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Reflections and practical tips from co-producing an intervention with neurodiverse children, their families, and professional stakeholders

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Transdisciplinary co-produced health research and co-designed interventions have the capacity to improve research quality and the relevance, acceptability, and accessibility of healthcare. This approach also helps researchers to address power imbalances to share decision-making with service-users and the public. However, this growing methodology is currently difficult to appraise and develop as detailed sharing of practice is limited. The 'CO-production of a Nature-based Intervention For children with ADHD study' (CONIFAS) aimed to create a novel intervention with and for children with attention deficit hyperactivity disorder (ADHD) using co-production and co-design methodologies. This knowledge exchange paper will be of benefit to researchers with aspirations to undertake co-production, especially in the context of working with under-represented groups. Critical reflection on the use of co-production identified that every attempt was made to adequately resource the co-production, share power, value diversity, and develop trust. The team reflected that the re-conceptualisation of the role of the researcher in co-production can be challenging. Whilst the use of models of co-production provides a framework for study development, designing and running the specifics of the workshops, as well as how to effectively engage co-researchers in an equitable way, came from utilising clinical skills, networking, and creativity. These methods are particularly pertinent to involving neurodiverse children and their families who are under-represented in participatory research and in need of bespoke health interventions.

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Introduction

The co-production movement and transdisciplinary research. Calls for diversification of research and knowledge practices in order to develop more effective solutions to different societal challenges have led to the rise of co-production and transdisciplinary research (Lawrence et al., 2022). Transdisciplinary research is characterised by teams of researchers and non-researchers working collaboratively and bringing their different logics and methodologies together in a reflexive way to develop solutions to specific challenges (Wickson et al., 2006; Lang et al., 2012; Knaggård et al., 2018;). Transdisciplinary research approaches have been adopted increasingly in areas including climate change (Boon et al., 2014), sustainability (Lang et al., 2012), and planetary (Wardani et al., 2022) and human (Pineo et al., 2021) health, where challenges frequently need system-level understanding due to the complexity of interactions between people and environment, and the various contextual factors that affect these.

The requirement for a transdisciplinary approach to collaborative working has led to the development of multiple 'co-' research terms to describe collaborative research principles and practices (Grindell et al., 2022; Robert et al., 2022; Fleming et al., 2023). 'Co-' research is inclusive research that encourages meaningful engagement, leading to greater relevance and significance of research focus and intended outcomes (Atkin et al., 2020). Within this practice, diversity is respected, every effort is made to ensure power is shared among groups, and attention is paid to reciprocity (Smith et al., 2022).

Co-production has been described as a partnership where everyone works towards a mutually agreed aim, plays an active part, and existing skills, experience, and knowledge are valued (Pettican et al., 2023). Co-design is a related but separate creative process, where individuals who are not designers work in partnership with those who are designers to improve services or develop interventions. Co-production involving potential users of research facilitates their involvement as active partners in the research process, rather than as passive recipients, and can bring improved outcomes for the people involved (Taylor et al., 2022). The involvement of people with lived experience also fosters academic excellence as it ensures that research is not detached from community needs and preferences, which in turn improves the research quality (Redman et al., 2021). When best practice is adopted, co-production can enable research to support the creation of a fairer society that addresses public concerns and needs, enhances study design and research processes, generates novel and conceptually rich knowledge, advances innovative concepts, and delivers impactful research (Smith et al., 2022).

Systematic reviews indicate that 'co-' research is relatively new in healthcare. There is a need to develop a clearer understanding of the methodology and outputs as it has been cited as a methodology without a strong and distinct description or model of 'doing' (Smith et al., 2022, Walker et al., 2023). Further resources are required that detail how co-produced research is being defined as well as how it might be carried out to increase and guide meaningful practice and generate agreement on what the minimum expectations and standards should be (Smith et al., 2022).

The CO-production of a Nature-based Intervention For children with ADHD Study (CONIFAS) was developed with a central ethos of equal partnerships between, children, parents and guardians, professional stakeholders, and researchers during the development of a well-being intervention. As co-production has been linked with better outcomes for service users and can support the development of stronger relationships by forging links with service providers (Wallace et al., 2012), it was hoped that adopting this approach would encourage the output to be accessible, acceptable, and fit-for-purpose. Designing, running, and managing a co-production study with a variety of stakeholders and within the confines of research required planning and presented a number of challenges which will be explored in this paper.

In developing this study, we identified a very small number of studies that seek to outline the process of co-producing and designing with children with ADHD. Some helpful learning was garnered from Fekete and Lucero's (2019) paper including the need to understand the culture of the participants and Benton et al.'s (2014) Diversity for Design Framework which helped us consider the importance of harnessing strengths-based approaches. Furthermore, Powell et al. (2021) co-designed a psychoeducational activity book about ADHD with children aged 7–11 called the ADHD Hero Activity Book; we met with the study leads to discuss this project, and practical tips for co-producing with this population, prior to commencing our work. This sharing of experience was particularly helpful as few specific recommendations could be found in published literature. The aim of the present paper is to build on this literature and share experiential learning to support future research.

CONIFAS study rationale. Attention deficit hyperactivity disorder (ADHD) is one of the most commonly diagnosed neurodevelopmental conditions in children and young people in the UK (Biederman, 2005). ADHD can have a significant impact on mental well-being as well as educational, occupational, and social outcomes (Vibert, 2018). NICE (2018) guidance recommends pharmacological support for ADHD alongside patient advice and support and, in some instances, Cognitive Behavioural Therapy (CBT). In practice, research indicates that medication adherence can be problematic (Adler and Nierenberg, 2010), and few children receive comprehensive non-pharmacological support, with families often relying on non-mainstream means of treatment for ADHD. These often have little or no supporting research evidence or clinical backing, such as homeopathy and massage (Fibert and Relton, 2020).

Studies have demonstrated that increased contact with green space can lead to positive improvements in the central difficulties of inattention and hyperactivity in ADHD (Kuo and Taylor, 2004) and can be beneficial, alongside medication use, in children with ADHD (de Vries and Verheij, 2022). Supporting parents, guardians, and children to access nature in meaningful ways may enable children and families to use the outdoors to enhance quality of life and reduce the impact of ADHD symptoms. However, to date, there are no specific evidence-informed nature-based interventions for children with ADHD.

It is a current research priority for children and young people to become more involved in making decisions about their mental health treatment (James Lind Alliance, 2023). Many pharmacological and psycho-social interventions for children have neglected their involvement at the design phase or have been adapted from research conducted into therapies successfully implemented with adults. Further, interventions are often not child-friendly, pointing to the need for more child-oriented interventions (Wright, 2023). The Emerging Minds network considers both amplifying young people's voices and power and working with children with complex needs, such as neurodevelopmental conditions, as research challenges and areas of priority (Lloyd et al., 2019). Instances in which a problem is individualised, and professionals offer the solution have long been challenged by disability rights activists and the service user movement (Oliver, 2002), thus involving those with lived experience was deemed paramount for children with ADHD in

our study. Nature can be conceived of as a complex therapeutic asset with boundaries that are less clear than is typical in other more clinical interventional contexts (Owens and Bunce, 2022).

Within the context of ADHD, whilst children will all share certain diagnostic characteristics (hyperactivity, impulsivity, and inattention) they are likely to present very differently and have a wealth of unique traits in terms of behaviour, interaction, and communication. They are also likely to have co-occurring conditions such as autism or learning difficulties (Jensen and Steinhausen, 2015). This complexity increases the need for ADHD-focused interventions to be directly informed by this population to increase the likelihood that they will be well-informed, accessible, and effective. Understanding the nuances of populations so often assumed to be homogenous is key to successful intervention creation and implementation.

There is a need to share good practices and increase understanding of how children can be actively engaged in health research, creating health interventions, and assessing the quality of research and interventions (Larsson et al., 2018). When co-producing research with children, it can be particularly important to share methodological processes as their competence is often under-appreciated (Clarke, 2015). Children are often considered hard to engage on the grounds that their participation may undermine the quality of research (e.g. Powell and Smith, 2009), or that participation may harm them (e.g. Coyne, 2010). However, not involving children in participatory practices may be detrimental to understanding their needs and developing their care.

Recognising these needs and complexities, CONIFAS employed a co-production methodology to create a novel intervention with and for children with ADHD. There was, however, little formal guidance about the practical implementation of such a methodology (e.g. how to format workshops with families to share power, and how to balance flexibility and accessibility with the needs of the research). The CONIFAS research team is a multidisciplinary team embedded in a research culture that includes expertise in participatory research and this stock of knowledge was harnessed to develop the co-production methodology for this study. Here, our aim is to share and exchange knowledge about developing and implementing a co-production approach, especially in the context of working with neurodiverse young people.

Methods

CONIFAS aimed to develop an accessible and engaging nature-based intervention with and for children with ADHD, their parents/guardians, and a group of relevant professional stakeholders (Armitt et al., 2022). Collaborators on this study included Humber Teaching Hospital NHS Foundation Trust, the University of York, Yorkshire Wildlife Trust, and the ADHD Foundation. The study ran for 18 months, beginning in March 2022 and ending in August 2023. It was sponsored by the Leeds and York Partnership NHS Foundation Trust and funded by the NIHR's Research for Patient Benefit stream (NIHR203043).

Double Diamond Model

The study consisted of two elements: (1) Co-production of a nature-based intervention; and (2) User-testing of the co-produced intervention. These elements were based on the four phases of the Design Council's Double Diamond model (Design Council, 2017): Discover, Define, Develop, and Deliver. The Discover phase in this model helps people understand rather than simply assume what the problem is, the Define phase then helps define the challenge in a different way using this new knowledge. The Develop diamond encourages people to give different answers to the clearly defined problem, seeking inspiration from elsewhere and co-designing with a range of different people. Finally, the Delivery phase involves testing out different solutions on a small scale, rejecting those that will not work and improving the ones that will (Design Council, 2017).

These phases mapped onto four phases of the research study, each with a specific objective: phase one involved discovery workshops that aimed to understand the 'problem', which in this study was the lack of support for children with ADHD and how they engage with nature and the outdoors; phase two involved co-production workshops to define the intervention; phase three involved user-testing to test and develop the intervention; phase four included refinement of the intervention with the co-production group based on the outcomes from phase three, ready for feasibility testing in a service context. Figure 1 provides an overview of the research phases and the indicative questions that guided each stage.

It has been suggested that using a model can be beneficial in driving co-produced work, which risks feeling daunting and unstructured (Buckley et al., 2022). The double diamond model provided direction for the study, influencing the research questions within the different phases. It also provided structure to guide the process and, whilst an iterative process of workshop delivery was developed within phases, having overarching aims and a model of delivery provided a clear vision for the workshop outlines.

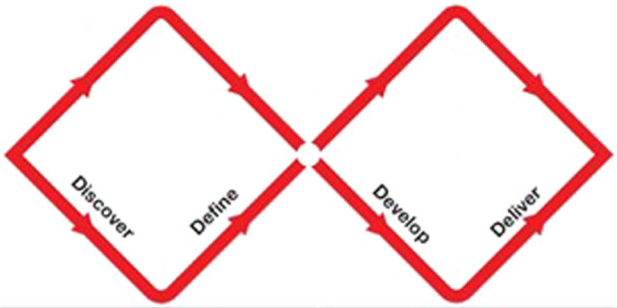
As this paper aims to reflect on the practice of co-production, details of phase three (user-testing) and the participants involved are not shared here. See Armitt et al. (2022) for details of phase three.

Participants

The study aimed to form a co-production group of 10 children, a parent/guardian or each, and 10 professionals working in relevant fields (e.g. with ADHD and/or nature) ($n = 30$). Eligible children were between 5–11 years and had a diagnosis of ADHD. Children who posed a risk of harm to themselves or others or who would not be able to participate due to significant additional difficulties were not eligible to take part. All co-producers were required to be able to travel to the location of the in-person workshops (Barlow Common Nature Reserve, Selby, UK) and speak sufficient English to participate in the workshops due to limited resources.

Co-producers from the community were invited to participate through public-facing advertisements and posters shared via social media, through schools, and in community settings (e.g. libraries, Barlow Common Nature Reserve). Most of the professional co-producers received invitations via email through networking and utilising researcher contacts. Overall, 10 parents/guardians took part with 9 children (aged 9–10) and 10 professionals. Table 1 details the job roles of professional participants and includes NHS Psychology professionals, School staff members, and Forest School Leaders (demographic information data were not collected).

Workshops. The workshops were primarily delivered in an outdoor setting (Barlow Common Nature Reserve) and structured by aims and objectives. Workshop development was an iterative process, with content, activities, and modes of delivery planned by the research team (including experts in the field) and guided by co-production participants at the time of delivery and adapted for the next session. A full summary of the co-production methodology and workshop delivery will be published in a results paper complementary to this article, but a summary has been provided for context.



Discover: Phase One	Define: Phase Two	Develop: Phase Three	Deliver: Phase Four
1. In-person workshop with professionals 2. In-person workshop with children and families 3. Virtual workshop with parents/guardians 4. Plus flexible virtual meetings/phone calls with participants who missed sessions	1. In-person workshop with professionals 2. In-person workshop with children and families 3. Virtual workshop with parents/guardians 4. In-person workshop with all participants 5. Plus flexible virtual meetings/phone calls with participants who missed sessions	1. User-testing with 10 new families across Yorkshire and Humber. Families used the intervention for 6 weeks, completed outcome measures, and received fortnightly phone calls from the study team for support.	1. In-person workshop with all participants 2. Second in-person workshop with all participants 3. Plus flexible virtual meetings/phone calls with participants who missed sessions
Indicative questions			
• How is ADHD experienced? • What methods and practices are beneficial for these children? • How might nature be used to support these children? • What might the barriers and enablers be?	• What should our intervention aim to achieve? • What should our intervention look like? • How should it be delivered? • How can we ensure our intervention is accessible?	• Is the intervention delivery feasible? • Is the intervention acceptable and accessible? • What are the barriers and enablers to using it as intended? • What works well and what can be improved?	• What needs to change based on the feedback? • How can we improve it ready for wider delivery and testing? • What do we need to consider moving forward?

Fig. 1 The Double Diamond Model (Design Council, 2017) and CONIFAS phases of work. The two diamonds indicate the discover, define, develop and deliver phases of the double diamond model. The table then illustrates how the CONIFAS study was structured to map onto this model in the first row of the table alongside key questions at each stage in the second row.

Table 1 Professional participant details.

Co-production participant details	
Specific job roles of professionals	Early Years Neurodiversity Specialist NHS Clinical Psychologist—Neurodevelopmental Services Children's Events/Education Lead NHS Art Psychotherapist—Neurodevelopmental services NHS Assistant Psychologist—Neurodevelopmental services Volunteer at play provision charity for children with special needs Forest School Director School staff member School Disability Confidence Specialist Higher Level Teaching Assistant and Forest School Leader

The aims of the research study were mapped onto the stages of the Double Diamond model which guided our phases of work. Phase One was the Discover phase and included three separate workshops to explore co-producer views on ADHD and nature, and to understand factors to consider when developing an intervention to support engagement with nature. Professionals met with the team first and, using a four quadrants exercise (eliminate, avoid, use, improve), identified a range of core principles and approaches to which the intervention should adhere based on their experiences. This information was then taken to the second session which involved children and their parents/guardians. Children were asked to describe their favourite and least favourite activities in nature to generate a list of activities that might be included in the intervention. Importantly we focused on understanding barriers to engaging with nature (e.g. bad weather) and exploring options to overcome these barriers. Some candidate activities, such as sensory exploration of the woodlands and constructing nature treasure boxes, were tested with the children and their parents/guardians. In the final discovery group, all co-producers (Participants) came together to engage in further activities.

Following on from the Discover phase, the Define phase consisted of four 2–3-hour workshops; three of which were at the Barlow Common Nature Reserve. The aim of this phase was to

garner sufficient information from participants about the content, look, feel, and delivery of the intervention to allow the research team to build a prototype for testing. The naturalistic play featured heavily in workshop 2 for children and parents/guardians. Here, children were offered the chance to take part in a wide range of activities to identify which activities and formats were most popular. Phase 3 was our Development phase which featured a user-testing of the prototype intervention with a new cohort of child and parent or guardian dyads. This phase was crucial to gather information on the practical application of the intervention across a 6-week time period. In phase 4, which was considered the Deliver phase, all the co-producers reconvened to consider the feedback given by the family dyads in the user-testing phase. This feedback was presented visually by the graphic designer. All co-producers used the finished prototype in a series of activities in the nature reserve.

In each of the 'co-production' phases (1, 2, and 4), an in-person workshop was held separately with professionals, then children and families, and then a virtual workshop was conducted with parents/guardians alone. As the phases progressed, all co-producers came together for joint in-person workshops. Any co-producers who could not attend a session were offered a 'catch-up' call with the research team to have the opportunity to discuss what came up in the sessions and to offer and explore their thoughts. These calls were particularly beneficial for the professionals who often had competing commitments.

The decision to initially keep the groups separate was debated during the design of the study but thought to be important to allow members to build their confidence as co-producers and to share their honest thoughts. The research team was aware that some contentious topics were likely to be discussed, such as difficulties families had faced in accessing clinical care. Some families may not have felt comfortable discussing these issues in front of professional co-producers and may have preferred for the research team to act as a mediator in these early discussions. The team was also aware that every kind of stakeholder would have different experiences and insights to bring to the study. As such it was deemed beneficial to hold smaller, more intimate workshops in the beginning to fully explore all viewpoints and ideas.

The workshops were co-facilitated by the research team and our Yorkshire Wildlife Trust partners. The researchers set the aims for each event and led discussions and the Yorkshire Wildlife Trust staff supported in designing and leading nature-based activities. Additional research team members also attended to support and take notes. A graphic designer attended all discovery and co-production sessions to act as a 'live scribe', taking visual notes of the discussions. The in-person events were held on Yorkshire Wildlife Trust property in Selby, UK. This location was recommended by and discussed with the Yorkshire Wildlife Trust and our Patient and Public Involvement (PPI) lead, who all felt that this was a good, central, and accessible location for families and professionals living across Yorkshire.

Reflections and practical guidance

The principles identified by B. Smith et al. (2023) have been used to guide reflections on the design and delivery of CONIFAS and the quality of the co-production. These principles were identified through literature reviewing and extensive engagement with various stakeholders involved in co-production projects, and so it is hoped that by exploring our experiences under these principles, we will contribute to more congruous literature. Within these reflections, we also share some practical tools and methods which supported us to meet these principles. Further practical considerations and guidance are then shared which the team found beneficial, or which were part of the learning curve when doing co-production.

Principle 1: Co-production is adequately resourced. CONIFAS adhered to NIHR PPI payment guidance to ensure that members of the public were appropriately reimbursed for research involvement (NIHR, 2023). There was a set amount of funding available to appropriately resource a multidisciplinary research team, PPI collaborators, and the co-producers.

Attendees at in-person workshops were given a £20 Love2Shop voucher and travel expenses were reimbursed. Children received a goodie bag and refreshments and lunch were provided. Co-producers were positive about the level of payment for attending the workshops. Travel expenses were seen as a way of supporting attendance as some co-production members travelled over 40 miles to join the workshops. The nature reserve, however, was in a remote location and, whilst it could be accessed by public transport, these needs were not adequately planned for. One interested participant declined to take part as they would have had to use multiple buses, a train, and a taxi to attend.

On reflection children and families could have been more involved in discussions about remuneration for their time. While the contents of the goodie bags were agreed with the PPI lead, children could have been involved in making decisions about what was included. Professionals did not receive Love2Shop vouchers as it was expected that involvement in the study would be commensurate with continuing professional development. Indeed, multiple professionals reported that they had benefitted professionally from participating in the co-production workshops, largely due to discussions with multidisciplinary practitioners. Nevertheless, it may be that more could have been done to show appreciation for their time, especially for attendance at sessions held on Saturdays which are outside typical working hours to accommodate attendance by families.

Principle 2: Power is shared through equitable partnerships which include those with relevant experiential knowledge, expertise, and assets. The research proposal was designed with PPI members, but it did take an 'inside-out' approach in which citizens are invited by researchers, rather than the study being community-created (Loeffler and Bovaird, 2021). There were constraints on using co-production principles from inception given that the study was funded via a NIHR funding stream that pre-specified the questions and parameters of the research. Utilisation of co-production principles from study inception given grant funding requirements has been recognised as a structural barrier in co-production research (Smith et al., 2022). PPI was valued as a central component when developing the funding application and a series of three group meetings were held with six parents/guardians to shape the research question, aims, and design of the study. The NIHR-funded study team included a PPI lead who had engaged in these group study development meetings as well as partners from The Yorkshire Wildlife Trust and the ADHD Foundation.

Shier (2001) conceptualised a five-level pathway to participation relevant to children which was adapted for co-production research by Larsson et al. (2018). Level five indicates that, when being included in the highest order, children share power and responsibility in the development of interventions. Upon reflection, although CONIFAS used practices to encourage and empower the children, it did not reach this level. The study team took an informal, play-based approach to ensure the workshops did not feel like an educational environment, as this was highlighted by co-production members as an important factor in ensuring children with ADHD could feel more engaged and confident. However, even with this consideration of ways to engage the children, CONIFAS may fit between levels three and four of the pathway. At these levels, the children's views were

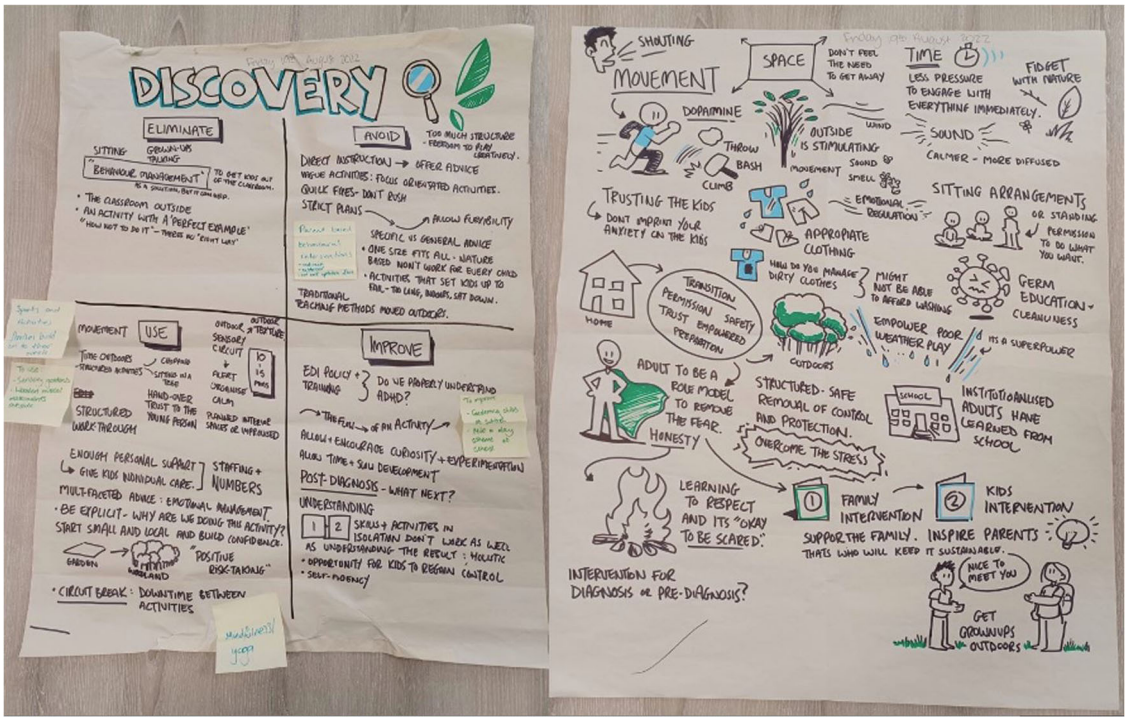


Fig. 2 Example of workshop notes taken by the live scribe and added to by co-producers. Visual notes taken from one of the discovery workshops.

'mostly taken into account in the development of the intervention,' and they were 'involved in some decision-making processes.' Adults, on the other hand, held more power in creating the intervention and did sit higher up this pathway by holding more equal power and responsibility. Working creatively with children to support them to be equitable power-sharers whilst enjoying an accessible process may be beneficial for researchers to consider moving forward (e.g. deciding on content together, utilise different mediums for discussions and activities).

Positive feedback from the adult co-producers was received at the end of the study. They highlighted that they felt 'true ownership' over the created intervention. Some had previously participated in research where they felt led by the research team to answer in particular ways, but they felt this was not the case with CONIFAS. The young co-producers reported enjoying the experience, but this sense of ownership differed throughout the group with some feeling ownership and others less so. Our organisational partners also reported enjoying the process and feeling listened to and involved by the core research team, expressing also that they enjoyed learning more about research processes and that they gained new skills.

There were areas for improvement within the design and implementation of the workshops. Time pressures between stages and minimal contact with co-producers at workshops meant it was difficult to involve this group day to day and in each step of intervention design. The pre-planned study methods and resources allowed for only three Discover and four Define workshops, meaning that participants were not directly involved in or present for the creation of the intervention itself. Whilst ideas about the format and content of the intervention were generated at the workshops and a prototype intervention was created directly from these and presented during the final Define workshop prior to user-testing, co-producers did not 'create' the intervention themselves. This was done by the research team and shown to co-producers with opportunities to discuss and refine it.

Additionally, it was, at times, difficult for the co-producers to cohesively envisage what this intervention might look like. Discussions in the workshops yielded many ideas and the research team did, wherever possible, include ideas agreed upon in the final product. For example, one child co-producer suggested the concept of a physical box which was then used for the final product. The research team continuously reflected on practice in study management meetings, being careful not to lead co-producers in any particular direction and instead using language techniques such as reflecting, summarising, and open questions.

Principle 3: Different knowledge bases and contributions are respected, valued, and blended

Ensuring that everyone felt confident in sharing their thoughts and felt listened to was central to the workshop design and a continuous point of consideration. The first workshops began with an open discussion sharing this aim and describing what co-production is. Co-producers then introduced themselves and explained their experience and knowledge. It was important to ensure that the group was aware that the researchers were there to facilitate the co-production process and that the intervention was to be developed by the co-producers based on their lived experience and first-hand knowledge of ADHD. Ensuring co-producers felt confident enough to actively engage in this way and clearly expressing appreciation for their input were both, at times, challenging tasks. Parents/guardians were initially unclear about what was expected of their involvement, and they were unsure about the intended outcome of the study. The aims and intentions of the study within the context of funding were laid out in participant information sheets provided prior to involvement and were reiterated on several occasions. The researchers aimed to be patient and supportive in helping co-producers to understand the study aims and methods. We have reflected that participant information sheets are not always the best way to describe a study, especially to children, and that the use of infographics or audio-visual explanations may also be helpful.

To improve transparency and accessibility, a graphic designer was used as a live scribe to take visual notes at every workshop

Fig. 3 Example of the sticker rewards sheet. This exercise was used to show appreciation for 'helpful' behaviour and contributions by children and young people.

(see examples in Fig. 2). This made the information easier and quicker to digest and more accessible for all co-producers. The live scribe took notes and depicted discussions in real-time. All co-producers were introduced to the live scribe and encouraged to add notes either directly or as sticky notes if anything was missed. Following each workshop, images of the visual notes were circulated along with written notes taken by the research team. Co-producers were encouraged to read and reflect on these and to inform the research team if anything was missing or misconstrued. Positive feedback from the co-producers was received with parents/guardians reporting that it gave them time to process the content and revisit it with their children. These visual notes were particularly beneficial for those in the group with reading difficulties, as is often expressed in those with ADHD.

One tool that was used to build confidence and show researchers respect and value for child engagement was a sticker rewards sheet for use during the first workshop (see Fig. 3). This was created by the graphic designer. Children were instructed that any time they said or did something "helpful," they could choose a sticker to add to their nature scene. Examples of "helpful" behaviour included answering questions, telling us if they did not understand or like something, asking for a break, etc. The sticker rewards sheet was very well received, and children were surprised and excited to receive a sticker for asking to sit out of an activity and participate in a different way, such as drawing on the live notes instead of playing a voting game. As a result of this activity, children were much more confident in expressing their views and asking to take part in alternative activities in later workshops. Parents and guardians also commented on how sticker rewards, along with the ongoing respect and understanding from the research team, were seen to improve the children's confidence and enjoyment.

At the first Discover workshop, everyone was invited to make their own badge and introduce themselves. An active and playful game was then led by the Yorkshire Wildlife Trust to create a sense of fun and comfort. This may, however, have led to confusion and some children may not have been fully aware of what they were participating in until near the end when they saw the intervention and realised what the questioning during workshops was for. Children were actively involved in discussions about design, format, and content as it was recognised that they were best placed to know what would be best received in terms of the look and feel of the intervention. The play-based approach was useful for building trust, connections, and confidence, but may have distracted from the aims and objectives at times.

Principle 4: Relationships are built and maintained based on mutual respect, dignity, trust, transparency, humility, and relational ethics. There is currently debate over whether it is best to involve parents/guardians when engaging young people in participatory research (Crowther et al., 2022). A better understanding of how this influences their input is required. Within CONIFAS, the ages of the children (9–11 years) were considered when setting up the workshop attendance. It was felt that the parents/guardians helped to build trust with the children and supported them to feel confident and able to participate. Helpfully, parents/guardians seemed comfortable and trusting with the research team and let the children engage freely within the natural space and with the activities and researchers. Indeed, parents/guardians were not always immediately present when their children did activities or had discussions with the researchers and other children. This allowed for parents/guardians to have their own discussions whilst still being able to see their children, and for children to engage independently but with the knowledge of their parent/guardian's presence. The children would often find their parents/guardians to gain clarification on something they wanted to share with the research team (e.g. the name of a game/product they used that was relevant to our intervention development). It was felt that parents/guardians were best placed to understand their children and help them to express themselves.

Ensuring mutual respect and dignity within the co-production group was carried out on an individual basis. Researchers were careful to foster positive relationships with all co-producers and there were no instances of group members being disrespectful towards each other or the research team. On the contrary, some members formed friendships and shared professional, childcare, and signposting tips with each other. A number of professionals expressed that they benefited from speaking with practitioners from different areas. The children presented as trusting of the researchers, all of whom had taken time to speak with them individually and play alongside them to understand and show genuine interest in their lives and opinions. This engagement was extended to adult co-producers and each workshop was supported by sufficient research team members to foster positive relationships and have genuine conversations with co-producers.

Principle 5: Diversity is important and supported when agonistic pluralism is practiced. CONIFAS endeavoured to recruit a diverse group of children, families, and professionals across protected characteristics representing the diversity of our region (Yorkshire and Humber, UK). The co-production group consisted of 29 individuals. An expression of interest (EOI) procedure was designed to purposively sample protected

characteristics. Unfortunately, due to insufficient time and public interest coming largely towards the end of the recruitment period, this method could not be meaningfully used.

It was intended that the recruited group was small to ensure that individual voices were not missed and that appropriate remuneration could be provided. Due to practical challenges associated with the costs of hiring interpreters, only English speakers were recruited, limiting diversity from non-English language cultures and communities. Children with co-occurring conditions were recruited and efforts were made to be inclusive. However, children who posed a risk of harm to themselves or others and those with significant additional difficulties, e.g. non-speaking or profound autism, were excluded as part of the study design.

Increased effort was also dedicated to including diverse families across protected characteristics and geographic locations in the user-testing phase which assessed the acceptability and accessibility of the intervention with different families. Feedback from these families was used in the continuing development of the intervention. Diverse recruitment was achieved, but the sample size was again small and the experiences of those from communities under-represented in research may have been missed. This may impact how effective and appropriate the CONIFAS intervention is for families from diverse communities and geographic locations. When testing the intervention in the next feasibility phase it will be critical to ensure a greater diversity of involvement to clearly identify whether the intervention suits the needs of the wider population.

Recruitment of professionals to the co-production group was opportunistic based on who was available and interested. However, effort was made to reach out to a range of services. Diversity of professions within the co-production group was achieved to some extent, as seen in Table 1. However, on reflection, there were several key professional groups not represented: those in positions of power such as service leads and commissioners may have provided valuable insights into the sustainability of the intervention delivery, and Special Educational Need Co-ordinators (SENCOs) could have provided additional insights into the presentation of the intervention and supported understanding of the educational impact of ADHD.

It was important to respect and support the individual profiles of the neurodivergent children in the co-production group as well as their parents and guardians who, in some cases, were also neurodiverse. The CONIFAS research team included clinicians and collaborators from YWT and the ADHD Foundation with extensive experience of working with neurodiversity. In addition, the PPI lead has lived experience of parenting two children with ADHD. This expertise initially guided the structure of the sessions which were then built upon by the participants herein named as our 'co-producers'. 1:1 support was provided to enable parents and children to find the venue and access online sessions. The Iriss inclusion checklist (Iriss, 2023) (a helpful way to record and share any accessibility needs/preferences that co-producers may have) was circulated before the first workshop but none were engaged with it. The use of a different tool would be helpful in providing participant input prior to the workshops running, especially as our group did involve members with various access needs that were not known about until the end of the first session.

Workshops were short and allowed for regular breaks. Refreshments and lunch were provided as the impact of ADHD medications on children's appetites was highlighted by parents/guardians. Siblings were welcome to attend workshops and extra staff were present to accommodate running separate activities where necessary. The use of play-based activities was central, and a range of targeted nature-based activities was included for the children to engage in., e.g. ice breakers. Visual aids were also used including a timetable at the start of the session, as recommended by findings from a recent review (Thomas et al., 2023). There were difficulties in meaningfully using visual schedules for every workshop as often the sessions changed depending on the children's needs and wishes. However visual aids in the form of activity materials were a prominent and helpful feature of the session delivery.

Principle 6: Practice reciprocity and mutuality. From the first workshop held, the co-producers described how they had enjoyed the process of attending and expressed a desire for these to continue in some format. The social aspect of the groups along with the chance for children to play and experience nature were highlighted as positives. Members were signposted to services where necessary to provide ongoing support (e.g. local green activities). Feedback indicated an overall positive experience of being involved in the research. For the co-producers, appreciation at the end of the study was demonstrated through letters and certificates for the children. Some children took these to show at school assemblies. To continue good practice, co-production members will be kept informed as we move to the next stage of the research, allowing them the opportunity to remain involved. Research grant funding can be a long process, and this has been highlighted to co-production members. This is a barrier in gaining mutual trust which can be difficult to manage.

Practical considerations. Quite often, the CONIFAS workshops deviated from the structure initially planned. The children taking part had very varied needs and profiles of strengths and differences. We ran the workshops in a way that not only allowed for these different needs and preferences but encouraged the children to engage in whatever way worked for them. For example, at times some of the children did not want to take part in an activity and preferred to be climbing trees or exploring the immediate woodland area. Often there were multiple activities running concurrently in the outdoor space with different research team members supporting these. It was important to be guided by the children's needs to help them engage in a way that was true to themselves. Extra researchers to support the additional activities and simply to sit with the children in the space and take notes on their thoughts was vital. The importance of trusting the process and this 'messiness' was recognised by Pettican et al. (2022) following post-study reflections with co-producers. The co-production process relies on active collaboration without the formal script or formula often seen in traditional research. This was a transformative process for the researchers involved in CONIFAS and it was critical to navigate frequent feelings of uncertainty until the final intervention took shape. Gaining feedback that confirmed the final intervention had full approval from the co-producers ensured a sense of emerging trust in the process. Smith et al.'s (2022) systematic review of co-produced research pointed out that there is currently no agreement about whether greater flexibility or structure is best during co-production. Taking field notes within the context of 'messier' sessions was complicated at times and the team benefited from a visual note taker who could sit back and observe and work in real-time bringing together the different thoughts offered by participants. The research team also took detailed notes during the sessions and then came together to merge these in themes to be presented back to the co-producers alongside the visual notes. Simple qualitative analysis was used on the notes.

A number of practical suggestions have arisen from reflection on CONIFAS. These are presented in the table below (Table 2).

Table 2 Practical suggestions for co-production.

Practical tips for co-production	Tools and approaches used in CONIFAS
Be well-resourced and include adequate and well-considered remuneration in your funding plan, and check this through PPI feedback. Consider vouchers, refreshments, lunch, travel reimbursements, and child-friendly tokens of appreciation.	£20 love-to-shop vouchers, travel reimbursements in line with LYPFT's mileage coverage, hot drinks, lunch, and goodie bags for children.
Allow for flexibility, especially when involving children and/or people with additional needs. This may require extra staffing and other resources.	Extra staffing, flexible but pre-planned activities, researchers equipped with lists of questions organised by priority.
Plan to change plans—build time within schedule and allow as much room as your funding remit will allow.	Workshops structured with extra time and back-up activities available.
Build in more meeting opportunities so that everyone can be involved, even if they need to skip a group meeting.	Built in 'catch up calls' to the project plan, usually with multiple co-producers so that full conversations could be had regarding missed workshop content.
Learn to become comfortable with flexibility and prioritise critical outcomes over ideal outcomes from each meeting with co-producers. Be reflexive in your practice.	Researchers are aware of key questions and critical outcomes as well as ideal points that could be missed. Co-producers advised to contact researchers with any additional points outside workshops.
Build a strengths-focused environment that uses positive language and builds confidence.	Shared ADHD Superhero booklet (Powell et al., 2021) before workshops. All study-related information and documents used strengths-focused language. Children were encouraged to participate in whatever way they were comfortable with.
Use a gentle rewards system with children to tangibly show that you're listening to them and respecting the ways they may prefer to participate.	Sticker chart which rewarded 'helpful' behaviour. Verbal praise for participating in whatever way made them comfortable.
Use a visual note taker to live-scribe meetings/workshops and explicitly allow co-producers to add to these. Visual notes are more accessible and easier to digest.	Experienced live-scriber/graphic artist was costed into the study and attended most discovery and co-production workshops.
When working with neurodiverse children, traditional workshop methods may not be preferred. Use covert play-based approaches to gather your information	To find out what kinds of activities the children preferred, multiple activities were made available during 'breaks.' Researchers observed these interactions and asked questions as the children played.
Use qualitative research skills and/or include a qualitative researcher to support your interpretations of meetings and conversations with co-producers and to translate them into something tangible.	We used a graphic designer to support in taking live notes to minimise interpretation afterwards; we used the qualitative research skills within the academic team (e.g. content analysis) to pull out key themes to take forward
Consider how to involve co-producers at every stage of production including the physical creation of a product, i.e. using craft materials to develop the product as opposed to just talking about it. Using creative methods to produce sections of a product that can be shown more frequently throughout the process or creating the final designs as a group.	Ideas for format and content came from co-producers in this study, but participants were not directly involved in the physical production of the nature activity boxes. We could have spent more time using craft materials, paper and pens, or computers with participants to make the final intervention box together.

Discussion

CONIFAS used co-production with children with ADHD, their families, and professional stakeholders in relevant fields to create a novel nature-based intervention for children with ADHD. The implementation of this co-production study was a learning process for the research team, and this paper summarises the strengths and limitations of our approach which we hope can help to inform future practice and appraisal.

From the outset, our study prioritised true power sharing and collaboration with all co-producers, ensuring that their contributions were valued and appropriately remunerated. We maintained an inclusive atmosphere, particularly focusing on empowering the children involved and ensuring their comfort and accessibility to the project. This emphasis on respect and flexibility for neurodiversity was sustained throughout the study, with accommodations made whenever necessary.

However, navigating this novel methodology presented challenges for the research team, requiring a level of flexibility and a re-conceptualisation of the researcher's role. While we employed the Double Diamond model (Design Council 2007) to structure our approach to co-production in this study, the specifics of workshop design and equitable engagement of co-researchers were learned through clinical skills, networking, and creative adaptation. It became evident that more flexibility was needed than initially anticipated, a lesson gleaned from ongoing workshop delivery and guidance from co-producers.

Reflecting on our experience, we acknowledge areas for improvement, such as greater involvement of co-producers in the creation of the intervention and clearer communication with children about their role in the study earlier on. We advocate for increased publication and reflection on co-production methods and practices across research teams, fostering shared learning and addressing common barriers. Additionally, as has been signalled in the transdisciplinary research in the sustainability space (Harris et al., 2024), managing power dynamics and imbalances between lay members, academics, and professional stakeholders in the context of co-production is challenging and requires time and know-how among researchers. In this sense, we see our contribution as a critical step toward orienting future researchers towards best practices in co-production in environmental and health research, thereby ensuring that the quality of research meets widely accepted institutional standards of quality.

While co-production is often praised for producing more relevant research (Smith et al., 2023), its effectiveness in creating interventions remains uncertain (Hubbard et al., 2020), not least because scientific comparisons of intervention effectiveness are rare (Kaehne et al., 2018). Furthermore, as has been noted by transdisciplinary researchers engaged in co-production (Polk, 2015), while co-production methodologies can generate valuable insights the approach can be divorced from practice-based contexts, making it difficult to translate findings for end-users, especially policymakers. It is likely that co-production needs to be a more reflexive practice to ensure the ambition to be inclusive and relevant for end-users is achieved. Some studies have used reflexive researcher diaries to this end (Clayson et al, 2018). We are engaging with this write-up as a reflection on our approach

and learnings. We aim to assess the effectiveness of CONIFAS in future work, and more details of the intervention can be found in our results paper (Armitt et al. 2022, under review).

CONIFAS worked with families with lived experience of ADHD and professionals to co-produce a new nature-based intervention for children with ADHD. An intervention was successfully created, and positive feedback was received from co-producers about participating in the study. It was a learning process for the research team, one which, in the context of growing focus on co-production and the importance of lived experience in research, the team feels is important to share. We are hopeful that the points discussed here will be helpful to other researchers and professionals working in this area.

Conclusion

Critical reflection on the use of co-production identified that every attempt was made to adequately resource the co-production, share power, value diversity, and develop trust. Taking an inclusive and flexible approach to running the co-production workshops allowed the research team to work in a truly equal way with the co-producers which led to an enjoyable experience and empowerment for them.

The team reflected that the re-conceptualisation of the role of the researcher in co-production can be challenging. Whilst the use of models of co-production provided a framework for study development, the designing and running of the workshops and effective engagement of co-researchers in an equitable way came from utilising clinical skills, networking, and creativity.

The researchers would recommend that co-production methodology is considered by researchers wherever possible to well-inform work with lived experience and to empower those with lived experience. We would also encourage researchers to work flexibly within this methodology and to communicate with co-researchers about their needs and ways to engage them in the process.

Data availability

The data that support the findings of this study are available from the corresponding author, HA, upon reasonable request.

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Author contributions

Hannah Armitt is the corresponding author. These authors contributed equally to this work as contributing authors: Hannah Armitt, Leah Atwell, Ellen Kingsley, Piran White, Kat Wooley, Megan Garside, Natasha Green and Peter Coventry.

Competing interests

The authors declare no competing interests.

Ethical approval

The co-production phases of the study were submitted for ethical review by the University of York Department of Environment and Geography Research Ethics Committee (REC) and were approved on the 23rd of May 2022. The user-testing phase was submitted to the same REC and approved on the 12th of December, 2022 (DEGERC/Res/01122022/1). The inclusive, neuro-affirming, and strengths-based language was utilised throughout communications, e.g. advertisements and participant information sheets reviewed by our patient and public involvement lead. All research was performed in accordance with relevant National Institute for Health and Care Research guidelines.

Informed consent

All parents provided informed written consent using a consent form approved by ethics. Children were provided with the option to assent to inclusion in the study however this was not required. Consent was collected by the research assistant working on the study.

Additional information

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