social personality values as signal of trustworthiness.

However, to the best of our knowledge, a link between the low-order personal values of the refined PVQ and the SVO slider-measure has not yet been studied or reported. To select three pro-social and three pro-self personality characteristics for the spider-graph signaling trustworthiness, we investigate in a pilot study the relation of SVO-angle and low-order PVQ constructs, as well as the distribution of these values in the population. In Section Four, we outline the design of the pilot study conducted to evaluate and understand this relationship. In Section Six, we outline which six low-order PVQ constructs are most suitable for the design of intervention elements.

3.2 Mental Contrasting for Collaboration Rules

The original goal pursuit technique MCII by Kirk et al. 2013 [18] is a combination of the goal setting technique mental contrasting [29] and goal striving via if-then-plans [14], to empower individuals to reach their goals leveraging the method of mental imagery [46].

Mental Contrasting [29] typically works by having an individual formulate a wish, a desired future or goal that the person would like to achieve, and then asking the individual to imagine it as vividly as possible. By thinking about the best possible outcome, which would be experienced upon achieving the desired goal, and visualizing it clearly in the mind's eye, it becomes easier to identify potential obstacles. Once the obstacles are clear, picturing them enables the individual to play through various possible courses of action, thus helping to

decide whether or not the desired goal is worth the necessary effort to overcome the foreseen challenges.

However, using this technique only allows to set a desired goal, leaving individuals with the opportunity to drop the goal. When an individual decides at this point to strive for the goal, it makes sense to combine also goal striving strategies such as if-then-plans with mental imagery, leading to higher levels of goal commitment [18]. To integrate these two techniques, the if-then plans are also imagined in the MCII, creating a process that consists of four phases: **W**ish, **O**utcome, **O**bstacle and **P**lan, making this technique more commonly known as WOOP[1].

All four phases of the WOOP consist of two logical steps. In the first step, the decision-maker starts to think of something (a Wish, Outcome, Obstracle or Plan) and formulates it. In the second step, he/she imagines what was formulated in the first step. Visualizing as vividly as possible in the mind's eye helps transition to the next phase or, at the end of the method, to take action. In order to move this technique from an individual level to a team level, we retain the thinking and imagery step, but extend each phase with an additional step, in which the team gains a shared understanding due to communication and builds common ground before entering the next phase.

To utilize this method as an intervention element for VMSs that account for both, a cooperative goal (Fig 1 arrow 6) of each individual within a team, and expectations that team members will behave cooperatively (Fig 1 arrow 5), we give the goal to follow cooperative norms (a collaborative goal) extrinsically. Next, we use the extended outcome phase to build a shared understanding of benefits that arise in a team following such collaborative norms. In addition, we use the extended obstacle phase to make the team identify together what hinders them from becoming such an efficient team. Finally, we leverage CR in the same three step-technique of the other phases to build trust within the team, that everyone will behave cooperatively. A conceptual overview of the proposed method is provided in Figure 3.

The intervention element will be applied via an audio track, guiding the team step by step in a *socratic approach* [6] through the phases of MCCR. The thinking and mental imagery steps in each phase occur at the individual level, so the VMS disables audio and video functionality accordingly. The thinking step will be also supported by a text box, allowing for individual note-taking. The communication step of each phase happens on the team level, where the VMS enables audio and video communication. This way the team gains a shared understanding at the end of each phase, providing common ground for the next phase in the sequence. Figure 4 presents a mockup illustrating the thinking and communication step of the planned VMS intervention element.

In future work we plan to apply the MCCR in a video meeting prior to the WLG. To create in the meeting an unrelated social dilemma in which the team develops a collaborative goal and builds generic collaboration rules, the participants will be confronted with a fictitious holiday together, despite having

[1] https://woopmylife.org/en/home

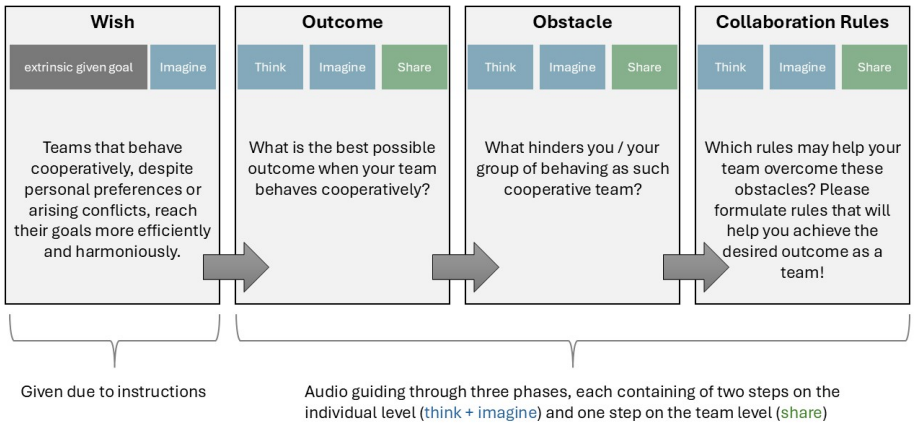

Fig. 3. Conceptual model of the MCCR

differing holiday preferences. The audio track was generated with an open-source online AI voice generator[2] and considered the pauses for thinking, imagining and communication in each phase.

The time needed to read the instructions as well as the time for each pause of the 8-minute-lasting audio intervention is provided in Table 1. We measured the time the AI voice needed to read each instruction to account for equal distribution of the pauses. Subtracting the 96 seconds which are needed for all instructions of the 8 minutes leaves 384 seconds. Therefore, 128 seconds could be allocated for the steps in each phase (outcome, obstacle, collaboration rule). In order to decide how many seconds we should allocate to each step (thinking, imagining, communicating), we oriented at timings used for a just-in-time adaptive mental contrasting intervention [3], indicating that the imagining phase should be longer than the thinking phase. To give participants as much time as possible to talk to each other and share what they experienced in the previous steps, we allocated 20 seconds to the thinking step, 30 seconds to the imagining step, and 78 seconds to the communication (sharing) step. A gong sound was added as a signal to conclude 5 seconds prior to the end of each step.

4 METHODS

4.1 Evaluating the relation of PVQ and SVO

We assessed SVO, with the 6-item Slider Measure [27, 26] and the PVQ with the refined 57-item version [43]. The questionnaires were implemented with the open-source python framework oTree [9] and the experiment was hosted on a local

[2] https://luvvoice.com/

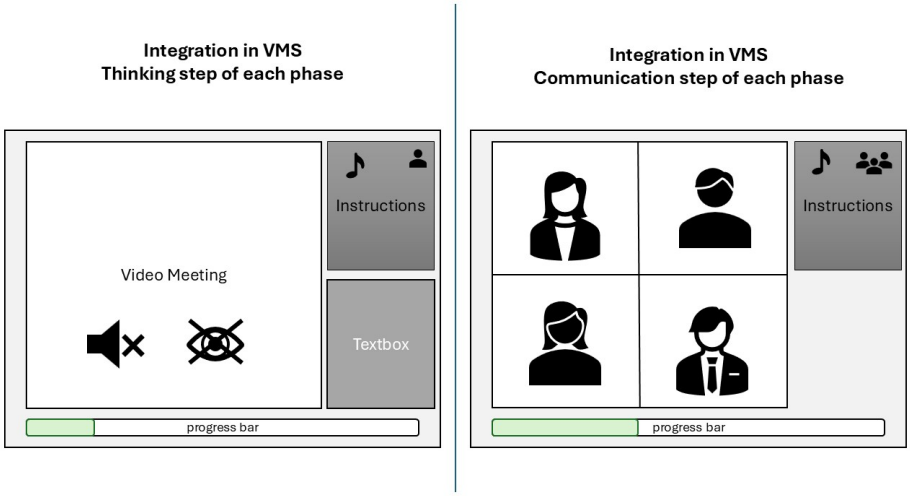

Fig. 4. Mockup of the VMS with the MCCR element in a thinking step (left) and a communication step (right) of any phase.

Phase	Thinking Instruction	Thinking Action	Imagining Instruction	Imagining Action	Sharing Instruction	Sharing Action
Outcome	11	20	11	30	7	78
Obstacle	8	20	13	30	11	78
Rule	17	20	11	30	7	78

Table 1. Durations in seconds needed to read out the instructions for each step (Thinking, Imagining, Sharing) across the three phases (Outcome, Obstacle, Rules) of the MCCR audio guide, and for taking action after each instruction.

server. The link was shared with students in business and information systems lectures and to students from Germany or United Kingdom via Prolific[3], an online platform for recruiting research participants.

Overall 70 students completed the questionnaires, but 25 failed the attention checks. Additionally, three participants were excluded as outliers based on the age demographic. With this, the sample constitutes 42 students (21 females; mean age 25.31 $\pm$ 4.65 years) with a native level of English skill. Participants were paid out a standard value of £10,62/hr on Prolific, scaled to the time taken to complete the survey. For the students from lectures, fixed payout was made equivalent to the value above.

We computed the SVO-angle and calculated the expression of each personal value as described in the related literature [27, 43]. Comparable to the procedure in Heilman & Kusev 2020 [15] we computed the Pearson correlation between the SVO-angle and each PVQ construct, but focused on the low-order constructs.

[3] https://www.prolific.com/

Further, we evaluated the distribution of the SVO-angle and the related categorical SVO-types in the population descriptively.

4.2 Piloting Mental Contrasting for Collaboration Rules

To avoid misleading instructions, in this pilot study, we tested the audio track of the MCCR in the context of the fictitious holiday together to see whether or not the method leads, as proposed, to generic rules and norms of social and collaborative behavior. To this end we provided to six fellow researchers (teams of three) mockups of differing holiday preferences (Figure 5), and asked them to imagine that they have agreed - despite their differing preferences - to a compromise and will be on a holiday together soon. Their task was to listen to the generated audio-file in a meeting and to follow the instructions as a team.

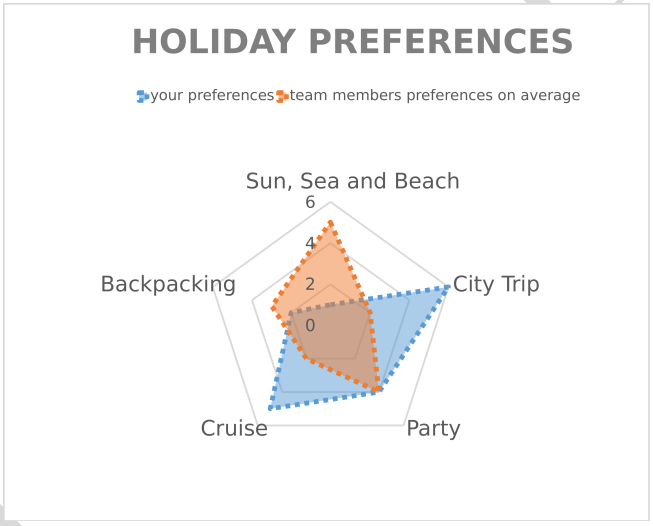

Fig. 5. Mockup of an exemplary spider graph that was shown during the tests of the MCCR. As shown, participants will see, prior to the video meeting, how their own preferences differ from and overlap with the average preferences of the team.

We used a think-aloud approach [45] to evaluate what the individuals thought, imagined and discussed in each phase of the MCCR. Participants took notes about what they thought in the first step of each phase and were observed in the discussion of the third step of each phase. To assess what they imagined, participants were asked afterwards to describe it a written manner. Further we asked them to rate the following 6-point Likert item (0 - not at all, 6 - very much): "When you are in a video meeting and the system detects tension hindering the team from reaching consensus, how much would you appreciate it

if the audio-guided method, Mental Contrasting for Collaboration Rules, intervened?". Finally, the experimenter questioned the participants about their behavior and experience during the task, while also providing an opportunity for unstructured feedback.

5 RESULTS

5.1 Distribution of SVO in the Population and the Relation to PVQ

In our sample of students (n=42), the SVO angle, theoretically ranging from -16.26° to 61.39° [27, 26], was between -14.26° and 43.19°, had a mean of 24.71° and a standard deviation of ±14.86°. Based on the thresholds, one out of 42 participants was classified as a competitor, with an SVO angle below -12.05°. Twelve participants had an SVO angle between -12.05° and 22.5° and were therefore classified as individualists. Twenty-nine pro-socials, with an SVO angle between 22.5° to 57.15°, representing with 69% the majority of the sample. There were no altruists in the sample, as no participants had an SVO angle greater than 57.15°. The distribution of the participants based on their SVO angle is shown as a boxplot in Fig 6.

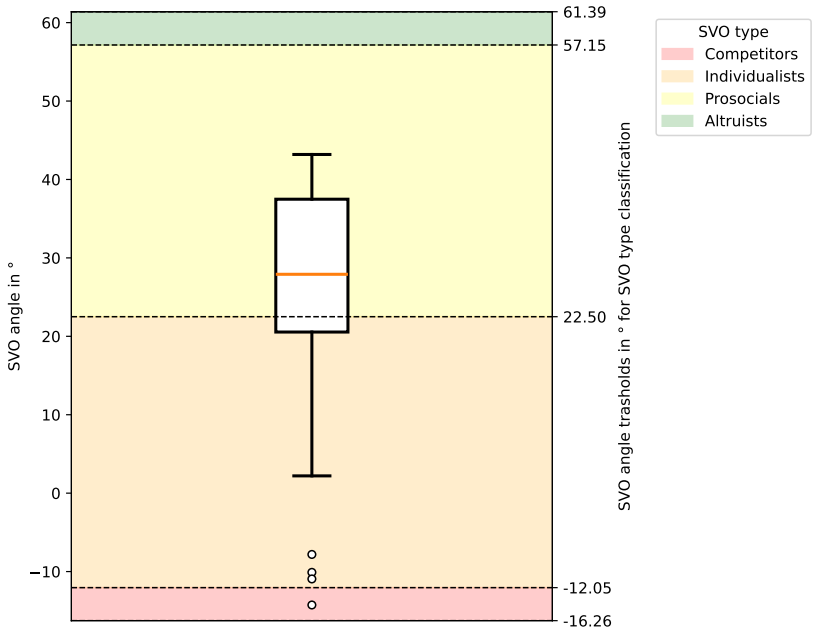

Fig. 6. The boxplot shows the distribution of the SVO angle [26] in a sample of 42 students from United Kingdom and Germany. Classification thresholds at -12.05°, 22.5°, and 57.15° are marked.

Out of the 19 low-level PVQ constructs, the 8 listed in Table 2 are associated with personal-focus. However, when ordered increasingly by Pearson's R correlation with the SVO angle, the bottom two show no negative correlation (r = 0.086, r = 0.008), and only the top four exhibit a weak ($0.1 \leq r < 0.3$) [10] negative correlation with the SVO angle. Among these, the only PVQ low-level construct negatively correlated with the SVO angle is achievement, which is close to the significance level (r = -0.291, p = 0.061).

PVQ: personal-focus	Mean	S.D.	Min	Max	Pearson-r	p-value
achievement	4.62	0.83	2.33	6.00	-0.291	0.061
power resources	3.67	1.09	1.67	5.67	-0.247	0.115
power dominance	3.33	1.08	1.00	5.67	-0.124	0.433
face	4.29	0.92	1.67	6.00	-0.109	0.493
self-direction thought	4.87	0.82	2.33	6.00	-0.052	0.744
hedonism	4.69	0.68	3.00	6.00	-0.042	0.790
self-direction action	5.03	0.70	3.67	6.00	0.008	0.959
security personal	4.75	0.83	3.00	6.00	0.086	0.588

Table 2. Pearson correlations of 8 PVQ personal-focus constructs and SVO. Descriptive values for the student sample (n = 42), Pearson correlation coefficients with the SVO angle and their p-values are shown.

The 11 low-level PVQ constructs listed in Table 3, sorted in descending order by their Pearson's r with the SVO angle, are theoretically related to social-focus. However, the bottom four constructs show negative correlations, while only the top four exhibit weak positive correlations (r = 0.137, r = 0.138, r = 0.152, r = 0.168), none of which are statistically significant.

PVQ: social-focus	Mean	S.D.	Min	Max	Pearson-r	p-value
universalism nature	4.22	1.24	1.00	6.00	0.168	0.287
universalism concern	4.98	0.82	3.33	6.00	0.152	0.335
universalism tolerance	4.71	0.77	2.67	6.00	0.138	0.384
conformity rules	4.11	1.22	1.33	6.00	0.137	0.386
conformity interpersonal	4.17	1.20	1.33	6.00	0.068	0.668
security societal	4.75	0.88	2.67	6.00	0.036	0.823
humility	4.10	0.95	2.00	6.0	0.018	0.908
benevolence dependability	4.98	0.61	3.67	6.00	-0.074	0.640
benevolence caring	5.06	0.72	2.67	6.00	-0.102	0.520
stimulation	4.33	0.93	2.00	6.00	-0.139	0.381
tradition	3.37	1.35	1.00	6.00	-0.149	0.347

Table 3. Pearson correlations of 11 PVQ social-focus constructs and SVO. Descriptive values for the student sample (n = 42), the Pearson correlation coefficients, the SVO angle and their p-values are shown.

Further, the correlation matrix (Fig 7) reveals significant medium ($0.3 \leq r < 0.5$) Spearman correlations for the ordinal SVO type with Achievement (r = -0.36, p = 0.019) and Power Resources (r = -0.45, p = 0.003). Additionally, the PVQ low-level constructs Conformity Interpersonal (r = 0.33, p = 0.034), Achievement (r = -0.32, p = 0.039), and Universalism Concern (r = 0.43, p = 0.005) are significantly related to age. Moreover, females show significantly higher concerns for safety and stability in the society at large in comparison to males (Security Societal with Gender: r = -0.43, p = 0.004).

Based on the results, the PVQ low-order personal-focus constructs *achievement*, *power resources*, *power dominance*, and *face* show the strongest negative correlations with the SVO angle. Given the small sample size, which likely contributes to the lack of statistically significant relationships between the PVQ constructs and the SVO angle, we also consider the Spearman correlations with the SVO types (r = -0.36, p = 0.019; r = -0.45, p = 0.003; r = -0.20, p = 0.203; r = -0.22, p = 0.156; r = -0.36, p = 0.019; r = -0.45, p = 0.003; r = -0.20, p = 0.203; r =- 0.22, p = 0.156). From this analysis, it becomes evident that *power dominance* is the least convincing construct of these four due to its higher p-values.

The PVQ low-order social-focus constructs with the strongest relationships to pro-social behavior are *universalism-nature*, *universalism-concern*, *universalism-tolerance*, and *conformity-rules*. However, their relationships with the continuous SVO angle, as well as their relationships with the ordinal SVO type (r = 0.13, p = 0.416; r = 0.17, p = 0.272; r = 0.20, p = 0.213; r = 0.20, p = 0.207; r = 0.13, p = 0.416; r = 0.17, p = 0.272; r = 0.20, p = 0.213; r = 0.20, p = 0.207), are less certain, as indicated by their p-values. Since *universalism-nature* describes characteristics that are not directly relevant to social interaction in an organizational setting, and its p-value for the SVO type is relatively high, we exclude this construct from further consideration for the recall treatment.

To balance the personal-focus and social-focus constructs, we also exclude *power dominance*. The selected PVQ constructs generally exhibit satisfactory inter-subject variance, which is necessary for modeling differing personalities artificially to signal (non-)cooperative behavioral intentions. To make these abstract constructs more explicit, we use the definitions of these values in the recall treatment, as shown in Figure 8.

5.2 Comprehension and perceived usability of MCCR

In contrast to our expectations, we observed that participants' discussions primarily revolved around their holiday preferences, leading to conversations about various places they could visit or activities they could do, rather than focusing on collaborative behavior during a hypothetical shared holiday. Due to a misunderstanding of the method's aim and the "outcomes" and "obstacles" discussed, participants appeared partially confused when formulating rules during the final phase. It also became clear during the observation that 20 seconds to think about something is a very limited amount of time, and that 78 seconds for a discussion was not sufficient, even for a group of three.

What we *observed* during the discussion was also reflected in the notes participants took during the thinking step. For example, for the best possible outcome they thought about "an enjoyable trip with lots of party" or "being in line with my team, with freedom for everyone to do anything they prefer to do", which made them think of obstacles such as "conflicting interest" and "everyone feeling obligated to compromise" or "conflicting locations and activities". This led them to thinking of rules like "discuss activities to match need of others" or "not be forced to compromise," and "respect the wishes and needs of others".

We further asked participants after the intervention to *reflect* what they imagined overall and formulate it as a note. The participants not only described "I imagined a holiday with nature and parties in the beginning" as the best possible outcome, but also imagined "seeing smiling faces and feeling comfortable". For obstacles, they described that "I imagined people with different routines for day and night and difficulties in doing activities together" and "someone would feel left out," or "the group can't decide what to do in particular." When the participants were asked to imagine what the holiday would be like if everyone followed the rules they thought of, they described "that felt good as it removed the tension" or "more harmonious; not ideal for everyone, but every one is generally satisfied". Moreover, some participants stated simply that "I imagined people doing activities separately and routines without being disappointed, and doing sometimes stuff together".

In the follow-up interviews, it became clear that the discussion focused on holiday preferences because the instructions were too complex and too long. For example, the sentence "Despite these differences, we would like you to imagine that three of you have found a compromise and will soon go on holiday together." was simply overlooked. Furthermore, the interviews revealed that the audio guidance instruction "Take some time to reflect individually and consider collaboration rules that could help your team overcome these challenges." did not necessarily make it clear to the participants what "collaboration rules" were meant. They also mentioned that the time for discussion was far too short, but that the 30 seconds to imagine something were more than they needed. In general, participants liked the gong which indicated, 5 seconds prior to the next instruction, the end of the current step. They mentioned that it helped them to conclude the current task and to mentally prepare for the next instruction, making it really valuable to navigate the intervention.

An additional Likert item (1 - not at all; 6 - very much), asking how much would participants appreciate if the MCCR intervened when a video meeting system detects tension that hinders the team in reaching consensus, was reported as follows: Mean = 4.2, S.D. = 0.4, n = 5 (One participant had to be omitted due to incomplete data).

6 DISCUSSION, LIMITATIONS AND FUTURE WORK

In this work, we set out to address the overarching research objective of designing adaptive intervention elements of VMS to foster collaboration in organizational

virtual teams. A major limitation in these settings are mixed-motive situations, in which the collaborative behavior is affected by the individual SVO (i.e. pro-self/pro-social). In the theory section we answered RQ1 and outlined that VMS should be equipped with two adaptation strategies, targeting the two mediators (i.e. general unwillingness to cooperate and generalized expectations of other) between SVO and collaborative behavior [7] in the context of the video meeting. Is the team predominantly pro-social orientated should the VMS support team building process by signaling trustworthiness, hence nonverbal cues that communicate such information are easily overseen in virtual environments. Are more pro-self tendencies within a virtual team the VMS should allow of building a common collaborative goal interactively. This way both strategies target the team's shared goals and expectations of collaboration, i.e. the teamwork-related SMM.

For this reason, we introduced in Section Three two adaptive elements which are planned to be applied in future work. To account for an adaptive element that explicitly signals trustworthiness, we plan to model personality artificially with a visualization of six personal values [37]. To account for shared collaborative goals and expectations, we utilize the technique of mental contrasting [30] to build CR in a socratic audio guidance.

In this work, we first investigated the distribution of SVO and the relation to low-order PVQ constructs in order to decide which values are most suited to display within the intervention element, creating transparency about the trustworthiness of teams. To this end, we conducted an online study with 42 students on Prolific, mimicking our target population for subsequent experiment designs. Based on our data, we confirm that using the Slider Measure [27, 26], which expresses the SVO as a continuous angle, provides more informative insights into participants' orientations compared to widely used ordinal measures (e.g., the Triple Dominance Measure [48] or the Ring Measure [19]). This is because most participants exhibit some degree of pro-socialness, as indicated by their classification into SVO types, but differ within each type in their prosocial tendencies. Our analyses further revealed that the values of *achievement, power-resources, and face* are related to pro-self SVO, and values of *universalism-concern, universalism-tolerance, and conformity-rules* to pro-social SVO. However, we found no significant correlations, which may be due to the relative small sample size, but raises the question whether the conceptual distinction of PVQ values into personal focus and social focus [37–43] is valid. Nevertheless, taking together the relation tendencies, the descriptions of the PVQ values (Tab. 4, Appendix), and their distributions in the population, these six personality constructs seem most suited to be recalled in a graphical visualizations to give insights about the teams' trustworthiness (RQ2). To guarantee of a shared understanding of these values, it is planned to provide in the final intervention element a hover functionality, displaying the explicit explanations (see Tab. 4, Appendix) of these values. For further design iterations, we also plan to derive motives that individuals may have in virtual collaboration from Schwartz's established personality constructs.

Comparing our results with existing work by Heilman & Kusev 2020 [15] conducted on 63 participants, the authors found a significant relationship for the high-level construct "Self-Transcendence" (composed by the constructs benevolence and universalism) with SVO-angle. However, our data showed only weak correlations of the SVO-angle with benevolence attributes. The differences in these results could be due to differences in the sample: whereas our study was conducted with students, and the compared study [15] predominantly examined working professionals. The positive association of the high-order construct *Self-Transcendence* in the older population could also be driven by the significant relationship between its component *universalism-nature* and age (see Figure 7, Appendix). These results also point to a bias in making generalizations regarding the correlations between SVO and PVQ for different population groups, warranting further research.

Second, we introduced and examined a novel design intervention (MCCR) - an audio guided method to facilitate collaborative goals in mixed-motive teams and align them to this goal. By means of pen-and-paper think-aloud protocols, we tested comprehensibility and perceived usability of the audio-guidance. Our results showed that designing a goal alignment intervention such as the MCCR needs to be highly nuanced in communicating the expected team task (i.e. developing a common collaborative attitude) as well as the intervention goals (i.e. formulating collaboration rules). The observation of the participants as well as the feedback revealed that the duration of the imagining step in each phase could probably shortened. Even though the participants wished for more time in the thinking phase, we believe that this may be due to hand-note taking. Given the observed shortage of time during the communication steps, these should be extended. In general, the findings from the pilot do not support RQ3, which posits that the MCCR in its current version leads to a shared collaborative goal. The intervention element needs further iterations of optimizing and piloting, before applying it to a more comprehensive study. In our next design iterations, we will separate the intervention element more clearly from the Holiday Conflict. However, despite the comprehensibility limitations, participants perceived the concept of MCCR as being useful for an intervention in a video meeting system, thus providing merit in the utility of this method as a whole.

7 CONTRIBUTION AND CONCLUSION

In this work, we detail interventions for adaptive design in video meetings to foster team collaboration. Future work will examine the efficacy of these interventions on collaboration outcomes in social dilemma tasks - to inform whether 1) the design interventions of recalling personal values and goal alignment process of MCCR is effective for overall collaboration and 2) whether the efficacy of these interventions is dependent on the team composition with respect to their social value orientations (i.e. pro-self vs. pro-others orientation). With our work, we aim to make the following contributions: 1) inform practitioners and system designers of virtual meetings about design processes for collaborative

systems for team work 2) establish the theoretical relationship between SVO, interplay of contextual influences - such as incentives, signals of trustworthiness, and goal alignment - on cooperative behavior in virtual meeting systems and 3) inform researchers on the effectiveness of adaptive designs for team collaboration in general, as well as based on team compositions - such as the SVO - in mixed-motive decision contexts. By examining the effectiveness of adaptive design interventions in virtual meetings, we aim to draw insights for researchers and practitioners, to effectively achieve goals of computer-supported collaborative work in an increasing digital space.

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9 Appendix

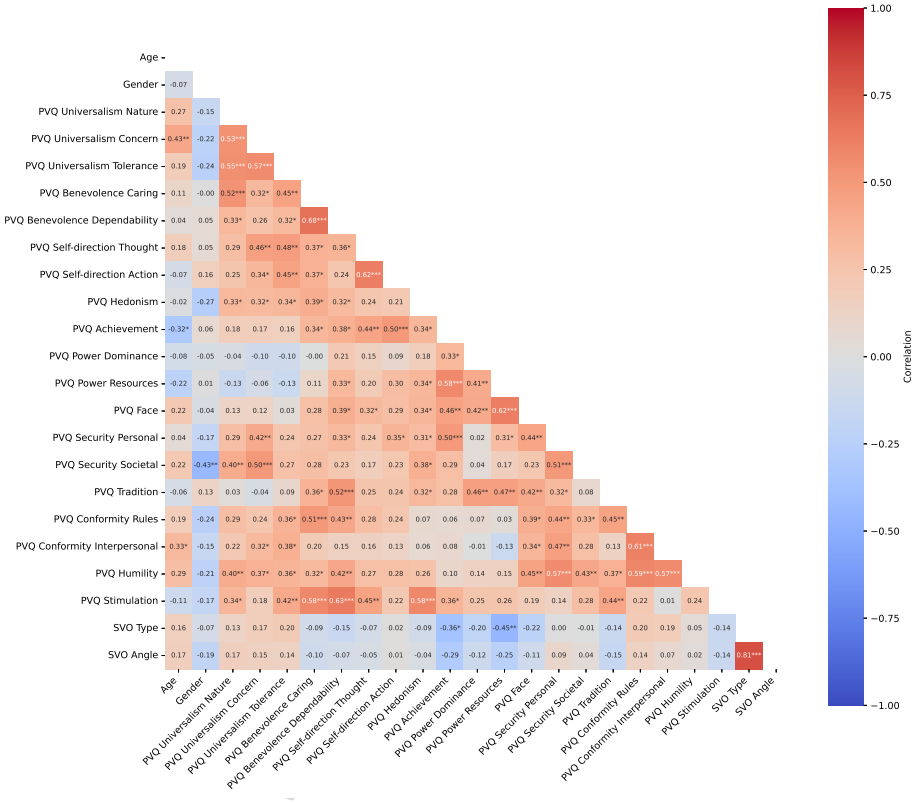

Fig. 7. A correlation plot visualizing the Pearson correlations of age, gender (female: 0, male: 1), and SVO angle with the PVQ low-order constructs, as well as their intercorrelations. Additionally, the Spearman correlations of the SVO types (0: competitors, 1: individualists, 2: pro-socials, 3: altruists) are shown. The heatmap color-codes the squares based on the direction and strength of the correlation: blue intensity represents negative correlations ($0 > r > -1$), and red intensity represents positive correlations ($0 < r < 1$). The r-values are shown inside the squares, and significant correlations are indicated by asterisks (* $p \leq 0.05$, ** $p \leq 0.01$, *** $p \leq 0.001$). Correlation plots visualizing the relations of the PVQ high-order and mid-order constructs are in the appendix: Figure 9 and Figure 10

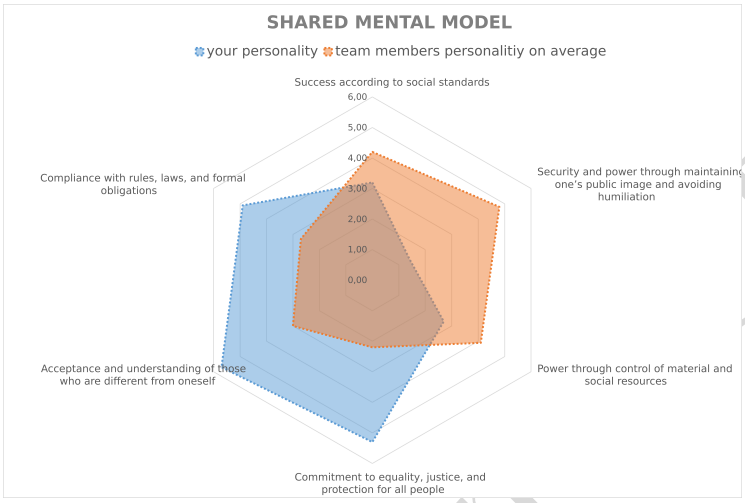

Fig. 8. Mockup of proposed portrait values for the recall treatment

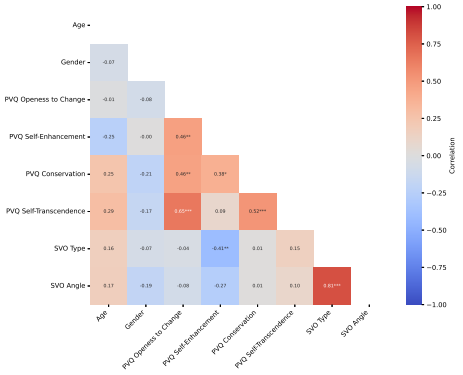

Fig. 9. Correlations of PVQ high-order constructs with SVO type and SVO angle

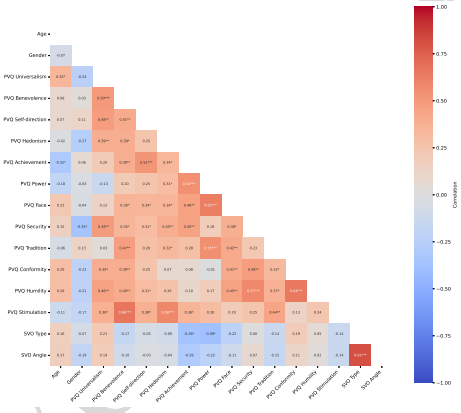

Fig. 10. Correlations of PVQ mid-order constructs with SVO type and SVO angle

Higher-order construct	Low-order construct	Conceptual Definitions
Openness to change	Self-direction–thought	Freedom to cultivate one's own ideas and abilities
	Self-direction–action	Freedom to determine one's own actions
	Stimulation	Excitement, novelty, and change
	Hedonism	Pleasure and sensuous gratification
Self-Enhancement	Achievement	Success according to social standards
	Power–dominance	Power through exercising control over people
	Power–resources	Power through control of material and social resources
	Face	Security and power through maintaining one's public image and avoiding humiliation
Conservation	Security–personal	Safety in one's immediate environment
	Security–societal	Safety and stability in the wider society
	Tradition	Maintaining and preserving cultural, family, or religious traditions
	Conformity–rules	Compliance with rules, laws, and formal obligations
	Conformity–interpersonal	Avoidance of upsetting or harming other people
	Humility	Recognizing one's insignificance in the larger scheme of things
Self-Transcendence	Benevolence–dependability	Being a reliable and trustworthy member of the ingroup
	Benevolence–caring	Devotion to the welfare of ingroup members
	Universalism–concern	Commitment to equality, justice, and protection for all people
	Universalism–nature	Preservation of the natural environment
	Universalism–tolerance	Acceptance and understanding of those who are different from oneself

Table 4. The table describes the conceptual definitions of the 19 PVQ low-order constructs and their relation to the 4 PVQ higher-order constructs, as [15] adapted it from [43]