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Leisure walks modulate the cognitive and affective representation of the corona pandemic: Employing Cognitive-Affective Maps within a randomized experimental design

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Abstract

In response to the corona pandemic, many leisure activities have been restricted while walking has been explicitly endorsed by health authorities. We investigated how leisure walking affects individuals' attitudes to the pandemic. We used *Cognitive-Affective Maps* (CAMs) to measure individual's cognitive and affective attitudes toward the corona pandemic and related issues. In a controlled randomized experiment, we asked ($N = 66$) participants to draw a CAM before and after a walk. Participants in a control group drew CAMs before and after any self-chosen activity at home. We found that walking led to a more negative evaluation of the pandemic itself, likely due to a more intense reflection, while in everyday routines one has already adapted to it. In further qualitative post hoc assessments of the CAMs, we observed that negative concepts other than corona disappeared after walking. We conclude that leisure walks have complex effects on individuals' cognitive and affective conceptualization of the corona pandemic. Hence, the exact mechanisms of these effects need to be

examined in future research. Our study has also shown that CAMs are a promising tool for measuring experimental interventions in health psychology.

KEYWORDS

Cognitive-Affective Mapping, corona pandemic, leisure walking

INTRODUCTION

In response to the corona pandemic, governments around the world have taken drastic measures to minimize transmission of the virus. Almost every country affected by the disease has imposed massive restrictions on public and private activities, including popular leisure activities such as traveling, public events, and private gatherings (Askitas et al., 2020; Burdett et al., 2021; Eckardt et al., 2020). In many countries, recreational facilities like gyms, swimming pools, and playgrounds have been closed (González-Valero et al., 2020; Shahidi et al., 2020). The restrictions greatly differ between countries rendering their effectiveness an increasingly popular subject for comparative evaluations (Cheng et al., 2020; Desson et al., 2020). In some countries, for example Italy, gathering in public spaces was prohibited, including sports; additionally, social amenities like museums, cinemas, and theaters were closed (Lazzerini & Putoto, 2020; Mahmoudi et al., 2021; Signorelli et al., 2020).

Scientific evaluations of lockdown policies have not been limited to assessing their epidemiological effectiveness (Adhikari et al., 2020; Ferguson et al., 2020; Flaxman et al., 2020) but have also intensely scrutinized negative psychological and societal side effects of the pandemic. For example, previous studies indicate that common reactions to the pandemic are anxiety, depression, and stress (Rajkumar, 2020; Wang et al., 2020). However, while the vast majority of official governmental interventions regarded explicit bans or restrictions of certain leisure activities, some governments complemented these restrictions with positive recommendations of leisure activities which have been explicitly endorsed by public health organisations, such as the World Health Organization (2020). For instance, during the first pandemic wave in Europe at the end of March 2020, the Press and Information Office of the German Federal Government (2020) officially announced that assistance for others, individual sport, and exercising outdoors, as well as other necessary activities, were permitted. Likewise, the Belgian government (2020) allowed, and even explicitly recommended, outdoor exercise together with family members or one friend. While the problematic psychological effects of the lockdown restrictions and bans have been previously investigated (Brooks et al., 2020; Rossi et al., 2020), the present study focuses on the psychological effects of a leisure activity that has explicitly been recommended by authorities during the lockdown, namely going for a walk.

In many countries, going for a walk was permitted—given that hygienic measures are taken—but not explicitly recommended by public authorities. For example, the French government (2020) implemented local curfews, entailing that leaving one's residence was only permitted with an exemption certificate and only for specific reasons, including brief walks with a pet. In countries with particularly severe lockdown regimes, even going for a walk was prohibited; for example, the Argentine president warned people not to walk more than 500 m from home (Horvat, 2020), and the Italian government (2020) only allowed walks when absolutely necessary. Thus, the recommendations in Germany and Belgium differed from other countries, and they have indeed not been based on scientific research or explicitly justified by the stipulated positive effects of going for a walk. A balance must be achieved between the risk of increased infection associated with outdoor activities in general and the potential

physical, immunological, and psychological gains of leisure walking. Thus, it is important to estimate and predict these gains in as much detail as possible. Consequently, the present study investigates the psychological effects of leisure walking, specifically in relation to coping with the corona situation. There is abundant evidence that leisure walks have diverse effects on psychological health and well-being. For example, nature walks lead to a more positive body image (Swami et al., 2018) and increased creativity (Oppezzo & Schwartz, 2014) as well as self-esteem (Barton et al., 2012; Roe & Aspinall, 2011). Other studies have shown that leisure walking can reduce rumination (Bratman et al., 2015) and symptoms of clinical depression (Berman et al., 2012; Iwata et al., 2016; Korpela et al., 2016). As a result, walking has become increasingly popular as a therapeutic tool (Cooley et al., 2020; La Torre, 2004; Revell & McLeod, 2016).

The present study aims to specifically investigate the effects of leisure walking on thoughts and attitudes toward the corona pandemic. Specifically, we investigate whether going for a walk affects how we cognitively and affectively represent the experience of the corona pandemic in our mental models of the world. At a first glance, one might expect that going for a walk leads to more positive attitudes toward the corona pandemic. This outcome would be in line with previous literature from various domains that revealed several indirect hints that leisure walks might have effects on cognitive representations and affective assessments. For example, there is abundant evidence that walking increases positive affect (Fuegen & Breitenbecher, 2018; Gidlow et al., 2016) even for walks as short as 10 min (Focht, 2009). This has also been confirmed in a recent study on walking during the corona pandemic (Lades et al., 2020).

The positive effects on mood and well-being are typically explained by beneficial effects from the moderate and pleasant physical activity that characterizes walking (Buecker et al., 2020; Reed & Ones, 2006), complemented by positive effects from the walking environment (Fuegen & Breitenbecher, 2018; Olafsdottir et al., 2020). The latter is commonly explained by the restorative characteristics of typical walking environments (see, e.g. Hartig et al., 1991; Martens et al., 2011). According to restoration theory, environments that direct attention effortlessly lead to the restoration of attentional capacities and induce a pleasant mood (Kaplan, 1995; Kaplan & Kaplan, 1989)

Such qualities have not only been demonstrated primarily for natural environments (see, e.g. Ehret et al., 2020; Korpela & Staats, 2014; Van den Berg et al., 2016) but also for certain types of buildings (e.g. museums, see Chatterjee & Noble, 2016; Kaplan et al., 1993a, 1993b; Packer & Bond, 2010) and some urban environments (Janeczko et al., 2020; Scopelliti & Giuliani, 2004; Subiza-Pérez et al., 2021).

When individuals have the choice between different environments—as is often the case when going for a walk—restorative landscapes are typically preferred to non-restorative ones (Hartig & Staats, 2006; Van den Berg et al., 2003). The mediating role of restorative experiences for the well-being effects of walking has recently been confirmed in a study by Korpela et al. (2016). With regard to the present study, one might speculate that the overall increase in positive affect by walking would lead to a more positive evaluation of any concepts in the individual's representation of the pandemic context, including the corona pandemic itself.

However, a closer look at the nature of restorative experiences also allows an alternative, more nuanced prediction. Research on the impact of restorative environments has shown that, in addition to positive affect, restorative experiences also lead to a reflected cognitive state (Herzog et al., 1997; Mayer et al., 2009). Accordingly, walking has often been described as a contemplative process enabling one to step outside of everyday routines and think in a more reflective way (Keinänen, 2016; Keinänen & Beck, 2017), often leading to a more existential perspective on one's own life than normal everyday experiences (Saunders et al., 2018; Stevenson & Farrell, 2018). Thus, walking might allow individuals to gain a more critically reflected evaluation of the corona pandemic and call into question their everyday habituation and adaptation to the situation. From this perspective, one might conjecture that a leisure walk could even lead to a more negative attitude to the corona pandemic due to a more distanced reflected

perspective. Note that this would well be compatible with a generally positive affect, as restorative experiences often support both positive affect and more reflective states (Herzog et al., 1997).

In the present study, we tested the hypothesis that leisure walking affects the valence of the corona pandemic in a controlled randomized experiment, where a group of participants went for a walk at a place of their choice, and a control group performed a different self-chosen activity. We measured the cognitive and affective representations of the corona pandemic with so-called Cognitive-Affective Maps (CAMs). In both groups, participants drew such a map before and after the intervention, and we analyzed the differences between the pre- and post-intervention maps. We used CAMs as they combine the advantages of quantitative and qualitative approaches (Möller et al., 2021).

A CAM is a network that connects cognitive and affective elements. The network concepts (called *vertices*, *nodes*, or *points* in graph theory; Diestel, 2017) can display any content in text form, for example thoughts, knowledge, or events. Additionally, each concept conveys an emotional value, which is represented by the color and shape of the concept's border. These valences or affects can refer to emotions, mood, and motivation (Thagard, 2012b). The CAM method was initially developed and employed by the philosopher Thagard (2010) and has so far been used primarily in conflict research and conflict management to visualize contrary positions and derive possible solutions (Homer-Dixon et al., 2014; Thagard, 2015). Other applications included the graphic representation of attitudes and their changes (Thagard, 2012a, 2012b, 2018; Wolfe, 2012) or CAMs as a methodological supplement in addition to other tools, for example for a triangulation with coding techniques from discourse theory (Luthardt et al., 2020). To date, in most published studies, CAMs are drawn by the researchers themselves and are subsequently based on other data or analysis methods. In the present study, we instead instructed the participants to draw the CAMs, an approach which has successfully been employed in several previous investigations (Kreil, 2018; Mansell et al., in press; Ricken, 2020). A more detailed description of the CAM method can be seen in the Methods section.

Based on previous literature examining the potential effects of leisure walks as previously reviewed, we hypothesised that walks exert a characteristic effect on participants' attitudes. First, we expected that the pre/post-change in the affective assessment of the concept *corona pandemic* will be more pronounced in the walking condition than in the control condition (Hypothesis 1). Second, we expected that the pre/post-change in the average affective assessment of the corona pandemic depicted by the entire CAM will also be more pronounced in the walking than in the control condition (Hypothesis 2). As previous literature allows diverging predictions, it was not clear whether the direction is positive (due to walks increasing positive mood) or negative (due to walks fostering a more reflected view).

For the first time, CAMs were employed in an experimental design with repeated measures. Thus, the present study can be regarded as a first methodological test of the applicability of CAMs in such designs. We come back to this aspect in the discussion. In order to better estimate the usefulness of CAMs to randomized experimental designs, we complemented the hypotheses-driven analyses by several exploratory quantitative and qualitative evaluations (see the Results section for details).

METHODS

Sample

Ethical approval for the study was granted by the ethics committee of the University of Freiburg (number 338/20). We recruited a sample of $N = 74$ participants from Prolific, an online recruitment platform for academic research. To register on Prolific, one must be an adult. We applied three filters in order to advertise the study only to individuals who indicated that they currently live in Germany

(1), speak German fluently (2), and have not participated in any other of our CAM studies on Prolific (3). A participant pool of 1545 individuals remained. We also specified that a desktop computer or laptop was required for the study. Of the 98 people who signed up for the study, 24 (24.49%) withdrew during the study. The 74 (75.51%) remaining participants who completed the study were paid a compensation of GPB17 (approximately equivalent to EUR19 GER), based on the hourly minimum wage in Germany. The study was scheduled for about 120 min, and participants were asked to engage only if they can go for a walk within the next 2 h. Participants were randomly assigned to the walk or control conditions. Incomplete datasets and CAMs with less than three concepts and links were excluded, as well as two CAMs from one participant focusing on a topic other than the given one. This resulted in a final sample of $N = 66$ participants, 30 in the walking condition (age, M = 29.13, $SD = 9.13$; 46.7% female) and 36 in the control condition (age, M = 26.97, $SD = 4.86$; 30.6% female).

Data collection and storage

We collected the data of all participants on April 8, 2020. At that time, the German Federal Government (Press & Information Office of the German Federal Government, 2020) had ordered strict regulations to slow the spread of the coronavirus, for example a contact ban. On April 8, the John Hopkins University recorded 113,296 cumulative and 5633 active cases in Germany (Johns Hopkins University & Medicine, 2020). Part of the data was stored on the server of the Questback GmbH until the completion of the study. The other part of the data was stored on a server of the Albert-Ludwigs-University. After completion of the survey, all data were stored on the university's server. The dataset of this study is openly available through OSF (Reuter et al., 2021).

Measures

Before the actual implementation of the study is explained, a more detailed description of the CAM method follows.

Cognitive-Affective Maps

Figure 1 shows an exemplary CAM. The rules for drawing a CAM were adapted from Thagard (2010): Each concept in the CAM is affectively evaluated. Participants can choose between eight valence gradations, divided into four different colors and shapes. Green ovals stand for positive valence and red hexagons for negative valence. Yellow rectangles represent neutral valence, while the purple mixed form stands for ambivalent evaluation, meaning that the concept is evaluated both positively and negatively. There are three levels of intensity for positive and negative valence—the thicker the concept's border, the more intense the affect. The concepts are connected through links (called *edges* or *lines* in graph theory; Diestel, 2017). There are two types of links: A solid link between two concepts means that they are positively correlated, thus reinforcing each other; dashed lines mean that the two concepts are negatively correlated, thus inhibiting each other. According to Thagard's (2010) CAM rules, the links do not represent causality. In this study, however, we gave participants the opportunity to specify causal directions with arrows, contrary to the original CAM rules. Such an arrow link is interpreted as a one-sided effect of one concept on the other. The CAM data was collected with the freely available software *Valence* (Rhea et al., 2020).

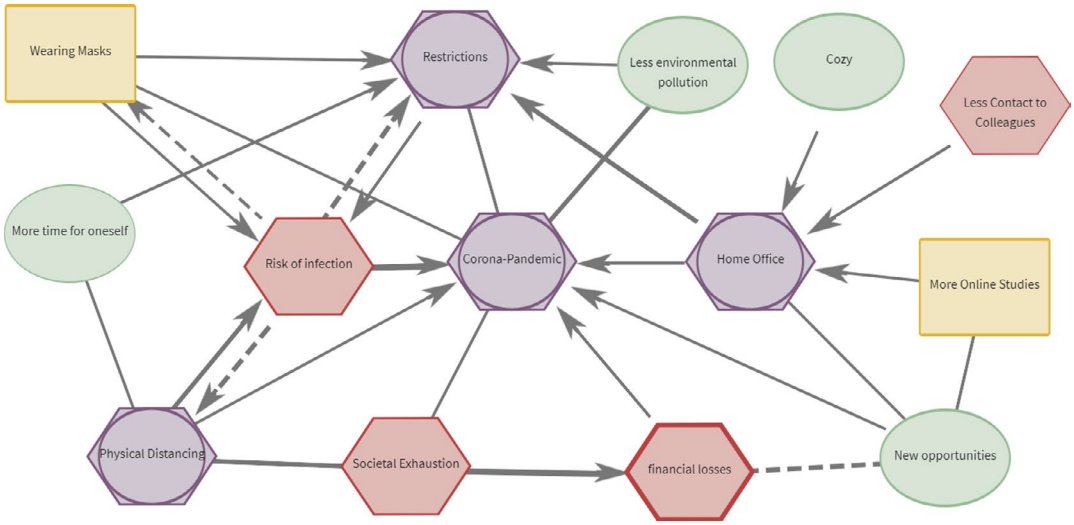

FIGURE 1 Exemplary CAM on the topic of the corona pandemic [Colour figure can be viewed at wileyonlinelibrary.com]

A detailed description of the instruction can be found in Appendix (S1, S3, S6, S7).

RESULTS

Descriptive analysis

Prior to the analysis, synonymous concepts were identified and collapsed into overarching terms, which reduced 480 terms to 131. The reduction steps (first going through online databanks to search for synonymous and regular expressions, then manually categorizing the terms) can be reconstructed in more detail in Appendix S3 and S4. On average, participants used 13.73 ($SD = 3.97$) concepts and 29.07 ($SD = 12.08$) links. The valence of a concept was numerically coded according to the border thickness as −3, −2, or −1 for negative concepts (−3 for the thickest negative border) and 1, 2, or 3 for positive concepts (3 for the thickest positive border); neutral and ambivalent concepts were coded as 0.

The mean valence of the *corona pandemic* concept was −1.26 ($SD = 1.43$) over all the CAMs. The average mean valence of these CAMs was −0.76 ($SD = 0.76$). Participants included most of the predefined concepts. The concepts most frequently left out were depressiveness (27%), mood (26%), and cohesion (22%). Furthermore, 92% of participants provided additional concepts. The average number of self-added concepts was 5.96 ($SD = 1.98$). A list with the frequencies of the most commonly used concepts, both predefined and self-added ones, can be found in Table 1 in Appendix S5.

Hypothesis-driven tests

In testing the first hypothesis, we verified whether walking affected the affective valence in participants' representation of the corona pandemic. To this end, we conducted a two-factorial mixed analysis of variance (ANOVA) with the between-subjects factor *group* (walking vs. control) and

the within-subjects factor *time* (pre vs. post). The dependent variable was the valence assigned by participants to the concept *corona pandemic* in their CAM, coded by us from −3 to 3. The valence of the concept *corona pandemic* was not normally distributed in either of the groups, as assessed by the Shapiro–Wilk test ($p > .05$). However, simulation studies have revealed that the ANOVA is robust against violations of the normal distribution (Blanca et al., 2017). All other assumptions of the factorial mixed ANOVA, like not having any significant outliers and the homogeneity of covariance matrices, were met (Johnson & Wichern, 2002).

We observed a main effect of *time*, $F(1, 64) = 5.13$, $p < .05$, $\eta_p^2 = .07$, $\eta_G^2 = .014$, as well as a significant interaction of *group* by *time*, $F(1, 64) = 5.13$, $p < .05$, $\eta_p^2 = .07$, $\eta_G^2 = .014$. There was no statistical significance for the main effect of *group*, $F(1, 64) = 0.06$, $p = .81$.

In other words, participants who went for a walk assigned a less negative valence to the concept of *corona pandemic* before walking (M = −0.97, *SD* = 1.43) than afterward (M = −1.63, *SD* = 1.38), $t(29) = 2.88$, $p = .007$, $d = .53$ (Figure 2). In participants who did not go for a walk, the difference between the assigned valences for *corona* in the first CAM (M = −1.22, *SD* = 1.42) and the second (M = −1.22, *SD* = 1.48) was not significant.

In a second hypothesis test, we verified whether walking affected the affective assessment across participants' entire CAM. To this end, we conducted a two-factorial mixed ANOVA with the between-subjects factor *group* (walking vs. control) and the within-subjects factor *time* (pre vs. post). The dependent variable was the average valence, calculated by participants' valuations of all concepts over the entire CAM.

We observed a main effect of *time*, $F(1, 64) = 6.49$, $p < .05$, $\eta_p^2 = .09$, $\eta_G^2 = .02$, due to less negative CAMs after the intervention, M = −0.62, *SD* = 0.69, than before, M = −0.77, *SD* = 0.64. However, there was no significant interaction of *group* by *time*, $F(1, 64) = 0.12$, $p > .05$, nor statistical significance for the main effect of *group*, $F(1, 64) = 0.70$, $p > .05$ (Figure 3).

Quantitative exploratory tests

In the current research, graph theory was applied to quantitatively analyze CAMs, in addition to developing and evaluating a number of quantitative indicators (Borsboom & Cramer, 2013; Mansell et al., in press). Although these indicators fundamentally possess a structural nature, networks in general might offer psychological interpretations and are an important current field of research (Lynn & Bassett, 2020; Newman, 2018). Adapted from Mansell et al. (in press), we calculated the following parameters:

- Centrality: Number of connections on a concept, normalized by the total number of possible connections.
- Density: Proportion of links in a network divided by all possible links in a network.
- Diameter: Longest path in the graph (maximum distance from one concept to another)
- Triadic Closure: Number of triangles (three connected concepts) divided by the number of possible triangles.
- Number of Concepts; Number of links; number of supporting (solid) links; number of contradicting (dashed) links.

FIGURE 2 Participants' affective assessment of the "corona pandemic" concept. $N = 30$ in the walking group (pre and post); $N = 36$ in the control group (pre and post). Coding of the single concept rating ranges from −3 to 3 according to the 7 valuation options available in the CAM forms—due to the broadly more negative valence of the *corona pandemic* concept, here the range of the vertical axis is limited to the minus area

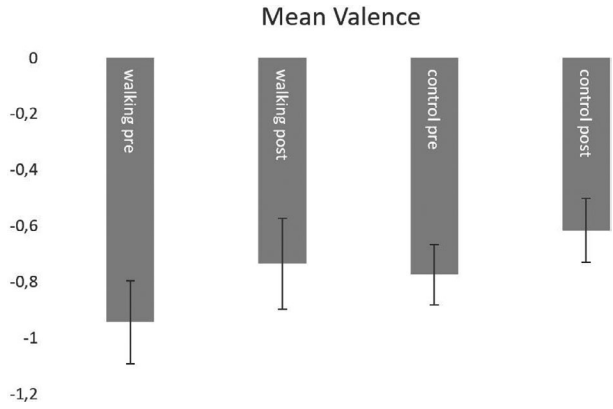

FIGURE 3 Average valences of participants' CAMs. $N = 30$ in the walking group (pre and post); $N = 36$ in the control group (pre and post). Coding of the single concept rating ranges from −3 to 3 according to the 7 valuation options of the CAM forms—due to the broadly more negative valence of the *corona pandemic* concept, here the range of the vertical axis is limited to the minus area

Additionally, we calculated an assortativity value, which is a quantitative expression of how likely two vertices are connected if they are of the same type, in our case, have the same valence (Newman, 2018). The assortativity coefficient is positive if similar vertices (based on some external property) tend to connect and negative if otherwise. For each of these measures, we conducted a mixed ANOVA analogously to the aforementioned hypotheses-driven tests. For none of these measures did we observe any main effect for *group*, all $p > .2$, or any interaction, all $p > .2$. However, there was a significant

main effect for *time* on the *number of positive concepts* (for details, see Table 2 in Appendix S5). Additional qualitative exploratory analyses of the CAMs can be found in Appendix S6.

DISCUSSION

Summary

We explored whether and how leisure walking affects participants' valence of the corona pandemic using CAMs. In a controlled randomized experiment, we assigned each participant to either the experimental group with the instruction to go for a 1-h walk or to the control group with the instruction not to go for a walk but to undertake any other activity. We hypothesised that participants who went for a walk would have a different perception of the corona pandemic afterward than before and that this change would be more pronounced than in the control group. We expected this effect for the valuation of the *corona pandemic* concept (Hypothesis 1) and for the average valuation of the entire CAM (Hypothesis 2). We measured potential changes with CAMs drawn by participants before and after the intervention. Additionally, we examined CAMs as a method using exploratory analyses.

Regarding Hypothesis 1, we discovered that participants rated the concept of *corona pandemic* more negatively after the walk than before, while no such difference was observed in the control group. As for Hypothesis 2, we found that generally the average valuation of the corona pandemic was less negative after the intervention than before. Nevertheless, contrary to our hypothesis, this difference was observed in the walking as well as in the control group. Our qualitative exploratory analyses (Appendix S6) revealed a tendency to omit negative concepts from the CAMs in the walking but not in the control condition. Furthermore, positive as well as negative concepts were introduced in the second CAM, although more were seen in the control than in the walking condition.

Leisure walks and cognitive-affective representation of the corona pandemic

Leisure walks seem to have a substantial and reliable effect on corona-related cognition and affect, which is more complex than initially hypothesised. The specific evaluation of the *corona pandemic* concept evolved into a more negative valuation after walking. This is in accordance with literature stating that walking fosters reflection (Keinänen, 2016; Keinänen & Beck, 2017). Given the central theme of the pandemic, it is not surprising that an intensified contemplation on the latter has a negative effect on its evaluation. Thus, a walking-induced, more distanced reflection on an initially negatively evaluated topic seems to sharpen walkers' views on negative aspects of the situation.

However, the leisure walks also allowed other negative topics to fade into the background (Appendix S6), so that they disappear from the cognitive-affective representation of the corona pandemic, which is likely due to the opportunity to contemplate and thereby positively resolving worries over the corona crisis. In summary, the cognitive processing during leisure walks had the somewhat ambiguous effect that the concept *corona pandemic* itself was evaluated more negatively, while negative issues disappeared.

In addition to this, the walking condition seems to have prevented new—positive and negative—concepts from entering the individual's representation of the corona pandemic (Appendix S6). We hypothesise that this might be because of a reduced variance of environmental stimuli during the walks. In the control condition at the participants' homes, participants were more likely to be stimulated by media, conversations, or greater variance in activities. The finding, contradictory at first sight, that

the corona concept itself was evaluated more negatively after the walk, while other negative concepts tended to disappear and also fewer concepts were added, could be explained by coherence mechanisms. According to the theory of emotional coherence (Thagard, 2000), the valence of an element may be constrained by the valences of the elements surrounding it. Applied to our scenario, the negative valence of the corona pandemic in the post-walking CAMs could result from a containment of the negative valence on the corona concept, while peripheral concepts were less affected. Confirmation of such an effect is provided by individual CAMs, an example from the collected CAM data can be taken from Figure 4a,b (see Table 4 in Appendix S5 for the original concepts in German).

Practical implications

When evaluating how valuable leisure walks are in the time of corona, our findings provide a more nuanced picture than initially hypothesised. Our study does not question the well-established antidepressant effect of walking in general (Bratman et al., 2015; Oppezzo & Schwartz, 2014; Swami et al., 2018), yet this effect does not lead to a more positive attitude toward the corona pandemic. On the contrary, also the well-established contemplating effects on reflecting cognition seem to impact CAMs here: lead to a more focused and probably more realistic evaluation of the pandemic, attributing the individual's negative affect on the pandemic, while reducing negativity toward other contextual factors. In spite of these findings, importantly, this modulation of affective distribution does not result in a generally more negative overall affective evaluation.

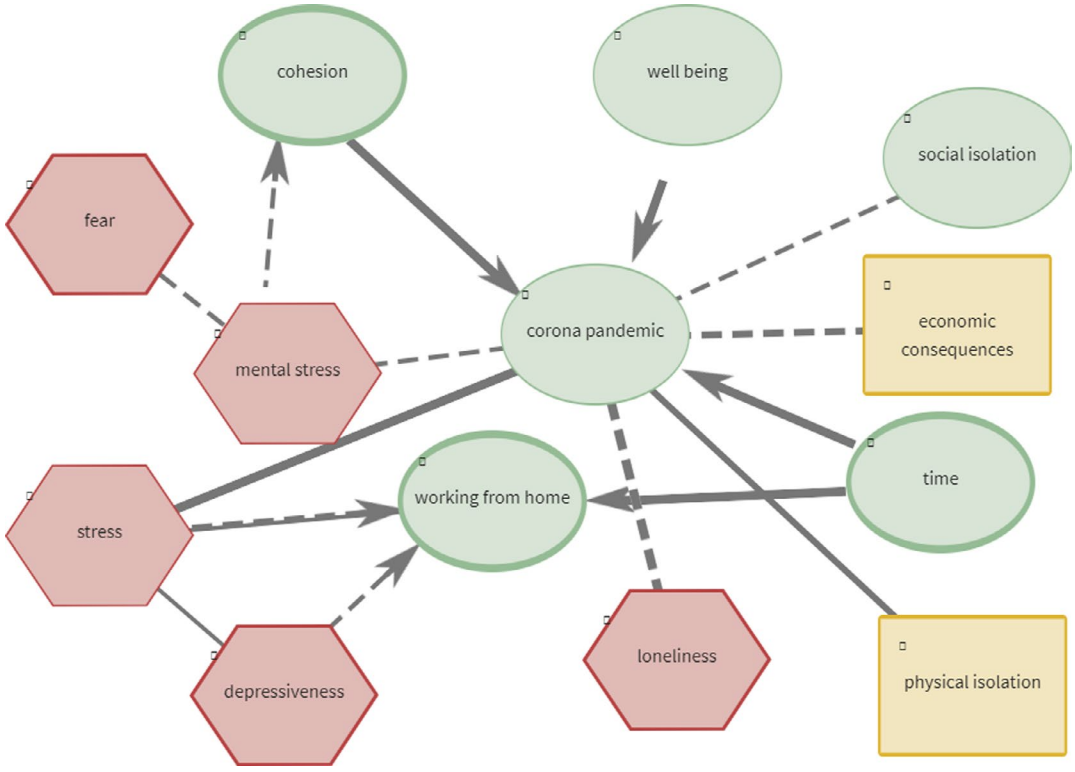

FIGURE 4 (a) Pre CAM—before walking. (b) Post-CAM—after walking [Colour figure can be viewed at wileyonlinelibrary.com]

Thus, the present findings do not speak against the recommendation of walking as a leisure activity in the time of corona, although they clearly show that the effects of walking do not cause a general boost of positivity in participants' cognitive-affective evaluation of the corona pandemic. Leisure walking, in other words, focuses the distribution of negative evaluation on the corona pandemic.

Limitations and future research

The limitations of our study include the fact that participants in the control group pursued any self-chosen activity. This choice was motivated by the applied perspective of our study because the alternative to an explicit recommendation to walk by health authorities was giving no recommendation at all. From this perspective, the most realistic condition to compare walking with was a condition with no instructed activity. However, future studies could assign control group participants to a specific suitable indoor activity, such as using an ergometer, which would allow researchers to pin down the walking effects to certain crucial parameters of an activity, like movement or rhythmicity. Furthermore, in our study, participants were instructed to go for a walk on their own—a walk together with companions could completely change the result pattern due to the content of the walkers' conversation. Thus, it would be interesting if future studies investigated whether differences were apparent between walking alone and walking with companions. It should also be noted that there was already a difference in CAM valence values between the walk and control groups when the first CAMs were drawn. This could be explained by the fact that at the time of the first CAM drawing participants already knew which condition they were in, which could have influenced their mood. Moreover, we could not verify whether participants really followed the instruction. We chose not to constrain the walking by control measures, as we aimed at making the experimental walks as unconstrained as possible with regard to the applied research question.

In our study, the majority of the pre-set concepts presented to the participants were likely to be assessed rather negatively. Thus, their thoughts may have been colored negatively during the intervention. Prospectively, the effect of assigned positive concepts could be investigated.

Regarding the different results of the quantitative and qualitative analysis, it should be noted that the study was originally designed to test hypotheses quantitatively. The qualitative analyses were of exploratory nature. It is indeed possible that the statistical power of the quantitative test was too low for a qualitatively observed effect.

Finally, it should be noted that the study cannot serve as a method validation, though we tested the method of Cognitive-Affective Mapping in a new design. The investigation of psychometric properties, such as validity, is still pending. Also, there is no information on reliability characteristics so far, although retest reliability, in particular, would be important for our repeated measures design. Also, it is possible that merely drawing a CAM changes the attitude toward the topic. We tried to prevent such changes from biasing the effect of leisure walking by using the break control condition. Future empirical CAM studies should examine such important psychometric properties in detail.

Also, the theoretical embedding of the CAM method in network and attitudinal models is not clear. This study cannot clarify such fundamental questions, but can only demonstrate as a first approach that its application in this kind of experimental design is possible.

CAMs for pre/post-designs

In general, the present study found that CAMs are feasible to use by participants and may be suitable for an experimental pre/post-design. Despite this, with exploratory mixed ANOVAs for certain

network measures, we found that generally the effect of *time* was more important than the effect of *group*. A number of main effects of time are remarkable in the ANOVAs, like the *number of positive concepts*, *assortativity*, and the *average CAM valence*. Interestingly, this suggests that there were generally substantial changes in CAM properties, regardless of whether the participants went for a walk or performed other self-chosen activities. This means that drawing a CAM twice has in itself an effect independent of condition. This does not affect our results, as they focus only on the differences in changes between conditions. This, however, is a vital implication for CAM research in general. Future research should explore the effects of drawing CAMs twice on the same or different topics in isolated research designs.

It is also remarkable that participants included new positive concepts in the pre- and post-CAMs. It is possible that in extant literature on corona, positive aspects have been allocated less importance. Our data, however, indicate that such concepts can be identified with the method of CAMs.

CONCLUSION

We conclude that leisure walks in corona times lead to a more reflective and accentuated perspective on the corona pandemic. While the negative evaluation of the *corona pandemic* concept was intensified, other negative context aspects were shifted to the background. Our findings show that leisure walking, a currently widely practiced activity, has complex effects on how people cognitively represent the pandemic and its context. The findings also call for a more comprehensive investigation of the detailed impact of leisure walking on cognition and affect. We further recommend the use of CAMs in experimental designs.

CONFLICT OF INTEREST

The authors declare that there is no conflict of interest.

ETHICS STATEMENT

Authors adhere to the APAs' ethical principles of psychologists and code of conduct.

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DATA AVAILABILITY STATEMENT

The supplementary study material and the data that support the findings of this study are openly available through OSF at: https://osf.io/zhysw/?view_only=f6b06d165d9640e1a6fb143b41824b55

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SUPPORTING INFORMATION

Additional supporting information may be found online in the Supporting Information section.

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