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RESEARCH ARTICLE



# “An Emotional Cycle”: Excitement, Worry, and Joy in a Citizen Science Biodiversity Project Using Bee Hotels

Mehita Iqani<sup>b</sup>, Natasha Shilubane<sup>a</sup> and Chevonne Reynolds<sup>a</sup>

<sup>a</sup>School of Animal, Plant and Environmental Sciences, University of the Witwatersrand, Johannesburg, South Africa;

<sup>b</sup>Centre for Science Communication, Department of Journalism, Stellenbosch University, Stellenbosch, South Africa

## ABSTRACT

This paper considers the affective and emotional aspects of citizen scientist engagement in a research project aiming to map solitary bee diversity across Johannesburg, South Africa. In social media engagement by people participating as citizen scientists, expressions of emotions were a key feature. To further understand the implications of emotions for the science and for the citizens, we undertook interviews with a sub-set of recruited participants. These are contextualized by a discussion of key literature on citizen science and human-insect relations. The findings presented show how excitement, worry and joy were expressed by participants at different stages of the citizen science project. We then theorize on the role of emotion in this specific citizen science project and argue that emotion should be considered at the design stage of other citizen science projects as it can play a key role in creating experiences that are rewarding for citizens, as well as producing useful data for scientists.

## ARTICLE HISTORY

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## KEYWORDS

Bees; emotion; citizen science; communication; Johannesburg

## Background: introduction to the Jozi Bee Hotel Project

This paper explores the emotional landscape of citizen scientists participating in a project mapping solitary-bee diversity across Johannesburg, South Africa. The Jozi Bee Hotel Project (JBHP) was a citizen science-based research project aimed at measuring solitary bee diversity across the socio-economic gradient of the City of Johannesburg through recording the presence of solitary bees in bee hotels hosted by project participants. The data gathering process was accompanied by ongoing social media communication, aimed at encouraging and supporting the participants in their tasks. Through social media participation, we noticed that many of the participants expressed intense emotions at different stages of the project. One participant posted on Facebook that taking part in the project was “a whole emotional cycle,” an apt phrase that we have borrowed for the title of this paper. We take the “emotional cycle” to mean the range of feelings, both negative and positive, that the participants experienced in relation to the project.

To contextualize this topic, we offer a discussion of key literature on citizen science, and to theoretically frame it, a discussion of insect-human relationships (specifically bees). Then, we discuss the qualitative research methods used to gain insight into the emotions experienced by the participants. Finally, we present the findings by describing participant’s emotional statements in relation to solitary bees and the JBHP. We conclude the paper by discussing the broader implications of our

**CONTACT** Mehita Iqani  [mehita@sun.ac.za](mailto:mehita@sun.ac.za)

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findings for citizen science projects and the communication of natural science research to the public.

### **Context: citizen science and environmental communication**

As one iteration of the ethic of “science for the people” (Irwin, 1995, p. 6), citizen science projects recruit ordinary people to help gather data sets for scientists (Wynn, 2017). Involving citizens in data collection for research projects is a long-standing strategy in the natural sciences, with “participants [...] monitoring biodiversity, mapping invasive plants, reporting environmental hazards,” for example (Golubic et al., 2020, p. 455).

The JBHP distributed 347 bee hotels to participants across the metropolitan City of Johannesburg in order to, measure “how solitary bee diversity and abundance change across the socio-economic gradient of the city [so as to] establish the areas are most in need of interventions to secure biodiversity” (<https://www.jozibeehotelproject.com>). Participants were asked to upload photographs of their bee hotel once a week over a 12-week period. The project managed good representation across the socio-economic gradient of Johannesburg and included participants living in low-income areas (households earning as little as R 15,000 per annum) to high-income areas (households earning approximately R 1 million per annum). Most participants were from middle-income areas and were based in the central leafy green suburbs of Johannesburg. In a separate analysis, we concluded that the social media presence of the JBHP played a key role in maintaining participant engagement (and therefore the quality of the data collected) (Shilubane et al., 2024). In similar citizen science research projects pertaining to insects and biodiversity, it has been found that participants benefit from their role in projects, while also generating useful data for scientists (MacPhail et al., 2020), making citizen science a positive experience for all parties. A significant theme in the citizen science literature examines how participating in citizen science can produce “positive attitudes” in citizens towards the science in which they are involved (Ballard et al., 2017; Forrester et al., 2017). But more research is needed to understand what these positive attitudes might mean, and how they can be integrated more fully into scientific research praxis.

It is not only positive attitudes that play a role in citizen science and environmental communication. Climate communication has received particular attention for considering the role of negative emotions in citizen participation and responses. The topic can provoke extreme fear, anger, distress, and anxiety in receivers of climate communication, even making them weep (Lockwood, 2016). Emotion is key in processing information and influencing judgement (Wong-Parodi & Feygina, 2021, p. 572). As such, indirect emotional messaging is a potential strategy for environmental communicators to find ways to resonate with potentially unreceptive audiences (Hoewe & Ahern, 2017). The role of emotion in science communication has recently started to receive more attention from researchers, such as the recent special issue on emotions and emotional appeal in the journal *Science Communication* (Taddicken & Reif, 2020). Indeed, “much science communication practice continues to focus on engendering positive emotions, such as wonder, delight, interest or excitement” (Davies & Horst, 2016, p. 175). These insights reveal that emotions are central to science and environmental communication as well as citizen science. Our project sought to understand what role emotional response played in the JBHP. This also requires framing of the literature documenting insect-human relations, specifically those involving bees.,

### **Framing: feelings and bees**

Honeybees are flagship insects (Sumner, Law, & Cini, 2018), which already are generally positively regarded by humans, and are perhaps the most well-known insects to humans (von Frisch, 1954). Although some fear their stings, people who have spent time with honeybees are earnest in their expression of love: “I wish to speak of the bees very simply, as one speaks of a subject one knows and loves to those who know it not” (Maeterlinck, 1901). In expressing this love and

appreciation, many artists throughout history have chosen bees as a topic of creative representation (Prendergast et al., 2021). We revere honeybees for the honey and wax they provide yet are nervous of them due to the pain and possible allergic reactions caused by their stings. Nevertheless, honeybees are beloved amongst people, and have received a disproportionate amount of media attention, which tends to obscure the pollinating roles played by other insects (Smith & Saunders, 2016). Honeybees have been the subject of sociological investigation and cultural theory. Notably, the book *Buzz*, on urban beekeeping in New York City (Moore & Kosut, 2013) explores the complex relations that beekeepers develop with the bees and hives they tend, and frames the rise in urban beekeeping as part of a cultural, trendy shift of “bringing the ‘natural’ into the urban” (Moore and Kosut, 2013: 2). The ethnographers found that “each beekeeper has his or her own philosophical and emotional relationship with the bees,” sometimes emerging as a “euphoria buzzing with feelings” (Moore and Kosut, 2013: 10). Building on theories of interspecies entanglements, the urban beekeeper ethnographers argue that there are “sonic and vibrating exchanges” between bees and humans (Moore and Kosut, 2013: 13), and that “the bee does things to cultural life just as [it exists] as a real and material insect” (Moore and Kosut, 2013: 38). Humans provide honeybees with hives, out of self-interest to harvest some of their honey. “Bees might or might not actually need human assistance, but they provide humans with purpose and self-importance” (Moore and Kosut, 2013: 210). Bees are important pollinating species, and play a crucial role in ecosystems and human life (Patel et al., 2021).



**Figure 1.** Left: Bee hotels were handed out to project participants during special sessions in public parks, outdoors (as the project took place during the Covid-19 pandemic). Right: Leader research on the JBHP prepares bee hotels for distribution. Images by third author, and courtesy of the JBHP.

The solitary bees studied by the JBHP are less widely understood, though bee hotels have become better known amongst nature lovers (Hane & Korfmacher, 2022). Bee hotels are, like hives, man-made structures that offer nesting sites to solitary bees (see Figure 1). They have been promoted as a conservation aid in that they are purported to support species that are responsible for a great deal of pollination, though the role of bee hotels in supporting bee conservation is complex (Geslin et al., 2020; MacIvor & Packer, 2015). The keepers of bee hotels have been found to know more about solitary bees and their roles in pollination, and to express more willingness to invest in their conservation (Penn et al., 2019). As solitary bees are less well-known to the general public, it is thus useful to consider them in the context of how people feel towards insects in general. Insects are a group of creatures facing extinction due to destructive human activities, such as industrial farming, mining, loss of habitat due to city expansion (Cardoso et al., 2020). We are in the age of an insect apocalypse (Cardoso & Leather, 2019), therefore insect conservation requires a massive effort to preserve both insects and the many benefits that humans enjoy due to their many roles in ecological function and ecosystem service provision, crucially, pollination (Samways et al., 2020). As well as providing provisioning services in an ecology, insects' contributions have also been classified as "cultural services" (Duffus et al., 2021) in that their pollination has had significant effects on human agriculture, culinary traditions, fashion, and more. Therefore, ordinary citizens can and must play a role in insect conservation in return (Basset & Lamarre, 2019; Kawahara et al., 2021).

Insects and animals are ripe with symbolic meaning, and indeed have been pulled into human mythology, narratives, and belief systems in all cultures and histories (Tüür & Tønnessen, 2014), including popular music (Coelho, 2000) and dream interpretation (Klein, 2011). Insects are however, still quite distanced from humans in cultural rhetoric and representation, inhabiting a so-called insect world that has historically been framed as separate from the human domain (Dodd, 2014). Humans tend to glean or interpret emotional affinity from the comportment and behavior of birds and other vertebrates more than they do insects, whose perspectives and experiences seem beyond our grasp (Parikka, 2010, p. 73). Instead, insects have been used as inspirational material for science-fiction or fantastical narratives about aliens and monsters (Budde, 2014). Franz Kafka's famous short story about the man who turns into a cockroach overnight illustrates the extent to which horror and alienation are to humans expressed by the insect form (Kafka, 2019). Insects as bearing horror is certainly played out in the prosaic fear that many have of spiders, or other insects like Johannesburg's famous "parktown prawns," which have become the stuff of dramatic urban legends and individual nightmares. Parktown prawns are a species of large cricket, with ungainly spiky limbs and a tendency to jump. Although they are absolutely harmless to humans and quite vulnerable to predation by domestic cats, they cause great panic amongst Joburg residents – an out-of-proportion response that has been interpreted as a metaphor for post-apartheid suburban anxiety (Falkof, 2020).

In contrast, insects and their collective strategies for survival have been inspirations and models for artificial intelligence innovation as well as media theory (Parikka, 2010), lending them more recognition to human sentiment, with the world of technology and machines than that of mammalian affect. Some insects, such as termites, produce impressive architectural forms, which are increasingly the basis of study for new forms of solar-powered ventilation (Ocko et al., 2017) and sustainable building solutions (John et al., 2005) in the human world.

As this discussion of human-insect relations reveals, it is perfectly common for people to feel negative and positive emotions towards the insects that they interact with in their lives. Building on these complex attitudes towards bees and insects evidenced in the literature, it is useful to explore the role of emotion in the interactions of citizen scientists with solitary bees in the context of the JBHP.

### **Methods: qualitative inquiry into emotions**

Alongside gathering the scientific data needed for the biodiversity study, which will be reported on in other publications, we also gathered communicative data by setting up social media profiles and

archiving all interaction and commentary. Social media was found to be a key strategy towards maintaining participation in the data-gathering tasks (see Shilubane et al., 2024). We took screenshots of all comments and responses to project posts on Facebook and Instagram, then developed a coding framework to ascertain the range of emotions being expressed by grouping comments into nine categories: emotion, encouragement, excitement, question, bragging, gratitude, tagging, and fun (see Table 1 in Shilubane et al., 2024 for examples and explanations of each category). In addition, Chi-square tests for independence were conducted using the frequency data on comments to test whether there was a statistical difference in user engagement across the two social media platforms. To gain deeper insight into those emotions, we recruited interview participants from among the citizen scientists who signed up for the project. At the conclusion of the scientific data gathering component of the project, we reached out to all 347 citizen scientists who participated in the JBHP to invite them to interview about their experiences of taking part in the project. Twenty people responded, and we scheduled half hour sessions with all who offered their time. The dropout rate was minimal: in the end 16 interviews took place. Eight hours of interviews were recorded resulting in 160 pages of transcripts. These were qualitatively thematically analyzed alongside the social media content archived. People who agreed to be interviewed were already very enthusiastic about the project. As such, we cannot take them as representative of the entire population of project participants, which also included people who got distracted, lost interest or for reasons unknown to us did not manage to complete the assignments, although it is worth noting that the drop out rate for the citizen scientists was very low (only 8%). Speaking to enthusiastic participants is nevertheless useful, as it offers an opportunity to take a deep dive into the shape and color of that enthusiasm, and to gain more insight into what kinds of emotions drive interest in and commitment to citizen science projects.

All ethical protocols were followed: all participants were adults, informed consent was secured, social media commentary is anonymized, and pseudonyms have been assigned to interview participants. In what follows, we refer both to the content of interviews and social media posts: where pseudonyms are noted next to interview quotes, and social media statements are noted as either having been posted on Instagram or Facebook. Interestingly, some of our interview participants were not active on social media – explaining that they preferred “old fashioned” modes of communications (emails and phone calls). We therefore infer that some of the people commenting and responding on Facebook and Instagram were not the same people who volunteered for interviews. Yet, as the presentation of findings show, there were some similarities and overlaps between the sentiments expressed in both participant discourses. This suggests that the emotions expressed on both social media and in interviews had relevance for citizen scientists participating in the JBHP.

### **Findings: excitement, worry, joy (the emotional cycle)**

It might be stating the obvious that people will only get involved as citizens in science projects that they already have some interest in. Yet it is worth exploring why some participants felt such strong emotions about the bee hotels that they put in their gardens or on their balconies, as enthusiastic participants can serve as ambassadors for citizen science projects. For example, they expressed excitement when they received their sponsored bee hotel (see [Figure 1](#)), worry and anxiety when the little holes offering bees a breeding site were not occupied or took a long time to be chosen by a bee, and joy and even love towards the bees that did take up occupation.

Many interview participants reported that they found out about the project through community or conservation WhatsApp groups of which they were already members. A participant we have named Buddy<sup>1</sup> is already a member of a WhatsApp group for bee enthusiasts and has used bee hotels in environmental educational programs that he runs for children, so he couldn't resist signing up for the JBHP. Like Buddy, several participants foregrounded their scientific interest in the project, stating that they got involved because they were interested in the science, and wanted to learn more about various bee species that might be in their gardens. Some of them were directly

linked to a university biology department or were active amateur entomologists. It is therefore particularly notable that alongside this intellectual interest an emotional discourse was often apparent.

One Facebook user described the experience of having a bee hotel as follows:

It's a privilege to be part of this project, and I've had so much fun gathering the data for my weekly submission. From the despondency of an empty hotel for the first two weeks to 80% occupancy recorded this week. Hotel filling up beautifully (3x honeybee emoji)

Another Facebook commenter called this, “a whole emotional cycle” (the phrase borrowed for the title of this paper). In borrowing this phrase, we do not wish to suggest that all project participants went through the exact same experiences, or that “emotional cycles” are a model that can be objectively applied. We use the term here to sum up the emotional phases that some project participants expressed, starting with the excitement of joining the project and setting up the hotel, the worry and even despondency while waiting for bees to arrive, and the delight of seeing them finally make their nests in the holes. We expand on three of these phases in the following subsections.

### ***“Super excited to get started!”<sup>2</sup>***

We analyzed the top 10 liked posts on each social media platform in order to understand the preferred imagery. On Facebook, bee hotels (50%), bees (20%), and observations (meaning bees observed on/inside bee hotels) (20%) were the most liked subjects in the multimedia posts. Instagram likes mirrored Facebook, with bee hotels (40%), bees (40%), and observations (10%) being most liked subjects in posts. It is important to note that most of the content in these top posts were shared by participants to the researchers. This shows that people like to look at multimedia content of bees in “action,” satisfying perhaps a certain scientific curiosity and offers pleasure to the human gaze. This was emphasized in some commentary in the follow up interviews. For example, one participant, Berry, enthused about bee hotel images that friends were taking and sharing over a private WhatsApp group: “one of them showed a bee’s little legs sticking out the hole!”

In the Facebook and Instagram comments, emotions of love and fondness were evident in majority of the comments. Although the nature of the comments varied slightly across the two social media platforms, the overall sentiment was similar ( $\chi^2 = 4.01$ ,  $df = 7$ ,  $p = .78$ ). On Facebook, the comments were mainly expressions of encouragement (30%), excitement (15%), and bragging (13%). Instagram comments showed a similar trend, with encouragement being the most common at 31%, followed by emotion (13%) and excitement (13%). We defined “emotion” as an expression of love or fondness towards the solitary bees. These were often expressed through affectionate emojis, such as the hug, hearts in various colors and forms, and emojis expressing excitement, such as grinning faces, and handclaps. These emojis would often appear alongside honeybee emojis, and exclamations of excitement and humorous puns about “AirBee’nBees” and the arrival of hotel “guests.” Some participants received the hotels as gifts from family members, others gave them as gifts. “[One of my friends] gave a bee hotel to all her friends and relatives for Christmas. Oh, that was lovely!” (Berry). Many participants expressed a pleasure at getting involved in something that included a sense of community and buzz. They enjoyed chatting with other participants about the project. They also highlighted the enjoyment that their children were taking in the project. Illustrated through this Instagram comment: “So so cool, my kids loved it [in love emoji].” These reports of delight in the project are particularly profound considering that the research took place during the difficulties and suffering of the Covid-19 pandemic. Jane expressed this well:

For me it's been ... [sighs sadly] ... it's been a very bleak, bleak two years. And I mean, it's not getting any happier from a Covid perspective. But [this project] was [...] a little ray of sunshine, a happy something. [...] when I'm sitting outside working, and I look up and see the hotel, it's really comforting.

As Jane implies, participating in the project was a positive experience, that brought comfort and joy into her life. Others also emphasized the pleasures of having something good to talk about with friends and family, to compare notes on the happenings of the project and their hotels. “My sister

got me a hotel. She knew I would love it,” said Trudy, implying that the sister also delighted in this new topic of conversation. Kiara decided to join the project, partly as a tribute to her late husband, who loved gardening and watching the bees. “I think [he] would have liked it, and if he was around we would have done it sooner.” Existing networks of families and friends and their relations of care and affection for one another seemed to be key to driving enthusiasm for the project. After the profound disconnection forced by Covid-19 lockdowns and restrictions, people were thrilled to find a new way to bond. “I think if it was just me with a bee hotel ... I would have not been as interested as I was. I was interested to see what was happening ... all around Jo’burg and with other people” (Berry).

These expressions of delight, excitement, and possibility at the launch of the project were followed by worry and anxiety about the “late” arrival of bees to the hotels.

### ***“The despondency of an empty hotel”<sup>3</sup>***

Kiara explains, “at first I was a bit disillusioned because” after “three weeks [...] I had nothing.” Was she jinxed, she wondered? Others had similar worries. Vanessa moved her hotel a few times: “I was so anxious because the bees just weren’t coming.” Louie doesn’t like to overstate his case and was cautious not to suggest that the bee hotel was at the center of his life. He explained that he was participating in the project mainly to help the scientists, and to make sure they collected enough data, especially when he saw that some participants were dropping off. But he ventures, “I kind of felt ... you know ... our bee hotel [...] wasn’t as fully occupied as I would have liked” (Louie). He continues, “Disappointment would be too strong a word. But ja, I definitely wanted to know that what I’d done was right and that I wasn’t creating misinformation” (Louie). Marina reported that she would eagerly go to view her hotel each week, to “see if I had any visitors.” Each week without a bee making its nest was another disappointment. Berry was so upset about not having bees in her hotel by Week 5, that when the project sent participants an interactive Google Earth graphic showing the distribution of hotels and occupancy, she zoomed in to her own neighborhood, located the other hotel-owners nearby, and went over to their houses to introduce herself and find out about their occupancy levels compared to her own bee hotel.

As well as non-occupancy, participants expressed disappointment about the types of bees that arrived in their hotels. Perhaps driven to high expectations by the photographs of the various species that might nest, as communicated on the project website and social media pages, many hoped to have *all* varieties of solitary bees: leaf-cutter bees, carder bees, Allodapula bees, and membrane bees (<https://www.jozibeehotelproject.com/solitary-bees>). If they only got one type, participants felt let down. Berry described it as “very disappointing” that only one type of species of bee decided to settle in her hotel. She recounts with envy how her sister, who also participated in the project, had all the promised species arriving, “mud bees, leaf cutters” and was sending photos and videos of the action to the friends’ WhatsApp group. Carla found it “quite disappointing” that she didn’t get any mud bees because, “I know their population exploded after the rain came. I didn’t get one” (Carla). She was also put out about not getting any leaf cutters, “because we have a giant bougainvillea plant that I’m sure they would absolutely love cutting little holes out of. But alas.” (Carla). Kiara’s pity was reserved for her “poor sister-in-law” who only got one bee in her hotel, while Kiara’s filled up completely. “It’s such a shame. She was disappointed, I must admit. So I kept sending her pictures of mine just to make her feel [better]” (Kiara).

The disappointment of too few bees, or not enough kinds, arriving perhaps suggests why such joy was experienced when they eventually did.

### ***“That was the best part!”<sup>4</sup>***

Maya explains that the “best part” of the project was when “we suddenly saw one hole closing. And then another. The excitement we felt when the bees started coming to our hotel!” After weeks of



waiting and “being a spy on that thing 24/7,” Kiara finally noticed a tiny buzzing insect but wasn’t sure if it was a bee or not. So, to try and find out, “I stood and did not breathe for like 30 minutes trying to video this thing going in and out the hole.” This sense of holding her breath in excitement while she quietly observed her first bee arriving, is echoed in many comments. Participants describe feeling “so happy” when they “got” their first bee and really enjoyed watching them come and go. This was especially heightened if they had not seen any bees for the first several weeks of the project. Maya and her husband enjoyed the bees’ arrival together: “One weekend we actually sat in front of the hotel waiting for the bees to come, so that we can see what they look like. It was so cute” (Maya).

When I saw the little bee in [the] hole, it was just lovely. [...] I called my husband and we were looking at this little bee. [...] It sort of hung around [...] while we were watching it and then suddenly flew off. (Martina)

Jane enthused, “it’s just lovely to see these little creatures doing well and thriving.” Such sentiments of excitement, happiness and joy in relation to the bees’ arrival came up repeatedly in the interviews and social media commentary. Buddy explained that when he started looking, his eyes were opened to other forms of insect life in his garden: “Actually that’s not a bee ... but I’ve never noticed that hover fly before. And that’s not a bee ... but this tiny butterfly! Or these tiny moths ... or things in the soil ... that you may never have spotted before!” These feelings echo how “a knowledge of bees [ ...] will bring its own delights” (von Frisch, 1954: v), something that is well established in the literature about people’s affinity with honeybees.

The arrival of a new species was a cause of great joy. “I was excited when I got a leaf cutter bee,” said Bobbie; “I got my first leaf cutter ... and it was all really very exciting,” said Sarah. Trudy embodies Rae’s observation that even though “most people’s idea of nature is the Kruger Park [...] they can have just as much excitement [...] in their back garden” (Rae). Trudy’s excitement turned slightly competitive. Although there was not much participants could do to “get” bees (which chose for themselves where to nest) Trudy, “aimed to get as many bees as I could.” She *really* wanted a mud bee, and a leaf cutter bee. And when they came, she felt triumph. Every morning, she would grab her mobile phone and run over to the bee hotel to “see if there was anything different” and then would send photos to all her friends to show them “look, I’ve got this, look, I’ve got that!” This aligns with what social psychologists have named “the mechanisms of social comparison” (Kruglanski & Mayseless, 1990), which also can play out in altruistic activities like participating in a citizen science project (Laut et al., 2017). Despite the competitiveness, Trudy was ecstatic when she noticed a leafcutter bee using agapanthus petals instead of leaves, and when she saw a bee carrying “a whole fat wad of pollen under her abdomen.” Her close and enthusiastic observation of her bee hotel was incredibly rewarding for her, and her telling of that enjoyment sums up quite aptly the wonder and joy that participation in this citizen science project created for some participants. Perhaps the sense of competition, “to see whose hotel was going to be occupied first,” as Vanessa put it, was a key motivating factor to the gathering of the data the scientists needed.

Some of the participants expressed a sense of attachment, which some might describe as “psychological ownership” (Pierce et al., 2003). The bees in the bee hotels on their property were “their” bees. Sandy would check the project’s social media pages to keep track of occupation in other people’s bee hotels. But, after her own hotel started filling up, she felt, “I had my own bees [...] and I was more excited about my own” (Sandy). “I lost my bees to a wasp ... I was so disappointed,” said Kiara who was grieving the loss of her husband at the time of participating in the project. At first, Kiara just observed the wasp, recording the interaction. But then, “eventually I took my bee hotel down ... and went and put it in the house ... so [the wasp] couldn’t get to it. I didn’t want to lose all my little baby bees ... after ... watching them for ... like ... three months” (Kiara). Knowing that some of her “little baby bees” survived filled Kiara with relief. Similarly, Maya felt worried about “my little nest” – she didn’t want the ants to get in and steal the pollen from the bees. The interactions with the wasps and ants are ordinary, as the project scientists explained. But project participants had formed strong emotional connections with “their” bees, and they wanted them to thrive so much that they were tempted to try and intervene with nature.

These emotional connections – joy, attachment, wonder – should be understood as integral to successful recruitment and retention of citizen scientists in projects on ecological research. As Rae puts it, science needs to get “people to fall in love with nature, even nature that isn’t necessarily on TV or isn’t glamorous.”

## Discussion: forging solitary bee appreciation through affinity

As the presentation of interview and social media data in the previous sections has shown, some participants experienced intense emotions in relation to the project. We have discussed the positive emotion of excitement about being a part of a science project, worry about the success of the hotel and the ability to contribute to the project, and the joy and delight that came when participants saw things going well and got to observe and know “their” bees. The data that we have collected, from mainly enthusiastic supporters of the project, is inherently skewed towards gaining insight into the drivers of participation.

In terms of the limitations of this project, we are unable to comment on negative emotions that participants might have felt about the project, which might have contributed to them dropping out (for example, stress regarding the pressure to complete the weekly assignments, guilt, and shame at not managing to do their part, fear or negativity towards the bees taking up residence, or even violence and anger towards them), though it is worth reiterating that citizen scientist dropout rates were low. The extent to which such negative emotional states might act as barriers to participation in citizen science projects is certainly a question requiring future research. Furthermore, we did not collect detailed individual demographic data about our participants, and as such cannot make an argument about how different identity markers such as race, gender, age or class might have played into their participation, and feelings during participation. This is also an avenue of future research for citizen science and science communication. As this was a qualitative study focussed on insights and the feelings of participants, these should not be taken to be representative of all citizen scientists in the project, or indeed all people. Further, these findings should not be taken to be representative of how people will feel about other insects, or all insects. However, the findings offer some insight into future research pathways for exploring how people feel about insects, especially considering their massive extinction rate (Cardoso and Leather, 2019), and how those feelings can contribute positively to research in the environmental sciences as well as broader conservation efforts.

The qualitative data shared in this paper shines a light on the positive affect that can be produced by a science research project that allows for individual close observation of solitary bees, which in turn forges a sense of personal connection. Although the scientific research agenda of the project was to map solitary bee diversity in a densely populated and highly socio-economically unequal city, it also produced collateral opportunities for social connection between people, and for affective relationships between humans and insects. These contributed to the success of the project, both in terms of the scientific data gathered and in terms of the experiences of citizen scientists who signed up. We found that the messages shared in the comment sections showed that the JBHP appealed to the core motivations of environmental volunteers. The motivations being (i) the need to help conserve the environment which was evident in commenters expressing how inspiring nature is; and (ii) the desire to learn more about it with many commenters asking the researchers to share more educational content about the types of solitary bees they might encounter (Shilubane et al., 2024). Based on our analysis of a subset of participants’ explanations of their emotional states at key stages of the research, we surmise that a sense of emotional connection is an important consideration to make in the design of a citizen science project. Scientists may find it useful to consider in advance not only the data collection needs that might be met by participants, but how being a part of the planned project might make participants feel, towards the project, towards the species being studied, and indeed towards the natural environment in general.

Johannesburg is a densely urbanized city, characterized by great inequality, a failing infrastructure, and a lot of social suffering. It is therefore apt that some project participants garnered real thrill

and joy from learning that some creatures could still live and thrive in urban conditions. In citizen science, a sense of place is crucial (Haywood, 2014), especially in conservation and ecology-related studies (Haywood et al., 2016). The fact that the project was designed such that participants collected data from their home environments also certainly contributed both to the success of the project, and the intensity of emotions experienced. The context of the Covid-19 pandemic is also crucial: the great collective suffering and isolation experienced by everyone in some form or another also arguably created a context for appreciating small moments of joy and positivity. It is notable that many participants expressed how being part of the project allowed them to connect with other people, both loved ones and strangers, both those alive and who have passed on. It is poignant that pausing to observe the presence and activities of other species can allow for the forging of positive social bonds amongst human beings.

The opportunity to observe solitary bees making nests in bee hotels offered participants an opportunity to observe insects up close, and to learn more about their behaviors. This opportunity to experiment with a scientific persona, and scientific methods of observation was a positive experience for participants. Unlike honeybees, which are colony nesting and swarm, the bees studied in the JBHP were solitary bees. Unlike the “uncanny headless animal” intelligence (Parikka, 2010, p. 48) of the swarm, which has so fascinated social theorists and network designers and provoked “strange emotions” in humans (Parikka, 2010, p. 50), the solitary bee offers an alternative affective assemblage. These are not strange emotions but familiar ones: connecting with family, getting the kids excited, seeing something lovely outside, and trying to protect it. It is notable that solitary bees specifically seemed to inspire emotions of fondness and familiarity, so contradictory to the emotions that might come up when encountering a swarm. Perhaps there is something about their very solitariness that invited a certain emotional regard to the lonely bee. It is more vulnerable than the bee that hives, it is up against the world on its own, in its quest to find a safe space to incubate its young. Perhaps some of the project participants identified with that loneliness – especially in the midst of a pandemic and lockdowns that kept people apart from their support networks, friends, and families. Most solitary bees do not sting unless very provoked (Batra, 1984) and as such pose little threat to humans. This fact also offered participants an opportunity to forge an affinity with the little creatures, along with the nurturing aspect of helping to provide them with “homes” where they could reproduce. Solitary bees lay the egg in one of the bee hotel “rooms” (the holes) and seal the nest, where the larvae hatches. The larva eats the provided food and then overwinters as a pupa, before emerging as a new bee the following spring.

This paper has demonstrated that people who sign up to citizen science projects are motivated by the thrill of being part of scientific endeavor, and that they also enjoy the excitement that comes along with being exposed to something new that opens their eyes to an aspect of the world around them that they have hitherto not had reason to pause to notice. People are looking for something interesting and fun to do, and they are also seeking joy, even though they might not know it when they sign up to a citizen science project about the natural world. Further, we have learned that some participants cannot help but become emotionally attached to the object of their study and will always create their own narratives about what they are doing and why, which may or may not match up with the scientific aims of the study. Although the scientists in charge of a research project may be operating (or trying to) with the dispassionate objectivity that characterizes data gathering and analysis, ordinary people who choose to take part have no reason to try to remain neutral. They want their part of the work to go “well,” and they cannot but help to become personally attached to the process. This attachment can be expressed through a competitive spirit, but also through a kind of possessive affection that can very quickly form with the objects of the study. It is perhaps to be expected that, considering the collective affinity that humans have with honeybees, that it is a small leap to also develop an affinity with solitary bees. Indeed, one of the communicative strategies of the JBHP was to leverage the existing public discourses about honeybees to get people interested in solitary bees. That affinity with solitary bees was produced quite quickly and easily for some people, through the simple process of looking at a bee hotel once a week (or more) and learning to notice,

identify and appreciate new bee species. Seeing the creatures, observing their behavior, feeling close to them, and learning about them, was a positive experience for some participants. That happiness should not be under-estimated, and surely adds value to the scientific process alongside the gathering of data. Some citizen science projects – arguably especially those dealing with animals, even insects – are more likely to produce these positive affinities and experiences, which in turn may help to make the data collection aspects of the research more successful.

It may be taking the argument too far to suggest that the JBHP allowed some participants to connect in deep and meaningful ways with the complex web of existence in the natural world. A slightly darker interpretation of the intense attachment to the bees and hotels would highlight the role of neoliberal, competitive individualism – the “I have more bees than my neighbor” attitude that was evident below the surface of worries about not having enough bees and celebrations about having many bees. This hints at proprietary ideologies of the place of humans in the web of life (that is, at the top of the pyramid rather than an equal member of a network). If the only way to get humans to care about insects is if they see them as “theirs,” it seems that the project of educating urban publics about conservation and biodiversity might be doomed from the outset. On the upside, possessive attitudes might have a positive spin, in that they encourage a sense of custodianship of nature, and a sense of personal and collective responsibility towards caring for (or at least not actively decimating) vulnerable creatures (as, tragically, all insects are in this age of the Anthropocene). The sense that they were providing refuge to something vulnerable was notable in the participant’s comments, and this might also be a useful insight for scientists to consider when they design the participatory aspects of their citizen science projects.

This paper has offered a qualitative inquiry into the emotional experiences of project participants in the JBHP and shows how people can forge new affinities and emotional relationships with insects, when given the opportunity to observe, interact, and bond with them. This can have benefits for the science, but also for the lived experiences and worldviews of participants. The relationship between human beings and other species has been a key topic in many disciplines, including environmental humanities, biology, ecology, and conservation studies. In the current age of human-produced mass extinctions and runaway climate change, many people are experiencing extreme emotional states in response, what some have referred to as “climate anxiety.” But there are also somewhat smaller, more everyday emotions, that exist between human beings and other creatures. These are not only worthy of study in their own right, but can be harnessed into driving mutually beneficial participation in citizen science research projects.

## Notes

1. All participant names cited in this paper are pseudonyms.
2. Facebook comment.
3. Facebook comment.
4. Maya (interview participant).

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