Exploring Virtual Nature to Promote Social Connectedness and Storytelling

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Abstract

As many people experienced loneliness during the COVID-19 pandemic, and nature has already been shown to improve social well-being, the interest of this study lies in answering the following question: Does a virtual nature scene with people promote storytelling and social connectedness? If so, virtual nature has the potential to be used as an alternative to real nature which can decrease negative feelings like loneliness, especially for handicapped people, people with poor access to nature, and for those in quarantine. The design of this study was between-subject with a total of 67 participants. In the experimental condition, participants watched a two-minute video of animated nature with social presence (i.e., humans walking along a path), while the control group watched a video without the social presence, to see if the presence of humans has a more positive effect on the viewer's social connectedness and storytelling. Moreover, it was analysed if nature-relatedness can be seen as a moderator, and it was expected that high nature-relatedness strengthens the positive effect of the trigger on storytelling. However, findings could neither show if a difference in social connectedness between both groups exists, nor could they feature a positive effect of the trigger for storytelling. Also, nature-relatedness could not be proven playing a moderating role and enhancing the effect of the social presence in the nature video. The results were not consistent with prior research because they showed no differences between the experimental group and control group, which was different to the expectations. It is advisable for future research to investigate similar research but with a less demonstrative trigger, in a controlled setting and by using a greater sample.

Keywords: virtual nature, digital nature, nature video, trigger, nature-relatedness, relationship with community, social connectedness, storytelling, reminiscence

VIRTUAL NATURE FOR CONNECTEDNESS & STORYTELLING

This research gives attention to a current and well-known problem for some people in our population: loneliness. Due to the circumstances caused by the Covid-19 pandemic, many people around the world suffer from not being able to interact socially because of isolation policies (Groarke et. al., 2020). Social connections in form of social activities and networks are necessary for the human being as they provide support when people experience negative feelings and emotions which are common during the covid-19 pandemic: People lose their routine and face various defeats, such as losing their job and the opportunity to practice, or they even lose a friend or family member due of the virus (Nitschke et al., 2020). It can be seen as a vicious circle because social connectedness has the potential to reduce feelings of distress and worry (Nitschke et al., 2020), however, it is currently only possible virtually for a majority due to the regulations in many nations, which prohibit social activities and meetings. These social distancing policies may prevent infections with the virus and save lives but might at the same time also be the reason for feelings of loneliness.

Feeling lonely should not be underrated as it can lead to serious mental health issues like depression and suicidal thoughts (Groarke et al., 2020). The rate of loneliness is even higher among those who have already experienced mental and physical health problems in the past (Killgore et al., 2020). Not only mental but also physical problems like cardiovascular diseases can occur as the consequence of loneliness, so that loneliness and perceived social isolation becomes a risk factor for mortality (Holt-Lunstad et al., 2015; Quadt et al., 2020). Moreover, Nitschke et al. (2020) explains that the younger generation is more negatively affected by social isolation policies while the elderly generation has learned to overcome loneliness with coping mechanisms they acquired during their lifetime. As some research results suggested a negative association between distress and social contact (Nitschke et al., 2020), social contact is hypothesised to be a preventer of negative feelings like feeling lonely.

VIRTUAL NATURE FOR CONNECTEDNESS & STORYTELLING

Social connectedness is a construct that encompasses several terms like “social network/support” or “social integration” but to give a short definition, social connectedness can be understood “as the sense of belonging and subjective psychological bond that people feel in relation to individuals and groups of others” (Haslam et al., 2015, p. 1). Such bonds and feelings of social belonging can already be formed and enhanced by online communication tools, showing evidence for the importance of communication for social connectedness (Van Bel et al., 2009).

What has been shown to increase emotional well-being as well as reduce feelings of loneliness is storytelling (Alexandrakis, 2017; Li et al., 2020). Reminiscence, which is often and especially in this study seen as a synonym for storytelling, has been defined as the “recall of memories about one’s own life” (Westerhof et al., 2010, p. 2). As the name already tells, storytelling is hereby seen as the narration of personal experiences and feelings. When a personal story is told, memories of past experiences and emotions arise in the teller, which can evoke reflective thinking and therefore, can lead to greater self-knowledge (Hausknecht et al., 2019).

A decreased feeling of loneliness and an enhanced sense of community can also be effectuated by having a green area nearby, which may prove for nature having a promotive effect on feelings of connectedness (Maas et al., 2009). Nature affiliation or nature-relatedness has been shown to increase vitality and well-being (Nisbet et al., 2011), but some people may not have the opportunity to go outside because of quarantine, lack of time, physical problems, or because they lack the natural environment. Therefore, virtual nature came into the focus of some researchers.

In this paper, virtual nature is understood as an immersive and artificial nature, which does not exist in the real life; It is technologically made and displayed on digital devices. Virtual and digital definitions are often overlapping and hard to differentiate. However, to

give an example of both terms, our society is already dependent on the internet and technological devices so that the world in which we live can be understood as a digital world, while a virtual world is an environment which exists only on such technological devices.

Weinstein et al. (2009) assessed the effect of photographs of nature on the intrinsic aspirations of their participants. Intrinsic aspirations can be understood as the striving for internal basic needs e.g., community and love. Extrinsic aspirations on the other side, include the goal to reach external goods like fame or money (Weinstein et al., 2009). It was demonstrated in their study that photographical nature (on a display) has a positive effect on one's intrinsic aspirations, generosity, and mood. Furthermore, the study revealed that a person feeling connected to nature shows less selfish behaviour and is overall less focused on external values than a person immersed in a non-rural environment. Generally, people with intrinsic aspirations are more community-oriented and happier than people with extrinsic values (Weinstein et al., 2009).

A study of Browning et al. (2020) which assessed the effect of virtual nature environments and nature videos, showed similar results to Weinstein et al. (2009) and demonstrated a positive effect on mood and emotion. Thus, it can be assumed that either photographical or virtual nature can have the potential to promote social connectedness and well-being and so be used as an alternative to real nature.

Even though the positive effect of either photographical, virtual, or real nature on one’s well-being could be verified in previous literature (Browning et al., 2020; Maas et. al, 2009; Weinstein et al., 2009), there is still little research about the features and characteristics of a nature that are responsible for this effect. Also, little is known about the trigger of (positive) storytelling. Nature can be seen in many different forms, places, times, and colours.

Van Houwelingen-Snippe et al. (2020) searched for the effect of tended and wild digital nature scenes on their participants, showing that social aspirations were more

expressed by those people who were immersed in the tended scenes. Because there is a positive correlation between positive storytelling and wellbeing (Pasupathi & Carstensen, 2003), the crucial question is which specific nature stimulus or phenomenon can evoke storytelling and social connectedness at the same time.

While social connectedness and storytelling both include social aspects, it was given consideration to combine both computer-animated humans and a nature video, to see if humans may be used as a trigger to enhance the effectiveness of the virtual nature on storytelling. Strojny et al. (2020) investigated a randomized control study with a sample consisting of firefighters to see whether their performance in the virtual trainee programme was affected by animated bystander-agents. Findings showed that those participants who reported high social realism (the feeling of being socially surrounded) were indeed affected by the virtual agents while those who reported low realism were not significantly affected which provided evidence for the moderating effect of perceived realism.

Moreover, the study of Staats & Hartig (2004) had shown that being in a group of people can have a positive impact on one's perceived safety and can therefore lead to higher restoration when experiencing an environment in which safety is not given. Accordingly, it could be that people who experience a virtual nature scene and do not perceive it as safe would prefer to experience it with company instead of alone. Therefore, it is hypothesised that the presence of animated humans in the digital nature scenes may evoke more positive emotions than virtual nature alone and may motivate viewers of these nature scenes to remember past experiences and/or feel the need to express feelings of social connectedness in form of storytelling.

What has also been shown to enhance positive sentiment is nature-relatedness, the feeling of being connected to nature (Zelenski & Nisbet, 2014). Nisbet et al. (2011) described nature-relatedness not only to be contributing to one's well-being but also saw it as a

mediating variable in the relationship between visiting nature and vitality. However, there is little research about suggesting nature-relatedness to be a moderator, which may strengthen the relationship between (virtual nature) and well-being, or in this context, social connectedness and storytelling.

In their book chapter "The Nature of Happiness: Nature Affiliation and Mental Well-Being", Howell and Passmore (2013) provided possible moderating variables for the relationship between nature affiliation and well-being. The moderator they mentioned by referring to Sagiv and Schwartz (2000), was nature affiliation within one's social group. Therefore, a certain group of people may value their nature affiliation higher if their culture and social group shares a sense of nature-belongingness. For example, psychology students tend to rate universalism, including nature-relation, more important than business students do (Sagiv and Schwartz, 2000). According to this, Howell and Passmore (2013) summarized that being surrounded by nature-loving people like Scandinavians are used to be, contributes to the formation of nature-relatedness and concepts such as "friluftsliv" (Translated as: "free-air life") (p. 247). As a result, this research is interested in whether nature-relatedness has a moderating role on the effect of the experience of virtual nature on social connectedness.

Hence, this study can help to fill in the research gap of the effectiveness of animated agents in a virtual setting, of the role of nature-relatedness and, it can help to find an intervention that prevents the previously mentioned consequences of loneliness and simultaneously keeps people safe from an infection with the virus.

Consequently, the hypotheses of this paper are formulated as follows:

1. Participants who saw a nature video with people in it show a higher increase in social connectedness, than those who saw the nature video without any presence of people.

1. a) Nature-related participants from the experimental group, compared to those who reported a low nature-relatedness, have a higher increase in social connectedness.

2. Participants who watched a nature video with people in it included more positive words/sentiments in their narratives than people from the control group, who did not see people.

Methods and Materials

Ethics

This study was approved by the BMS ethical committee / Domain Humanities & Social Sciences of the University of Twente. It has the request number "210388". Before people participated, they were provided with information and asked for consent. All participants were informed about the anonymous usage and storage of their data as well as their right to quit their participation at any time.

Research design

The design of the study was between-subject because one study with two conditions has been offered. One of the conditions included a trigger (experimental group) and the other did not. In both studies, a two-minute video of a digital nature environment was used with the difference that in one video walking humans were visible (experimental group) (see figure 1) while in the other one they could not be seen (control group) (see figure 2).

Stimuli

For the creation of the virtual nature and its stimuli, the Virtual Nature Recorder, which was developed by the BMS Lab at the University of Twente, was used ("Virtual Nature Healing Environment", n.d.). An advantage of using the software is that nature characteristics like trees and benches can be placed as preferred so that an individual nature scene can be created, fitting to the researchers' demands and allowing for experiments with nature.

Figure 1

Virtual nature with trigger (i.e., animated humans)

Figure 2

Virtual nature without the presence of the trigger

Participants

First, the data were screened for participants who did not finish the study. After the screening, the number of participants was reduced from 88 to 67. To ensure validity and consistency, participation was only possible for people aged 18 to 30 years old. The inclusion of ages above 30 could reduce reliability because of possible moderating variables (e.g., technological knowledge or interest in technology), while ages underneath the age of 18 could cause ethical concerns. Furthermore, participants were required to understand English

or German to answer the questions of the questionnaires. Additionally, they needed access to an online device (e.g., tablet, notebook/laptop) to access the study, watch the scenes and fill out the questionnaires. Some participants were students from the University of Twente who participated via the "Sona system", while others were collected through snowball sampling.

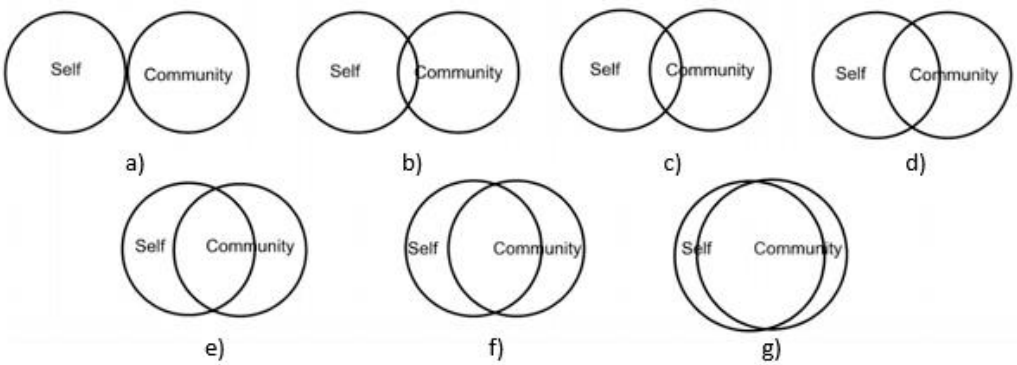
Measures

Social connectedness.

The level of the participants' connectedness to the community was measured by using **the Inclusion of Community in the Self Scale (ICS)** by Mashek et al. (2007) (see figure 3). It is a single-item pictorial assessment with high test–retest reliability, moderate validity, and good generalizability, wherefore this measure was seen as the best and simplest way to measure the participants' feeling of social connectedness. Participants were asked to select the picture which best describes their relationship with the community. It was used as a pre- and post-test to see if the nature video led to higher social connectedness in its viewers.

Figure 3

The Inclusion of Community in the Self Scale (ICS)



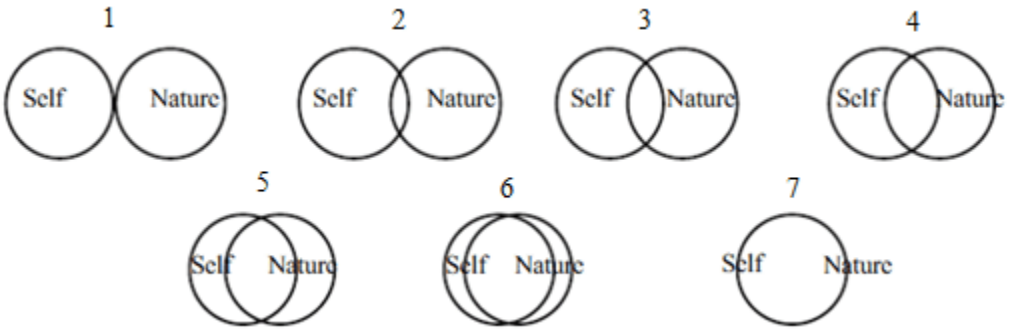
Note. By Mashek et al. (2007).

The Inclusion of Nature in Self scale (INS)

To test one's level of nature connectedness, **the inclusion of nature in self scale (INS)** of Schultz (2002) was used, which is a single-item pictorial measure. Participants were asked to choose the picture which describes their relationship with nature (see figure 4). It was used a pre-test only to assess the participants' nature-relatedness before their participation in order to evaluate if it has a moderating effect on the relationship between the experiment and people's sentiment in their narratives.

Figure 4

Inclusion of nature in self scale



Note. Source: Windhorst, Eric. (2019). Exploring the Ecological Self. An Interpretive Phenomenological Analysis with Gifted Adult.

Spatial Presence: Self Location (SPSL), 4-item scale

To test whether participants were immersed in the video, the four-item scale of **the Spatial Presence Self Location questionnaire** by Vorderer et al. (2004) was used, which measures the level of presence in a virtual environment. The Cronbach's alpha for this four-item scale is .905 and corresponds to the alpha of 0.92 mentioned in the paper of Vorderer et al. (2004) and moreover, conforms to its original version with eight items, ensuring high reliability and internal consistency (Vorderer et al., 2004). The participants had to indicate

whether they agreed or disagreed with the statements on a 5-point Likert scale (1= I do not agree at all; 5= I fully agree). This questionnaire was used as a post-test only, to see whether the participants could immerse themselves in the digital environment sufficiently.

Table 1

The four statements of the Spatial Presence Self Location questionnaire

1	I felt like I was actually there in the environment of the presentation
2	It was as if my true location had shifted into the environment in the presentation
3	I felt as if I was physically present in the environment of the presentation
4	It seemed as if I actually took part in the action of the presentation

Note. Vorderer et al. (2004)

Procedure

Participants either received a link to the study or got access to it by their "Sona" account. Participation was only possible online. There were two languages to choose from for the surveys: English and German. First, they were informed and asked for consent. Then, they received the instruction to fill out the ICS (Inclusion of Community in Self scale) and the INS (Inclusion of Nature in Self scale). Next, they were asked to place themselves in a quiet environment and to watch the nature video carefully. They were randomly placed either in the experimental or control condition.

To ensure that the participants can concentrate and immerse themselves in the video, they were reminded the following, before they watched the video: "Now, you will be shown a nature video of two minutes long. To watch it carefully, please place yourself in a quiet and

comfortable position. You should turn the volume on and listen to the sound. Also, please make sure to set the settings of the video to HD quality and watch it in full-screen mode. After the video, you will be asked a few more questions. To be able to answer them, please reflect on your feelings and memories while watching the nature video ".

After they watched the nature video, they filled out the ICS again, and in addition, the SPSL (Spatial Presence Self Location scale). In the end, to measure storytelling, participants were asked to type in an empty box: "Earlier, you saw a nature video. With that video in mind, think about and write down the emotions and memories which arose when you were watching the nature video. Please be as elaborate as possible and write whole sentences ". In the end, they were thanked and enlightened about the purpose of the study and its two conditions. The overall time to participate was approximately 10 minutes.

Data analysis

The data were analysed by using the statistical software package SPSS (Version 27). First, the data were screened for participants who did not finish the study.

To test whether participants who saw a nature video with people in it show a higher increase in social connectedness than those who saw the nature video without any presence of people, the mean difference scores for the ICS between the treatment group (nature video with people) and the control group (nature video without people) were calculated by subtracting the ICS pre-scores from the ICS post-scores. A value of zero would mean that the ICS scores do not differ before and after the video. Positive values were expected according to the first hypothesis. An independent samples t-test was computed to test if there were significant mean differences in the level of social connectedness between the experimental and control group.

For testing whether participants from the experimental group who reported high rates of nature-relatedness, compared to those who have low rates in the INS before the video,

have a higher increase in social-connectedness, the Mann-Whitney U test was run. For this, a dummy variable of participants from the experimental group was created: Participants who had scored high on the Inclusion of Nature in self scale (INS) before the video (4<) were labelled as "highINS" (1), while those who had scored low on the scale (below 4) were labelled as "lowINS" (0). The participants who had chosen the fourth answer possibility in the INS, were excluded in this analytical test because their score was on par with the mean score (M= 4.18, SD =1.11), and neither a high nor a low score.

To test whether participants who watched a nature video with the trigger include more positive words/sentiments in their narratives than people from the control group, who did not see animated humans, the narratives of the different groups were compared and analysed by an individualised sentiment analysis in an online tool called "monkeylearn" ("Sentiment Anaylzer", n.d.). Different pieces of texts were first coded into one or multiple of the following categories: positive, negative, and neutral. After this, the sentiment analyser was able to put the narratives from the data autonomously into the sentiment categories. All stories which fit multiple sentiments, were neutral or had a sentiment with a confidence percentage beneath 60 were counted as neutral. Furthermore, a chi-square test was executed to assess the significance of the sentiments' results.

Additional analysis

Additional analysis was done to see whether immersion was low or differed between the experimental and control group. Therefore, the means on the SPSL of both groups were compared by an independent t-test. The mean results were grouped into "Control" and "Experimental". A sufficient level of immersion would be a score of 4 (=I somehow agree) as a minimum.

Results

Demographics

The final dataset consisted of 67 participants who were randomly divided into two groups. 46% were male, and 54% were female. The age range was from 18 to 25 years (M = 21.43, SD = 1.47). The Experimental group consisted of 31 participants, whereas 36 people participated in the control group. In total, most participants chose the third answer possibility "Highschool" (M = 3.46, SD = 1.22) as their highest level of education. In general, 87% of all participants were German and 6% were Dutch. Other nationalities, which occurred once, were Serbian, Palestinian, Finnish, White-Russian, and Turkish. In total, no significant differences in education, gender and age could be found between the control and the experimental group.

Hypotheses testing

Independent Samples T-Test

An independent samples t-test was done to test hypothesis 1. Table 2 represents the independent samples t-test and shows the mean difference ("Md") scores for the Inclusion of Community in Self scale of two pairs, the experimental and the control group. No statistically significant differences were found for the relative scores of the Inclusion of Community in Self scale between the experimental group (Md = -0.032, SD = 1.08) and the control group (Md = -0.139, SD = 0.72), $t(65) = 0.48$, $p = .632$. The 95% confidence interval ranged from *-0.34 to 0.55.* As a result, no significant difference in the means of the relative ICS scores between the two groups were found.

Table 2

Independent t-test – Inclusion of Community in Self scale mean differences for control and experimental group

Group	Mean difference	SD
Experimental	-0.032	1.08
control	-0.139	0.72

Mann-Whitney U

To test hypothesis 1a, the Mann-Whitney U test was executed. Nine participants were excluded from the data because they scored a 4 in the INS scale which means that they were neutrally related. The final sample consisted of 22 participants, from which nine people (41%) scored low and 13 people (59%) scored high on nature-relatedness (see Table 3). The Mann-Whitney U test indicated that there were no significant mean differences (Md) and therefore no significant differences in the relative ICS scores between participants who scored high on nature-relatedness ($Md = 0.00$, $n = 13$) and participants who scored low on nature-relatedness ($Md = 0.00$, $n = 9$), $U = 55.5$, $z = -.3$, $p = .766$.

Table 3

Mann-Whitney Test Ranks of experimental group

	INS before video	N	Mean Rank
	Low	9	11.83
	High	13	11.27

Note. INS= Score level for the inclusion of nature in self scale, N= number of participants in the sample

Sentiment Analysis

To test hypothesis 2, a sentiment analysis was conducted which results were as follows: 13 (42%) narratives from the experimental group were rated as "positive", 2 (6%) were "negative", and 16 (52%) were analysed as "neutral". On the other side, from the control group's narratives, 26 (72%) out of 36 were coded positive, 2 were negative (6%) and 8 were neutral (22%) (see table 4). Overall, sentiments were mostly positive. In general, the probability for a positive sentiment was 58%. A chi-square test was calculated with the expected number of 58 for positive sentiment. The critical value was 3.84. Consequently, contrary to the hypothesis, the control group's stories contained significantly more positive sentiments than those of the experimental group (x^2(1, N = 2) = 7.8, p< .05).

Table 4

Number of narratives for each sentiment and the mean percentage of the certainty for the sentiment

group	Positive narratives (*)	Negative narratives (*)	Neutral narratives (*)
Experimental group	13 (88%)	2 (70%)	16 (80%)
Control group	26 (85%)	2 (84%)	8 (81%)

Note. *Mean percentage of the certainty for this sentiment

Additional findings

To see whether immersion differs between the two samples, the means of both groups were compared by an independent t-test.

Independent Samples T-Test for the Spatial Presence Self Location questionnaire

Table 5 represents the mean score for the SPSL for the control and experimental group. The scores represent the average level of agreement to the statements. No significant difference in

mean scores between the experimental (M = 2.98, SD = 0.23) and the control group (M = 2.56, SD = 0.22) were found, $t(65) = 1.407$, $p = .189$.

Table 5

Combined means and standard deviations for the "Spatial Presence Self Location questionnaire"

Experimental group's mean (SD)	Control group's mean (SD)
2.98 (0.23)	2.56 (0.22)

Discussion

This study aimed at finding out whether there is trigger which can positively affect social connectedness and storytelling for users who saw a virtual nature video. Practically speaking, it was hypothesised that seeing animated walking humans in a virtual nature triggers more feelings of social connectedness than virtual nature alone. Furthermore, it was expected that positive emotions will be evoked so that stories of the experimental group show a more positive sentiment than those of the control group, which saw the video without the existence of humans in it. Moreover, it was assumed that highly nature-related participants are more triggered by the people in the video, meaning that nature-relatedness would work as a moderator and lead to an enhancement of positive sentiment for storytelling.

M**ain findings**

Due to the findings, it can be said that the average post-scores of the Inclusion of Community in Self scale were not significantly higher than the average pre-scores, neither for the control nor for the treatment group. Consequently, the first hypothesis "Participants who saw a nature video with people in it show a higher increase in social connectedness, than

those who saw the nature video without any presence of people" cannot be verified. In a prior study of Van Houwelingen-Snippe et al. (2020), participants' social connectedness was measured based on the ICS scale before and after they had been exposed to a virtual nature scene, and contrary to the results found in this paper, they found a significant increase in scores. They made use of different digital nature scenes (tended or dense) to see which is triggering the greatest effect. Comparing their research to the research on hand, Van Houwelingen-Snippe et al. (2020) analysed a greater sample and used a different type of nature as the trigger which might have led to the significant increases in the participants' social connectedness scores. This might be an indicator of animated humans being inappropriate to trigger social connectedness and storytelling.

Furthermore, the Mann-Whitney U Test produced no significant results. Consequently, hypothesis 1 a) "Nature-related participants from the experimental group, compared to those who report a low nature-relatedness, have a higher increase in social connectedness" was falsified. Opposed to these results were those of Weinstein et al. (2009) who reported that nature-relatedness leaded to an increase in intrinsic aspirations, such as being community-oriented. Different to their research, the study on hand was not executed in a laboratory, wherefore it could not be controlled for appropriate participation and immersion.

There is only little prior research relating to nature and sentimental narration but Doughty (2013), who studied social activities in real nature, revealed that positive effects or sentiments occur when nature is experienced in a social setting (e.g., a group walk). Moreover, Strojny et al. (2020) could prove for significant effects of virtual agents on social facilitation when participants perceived themselves in the virtual setting as being socially surrounded. Because of the earlier findings and to accord with Weinstein et al. 's (2009) paper in which people immersed in a digital nature scene showed more intrinsic aspirations

positively relating to happiness, it was assumed that the visualisation of humans can trigger positive emotions, which was simply not the case. The sentiment analysis demonstrated that the narratives of the control group were significantly more positively rated than those in the experimental group. Because contrary results were hypothesised, the second hypothesis "Participants who watched a nature video with people in it included more positive words/sentiments in their narratives than people from the control group, who did not see people", must be rejected. This may be due to social company having an ambiguous effect and therefore, leading to an inhibition of emotional restoration mentioned in the paper of Staats et al. (2010).

Additional analysis showed that there is no difference between the control and experimental group's level of immersion in the digital nature environment. In general, participants reported in their narratives that they enjoyed the video and its bird sound. It was perceived as relaxing, and participants were remembered of past experiences with their family or friends. This is a strong point for (virtual) nature positively affecting a person's mood.

Limitations

One limitation is that the software was, during its usage for this study, still in its test phase and could not produce digital nature scenes of high quality and including people who look realistic. 16 Participants mentioned negative points in their narratives about the video. The most frequent comment, which was mentioned by 13 participants in total, was that the video was perceived as animated and surreal. Three people from the control group had this complain, as well as one-third of the experimental group mentioned (10 out of 31) of which nine were relating to the trigger. The animated people in the video were perceived as being annoying, confusing, and/or destroying an immersion into the nature scene.

By relating to Staats et al. (2010), the reason for the trigger being this disruptive might

be that participants were seeking for a state of relaxation and did not perceive the virtual nature to be threatening so that they were not in need of safety to reach this state. Lastly, two participants from the control group added the limitation that the bird sounds were too noisy.

Recommendations for future research

According to Strojny et al. (2020), perceived social realism can moderate the relationship between the variable of computer-animated agents and social facilitation, wherefore it is strongly advisable to work on a realistic animation of nature and its triggers. Staats et al. (2010) states that psychological restoration cannot be determined by specific physical or social characteristics because sometimes those characteristics may have ambiguous effects so that social presence for example can even inhibit psychological restoration whenever there is no need for company and safety. Also because of participants claiming that the video was too unrealistic, future research should use a video of a real nature scene with bird sounds, once with real humans and one time without them to see if social presence is or is not a trigger for variables such as social connectedness and storytelling.

If the software and the quality of its stimuli will be enhanced in the future, an alternative would then be to place the walking people more in the background to be less penetrative and trigger participants on a subliminal level. Voices of people and walk sounds can also be included in future research to create a more social and realistic atmosphere.

To ensure that participants watch the movie and have equal conditions, an idea is to do a controlled study and invite participants to a lab to assist them. The usage of other sampling methods, like systematic or random sampling, instead of convenience sampling only, could also be implemented in future research to increase the number of participants and enhance the representativeness of the sample.

Conclusion

This study was operated during the COVID-19 pandemic, which had led to social isolation, wherefore the problem of loneliness got greater attention. As this problem will always occur and affect people's health, the focus of this research lied on virtual nature and its positive effect on social connectedness and storytelling because they have the potential to decrease feelings of loneliness. While past research demonstrated a positive effect of digital nature on mood, this study tried to figure out if animated humans can be used as a trigger and if nature-relatedness could act as a moderator to enhance the effect of the nature video (including the trigger) on social connectedness and storytelling. Unfortunately, this study could not reveal such significant effects. However, earlier studies were indeed showing a positive effect of virtual nature on social connectedness, wherefore it should be still of interest to do further research and to investigate triggers that increase the positive effect of virtual nature on social connectedness and storytelling. The narratives of the participants of this study were mostly positive, leading to the assumption that virtual nature can evoke positive sentiments. Considering prior research and the results and limitations of this study, this field of research should be held as relevant because it aims at preventing/reducing feelings of loneliness, so that medical and psychological health care institutions can benefit from it. Moreover, the general population can take advantage from virtual nature as well, as it enhances their mood without them leaving their private setting.

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