

Article

Connectedness to Nature and Bird Sounds in Children: A Rural-Urban Comparison in the Child Population of Central Mexico

Aracely Camacho-Guzmán¹, Víctor D. Ávila Akerberg², Joel Martínez-Soto³

¹ PhD Student at Universidad Autónoma del Estado de México, México. ORCID: 0000-0003-3328-3919. E-mail: aracelycamachog@yahoo.com

² PhD at Universidad Autónoma del Estado de México, Mexico. ORCID: 0000-0001-5369-0920. E-mail: vicaviak@gmail.com

³ PhD at Universidad de Guanajuato. ORCID: 0000-0002-9418-9726. E-mail: masjmx@yahoo.com.mx

ABSTRACT

Connectedness to Nature (CTN) can be studied from a cognitive, emotional and behavioral perspective as it is formed by the union of these three aspects. Furthermore, CTN is known to have implications for health, well-being, and behavior. Likewise, the presence and sounds of birds are known to be related to CTN. The aim of this study was to analyze the relationship between CTN and bird sounds in a child population from a rural and urban area in central Mexico. In this study, questionnaires were conducted with 500 children from a rural and an urban area in central Mexico using recordings of bird sounds and quantifying CTN, emotions and memories and associations. Some differences were found between the rural and urban population. It is suggested that the rural population could have a higher CTN and therefore, could feeling happier.

Keywords: connectedness to nature; emotions; birds; sounds; children.

RESUMO

A conexão com a natureza (CTN) pode ser estudada a partir de uma perspectiva cognitiva, emocional e comportamental, pois é formada pela união desses três aspectos. Para além disso, sabe-se que a CTN tem implicações na saúde, no bem-estar e no comportamento. Pessoas com maior CTN têm sido associadas positivamente a comportamentos pró-ambientais. Da mesma forma, sabe-se que a presença e os sons de aves estão relacionados ao CTN. O objetivo deste estudo foi analisar a relação entre o CTN e os sons de aves numa população infantil de uma área rural e urbana no centro do México. Neste estudo, foram aplicados questionários a 500 crianças de uma zona rural e de uma zona urbana do centro do México, utilizando gravações de sons de aves e quantificando o CTN, as emoções, as memórias e as associações. Foram encontradas algumas diferenças entre a população rural e a urbana. Sugere-se que a população rural poderia ter um CTN mais elevado e, portanto, poderia apresentar atitudes pró-ambientais.

Palavras-chave: conexão com a natureza; emoções; aves; sons; crianças.



Submissão: 28/03/2024



Aceite: 26/09/2024



Publicação: 14/11/2024



Introduction

It is known that urban space and its processes are related to the deterioration of people's quality of life (Lecic-Tosevski 2019) and that it represents a challenge for the health of the population (Okkels et al. 2018). It is predicted that by 2030, 60% of the population will live in urban regions (United Nations 2020), so it is suggested that urban space should provide spaces with green areas so that children can obtain the benefits of this contact such as developing environmental awareness, as well as greater physical, psychological and social well-being (Prieto et al. 2017). It is then necessary to understand the impact of CTN in children.

Connectedness to Nature (CTN) is the way in which people feel emotionally connected to nature (Mayer & Frantz 2004), "Connectedness refers to the extent to which an individual includes nature within his/her cognitive representation of self" (Schultz 2002, pp. 67). CTN has an affective, cognitive, and physical/behavioral relationship with the natural world (Nisbet et al. 2009).

CTN has implications in happiness (Capaldi et al. 2014; Zelenski & Nisbet 2014) health (Martin et al. 2020; Dushkova et al. 2021), behavior (Rosa et al. 2018; Colléony et al. 2019; Whitburn et al. 2019; Martin et al. 2020) and well-being of people (Nisbet et al. 2020; Martin et al. 2020).

The presence of birds as well as their sounds has been related to people's well-being. Ferrrao et al. (2020) found that bird sounds support in self-reported well-being in adults in CA, United States ($n = 665$). Methorst et al. (2021) showed that self-reported life-satisfaction in adults is positively associated with bird species richness in a study in Europe ($n = 26\ 000$; 26 countries). Camacho-Guzmán et al. (2023) found in a literature review (41 papers, 16 countries) that presence of birds or their perception supports to explain the relationship between CTN and variables related to Well-being.

In addition, the influence of bird and CTN has been studied. Cox & Gaston (2016) found in a study in England that people in urban areas feel more relaxed and report a greater CTN if they fed bird frequently ($n = 331$, 60% female, 40% male, adults). Hammond (2020) found in a study in United States that bird feeders help to increase CTN in adults ($n = 234$) but not in children ($n = 200$, 11-12 years). Experiences in nature during childhood have repercussions on the CTN that children develop (Mustapa et al. 2019; Colléony et al. 2020), on health, well-being, attitudes and behavior (Colléony et al. 2020), as well as on the pro-environmental behavior that develop during people's adulthood (Molinario et al. 2020). These experiences impact the memories and associations that people develop (Mynott 2009). Bird sounds are recognized as having different types of associations or memories by people (Mynott 2009). These associations have been related to how sounds are rated and ranked (Ratcliffe et al. 2016).

The aim of this study was to analyze the relationship between CTN and bird sounds in a child population from a rural and urban area in central Mexico, in order to respond the research question, How is the relationship between CTN and bird sounds in a child population in a rural and urban area of central Mexico?

Methods

Participants

A non-probabilistic convenience sampling (Otzen & Manterola 2017) was conducted with boys and girls from public elementary schools in fifth and sixth grade of primary school. The study was conducted in the months of April, May, and October 2022.

Eight primary schools were visited: four in rural areas ($n=189$, $M_{age}=10.61$, $SD_{age}=0.67$, 52% female, 48% male) and four in urban areas ($n=313$, $M_{age}=10.67$, $SD_{age}=0.74$, 47% female, 53% male), with a total of 502 participants, of which 2 were not considered due to incomplete data, leaving a total of 500 participants.



Inclusion criteria were: children in fifth and sixth grades of public elementary schools. Exclusion criteria were children whose parents did not agree to their participation in the research.

The ethical aspects of the research included requesting permission by means of a document to the principal of the elementary school, and signed permission to each parent where the research was also explained. Each participant's information was handled anonymously and no photographs were taken of the children.

Instruments

Connectedness to Nature (CTN)

In this study CTN is understood like the way people feel emotionally connected to nature (Mayer & Frantz 2004) “Connectedness refers to the extent to which an individual includes nature within his/her cognitive representation of self” (Schultz 2002, pp. 67). CTN includes a cognitive, physical/behavioral and affective relationship with the natural world (Nisbet et al. 2009).

The cognitive aspect was evaluated by The Inclusion of Nature in Self (INS) graphic scale (Schultz 2002). The INS is a single item scale, INS has seven overlapping circles in different ways with the words “Me” and “Nature”. Each image is evaluated by placing an X on one of the circles.

The physical/behavioral aspect was evaluated by the Outdoor time in contact with nature (Larson et al. 2019, pp. 971) using one item, “In the past week, including Saturday and Sunday, about how many hours per day did you spend outdoors in nature (in a park, a forest, a backyard or school play-ground with trees, or similar place)?”

The affective aspect was evaluated by measuring affective valences toward birds sounds.

Emotional Response

In this study Emotions are understood like “a response to changes inside or outside the organism” (Keil & Miskovic 2015, pp. 25). An emotional response was evaluated by the Self-Assessment Manikin (Bynion & Feldner 2017). The Self-Assessment Manikin graphic scale (SAM; Bradley & Lang 1994), which measures pleasure, arousal, and dominance, on a nine-point scale, was used to measure emotions. SAM has five human figures indicating Pleasure, from 1 (unhappy, sad) to 9 (happy, pleased), arousal from 1 (calm, relaxed) to 9 (nervous) and dominance from 1 (uncontrollable, unimportant) to 9 (controllable, important, a leader). Each image is evaluated by placing an X on one of the figures or between them.

Stimulus

Birds sounds

Bird sounds have been identified as supporting people's CTN (Cox & Gaston 2016; Hammond 2020).

Recordings of bird sounds downloaded from www.xeno-canto.org (a citizen science repository of bird vocalizations) were used. The volume used was between 50 and 60 db (decibels) as it is considered a safe level of noise in health (WHO 2022).

The sounds were: QM *Quiscalus mexicanus* (Zanate), PD *Passer domesticus* (House Sparrow), CS *Cyanocitta stelleri* (Chara), TM *Turdus migratorius* (Spring/Thrush), WA Water and SI Silence.

The sounds of these birds were selected because QM and PD are more commonly found in an urban environment, CS and TM are more commonly found in a rural environment. Also, sounds of species that were more likely to be familiar to the children (more common birds) were considered, as well as good quality records on the web page www.xeno-canto.org and options were also consulted with a bird biologist.



It is known that the sound of water is one of the sounds that people report as the most pleasant to listen to (Shu & Ma 2020), which is why it was selected as the reference sound.

The sounds were presented without telling the children the type of sound or any information about them.

Memories and/or associations with bird sounds

In this study, memories and associations are understood as some relationship (idea) one has with each sound. Memories and associations were evaluated by a qualitative item. "Do you have any memories or associations with this sound" (Ratcliffe et al. 2016; pp. 138). An open-ended response format was used. Word clouds for sounds were also created using the answers.

Procedure

Primary schools were visited and the activity was carried out during school hours. The activity took place inside the classroom. The sounds were presented on a speaker and participants were asked to remain silent. The children handed in a document with informed consent from their parents. First the CTN was asked, then the first sound was presented, followed by questions related to Emotions, Memories/associations, to continue with the other sounds and questions. At the end, questions were asked about time spent outdoors in contact with nature. The children were not told the origin of the sounds until the end of the test where an explanation of the activity was given. The approximate duration of the activity was 10 minutes.

Data analysis

Sound analysis

Spectrograms (visual representation graphs of the sound) were generated by means of the Merlin Bird ID application, with the Audio ID tool. Spectrogram parameters: x-axis: time (15 secs), y-axis: Frequency (Hertz). The spectrograms were used to analyze sound frequency and noise.

Statistical analysis

R software version 4.1.2 (R Core Team 2021) was used for data analysis. Descriptive statistics were performed for the variables, obtaining the average and standard deviation, as well as histograms and box and whisker plots to have a graphic representation of the data and a first view of its distribution. The Kolmogorov-Smirnov (KS) test showed that the variables do not follow a normal distribution ($p < 0.05$), so the Kruskal-Wallis test was performed to evaluate differences in the groups. The Kruskal-Wallis nonparametric statistical test was used, with a significance level of 0.05. The Wilcoxon test was then used to see differences in each sound.

Results

For the urban population the average INS value was 4.58 (SD = 1.50), for the rural population the average INS was 4.59 (SD = 1.56), there was no significant difference ($p > 0.05$) between the two populations (Fig. 1).

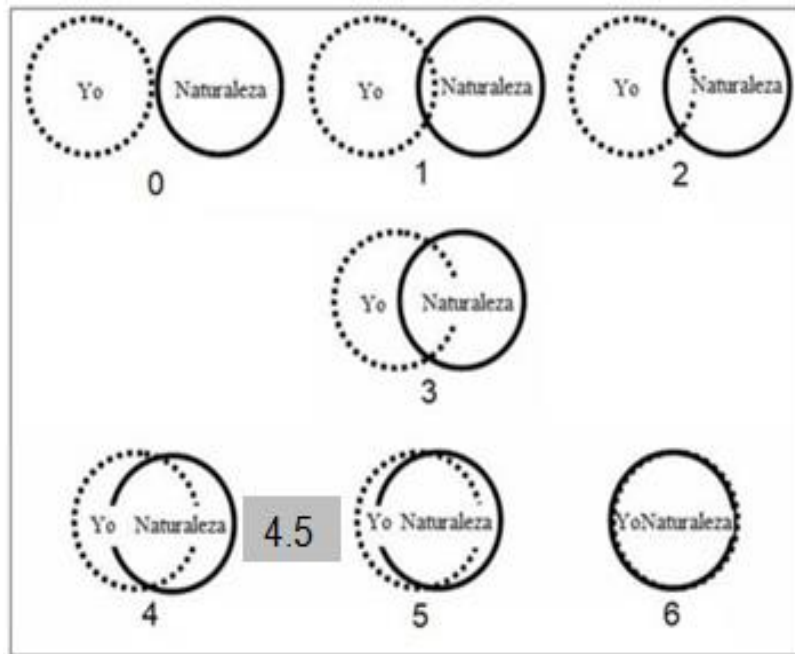


Figure 1. Translated from the Schultz Graphic Scale (2002) used to quantify INS. Source: Own elaboration

With respect to time spent outdoors in contact with nature, the rural population spends 26.98 hours on average (SD = 35.51) per week, while the urban population spends 13.96 hours on average (SD = 22.85).

Emotional Response

Differences were found in pleasure and arousal but not in dominance. Regarding Pleasure, significant difference ($\chi^2 = 161.3$, $p = 0.000$) was found in sounds in both urban and rural populations.

With respect to the urban population (Fig. 2, a) *Cyanocitta stelleri* was different from all ($p < 0.05$), which had the lowest value (18.4%) of children who responded feeling pleasure (value 9) when listening to it. Water had a value of 48.4% and Silence a value of 38.4%, which were different among them ($p = 0.001$). Listening to bird sounds (*Quiscalus mexicanus*; *Passer domesticus*; *Turdus migratorius*) was reported to be more pleasurable than listening to silence ($p < 0.05$). No difference was found between listening to bird sounds (*Quiscalus mexicanus*; *Passer domesticus*; *Turdus migratorius*) and Water ($p > 0.05$).

With respect to the rural population (Fig. 2, b), *Cyanocitta stelleri* was different from all ($p < 0.05$), which had the lowest value (30.5%) of children who responded that they felt pleasure (value 9) when listening to it. Water and Silence showed no difference ($p > 0.05$). There was also no difference between listening to the sound of birds (*Quiscalus mexicanus*, *Passer domesticus*; *Turdus migratorius*) and Water or Silence ($p > 0.05$).

Although *Cyanocitta stelleri* was the sound that registered the lowest values in pleasure, a difference ($p = 0.009$) was found between the urban (18.4%) and rural (30.5%) populations. A difference ($p = 0.020$) was also found in Silence between the urban (38.4%) and rural (53.8%) populations.

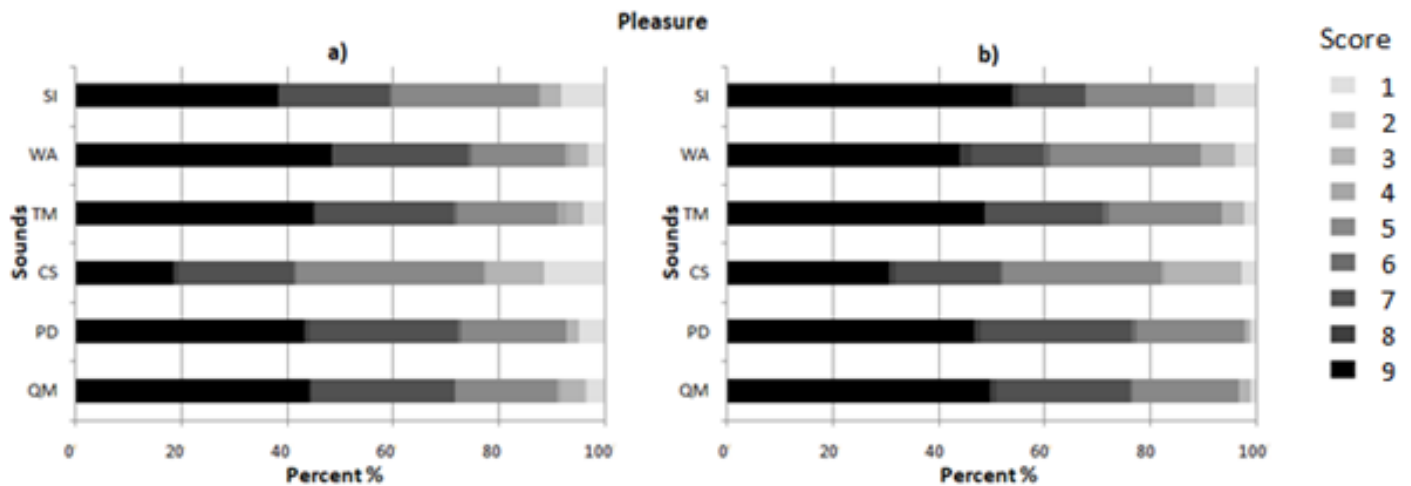


Figure 2. Pleasant response to different sounds, a) Urban, b) Rural. QM = *Quiscalus mexicanus*, SI = Silence, PD = *Passer domesticus*, CS = *Cyanocitta stelleri*, TM = *Turdus migratorius*, WA = Water. Source: Own elaboration

With respect to Arousal, a significant difference was found ($\chi^2 = 155, p = 0.000$) in the sounds in both the urban and rural populations.

With respect to the urban population (Fig. 3, a) *Cyanocitta stelleri* was different from all ($p < 0.05$), which had the lowest value (23%) of children who responded feeling calm, relaxed (value 1) when listening to it.

Water had a value of 53.2% and Silence a value of 53.0%, which were not different between them ($p > 0.05$). No difference ($p > 0.05$) was found between bird sounds (*Quiscalus mexicanus*; *Passer domesticus*; *Turdus migratorius*) and Water or Silence.

With respect to the rural population (Fig. 3, b) *Cyanocitta stelleri* was different from all ($p < 0.05$), which had the lowest value (25%) of children who responded feeling calm, relaxed (value 1) when listening to it.

Water had a value of 40.5% and Silence a value of 58%, which were different among them ($p = 0.000$).

A difference ($p = 0.034$) was found between listening to the sound of *Turdus migratorius* (41.8%) and silence (53.0%). Difference ($p = 0.005$) was found between listening to *Passer domesticus* (48.9%) and Water (40.5%). A difference ($p = 0.035$) was found between listening to *Quiscalus mexicanus* (46.7%) and Water (40.5%).

A difference ($p = 0.001$) was found between the urban (53.2%) and rural (40.5%) population for the sound of Water.

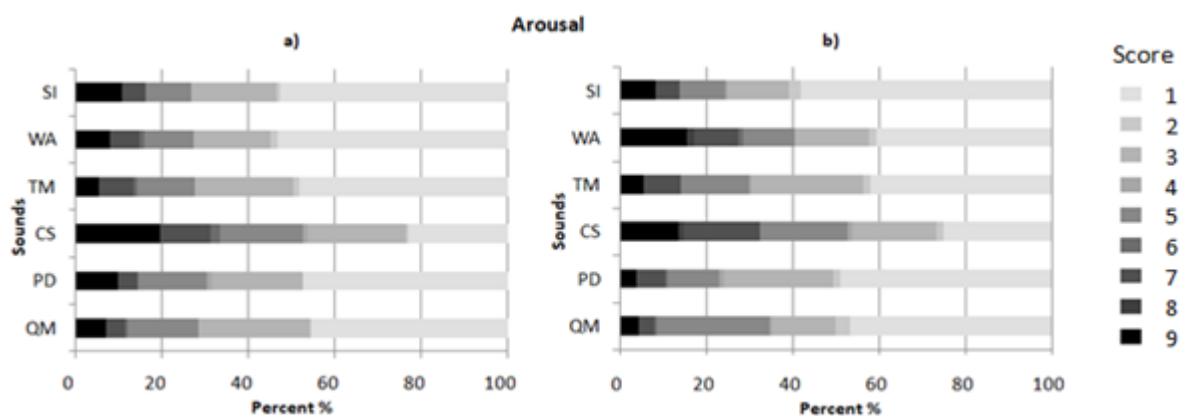


Figure 3. Arousal response to different sounds, a) Urban, b) Rural. QM = *Quiscalus mexicanus*, PD = *Passer domesticus*, CS = *Cyanocitta stelleri*, TM = *Turdus migratorius*, WA = Water, SI = Silence. Source: Own elaboration



4.2 Sound analysis

According to Fig. 4, the sounds ordered by frequency (highest to lowest) were: WA, PD, TM, QM, CS and SI. The sounds that presented noise were: CS and TM.

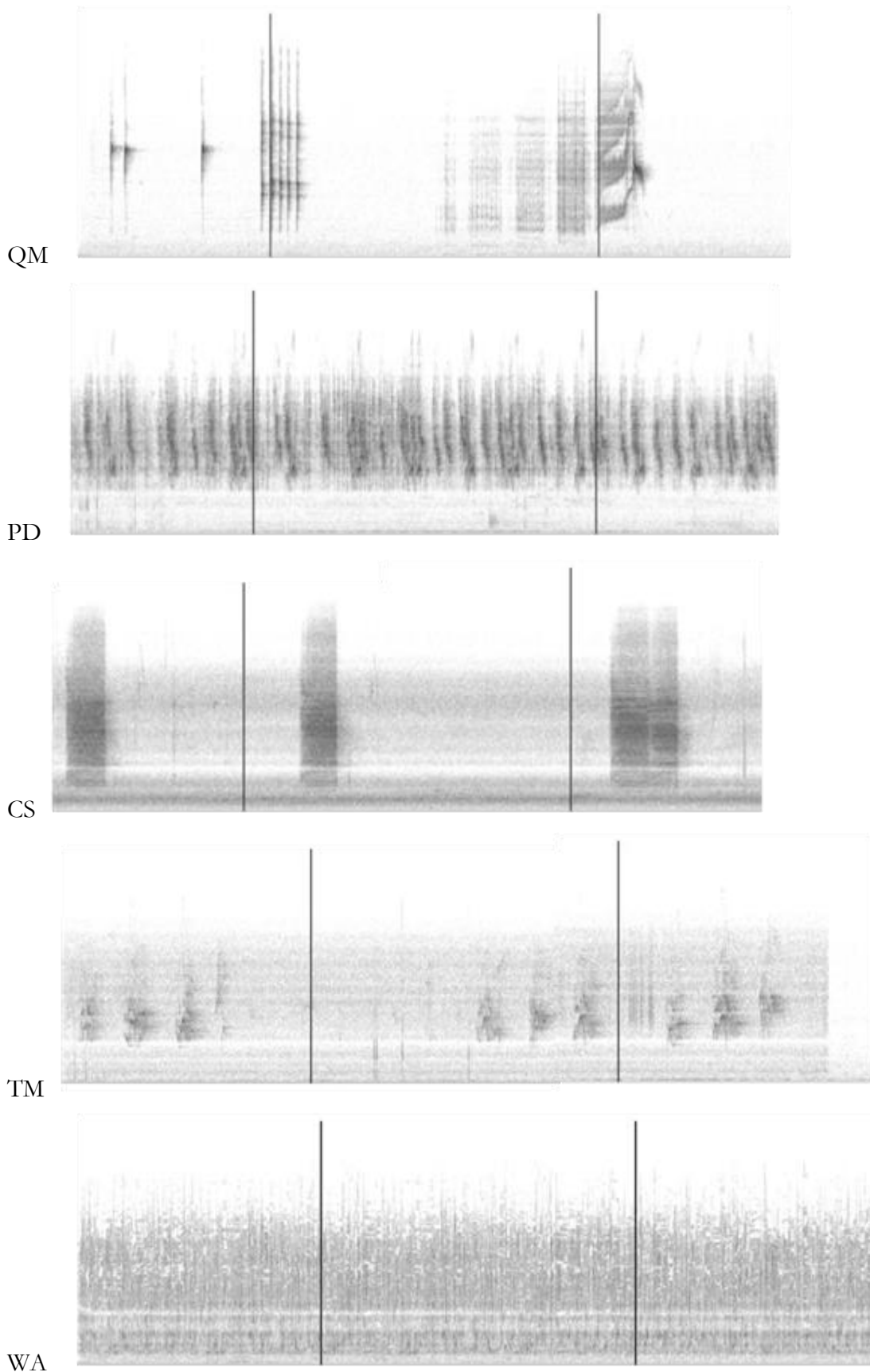




Figure 4. Spectrograms. QM = *Quiscalus mexicanus*, PD = *Passer domesticus*,

CS = *Cyanocitta stelleri*, TM = *Turdus migratorius*, WA = Water, SI = Silence. Spectrogram parameters: x-axis: time (15 secs), y-axis: Frequency (Hertz).

Source: Merlin Bird ID application

4.3 Memories and/or associations

The sounds where differences were observed were: *Cyanocitta stelleri* and Silence. For the sound of *Cyanocitta stelleri* (Fig. 5) 60 children responded in the urban area (with 87 word mentions) and 51 children responded in the rural area (with 83 word mentions).



Figure 5. Word cloud for sound *Cyanocitta stelleri*, a) Urban, b) Rural. Source: <https://www.nubedepalabras.es/>

For the sound Silence (Fig. 6) 66 children responded in the urban area (with 80 word mentions) and 66 children responded in the rural area (with 94 word mentions).



Figure 6. Word cloud for sound Silence, a) Urban, b) Rural. Source: <https://www.nubedepalabras.es/>

Discussion

The aim of this study was to analyze the relationship between CTN and bird sounds in a child population from a rural and urban area in central Mexico.

Differences were found between the rural and urban population. It could be observed that the way of analyzing CTN with its three components (cognitive, affective and behavioral aspects) helped to explain the results in an integral way.

It was found that the type of sound had an influence on the results. It is suggested that listening to bird sounds has an impact on emotional response. Memories and associations had an influence on the results. *Cyanocitta stelleri* had the lowest values in Pleasure with respect to the other sounds, however for rural children the value of pleasure was higher with respect to urban children. The CTN analyzed in this study and considered in a general way (cognitive, affective and behavioral aspects) could help to explain this result, since as suggested by Frankel et al. (2019) the CTN has an association with the frequency of visitation in the forest. Furthermore, Capaldi et al. (2014) in a meta-analysis found that people who have a higher CTN also feeling happier.

The type of bird sound has an influence on the results. *Cyanocitta stelleri* had the lowest values in pleasure and the highest values in arousal with respect to *Quiscalus mexicanus*, *Passer domesticus* and *Turdus migratorius*. The above coincides with that reported by Zhu et al. (2020) who also found a difference between bird sounds, where crows had the lowest values but they assessed restoration (recovery from psychological fatigue and negative emotions associated with stress) and also compared against sparrows. Crows' bird songs have also been associated with low values for restoration compared to other bird sounds by Ratcliffe et al. (2016). *Cyanocitta stelleri* and crows both belong to the family Corvidae and have characteristics in common.

CTN

The CTN includes a cognitive, affective and physical/behavioral relationship with nature (Nisbet et al. 2009), therefore, it can be included in these three dimensions (Schultz 2002). Therefore, in this study the CTN is quantified from this perspective.

With respect to the cognitive aspect, no significant differences were found between the urban and rural population. However, the INS value obtained ($M = 4.5$, $SD = 1.5$) suggests that the children feel to some degree as part of nature since the value is found on the graphic scale as two overlapping circles, although not completely (Fig. 1).

For the behavioral aspect, the rural population spends twice as much time outdoors in contact with nature as the urban population. Of course, it does not depend entirely on the children, as the opportunities for access and exposure to nature are influenced by different factors (Colléony et al. 2020), for example: available green areas, proximity, people who can accompany, time to go, etc. Therefore, children in rural areas could have more opportunities for access and exposure to nature than children in urban areas and have a higher CTN.

With respect to the affective aspect, it is taken up again in the following section (4.2). The implications of having a higher CTN are related to cooperative and environmentally behavior (Rosa et al. 2018; Colléony et al. 2019; Whitburn et al. 2019; Martin et al. 2020; Zelenski et al. 2015). According to the results of this study for CTN it is suggested that children from the rural population could produce a better cooperative and environmentally behavior, which coincides with what was reported by Zelenski et al. (2015) who found that exposure to nature can produce cooperative and environmentally behavior.



Emotional Response

As a result of this research, it is suggested that listening to bird sounds has repercussions on emotions. This coincides with what was reported by Buxton et al. (2021) where they found in a systematic review that natural sounds (birds, water, mixed) can have an influence on positive affect (improved mood) and can help improve health (improve cognitive performance).

According to the circumplex model of affect (Posner et al. 2005), it is proposed that all affective states originate from the combination of two neurophysiological systems related to the valence (pleasant/unpleasant) and arousal (activation/deactivation) systems. From this perspective, emotions are a combination of these two systems. Therefore, the use of the SAM (Bradley & Lang 1994) turns out to be a useful tool to quantify basic emotions (valence/pleasure, arousal and dominance) recognizable in child population since it is an instrument that has been used to measure emotions in children (Tortello & Becerra 2017; Mcmanis et al. 2001; Shu & Ma 2020) and with bird sounds (Subirana-Malaret et al. 2023).

The findings of this study coincide with those reported by Shu and Ma (2020) where they evaluated children's pleasure, arousal and dominance of different sounds and found differences in pleasure and arousal but not in dominance. SAM has been used to quantify affective appraisal in children using bird songs (Ratcliffe et al. 2020).

Sound analysis

The amount of noise present in the sound recording may have influenced the children's responses. According to Ratcliffe et al., (2020) bird sounds with higher noise levels are reported to have higher arousal levels, which coincides with what was found in this study since CS presented the highest arousal values in the urban and rural population (Fig. 3) and also the highest noise values which can be observed in Fig. 4 as the gray band behind the graph.

Bird sound frequency may be related to affective judgments (Ratcliffe et al. 2020). Sounds with higher frequencies may be perceived as more pleasant (Ratcliffe et al. 2020). The above coincides with the results of this work where the sounds of the birds with the highest frequencies coincide with the highest values in Pleasure, likewise, the sound of the bird with the lowest value in frequency (*Cyanocitta stelleri*) is the sound that was also evaluated with lower values in pleasure.

Memories and/or associations

In the case of *Cyanocitta stelleri*, which was the bird with the lowest values in Pleasure and the highest values in Arousal, associations could help explain the results. Negative associations were found with words such as: sad, died, angry. Likewise, associations were found with the word Crow, which in this study is suggested to have a negative association and which coincides with that reported by Ratcliffe et al. (2016) where Crows have been associated with negative behavior of birds (defensive or aggressive) or with superstitions with negative symbolism. No differences were observed between urban and rural children.

With respect to Silence which had the highest value in Pleasure in rural children compared to urban children, associations could help explain these results. In the case of rural children, associations were found such as: happy, calm, relaxed. In the case of urban children the associations were: Calm but also others such as died, sad, grandfather.

On the other hand, in a natural environment, isolated sounds are never heard and it has been proven that by having audio-visual stimulation, the results can be greater, where the incorporation of bird sounds can be supportive to have positive emotions (Zhao & Ye 2018).



Conclusions

Bird sounds impact CTN. Listening bird sounds has an influence on the cognitive and emotional response. Furthermore, the time spent outdoors in contact with nature and previous experiences (memories and/or associations) influence the results. On the other hand, analyzing CTN in its cognitive, affective and behavioral components helped to understand these results. In this study, it was suggested that the rural population could have a higher CTN and, therefore, could feeling happier.

References

- Bradley M & Lang P 1994. Measuring emotion: The self-assessment manikin and the semantic differential. *Journal of Behavior Therapy and Experimental Psychiatry*, 25(1), 49–59.
- Buxton R, Pearson A, Allo C, Fristrup K & Wittemyer G 2021. A synthesis of health benefits of natural sounds and their distribution in national parks. *Proceedings of the National Academy of Sciences*, 118(14), e2013097118.
- Bynion T & Feldner MT 2017. Self-assessment manikin. *Encyclopedia of personality and individual differences*, 4654–4656.
- Camacho-Guzmán A, Ávila Akerberg VD, Martínez-Soto J, Rodríguez-Soto C, Román Reyes RP 2023. Connectedness to Nature, Well-Being and Presence of Birds. *Fronteiras*, 12(1), 248-264.
- Capaldi CA, Dopko RL & Zelenski JM 2014. The relationship between nature connectedness and happiness: A meta-analysis. *Frontiers in psychology*, 976.
- Colléony A, White R & Shwartz A 2019. The influence of spending time outside on experience of nature and environmental attitudes. *Landscape and urban planning*, 187, 96-104.
- Colléony A, Cohen-Seffer R & Shwartz A 2020. Unpacking the causes and consequences of the extinction of experience. *Biological Conservation*, 251, 108788.
- Cox DT, Gaston, KJ 2016. Urban bird feeding: connecting people with nature. *PloS one* 11(7):1-13. doi: 10.1371/journal.pone.0158717.
- Dushkova D, Ignatieva M, Hughes M, Konstantinova A, Vasenev V, Dovletyarova E 2021 Human Dimensions of Urban Blue and Green Infrastructure during a Pandemic. Case Study of Moscow (Russia) and Perth (Australia). *Sustainability*, 13, 4148. <https://doi.org/10.3390/su13084148>
- Ferraro DM, Miller ZD, Ferguson LA, Taff BD, Barber JR, Newman P & Francis CD 2020. The phantom chorus: Birdsong boosts human well-being in protected areas. *Proceedings of the Royal Society B*, 287 (1941), 20201811.
- Frankel S, Sellmann-Risse D & Basten M 2019. Fourth graders' connectedness to nature-Does cultural background matter?. *Journal of Environmental Psychology*, 66, 101347.



- García CH, Corral-Verdugo V & Benavides G 2015. Preference for trees, optimism and physical, psychological and social wellbeing among highschool students/Preferencia hacia el árbol, optimismo y bienestar físico, psicológico y social en estudiantes. *Psychology*, 6(2), 213-228.
- Hammond RL 2020. Bird feeders increase connection to nature in parents but not in their children. *Ecopsychology* 12(1):44-53. doi: 10.1089/eco.2019.0036.
- Jo H, Song C, Ikei H, Enomoto S, Kobayashi H & Miyazaki Y 2019. Physiological and psychological effects of forest and urban sounds using high-resolution sound sources. *International Journal of Environmental Research and Public Health*, 16(15), 2649.
- Keil A & Miskovic V 2015. Human emotions: A conceptual overview. *Sleep and Affect*, 23-44.
- Larson LR, Szczytko R, Bowers EP, Stephens LE, Stevenson KT & Floyd MF 2019. Outdoor time, screen time, and connection to nature: troubling trends among rural youth?. *Environment and Behavior*, 51(8), 966-991.
- Lecic-Tosevski D 2019. Is urban living good for mental health?. *Current opinion in psychiatry*, 32(3), 204-209.
- Luo J, Wang M & Chen L 2021. The effects of using a nature-sound mobile application on psychological well-being and cognitive performance among university students. *Frontiers in Psychology*, 12, 699908.
- Mayer FS & Frantz CM 2004. The connectedness to nature scale: A measure of individuals' feeling in community with nature. *Journal of environmental psychology*, 24(4), 503-515.
- Martin L, White MP, Hunt A, Richardson M, Pahl S & Burt J 2020. Nature contact, nature connectedness and associations with health, wellbeing and pro-environmental behaviours. *Journal of environmental psychology*, 68, 101389.
- McManis MH, Bradley MM, Berg WK, Cuthbert BN & Lang PJ 2001. Emotional reactions in children: Verbal, physiological, and behavioral responses to affective pictures. *Psychophysiology*, 38(2), 222-231.
- Methorst J, Rehdanz K, Mueller T, Hansjürgens B, Bonn A & Böhning-Gaese K 2021. The importance of species diversity for human well-being in Europe. *Ecological Economics*, 181, 106917.
- Michels N & Hamers P 2023. Nature Sounds for Stress Recovery and Healthy Eating: A Lab Experiment Differentiating Water and Bird Sound. *Environment and Behavior*, 00139165231174622.
- Molinario E, Lorenzi C, Bartoccioni F, Perucchini P, Bobeth S, Colléony A,... & Bonaiuto M 2020. From childhood nature experiences to adult pro-environmental behaviors: An explanatory model of sustainable food consumption. *Environmental Education Research*, 26(8), 1137-1163.
- Mustapa ND, Maliki NZ, Aziz NF & Hamzah A 2019. Children's direct and indirect experiences with nature and their connectedness to nature. *Planning Malaysia*, 17.
- Mynott J 2009. *Birdscapes: Birds in our imagination and experience*. Princeton University Press.



- Nisbet EK, Zelenski JM & Murphy SA 2009. The nature relatedness scale: Linking individuals' connection with nature to environmental concern and behavior. *Environment and behavior*, 41(5), 715-740.
- Nisbet EK, Shaw DW & Lachance DG 2020. Connectedness with nearby nature and well-being. *Frontiers in Sustainable Cities*, 2, 18.
- Okkels N, Kristiansen CB, Munk-Jørgensen P & Sartorius N 2018. Urban mental health: challenges and perspectives. *Current opinion in psychiatry*, 31(3), 258-264.
- Otzen T & Manterola C 2017. Técnicas de Muestreo sobre una Población a Estudio. *International journal of morphology*, 35(1), 227-232.
- Posner J, Russell JA & Peterson BS 2005. The circumplex model of affect: An integrative approach to affective neuroscience, cognitive development, and psychopathology. *Development and psychopathology*, 17(3), 715-734.
- Prieto PF, Arrieta NRG & Flores JPO 2017. Urbanismo e infancia: hacia un modelo de ciudad que promueva la conciencia ambiental. *Chasqui. Revista Latinoamericana de Comunicación*, (136), 79-94.
- Ratcliffe E, Gatersleben B & Sowden PT 2016. Associations with bird sounds: How do they relate to perceived restorative potential?. *Journal of Environmental Psychology*, 47, 136-144.
- Ratcliffe E, Gatersleben B & Sowden PT 2020. Predicting the perceived restorative potential of bird sounds through acoustics and aesthetics. *Environment and Behavior*, 52(4), 371-400.
- Rosa CD, Profice CC & Collado S 2018. Nature experiences and adults' self-reported pro- environmental behaviors: the role of connectedness to nature and childhood nature experiences. *Frontiers in psychology*, 9,(1055). 1-10. <https://doi.org/10.3389/fpsyg.2018.01055>
- Schultz PW 2002. Inclusion with nature: The psychology of human-nature relations. *Psychology of sustainable development* (pp.61-78). Springer, Boston, MA
- Shu S & Ma H 2020. Restorative effects of urban park soundscapes on children's psychophysiological stress. *Applied Acoustics*, 164, 107293.
- Subirana-Malaret M, Miró A, Camacho A, Gesse A & McEwan K 2023. A Multi-Country Study Assessing the Mechanisms of Natural Elements and Sociodemographics behind the Impact of Forest Bathing on Well-Being. *Forests*, 14(5), 904.
- Tortello C & Becerra P 2017. ¿Cómo se estudian las emociones en los niños. *Cuadernos de Neuropsicología Panamerican Journal of Neuropsychology*, 2-20.
- Uebel K, Marselle M, Dean AJ, Rhodes JR & Bonn A 2021. Urban green space soundscapes and their perceived restorativeness. *People and Nature*, 3(3), 756-769.
- United Nations 2020. World Cities Report. The value of sustainable urbanization.



Whitburn J, Linklater W & Abrahamse W. 2019. Meta-analysis of human connection to nature and proenvironmental behavior. *Conservation Biology*, 34(1), 180-193.

WHO World Health Organization 2022. Media brief on safelisting.

Zelenski JM, Dopko RL & Capaldi CA 2015. Cooperation is in our nature: Nature exposure may promote cooperative and environmentally sustainable behavior. *Journal of environmental psychology*, 42, 24-31.

Zelenski JM & Nisbet EK 2014. Happiness and feeling connected: The distinct role of nature relatedness. *Environment and behavior*, 46(1), 3-23.

Zhao J, Xu W & Ye L 2018. Effects of auditory-visual combinations on perceived restorative potential of urban green space. *Applied Acoustics*, 141, 169-177.

Zhu X, Gao M, Zhao W & Ge T 2020. Does the presence of birdsongs improve perceived levels of mental restoration from park use? Experiments on parkways of Harbin Sun Island in China. *International Journal of Environmental Research and Public Health*, 17(7), 2271.