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Kitty Forster & Lara Maister

‘Interoceptive Awareness Opportunities’ during Outdoor Education for children with a history of complex trauma

Abstract

Adventure therapy can benefit children with emotional or behavioural difficulties. Looked After Children frequently have a history of complex trauma and tend to avoid traditional therapies. Early adversity exposes a developing child to toxic stress, sometimes leading to a dysregulated nervous system.

Interoception refers to internal bodily processes that sometimes enter conscious awareness, including heart-rate, breathing and emotional sensations. Maladaptive interoception can develop following traumatic life experiences, contributing to mental health symptoms. Interoception is associated with emotional regulation and mindful body-based activities can improve interoceptive awareness. The physicality of outdoor activities makes them ideal sensory experiences for enhancing the connection between mind and body.

This current project developed Interoceptive Awareness Opportunities (IAOs) during outdoor activities. Instructors reported IAOs were feasible to incorporate within 1:1 Outdoor Education sessions at a therapeutic children’s home. Instructors successfully engaged children who were resistant to conventional therapy and reported an apparent increase in bodily awareness.

Keywords

Interoception; trauma; exercise; outdoors; therapeutic

Introduction

1.1 Adventure therapy

Children are often resistant to traditional therapy (Oetzel & Scherer, 2003), if this is offered before they are ready to process their adverse experiences. Adventure therapy has produced positive outcomes on mental health symptoms as well as emotional and behavioural presentation (Bowen, Neill & Crisp, 2016), providing a viable alternative to conventional talking therapies.

There have been many theories regarding the mechanisms of adventure therapy's success. For instance, kinaesthetic and experiential learning can instigate therapeutic change (Harper, Peeters & Carpenter, 2014). The active nature of outdoor activities requires physical involvement in tasks to respond to bodily needs, facilitating experiential learning. Other theories include the possibility that Adventure Therapy leads to improvements in brain resilience; due to its neuroplasticity, the brain can undergo structural alterations following progressive exposure to challenging tasks within the outdoors (Allan, Mckenna & Hinda, 2012).

The majority of adventure therapy models (i.e. Wilderness Therapy) involve protracted periods interacting with peers and learning to be cooperative within the social group, a component considered to be instrumental in its success (Russell & Farnum, 2004). However, this could be too challenging for children with a history of complex trauma and it has been acknowledged that adventure therapy is not always appropriate (Pringle, Dobud & Harper, 2021).

1.2 Trauma and mental health

Traumatised children have a significantly increased risk of mental health problems (Torjesen, 2019) and generally struggle to regulate their intense emotional experiences (Weissman, Bitran, Miller, Schaefer, Sheridan & McLaughlin, 2019), which can contribute to future psychopathology (Dvir, Ford, Hill & Frazier, 2014). A 'phased' approach is recommended when offering adventure therapy to Looked After Children who have experienced trauma (Trundle & Hutchinson, 2020), prioritising safety, as advised by the Trauma Recovery Model (Skuse & Matthew, 2015) before any deeper therapeutic work. Pringle and colleagues (2021) advocate for outdoor practitioners to follow trauma-informed guidelines (Kezelman & Stavropoulos, 2012, 2019a, 2019b), focusing on 5 key principles: safety, trustworthiness, choice, collaboration, and empowerment.

The UK Trauma Council define complex trauma as experiencing recurring traumas as a child, typically occurring within interpersonal relationships. These may encompass neglect and/or physical, emotional, mental or sexual abuse, consequently placing the developing mind and body under toxic stress (Bucci et al., 2016; Shonkoff & Garner, 2012). As a result, the body is traumatised as well as the mind and some purely verbal therapies may not suffice if they don't acknowledge the physiological trauma (Payne, Levine, & Crane-Godreau, 2015; van der Kolk, 2014). Trauma can lead to dysregulated

nervous systems (Boullier & Blair, 2018; Corrigan, Fisher & Nutt, 2011), subsequently, physical experiences in response to everyday situations can be aversive or cause dissociation. Outdoor professionals need to be aware that traumatised individuals may be more prone to experience autonomic fight or flight reactions within outdoor activities (Pringle et al., 2021).

Research evidence supports body-based approaches for mental health (de Manincor, Bensoussan, Smith, Barr, Schweickle, Donoghoe et al., 2016) and trauma (Brom, Stoker, Lawi, Nuriel-Porat, Ziv, Lerner et al., 2017), including yoga (Pasco, Hallgren, Baldwin, Tseberja & Parker, 2021) and mindfulness (Kang, Sponheim & Lim, 2021). Body-based interventions have been recommended for trauma (Grabbe & Miller-Karas, 2018; Fisher, 2019) as opposed to solely cognitive therapies. Mindfulness has been successfully incorporated into adventure therapy approaches (Kirwin, Harper, Young & Itzvan, 2019); within this setting, the physical body is engaged and therefore can be involved in the therapeutic process.

1.3 Interoception and interventions

'Interoception' refers to internal autonomic bodily processes, that sometimes enter our conscious awareness, including respiratory, cardiac, and gastric activity. Emotional experiences are produced via these iterative signals between mind and body to maintain homeostasis (Craig, 2015). Interoception is involved in emotional regulation (Zamariola, Frost, Van Oost, Corneille & Luminet, 2019) and interoceptive anomalies are associated with psychiatric disorders (Brewer, Murphy & Bird, 2021; Khalsa & Lapidus, 2016; Khalsa, Adolphs, Cameron, Critchley, Davenport, Feinstein et al., 2018). One possible aetiological mechanism for interoceptive dysfunction could include the autonomic stress response to early adversity (Bucci et al., 2016), leading to maladaptive interoception as a result of traumatic life experiences (Wilkinson, Dodgson & Meares, 2017).

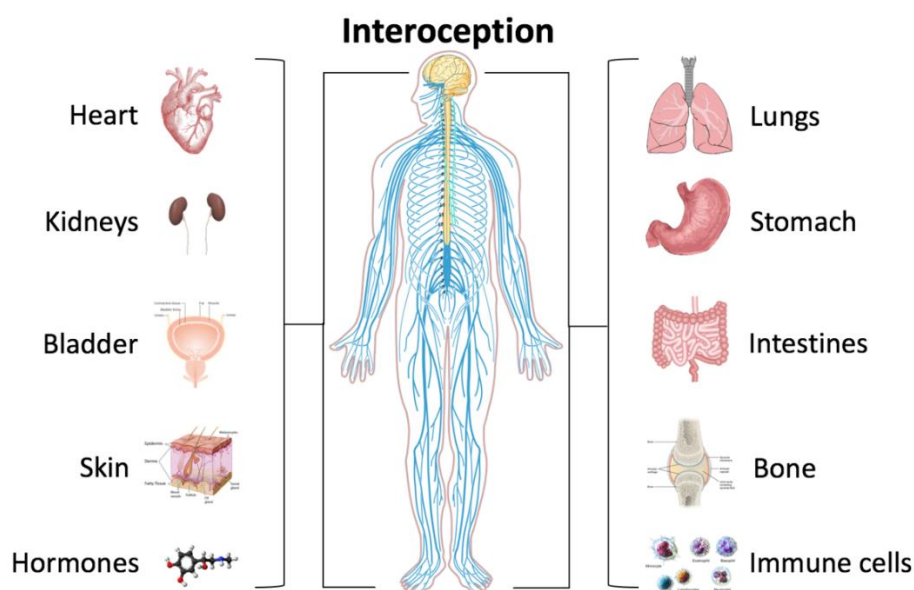


Figure 1: 'Interoception and the body' graphic (Schapelle) licensed under CC BY-SA 4.0

Disciplines involving mind-body integration and awareness through movement, such as yoga (Neukirch, Reid & Shires, 2019) and mindfulness (Gibson, 2019), are thought to operate through interoceptive mechanisms (Farb, Daubenmier, Price, Gard, Kerr, Dunn et al., 2015). They improve connections between mind and body by bringing attention to internal processes, for example breathing and muscle activation.

Interoceptive awareness interventions can reduce symptoms of mental health disorders (Khoury, Lutz & Schuman-Olivier, 2018). Some preventative programmes have targeted children in mainstream schools (Goodall, 2020; March & Mcauley, 2019), others have focused on programmes for children with neurodevelopmental diagnoses (Mahler et al., 2022). Interoceptive awareness is interwoven with 'dispositional mindfulness' (D'Antoni, Feruglio, Matiz, Cantone & Crescentini, 2021; Gibson, 2019; Hanley, Mehling & Garland, 2017), which is associated with emotional regulation (Brown & Ryan, 2003).

'Predictive coding' models of interoception (Seth, 2013) postulate that our lived experience develops from sensory input, subsequently forming unconscious bodily expectations. This becomes an iterative process, with predictions updating in response to ongoing sensory information, creating emotional experience (Quad, Critchley & Garfinkel, 2019). Interoceptive dysfunction can result from previous experiences and persevere when the interoceptive system doesn't amend its expectations (Paulus, Feinstein & Khalsa, 2019). It may have been adaptive for survival to associate increased heart-rate and respiration with danger, due to a conditioned fear response from recurring traumatic incidents. Consequently, even in objectively safe situations, the brain interprets these body signals as a sign of imminent threat, activating the sympathetic nervous system to prepare for fight or flight.

Within clinical disorders, the 'predictive coding' model of interoceptive psychopathology suggests that interoceptive awareness can decondition maladaptive patterns, attributing new associations to certain sensations. Gradual interoceptive exposure is typically used for anxiety (Boettcher, Brake & Barlow, 2016; Boswel, Farchione, Sauer-Zavala, Murray, Fortune & Barlow, 2013) and may involve raising the heart-rate slightly, typically through physical movement in tolerable increments, to reduce sensitivity to anxiety symptoms. From a predictive coding perspective, concepts utilizing exposure have been suggested for trauma (Wilkinson et al., 2017), anxiety (Garfinkel et al., Manassei, Hamilton-Fletcher, den Bosch, Critchley & Engels, 2016) and PTSD (Krupnik, 2020; Kube et al., 2020; Lyndon & Corlett, 2020).

The benefits of physically regulating a traumatised nervous system (Perry, 2009) prior to overt processing of past experiences have been recognised in the adventure therapy literature (Pringle et al., 2021). In particular, it was noted that the physical aspects of outdoor activities could help to regulate the body, due to the repetitive and rhythmic nature of walking or other active pursuits. This indicates adventure therapy could be the ideal vessel for 'bottom up' somatic approaches to trauma, in contrast to the 'top down' approach of cognitive therapies.

Exercise can ameliorate anxiety (Sabourin, Stewart, Watt & Krigolson, 2015) and PTSD symptoms (Mehling, Chesney, Metzler, Goldstein, Maguen, Geronimo et al., 2018)

through interoceptive mechanisms, with clinical implications of physical activity on interoception yet to be fully explored (Wallman-Jones et al., 2021).

1.4 Interoceptive Awareness Opportunities

The tasks developed in the present research have been named ‘Interoceptive Awareness Opportunities’ (IAOs). Children experience visceral sensations when their heart is beating after cycling, their inhalations sharpen when hiking, their muscles are working hard to climb, or they are hungry after kayaking. Providing subtle moments for children to ‘tune in’ to interoceptive sensations during outdoor activities could benefit their wellbeing. IAOs could be more salient than sedentary meditative disciplines.

The IAOs were aligned with descriptions of how to promote more adaptive interoceptive systems (Farb et al., 2015; Garfinkel et al., 2016; Krupnik, 2020; Kube et al., 2020; Linson & Friston, 2019; Lyndon & Corlett, 2020; Paulus et al., 2019; Wilkinson et al., 2017). The intention was to develop an enjoyable way for children to learn to discern bodily sensations and help them identify their feelings. It was anticipated that the children would be more likely to participate in the novel coaching techniques than traditional therapies.

2 Method

2.1 Location

Afon Goch Children’s Homes Ltd. (‘Afon Goch’) provides two children’s homes in North Wales registered with Care Inspectorate Wales. Afon Goch holds an AALS licence (L27484) in relation to various adventure activities. Placements are provided for children aged 11 – 18 years old; typically, they have a history of complex trauma.

2.2 Participants

Three residents at Afon Goch signed informed consent to participate. One young person (age 18) performed a consultant role prior to implementation of Interoceptive Awareness Opportunities (IAOs). Two children (age 14 – 16 years old) consented to be a recipient of IAOs within Outdoor Education; only one child agreed to participate in research measures.

The project received ethics approval from Bangor University’s School of Psychology Research Ethics Committee (REC) on 28.04.21, Research Proposal Number: 2020-16887-A14783.

2.3 Materials

2.3.1 Equipment

Outdoor Education equipment belonging to Afon Goch was used by qualified Outdoor professionals in permanent employment. Activities permitted under their AALS license included: hill walking, mountaineering, rock climbing, abseiling, ice climbing, gorge scrambling, coasteering, kayaking, canoeing, stand-up paddleboarding, improvised rafting, paddle surfing.

2.3.2 Interoceptive Awareness Opportunities (IAOs)

The IAOs were informed by published empirical and theoretical work and reviewed following consultation of professionals with relevant expertise (see Acknowledgements). Over 100 IAOs were developed, suitable for a range of outdoor activities.

The researcher delivered training sessions for the Outdoor Education Instructors, encompassing the principles and therapeutic benefits of interoception, plus how to deliver IAOs within 1:1 sessions. Instructors contributed their ideas and discussed any potential issues with implementation.

2.4 Protocol

Outdoor Education sessions were delivered as per normal activity programming. Children at Afon Goch are offered between 1-3 sessions of Outdoor Education per week, plus an expedition every 6 weeks.

The researcher suggested suitable IAOs that could be incorporated within the scheduled sessions. Instructors were advised to choose 1 – 4 IAOs per session and to deliver these during individual sessions, not group Outdoor Education. Child engagement and instructor feedback was reviewed on a weekly basis. For expeditions the suggested IAOs were refined or extended based on prior engagement.

IAOs were introduced to two consenting children by experienced Outdoor Education Instructors, with whom the children had a trusting relationship. IAOs were incorporated into biking, rock climbing, hiking, kayaking and canoeing sessions between August 2021 and September 2022.

The Cognitive Behavioural Therapist (see Acknowledgements) was available to give weekly guidance on developing a child's coping strategies, using the insights generated from the IAOs.

2.5 Measures

The researcher reviewed session records and made notes during discussions with instructors following scheduled sessions.

3 Results

3.1 Child engagement

The children engaged positively in numerous IAOs during Outdoor Education and useful feedback from instructors was gathered. A selection of anecdotal reports of successful engagement have been described in Table 1.

Table 1: Descriptions of children's engagement in Interoceptive Awareness Opportunities

Interoceptive Awareness Opportunities* during Biking	Anecdotal report of child engagement
<p><i>Heart-beat detection</i></p> <p>Before exercise: Can they notice their heartbeat? Try to walk or cycle a short distance and try again.</p> <p>Repeat until it can be felt.</p> <p>Can they notice it slowing down at rest?</p> <p>How long can they maintain awareness?</p>	<p>A child was repeatedly guided to notice their heart rate in their chest after cycling. They soon began to spontaneously mention when they noticed their heart rate in their chest. With the guidance of the instructor, they stopped thinking of these bodily signals as upsetting indications of being unfit and instead began to associate them with actively improving fitness, to help them with biking.</p>
<p><i>Breathwork when cycling uphill</i></p> <p>Experiment with what is easiest, e.g.</p> <ul style="list-style-type: none"> • Inhale for 2 pedals, exhale for 2 pedals • Inhale for 3 pedals, exhale for 4 pedals <p>Try any other variations to suit terrain and energy levels.</p> <p>This plants the seed that controlling the body can help emotions.</p>	<p>A child was initially unwilling to try the different breathwork techniques to assist them cycling uphill, because they disliked feeling unfit and preferred to push their bike uphill. They were open to listening to discussions about being out-of-breath, but didn't actively participate. During subsequent sessions, they were willing to try a breathing rhythm when cycling, inhaling for every 3rd pedal push on a short incline. They were also coached to breathe deeply for extra oxygen before approaching a steep section. In ongoing biking sessions, they experimented with different breathing rhythms for various terrains, encouraged to find what worked for them. A year later, they taught a new instructor their personal breathing technique they'd developed to help them up hills.</p>
<p><i>Which muscles in the legs are best when cycling uphill</i></p>	<p>During an initial biking session, when prompted to identify which muscles they could feel, a child simply stated they didn't find cycling hard work on their legs.</p>

First focus on sensations in the right leg for a few rotations, then the left leg, then both together.

Can break it down into muscle groups – right quad, right glute, right calf... then try on the left.

Can they focus on the angle of the foot at each point of the rotation, and the changed sensations in legs.

Who can cycle the slowest?!

Do they end up being really aware of which muscles start ‘firing’ at which point of the pedal cycle? How much focus is on the arms, pushing into the handlebars? Do they hold their breath?

Rise in body temperature: and relationship with anger or stress

If children can recognise that getting too hot when exercising leads to feeling frustrated or bad tempered, this can lead to conversations about alternative behaviours when they are getting too hot and angry in ever day life and how to notice this. They can use body-based techniques to help mood (calm when cooler). Use the neutral context of OE to teach how to notice the interoceptive signals in the body when getting too hot. Maybe as well as encouraging them to take off a layer of clothing, they could be prompted to stop and feel the fresh air on their face, have a drink of water, put the cold water bottle on face/neck, or putting wrists on cool rock, in stream etc? Can they notice feeling better emotionally?

Noticing fluctuations in temperature

Noticing the internal heat rise when you cycle uphill fast... you might need to take off some warm layers. If you’re cold to start with, you might notice that cycling hard uphill increases your temperature relatively quickly. How long until you feel warm? You could guess at the bottom of the hill – I’ll be warm by that tree....

Subsequently, across various sessions, they could identify that they felt exertion in their thighs, stomach, back, ball of their feet, heels and outer side of their knees when cycling, allowing the instructors to coach optimum technique.

A child was really amused by a biking game involving balance within a ‘slow race’. It gave them opportunity to play and laugh.

They didn’t engage in competitive element because the instructor had better balance.

A child became too hot whilst cycling and felt much less irritable when they had removed a warm layer of clothing. This led onto a conversation about how being too hot can affect your mood. They spontaneously shared details of an event from a few days previously when they had become too hot in a car, recognising that this had directly affected their mood and caused agitated behaviour. Following this, plans were made for any opportunities to bring the child’s attention to pleasant cooling sensations, and linking this with feeling calm, for example splashing their face with cold water or dipping their wrists in a stream. Practising this during outdoor activities provides practical coping strategies to rely on if they become overheated and angry in everyday life. They also identified that going outside into cooler air can help them feel less angry.

Instructors reported that a child who resisted formal coaching of technique within Outdoor Education was therefore often difficult to engage in IAOs unless they were focusing on muscle groups.

However, they could be guided to notice their temperature increasing when cycling hard up hill to keep warm.

Interoceptive Awareness Opportunities* during rock climbing	Anecdotal report of child engagement
<p>Analyse which parts of the body are working whilst climbing.</p> <p>What muscles are doing most of the work?</p> <p>Which other muscles could also work?</p>	<p>A child reported they felt their arms were working the hardest whilst climbing.</p> <p>An instructor wanted to improve their climbing ability by encouraging them to focus on leg muscles as well.</p>
<p>Use the whole body, not just the arms. If glutes and core are working as well as calves and forearms you're going to reduce workload on arms. Experiment with tensing different parts of the body, whilst on a climbing wall, to test this out.</p>	<p>On a sloping 'slab' indoor wall, the child managed the entire roped climb using only their legs!</p>
<p>Climbing route with eyes closed</p> <p>Choose a climb well within their ability, and top roped. Try guiding:</p> <p>Reach up and right with right hand...</p> <ul style="list-style-type: none"> • Move left foot up to where left knee is... etc 	<p>A child was open to trying this and managed well, however found it frustrating waiting for the instructors' guidance.</p> <p>They could open their eyes at any time but declined when reminded. Instead, they proceeded by feeling their way up the entire route with their eyes shut!</p>
Interoceptive Awareness Opportunities* during paddle sports	Anecdotal report of child engagement
<p>Noticing which muscles in the body are working whilst kayaking or canoeing.</p> <p>Which muscles should ideally be activating?</p> <p>Can they use these?</p> <p>You could play a game where you paddle with the worst technique deliberately and compare how much easier it is with good technique!</p>	<p>When teaching trunk rotation whilst paddling a canoe, the instructor directed a child's attention to different muscle groups.</p> <p>They were able to identify that their paddle technique felt more powerful when they focused on moving their shoulders and were able to identify that specific areas of the shoulder and back muscles were being activated.</p>
<p>Practising finding the edge in a kayak.</p> <p>Is there a panic moment, then relief when they don't tip? Where do those 2 sensations occur in the body? Adrenalin sort of shooting to ends of feet / hands? It may be different for everyone, there's no right and wrong. Do these feelings of panic occur less with practise?</p>	<p>A child was able to notice that they were using their knees and hips when learning new kayak skills and getting used to balancing, leaning and edging on the water.</p>

Are both sides of the body firing symmetrically whilst kayaking? See if they can notice all the muscles firing when they do a right-hand paddle stroke, then repeat on the left. Are the same muscle groups firing for each side? Try to consciously fire the right muscles on the weaker side

Paddle to middle of lake and just sit... Option to close eyes and sit there for ages... Encourage a child to identify which way the boat may be drifting. Can they feel the direction of the wind, current, sun on their face

Guess when instructor is slightly disturbing the water nearby. Child is sitting still/ lying in the boat with eyes open/closed (their choice). The instructor starts with the tiniest possible disturbance (within 30 seconds of the child relaxing) and increases until the child notices. Child is 'listening' to their internal sensations waiting for that change in sensory input.

Which way are you facing? Start with eyes open and orient to surroundings. Then close eyes and let the boat drift, turn for a certain amount of time OR physically manipulate the boat. "Point to the *tree*" and all try to do this challenge with eyes closed

Lying back and looking at sky, feeling boat gently rock with the water. Encourage them to notice the slight waves in a lake lapping at the boat, or little movements of their own body making changes. How do they feel? Calm? Relaxed? Vulnerable? Sleepy?

The instructor guided awareness to their oblique muscles whilst paddling. Later trying twisting movements, they discovered that they loved how it felt on their back to twist around in the kayak. A child was practising edging the boat on both sides and then attempted this with their eyes shut, noticing that they could lean over far more on their right side than the left.

Whilst on a lake in a canoe with an instructor, a child was asked which direction they thought the wind was coming from, by feeling it – they paid attention to the sensations of the wind on their face.

Two instructors and a child in kayaks played a game of trying to move past each other without one person noticing the movement of water. The child was challenged to notice when the instructor rocked their boat nearby, to create some movement in the water; they closed their eyes and were able to notice the movement of water with only very slight waves.

Sitting in the middle of the lake facing a mountain, the instructor asked the child to close their eyes and use a sweep stroke to spin their boat around – then to try and stop it when they thought they were facing the mountain again. They tried several times and over-rotated – it's irrelevant whether or not they got this accurate, because the opportunity to focus on internal sensations was the agenda of any challenge.

A child relished the sensation of lying back in their kayak and shared that they found it very relaxing. They also spontaneously noticed when the lake was calm it made them feel peaceful to be in the kayak. During an expedition an opportunity for this was created in a beautiful environment, with everyone on the expedition team lying back in their kayaks looking at the sun rays coming

	<i>through the trees for ages. The child loved this experience and was in a peaceful state of mind during this.</i>
<i>Paddle to middle of lake and just sit... Can they separate the feel of the current's pull on the bottom of the boat from the wind's push on their bodies and top of boat?</i>	<i>With increasing kayaking competence, a child tried to discern sensations of water and wind on the boat with their eyes shut. They could feel the boat turning in response to the waves and identified this by noticing internal sensations that were like feeling dizzy.</i>
<i>Start with eyes open and paddle into current ... to feel when the water is taking the boat. This is for people who are learning to go on white water. With experience, try with eyes closed.</i>	<i>This awareness was developed further by learning a technique of moving into an eddy; then paddling towards it with their eyes shut, opening eyes as soon as they felt the moving water.</i>

Notes *Summarised versions of Interoceptive Awareness Opportunities

3.2 Improvements suggested during IAO delivery phase

- The IAOs could be delivered numerous times in different settings – the repetition seemed helpful because the children reported sensations with greater nuance with practise.
- It seemed to be helpful if the interoceptive sensations were explored collaboratively. Instructors were encouraged to share their own experience, providing they were aware there is no 'right' way to feel something, and make it clear to the child that they may feel something different.
- Sometimes it seemed that identifying very specific muscle groups is difficult for the children. It was best to start with general areas of the body and build up to more specific muscles over time.
- It helped if instructors pointed to areas of the body rather than relying on language.
- It became apparent that it probably wasn't necessary for the children to give verbal feedback regarding their experiences.
 - The children were sometimes clearly focusing inwards on an IAO. When an instructor asked questions they appeared open and attempted to articulate responses, but struggled to vocalise their experience.
 - It was decided that providing the opportunity for them to be fully immersed in noticing their interoceptive sensations was the agenda, not distracting by prompting them to find adequate vocabulary.
 - Conversely, it was often useful for instructors to label some sensations and give a little bit of psychological education. For example, after enjoying their first river rapid in a kayak, a child wanted to repeat this but had butterflies in their stomach. This was an opportunity to talk about what adrenalin is

and how this can cause nervousness but can also help with focus. They kayaked the rapid again.

- There will be a happy balance between these two approaches that instructors can select according to the child, their receptivity, the activity and the IAO.

3.2 Additional feedback from Outdoor Education Instructors

- It is often natural to introduce IAOs alongside standard coaching of skill progressions.
- If a child isn't receptive to coaching, then it is more difficult to incorporate IAOs. However, IAOs related to muscular sensations and temperature were easier to introduce than heart rate or breathing IAOs.
- After trying both approaches, it was found to be better to intertwine IAOs subtly within the session, rather than overtly announce a task.
 - Incorporating it more naturally into the session initiated a good level of engagement.
 - One instructor suggested that introducing them as 'focused coaching' may also help.
 - Rather than telling them it's an IAO, the instructor would just plant the seed, then the child would speak about it relatively openly and recognise what was being spoken about.
- Knowing the fitness and disposition of the children was important. An instructor noticed that he had to exercise quite hard to feel a pulse in other areas of his body, not just his chest. He knew a child would become emotionally aroused if they exercised to this intensity, feeling overwhelmed due to believing they were unfit. Therefore, he knew this wasn't an appropriate IAO to introduce to this child.

3.3 Testimonials from Outdoor Education Instructors

"The IAO's are perfect for working with our children as many of them don't understand what their bodies are trying to tell them. Using the IAOs during Outdoor Education sessions allows the children to be educated on their body signals, which then helps them regulate their emotions. As this is done during Outdoor Education the children are usually relaxed and receptive and let their defenses down."

"It works. I'm sure that skills that [child] has picked up [in biking and kayaking] are as a result of being more in tune with and listening to their body".

"The IAOs cross over with coaching very easily and very well. It's quite easy to do them with [child] because they're so responsive to coaching, and because they're listening to the coaching points, they're recognising what their body's doing, how their heart rate and breathing is affecting their ability to ride their bike."

4 Discussion

This exploratory research found that it was feasible for Outdoor Instructors to incorporate Interoceptive Awareness Opportunities (IAOs) into Outdoor Education

sessions. Importantly, children resistant to conventional therapy could be engaged successfully. Anecdotally, it appears that the IAOs may have helped increase children's awareness of their bodies.

4.1 Interoceptive Awareness

Due to the nature of interoception, there are many incidental overlaps between the activities in established Interoception curriculums (Goodall, 2020; Mahler et al., 2022; March & Mcauley, 2019) and the IAOs, with a lot of suggestions guiding attention to heart-rate, breathing, gastric sensations and muscular stretches. The notable difference with IAOs is the comparative subtlety with which they are introduced to children, whilst they are already immersed in an activity. This is ideal for children who are resistant to therapeutic approaches and reduces the likelihood that they will block further attempts to interact. The instructor and child can both explore and share what they are sensing, lowering the child's defensiveness. Everyone has interoceptive sensations, so it doesn't feel like another professional's attempt to intervene because of their mental health.

Some IAOs functioned well as light-hearted and fun challenges, allowing a chance for play that they may not have experienced as younger children, for example riding a bike very slowly, or trying to sense when another kayak has passed. The IAOs encourage curiosity and 'behavioural experiments' (Kube et al., 2020), for instance by seeing how far up a hill they have to cycle until they notice their heart rate. If the children chose to close their eyes, this facilitates internal focus and can bring salience to interoceptive sensations.

Focusing on the body in this way could enable genuine sensations to be noticed instead of habitual cognitive appraisals of the sensations, potentially initiating positive reappraisal (Garland, 2011). Conscious processing of interoceptive senses relies on integrating expectations and sensory experience. Widening perception of sensory input could enable more dynamic and accurate representations of interoceptive sensation. Within a predictive coding framework of interoception, this could shift attentional focus to observation of current bodily signals, rather than defaulting to expectations (Farb et al., 2015; Paulus et al., 2019).

4.2 Proprioception

Many of the IAOs involved muscular awareness, which could be categorised as proprioceptive rather than interoceptive. Proprioception is potentially more readily accessible and therefore a nice introduction to observing body signals. With practise they could become accustomed to noticing sensations and subsequently start detecting interoceptive experiences. Somatic awareness of proprioception and interoception have been combined for use within trauma therapy (Payne et al., 2015). The reports of engagement in IAOs seem to suggest gradual improvement in proprioceptive awareness, due to repeated prompting to discern sensations in their muscles whilst exercising.

4.3 Relaxation

Delivering IAOs facilitated moments for children to relish positive and relaxing sensory experiences, for example when lying back in a kayak. This could be valuable respite for a nervous system that has been under toxic stress due to early experiences (Bucci et al., 2016). Providing a rare opportunity to luxuriate in parasympathetic nervous system is beneficial, because in this physiological state of safety it is possible to become more receptive to social connection (Porges, 2022). During expeditions the children were more likely to reflect on behaviours that they wanted to change and become receptive to planning alternative strategies. A regulated nervous system allows a calm state of mind, which is necessary for these conversations to occur; a stressed brain defaults to habitual choices rather than more optimal decision-making based on rational goals (Soares et al., 2012).

4.4 Breathing

Control of breath is an ancient concept and research has extolled the merits of breathing exercises within therapeutic contexts (e.g. Jerath & Crawford, 2015). Many of the IAOs involved an awareness of breathing, such as experimenting with breathing rhythms during physical exertion to find the most sustainable pace. As well as facilitating personal achievement, associated with increased self-esteem (Conlon, Wilson, Gaffney & Stoker, 2018), this plants the seed that their emotional state can be altered by what they choose to do physically with their bodies, inferring that it's possible to have more autonomy over their moods.

The IAOs were developed with awareness of how breathing patterns can influence the autonomic nervous system, hence some IAOs enable children to discover the calming effect of long slow exhales (Jerath, Edry, Barnes & Jerath, 2006; Zaccaro, Piarulli, Laurino, Garbella, Menicucci, Neri et al., 2018). Children with a history of trauma can have dysregulated nervous systems (Boullier & Blair, 2018; Corrigan, Fisher & Nutt, 2011), so learning these skills to facilitate activation of the parasympathetic nervous system could be beneficial.

4.5 Retraining the brain – creating new associations

Interoceptive Awareness Opportunities are aiming to 'reprogramme' the brain's associations with bodily sensations, attenuating conditioned reactions if they have become maladaptive. The IAOs were aligned with relevant therapeutic theories i.e. gradual interoceptive exposure to develop new associations with interoceptive sensations (Boettcher et al., 2016; Garfinkel et al., 2016; Kube et al., 2020; Krupnik 2020; Paulus et al., 2019; Wilkinson et al., 2017). During IAOs children experience visceral sensations that could conceivably be related to anxiety or trauma, but at a tolerable level, presented within the neutral or positive emotional context of outdoor activities. The focus of the tasks primes a conscious awareness that any enhanced cardiac and respiratory sensations were exercise-induced.

Repeated physical exercise is thought to help anxiety by a similar mechanism; ‘retraining’ the brain to receive interoceptive sensations and associate them with neutral or positive causes. People learn through exposure to enhanced respiratory and cardiac sensations that these signals aren’t always ‘catastrophic’ (Asmundson, Fetzner, DeBoer, Powers, Otto & Smits, 2013). One young person could become emotionally aroused when cycling or walking uphill. However, with instructors sensitively tailoring a sustainable pace, discussing how to increase fitness and repeatedly introducing heart rate IAOs during calm emotional states over many months, they began to associate a raised heart rate with becoming physically fit.

IAOs bring attention to the physical reality of the moment. Attending to a range of sensory input is possibly helpful, because impaired ‘reality testing’ in PTSD is thought to impede adaptive updates to the brain’s interoceptive expectations (Linson & Friston). IAOs guided children to notice novel sensory experiences, such as being splashed by white water or feeling the pull of the current under their boat. Opportunities to discriminate and attend to sensory input (Kube et al., 2020) are made more readily available during IAOs, due to the novel and visceral experience of the outdoor activities.

The brain resilience hypothesis was postulated as a mechanism behind adventure therapy’s success (Allan et al., 2012) and echoes these concepts, albeit from another paradigm. Following ‘stress and recovery’ principles, gradual exposure and adaptive responses leads to positive change in mental health.

4.6 Is cognitive appraisal required?

Providing intense sensory input in a new context is thought to help diminish maladaptive negative associations to the sensory experience. Ideally, guidance from a therapist helps consolidate learning that the physiological signals don’t necessarily indicate danger (Kube et al., 2020). In the context of IAOs, children commented on their raised heart-rate and it was implicit that physical exertion had caused this, but they did not discuss other times in their lives when these body signals occurred due to a traumatic circumstance. The children are not always ready to have these conversations, so the IAOs were designed to be engaging and positive experiences. However, IAOs provide a natural entry point for these more difficult conversations, if a child was receptive.

The IAOs naturally generated discussions relating to how physical sensations are linked to emotions, for example overheating and anger. This insight could potentially lead to conversations about practical coping strategies for emotional regulation; learning that emotions can sometimes be regulated by simply manipulating how they feel in their body is a powerful lesson. If it is physically practised during Outdoor Education, it’s possible the somatic tools learned could be remembered and utilised in other contexts too.

Physical and somatic interventions could be a more direct way of ameliorating distressing associations with physiological experiences. They provide the brain with rich sensory information, enabling it to gradually become more tolerant to interoceptive

sensations that had been conditioned to an unpleasant emotional response, ultimately eliciting new associations. In an ideal therapeutic alliance, as well as a complementary cognitive element to the intervention, the interoceptive states that are particularly upsetting to an individual would be targeted (Paulus et al., 2019). However, if the children aren't ready or able to discuss how their mental health symptoms manifest physically, then a body-based intervention in isolation seems preferable to zero intervention. Additionally, a child with a physically regulated nervous system is more likely to feel safe enough to subsequently engage in formal Cognitive Behavioural Therapy, and increased emotional awareness would help this therapeutic process.

Other sources indicate that physical activity can change responses to anxiety sensations (Asmundson et al., 2013; Sabourin et al., 2015), and possibly exercise alone is sufficient to alter interoceptive processing (Wallman-Jones et al., 2021). This suggests it isn't necessary to have an overt conversation to benefit from a body-based intervention, indeed, some theorise that somatic approaches are more appropriate for trauma (Grabbe & Miller-Karas, 2018; Payne et al., 2015).

4.7 Limitations

4.7.1 Methodological

Implementation of IAOs was provided by 7 outdoor instructors, who delivered IAOs to just 2 consenting children. Although this is a tiny sample size, it was valuable to establish feasibility and to successfully engage a child who avoided conventional education and therapy.

Despite the underlying theories, it cannot be inferred that the children's interoception improved. Alongside descriptive records of child engagement in IAOs and instructor feedback, more formal measures were intended for data acquisition at monthly intervals:

- a) objective measure of cardiac interoceptive accuracy using the Phased Adjustment Task (PAT app; Plans, Ponzio, Morelli, Cario, Ring, Keating et al., 2021) on an iPhone;
- b) subjective measure of interoceptive awareness using the Multi-dimensional Assessment of Interoceptive Awareness for Youth (MAIA-Y; Jones, Silas, Todd, Stewart, Coulson & Mehling, 2020).

The children either declined consent to participate in the research measures, or did not engage consistently enough, therefore no formal data could be analysed.

4.7.2 Clinical implications

Recent literature suggests precise interoceptive interventions could be developed to diminish mental health symptoms (Jerath & Beveridge, 2020; Lavretsky & Feldman, 2021; Nord & Garfinkel, 2022). This could involve an assessment of specific interoceptive dysfunction prior to assigning bespoke techniques to mitigate symptoms. The children's individual interoceptive systems weren't assessed, and the instructors are not therapists. However, IAOs were designed to aid interoceptive

dysfunction in trauma and resultant mental health symptoms, so they are appropriately targeted to the demographic. Additionally, the Cognitive Behavioural Therapist could give guidance based on children's responses to IAOs.

4.7.3 Risks

Somatic interventions are not a panacea, and there are some risks associated with meditative practices, particularly for people with a history of trauma or mental health disorders (e.g. Van Dam et al., 2017). Interoceptive focus can induce panic symptoms if the bodily signals are catastrophised through cognitive evaluation or conditioned emotional association. Some mindfulness and meditation techniques can be aversive or stressful for people who have experienced trauma, if scanning for sensations in the body during stillness. They could end up focusing on a trauma-based sensation and dissociating, or experiencing a flashback (Treleaven, 2018), therefore instructors were advised to only deliver IAOs when children were emotionally settled and to never use coercion. Risk was minimized by consulting relevant professionals during the design phase (see Acknowledgements). IAOs are designed to focus on physical sensations that become visceral as children relate to and exercise in the natural environment. This has a grounding effect by promoting mindful awareness of the present moment, anchored within physical surroundings.

The complexities of discerning adaptive and maladaptive interoception have been considered (Farb et al., 2015; Hanley et al., 2017). The latter refers to dysregulated interoception, which manifests as hypervigilance and catastrophising over-responsiveness to bodily cues. To discern if different meditation styles were implicated in advantageous forms of interoceptive awareness, various facets of meditation have been discussed (Gibson, 2019). 'Focused attention' enhances interoceptive awareness, emotional literacy and could be a prerequisite for more mindful 'Open Monitoring' styles, however particular 'Focused attention' techniques can make some people uncomfortably aware of distressing sensations (Gibson, 2014, cited in Gibson, 2019).

There are aspects of 'Focused Attention' utilised in IAOs (focusing on a singular point i.e. heartbeat or the breath), under the advisories of gradual interoceptive exposure from the predictive coding literature. Instructors were aware that any IAOs involving interoceptive exposure concepts (i.e. heart rate awareness) needed to be very gentle and gradual (Lyndon & Corlett, 2020), ensuring the child could tolerate the sensations and become resilient to them.

4.8 Conclusion

4.8.1 Summary

It is feasible to incorporate IAOs within Outdoor Education and children who are resistant to conventional therapy can willingly engage. The experience of novel visceral sensations during the IAOs is thought to be beneficial for the children. IAOs could

function as a therapeutic tool to support children to become more aware of their bodies and promote mindful attention towards sensations.

To cite a metaphor used by a prestigious neuroscientist, if we “seed” our brains with novel sensory experiences, our brains will be enabled to predict differently in the future (Feldman Barret, L., 2017), so that different emotional “recipes” can be made using the new “ingredients” (Feldman Barret, L., 2018). In other words, interoceptive predictions will shift from our habituated *modus operandi* to a more adaptive state.

4.8.2 Integrating disciplines

The underlying concepts detailed in this article are derived from psychology, rather than guided by outdoor professionals. Therefore, despite consultation with instructors, there is the risk of diverging too far from naturalistic principles of simply enjoying life in nature, if contrived activities such as IAOs became too prescriptive.

However, when reviewing the history of adventure therapy that the models have reflected evolving approaches in clinical psychology, for instance psychotherapeutic (e.g. Stouffer, 1999) towards cognitive behavioural methods (e.g. Trundle & Hutchinson, 2020). Considering the recent surge of interest in interoception within the field of psychology, it could be prudent for adventure therapy as a discipline to utilise the inherently physical tasks within the outdoors as opportunities for interoceptive awareness, and for experts from both disciplines to collaborate for the benefit of children’s mental health.

5 Acknowledgements

5.1 Funding and collaboration

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Outdoor Education Instructors (Afon Goch). Instructors who contributed ideas for and/or delivered IAOs: Lynsey Evans, James Brake, Niamh Stack, Tom Kirby, Dom Richards, Rich Detton, Clare Oliver. Instructors provided feedback regarding feasibility, and ultimately trialed the programme. They were also carers of the children as part of their employment and trained in Therapeutic Crisis Intervention.

Consultant: A young person had engaged in over 4 years of Outdoor Education and experienced many different styles of coaching. They had developed excellent personal competence in the outdoors and related career prospects. It was valuable to have their insight during the process of reviewing every IAO prior to

implementation. Their useful feedback helped to discern which IAOs to set for particular children - they indicated which IAOs children would find appealing. They highlighted that IAOs that directly queried connection with emotional states may make some children disengage, suspicious that they are being drawn into a therapeutic conversation.

5.2 Consulted experts

Dr Lara Maister: 1st academic supervisor (Interoception researcher/lecturer, Bangor University). Lara suggested using a predictive coding framework for interoception could help to establish which aspects of interoception are dysfunctional in trauma-related mental health symptoms. The researcher aligned the IAOs with therapeutic recommendations from this published literature.

Dr Dawn Wimpory: 2nd academic supervisor (Bangor University). Dawn is a Consultant Clinical Child Psychologist (BCUHB) and has delivered workshops on body-based strategies for emotional regulation of children. She suggested amendments and extensions for some of the IAOs.

Kieran Mullin: Cognitive Behavioural Therapist (Afon Goch). Historically, Kieran is very experienced in working with Looked After Children as a support worker. He has been a CBT therapist at Afon Goch since 2014. Kieran reviewed the Interoceptive Awareness Opportunities for suitability on 03.02.21 and agreed they could complement a CBT approach.

Kelly Mahler: consulted expert (Mahler Autism Services). Kelly specialises in developing Interoceptive Awareness curricula for autistic children; her material is also used for traumatised children. Kelly has been in supportive correspondence with the researcher since the initial idea of IAOs was formulated.

Dr Terry Petrenchik: consulted expert (PhD, OTR/L, Director, Well & Ready Kids). Terry specialises in child and adolescent mental health, focusing on trauma and resilience. She is interested in developing interoceptive awareness interventions and has been in supportive email correspondence with the researcher.

Dr Sholto Radford: consulted expert (Clinical psychologist, BCUHB). Historically, Sholto has been a mindfulness teacher in outdoor settings and worked for an adventure therapy project for young people with trauma and psychosis. He advocated for opportunities for service-user involvement, which was incorporated into the protocol. Sholto emphasised the need for trauma-informed training for the instructors in relation to delivering the IAOs.

Dr Cynthia Price: consulted expert (Research Professor, University of Washington; Director, Centre for Mindful Body Awareness). Cynthia gave encouragement during the genesis of the idea for IAOs. Cynthia was positive in response to the draft IAOs and thought these would be appropriate for children and young people.

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