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Understanding environmental generational amnesia through urban school garden learning experiences in Gimuy/Cairns, Australia

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ABSTRACT

This paper explores the potential role of school garden learning experiences in remediating Environmental Generational Amnesia (EGA). EGA is a generational type of environmental forgetting brought about by prolonged disconnection from "natural" landscapes, with symptoms manifesting as poor motor skills, deficient food origin knowledge, a lack of environmental moral affiliation and undeveloped connections to place. Drawing on interviews with teachers, parents, counsellors, groundskeepers, and administrators at a Far North Queensland primary school, this paper explores how school garden learning experiences foster interaction patterns that combat EGA's symptoms. We find that urban school gardens offer new possibilities for reassembling students into more-than-human local ecologies in ways that can remediate the manifestation of EGA.

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Introduction

Urbanisation is a key feature of the Anthropocene, with many urban dwellers now physically and mentally removed from "natural" landscapes (Kellert 2002) and the agricultural practices that provide human sustenance (Head 2016). This disconnection leads to a particular form of collective amnesia that Kahn (2002) first identified two decades ago. Environmental Generational Amnesia (EGA) is a disassociation with the natural/environmental realm and a perception of nature that needs it to be "big" or "pristine" to be recognised and classified as "nature[1]" (Kahn 2007; 2022; Kahn and Weiss 2017; Kellert 2002). This paper recognises children as susceptible to EGA without tangible contact time with more-than-human ecologies, such as the plants, animals, and critters in the city. This more-than-human world is made up of intricate connections and mutual reliance between human and non-human elements within the urban environment (Taylor, Pacinini-Ketchabaw, and Blaise 2012) although without involved contact it can seem invisible. Gardens are spaces that can address this, and where humans and non-humans come together with a shared goal: assembling co-creation (Sarmiento 2017). The research charted in this paper explores how one garden in a Gimuy/Cairns primary school, referred to as Tropical North State School (TNSS) (pseudonym), engages this process by offering everyday environmental encounters and assimilating children into a garden assemblage. Research exploring EGA is limited to a small number of studies[2] that examine how to "de-escalate" EGA. The language of de-escalation has the tendency to be

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alarmist and universalise experience; instead, we deploy the term "remediate" to allow for differing encounters with EGA. Moreover, the research presented here narrows the focus to examine how school gardens as learning spaces can remediate the manifestations of EGA.

Our paper thus builds upon scholarship that charts EGA symptoms but is novel in that it goes beyond existing research to explore the potential role of school gardens in remediating them. Indeed, we extend existing scholarship to question whether food origin disconnection might be a missing manifestation of EGA in the literature. We also recognise that Kahn (2002; 2022) sometimes unwittingly reinforces the dichotomy between humans and nature; here we aim to acknowledge the intricacies of a more-than-human framework, one that encompasses plants, animals, technologies, and children. In what follows, we are thus conscious of language choices surrounding "nature" and "the environment" to acknowledge the more-than-human world. In what follows we present the context and research methods used for conducting this study, before delving into and critiquing the literature that discusses EGA's manifestations. We then explore potential ways of remediating EGA discussed in the literature and analyse our own research findings to suggest opportunities for EGA remediation through school garden interactions. Finally, we discuss the implications of using gardens for academic, social, and environmental agendas, reflecting on the unique lessons that can be learnt from TNSS.

Context and methods

Although the Gimuy/Cairns region has undergone significant urban development in recent decades, it remains relatively green/lush as it sits in a protected and ecologically significant corridor: between the World Heritage-listed Daintree Rainforest and the Great Barrier Reef. TNSS sits amidst these natural wonders in a large school catchment (depicted in Figure 1) which has seen an influx of families with school-aged children. The area is home to many new master-planned residential estates which are displacing semi-forested, vacant, and less viable farming land. With a total attendance population of almost 1000 children, from Preparatory to Year 6, TNSS is considered a large primary school.

TNSS has two learning streams, one Montessori-affiliated, and one a regular state school stream. The regular school stream uses mostly explicit instruction pedagogies where the teacher leads most aspects of the lesson (O'Neill, Geoghegan, and Petersen 2013). The Montessori-affiliated stream instead relies on experiential/place-responsive pedagogies that are child-led and respond to and work with the natural environment (Lynch and Mannion 2021). TNSS has two gardens that mostly act as sites for learning. For example, the Montessori-affiliated stream spends one entire day using the garden as their English, Maths, Science, Arts and Humanities learning space; the Digital Technology class uses gardens for enhancing farm-to-plate knowledge; and lastly gardens are used to engage at-risk or disempowered youth. The school also has a gardening club and beautification program, where members of the public (alongside school children) can weed, water, and look after the flora around campus. In 2021, the school initiated a native species planting project to restore a school wetland area and combat annual seasonal flooding. Finally, the school is in the process of building a market garden, where the entire school community will participate in the growing of fruits and vegetables to provide fresh produce to the school tuckshop and to sell to parents and the community.

The research for this paper analyses fifteen semi-structured and rapid walking interviews (Walshe and Law 2024) with two parents, seven teachers, a religious instruction educator, two guidance officers, the school Principal, one teacher aide, and the groundskeeper. Interviews with adults were chosen as the primary means of data collection as most studies engage with children and explore EGA through their viewpoints and perspectives (Kahn 2002; 2022). Our research is the first to understand *adult perspectives* regarding the manifestation of the phenomenon in children, and a diverse group of participants were selected to gather a wide range of perspectives. Interview questions were formulated using examples from both school garden and community garden

Figure 1. Four satellite images of the TNSS catchment region from 2002 to 2022, showing the development undergone in the region in the last two decades. Sourced and adapted from Google Earth (2023).

literature such as Wake and Birdsall (2016), Hardy and Grootenboer (2013), Bucher (2017), Datta (2016), and Bice et al. (2018). Interview questions enabled participants to reflect on their own experiences and the themes of EGA.

Interviews were advertised on the school's social media site and internally through the school administration. Interviews were recorded using a Zoom field recorder and run through the transcription program Otter.ai before being thematically coded using the program NVivo 12. Following Boyatzis (1998) and Soutter et al., the research deployed deductive and inductive techniques to understand pre-conceived and emerging themes relating to EGA. Interview transcriptions were explicitly coded for impact on *motor skills,* **environmental disconnection**, and emotional development (key themes of EGA). The following example uses italicised, bold, and underlined text, reflecting the above formatting, and illustrates how themes were coded: "I think that students, or just **people in general, are getting more removed from the natural world.** And I think and especially children, **spending so much indoor time now** […] I see it in their *gross motor skills* […] I think there's connections to cognitive as well as emotional, your whole development." We further implicitly coded

the transcripts by analysing the contextual nuances surrounding explicit mentions of key words, extracting additional layers of meaning such as positive or negative connotations, as well as associations with other thematic elements. This process was then cross-referenced with Kahn (2002; 2022) and Kahn and Weiss (2017) to identify correlations with findings and outcomes.

Identifying and remediating EGA

In this section we review the EGA literature, paying particular attention to the origin and causes of EGA, how it manifests and its remediation. Interwoven throughout are perceived[3] instances of EGA at TNSS to help contextualise the research. We explore known ways for remediating EGA found in the literature and discuss the potential of school gardens in remediating it. We argue that using gardens as learning spaces gives children opportunities to engage in meaningful nature and place-based experiences that enrich their affection towards the environment, increase motor skills, and improve their food origin awareness.

Although few scholars specifically explore the concept of EGA, we consider it a valuable framework for our research. EGA was initially introduced to elucidate the psychological ramifications of limited exposure to natural environments and how this leads to a collective forgetfulness (Kahn 2002). EGA bears resemblance to the shifting baseline syndrome (Mora 2015), yet underscores the notion that our evolving perceptions of a changing environment are shaped across generations. Children not only undergo environmental disconnection through their day-to-day experiences but also inherit a declining understanding (from the previous generation) of ecological standards for what constitutes a "normal" environmental or natural experience.

Most EGA research concentrates on regions such as North and South America and the United Kingdom, while exploration in Australia is lacking (Kahn 2002; P. H. Kahn 2022; P. H. Kahn and Weiss 2017; Mora 2015). Scholars investigating EGA span various disciplines, from technological studies (Kahn, Severson, and Ruckert 2009) to environmental management (Boyd and Folke 2011), and extend to coral reef and marine studies for insights into shifting baselines (Mora 2015). Most researchers delve into understanding children's perceptions of the natural world (Kahn 2002; Kahn and Weiss 2017; Kellert 2002), examining how the disappearance of green spaces in urban settings hampers and creates less opportunity to interact with what Kahn refers to as "big nature" (uninterrupted spaces such as National parks [2002]). This affects children's ability to appreciate nature's value, resulting in a "disconnection" from it. Thanks to Kahn's (2002) pioneering research, we can identify tell-tale signs of EGA. In children EGA manifests as poor motor skills (Kahn and Weiss 2017), limited environmental moral affiliation (Kahn 2007, 2022), and place disconnection (Kahn 2002; Kellert 2002).

EGA as limited or poor motor skills

Motor skills are not inherent; they are a developmental outcome gained through experience. Researchers suggest limited outdoor interaction results in less opportunity to engage in practices such as walking on uneven surfaces, digging, standing, climbing, running, and jumping (Kahn and Weiss 2017). Without these experiences, kinaesthetic memory is reduced and can result in an inability to instinctively protect ourselves when we fall. Children who do not trust their bodies to know how to climb or where to place their feet to support themselves lack experiences that build these skills. Kahn and Weiss (2017) argue motor skills are learned through interacting with "big nature" and evolve from a wide array of movements and experiences. We think declining motor skills also stem from children's limited opportunities to *actively participate* in natural settings (and not just "big" settings, outside of cities). Gardens afford this opportunity through digging, planting, pulling weeds, walking around and watering garden beds, building fine and gross motor skills. Indeed, Kahn (2002) previously noted that children have fewer and fewer chances to actively participate with, explore, play, and experience nature at their own pace and in their own manner. Malone

(2007) similarly argues that children's freedom is increasingly restricted, leading to a generation sheltered from independent nature play, away from parental supervision. Even teachers at TNSS referred to the "bubble wrapping" of children in relation to their nature-based experiences. Overly protecting and coddling children thus exacerbates EGA; it is imperative to have multiple opportunities to develop and hone skills in childhood. As one teacher at TNSS expressed:

> I set up a circuit where they [could] be involved in climbing, jumping, and balancing. So just for their gross motor skills. And some children, well you can see they've never really played on playgrounds, or they're scared to climb up the ladder, turn around, and go back down backwards. Their minds are going, where do I put my hands? My feet? That's something that makes you think if children have been outdoors, not even playgrounds, but if they've been climbing trees, then traditionally they've got all that, they have gross motor skills – Teacher 2

EGA as limited moral affiliation

Environmental moral affiliation is evident when children extend the same moral relationships they have with humans to their non-human counterparts such as trees, birds, and plants (Kahn 2022). Morals in this sense are standards of behaviour that reflect the importance of the well-being of plants and animals, and their just and fair treatment (Kahn 2022, 76). Children's morals are not taught directly but are affectively developed through personal encounters with non-humans (Malone 2016) and evolve during the developmental years from 0–8 years of age. On the other hand, limited moral affiliation looks like a lack of respect towards the natural environment, through acts such as intentional vandalism or harm, and children lacking this respect show signs of EGA (Kahn 2002). Kahn (2002) suggests that if children grow up in environments with excessive trash or vandalism, for example, they come to expect this as the norm. De Veer et al. (2022) similarly propose that children do not consider litter in concreted, built-up areas as environmentally damaging but do if the litter is at a beach or in a park.

Participants identified the manifestation of EGA in TNSS students through witnessing their poor moral affiliation towards nature. One teacher aide was particularly sceptical about people's attitudes towards the garden: "I don't think they'll care enough to [treat it with respect], and it'll just be destroyed." Some interviewees suggested children expressed signs of poor moral affiliation by vandalising their environment.

> I think if they can be more aware of the environment and think of the flow on effects of how they treat it, by not throwing litter out their windows (Maccas packets), and all that crap […] then they can hopefully treat it with a little bit more respect – Grounds keeper

> Yeah, vandalism, and trying to ensure that people respect it [the gardens]. That they don't get in there and trash it out of hours, or even in school hours […] that people have respect for it. I think that would be the biggest barrier – Teacher 6

These reflections show a generalised worry about children's moral affiliations towards the surrounding environment – a lack of respect without fairness or justice. Some children even treat the local environment as their personal trash can. Because Gimuy/Cairns is the meeting place for two World Heritage-listed sites – the Daintree rainforest and Great Barrier Reef – pro-environmental attitudes are encouraged in both schools and the broader community. The school has a Beautify My Neighbourhood program where children and residents are encouraged to pick up litter, for example, and local storm drains have been stencilled with fish and "save the reef" messaging by a local environmental organisation. The drains highlight that litter anywhere in the city eventually flows through the stormwater system and directly to the Great Barrier Reef. To witness vandalism and disrespect suggests that the messaging is still not sinking in.

EGA as place disconnection

Place disconnection is considered a manifestation of EGA. Place disconnection means children do not perceive their surrounding environments as nature (Kahn 2002), even though everything

around them, including themselves, their food, and the weather, is nature. It is only through tangible, everyday experiences with the outdoors that humans develop a deep understanding of their local environment (Law 2019). More-than-human encounters and places (such as gardens [Sarmiento 2017]) provide visceral memories for people to draw upon, helping shape their environmental knowledge and understanding of place. Without these encounters and places, it is difficult to recognise shared existence and similarities. Ensuring children feel a connection to place is vital as they age because place attachment and connection have been linked to higher levels of personal well-being and development (Afshar et al. 2017; Albers et al. 2021; Altman and Low 1992; Basu, Hashimoto, and Dasgupta 2020; Kingsley, Townsend, and Henderson-Wilson 2009; Scannell and Gifford n.d.). While some scholars discuss the inadequacies of understanding place, here we expand this discourse by examining the particular disconnection from wet, tropical environments such as Gimuy/Cairns.

At TNSS, students suffer from place disconnection. This occurs for a variety of reasons, but the Principal believes it begins with the removal of green spaces: "the way we're living, and the development of the suburbs, we've just got less and less [nature]." Although Gimuy/Cairns is a lush city, the suburbs where TNSS is situated are experiencing rapid urban development. Places that were once rainforests and important habitats are now mud or dust pits making way for housing and supermarket chains. For example, a small section of rainforest near the school was recently bulldozed to make way for a new shopping complex. By witnessing the removal of these spaces, children are conditioned to view nature as something "in the way" of human development (*see also* Freeman et al. 2015; Nisbet, Shaw, and Lachance 2020). In fact, Bohnet and Pert (2010) forecast that if urbanisation and population growth continue their current trajectories in Gimuy/Cairns, this will leave the city with far fewer greenspaces and even less opportunity to engage in nature play. Teachers already recognise reduced opportunities, with Teacher 2 suggesting "children need to touch it [nature] and engage [with the weather] … Because here is so different from Brisbane or Darwin." Teacher 6 similarly claims "They [the children] don't actually understand that when you're looking at texts for kids [for winter], that it wouldn't be a dry season like we have here, it would be about snow."

Because the Gimuy/Cairns tropical climate contrasts with most of Australia's populated centres (Figure 2), teachers expressed concern about children learning Euro-centric temperate seasons (summer, autumn, winter, spring) which do not align with the reality of the local climate. Although TNSS teachers do communicate how the local climate varies, many suggested it can be hard for children to conceptualise. In temperate climates, Euro-centric seasons make sense, but the northern tropical regions of Australia experience alternating hot, wet and dry seasons. Indeed, Gimuy/Cairns holds more significant similarities to our neighbouring tropical monsoon belt countries than to the rest of Australia. Learning tropical seasonality is a vital part of connecting to place, and learning appropriate seasons in school and experiencing them in the garden assemblage can be an important way to remediate EGA.

EGA as deficient food system awareness

Finally, EGA can manifest as deficient food system awareness. To our knowledge, no scholar has linked EGA to food origin disconnection, although there are points of convergence between EGA and other scholarly debates. Uhlmann, Lin, and Ross (2018) depict food disconnection as a form of amnesia, exploring how urbanites are removed from the spaces and processes of food production which results in a low awareness that food is "nature". Together with Grafton (2020), they emphasise the importance of gardening and growing food for individual consumption to build awareness and an ethics of food and the environment in which it is grown. Not understanding where food comes from or how it grows is not just a problem for children; it is a problem that holds massive ramifications for the future of food systems (Vileisis 2008). While some may argue that food knowledge in children is shaped by parents, schools play a vital role and have duty of care in shaping this awareness (Goldner, Sosa, and Garitta 2021). Routinely buying food from the grocery store or having no interactive experiences with growing it suggests children are not in contact with their local food

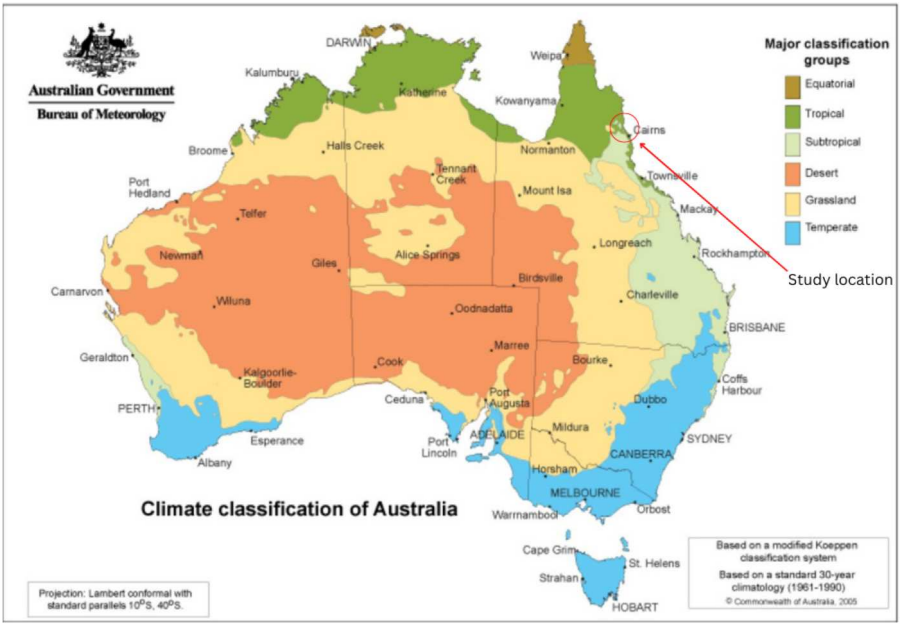

Figure 2. An adaption of the Köppen Climate map from the Bureau of Meteorology (2022) depicting Cairns local climate.

systems (Uhlmann, Lin, and Ross 2018). This is the gap schools can fill with informed, hands-on learning.

Some interviewees at TNSS were vocal about how children are physically and cognitively disconnected from their environment, suggesting that a physical disconnection from the processes involved in growing food leads to children not recognising the origins of their food. "Kids nowadays are out of touch with food", suggested Teacher 4, and Teacher 2 (sadly) outlined how "some children don't realise that milk comes from a cow, or that farms produce food for us." Moreover, Parent 2 attributed this disconnection to the presence of supermarkets and children over exposure to them: "I think that children need to learn about food creation and food preparation. Not just for their self-sufficiency but to understand where their food comes from. It doesn't just grow in the supermarket."

In sum, EGA manifests at TNSS and participants suggest it stems from limited active, outdoor participation. This in turn affects day-to-day well-being, motor skills, moral affiliation, place connection, and food origin/system awareness. Before examining how TNSS school gardens remediate symptoms of EGA, we first review the remediation perspectives outlined in literature.

Opportunities for remediating EGA

Remediating EGA requires meaningful and participatory contact in an environmental assemblage. One of the most viable techniques to remediate EGA is to develop an interaction pattern repertoire (Kahn and Weiss 2017). Interaction patterns are recognisable when one does something repeatedly until the movement is added to their mental and physical vocabulary – for example, foraging for berries or swimming in the ocean. When children see wild berries, their kinaesthetic and sensorial response is to pick and eat the fruit, or when they see the ocean, they associate it with swimming (Kahn and Weiss 2017). Interaction patterns can be considered a dictionary of sorts. Once an activity or association is sufficiently built up, it remains instilled in our bodies until we need to use it again.

Interaction patterns, such as digging in the earth, also result in increased environmental moral affiliation (Kahn and Weiss 2017; Wake and Birdsall 2016). Kahn and Weiss suggest building moral

affiliation towards any form of nature is the end goal of repeatedly performing interaction patterns. Other acts that address EGA are planting in a garden, falling (safely) with something in your hand, watching a sunset, and even hugging a tree. All these interactions remind children (and others) that nature *is* everywhere and can increase moral affiliation towards it.

Gardening is consistently identified as a strategy to remediate EGA (Grafton 2020; Kahn and Weiss 2017; Wake and Birdsall 2016). Wake and Birdsall (2016) argue that the processes involved in planning, building, planting, and maintaining school gardens increases moral affiliations towards the environment. Similarly, Grafton (2020) explores how sensory activities such as gardening create food chain awareness and establish eco-consciousness in children – reminding them of their role within the natural assemblage. Ultimately, school gardens help situate people by creating opportunities for interaction with other species and ecological systems (Kahn 2022). Research therefore suggests that nature experiences and building interaction patterns provide important experiences for remediating EGA. We now turn to an analysis of participants' perceptions of school gardens.

Remediating EGA in school gardens

This part of the paper categorises the research findings into three themes. The first theme explores the benefits of learning in the school garden and how it builds skills that can remediate EGA. The evidence presented explores how the first two symptoms of EGA, poor motor skills and moral affiliation, can be remediated in the garden. The second theme explores gardens as learning spaces connecting children to place through embodied weather experiences and farm-to-plate knowledge, therefore addressing the second two symptoms of EGA. Finally, the third theme provides examples of previously existing interaction patterns at TNSS that hold the capacity to remediate EGA.

Gardens build motor skills and moral affiliation

Learning in the garden provides many opportunities to engage in movement that contributes to both cognitive and physical development (Wainwright et al. 2020). Gardening is filled with activities inclusive of digging, foraging, planting, raking, weeding, etc., all of which build gross and fine motor skills. Fine motor skills are, first and foremost, a precursor for any child to write efficiently (Baker, Waliczek, and Zajicek 2015); they are, therefore, essential to develop for future learning. As some participants were conscious of the children lacking confidence in their physical abilities, motor skills are an important skill to develop. For some teachers, the gardens at TNSS were recognised for their ability to develop and hone these fine motor skills and enhance learning:

> There is raking, digging, turning, and stalling. Yes, it's all pre-reading and pre-writing [motor] skills that they're building out there in the garden. They then bring these skills in here and write, read, or talk about it – Teacher 1

> [Gardening builds] gross motor and fine motor skills […] But I do think that, yes, it's very important that we're connecting with our environment – Teacher 2

While Kahn and Weiss (2017) explore the importance of building motor skills, we extend their ideas by offering new perspectives on how to hone fine motor skills from an early age. Gardens offer children the opportunity to engage in nature-based tasks that challenge their bodies to learn new forms of movement (Baker, Waliczek, and Zajicek 2015; Wainwright et al. 2020). The participants' reflections highlight that teachers can witness children's physical development in the garden, and the flow on effects it has into classroom learning.

Earlier, we highlighted participants' awareness of children's lack of environmental moral affiliation. However, before developing this moral relationship, they must have a baseline of emotional well-being (Kahn 2022). Cultivating a sense of well-being is a precursor to building moral affiliation and respect for the environment, as it provides positive foundational experiences to draw from. Regular opportunities to connect with nature can foster long-term health and well-being in children (Lovell et al. 2014), increase engagement and fulfilment from schooling experiences, and encourage

better social relationships (Maller 2004; Scannell and Gifford n.d.). This is especially important for disempowered or at-risk youth who struggle to engage at school and, as the school counsellor and youth support worker proposed, do not necessarily hold moral consideration for anything within the school grounds. If interactions with nature are consistently harmful or destructive, it can be hard to reflect positively on their experiences. Thus, children must find a sense of well-being before attempting to remediate symptoms of EGA. The following examples provide insight into participants' views on gardens fostering well-being:

> I think it's great for their mental health and their physical health – Teacher 7

> But there's also so many links with mental health and being outdoors in nature. I just think children really need to get off the screens, or what do they say? Less screen time, more green time? – Teacher 2

> It's nice to see kids who feel like they can't be good at very much having that success [in the ability to grow plants] – School Counsellor

> [Gardens are] really good for teaching [the at-risk youth] social skills, increasing pride, giving them something that they can chill out with – Youth Support Worker

The gardens at TNSS appear to be engendering environmental moral affiliation in two different yet potent ways. The first, where gardens are integrated into the entire curriculum, demonstrates how children develop a strong emotional bond to the plants they are responsible for, like that of a cat or dog. The second, where the at-risk youth were given the autonomy to build and raise their own gardens, demonstrates how children can develop a sense of agency in being environmental stewards. Using gardens in these two capacities has been transformational in creating moral consideration, exhibited by the children being emotionally affected by what happens to their gardens and, similarly, being eager to communicate to their peers the benefits of gardening and composting. They exhibit moral affiliation because they are aware the environment deserves respect – like any human would (Kahn 2022). The children are learning to think about their interactions with plants and act in their combined best interests. As in the work of Wake and Birdsall (2016), if children are involved in building and learning in the garden, they will find a sense of pride and increased affiliation with it – they will respect the health of the plants they are responsible for raising. The following are small snapshots of how gardens contribute to de-escalating this symptom of EGA:

> The children were mortified that year when the vandals came in [and smashed their watermelons], they just couldn't understand it. "Why would they do it?" You know, "this is our garden […] and why did they come and do this?" They took it very personally – Teacher 1

> Some of the really naughty kids get into it [gardening] and they're like, you know, planting those seeds and watering it. They want to be out there – Parent 1

> Take ****, for example, they want to get up and talk about composting now in the whole school parade, he loves it. He wouldn't have done that if it wasn't for being involved and doing it – Youth Support Worker

These considerations suggest that participants recognise the role that gardening experiences offer children in developing embodied emotional connections. In other words, the gardens are shaping school experiences and enhancing environmental moral affiliation. It is important to contextualise that TNSS is in a neighbourhood with diverse socio-economic demographics. Reflecting this, the school has established many avenues to support and empower disempowered local youth; the gardens being just one. The Youth Support Worker claims disempowered youth exert agency through building raised garden beds and being the sole caretakers, caring for life forms beyond themselves. Some disempowered youths are eager to understand their garden and compost system enough to make it thrive, and then share their knowledge with their peers. Their newly found pride and respect highlights the significance of alternative learning opportunities for well-being and improving human–nature relationships. It also engages children in their place (Scannell

and Gifford n.d.), as discussed below. Similarly, the children's devastation by the intentional destruction of their garden suggests children are particularly well-disposed to learning valuable lessons by building interspecies relationships (such as the fragility of life – exhibited by the destroyed watermelon) (see also Malone 2016). The take-home messages this leaves us with are: (1) gardens set children up to have increased physical resiliency by building body awareness; and (2) gardens extend children's moral affiliations past human–human relationships and into the more-than-human realm, solidifying their role in the natural assemblage and directly disrupting the manifestation of EGA.

Growing place connection through embodied experiences

The Australian Curriculum, including the adjacent sustainability cross-curriculum priorities, are national policy documents that can be delivered in place-specific ways (Walshe, Evans, and Law 2022). So, whilst weather-related content first refers to the standard Euro-centric calendar of Summer – Autumn – Winter – Spring, it is and should be adaptable to local contexts. Depending on the place, these Euro-centric seasons can be a disorienting concept to learn. As highlighted in the literature review above, participants were aware of children's intellectual disconnection from their local climatic conditions. However, teachers also see learning in the garden as an opportunity to engage children in place. While the teachers at TNSS teach local seasons to the children, learning in the garden helps communicate this difference more effectively, as the children are experiencing how the tropical climatic conditions affect their bodies and their surrounding environment. The ability to physically understand how intertwined we are with the weather is recognised as an important practice in effective weather-related education (Ødegaard and Marandon 2019). It also engenders someone in their place (Scannell and Gifford n.d.). By increasing place attachment through embodied weather-related activities, teachers can effectively aid in de-escalating EGA. Teachers recognised the interrelationship of embodied weather-work and gardening experiences:

> It makes it more real and purposeful […] like if they're outdoors, then they're learning about things outdoors. The seasons fit with that. They're learning about gardening – the seasons fit with that. They must learn seasons to be able to engage with the outdoors – Teacher 2

> And now we're getting to this really tumultuous type of weather [wet season]. So, it really shows, we take the temperature of the room, we take the temperature outside [at their garden] and see how it affects them [the kids] and plants, and other animals as well, like the birds! The birds are starting to nest too – Teacher 7

This illustrates that teachers are aware that children can build their place connection by regularly working with the garden, as they understand how their local weather affects growth cycles and life, which may differ from those in other regions and books. This speaks to Law's (2019) findings that gardens build knowledge of the local environment, and that (both ourselves, and) the produce grown in the garden is a physical embodiment of the weather (Ingold 2010). Our data also joins an extensive list of scholars highlighting how school gardens enhance farm-to-plate food system knowledge.

Food is an inherent part of nature and growing up in urban environments shields children from the processes involved in cultivating their food (Grafton 2020; Uhlmann, Lin, and Ross 2018). Historically, food was a place-bound concept: we ate seasonally and locally, foraged, hunted, or gathered. Now we go to shopping centres or supermarket chains and have access to food that neither grows seasonally (e.g. cabbage being available all year), or locally (e.g. mangoes in temperate climates). Understanding that food is mostly or initially natural and not originating in a supermarket, is a crucial factor to building urban food system resilience (Anderson 2015), and bridges the (generational and physical) gap between farmer and urbanite. Below are examples highlighting how teachers and parents considered garden interactions to instil life-long skills and a sense of how weather affects food growing processes. One teacher alluded that gardening brings children into contact with their local non-human counterparts:

> if they were growing food themselves, they would have a lot more connection to it, and maybe less waste. They would get an appreciation for how long something takes to grow – Teacher 3

> I mean they may not know spring or autumn or something like that. But they know hey it's getting hotter, and our vegetables are going to die if we don't put something up! – Religious education instructor (REI)

> So that's where the benefits are [in gardening]. You teach a lot of important stuff, like life skills … and growing our own food is one of them [the benefits] – Parent 1

> Yeah, it's real. It's natural. You pick it, and eat it, and talk about it. And talk about the life of the bugs in there, too. We've bought food in that has caterpillars on it! – Teacher 1

> I think gardening also just creates an awareness of being more environmentally conscious and of how things grow and stuff […] – Teacher 4

These reflections highlight that teachers and parents recognise the value of gardening in improving food relationships by distinguishing their locality and seasonality. Understanding how weather influences food is vital for encouraging food sovereignty in urban areas as it prepares urbanites to understand potential climatic impacts on the agri-food sector (Larder, Lyons, and Woolcock 2014). Understanding the embeddedness of food can improve pro-environmental behaviours (Larder, Lyons, and Woolcock 2014; Reis and Ferreira 2015) and result in children treating their environment with more agency and respect – feeding back into building moral affiliation to combat EGA. Furthermore, Teacher 1, recalling that their food had caterpillars when they brought it in from the garden, speaks to debates that consider our place within the natural assemblage. Teachers explained how the children watched the caterpillars eat the leaves of their produce, demonstrating that food is just as much needed by our non-human counterparts as it is by us (Sarmiento 2017). This could have informed discussions on how food–nature–human relationships are deeply connected. Extending these themes of embodied weather and food knowledge we now provide examples of interaction patterns in the garden. These instances also offer us some insight into how pedagogical approaches matter in regard to food education (Walter 2013).

Building interaction patterns in the garden

Interaction patterns are defined as tasks or activities that enhance a child's ability to critically understand and describe how they themselves, and all things in their life, are part of and engage with nature (Kahn and Weiss 2017). Although EGA informs researchers focusing on gardens in schools, there is little understanding of how EGA can be combatted by embodied food (growing) and place-based weather interactions. As a learning space that readily involves child-led pedagogical approaches and is both experientially driven (Fisher-Maltese 2016) and place-responsive (Lynch and Mannion 2021), gardens offer the opportunity to experiment with different pedagogical approaches in school. Gardens reinforce the relationship between food in the ground and food from shops. Gardening embeds an understanding of place, as the seasons and local environment dictate what will/will not grow. Embedding gardening as a regular activity into the school experience ensures that children have tangible experiences to draw upon later in adulthood.

Gardens situate us by connecting us to the local seasons and environment. They challenge us to consider how nature works (Law 2019). Tending to the garden throughout various seasons, and completing tasks such as digging, weeding, planting, and harvesting, situates people in place (van Holstein 2016) by involving them in the environmental processes around them. Our research illuminated how interaction patterns are developed in the garden, highlighting gardening experiences that increase seasonal awareness through food availability, and how processing food from ground to plate can close the gap between farmer and urbanite:

> you start to know like […] Christmas time is lychee season […], or that Mango trees are in flower – Parent 2

> [knowing the seasons] plays a part in what you're going to plant, you want drought hardy plants that are tropical you know, for dry season – Parent 2

> [Because of gardening] we know grows at what time of year – Youth Support Worker

> Just the joy, you know, the kids squeal with delight. And so, in the garden out here [points to the garden outside the classroom], we have potatoes. Which is cool! And so, we do the entire process. That's the lesson. We grow them [the potatoes]. We dig them. We clean them, we cut them up, we make them into chips, and then we eat them – Teacher 1

Building the skills, knowledge, and means to grow food challenges the disconnected food practices symptomatic of EGA. Our participants highlight that growing food is a skill children can carry into adulthood; this is a fundamental goal of positive interaction patterns (Kahn and Weiss 2017). To summarise, our informants emphasised that by engaging with processes in the gardens children come to understand what fruit or vegetables will be available depending on the time of year. Gardening thus increases awareness of the seasonal calendar and how it affects our diets. Our research informants also called attention to interaction patterns that enhance food connection by engaging students in the complete process of planting, growing, harvesting, cooking, and eating. They highlighted that through gardening, children can build the association between what grows in the ground and what they eat. Figure 3 is a drawing from one student at TNSS who regularly engages with their school garden. It was drawn in response to a group activity where students were asked to draw "food" and expresses the link between food and growing plants, including potatoes which are grown annually in their class garden.

Figure 3. Children's drawing of food growing context.

This drawing reflects the food–nature interaction patterns that gardening creates. It highlights that gardening develops an associating between the potatoes children eat as food to the potatoes grown in the ground. Teachers also commented on how these outdoor experiences allowed children to recognise and anticipate seasonal change by the bird species present in the garden (such as the Torresian imperial pigeon or Masked lapwing plovers). This insight suggests that garden interactions are enhancing children's awareness of their surroundings. Food and weather-related interaction patterns in the garden further invite us to consider how school gardens can physically challenge children to see nature happening within their urban fold; opposing the notion that it needs to be big, pristine, or out there (Kahn 2002).

Conclusion

EGA manifests in the children at TNSS, and this paper provides evidence that reflects the symptoms of EGA highlighted by other researchers including Kahn (2002, 2022), Kahn and Weiss (2017), Uhlmann, Lin, and Ross (2018), and Grafton (2020). Teachers, parents, counsellors, groundskeepers, and administrators at TNSS all noted evidence of poor motor skills, limited or poor environmental moral affiliation, and both disconnected food origin and place awareness. Their perceptions attest to the manifestation of EGA and contribute to wider discussions of how EGA presents itself in urban, school-aged children. Throughout the literature review, we analysed instances perceived by our interview participants and offered a place-based analysis of how EGA manifests. EGA can manifest for different reasons, and these often depend on the particularities of place (in this research, being in the tropics is important). Moreover, although EGA is written about mostly in relation to children in densely urban areas with limited natural spaces, symptoms can manifest in locales where the natural environment is less degraded.

Our discussion explores how EGA can be remediated through gardening by providing insight into how TNSS gardens provide learning spaces that are increasing children's motor skills and enhancing environmental ethics. We further explored connections to place and delved deeper into how gardening, and using gardens as learning spaces, connects children to their local place and food systems by facilitating interaction patterns that ultimately increase awareness. A summary of these findings is depicted in Figure 4. We extend previous research by presenting what our interviewees perceived to be instances of interaction patterns that contribute to the development of essential motor skills, seasonal embodiment, food origin connection and enhanced environmental moral affiliation.

Students at TNSS are fortunate as this school provides many opportunities for gardening on the school campus, from in-class activities and gardens as learning spaces to social groups and

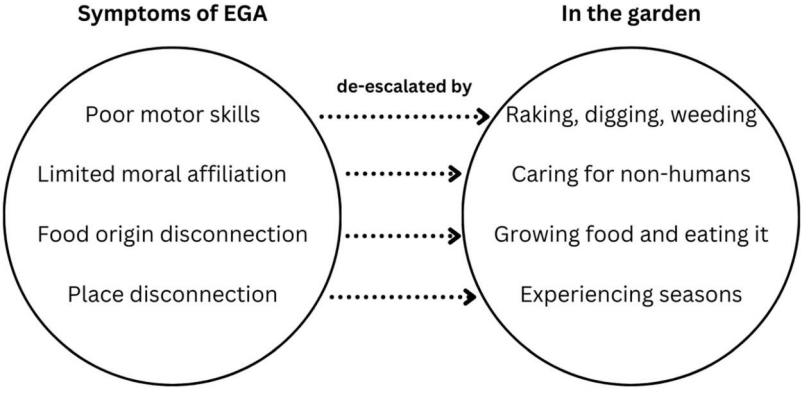

Figure 4. Summary of activities performed or experienced in the garden that can de-escalate symptoms of EGA.

alternative learning programs. The role gardens play at this school is ever increasing, for reasons which reflect the benefits of gardening found within this paper. Because of gardens' practicality as learning spaces (Walshe, Evans, and Law 2022), TNSS has easily incorporated them into students' learning journeys while still adhering to the Australian curriculum. This puts TNSS on the forefront of addressing EGA as gardens in schools provide unique opportunities to build interaction patterns in the urban environment, capable of remediating symptoms of EGA. As our cities become larger and higher, there will be many instances of children having fewer opportunities to create their own meaningful nature-based experiences. School gardens can thus provide safe havens for children to understand their role in the natural assemblage which, in the long run, can contribute to remediating EGA.

Notes

1. We are acutely aware that the nature/culture dyad is exacerbated by referring to non-human counterparts explicitly as 'nature'. This paper thus positions culture as an embedded part of nature. Following the Greek origin of the word 'nature', we recognise that nature is anything subject to the spontaneous process of growing and/or producing, a process that humans are themselves part of (Ducarme and Couvet 2020).
2. We are acutely aware that the nature/culture dyad is exacerbated by referring to non-human counterparts explicitly as 'nature'. While nature is ever-present and a subjective term, this paper positions culture as an embedded part of nature. Following the Greek origin of the word 'nature', we recognise that nature is anything subject to the spontaneous process of growing and/or producing (but not explicitly limited to these 'productive' and very anthropogenic processes), a process that humans are themselves part of (Ducarme and Couvet 2020).
3. Gender-neutral language is maintained when referring to interviewees and the children they refer to. This is an intentional ethical choice made by the authors to respect the identities of participants and as a defiance of the gender bias that exists in both the environmental (Ossana, Helms, and Leonard 1992) and education disciplines (Frawley 2005).

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