

Exploring Generational Differences in Black Perceptions of Indoor Plants

by

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ABSTRACT

Indoor plants have become a mainstay in contemporary culture. In conjunction with their purported links to air purification, much evidence has supported that the cultivation of indoor plants may improve mood, increase productivity, and reduce stress. However, the studies of indoor plant health perceptions have limited participation. To better understand perceptions of benefits from indoor plant cultivation, twenty-seven interviews were conducted with self-identified Black participants representing two generations. Aggregated responses of the interviews were then transcribed using the software Scribe and analyzed using open coding. Generally, participants' responses aligned with current literature, yet millennials diverged with no conclusive association between indoor plants and improvements to productivity or cognition. There were also few responses that plants altered thermal comfort. Ultimately, this work illuminates new insights into how inclusive research can advance understanding about indoor plants and has implications for how future studies should solicit participation, so results apply to the greater public.

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INTRODUCTION

Plants found in natural environments have been and remain an integral part of human evolution, helping to give rise to different civilizations and cultures^{6,31,84}. The reverence for plants in society is not just founded in human reliance on them for food, shelter, and medicine but at a basic physiological level plants provide additional ecosystem services by helping to sequester greenhouse gases⁷⁹.

Other benefits include stabilizing soil, limiting runoff, and perhaps most importantly as phytoremediators; a passive and cost-effective way to remove pollutants from the environment^{23,28,66,82}. Additional positive aspects of plants have garnered considerable interest from academics with many studies documenting advantages to physical and mental well-being from immersion in natural environments^{11,25}. Thus, the understanding that plants offer a plethora of benefits has long spurred people

to create versions of natural environments indoors with the hopes to replicate similar results, particularly in the form of indoor plants.

Many of the advantages of indoor plants include cleaning or purifying the air, improving cognition, increasing productivity, and relieving stress^{4,8,86}. Though the validity of some benefits reported on indoor plants are disputed given that most people in industrialized countries spend 95% of their time inside understanding how indoor plants improve indoor environmental quality (IEQ) and overall health is a global worthwhile endeavor^{16,59}. Moreover, because the actual benefits of indoor plants may be harder to quantify, *ex situ* complications, researchers have continuously used perceptions to quantify benefits^{1,16,20,35}.

However, while the number of studies on perceived well-being and indoor plants continues to rise, a participation bias remains which could ultimately misinform the policy

that is derived from this work^{8,34}. According to a systematic review of 45 self-reported perceptions of well-being studies that used indoor plants as an experimental variable included almost solely Caucasian and Asian participants. Further, most countries that funded these studies were found in Eastern Asia and Western Europe³⁴. And nearly half of the studies did not mention the age of their participants or focused on one age range limiting our understanding of generational differences.

Plus, only one study focused on indoor plant contributions to thermal comfort^{34,47}. In effect there remains a gap in holistically understanding the perceptions of indoor plants and related well-being benefits by excluding people of color and age variability. There also is evidence that perceptions about the benefits plants offer are misinformed by outdated studies as current literature fails to reach broad audiences¹⁶.

Additionally, perceptions of benefits from indoor plants are not ubiquitous, but rather are culturally circumstantial and commonly tied to space and time^{15,41,85}. The history of indoor plants started in the 10th century BC and has since transcended cultures. The first known historical documentation of indoor plants was in ancient China, where indoor plants were a sign of wealth and used to display status^{67,77}.

It would not be until 700 AD that Pensai, the meditative art of creating dwarf trees, would be introduced to Japan, and become popular due to its ties to Zen Buddhism⁶⁴. Indoor plants continued to be a signal of power and wealth through the 6th century BC with perhaps the best-known example being King Nebuchadnezzar II commissioning the Hanging Gardens of Babylon for his wife Queen Amytisand, which is commonly referred to as an interpretation of a botanical haven¹⁷.

In the 17th century, Europe began to experience indoor plant cultivation by way of colonization and botanical imperialism⁹. In addition to raw materials, plant species native to tropical and arid environments such as ZZ plants (*Zamioculcas* sp.), snake plants (*Sansevieria* sp.) and aloe (*Aloe* sp.) were brought indoors out of necessity due to climatic constraints and became valued for their aesthetics rather than their ceremonial and medicinal purposes.

In Great Britain, indoor plant cultivation was popularized by the book *The Garden of Eden* (1652), written by the agricultural expert Sir Hugh Plat⁶⁵. In it Sir Hugh Plat used Christianity to impose the need for indoor plants particularly by concluding greenery was a gift from God. Yet the idea of socioeconomic status being related to indoor plant ownership remained and their benefits were reserved for the wealthy.

This was primarily because the indoor environments of homes during this period were not conducive for plants and greenhouses were expensive to build². In stark contrast to the aristocratic ties in Europe, indoor plants were a means of connection and survival for indigenous people and enslaved Africans. While it is unlikely that the enslaved workers on plantations possessed indoor plants in the potted plant sense, archaeological excavations of slave cabins did find stored roots, and limited anecdotal evidence shows plants were regularly carried during the transatlantic slave trade, suggesting an ambiguity in what can be considered an interior plant^{37,51,70}.

This critical knowledge of plant use would likely be passed onto future generations^{10,61}. Other historical and ethnographic studies show herbs and roots were used, and remain used in ceremonies, rituals, and medicinally by descendants of

enslaved Americans^{50,69}. Undoubtedly, the history, uses, and perceptions of indoor plants are storied, and like all history, is likely to continue influencing future thinking^{3,24}.

In modern times, indoor plants are enjoying a resurgence in popularity not seen since the 1970s with millennials contributing to much of the rise in indoor plant demand^{5,49}. The unprecedented infatuation with indoor plants has expanded sales of indoor plants over the last decade, reaching 3.07 billion USD globally in 2018 while the use, significance, and perceived benefits of indoor plants remain linked to people's identities, including cultural practices, religious views, and racial affiliation^{36,80}. Again, some plants are a part of cultural traditions synonymous with certain aspects of life. For other marginalized communities, indoor plant ownership has been linked to a revival in open expression for appreciation of the environment led by so-called "plantfluencers" on social media⁶⁸.

For many African descendants, indoor plant ownership is viewed as an act of defiance and resilience to antiquated stereotypes of people of color disregarding the environment^{27,40}. Notably, the rejuvenation in indoor plant popularity has coincided with the subsequent reestablishment of indoor plants and well-being as an important and necessary research field with new collaborations with the disciplines of economics and energy⁵⁵.

Yet, as previously stated the participation in indoor plant perception studies does not reflect the reality of who is accessing plants for their benefits by restricting participation in these studies to distinct populations. Here using targeted structured interviews of self-identified Black baby boomers and millennials we 1) gain insight into perceptions of well-being, ownership, care, knowledge as it relates to indoor plants 2) elucidate general trends in perceptions of two generations of Black

indoor plant owners, and 3) expose the links Black indoor plant owners make between ownership, care, knowledge, and well-being to showcase the cultural relevance indoor plants have for the Black community. By showing the nuances in how culture shapes perception of well-being future work will be able to evaluate perception results more accurately.

METHODS

Participant recruitment

Eligible participants were self-identified people of color, who had completed high school, and owned at least one indoor plant. Millennials and baby boomers, adults born between 1981 — 1996 and 1946 — 1964, respectively, were chosen because these two generations represent the forbearers and current generation that continue to cement indoor plants in American culture. Age ranges were defined using the Pew Research Center's classification of generations. Participants were either paid \$10 USD or given an indoor plant as compensation for their time and responses. A study solicitation email was shared with two black academic organizations to spearhead recruitment. The remaining participants were solicited using a snowball sampling method, wherein previous participants were asked to share the study within their networks⁵⁷. Schools, churches, and concurrent studies

were also used to solicit participation. A detailed consent form stating the objective of the study, and risk was shared with all participants. All participants electronically signed a consent form or stated verbally that they met the full criteria to participate and understood the minimal risk involved.

Data collection and Analysis

The four major categories of questions were determined based on the study aims and constituted the major themes of the interviews. Within each theme questions were modeled using different sources and applicable guides. Knowledge-focused questions were modeled after the *If/then/Therefore* framework⁴⁴. Care and ownership questions were created using reference books as guides to understand best practices, while perception questions were formatted using previous literature focused on the perceived benefits of indoor plants and novel ideas such as thermal comfort^{14,34,53}. Within each theme, groups of pre-chosen

questions created subthemes (Table 1). For example, within the theme of plants and perceptions well-being, subthemes were thermal comfort, environmental, cognition, and therapeutics. An initial control interview was carried out with a participant indicative of a common participant of indoor plant well-being studies to ensure major categories were sufficient and questions were comprehensive.

Structured interviews were completed virtually and recorded using Zoom and Google Hangouts and typically lasted 60 minutes. The target of 15 interviews per generation was established to allow for sufficient data saturation when conducting qualitative studies where interviews are used^{29,56}. Once interviews were completed, the recordings were transcribed verbatim using the Scribie © 2021 software. Instances where participants' responses are shared received minimal editing for clarity and conciseness, to ensure the meaning and tone

of the response were unaltered. Participants were asked about a range of topics concerning general ownership, care of, knowledge of, and well-being benefits of indoor plants (Appendix A). Initial questions about ownership and care were asked before asking questions about perceptions and knowledge. Questions were asked in this order to initially build a foundation in which indoor plant perceptions and knowledge questions could become more personalized to uncover more in-depth answers, and to highlight any complexities or linkages between ownership/care and perceptions of well-being and knowledge.

Subsequently, all transcripts were analyzed manually by a mix of open deductive and inductive coding using the grounded theory method^{12,21,71}. Deductive coding was used in comparing Black perspectives to current indoor plant well-being studies. Within each major theme preset codes were created based on literature

but could organically form over the course of the interviews and iteratively evolved while analyzing participant responses. Inductive coding allowed us to isolate generational trends. A full coding schema for each sub theme is detailed in (Table 1). The first round of coding consisted of listening to interviews and reading transcripts to assess if preset codes were sufficient to conduct a full analysis. The second round of coding consisted of extracting specific responses and using a chromatic schema to delineate nodes

could not be established because responses varied too much or not at all, general responses were captured to show the diversity in answers. I ran chi-squared tests of independence for both overall health perceptions and plant variety owned to see if there were significant differences between generations.

or specific lines applicable to the questions and justified coding. An additional step of vetting emergent codes was carried out in the end to see if they could be combined with preset codes. Codes also created the basis of understanding trends within generations by quantifying results. Trends were created if there was a simple majority of agreement between participants or if multiple codes were repeated through a generation's responses. If distinguishable trends in coding

RESULTS

Overview

I conducted 27 interviews between November 2020 and January of 2021. Participants comprised millennials (56%) and baby boomers (44%), with a female bias of (81%) (Table 2). There was a noticeable difference in participant living location, with all baby boomers living in private homes and all but three millennials living in apartments.

Well-being

General perceptions

To gauge perceptions of indoor plant contributions to well-being, I asked participants broad questions about feelings and well-being. Afterward, I asked a series of more targeted questions to investigate perceptions more thoroughly that agreed with current literature on perceptions of well-being. Overwhelmingly, (96%) of participants associated indoor plants with positive feelings and perceived plants as beneficial to general health. Typical

responses included direct feelings of, “joy, soothing, meditative, and happiness”. A millennial participant stated *“It makes me feel warm, and it also makes me feel accomplished. It makes my home feel warm and welcoming and inviting...”*, *“It’s joyful to really see plants sitting there and just thriving and knowing that I’ve cared for them and they’ve become something great over time”*. While a baby boomer stated, *“It’s the coolest thing to me to see them grow.”* For seven participants (26%), positive feelings were reported as circumstantial to how their plants were doing. A millennial said, *“When my plants are living and doing well, I do feel accomplished.”* A baby boomer commented, *“When they’re doing well, it makes me feel great, it makes me feel like I am a part of something really special in watching them grow.”* For broad questions surrounding health benefits, the two main benefits were mental health and IEQ, specifically purifying the air (Figure 1). Common responses from

both millennials and baby boomers were similar, “*Well, other than air purification, just for making me smile and have a happier disposition, that's definitely a beneficial aspect for me,*” and “*I think the air quality, they may benefit the air in my home, and they I don't know I think they're my mood boosters.*” Another millennial participant stated, “*I know that they're excellent air purifiers and all that stuff, so I... Like my parents growing up, like my parents would always say, put plants out and open a window and you'll have clean air inside your house, you don't need Febreze or anything like that.*” Fewer participants, (19%) from both generations shared they used their indoor plants for sustenance, such as growing healthy food or topically, such as using aloe for a burn.

Therapeutic and mindfulness

Given that there was a near unanimous agreement that plants contributed to positive feelings, it was unsurprising that

most (93%) participants reported that they found indoor plants to be therapeutic. Participant responses indicated attitudes of plants evoking relaxation and reducing stress. Specifically, it was common to reference that seeing the plants alone was therapeutic as one baby boomer said, “*Absolutely, because like I said, they remind me of the individual who gave them to me, they make me smile, and I know that they are improving my quality of life, so... Yes.*” Two participants also noted that the aroma that certain plants produce can be therapeutic.

Importantly, when asked about therapeutics both millennials and baby boomers noted that cultivating their indoor plants was linked to the act of caring for the plants such as watering, removing leaves, and repotting and was seen as a hobby (Figure 2). For example, to reflect this sentiment a millennial stated, “*I do find it therapeutic. Just in the sense of like taking care of something and I guess it's also kind of a time*

to just sit and think. I feel like there's some things that are kind of mindless activities like you're paying attention to your plant, but like. I feel like you still have the opportunity for your thoughts to drift off." A baby boomer also noted, *"For therapeutic reasons, it kind of clears your head, relaxes, reduces anxiety, and stress, and it gives you something to think about, something to do. And you're kind of, you're proud of the fact that you can grow plants 'cause everybody can't grow plants."*

Productivity and cognition

A minority of participants, (30%) were unequivocal in their belief plants positively impacted their productivity. Half of the baby boomers refuted this idea and was typically for both millennials and baby boomers to answer in an inconclusive manner. For example, millennials said, *"Yeah I don't know if that helps with my productivity, but it does help me center myself."* while another stated, *"I don't have any evidence of that, but... I have a room*

where I have a desk, and I always...If I'm gonna be working there for a long period of time I bring a plant... I don't know, it just makes me feel productive or something, I don't know, it makes... It makes you feel motivated, I think." Baby boomer responses were fewer with only two participants stating there were positive benefits to their productivity and cognition. Most responses were similar to the following, *I cannot say that I feel that it does improve in any way... No, no. And you're meaning cognitive thinking, or your thought process improves because of the plants? No, I don't think my plant has anything to do with it, no."*

Thermal Comfort

Given the novelty of this idea in academic literature participants were asked a series of probing questions about general thermal comfortability and the shade their plants provide. Afterward, participants were asked their thoughts of plants either affecting their thermal comfort or physical temperature

of their residence. There was near unanimous consent from participants that their thermal comfort was ultimately not affected by their indoor plant (85%). (11%) believed that the emotional energy plants provide added a layer of warmth and coziness internally and one participant had been made aware of the concept but was unsure about what it meant. However, when asked if plants could physically change the temperature of a room responses varied. More often baby boomers attributed plants altering the temperature of a room because of temperature requirements rather than the plants physiologically altering the temperature, like this statement, *“I cannot say, I cannot say that I've noticed. And in what ways do you think that a plant could affect the temperature of a room? I would think if a plant had to be in a cooler temperature and you kept your thermostat at a cooler temperature to keep the plant alive, that's the only way I can see it because like a fern... Some of those plants can't tolerate too*

much heat, natural heat and sun, like Can't tolerate a lot of direct sunlight or the heat...”

In contrast, seven millennials reported knowledge of the physiological pathways that plants can either cool or heat the surrounding air. Answers about this phenomenon ranged from knowledge about transportation in which gases are released which can affect ambient temperature or simply by the energetic process much like gaining heat by being next to another person. One example is this comment made by a millennial, *“I've heard of people getting near plants and feeling warmer like if they're near a plant if they stand next to a plant, but in terms of the overall temperature I have never thought about that.”*

Responses to the question, "Do you ever feel too cold or too hot in the rooms you have plants in?" were varied across both generations. While most baby boomers had not experienced thermal discomfort in a room that contained indoor plants it was common

for millennials to experience temperature extremes in areas where plants were present in the house. However, less than half of millennials connected temperature extremes to either being detrimental or beneficial to their plants, instead focused their responses on coping mechanisms to the extreme temperatures they were facing. In comparing the two groups all baby boomers who had experienced adverse temperature did express concern about what it would do for their plants.

Similarly, only baby boomers (33%) explained they changed the thermostat setting for the sole benefit of aiding indoor plant health. No millennial participant took this action expressing that temperatures were set based on personal preferences. Still, a few millennials mentioned other alternatives to keep plants at their preferred temperature including indoor greenhouses, using humidifiers, and opening doors. An equally small number shared they would alter the

temperature for plants if it was deemed necessary but had not in the past because they had considered the temperature of their indoor plant before purchasing indoor plants. Overall, it was extremely uncommon for indoor plants to provide sufficient shade that participants registered this phenomenon (.07%).

Negative perceptions

Chiefly the perceptions of indoor plants being harmful were for young children and pets specifically domesticated cats and dogs. Much of the unforeseen consequences of indoor plant cultivation came from worries that plants were toxic and could potentially be ingested. This is exemplified in the millennial comment, *“If you have anything that's toxic, I try a lot because I have plants that cats try to eat, so I try to keep stuff away from that I feel like would hurt them.”* This led to adaptations such as full plant removal, relocation, and rearing of pets and children to leave plants alone. Other harms included

allergic reactions to plants from either unknowingly touching and from the pollen of germinating plants. Noxious fumes from plants were also a concern though it was an uncommon remark but highlights the complexity of answers given earlier responses regarded plant fumes as aromatherapy such as the response made by a baby boomer, *“I think if you're not taking care of them, then they can release certain fumes or certain smells. So, for me, I think that if I'm not taking care, my plant can release toxins that arise from the death of the plant.”*

Both generations shared a common disbelief that indoor plants could be harmful at all and at most the negative effects were not drastic compared to how plants may be detrimental to pets or young children. Only one baby boomer and three millennials provided unequivocal responses that plants could be detrimental to themselves. All other responses were circumstantial or refuted the

idea. The most common ways plants were seen as being harmful were bugs. Commonly noted bugs included classic indoor plant pests such as gnats (*Lycoriella sp* and *Bradysia spp*), spider mites (*Tetranychidae*), and mealybugs (*Pseudococcidae*). Having a diseased plant that had notable signs of fungus was also associated with negative impacts. A baby boomer said, *“Again, if you've got a diseased plant or bugs, there's no telling what you're breathing in.”* Second was the negative impacts plants could have on one's mental health. A few responses noted being emotionally attached to a plant and having it die or having plants be tied to deceased people and causing emotional distress as one millennial stated, *“Yeah like if you have a really close connection with your plants and they do die that could be detrimental for your mental health.”*

Ownership

Reasons for owning indoor plants

Both groups of participants justified their rationale for plant ownership around the general belief that plants were good for the home and its residents. This appreciation for plants extended to shared beliefs that plants were meditative or had positive indoor environmental qualities, such as purifying the air or adding an aesthetic value. Interestingly, one millennial participant linked the air-purifying values of plants to concerns around sustainability, citing they were more cost-effective, *"Yeah, I just like flowers personally, so I felt like a plant is sort of more sustainable than flowers with flowers, they die after seven days or so, so like plants or just another sort of something to look at that's more sustainable and not as costly to try to continue to replace each week, such as flowers."* Caring for something other than themselves was also a recurring response for millennials though a few baby boomers did share this sentiment. Seven millennial participants expressed that, while having a

pet or child can be cumbersome, taking care of indoor plants is a lower-stakes alternative that still allows them to satisfy caregiving instincts as one millennial noted, *"You know, we now have this phase of life called early adulthood, but I think that we still want to hold on to something like we still want to take care of something. So, some people have children, but some people get pets to take care of and I've noticed that a lot of people get plants as well. It's kind of like a more low-key alternative to taking care of something like..."*

Overall, baby boomers shared similar views in that their reasons for owning indoor plants were predominantly an appreciation for how plants can alter a space aesthetically and have beneficial impacts on mental health, as indicated by this remark, *"Well, first of all, I like plants because I think that they add a character to the house and personality,"* and *"I like plants... I like to see the color of them... I like to see something grow. I like to*

nurture it and see it mature actually, and not to mention that it gives off good oxygen". Lastly, for some baby boomers and millennials, plant ownership was seen as part of or an extension of their identity. One baby boomer explained that, "*they've*" *always been a part of my life plants,*" while another stated that they, "*really began having a passion to have house plants.*"

Plant Variety

Across generations, there was high variability in how many plants participants owned ranging from one to more than fifty. Fifty-three different plant species were currently owned. Thirteen plants were shared across generations (Figure 3). The most popular plants described between the two demographics were small to medium "low-maintenance" plants, such as varieties of pothos (*Epipremnum sp.*) and snake plants (*Sansevieria sp.*). For millennials and baby boomers, "succulents," a catch-all term for lesser-known engorged water-retaining

plants and Aloe or cactus, were the most reported plant though millennials owned a greater amount. Another common plant included (*Maranta sp.*) which was equally reported by both millennials and baby boomers. Poinsettias (*Euphorbia pulcherrima*) were popular with baby boomers and often bought during the winter holiday season. It should also be noted the reported names of plants is not an exhaustive list as some participants did not mention all their plants or did not currently have the name of plants they owned.

Sociodemographic relationship to indoor plant ownership

When asked questions about indoor plant ownership being related to social equity metrics (SEM) responses varied by participant though certain trends were evident. One millennial, made a positive linkage that being black and cultivating indoor plants amplified an appreciation for and a historical connection to the environment saying, "*I've also seen*

cultivating plants and caring for plants went to black liberation as well, returning to aspects of our ancestry where we had a deep relationship with taking care of plants, for sustaining our own food and nourishing ourselves.” There was a common description that socioeconomic status was a limiting factor in being able to obtain indoor plants (41%) highlighting the prohibitive cost of some plants that are larger, healthier, and come from boutique shops. Many participants spoke candidly about people making a decision to buy necessities or buying a plant putting plant ownership in a de facto luxury category as one millennial poignantly stated, *“people with lower socioeconomic status have less resources. So, they're less likely to own a plant because it requires excess resources and if your options are to feed your family or water this plant, the plant is going to die. Which really sucks because of the benefits of having plants, you know I feel like people in lower socio-*

economic status or living in poverty, I feel like they could definitely benefit from having a bunch of plants.” Education status was also linked to knowledge of the benefits indoor plants offer; however, this concept was not monolithic.

Participants also noted the sheer understanding that indoor plants could be cultivated could be a limiting factor in that if you did not see indoor plants growing up then it is unlikely unless you come from an environmentally connected background would someone know the benefits of indoor plants. Others spoke of the lack of readily available material to learn about plants and their benefits as a potential limiting factor. It is important to note some responses were coded multiple times as their responses induced multiple factors. For example, while a participant might believe plants are associated with a person's economic status but not their religion and vice versa as indicated by in the following baby boomer

response, "*... and I say that because I lived in the inner city, and as I said, none of the friends that I had, had plants in their home that I remember or know about, however, if I went down south to visit my relatives, they had plant inside in the homes... In terms of religion, and I'm only saying this because I know that there are certain plants that are more tied to Oriental religions, like bamboo. So, I know some families that have it, but it's for religious purposes, and then in terms of education, I don't know if there is a tie. I don't know, there may be, but I don't know. I can't say that if you have more education, you might be more inclined to have a plant.*"

Care

Responses to questions about indoor plant care routines were individualistic with no apparent generational trends in general care routines (Figure 4). Rather, care and thoroughness were based on the number of plants owned, knowledge participants had about their plants and care acumen. One

millennial who was relatively new to owning indoor plants stated, "*It goes with my mental health and my plants we work together, so it's based off of how I'm doing,*" while a seasoned cultivator said, "*my larger plants, I try to water them once a week, but the small ones, like the violets, I put a little bit of water just in the bottom of the clay dish, and I try to water those twice a week, and that's about it. And I try to clip dead leaves 'cause the peace lilies, they will have leaves that get brown, so I try to do that maybe every two weeks...*"

(52%) of the participants moved plants outdoors for various reasons. Other actions like playing music for plants had notable heterogeneity among generations. The idea of playing music was not something participants did explicitly for plants but noted that playing music was likely appreciated by plants. This variation in response was evident in the following two competing responses by baby boomers, "*Yeah, no, I don't move the plants that I have indoors out,*" and "*They*

just seem to thrive and when I can put them outside in the spring, summer and even to part of the fall time, they just seem to be healthier and grow much faster when they're outdoors.”

Knowledge

Millennials most often obtained information about indoor plants from internet sources, such as YouTube videos and relevant Google searches. Baby boomers were more likely to mention readings including reference books and magazines. Thus, it was unsurprising that (50%) of baby boomers reported owning indoor plant care books compared to (13%) of millennials. That is not to say the younger generation did not have books about plants, several millennials owned either taxonomic textbooks, predominantly focused on wild plants or those that loosely incorporated plants such as interior design books. Nearly all millennials (87%) were on social media and followed indoor plant accounts compared

to only (17%) of baby boomers were. Participants most often followed social media accounts of Black indoor plant influencers who post content on caring for plants and quality photography of plant collections. Additionally, participants rarely mentioned having read academic articles about indoor plants and their benefits, only (15%) reported having done so. Another primary source of information for millennials and baby boomers was their relationships with other plant cultivators who were generational peers.

Other knowledge questions focused on if participants believed that the information, they base their perceptions on was accurate or used for marketing given the notable rise in indoor plant popularity and disinformation common on social media. Baby boomers were equally split on indoor plant information being used for marketing purposes while millennial participants generally replied circumstantially either

believing it was true but only for certain larger online media platforms regarding how companies sell the benefits of plants. This trend extended to ideas about information accuracy. Most baby boomers (67%) believed the information they had on indoor plants was accurate. (87%) of millennial participants found accuracy in the information they received about indoor plants was circumstantial and was based on what website they used, and who was providing the information. When asked... one millennial responded, "*Mostly. Yeah, goes back a little bit to taking everything with a grain of salt, but that's also just my understanding that there's a variety of factors or conditions that have to be met for a plant to grow successfully, and everyone's house and soil type and whatever, humidity. So, all that's gonna be different,*" or in another response "*Yes, when it comes to the health benefits, I feel like it's sort of a marketing ploy, but it's good, it's not necessarily false,*

but it's a way to bring people into the indoor plant community." More often baby boomers' responses vindicated the accuracy of their sources.

DISCUSSION

Summary and conclusion

Using interviews, we conducted the first qualitative research focused on Black people and their perceptions of well-being derived from indoor plants. We also denoted trends between generations and drew linkages surrounding the major themes of ownership, care, knowledge, and well-being. We found that, overall, both millennials and baby boomers had views that aligned with the current literature, specifically that plants add value environmentally and boost mood^{60,75}. Both participant groups disagreed with the current literature that indoor plants benefit productivity. Trends were evident in sources of knowledge, with social media being the number one contributor for millennials and both generations used formal and informal relationships to gain knowledge about indoor plants. However, we were unable to statistically verify any differences between

generations in their perceptions of overall health and plant variety owned.

Perceptions of well-being

While many well-being benefits focus on IEQ and mental health, there are still connections within these frameworks deserving of further study³⁴. While plants may not effectively filter the air in real-world situations, when questioned about general health benefits, many participants believed it to be the case¹⁶. While it is currently believed to be unlikely that indoor plants lower indoor particulate matter, ongoing research is using gene editing to allow plants to uptake pollutants in greater quantities. If paired with sufficient airflow, these modifications could benefit indoor air quality significantly by removing pollutants¹³. Our results also showed linkages between the types of plants owned and how you must care for them had therapeutic benefits. While some studies have assessed how cultivating plants can be therapeutic the focus has been on older

individuals and not in a well-being perception study⁸¹. While previous studies have found significant results that indoor plants improve productivity and cognition our results were mixed^{26,43,46,47,48,58}. While this could be from either a cultural divide in perception or an anomaly, this result warrants future statistical analysis between different demographics. This is because combined cognition and productivity studies comprise a significant proportion of indoor plant well-being literature and the amount of time spent indoors working continues to rise. We also found evidence of negative perceptions as it pertains to mental health and using indoor plants as memorials for deceased loved ones. Negative perceptions also dealt with the harmful microbes that may be present in plants which have been documented by the CDC but still is an understudied effect of indoor plant exposure⁷⁴.

Perhaps most important were the insights garnered from questions about

thermal comfort. I found evidence of widespread regard for the temperature specifications among baby boomers and millennials and a working understanding of indoor plants could affect temperature. However, it was an unpopular perception that plants affect thermal comfort posing potential challenges to implementing thermal comfort into future work. This is different from the earlier work that reported office workers were more thermally comfortable in spaces with more foliage⁴⁷. Future work should put more emphasis on temperature as is regarded as the second most important measure to keeping indoor plants healthy, a growing body of literature supports that lack of thermal comfort leads to adverse health effects^{62,63}. Additionally, because people of color face disproportionately higher rates of energy poverty potentially meaning extremely low or high temperatures understanding the effects plants have could lead to important breakthroughs in creating

solutions to excess winter deaths and heat-related morbidity^{18,83}.

Ownership

An emergent finding of importance for ownership was varying views on how accessibility, religion, and education can affect indoor plant perception. When designing indoor plant perception studies these connections are often disregarded³⁴. Incorporating other communities like Black and indigenous people allows for new insight by underpinning unique experiences that will factor into how they perceive the benefits of their indoor plants³⁹. Moreover, there has been continued pressure from both academics and institutions to reckon with the exclusion of marginalized groups taking part in scientific research across disciplines in the wake of the BlackLivesMatter movements and social unrest during the summer of 2020⁵⁴. Other socio-demographic factors, such as geography, may apply given that

most publications to date are based in Eastern Asia and America.

Care and knowledge

As mentioned, prior, care for plants was linked to therapeutic benefits. Other aspects of care focused on specific actions that were taken that proved beneficial to plants such as moving plants outdoors for optimal sunlight⁵³. In all, care was individualized and not tied to one specific generation. There is also limited evidence that plant cultivation may make people more empathetic to others⁵². One idea to manifest aspects of care in future studies is to set up different trials where participants are responsible for the plants rather than passive observers of their foliage.

Trends in knowledge obtainment were divided by generation. Millennials used online and social media to obtain information and typically questioned the authenticity of information while baby boomers commonly used print media and friends and did not

question their understanding about indoor plants. Both groups believed that information was being used for marketing but that it was still reliable. Some knowledge however was ultimately incorrect. This misinformation in the benefits of plants particularly related to air purification is severely understudied. Thus, contextualizing our results with the larger body of literature is difficult though there is a known discrepancy in what is reported and actual benefits that are quantitatively verified⁷⁸. In effect understanding where and how knowledge about plant benefits is obtained will allow us to stop the spread of misinformation and instead focus on the proven benefits of indoor plants.

Limitations and next steps

One factor that can limit the utility of qualitative research is that it is not statistically representative⁷⁶. We also have a bias of women and younger participants. Because this research intersects with medical

expertise, it's best to adhere to standards of statically significant results of random control trials. Part of our limitation was not having as robust of a recruitment effort. To overcome both shortfalls future research should collaborate with medical professionals who study the factors associated with indoor plants. Lastly, within exploratory frameworks coupled with multi-discipline collaborative research, the scope of analysis can be far reaching. In that regard only a few items can be conveyed in any given manuscript. To that end, it makes sense to call other researchers interested in the pathways through which natural environments benefit humans to insist such research is inclusive and equitably funded. In closing, as the popularity of indoor plants and their positive attributes persist ensuring that the research is both inclusive, rigorous, and interdisciplinary should be a serious consideration for any future work to ensure

the utility of results and efficacy of
dissemination

APPENDIX

Appendix A: Interview Script

Personal

Can you please state your age, and sex, and education status, household size, occupational status?

General Ownership of plants

This interview is for people who have already disclosed they own house plants. Did you grow up in a house that had house plants?

Why do you own house plants? What was your original reason for becoming a plant owner?

Can you please describe the plants you own? How many? What type?

Have your reasons for owning plants changed?

Where have you bought these plants? Are you aware of any Black Owned nurseries? Would you be inclined to buy from minority owned nurseries? If so, why?

Do you feel that you are a part of a community of plant owners?

Have you received plants as a gift before?

In the future would you own more plants?

Do you have any limitations on your plant owning aspirations?

Can you think of anyways that indoor plant ownership may be tied to race, socioeconomic status, or education or religion?

Care for plants

Can you please describe your care routine for your plants?

What do you do when you are unsure of how to take care of your plants?

How often have you repotted your plants?

Do you arrange your plants in any particular way? What is the reasoning behind them?

Do you move plants outdoors for any time during warm seasons?

Have you had issues with bugs in the past because of your plants?

Have you ever played music for your plants?

Well-being

Have you ever been burdened by owning plants? Such as not being able to properly care for them.

How does it make you feel when you look at your plants or are around them?

In what ways do you think indoor plants benefit your health?

Can you talk about what rooms have plants and you're reasoning for where they are?

Are you ever too cold or too hot in the rooms that you have plants?

Have you ever known of plants to affect thermal comfort?... In what ways do you think plants can affect the temperature of a room?

Do your plants provide any shade? Have you ever changed the temperature of your house to keep your plant warmer or colder?

Do you think your productivity or cognition is improved when you are around plants?

In what ways do you think plants reduce physical discomfort? In what way?

Do you find it therapeutic to be around your plants? In what way?

Can you think of any ways indoor plants may harm your health?

Aside from your health can you think of any way indoor plants can harm your pet or be harmful to young children?

Do you incur any undue financial burden because of the plants you own?

Knowledge

Where do you get most of your information on indoor plants from?

If you are on social media, do you follow any indoor plant accounts?

Have you ever watched any videos on propagating plants, plant care, or what plants to buy?

Do you listen to any podcast or radio shows about plants, or would you consider that?

Do you own any books about plants? If so which ones and why? Would you consider it?

Do talk about your plants with family or friends? What do you typically discuss?

Have you ever read any academic articles on indoor plants and their benefits or perceived benefits?

Do you feel that the information you get about plants from websites, books, and social media is accurate?

Have you ever thought that the information you get from plants is used for marketing?

If what you perceive about plants were false would you still be inclined to own plants?

What type of media would you need to take in to make you a better plant owner or a more competent owner etc.?

Is there anything that we have not discussed related to indoor plants that you would like to speak on?

TABLES

Table 1 Full interview breakdown of themes, subthemes and codes used in the analysis

Major Themes	Sub Themes	Preset/Emergent Codes
Ownership	Reason	Environment; Décor, Nurture, Sustenance, Religion
	Purchases	Place of purchase, Type of plant
	Community	Family, Friends, Online, Present/Absent
	SEM	Religion, Socioeconomic status, Education, Race
Care	Routine	Watering, Cleaning, Repotting, Seasonality, Quality
	Arrangement	Placement, Sun requirements, Personal requirements
Well-being Perceptions	Negative	Financial, Harm to pets or to self, Travel, Bugs
	Therapeutic	Enhancement Present/Absent, Mental health, Meditative
	Cognition	Enhancement Present/Absent, Focus
	Thermal Comfort	Enhancement, Physiological heating and cooling, Temperature adjustment
	Environment	Air quality, Feng Shui (Energy, Vibes, Decor)
	Physical	Alleviation of discomfort, Medicinal

Knowledge	Obtainment	Use of Books, Social media, Academic articles, Podcast/ Radio, People, Videos
	Marketing	Believability, Use of Information
	Accuracy	Believability, Use of Information

Table 2 Attributes of participants

	1946 — 1964	1981— 1996
Gender		
Male	2	3
Female	10	12
Education		
Some College	1	0
2-4 Year Degree	8	2
Masters or Higher	3	13
Living Arrangement		
Apartment	0	12
House	12	3

FIGURES

Figure 1 Coding frequency for general health benefits. X-squared = 24, df = 20, p-value = 0.2424.

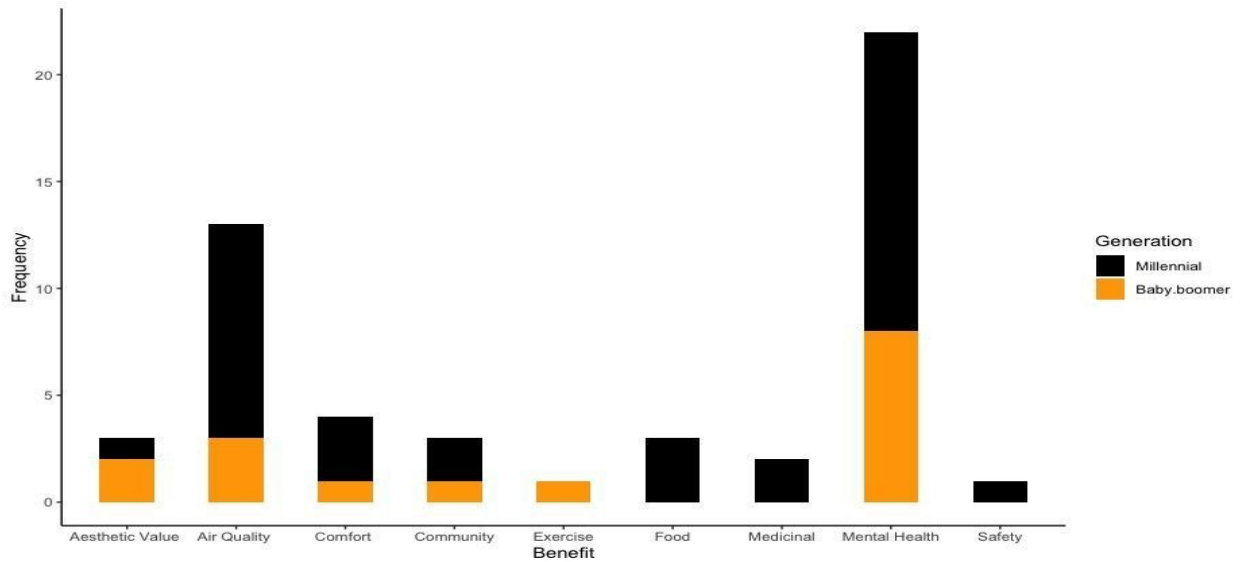


Figure 2 Circles represent main themes while rectangles represent subthemes. Not

represented are the codes that

make up the subthemes.

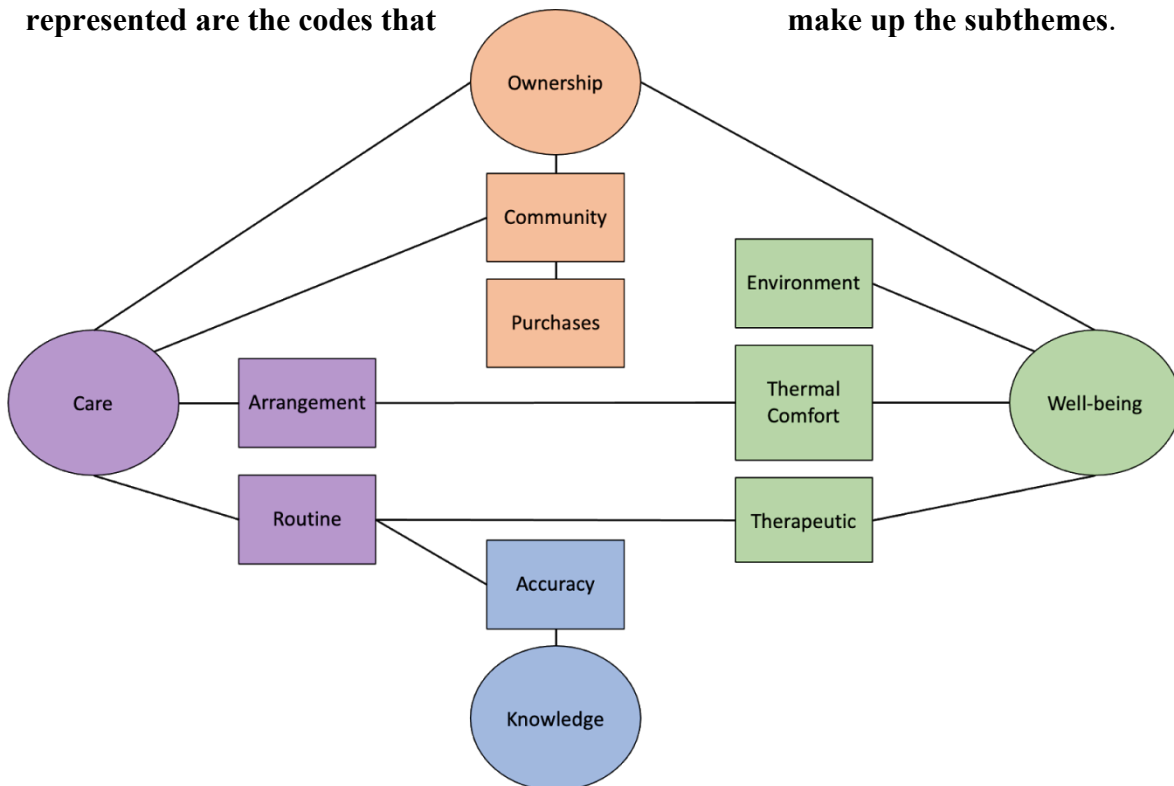


Figure 3 Frequency of plants shared between generation groups. $\chi^2 = 10.957$, $df = 12$, $p\text{-value} = 0.5326$

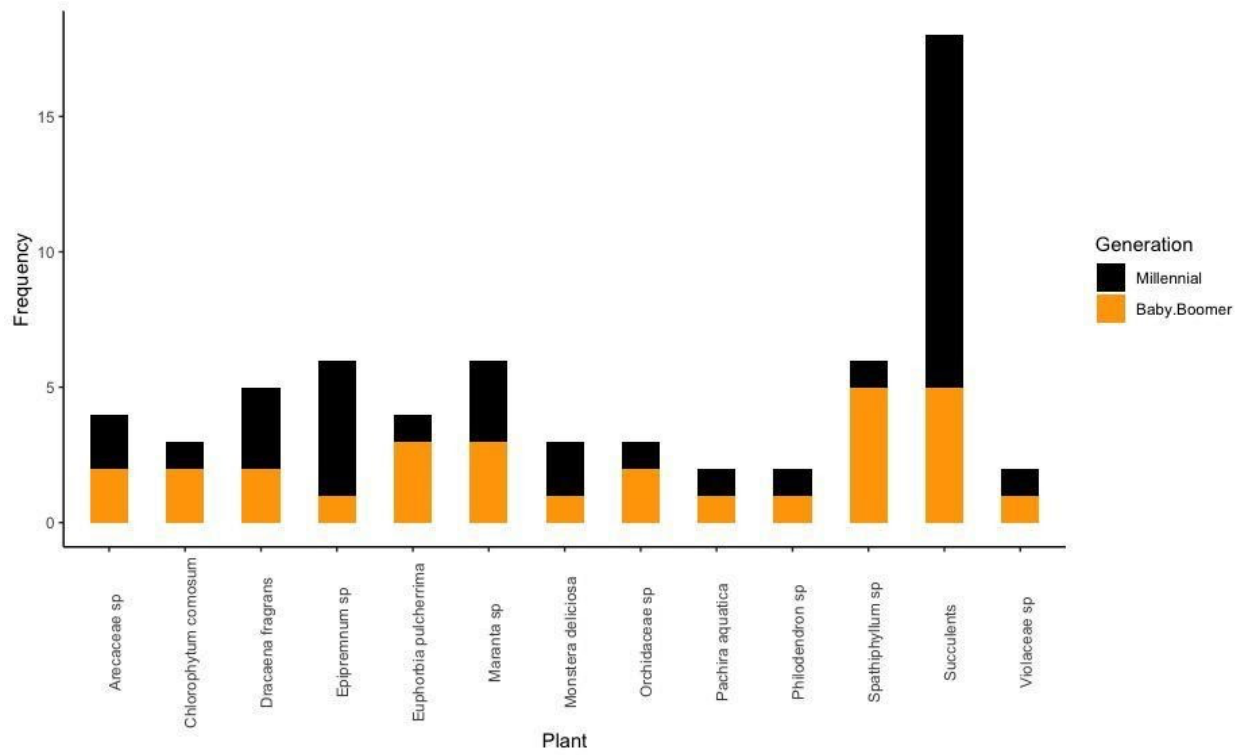
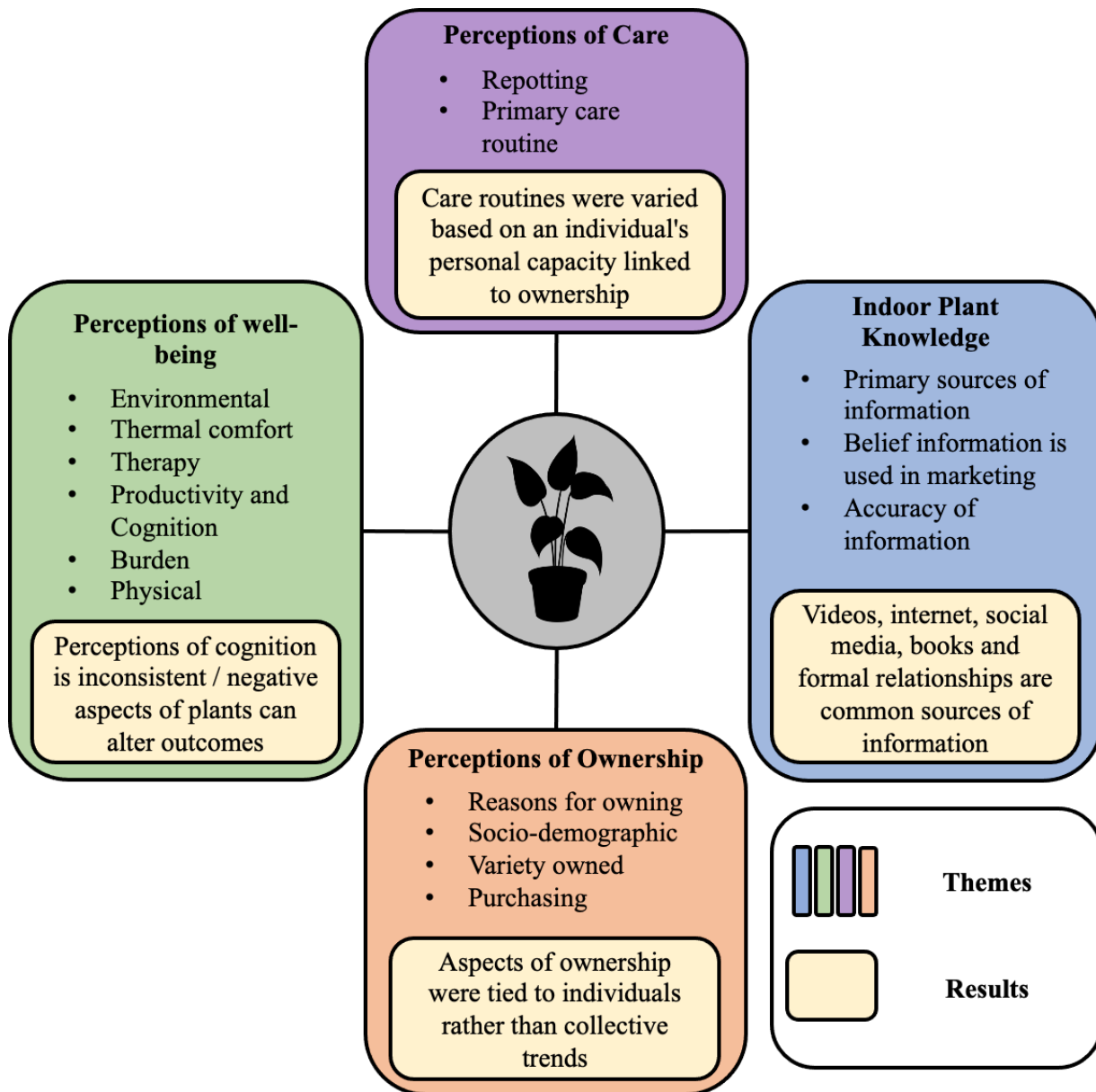


Figure 4 Conceptual diagram of fundamental themes and abbreviated relevant findings.



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