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How the Connectedness between Humans and Nature Can Be Increased? Comparing ChatGPT's Language Use to Scientific Literature

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Abstract: The artificial intelligence chatbot ChatGPT can answer questions and solve tasks posed by the user within seconds. Using an exemplary task, this study investigates the reliability and consistency of the answers given by ChatGPT. For this purpose, it was analyzed whether the answers differ when a question is asked repeatedly and whether selected content categories and associated word combinations coincide with those from scientific literature. ChatGPT was asked 400 times, how the connectedness between humans and nature can be increased. The responses were classified into a categorization system and the most frequently occurring word combinations for each category were extracted. These word combinations were used for a search of related scientific literature. In addition, the Normalized Mutual Information (NMI) between the 400 individual responses was calculated. The results show that the phrases used by ChatGPT within the categories are also found in the scientific literature, however, the number of mentions between scientific literature and ChatGPT differs. In addition, the NMI suggested that there are large differences between the categories mentioned in the individual answers. These results indicate that ChatGPT currently still has difficulties in answering complex questions and cannot yet replace scientific literature research or academic writing.

Keywords: ChatGPT; connectedness between humans and nature; literature search; literature review; Normalized Mutual Information (NMI); artificial intelligence

1. Introduction

ChatGPT (Chat Generative Pre-Trained Transformer) is an artificial intelligence (AI) chatbot developed by Open AI based on the large language model GPT-3 [1]. Users can receive personalized answers by entering questions or orders, so-called prompts. Already 2 months after the launch of the chatbot, more than 100 million active users have been registered [2]. One of the main reasons for this great success is probably the huge potential and possibilities of large language models like ChatGPT.

ChatGPT can already write abstracts for scientific texts, which are currently still recognized by AI recognition software, but in some cases fool human reviewers [3]. Without any particular training, ChatGPT was able to pass medical [4] and law exams [5]. ChatGPT can answer questions in a wide variety of disciplines, although care must be taken with the information given out, especially in the medical field [6]. It can be seen as a possible tool to assist, for example, in writing discharge summaries in hospitals, even if these still need to be checked by human doctors [7].

ChatGPT has the ability to write entire texts or articles on its own [8], and scientists are already using it as a tool for writing scientific texts [9] or as a tool to support them [10]. ChatGPT also handles translations at a level that can compete with commercial translation products, at least for languages with sufficient training data [11]. Especially in teaching, ChatGPT can be used as a possible tool with many capabilities and possibilities [12,13], for example, for personalized tutoring, automatic

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generation of grades, interactive and adaptive learning. However, it can also lead to the decline of human interaction, creativity, or understanding [14]. The majority of people have a very positive attitude towards ChatGPT and only a few people are concerned [15].

Despite all the strengths, there are currently also significant weaknesses and problems, which causes issues and controversies especially in science and research. For complex questions that require a deep understanding of the literature, ChatGPT often produces incorrect or misleading texts [16]. The mathematical abilities of ChatGPT are lower than those of a mathematics graduate student and it often cannot answer questions in this context [17]. Also, language models such as ChatGPT often show undesirable behavior, including making up facts, giving toxic or biased answers, or not following instructions [18]. Leading scholarly publishers agree that ChatGPT cannot be the author of scholarly publications [19,20] and express their concerns about the use of ChatGPT in academic writing [21]. Therefore, it is important that the discussion about the ethical challenges and applicability for scholarly content is held now [22,23].

But to what extent is ChatGPT able to answer questions that are still being studied in the scientific literature? Using an example prompt, this study aims to investigate two questions: First, the question whether ChatGPT uses the same content categories and associated word combinations in its responses that are found in the scientific literature. Second, if ChatGPT is consistent with its answers when repeatedly asked the same question.

2. Materials and Methods

"Answer the question, how can the connectedness between humans and nature be increased?" was chosen as a prompt for this study. This question was chosen because there is no simple or one-dimensional answer to it in the literature. That implies that ChatGPT cannot just give a textbook answer, but must set criteria for which factors are considered important when answering the question. There are different approaches and opinions on which factors have an influence on a person's connectedness to nature. These include, for example, the time a person spends in nature, childhood experiences, environmental education, or the quality of nature experiences [24–26].

This question was asked ChatGPT (January 30, 2023 version) 400 times and the answers were recorded. A new chat window was opened for each prompt so that the different answers did not relate to each other, but were answered independently. In general, ChatGPT answered with a numbered list of four to ten items (mean: 5.91 ± 0.93). In rare cases, responses were given with a bulleted list without any numbering. In this case, the bulleted list was numbered in the indicated order. In total, ChatGPT responded to the 400 prompts with a total of 2364 points.

In order to analyze the data, it was necessary to structure the answers provided by ChatGPT and to summarize their content. For this purpose, a categorization system was created in which the answers of ChatGPT can be classified. An inductive approach was adopted, taking into account the responses to the first 50 prompts. This categorization system was created by one of the authors and independently evaluated and improved by two other authors. Assignment criteria and sample responses can be found in Appendix Table A1. In this way, ten categories were obtained. Each of the 2364 responses could only be assigned to one category. To test the reliability of the categorization, three persons independently categorized the answers into the categorization system. The inter-rater reliability between the results of the three persons was calculated using fleiss' kappa [27]. For all categories (with the exception of the rest category) adequate scores could be obtained, which indicates reliability of the categorization system (Table 1).

In order to answer the question whether ChatGPT's uses the same word combinations in its answers as the scientific literature, a literature search was conducted in the scientific database WebOfScience. The aim was to check how often the word combinations used by ChatGPT in the individual categories in relation with nature connectedness were also mentioned in scientific publications. This allows a comparison of how often the categories and phrases mentioned by ChatGPT are found in literature.

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Scientific literature search

Because nature connectedness is a frequently used construct that is studied in different disciplines [28] and therefore often named differently, search strings from two literature reviews on the topic were combined to reflect a broad denomination of nature connectedness [25,29].

The search string used in this study for nature connectedness was:

"connection to nature" OR "connectedness with nature" OR "connection with nature" OR "nature relatedness" OR "nature connectedness" OR "environmental identity" OR "Inclusion of nature in the self" OR "Inclusion of nature in self" OR "nature connectivity" OR "connectivity to nature" OR "connectivity with nature" OR "disposition to connect with nature" OR "disposition to connect to nature" OR "emotional affinity to nature" OR "emotional affinity with nature" OR "love and care for nature" OR "Nature connection" OR "nature affinity" OR "kinship with life" OR "biophilia" OR "ecological identity"

To examine how often the categories used by ChatGPT occur in the scientific literature, the 25 most frequently used bigrams and trigrams (word combinations consisting of two or three words) were extracted from the responses of each category. Binding words (it, can, with, or, that, their, and, such, to, as, of, its, in, the, into, on, a, for) were excluded when generation the bi- and trigrams. The proximity operator "NEAR/3" was used between the words of the individual bi- and trigrams. This operator allows a maximum of three other words between the words of the bi- and trigrams. In this way it could be ensured that there is a contextual connection between the words and that they do not occur together by coincidence. The 50 strings within a category were connected with the Boolean operator "or". Only the topic (abstract, keywords, title) were searched in WebOfScience. Since ChatGPT's training data only extends to 2021, the literature searches only included publications up to 2021. A list with the full search strings for each category is in the Appendix (Table A2).

Consistency in responses

To verify how consistent ChatGPT responded, the Normalized Mutual Information (NMI) between all 400 responses was calculated. NMI is defined as:

$$NMI\ (X,Y) = \frac{I(X,Y)}{\sqrt{H(X)H(Y)}}$$

where I(X, Y) is the mutual information between X (ten-dimensional vector of answer i) and Y (ten-dimensional vector of answer j), and H(X) and H(Y) are the entropies of X and Y, respectively. NMI ranges from 1 to 0, where 1 indicates a perfect match and values close to 0 represent a random distribution.

To perform this analysis, it was checked for each of the 400 answers which of the ten categories were mentioned. A ten-dimensional vector of ones and zeros was created for each answer, indicating which categories where mentioned in each response. Subsequently, using the above formula, the pairwise NMI between all 400 response vectors was calculated (a total of 79,800 pairwise comparisons). From these pairwise NMI values, an overall mean was calculated, providing an estimate of how variably ChatGPT's used the categories in its responses.

3. Results

The results show how often ChatGPT mentioned the different categories in proportion to each other. "Voluntary work", "activity in nature" and "education" were mentioned particularly often as factors to increase nature connectedness. In addition, it was possible to determine how often ChatGPT used similar word combinations in each category as scientific literature (Table 1). In this process, similarities as well as differences were identified. For example, ChatGPT mentions the categories "time in nature", "ecotourism" and "therapy" significantly less frequently than the literature on connection to nature registered in WebOfScience. On the other hand, "education", "greenspaces", "individual environmental behavior" and especially "voluntary work" are mentioned considerably

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more often by ChatGPT than they appear in the literature. Table 1 and Figure 1 show the similarities and differences between ChatGPT and the WebOfScience search for each category.

The kappa values for inter-rater reliability range from .544 to .982 (Table 1).

Table 1. Categorization system with the number of mentions by ChatGPT, the occurrence in WebOfScience and the Fleiss' Kappa values for each category. The values in parentheses indicate the percentage distribution.

	ChatGPT (%)	WebOfScience (%)	Fleiss' Kappa
Visiting nature	115 (4.86)	854 (16.4)	.691
Activity in nature	411 (17.39)	759 (14.58)	.819
Education	410 (17.34)	427 (8.2)	.962
Greenspaces	303 (12.82)	413 (7.93)	.892
Individual environmental behavior	245 (10.36)	243 (4.67)	.816
Voluntary work	506 (21.4)	326 (6.26)	.853
Technology	166 (7.02)	460 (8.84)	.982
Ecotourism	62 (2.62)	354 (6.8)	.945
Therapy	15 (0.63)	484 (9.3)	.846
Others	131 (5.54)	886 (17.02)	.544

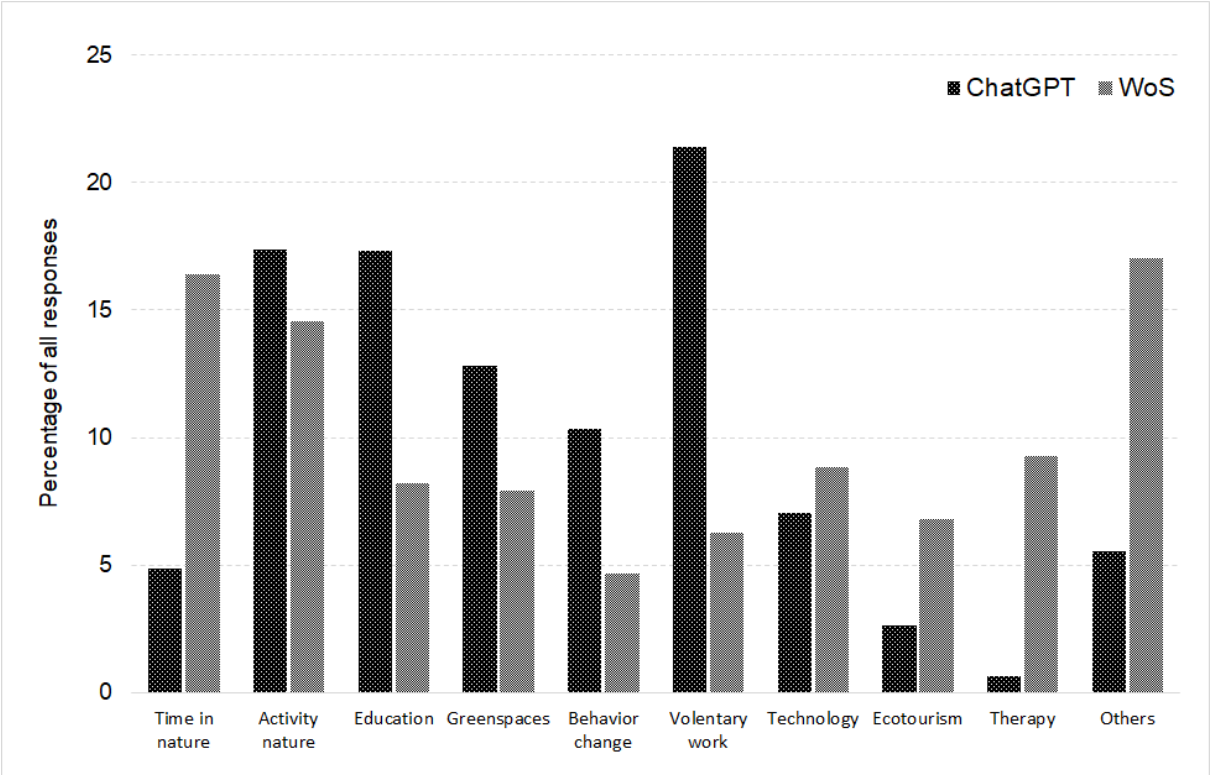

Figure 1. Mentions of the different categories by ChatGPT and how often they appear in scientific literature (applying the bi- and trigrams used by ChatGPT) in percent.

4. Discussion

The results of the analysis indicate that the categories used by ChatGPT, using similar phrases and word combinations, are also found in the scientific literature. This means that ChatGPT can answer the question at least to some extent and also makes use of scientifically appropriate expressions. However, the literature and ChatGPT differ in how often each category was mentioned.

For example, ChatGPT listed "time in nature" less frequently as a possible reason for increasing nature connectedness than it is considered in the scientific literature. However, time spent in nature is often considered one of the most important reasons for an increased nature connectedness [25,30,31].

Because ChatGPT was trained with a variety of sources up to 2021, which go beyond the scientific literature, it is understandable that the results between ChatGPT and WebOfScience differ. “Voluntary work” in conservation projects is mentioned very frequently in ChatGPTs responses and therefore seems to be much more common in the training data than in the scientific literature.

In addition, the NMI indicates that ChatGPT makes significant differences in the selection of categories among the 400 responses to the same question. An NMI value of 0.5 or higher would indicate more consistent responses [32,33]. In this case, the NMI value is significantly lower with a value of 0.242, which indicates that the given categories vary greatly in the responses. This result provides evidence that ChatGPT does not answer the question systematically or according to self-defined criteria, but according to statistical probabilities that derive from the training data.

Based on the results obtained here, it is once again clear that the responses of ChatGPT and other large language models must be viewed critically. Asking ChatGPT cannot replace a systematic literature search, nor can it be used to obtain answers to scientific questions. Students in particular need to be made aware of these weaknesses, as ChatGPT's quick and well-formulated answers may tempt them to overlook scientific ways of working. In addition, it must be taken into account that ChatGPT, like other language models, is based on probabilities of word sequences and therefore may output incorrect or inaccurate answers [34,35]. These study shows that ChatGPT still has weaknesses in answering questions that do not have a direct clear textbook answer, but require research and background information. Thus, these results are consistent with the assessment of other authors [16].

5. Limitations

Although this study was conducted with great care, there are some limitations that need to be considered. Especially for the large language models, development has been rapid since the release of ChatGPT. Therefore, it cannot be avoided that new versions or new models have already appeared at the time of the publication of a study [36]. This study was conducted with an earlier version of ChatGPT (as of January 30, 2023).

Moreover, this study cannot provide a concrete answer to the question of whether the interventions most frequently cited in scientific sources to increase nature connectedness are also the most important. For example, it is possible that a factor that is still underrepresented in the scientific literature has a very large impact on nature connectedness. What the study was able to determine is whether the categories mentioned by ChatGPT are also represented with similar word combinations in the scientific literature.

Also, despite high kappa values, there could have been minor misclassifications of the three observers when assigning the individual responses from ChatGPT to the categorization system.

6. Conclusions

The results show that ChatGPT can find answers to a complex question and also uses phrases that are found in the scientific literature. However, the large language model is not constant in its answers and there are major differences in the number of factors mentioned compared to the literature. Therefore, ChatGPT cannot currently be used as a tool to replace scientific research or a basic literature search. Especially students and scientists should therefore only use ChatGPT with extreme caution. Currently, the AI cannot yet do the work of a good scientific author.

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Appendix A

Table A1. Categories with definitions and example items.

Category	Definition	Example answer of ChatGPT
Visiting nature	It is suggested to spend time in nature. No activities in nature are proposed beyond that.	"Spending more time in natural environments: Encourage people to spend more time in parks, forests, or any other natural environments. This can help build a deeper appreciation for nature and its benefits."
Activity in nature	It is suggested to spend time in nature. In addition, other activities that can be done in nature are suggested. These activities are recreational activities that do not primarily serve nature conservation and are described as tourism.	"Spending time in nature: Engage in outdoor activities such as hiking, camping, gardening, etc."
Education	The importance of school or extracurricular education is indicated.	"Outdoor education programs: Implement outdoor education programs for schools and communities that focus on teaching about nature and its importance."
Greenspaces	The importance of public green spaces is indicated.	"Creating parks and green spaces in urban areas"
Individual environmental behavior	The implementation of environmentally friendly behaviors that affect personal daily actions are described.	"Sustainable practices: Encourage the adoption of sustainable practices, such as reducing waste and conserving resources, that help protect the environment."
Voluntary work	The participation in initiatives on the societal level is referred to (via institutes, NGOs, etc.). The political level also belongs to this category. Participation in concrete nature conservation measures that go beyond the individual's everyday actions (except for statements that refer to educational measures).	"Supporting protected areas: Support protected areas such as national parks and wildlife reserves that help preserve habitats and promote conservation."
Technology	The importance of technology is indicated.	"Technology: Using technology, such as virtual reality and augmented reality, can bring the natural world into

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		people's lives and help them experience it in new and innovative ways."
Ecotourism	The importance of tourist forms of experiencing nature is pointed out and the term "tourism" or a variation of it is used in the description.	"Nature-based tourism: Support nature-based tourism, which can raise awareness about the beauty and importance of nature and encourage conservation efforts."
Therapy	The therapeutic importance of nature is mentioned.	„Nature-based therapy: Utilizing nature-based therapy, such as forest therapy, gardening, or ecotherapy, can help people feel more connected to nature and improve their physical and mental health."

Table A2. WebOfScience search strings for the individual categories.

Category	ChatGPT (%)
Connection to nature	"connection to nature" OR "connectedness with nature" OR "connection with nature" OR "nature relatedness" OR "nature connectedness" OR "environmental identity" OR "Inclusion of nature in the self" OR "Inclusion of nature in self" OR "nature connectivity" OR "connectivity to nature" OR "connectivity with nature" OR "disposition to connect with nature" OR "disposition to connect to nature" OR "emotional affinity to nature" OR "emotional affinity with nature" OR "love and care for nature" OR "Nature connection" OR "nature affinity" OR "kinship with life" OR "biophilia" OR "ecological identity" OR "environmental identity"
Visiting nature	(spending NEAR/3 time) OR (time NEAR/3 nature) OR (people NEAR/3 spend) OR (parks NEAR/3 forests) OR (time NEAR/3 natural) OR (natural NEAR/3 environments) OR (forests NEAR/3 beaches) OR (encouraging NEAR/3 people) OR (more NEAR/3 time) OR (nature NEAR/3 encouraging) OR (environments NEAR/3 parks) OR (spend NEAR/3 more) OR (nature NEAR/3 spending) OR (connection NEAR/3 nature) OR (beaches NEAR/3 help) OR (spend NEAR/3 time) OR (time NEAR/3 outdoors) OR (increase NEAR/3 connection) OR (natural NEAR/3 world) OR (nature NEAR/3 encourage) OR (help NEAR/3 them) OR (encourage NEAR/3 people) OR (help NEAR/3 increase) OR (beaches NEAR/3 spending) OR (deeper NEAR/3 connection) OR (spending NEAR/3 time NEAR/3 nature) OR (encouraging NEAR/3 people NEAR/3 spend) OR (parks NEAR/3 forests NEAR/3 beaches) OR (time NEAR/3 natural NEAR/3 environments) OR (natural NEAR/3 environments NEAR/3 parks) OR (time NEAR/3 nature NEAR/3 encouraging) OR (nature NEAR/3 encouraging NEAR/3 people) OR (spend NEAR/3 more NEAR/3 time) OR (people NEAR/3 spend NEAR/3 more) OR (environments NEAR/3 parks NEAR/3 forests) OR (more NEAR/3 time NEAR/3 natural) OR (forests NEAR/3 beaches NEAR/3 help) OR (connection NEAR/3 nature NEAR/3 spending) OR (people NEAR/3 spend NEAR/3 time) OR (spend NEAR/3 time NEAR/3 natural) OR (time NEAR/3 nature NEAR/3 encourage) OR (increase NEAR/3 connection NEAR/3 nature) OR (encourage NEAR/3 people NEAR/3 spend) OR (nature NEAR/3 encourage NEAR/3 people) OR

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	(forests NEAR/3 beaches NEAR/3 spending) OR (more NEAR/3 time NEAR/3 outdoors) OR (natural NEAR/3 world NEAR/3 spending) OR (beaches NEAR/3 spending NEAR/3 time) OR (help NEAR/3 increase NEAR/3 connection) OR (world NEAR/3 spending NEAR/3 time)
Activity in nature	(hiking NEAR/3 camping) OR (time NEAR/3 nature) OR (outdoor NEAR/3 activities) OR (spending NEAR/3 time) OR (people NEAR/3 spend) OR (activities NEAR/3 hiking) OR (encouraging NEAR/3 people) OR (more NEAR/3 time) OR (camping NEAR/3 gardening) OR (spend NEAR/3 more) OR (natural NEAR/3 world) OR (time NEAR/3 outdoors) OR (nature NEAR/3 encouraging) OR (increase NEAR/3 connection) OR (connection NEAR/3 natural) OR (connection NEAR/3 nature) OR (spend NEAR/3 time) OR (simply NEAR/3 taking) OR (camping NEAR/3 simply) OR (help NEAR/3 people) OR (activities NEAR/3 encouraging) OR (encourage NEAR/3 people) OR (encouraging NEAR/3 outdoor) OR (nature NEAR/3 spending) OR (outdoor NEAR/3 recreation) OR (activities NEAR/3 hiking NEAR/3 camping) OR (spending NEAR/3 time NEAR/3 nature) OR (encouraging NEAR/3 people NEAR/3 spend) OR (spend NEAR/3 more NEAR/3 time) OR (hiking NEAR/3 camping NEAR/3 gardening) OR (people NEAR/3 spend NEAR/3 more) OR (outdoor NEAR/3 activities NEAR/3 hiking) OR (time NEAR/3 nature NEAR/3 encouraging) OR (nature NEAR/3 encouraging NEAR/3 people) OR (more NEAR/3 time NEAR/3 nature) OR (connection NEAR/3 natural NEAR/3 world) OR (people NEAR/3 spend NEAR/3 time) OR (outdoor NEAR/3 activities NEAR/3 encouraging) OR (more NEAR/3 time NEAR/3 outdoors) OR (hiking NEAR/3 camping NEAR/3 simply) OR (natural NEAR/3 world NEAR/3 spending) OR (engaging NEAR/3 outdoor NEAR/3 activities) OR (world NEAR/3 spending NEAR/3 time) OR (activities NEAR/3 like NEAR/3 hiking) OR (like NEAR/3 hiking NEAR/3 camping) OR (activities NEAR/3 encouraging NEAR/3 people) OR (camping NEAR/3 simply NEAR/3 taking) OR (spend NEAR/3 time NEAR/3 nature) OR (help NEAR/3 increase NEAR/3 connection) OR (hiking NEAR/3 camping NEAR/3 bird-watching)
Education	(about NEAR/3 importance) OR (importance NEAR/3 nature) OR (education NEAR/3 awareness) OR (people NEAR/3 about) OR (natural NEAR/3 world) OR (help NEAR/3 people) OR (providing NEAR/3 educational) OR (education NEAR/3 providing) OR (people NEAR/3 understand) OR (educating NEAR/3 people) OR (awareness NEAR/3 about) OR (nature NEAR/3 education) OR (educational NEAR/3 opportunities) OR (importance NEAR/3 preserving) OR (awareness NEAR/3 providing) OR (educational NEAR/3 programs) OR (nature NEAR/3 how) OR (education NEAR/3 about) OR (nature NEAR/3 role) OR (raising NEAR/3 awareness) OR (environmental NEAR/3 education) OR (about NEAR/3 natural) OR (awareness NEAR/3 educating) OR (help NEAR/3 increase) OR (our NEAR/3 lives) OR (about NEAR/3 importance NEAR/3 nature) OR (people NEAR/3 about NEAR/3 importance) OR (help NEAR/3 people NEAR/3 understand) OR (educating NEAR/3 people NEAR/3 about) OR (awareness NEAR/3 about NEAR/3 importance) OR (providing NEAR/3 educational NEAR/3 opportunities) OR (education NEAR/3 awareness NEAR/3 providing) OR (importance NEAR/3 nature NEAR/3 how) OR (importance NEAR/3 nature NEAR/3 role) OR

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	(education NEAR/3 providing NEAR/3 educational) OR (about NEAR/3 natural NEAR/3 world) OR (awareness NEAR/3 educating NEAR/3 people) OR (about NEAR/3 importance NEAR/3 preserving) OR (teach NEAR/3 people NEAR/3 about) OR (education NEAR/3 providing NEAR/3 education) OR (raising NEAR/3 awareness NEAR/3 about) OR (education NEAR/3 awareness NEAR/3 educating) OR (education NEAR/3 about NEAR/3 importance) OR (educate NEAR/3 people NEAR/3 about) OR (awareness NEAR/3 providing NEAR/3 educational) OR (providing NEAR/3 education NEAR/3 about) OR (nature NEAR/3 education NEAR/3 awareness) OR (natural NEAR/3 world NEAR/3 education) OR (providing NEAR/3 educational NEAR/3 programs) OR (importance NEAR/3 preserving NEAR/3 natural)
Greenspaces	(green NEAR/3 spaces) OR (urban NEAR/3 areas) OR (spaces NEAR/3 urban) OR (community NEAR/3 gardens) OR (nature NEAR/3 urban) OR (connect NEAR/3 nature) OR (parks NEAR/3 gardens) OR (urban NEAR/3 green) OR (spaces NEAR/3 parks) OR (urban NEAR/3 design) OR (people NEAR/3 connect) OR (parks NEAR/3 community) OR (creating NEAR/3 green) OR (green NEAR/3 roofs) OR (spaces NEAR/3 creating) OR (daily NEAR/3 lives) OR (nature NEAR/3 daily) OR (access NEAR/3 nature) OR (integrating NEAR/3 nature) OR (gardens NEAR/3 urban) OR (areas NEAR/3 parks) OR (incorporating NEAR/3 green) OR (spaces NEAR/3 cities) OR (bring NEAR/3 nature) OR (more NEAR/3 green) OR (green NEAR/3 spaces NEAR/3 urban) OR (spaces NEAR/3 urban NEAR/3 areas) OR (green NEAR/3 spaces NEAR/3 parks) OR (people NEAR/3 connect NEAR/3 nature) OR (parks NEAR/3 community NEAR/3 gardens) OR (green NEAR/3 spaces NEAR/3 creating) OR (urban NEAR/3 areas NEAR/3 parks) OR (spaces NEAR/3 parks NEAR/3 gardens) OR (integrating NEAR/3 nature NEAR/3 urban) OR (green NEAR/3 spaces NEAR/3 cities) OR (incorporating NEAR/3 green NEAR/3 spaces) OR (more NEAR/3 green NEAR/3 spaces) OR (urban NEAR/3 areas NEAR/3 provide) OR (provide NEAR/3 opportunities NEAR/3 people) OR (nature NEAR/3 urban NEAR/3 design) OR (opportunities NEAR/3 people NEAR/3 connect) OR (access NEAR/3 green NEAR/3 spaces) OR (areas NEAR/3 parks NEAR/3 community) OR (nature NEAR/3 urban NEAR/3 areas) OR (nature NEAR/3 daily NEAR/3 lives) OR (natural NEAR/3 elements NEAR/3 urban) OR (connect NEAR/3 nature NEAR/3 daily) OR (gardens NEAR/3 urban NEAR/3 areas) OR (parks NEAR/3 gardens NEAR/3 urban) OR (community NEAR/3 gardens NEAR/3 green)
Individual environmental behavior	(sustainable NEAR/3 living) OR (reducing NEAR/3 waste) OR (sustainable NEAR/3 practices) OR (waste NEAR/3 conserving) OR (practices NEAR/3 reducing) OR (living NEAR/3 practices) OR (promoting NEAR/3 sustainable) OR (help NEAR/3 people) OR (conserving NEAR/3 energy) OR (impact NEAR/3 environment) OR (encouraging NEAR/3 sustainable) OR (understand NEAR/3 impact) OR (conserving NEAR/3 resources) OR (practices NEAR/3 encouraging) OR (more NEAR/3 connected) OR (natural NEAR/3 world) OR (renewable NEAR/3 energy) OR (feel NEAR/3 more) OR (using NEAR/3 renewable) OR (adopting NEAR/3 sustainable) OR (people NEAR/3 understand) OR (people NEAR/3 feel) OR (energy NEAR/3 help) OR (environment NEAR/3 sustainable) OR (nature NEAR/3 sustainable) OR (reducing NEAR/3 waste NEAR/3 conserving) OR

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	(sustainable NEAR/3 living NEAR/3 practices) OR (practices NEAR/3 reducing NEAR/3 waste) OR (waste NEAR/3 conserving NEAR/3 energy) OR (living NEAR/3 practices NEAR/3 reducing) OR (sustainable NEAR/3 practices NEAR/3 reducing) OR (waste NEAR/3 conserving NEAR/3 resources) OR (feel NEAR/3 more NEAR/3 connected) OR (help NEAR/3 people NEAR/3 understand) OR (using NEAR/3 renewable NEAR/3 energy) OR (help NEAR/3 people NEAR/3 feel) OR (promoting NEAR/3 sustainable NEAR/3 living) OR (people NEAR/3 understand NEAR/3 impact) OR (promoting NEAR/3 sustainable NEAR/3 practices) OR (encouraging NEAR/3 sustainable NEAR/3 practices) OR (people NEAR/3 feel NEAR/3 more) OR (conserving NEAR/3 resources NEAR/3 help) OR (conserving NEAR/3 energy NEAR/3 help) OR (encouraging NEAR/3 people NEAR/3 adopt) OR (reducing NEAR/3 waste NEAR/3 using) OR (practices NEAR/3 adopting NEAR/3 sustainable) OR (environment NEAR/3 sustainable NEAR/3 living) OR (renewable NEAR/3 energy NEAR/3 sources) OR (human NEAR/3 impact NEAR/3 environment) OR (people NEAR/3 adopt NEAR/3 sustainable)
Voluntary work	(conservation NEAR/3 efforts) OR (natural NEAR/3 areas) OR (community NEAR/3 involvement) OR (natural NEAR/3 habitats) OR (supporting NEAR/3 conservation) OR (natural NEAR/3 world) OR (efforts NEAR/3 supporting) OR (protecting NEAR/3 natural) OR (future NEAR/3 generations) OR (protect NEAR/3 natural) OR (preserving NEAR/3 natural) OR (support NEAR/3 conservation) OR (community NEAR/3 engagement) OR (conservation NEAR/3 restoration) OR (help NEAR/3 people) OR (sense NEAR/3 ownership) OR (preserve NEAR/3 natural) OR (efforts NEAR/3 protect) OR (people NEAR/3 feel) OR (connect NEAR/3 nature) OR (encouraging NEAR/3 community) OR (efforts NEAR/3 protecting) OR (nature NEAR/3 community) OR (involvement NEAR/3 encouraging) OR (protecting NEAR/3 preserving) OR (supporting NEAR/3 conservation NEAR/3 efforts) OR (support NEAR/3 conservation NEAR/3 efforts) OR (protecting NEAR/3 natural NEAR/3 areas) OR (help NEAR/3 people NEAR/3 feel) OR (conservation NEAR/3 efforts NEAR/3 protect) OR (community NEAR/3 involvement NEAR/3 encouraging) OR (conservation NEAR/3 efforts NEAR/3 protecting) OR (protecting NEAR/3 preserving NEAR/3 natural) OR (conservation NEAR/3 restoration NEAR/3 efforts) OR (preserving NEAR/3 natural NEAR/3 habitats) OR (involvement NEAR/3 encouraging NEAR/3 community) OR (efforts NEAR/3 protect NEAR/3 natural) OR (sense NEAR/3 ownership NEAR/3 responsibility) OR (ensure NEAR/3 future NEAR/3 generations) OR (conservation NEAR/3 efforts NEAR/3 support) OR (natural NEAR/3 habitats NEAR/3 wildlife) OR (natural NEAR/3 areas NEAR/3 wildlife) OR (feel NEAR/3 more NEAR/3 connected) OR (protect NEAR/3 natural NEAR/3 habitats) OR (protect NEAR/3 natural NEAR/3 areas) OR (preserving NEAR/3 natural NEAR/3 areas) OR (protecting NEAR/3 natural NEAR/3 habitats) OR (bring NEAR/3 people NEAR/3 together) OR (participating NEAR/3 conservation NEAR/3 efforts) OR (protect NEAR/3 preserve NEAR/3 natural)
Technology	(virtual NEAR/3 reality) OR (technology NEAR/3 virtual) OR (augmented NEAR/3 reality) OR (technology NEAR/3 using) OR (bring NEAR/3 people) OR (people NEAR/3 closer) OR (reality NEAR/3 bring) OR (closer NEAR/3 nature) OR (natural NEAR/3 world) OR (virtual NEAR/3 augmented) OR

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	(technology NEAR/3 use) OR (people NEAR/3 nature) OR (connect NEAR/3 people) OR (nature NEAR/3 virtual) OR (reality NEAR/3 experiences) OR (technology NEAR/3 utilizing) OR (help NEAR/3 people) OR (nature NEAR/3 technology) OR (nature NEAR/3 even) OR (experiences NEAR/3 nature) OR (nature NEAR/3 new) OR (technology NEAR/3 connect) OR (nature NEAR/3 help) OR (reality NEAR/3 provide) OR (new NEAR/3 ways) OR (technology NEAR/3 using NEAR/3 technology) OR (technology NEAR/3 virtual NEAR/3 reality) OR (virtual NEAR/3 reality NEAR/3 augmented) OR (reality NEAR/3 augmented NEAR/3 reality) OR (using NEAR/3 technology NEAR/3 virtual) OR (bring NEAR/3 people NEAR/3 closer) OR (people NEAR/3 closer NEAR/3 nature) OR (augmented NEAR/3 reality NEAR/3 bring) OR (reality NEAR/3 bring NEAR/3 people) OR (virtual NEAR/3 augmented NEAR/3 reality) OR (technology NEAR/3 use NEAR/3 technology) OR (connect NEAR/3 people NEAR/3 nature) OR (technology NEAR/3 utilizing NEAR/3 technology) OR (technology NEAR/3 virtual NEAR/3 augmented) OR (utilizing NEAR/3 technology NEAR/3 virtual) OR (virtual NEAR/3 reality NEAR/3 experiences) OR (nature NEAR/3 virtual NEAR/3 reality) OR (use NEAR/3 technology NEAR/3 virtual) OR (technology NEAR/3 connect NEAR/3 people) OR (people NEAR/3 nature NEAR/3 virtual) OR (natural NEAR/3 world NEAR/3 technology) OR (augmented NEAR/3 reality NEAR/3 provide) OR (ways NEAR/3 technology NEAR/3 using) OR (virtual NEAR/3 reality NEAR/3 bring) OR (reality NEAR/3 experiences NEAR/3 online)
Ecotourism	(nature-based NEAR/3 tourism) OR (conservation NEAR/3 efforts) OR (sustainable NEAR/3 tourism) OR (people NEAR/3 experience) OR (connect NEAR/3 nature) OR (help NEAR/3 people) OR (nature NEAR/3 while) OR (tourism NEAR/3 encouraging) OR (encouraging NEAR/3 sustainable) OR (local NEAR/3 communities) OR (people NEAR/3 connect) OR (natural NEAR/3 world) OR (promoting NEAR/3 eco-tourism) OR (opportunities NEAR/3 people) OR (eco-tourism NEAR/3 encouraging) OR (also NEAR/3 supporting) OR (supporting NEAR/3 conservation) OR (sustainable NEAR/3 travel) OR (eco-tourism NEAR/3 sustainable) OR (nature NEAR/3 responsible) OR (experience NEAR/3 appreciate) OR (supporting NEAR/3 local) OR (tourism NEAR/3 practices) OR (eco-tourism NEAR/3 which) OR (efforts NEAR/3 nature-based) OR (nature-based NEAR/3 tourism NEAR/3 encouraging) OR (encouraging NEAR/3 sustainable NEAR/3 tourism) OR (also NEAR/3 supporting NEAR/3 conservation) OR (supporting NEAR/3 conservation NEAR/3 efforts) OR (opportunities NEAR/3 people NEAR/3 experience) OR (people NEAR/3 experience NEAR/3 appreciate) OR (people NEAR/3 connect NEAR/3 nature) OR (sustainable NEAR/3 tourism NEAR/3 practices) OR (conservation NEAR/3 efforts NEAR/3 nature-based) OR (efforts NEAR/3 nature-based NEAR/3 tourism) OR (experience NEAR/3 connect NEAR/3 nature) OR (promoting NEAR/3 nature-based NEAR/3 tourism) OR (promoting NEAR/3 eco-tourism NEAR/3 sustainable) OR (eco-tourism NEAR/3 sustainable NEAR/3 travel) OR (people NEAR/3 experience NEAR/3 nature) OR (connect NEAR/3 nature NEAR/3 while) OR (conservation NEAR/3 efforts NEAR/3 eco-tourism) OR (help NEAR/3 people NEAR/3 connect) OR (allow NEAR/3 people NEAR/3 experience) OR (provide NEAR/3 opportunities NEAR/3 people) OR (encourage NEAR/3 sustainable NEAR/3 tourism) OR (nature-based

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	NEAR/3 tourism NEAR/3 promoting) OR (tourism NEAR/3 encouraging NEAR/3 sustainable) OR (nature NEAR/3 help NEAR/3 people) OR (experience NEAR/3 nature NEAR/3 responsible)
Therapy	(nature-based NEAR/3 therapy) OR (mental NEAR/3 physical) OR (physical NEAR/3 health) OR (forest NEAR/3 therapy) OR (therapy NEAR/3 forest) OR (improve NEAR/3 mental) OR (mental NEAR/3 health) OR (forest NEAR/3 bathing) OR (help NEAR/3 people) OR (nature-based NEAR/3 therapies) OR (therapy NEAR/3 ecotherapy) OR (have NEAR/3 positive) OR (natural NEAR/3 world) OR (reduce NEAR/3 stress) OR (stress NEAR/3 improve) OR (people NEAR/3 connect) OR (connect NEAR/3 nature) OR (therapy NEAR/3 utilizing) OR (utilizing NEAR/3 nature-based) OR (nature NEAR/3 nature-based) OR (nature NEAR/3 improve) OR (use NEAR/3 nature-based) OR (people NEAR/3 feel) OR (bathing NEAR/3 have) OR (well-being NEAR/3 nature-based) OR (mental NEAR/3 physical NEAR/3 health) OR (nature-based NEAR/3 therapy NEAR/3 forest) OR (therapy NEAR/3 forest NEAR/3 therapy) OR (improve NEAR/3 mental NEAR/3 physical) OR (reduce NEAR/3 stress NEAR/3 improve) OR (stress NEAR/3 improve NEAR/3 mental) OR (help NEAR/3 people NEAR/3 connect) OR (people NEAR/3 connect NEAR/3 nature) OR (utilizing NEAR/3 nature-based NEAR/3 therapy) OR (nature NEAR/3 nature-based NEAR/3 therapy) OR (therapy NEAR/3 forest NEAR/3 bathing) OR (forest NEAR/3 bathing NEAR/3 have) OR (have NEAR/3 positive NEAR/3 impact) OR (natural NEAR/3 world NEAR/3 nature-based) OR (world NEAR/3 nature-based NEAR/3 therapy) OR (connection NEAR/3 nature NEAR/3 nature-based) OR (ecotherapy NEAR/3 help NEAR/3 people) OR (nature-based NEAR/3 therapies NEAR/3 forest) OR (therapies NEAR/3 forest NEAR/3 bathing) OR (connect NEAR/3 nature NEAR/3 improve) OR (nature NEAR/3 improve NEAR/3 mental) OR (physical NEAR/3 health NEAR/3 nature-based) OR (encourage NEAR/3 use NEAR/3 nature-based) OR (use NEAR/3 nature-based NEAR/3 therapy) OR (forest NEAR/3 therapy NEAR/3 ecotherapy)
Rest	(natural NEAR/3 world) OR (sustainable NEAR/3 agriculture) OR (daily NEAR/3 life) OR (nature NEAR/3 daily) OR (help NEAR/3 people) OR (art NEAR/3 culture) OR (sustainable NEAR/3 practices) OR (nature NEAR/3 through) OR (through NEAR/3 art) OR (between NEAR/3 humans) OR (promoting NEAR/3 sustainable) OR (humans NEAR/3 nature) OR (mindfulness NEAR/3 practices) OR (connection NEAR/3 nature) OR (connection NEAR/3 between) OR (practicing NEAR/3 mindfulness) OR (incorporating NEAR/3 nature) OR (art NEAR/3 literature) OR (connection NEAR/3 natural) OR (nature NEAR/3 help) OR (help NEAR/3 increase) OR (integrating NEAR/3 nature) OR (nature-based NEAR/3 solutions) OR (supporting NEAR/3 sustainable) OR (mindfulness NEAR/3 meditation) OR (nature NEAR/3 daily NEAR/3 life) OR (between NEAR/3 humans NEAR/3 nature) OR (connection NEAR/3 between NEAR/3 humans) OR (incorporating NEAR/3 nature NEAR/3 daily) OR (nature NEAR/3 through NEAR/3 art) OR (connection NEAR/3 natural NEAR/3 world) OR (supporting NEAR/3 sustainable NEAR/3 agriculture) OR (art NEAR/3 culture NEAR/3 celebrating) OR (integrating NEAR/3 nature NEAR/3 daily) OR (sustainable NEAR/3 agriculture NEAR/3 practices) OR (through NEAR/3 art NEAR/3 literature) OR (promoting NEAR/3 sustainable

	NEAR/3 agriculture) OR (promoting NEAR/3 sustainable NEAR/3 practices) OR (mindfulness NEAR/3 practices NEAR/3 meditation) OR (practices NEAR/3 meditation NEAR/3 yoga) OR (traditional NEAR/3 ecological NEAR/3 knowledge) OR (help NEAR/3 people NEAR/3 understand) OR (help NEAR/3 people NEAR/3 feel) OR (sustainable NEAR/3 agriculture NEAR/3 forestry) OR (nature NEAR/3 help NEAR/3 individuals) OR (sustainable NEAR/3 practices NEAR/3 encourage) OR (practices NEAR/3 encourage NEAR/3 individuals) OR (sustainable NEAR/3 practices NEAR/3 reduce) OR (practices NEAR/3 reduce NEAR/3 impact) OR (reduce NEAR/3 impact NEAR/3 environment)

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