



universität
wien

MASTERARBEIT / MASTER'S THESIS

Titel der Masterarbeit / Title of the Master's Thesis

„Does nature make us better people? – Effects of various
landscape types on human prosocial behaviour“

verfasst von / submitted by

Elisabeth Arnold, BSc

angestrebter akademischer Grad / in partial fulfilment of the requirements for the degree of
Master of Science (MSc)

Wien, 2023 / Vienna 2023

Studienkennzahl lt. Studienblatt /
degree programme code as it appears on
the student record sheet:

UA 066 840

Studienrichtung lt. Studienblatt /
degree programme as it appears on
the student record sheet:

Masterstudium Psychologie UG2002

Betreut von / Supervisor:

Univ.-Prof. Dipl.-Psych. Sabine Pahl, MSc PhD

Acknowledgements

I would like to express my appreciation and gratitude to my supervisors Sabine Pahl, and especially Sari Nijssen and Lisbeth Weitensfelder. Thank you for introducing me to the world of research. Thank you for always having an open ear, for your guidance, support, and feedback – during every single stage of this research.

I am also grateful to my parents who made it possible for me to start this degree in the first place and supported me through all of it.

I want to say thank you to other family and friends, who continuously were there for me during the creation process of this thesis.

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Introduction

Spending time in green nature (e.g., human-made green spaces such as parks or natural green spaces such as forests) has various benefits for humans. Nature promotes health benefits (e.g., stress relief, lower blood pressure) and brings people closer together (see review Goldy & Piff, 2020). Apart from beneficial factors that are crucial for the physical and mental health, green nature seems to have a positive influence on people's social connections and their prosocial behaviour (Goldy & Piff, 2020). However, with populations in urban areas growing, access to nature is impeded, which might have a negative impact on people's lives.

Rural exodus is increasing worldwide. Since 2018, 72% of the European population live in urban areas (United Nations, 2018) with an expected rise to almost 84% by 2050 (European Commission, 2020). As population shifts from rural areas to cities, downsides come with it, one of them being the potential loss of access to natural areas. This might have negative consequences for people, since nature plays an important role in the well-being of individuals (e.g., Aerts et al., 2018; MacKerron & Mourato, 2013). The current study investigates the influence of different nature types on prosocial behaviour. A research gap is narrowed, as most of the studies in this field only looked at effects of green spaces on prosocial behaviour (Putra et al., 2020). By replacing real nature experiences with nature experiences on-screen, a way of reacting to nature loss is examined.

Prosociality

There are time-stable interindividual differences in thinking and acting prosocially (e.g., Eisenberg et al., 1999; Penner & Finkelstein, 1998). Prosociality as a personality trait implicates that there are individuals who act in a more and others who act in a less prosocial way. Trait-level prosociality should therefore predict specific, situational prosocial behaviour.

Prosocial behaviour generally describes all voluntary actions that benefit others (e.g., Pfattheicher et al., 2022; Batson & Powell, 2003) but come with costs (e.g., financial costs, physical effort) for oneself (Wittek & Bekkers, 2015). Specific behaviours include helping, sharing, and comforting (Dunfield, 2014), which are assumed to be different reactions to different needs: instrumental, material, and emotional, respectively (e.g., Dunfield & Kuhlmeier, 2013). Measuring prosocial behaviour through willingness to help as opposed to measuring it with economic games (i.e., dictator game, trust game) as it is often done (Thielmann et al., 2020) might relate more to everyday prosocial acts, as it does not involve financial costs, but rather physical effort (Lockwood et al., 2021).

Nature and prosocial behaviour

Nature enhances social connections and prosociality (Goldy & Piff, 2020) and people's social relationships are promoted through natural environments (Holtan et al., 2015). People are more trusting and more generous after spending time in nature (Castelo et al., 2021) and they tend to be more helpful after short visits to parks (Guéguen & Stefan, 2016). Enhanced prosocial behaviour after nature exposure is often explained by a mood boosting effect of nature (e.g., Berman et al., 2012; Cervinka et al., 2012). Enhanced mood lets people's attention shift from themselves towards others, which makes prosocial behaviour (i.e., helping) more likely (Aknin et al., 2018).

People seem to benefit from nature when effectively spending time in it, but also when confronted with nature in a laboratory setting. Exposing people to nature on a screen positively affected their prosocial behaviour: When watching videos of BBC's Planet Earth, participants' generosity increased (Piff et al., 2015). Even just looking at pictures of natural landscapes as opposed to urban areas enhanced people's generosity in a trust game (Weinstein et al., 2009).

Still, not all natural settings might promote prosocial behaviour the same way. Studies that investigated this effect mostly looked at the impact of exposure to green spaces on prosocial behaviour (Putra et al., 2020). There is little evidence on the effects of other natural environments such as blue spaces (Smith et al., 2021) or natural landscapes that do not contain green or blue features at all.

Different natural sceneries may evoke different levels of prosocial behaviour, or rather, different features of environments might account for differences in the effect of nature on prosocial behaviour. Theoretical explanations for that include a broad variety, ranging from feelings of awe/beauty or (resource) security to personal preferences.

Feelings of awe and beauty

Awe-inducing experiences in nature enhance feelings of closeness and social ties to others (Bai et al., 2017), as well as generous behaviour (Piff et al., 2015). Perceived beauty of a landscape might also be a driver in the effect of nature on prosocial behaviour. Exposure to nature that was perceived more beautiful as opposed to nature perceived less beautiful lead to enhanced generosity (Zhang et al., 2014).

Security and resources

Environments considered high in resources and security (such as gardens, parks) as well as environments considered low in resources and security (such as deserts) lead to more

prosocial behaviour (Ng et al., 2019). Thus, features of resources and security in an environment might account for different levels in prosocial behaviour after exposure to nature.

Landscape preferences

People prefer landscapes that are fascinating and make them feel comfortable and safe (e.g., Gao et al., 2019; Wilkie & Clements, 2017). Being exposed to preferred landscapes might indirectly contribute to beneficial health outcomes (Hartig et al., 2011) and it correlates with increased mood (Gao et al., 2019) which is said to make people more willing to act prosocially (e.g., Lyubomirsky et al., 2005).

The preference of certain environments over others is discussed in a set of three different theories. First, the “biophilia hypothesis” (Wilson, 1984) states that people have an innate preference for life and diversity of species and landscapes, although it is not really clarified what kind of species or landscape type is the most preferred one. Second, the “habitat theory” (Orians, 1980, as cited in Tveit et al., 2019), based on the theory of evolution, states that people mostly prefer savannah-like landscapes, because that is where our ancestors lived. Third, the concept of “topophilia” also seems to play an important role in landscape preferences. Tuan (1974, as cited in Tveit et al., 2019) explains topophilia as a preference for known and familiar landscapes (e.g., landscapes that people grew up in). It is presumed that people’s preferred landscape type has the strongest enhancing effect on their prosocial behaviour.

Following the “biophilia hypothesis”, people would feel most comfortable in biodiverse settings (i.e., landscapes with a variety of plants) and, thus, act more prosocial being exposed to this environment. Should the “habitat theory” or the “topophilia theory” determine which landscape type is preferred, the same assumption is made for each landscape type, respectively. Should people prefer savannah-like, dry, landscapes, they would act more prosocial being confronted with this type of landscape. Should people prefer familiar looking landscapes (i.e., mostly green meadows, hills, or mountains for people in Austria and Germany), they would act more prosocial when being exposed to this landscape type.

Connectedness to Nature

Additionally to their preferences, people can vary in how connected they feel with nature. Connectedness to Nature (CN) describes the relation and connection of an individual with nature (Schultz, 2002, p. 67), and can even be seen as a trait characteristic (Mayer & Frantz, 2004). Besides probed correlations between CN and prosocial behaviour (Whitten et

al., 2018), research has also shown the positive relation of CN to understanding of others (perspective taking) and altruism (Mayer and Frantz, 2004). A feeling of CN seems to develop from spending time in nature during childhood, as well as in adult life, as it is positively linked to access to nature (e.g., Nisbet et al., 2009; Pensini et al., 2016; Rosa et al., 2018).

The current study

By conducting two different studies, the effect of nature on one specific facet of prosocial behaviour (i.e., willingness to help) is investigated. To minimize possible confounders, willingness to help was chosen as an operationalization, as it does not include financial costs, nor the need to share material goods. Study 1 investigates the effect of three different landscape types (focusing on the mentioned theories of landscape preferences) on prosocial behaviour. The current study brings new insights to the field of beneficial effects of nature, since most studies only investigated the effects of green spaces. Additionally, trait-level characteristics (CN, access to nature, trait-level prosociality) are measured. The main hypothesis reads as follows:

Hypothesis 1: Different landscape types will evoke differences in the willingness to help.

A set of subordinate hypotheses is formed:

Hypothesis 2: CN will positively influence the effect of different landscape types on willingness to help.

Hypothesis 3: Access to nature will positively correlate with CN.

Hypothesis 4: Higher trait-level prosociality will predict more willingness to help.

Study 2 tries to replicate the effect of nature versus urban areas on prosocial behaviour. Contrary to the study of Weinstein et al. (2009) the effect is investigated on willingness to help instead of trust/generosity. This helps to further support previous findings with a new look on one specific facet of prosocial behaviour. The hypothesis reads as follows:

Hypothesis 1: The landscape and the urban area will evoke different levels of willingness to help.

Methodology Study 1

Participants

Study 1 consisted of a survey, which was carried out online in German via SoSciSurvey (<https://www.soscisurvey.de/>). Minimum required sample size was calculated

with G*Power 3.1.9.7 ($f = .25^1$, $power = .8$, two-tailed $\alpha = .05$) and resulted in an $N = 120$. Participants were mostly recruited via social media (Facebook, WhatsApp) and the platform “Surveycircle”² (<https://www.surveycircle.com/de/>). Inclusion criteria were speaking German and being at least 18 years old. Data collection was stopped when a total of 209 participants filled out the survey, to account for attrition. Six participants were excluded because of missing values in the key variables (= ratings of willingness to help), one because they were younger than 18 years. This resulted in a final sample of 202 participants (168 female; $M_{age} = 30.1$ years, $SD_{age} = 12.5$).

Materials and Procedure

Participants started the online survey by opening a link that was posted on social media. They were guaranteed confidentiality and informed that participation in this study was entirely voluntary and could be ended anytime. After stating demographic information, participants answered six questionnaires not relevant to this study³, which took up to ten minutes approximately.

After that, participants filled out the subscale for prosociality of the “Inventar Sozialer Kompetenzen [Inventory for Measuring Social Competence]” (ISK; Kanning, 2009) to measure their trait-level prosociality. Seven items were rated on a 4-point Likert scale (from 1: “strongly disagree“ to 4: “strongly agree”; e.g., “Ich engagiere mich aktiv für andere Menschen [I am actively committed to helping other people].”) (Cronbach’s $\alpha = .65$).

To measure access to nature, participants answered four self-created questions regarding the proximity of natural sceneries during their childhood and the estimated time spent in these during their childhood and in the present. The questions were based on items from previous studies investigating people’s contact with nature (e.g., Hartig et al., 2014; Rosa et al., 2018). Due to insufficient reliability (Cronbach’s $\alpha < .5$) one item was removed in the data analysis process (Cronbach’s α after removing one item = .62). Questions are shown in Appendix A.

Then, participants filled out the German short version of the “Connectedness to Nature Scale” (CNS; Mayer & Frantz, 2004). To measure how connected participants feel with the environment, they rated thirteen statements on a 5-point Likert scale (from 1:

¹ No estimated effect size could be found in previous studies, so the effect was assumed medium sized.

² Surveycircle: This is a platform to post research projects and gather participants. By participating in other studies, points can be gathered. The more points gathered, the higher the chances of getting participants for the own research project.

³ The current studies were part of a bigger research project at the Center of Public Health in Vienna.

“strongly disagree” to 5: “strongly agree”; e.g., “Ich fühle mich häufig eins mit der mich umgebenden Natur [I often feel a sense of oneness with the natural world around me].”) (Cronbach’s $\alpha = .89$).

After that, participants were assigned to groups by randomly showing them one of three pictures (either a biodiverse landscape, a green meadow, or a desert) for one minute (Appendix A).

To allow participants to immerse a little deeper into the landscape, and to counteract face validity, they rated how comfortable they would feel living in the landscape they just looked at on a 7-point Likert scale (from 1: “extremely uncomfortable” to 7: “extremely comfortable”; Appendix A). The rating served as a measurement of landscape preference.

Lastly, to measure willingness to help, participants rated the probability of them helping a stranger in a scenario that was described before on a 7-point Likert scale (from 1: “extremely unlikely” to 7: “extremely likely”). Probability was rated two times, one time imagining they were in a hurry (stressful situation), and one time imagining they had enough time (neutral situation). The self-created scenario was based on previous studies that measured people’s prosocial behaviour (e.g., Einolf, 2008; Korndörfer et al., 2015). The example is displayed in Appendix A.

The survey ended after approximately 20 minutes, participants were debriefed and thanked for their time.

Statistical Analyses

Data analyses were done with SPSS (version 28). For Hypothesis 1, the difference in willingness to help after being exposed to different landscape types was investigated by conducting a two-way repeated measures analysis of variances (rmANOVA). Willingness to help served as dependent variable (DV) and was analysed regarding a main effect of nature exposure (biodiverse, green meadow, desert; between-subjects-factor), a main effect of stress (stressful situation, neutral situation; repeated within-subjects-factor), and an interaction effect of nature exposure and stress.

To check if CN influences the difference in willingness to help between the exposure groups CN was added as a covariate in a repeated measures analysis of covariances (rmANCOVA) and tested for the same effects as in the rmANOVA (Hypothesis 2).⁴

⁴ The rmANOVA/ANCOVA was chosen as a method to additionally investigate the influence of the factor stress. Assuming that rating willingness to help in two different situations are two separate DVs, a multivariate analysis of (co)variances (MANOVA/MANCOVA) could also be conducted instead. Nothing changes in the outcomes, the results of the MANOVA/MANCOVA can be found in Appendix B.

A Pearson's correlation was done to investigate the connection between access to nature (independent variable) and CN (DV) with calculated sum scores of items of each questionnaire (Hypothesis 3).

A simple linear regression was done to check if trait-level prosociality (sum score of ISK; independent variable) can predict willingness to help (rating of probability to help in the stressful situation; DV) (Hypothesis 4). Bootstrapping was carried out with 1000 samples.

Landscape preferences were analysed with an ANOVA, comparing the ratings of how comfortable participants would feel living in the displayed landscape.

Results Study 1

Hypotheses 1 & 2: Landscape Types and Willingness to Help

There was no difference in the willingness to help between the different types of landscapes, $F(2, 199) = 1.50$, $p = .227$, partial $\eta^2 = .015$. For the sake of completeness, a Tukey-HSD post-hoc analysis was conducted. No significant differences were revealed between the three groups ($p > .05$). Willingness to help did not differ between biodiverse scenery and green meadow (.25, 95%-CI [-.19, .70]), nor between biodiverse scenery and desert (.30, 95%-CI [-.14, .74]), nor between green meadow and desert (.05, 95%-CI [-.39, .49]). Willingness to help differed statistically significant between the stressful and neutral situation, $F(1, 199) = 177.36$, $p < .001$, partial $\eta^2 = .471$, with participants rating willingness to help higher in the neutral than in the stressful situation (1.41, 95%-CI [1.20, 1.61]). There was no interaction effect of nature exposure and stress situation, $F(2, 199) = .23$, $p = .796$, partial $\eta^2 = .002$. To quantify evidence for the null hypothesis, a Bayesian rmANOVA was performed. This provided moderate evidence that the effect of looking at natural sceneries was the same for all landscape types ($BF_{01} = 8.19$ compared to null-model).

By adding CN as a covariate, five participants were excluded due to missing values in the CN sum score ($N = 197$). No significant differences in willingness to help were found between different landscape types, but CN had a statistically significant influence on willingness to help (Table 1). Willingness to help showed a statistically significant difference between the two stress conditions with participants being more willing to help in the neutral than in the stress situation (1.40, 95%-CI [1.19, 1.61]), no interaction effects were found (Table 2).

Table 1

Between-Subjects Effects of rmANCOVA for Willingness to Help by Group Assignment with CN as Covariate

	<i>SS</i>	<i>df</i>	<i>MS</i>	<i>F</i>	<i>p</i>	η_p^2
CN (covariate)	33.21	1	33.21	14.86	< .001	.071
Group Assignment	7.34	2	3.67	1.64	.196	.017
Error	431.26	193	2.23			

Note. Total $N = 197$, SS = sum of squares, df = degree of freedom, MS = mean squares, η_p^2 = partial eta².

Table 2

Within-Subjects Effects of rmANCOVA for Willingness to Help by Group Assignment with CN as Covariate and Stress as Repeated Measure

	<i>SS</i>	<i>df</i>	<i>MS</i>	<i>F</i>	<i>p</i>	η_p^2
Stress	10.30	1	10.30	8.97	.003	.044
Stress*Group						
Assignment	.77	1	.38	.33	.717	.003
Stress*CN	.30	2	.23	.26	.611	.001
Error	221.60	193	1.15			

Note. Total $N = 197$, SS = sum of squares, df = degree of freedom, MS = mean squares, η_p^2 = partial eta².

Hypothesis 3: Access to Nature and CN

Five participants were excluded because of missing values in the CN sum score ($N = 197$). Access to nature ($M = 9.57$, $SD = 2.15$) and CN ($M = 46.46$, $SD = 9.15$) were moderately positive correlated, $r = .36$, $p < .001$.

Hypothesis 4: Trait-Level Prosociality and Willingness to Help

Four participants were excluded due to missing values in the ISK ($N = 198$). The regression model turned out to be significant, with a small goodness-of-fit (Cohen, 1988), $R^2 = .04$, $F(1, 196) = 8.40$, $p = .004$. Trait-level prosociality ($M = 22.73$, $SD = 3.00$) significantly predicted willingness to help ($M = 5.06$, $SD = 1.62$), $b = .11$, 95%-CI [.04, .19], $p = .004$.

Discussion Study 1

This study investigated the level of willingness to help after being exposed to different landscape types on screen. The results lead to the conclusion that different natural sceneries do not evoke different levels of prosocial behaviour, but rather that stress induces differences in willingness to help, as participants were more willing to help in the neutral situation. The effect of nature on prosocial behaviour seems to be the same for all three landscape types. Although landscape preference could be shown for the biodiverse landscape and the green meadow (Appendix B), this does not seem to be a driving factor in the effect of nature on prosocial behaviour, as levels of willingness to help did not differ between the different landscape types. Overall landscape preference might be suppressed by distinct, singular features in the environment (such as awe, resources, ...), as previous studies already found beneficial effects for prosocial behaviour in them (e.g., Bai et al., 2017; Zhang et al., 2014).

A significant moderate correlation between access to nature and CN was found. This supports previous findings (e.g., Nisbet et al., 2009; Rosa et al., 2018) and underlines that possibilities to spend time in nature and time spent in nature is linked to a deeper feeling of connectedness with the nature around one. Results also support the assumption that people who report higher trait-level prosociality than others tend to help more in a specific situation that requires help.

Since no difference in willingness to help between the three different landscape types was found, the question arises if all landscape types have the same beneficial effect on willingness to help, or if nature does not influence this facet of prosocial behaviour. To tackle this, Study 2 investigates a possible difference in the effect of nature and urban areas on willingness to help. This should help to clarify if the effect of nature on willingness to help is the same for different landscape types, or if the beneficial effect of nature might just not exist for willingness to help.

Methodology Study 2

Participants

Minimum sample size was calculated with G*Power 3.1.9.7 ($f = .25^1$, $power = .8$, two-tailed $\alpha = .05$) and resulted in an $N = 98$. Participants were recruited via different Facebook groups. Inclusion criteria were the same as in Study 1. Data collection was stopped when 145 participants filled out the survey, to account for attrition (120 female; $M_{age} = 28.5$, $SD_{age} = 7.6$).

Materials and Procedure

As in Study 1, participants stated their demographic information (gender, age, education) after they were informed about confidentiality and agreed to voluntarily participate. They completed the same three questionnaires that were used in Study 1 to measure trait-level prosociality, access to nature and CN.

Then, participants were randomly assigned to two different groups by either showing them a picture of a biodiverse or an urban landscape for one minute (Appendix A).

The question to measure landscape immersion and landscape preference as well as the example to measure willingness to help stayed the same as in Study 1.

Contrary to Study 1, a second item was added to measure the participants' prosocial behaviour more actively. After rating the probability of helping a random person, participants were asked to help fill out a second survey (i.e., willingness to participate in another study; Appendix A).

Regardless of their answer, participants reached the end of the survey afterwards. They were thanked for their time and informed that it will not be necessary to fill out another survey and that the purpose of the last question only was to measure their prosocial behaviour.

Statistical Analyses

To investigate the influence of a natural scenery versus an urban area on willingness to help, a rmANOVA was conducted for the same reason as in Study 1. Willingness to help served as DV, tested for a main effect of landscape exposure (nature, city; between-subjects-factor), a main effect of stress (stressful situation, neutral situation; repeated within-subjects-factor), and an interaction effect for landscape exposure and stress.

A chi-squared test for association was conducted to analyse willingness to participate in another study between the two assigned groups.

Landscape preferences were analysed with an independent samples t-test, comparing the ratings of how comfortable participants would feel living in the displayed landscape (results Appendix B).

Results Study 2

Hypothesis 1: Nature vs. City and Willingness to Help/Participate in Another Study

There was no statistically significant difference in willingness to help between the nature and the city group, $F(1, 143) = .61$, $p = .435$, partial $\eta^2 = .004$. Willingness to help did

not differ between landscape and city group (.18, 95%-CI [-.28, .64]). Willingness to help differed statistically significant between the two stress conditions with participants being more willing to help in the neutral than in the stress situation (1.18, 95%-CI [.97, 1.39]), no interaction effect was found for landscape exposure and stress (Table 3). A Bayesian rmANOVA provided moderate evidence that the effect of looking at natural sceneries on willingness to help was the same as looking at urban areas ($BF_{01} = 3.77$ compared to null-model).

Table 3

Within-Subjects Effects of rmANOVA for Willingness to Help by Group Assignment with Stress as Repeated Measure

	<i>SS</i>	<i>df</i>	<i>MS</i>	<i>F</i>	<i>p</i>	η_p^2
Stress	100.94	1	100.94	127.77	< .001	.472
Stress*Group						
Assignment	.69	1	.69	.878	.350	.006
Error	112.98	143	.79			

Note. Total $N = 145$, SS = sum of squares, df = degree of freedom, MS = mean squares, η_p^2 = partial eta².

Seven participants were excluded when running the chi-squared test due to missing values in willingness to participate in another study ($N = 138$). All expected cell frequencies were greater than 5. Results showed no statistically significant correlation between assigned group and willingness to participate in another study, $\chi^2(1) = .03$, $p = .863$, $\phi = -.02$. A Bayes Factor provided moderate evidence that the effect of looking at natural sceneries or urban areas on willingness to participate in another study was the same for both conditions ($BF_{01} = 4.74$ compared to null-model).

Discussion Study 2

This study investigated the level of willingness to help after exposure to either a landscape or an urban area on screen. Results showed no difference in the effect of looking at nature as opposed to an urban area on prosocial behaviour: neither on willingness to help, nor on willingness to participate in another study. Willingness to help only showed differences between the two stress conditions, with people being more willing to help in the neutral than in the stressful situation. This partly contradicts findings that implicate looking at natural

sceneries as opposed to urban areas enhances generosity in people (Weinstein et al., 2009). Thus, results from this study suggest that the beneficial effect of nature on prosocial behaviour might not apply to prosocial behaviour in general, but only to specific sub-facets.

General Discussion

Both studies investigated the influence of nature on an important facet of prosocial behaviour: willingness to help. Different landscape types were assumed to elicit different levels of willingness to help in participants. Other influential factors were investigated additionally. Access to nature was assumed to correlate with CN, and trait prosociality was assumed to predict willingness to help. Results show that contrary to the hypotheses, different landscape types did not evoke different levels of willingness to help in people (Study 1). No difference in willingness to help/willingness to participate in another study was found between exposure to nature and urban area (Study 2). Stress rather than landscape type influenced peoples' willingness to help. Still, results from Study 1 showed that people who have nature near them and spend more time in it also have a higher level of CN. Trait-level prosociality was positively connected to willingness to help. Results from an exploratory regression analysis with participants from both studies showed that CN seems to be related to trait-level prosociality and willingness to help in a specific situation (Appendix B). Overall, the results implicate that nature exposure, at least on screen, does not impact willingness to help, but rather that people's trait characteristics (CN, prosociality) might relate to their prosocial behaviour. These findings and their implications shall be discussed in more detail.

Exposing people to nature on screen does not seem to have the beneficial effect on willingness to help as it did in other experiments on trust and generosity (e.g., Weinstein et al, 2009; Zelenski et al, 2015) and no differences could be found after exposure to different landscape types. Limitations of the present study must be considered as explanations for these results. First, the sample is very homogenous, with participants mostly being students, female, and young grown-ups. Second, it was an online study, participants could fill it out whenever and wherever they wanted. This way, it could not be controlled how thorough it was done and what other confounders might have been present. Nonetheless, it can be argued that a beneficial effect of nature exposure on prosocial behaviour would be of most use if it occurs in fleeting and uncontrollable settings in everyday life.

There are reasonable explanations besides the limitations as to why the anticipated effect could not be found in the current studies. It is likely that the beneficial effect of nature on prosocial behaviour is only applicable to a certain aspect of prosocial behaviour and not to

willingness to help. This might explain why the effect in Study 2 could not be seen as it has been in other studies (e.g., Weinstein et al., 2009). This suggests that the beneficial effect of short nature exposure on a screen only applies to a specific facet of prosocial behaviour (i.e., generosity). Different prosocial behaviours underlie different psychological processes. While helping mostly requires effort exertion, showing generosity involves financial costs (Lockwood et al., 2021). Further, people are generally more eager to help others than to share and give away resources (Yang et al., 2014). This study included a measurement of landscape preference, but even though the green and biodiverse landscape were preferred over the desert and the city (Appendix B), it did not moderate the influence on the level of willingness to help in participants. There might be other features of landscapes, such as awe-inducing features or resources and security in a landscape (e.g., Bai et al., 2017; Ng et al., 2019), that suppress the effect of landscape preference on willingness to help. Lastly, it could also be assumed that nature exposure on screen simply cannot replace actual visits to nature and the beneficial effects that come out of that. On-screen exposure, especially limited to one minute, just might not have been enough to increase specific behaviours: Although both simulated natural environments and ‘real’ natural environments can have positive effects on health (e.g., reduced stress), people sometimes are not fully stimulated by simulated natural environments or do not feel connected to nature after such an experience (Kjellgren & Buhrkall, 2010). As participants in this study looked at pictures of landscapes rather than videos or having virtual-reality (VR) experiences, they underwent one of the least immersive nature exposures. The more immersive the nature experiences, the greater the resulting benefits (Yu et al., 2018). Lack of immersion could therefore account for not seeing any change in the level of willingness to help. Though some studies surprisingly showed results on attention restoration after just some seconds of on-screen picture presentation (Lee et al., 2015), this does not necessarily mean that on-screen picture-exposure is enough to induce effects in other areas.

Findings of the current study still suggest that nature plays a part in influencing humans and their behaviour. Concluding from the marginal measurements of trait-prosociality, access to nature, and CN in this study, people with natural environments closer to them tend to develop a deeper connection and feeling of belonging to nature. Trait-level prosociality predicts acts of prosocial behaviour in specific situations and it seems to be related to CN. Results implicate that fleeting exposures to nature do not necessarily influence people’s willingness to help in a specific situation, but rather that access to nature and real

exposure to it form deeper CN as a trait-level characteristic. Formed CN might help shaping trait prosociality and influence acts of helpfulness in specific situations.

As previously mentioned, the low level of immersion during nature exposure might account for the lack of significant evidence for an effect of nature on prosocial behaviour. With new VR systems available, future studies should investigate if more immersive simulated nature exposures have a greater influence on prosocial behaviour than exposure to different landscape types on screen had in this study. As loss of nature and impeded access to nature keep posing a threat to humans, further investigation of the beneficial effects of nature as a VR-experience is needed.

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Appendix A

Table A1a

Self-created Items to Measure Access to Nature

Introduction	Die folgenden Fragen beziehen sich auf Naturlandschaften in Ihrer Umgebung.
Item 1	Wie lange brauchten Sie während Ihrer Kindheit/Jugend ohne Auto, um zur nächst gelegenen Naturlandschaft (Wälder, Berge, Seen/Flüsse) zu gelangen?
Item 2	Wie häufig haben Sie im schulpflichtigen Alter Zeit in natürlichen Landschaften (Wälder, Berge, Seen/Flüsse) verbracht? Bitte schätzen Sie einen Durchschnittswert.
Item 3	Wie häufig haben Sie im letzten Jahr Zeit in natürlichen Landschaften (Wälder, Berge, Seen/Flüsse) verbracht? Bitte schätzen Sie einen Durchschnittswert.
Item 4	Wo leben Sie derzeit?

Note. Item 4 was excluded from data analyses to guarantee higher reliability (Cronbach's α including Item 4 = .36; Cronbach's α excluding Item 4 = .62).

Table A1b

Self-created Items to Measure Access to Nature

Answer-categories	
Item 1	< 10 min, zwischen 10 u. 30 min, zwischen 31 u. 60 min, > 1 Stunde
Item 2	täglich, mehrmals pro Woche, ca. 1 mal pro Woche, mehrmals pro Monat, ca. 1 mal pro Monat, weniger als 1 mal im Monat
Item 3	täglich, mehrmals pro Woche, ca. 1 mal pro Woche, mehrmals pro Monat, ca. 1 mal pro Monat, weniger als 1 mal im Monat
Item 4	in einer Stadt mit mehr als 300.000 Einwohner*innen, in einer Stadt mit mehr als 10.000 Einwohner*innen, in einem Ort mit weniger als 10.000 Einwohner*innen

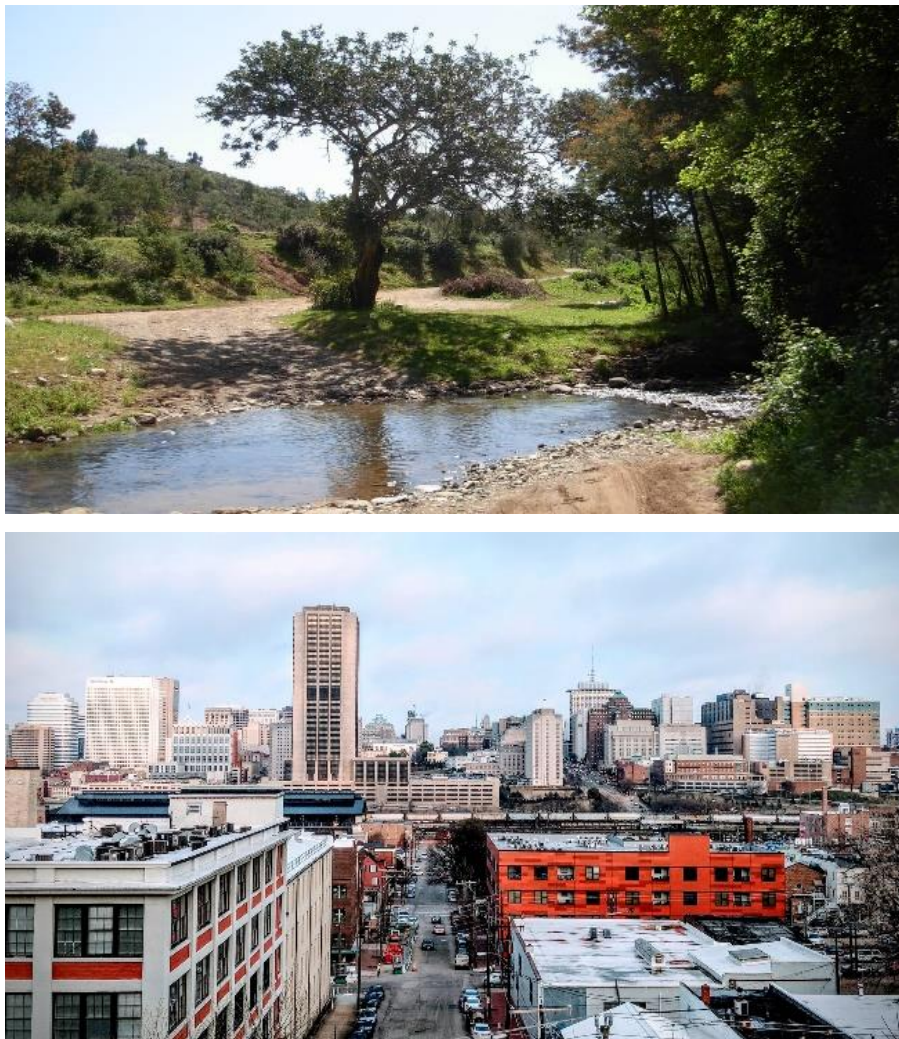
Note. Item 4 was excluded from data analyses.

Figure A1

Images for Group Assignment Study 1



Note. Images are “biodiverse”, “green meadow”, “desert” from top to bottom. Image selection was based on the mentioned theories of landscape preferences (i.e., “biophilia hypothesis”, “topophilia hypothesis”, “habitat theory”). All three images were taken personally.

Figure A2*Images for Group Assignment Study 2*

Note. Top image is biodiverse, bottom image is city. The image of the biodiverse landscape is a personal shot, the image of a city was downloaded from the free access website <https://unsplash.com/de>.

Table A2*Nature Immersion and Measurement Landscape Preference*

Introduction	Bitte denken Sie nun an die Landschaft, die Sie soeben gesehen haben.
Item	Angenommen Sie würden dort wohnen, all Ihre sonstigen Lebensumstände (Familie, Arbeit, Einkommen...) wären unverändert: Wie wohl fühlen Sie sich in dieser Lebenssituation?

Note. Item was rated on a 7-point Likert scale from 1 (extremely uncomfortable) to 7 (extremely comfortable).

Table A3*Example 1 Willingness to Help (Scenario Measurement, Study 1&2)*

Introduction	Stellen Sie sich vor, Sie sind auf dem Weg zu einer Besprechung. Sie sind schon ein bisschen knapp in der Zeit und müssen sich beeilen, damit Sie nicht zu spät kommen. Aus dem Augenwinkel sehen Sie auf der anderen Straßenseite eine Frau mit Kleinkind an der Hand und einer Einkaufstasche. Plötzlich reißt der Frau die Einkaufstasche und alle Einkäufe rollen über den Boden. Andere Personen sind derzeit nicht in Sicht.
Item 1 (stressful situation)	Für wie wahrscheinlich halten Sie es, dass Sie der Frau helfen ihre Einkäufe aufzusammeln?
Item 2 (neutral situation)	Angenommen Sie sind 10 Minuten früher aus dem Haus gegangen: Für wie wahrscheinlich halten Sie es in diesem Fall, dass Sie der Frau helfen?

Note. Items were rated on a 7-point Likert scale from 1 (extremely unlikely) to 7 (extremely likely).

Table A4*Example 2 Willingness to Participate in Another Study (Study 2)*

Introduction	Vielen Dank für Ihre Teilnahme! Wir möchten uns ganz herzlich für Ihre Mithilfe bedanken. Wir hoffen, durch die Studie Erkenntnisse zu gewinnen, die auf längere Sicht wetterempfindlichen Menschen helfen können. Aus der Studie ist derzeit auch eine Masterarbeit im Entstehen. <u>An dieser Stelle möchten wir Sie noch bitten, zusätzlich bei einer weiteren Online-Umfrage teilzunehmen.</u> Eine Studienkollegin hat Schwierigkeiten, genügend Testpersonen zu finden, und Sie würden ihr damit enorm weiterhelfen. Die Teilnahme ist natürlich freiwillig. Wenn Sie noch ca. 5-10 Minuten Ihrer Zeit aufwenden können, klicken Sie bitte auf „Ja“, Sie werden direkt zum Fragebogen weitergeleitet. Andernfalls klicken Sie bitte auf „Nein“, Sie gelangen somit ans Ende dieser Umfrage. Vielen Dank!
Item	Ich möchte an der Umfrage teilnehmen.

Note. Item was answered with either “yes” or “no”.

Appendix B

Table B1

ANOVA for Landscape Preferences by Group Assignment Study 1

	Biodiverse (n=67¹/60²)		Green Meadow (n=67¹/67²)		Desert (n=68¹/61²)		F	p	η²
	M	SD	M	SD	M	SD			
With outliers ¹	6.09 _a	1.25	5.82 _a	1.28	2.65 _b	1.39	144.82	<.001	.593
Without outliers ²	6.43 _a	.70	5.82 _b	1.28	2.31 _c	.99	358.02	<.001	.756

Note. Means not sharing subscripts differ significantly at $\alpha < .005$ as indicated by Tukey-HSD¹ and Games-Howell². Total $N^1 = 202$ ($df = 2,199$), Total $N^2 = 188$ ($df = 2,118.76$); Dependent variable = rating of comfortableness in landscape, M = means, SD = standard deviation.

Table B2

Independent Samples t-Test for Landscape Preferences by Group Assignment Study 2

	Biodiverse (<i>n</i> =72 ¹ /63 ²)		City (<i>n</i> =73 ^{1,2})				95% <i>CI</i>		
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>t</i>	<i>p</i>	<i>LL</i>	<i>UL</i>	<i>d</i>
With outliers ¹	5.93	1.25	3.01	1.76	11.52	< .001	1.51	2.30	1.53
Without outliers ²	6.30	.76	3.01	1.76	14.42	< .001	1.92	2.80	1.39

Note. Total $N^1 = 145$ ($df = 129.92$), Total $N^2 = 136$ ($df = 102.04$); Dependent variable = rating of comfortableness in landscape, M = means, SD = standard deviation, d = Cohen's d .

Table B3

Explorative Analysis Study 1 & 2: Regression Coefficients for Predicting Willingness to Help

Variable	B	95% CI	β	t	p
Intercept	3.86	[2.99,4.74]		8.66	<.001
CN	.03	[.01,.05]	.15	2.78	.006

Note. Total $N = 341$ ($df = 1,339$), $R^2 = .002$; Dependent Variable = willingness to help (stressful situation), CN = Connectedness to Nature, CI = confidence interval for B .

Table B4

Explorative Analysis Study 1&2: Regression Coefficients for Predicting Trait-Level Prosociality

Variable	B	95% CI	β	t	p
Intercept	19.09	[17.56,20.62]		24.53	<.001
CN	.08	[.05,.11]	.25	4.77	<.001

Note. Total $N = 337$ ($df = 1,335$), $R^2 = .064$; Dependent Variable = trait-level prosociality, CN = Connectedness to Nature, CI = confidence interval for B.

Table B5

Pearson Correlations among Measured Variables Study 1

	1.	2.	3.	4.	5.	6.	7.
1. Age	-						
2. Gender	.13	-					
	$N = 201$						
3. Prosociality	.06	<i>-.17*</i>	-				
	$N = 197$	$N = 197$					
4. AtN	<i>.19**</i>	-.03	<i>.15*</i>	-			
	$N = 201$	$N = 201$	$N = 197$				
5. CN	<i>.18**</i>	.04	<i>.23**</i>	<i>.36**</i>	-		
	$N = 196$	$N = 196$	$N = 192$	$N = 196$			
6. WtH (stressful)	.12	-.07	<i>.20**</i>	<i>.16*</i>	<i>.20**</i>	-	
	$N = 201$	$N = 201$	$N = 197$	$N = 201$	$N = 196$		
7. WtH (neutral)	<i>.17*</i>	-.07	<i>.32**</i>	.13	<i>.29**</i>	<i>.42**</i>	-
	$N = 201$	$N = 201$	$N = 197$	$N = 201$	$N = 196$	$N = 201$	

Note. Numbers in bold and italic correlate statistically significant; Gender = female (1), male (2);

AtN = Access to Nature, CN = Connectedness to Nature, WtH = Willingness to Help

** Correlation is significant at an α -level $< .01$ (two-tailed)

* Correlation is significant at an α -level $< .05$ (two-tailed)

Table B6*Pearson Correlations among Measured Variables Study 2*

	1.	2.	3.	4.	5.	6.	7.
1. Age	-						
2. Gender	.15	-					
	<i>N</i> = 145						
3. Prosociality	-.01	-.05	-				
	<i>N</i> = 144	<i>N</i> = 144					
4. AtN	.16	.20*	.20*	-			
	<i>N</i> = 145	<i>N</i> = 145	<i>N</i> = 144				
5. CN	.12	-.14	.28**	.28**	-		
	<i>N</i> = 143	<i>N</i> = 143	<i>N</i> = 143	<i>N</i> = 143			
6. WtH (stressful)	.02	-.02	.39**	-.01	.09	-	
	<i>N</i> = 145	<i>N</i> = 145	<i>N</i> = 144	<i>N</i> = 145	<i>N</i> = 145		
7. WtH (neutral)	-.07	-.19*	.42**	-.05	.08	.69**	-
	<i>N</i> = 145	<i>N</i> = 145	<i>N</i> = 144	<i>N</i> = 145	<i>N</i> = 143	<i>N</i> = 145	

Note. Numbers in bold and italic correlate statistically significant; Gender = female (1), male (2);

AtN = Access to Nature, CN = Connectedness to Nature, WtH = Willingness to Help

** Correlation is significant at an α -level < .01 (two-tailed)

* Correlation is significant at an α -level < .05 (two-tailed)

Table B7*MANOVA for Willingness to Help in Both Stress Situations by Group Assignment**Study 1*

	Dependent		df	MS	F	p	η_p^2
	Variable	SS					
Group Ass.	Stress	5.40	2	2.70	1.02	.362	.010
	Neutral	2.16	2	1.08	1.29	.277	.013
Error	Stress	526.49	199	2.65			
	Neutral	166.26	199	.84			

Multivariate

Tests	Wilks λ	Hypothesis df	Error df	F	p	η_p^2
Group Ass.	.98	4	396	.84	.501	.008

Note. Total $N = 202$, SS = sum of squares, df = degree of freedom, MS = mean squares, η_p^2 = partial eta²; Group Ass. = Group Assignment

Table B8*MANCOVA for Willingness to Help in Both Stress Situations by Group Assignment**with CN as Covariate Study 1*

	Dependent		df	MS	F	p	η_p^2
	Variable	SS					
CN (covariate)	Stress	19.89	1	19.89	7.65	.006	.038
	Neutral	13.61	1	13.61	17.36	< .001	.083
Group Ass.	Stress	6.29	2	3.15	1.21	.300	.012
	Neutral	1.82	2	.91	1.16	.316	.012
Error	Stress	501.58	193	2.60			
	Neutral	151.28	193	.78			

Multivariate

Tests	Wilks λ	Hypothesis df	Error df	F	p	η_p^2
CN (covariate)	.91	2	192	9.45	< .001	.090
Group Ass.	.98	4	384	.86	.486	.009

Note. Total $N = 197$, SS = sum of squares, df = degree of freedom, MS = mean squares, η_p^2 = partial eta²; Group Ass. = Group Assignment

Table B9*MANOVA for Willingness to Help in Both Stress Situations by Group Assignment**Study 2*

Dependent							
	Variable	SS	df	MS	F	p	η^2
Group Ass.	Stress	.26	1	.26	.09	.770	.001
	Neutral	2.84	1	2.84	1.66	.200	.012
Error	Stress	427.98	143	2.99			
	Neutral	245.00	143	1.71			
Multivariate							
Tests		Wilks λ	Hypothesis df	Error df	F	p	η^2
Group Ass.		.98	2	142	1.16	.317	.016

Note. Total $N = 145$, SS = sum of squares, df = degree of freedom, MS = mean squares, η^2 = partial eta²; Group Ass. = Group Assignment

Abstract

Exposure to green nature (human-created or natural green spaces) positively influences human prosocial behaviour or related behaviour such as generosity. As studies mostly investigated the effect of green spaces, there is little evidence about the effects of other natural environments on prosocial behaviour. The present study therefore seeks to further investigate the effect of nature on human prosocial behaviour with two studies. Study 1 investigates the effect of on-screen exposure to one of three different landscape types (biodiverse, green meadow, desert) on one specific facet of prosocial behaviour (willingness to help). Additionally, other influential factors and trait characteristics (connectedness to nature, access to nature, trait-level prosociality) are measured. $N = 202$ participants completed self-report questionnaires (ISK, CNS, and self-created items) and their willingness to help was compared between the assigned nature exposure groups. Study 2 tries to partly replicate the effect of looking at a natural scenery as opposed to an urban area on willingness to help. $N = 145$ participants mostly completed the same questionnaires and items as in Study 1 (with few alterations) and their willingness to help was compared between the assigned nature exposure and city exposure group. Analyses showed no statistically significant differences in participants' willingness to help between the three assigned exposure groups (Study 1). Furthermore, no difference in willingness to help could be found between the nature and the city exposure group (Study 2). Opposed to picture exposure, all additional trait measures showed statistically significant connections to the willingness to help.

Keywords: nature exposure, landscape types, prosocial behaviour, willingness to help, connectedness to nature

Zusammenfassung

Grüne Naturräume (menschengemachte oder natürlich entstandene grüne Areale) zeigen positiven Einfluss auf menschliches prosoziales Verhalten bzw. auf verwandte Korrelate wie Großzügigkeit. Ein Großteil der Forschung bezieht sich hierbei aber nur auf natürliche Grünräume und es gibt wenig Evidenz über Effekte von anderen Arten natürlicher Landschaften (blaue Räume, trockene Landschaften) auf prosoziales Verhalten. Die vorliegende Studie erweitert vorhandene Forschung in diesem Bereich anhand von zwei Studien. Studie 1 untersucht den Einfluss drei unterschiedlicher Landschaftstypen (biodivers, grüne Wiese, Wüste) auf eine spezielle Facette prosozialen Verhaltens (Hilfsbereitschaft). Außerdem wurden zusätzliche Charakteristika (Zugang zu Naturräumen, Naturverbundenheit, Prosozialität) erhoben. $N = 202$ Teilnehmende füllten Selbstberichtsfragebögen zu sozialen Kompetenzen und Naturverbundenheit aus (ISK, CNS, Eigenerstellungen) und ihre Hilfsbereitschaft wurde zwischen den drei zufällig zugeteilten Landschaftsgruppen verglichen. Studie 2 versucht den Effekt von Naturräumen gegenüber Stadträumen auf prosoziales Verhalten teilweise zu replizieren. $N = 145$ Teilnehmende füllten großteils dieselben Fragebögen wie in Studie 1 aus (mit wenigen Abänderungen) und ihre Hilfsbereitschaft wurde zwischen Naturgruppe und Stadtgruppe verglichen. Die Analysen zeigen, dass es keine statistisch signifikanten Unterschiede in der Hilfsbereitschaft zwischen den unterschiedlichen gezeigten Naturbildern gibt (Studie 1). Es wurde auch kein statistisch signifikanter Unterschied in der Hilfsbereitschaft zwischen Naturräumen und Stadträumen gefunden (Studie 2). Dem entgegenstehend fanden sich Unterschiede in Abhängigkeit von allen erhobenen Trait-Ausprägungen auf die Hilfsbereitschaft.

Stichwörter: Naturräume, Landschaftstypen, prosoziales Verhalten, Hilfsbereitschaft, Naturverbundenheit