



**FACILITATING INTEROCEPTIVE AWARENESS AS A SELF-MANAGEMENT AND  
SELF-REGULATION TOOL TO INCREASE ENGAGEMENT IN LEARNING AND  
EDUCATION**

A Thesis submitted by

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## **Abstract**

Interoceptive awareness is the conscious perception or active noticing of one's internal body signals, such as muscle tension, bladder state, heart rate, etc. This mixed methods thesis examined whether teaching students to actively notice their internal body signals would increase self-management and self-regulation within the school context, the consequence of which would be a reduction in behaviours that were affecting teaching and learning. In addition, this thesis examined if there was any impact on engagement in learning and education as students developed their interoceptive awareness. Data were drawn from a one-year pilot with one school, and then a one-year trial with 11 schools in regional South Australia. The findings demonstrated a reduction in reported behavioural consequences across the schools, with qualitative findings detailing the impacts of learning interoceptive techniques for individuals and their own perceptions of their behaviours. This thesis utilised Siegel's (2010) hand model of the brain, in combination with a novel way of presenting the two branches of the autonomic nervous system, as a potential explanation for the findings that teaching interoceptive awareness increased engagement in learning and education, self-management, and self-regulation in the school context. The resultant model that was developed by the researcher is a clear visual that can support education staff to understand and respond to challenging behaviour more effectively and proactively across both high school and primary school contexts.

## **Thesis certification page**

This Thesis is entirely the work of Emma Lynne Goodall except where otherwise acknowledged.

The work is original and has not previously been submitted for any other award, except where acknowledged.

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## List of abbreviations

n.d.(no date) is used on page 10

IC (insular cortex) is used on page 12

ACC (anterior cingulate cortex) is used on page 12

IA (interoceptive awareness) is used on page 13

PTSD, (post-traumatic stress disorder) is used on pages 13, 14, 66, 88 and 90

ANS (autonomic nervous system), is used on pages 15 and 16

SNS (sympathetic nervous system) is used on pages 15, 16, 17 and 64

PNS (parasympathetic nervous system) is used on pages 15, 16, 17 and 64

CIHM (Center for Investigating Healthy Minds) is used on page 17

EDSAS (a software program used to record behavioural incidents and consequences in government schools in South Australia) is used on pages 26, 37 and 61

USA (United States of America) is used on page 29

SSO (school support officers/teaching assistants) is used on pages 39 and 61

NIT (non-instruction time) is used on page 63

PE (physical education) is used on page 65

ODK (a mobile data collection app) is used on page 77



## **Chapter 1: Introduction**

This research was instigated following requests from schools for support with students struggling to self-manage and self-regulate, resulting in poor engagement in learning. Delays or difficulties with self-management and self-regulation in children and young people come with a high cost to both those individuals themselves, as well as their peers, families, and involved professionals (Füstös et al., 2012; Moffitt, Poulton, & Caspi, 2013; Nigg, 2017; Slutske, Moffitt, Poulton, & Caspi, 2012). The concept of self-management refers to ongoing, dynamic, and adaptive behaviours, which are made as responses to internal states relating to biological homeostasis needs within the body. In contrast self-regulation refers to the individual's ability to control and helpfully express their own social-emotional needs and wants, thoughts, emotions, and actions (Heatherton & Tice, 1994). Conceptually, there is a distinction between self-management and self-regulation based in responses to internal states relating to biological homeostasis needs, but practically self-regulatory behaviours can arise from self-management needs. For example, Nigg (2017) highlighted that poor self-regulation arising from self-management demands is implicated in increased mental health difficulties, increased physical ill-health and lower life outcomes for children impacting social and academic outcomes.

Improving low levels of self-management and self-regulation in children and young people could address a wide range of negative impacts that arise in schools when children and young people are unable to behave in ways that are socially acceptable and actively engage in learning. Self-regulation enables children to engage in learning activities (Blair & Raver, 2015) and with poor self-regulation comes less engagement in learning and higher rates of internalising and externalising (disruptive) behaviours. Therefore, families and educators can struggle to manage children and young people who are highly dysregulated and unable to self-regulate.

In the case of this research, schools were concerned with high levels of take homes (unofficial suspensions whereby school's phone the parent and ask them to come and pick their

child up), suspensions, and exclusions; all of which temporarily cease all engagement with learning. Research indicates that fostering the development of self-regulation in early childhood offers the potential to ensure early education is effective for all children (Blair & Raver, 2015). However, to support families and educators there is a need within the literature on self-management and self-regulation to develop and deploy a theoretical framework to suggest why self-regulation may be under-developed and conversely how self-regulation may be effectively developed across a wide range of contexts.

Emotions and actions are widely understood to have a contextual element, in that individuals express emotions or carry out actions in response to their thoughts and/or their experience of the context around them (Wilutzky, 2015). Indeed, Grecucci, Koch, and Rumiati (2011) found that emotions can also impact imitative actions (e.g. if someone shouts loudly and excitedly, people around are more likely to shout loudly and excitedly back). Mayer, Salovey, and Caruso's (2008) conception of emotional intelligence has individuals engaging in complex information processing about their own and others' emotions, with behaviour guided by this processed information. To accurately process emotions, individuals need to be not only aware of their emotions but also able accurately interpret any given context in which the emotions are occurring. Both external and internal contexts impact the experience of and responses to emotions. This awareness is a key aspect of interoception.

### **Interoception**

Interoception is sometimes referred to as somatic awareness or somatic interoceptive awareness (Kanbara & Fukunaga, 2016), and colloquially known as the eighth sense (Mahler, 2017) with the other seven being; sight, hearing, taste, smell, touch, proprioception, and vestibular (Lynch & Simpson, 2004). While most people are familiar with sight, hearing, taste, smell, and touch, the vestibular and proprioception senses are less well known and are focussed on the awareness of the whole body. Vestibular refers to our sense of balance, which is governed by the

inner ear and proprioception refers to the sense of where our body is placed in space, for example where our head ends and space starts, which is useful to prevent us banging our heads on overhanging objects. Interoception can be described as mindful body awareness, as it is the conscious perception (mindful) of internal body signals (body awareness).

Interoception is the awareness of the physiological state of the body, possibly originating in the visceral organs. Interoception at a physiological and psychological level is implicated in maintaining homeostasis and regulating emotions (Badoud & Tsakiris, 2017). Much like the other senses, interoception has at least two components; interoceptive awareness and interoceptive accuracy (Cali et al., 2015). Interoceptive awareness refers to metacognitive abilities relating to an individual's bodily performance (Garfinkel et al., 2016), that is to say the individual is aware of their internal body signals in relation to the body's needs (for homeostasis) and wants (emotions). Researchers have currently referenced interoceptive accuracy - solely in relation to heartbeat detection, rather than more generally as accurate perception of the internal body signals. For example, Garfinkel et al. (2016) defined interoceptive accuracy as "performance on objective behavioural tests of heartbeat detection" (p.65). An example - the author's defined interoceptive accuracy a bit further on in the article as "objective accuracy in detecting internal bodily sensations". Whilst the facets explain different aspects of interoception, some argue there is no significant correlation between each of them, suggesting that interoception is not a single entity, but a concept with multiple dimensions (Meessen et al., 2016).

Interoceptive awareness can be broadly defined as the conscious perception of an internal bodily state, for example, one's heart beating and breathing. This definition can also apply to the mindful body awareness, the conscious noticing in the present moment of body signals. These senses are related to emotional experiences. Interoceptive awareness is the perception of internal body signals processed in the parts of the brain responsible for interoception. Mindful body awareness is the conscious choice to focus any internal body signals that arise when an individual

is purposefully noticing their body in the present moment. Awareness of physiological internal body cues is altered in individuals who are affected by trauma, including intergenerational trauma, and neurodevelopmental disabilities including autism (Mahler, 2017; Schauder et al., 2015). Against a background of the human species' survival instinct, including our biological need for and drive towards homeostasis, interoceptive awareness can be broadly split into three categories. These categories are; ability to notice internal body signals (Craig, 2002), ability to notice and interpret collections of body signals as emotions and feelings (Craig, 2009), and the ability to notice external signals and interpret the impact these will have on the body (Craig, 2009). Goodall (2019) designed Figure 1 as a visual depiction of the theoretical way the combination of these categories of interoceptive awareness (Craig, 2007) enable people to respond to their internal body signals and therefore in effect, understand themselves and develop the skills to self-regulate and self-manage.

**Figure 1**

*Aspects of interoceptive awareness (Goodall, 2019)*



Füstös et al. (2012) suggested that self-regulation of emotions is reliant on both attention to and awareness of one's emotional state, which could be linked to, or interpreted as interoception.

Self-regulation is commonly understood in education settings as the moderation or control of emotions and behaviour in order to follow social norms in context (Popham, Counts, Ryan, & Katsiyannis, 2018). This is sometimes referred to as self-control. Self-management on the other hand is related to the control of, or actioning of, behaviours in order to fulfil biological needs, usually in accordance with a drive to return to homeostasis (Craig, 2007). Self-management behaviours include; drinking water when thirsty or putting a sweater on when cold. Self-management is more obviously linked to homeostasis, as evidenced by the need for our bodies to be within a particular temperature range, have energy input through food and output through waste elimination, energy usage and muscle movement within given parameters.

Interoception skills are required for a range of basic and more advanced functions such as knowing when to go to the toilet, being aware that you are becoming angry or upset, and being able to manage your emotions proactively. Children and young people who have not yet developed interoception skills struggle with not only their own emotions (Brewer, Cook & Bird, 2016), but with social interactions and sometimes just being around others (Goodall et al., 2019). There is a significant gap in the literature in the relationship between interoception and emotional regulation, with research only looking at how interventions involving interoception are effective in ameliorating a range of mental health disorders' symptoms (Khoury et al., 2018). Furman et al. (2013) found that altered interoception in adults with major depression impacted the participants' ability to feel positive as well as their ability to make decisions based on interoceptive signals. However, there is a dearth of research on the impact of altered interoception on developing or improving interpersonal difficulties, self-regulation, social anxiety, or other behaviours in adults or children. It seems likely that children and young people with well-developed interoception are able to use both logic and emotions to respond to their environment, whereas those without tend to rely solely on logic and have to carefully think through their possible responses to each situation.

Thinking through each situation long term can be extremely tiring and can contribute to overload, shutdown, meltdowns, anxiety, and depression (Zener, 2019).

As discussed previously, demonstrating the contextual element of emotions and actions, individuals express emotions or carry out actions in response to their thoughts and/or their experience of the context around them (Wilutzky, 2015), including how people imitate the actions of those around them Grecucci et al., (2011). Goleman (1995) described emotional and behavioural self-regulation as top level skills in an emotional intelligence hierarchy. Goleman suggested that emotional intelligence, sometimes known as social intelligence, is composed of three skill sets; emotional skills, cognitive skills, and behaviour skills. When these theories are looked at in conjunction with metacognition, thinking about thinking (Moses & Baird, 1999; Wellman, 1985), the key role of interoception can be identified, as without interoception there can be no emotional awareness.

This thesis puts forward the idea that interoception can also be described as mindful body awareness, as it is the conscious perception (mindful) of internal body signals (body awareness). Mindfulness is a broad term, used in popular culture in a variety of ways. As a lifestyle concept mindfulness means to pay attention on purpose (Sher, 2016), in the present moment, and nonjudgmentally, whereas as a spiritual concept mindfulness can be used to mean being present and aware (Fox Lee, 2019). In this thesis, mindful body awareness rather than mindfulness, is the focus. Mindful body awareness is taken as purposeful attention in the present moment focused on changes and sensations within the body or self (interoception). This focused attention should guide the plasticity of the brain to create and strengthen interoceptive aware brain connections, as per the findings of Ahissar et al. (2009) that attention and working memory can drive neuroplasticity. Someone who is skilled at mindful body awareness, can for example, tell when their heartbeat is signalling fear versus excitement because they can notice and recognise all the other internal

bodily signals that they are experiencing which help them to process and respond to their overall emotional state. On a more basic level, interoception enables people to know when they are hungry, thirsty, tired etc., all of which are necessary precursors to positive development and self-regulation.

Kuhn et al., (2018) suggested that when young people can self-regulate their physiology, they may be able to decrease externalising behaviours. For this research awareness of pulse/heart rate was used in the interoception activity context as a very simple tool for students to learn about the variations in pulse/heart rate signalling different states. Students were provided with opportunities to monitor their heart rate manually or using a smart watch or pulse oximeter on their finger. Students were then able to use their pulse rate as a guide or signal for a change in their emotions..

Without interoception, it is probable that children and young people will be unable to develop metacognitive emotional abilities (Goodall, 2016). The following table from Goodall (2016), illustrates the links between metacognition, social-emotional intelligence, and interoception. From table 1 below it is clear that the role of interoceptive awareness in the highest level of emotional metacognition, i.e., being able to self-assess cognitive processes to direct personal behaviour (Wellman, 1985), is to notice and then manage internal body states and external responses, which demonstrates socio-emotional self-regulation.

**Table 1 (Adapted from Goodall, 2016)***Relationship between metacognition, emotional intelligence, and interoception*

Metacognition (Wellman, 1985)	Emotional intelligence as foundation to social-emotional skills (Goleman, 1995)			Interoception (mindful body awareness) (Goodall, 2016)
	Emotional skills	Cognitive skills	Behaviour skills	
Knowledge that mental states exist	Labelling feelings	Self-talk	Non-verbal communication	Noticing internal body states
Knowledge that there are distinct mental processes	Expressing feelings	Understanding social cues and how others perceive you	Effective verbal communication	Recognising and naming internal body states
Knowledge that these distinct processes are a function of cognition	Identifying feelings as responses to stimuli	Being able to problem solve in response to impulses and anticipating consequences.	Control of impulses	Understanding the link between internal body states and feelings/emotions.
Knowledge that cognition is influenced by context	Understanding and responding to intensity of feelings	Understanding the perspectives of others and societal norms.		Understanding effects of others and wider environment on self, and feelings/emotions.
Being able to self-assess cognitive process to direct personal behaviour.	Emotional self-regulation	Self-awareness	Behavioural self-regulation	a. Managing responses of internal body states to external stimuli b. Socio-emotional self-regulation

Table 1 highlights the links between increasing levels of metacognition and emotional intelligence skills, where the skill of self-assessing cognitive process is used to direct personal behaviour, which equates with both emotional and behavioural self-regulation which is the highest skill in interoception. The table also illustrates the parallels between the levels of metacognition and interoception, where both start with knowing and noticing mental states then end with self-regulation. However, in Goleman's (1995) summary of the stages of emotional intelligence, labelling feelings is listed as the first stage. None the less, taking interoception into account, it is clear that there are foundational steps required, prior to being able to label feelings, that of



noticing and recognising individual internal body signals and then accurately recognising and interpreting collections of internal body signals as feelings and emotions. This may go some way to explain why in the general school population, it is evident that there is a huge variance in socio-emotional self-regulation, with observations throughout this research demonstrating that many students are unable to notice and/or unable to accurately label feelings and emotions. Additionally, it is known that students who have experienced poverty and/or chronic stress are known to have attenuated self-regulation (Evans & Kim, 2013). The other cohort with known reduction in self-regulation are those with mental illnesses. When experiencing mental illness, people can respond atypically to internal and external stimuli. Zamariola et al. (2019) in talking about people with depression, stated that “people with low interoceptive abilities show more difficulties in verbalizing their feelings and in decreasing the impact of emotions generated by negative experiences in daily life” (p. 480). The schools in the present research were requesting assistance due to the high numbers of students within their schools who were struggling with emotional self-regulation.

### **Interoceptive atypicality**

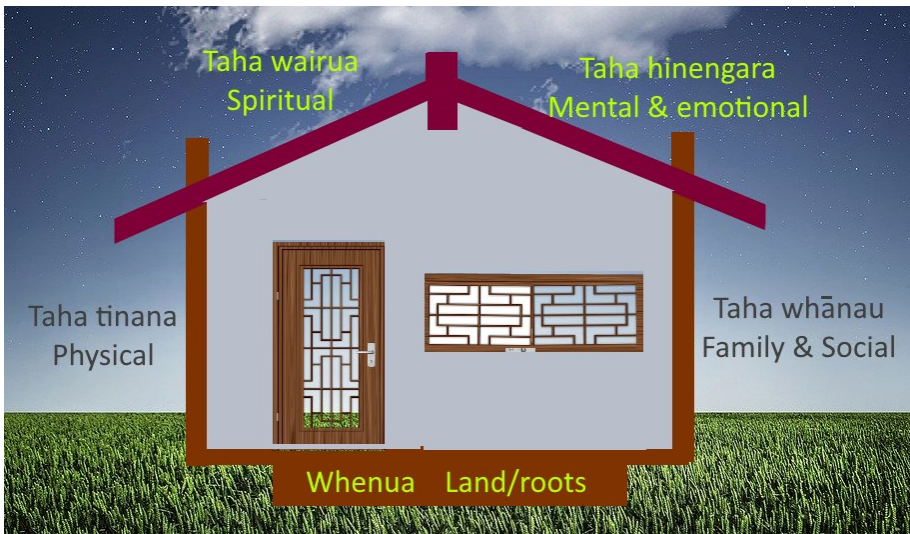
Interoceptive atypicality is implicated in many psychological and developmental disorders such as Autism Spectrum Disorder, Anxiety, Depression, Schizophrenia, Eating Disorders, and Alexithymia, many of which are characterised by difficulties with self-management and or self-regulation. Neurodiverse individuals tend to show a variety of differences in interoceptive accuracy and awareness (Badoud & Tsakiris, 2017). Due to the involvement of interoception in so many psychological conditions, it has been proposed that it could be the underlying factor of many psychiatric disorders (Murphy et al., 2017). Indeed, poor interoception is implicated in poor self-regulation, which as Nigg (2017) reported is also implicated in psychological and developmental disorders. Targeting interoceptive abilities early in development may be an effective way to

decrease the risk of developing psychological disorders later in life, by increasing the ability of individuals to self-regulate through facilitating their awareness of their internal body states, feelings, and emotions. Indeed, in Mayer et al's. (2008) four branch model of emotional intelligence, interoception is a precursor to all four branches, indicating that improving interoception will increase emotional intelligence overall, as well increasing the ability to self-regulate.

Yehuda et al. (2016) showed that preconception parental trauma was associated with epigenetic alterations in both the exposed parent and their children. They found “an intergenerational epigenetic priming of the physiological response to stress in offspring of highly traumatized individuals” (p. 379). In the context of Aboriginal peoples, Canadian research has highlighted the complex contexts that contribute to the intergenerational transmission of trauma in Aboriginal/First Nations people (Aguiar & Halseth, 2015). Nathan (2015, p. 371) writes about the “hurting hearts that are endemic in the post-colonial trauma” of Aboriginal Australians. Hurting hearts is a concept that may not resonate with behaviour coaches or teachers as a possible cause of difficulties with self-regulation, but sits well with understandings of Māori (*Te Whare Tapa Whā*) and Pacific Island models of health and well-being which are more holistic than dominant culture models of health and/or well-being in Australia. Whilst hurting hearts is a cultural concept that crosses a number of cultures, it is not a typical part of mainstream Australian culture. These models provide a framework for understanding the relationship between context and well-being, including emotional health. Emotional health is based on the ability to recognise and manage your emotions, as shown in figures 2 and 3 on the following page.

**Figure 2**

*Māori Health Model*



*Note.* this is adapted from Durie (n.d.)

**Figure 3**

*Pasifika Health Model*



*Note.* This figure is adapted from Pulotu-Endemann (2007).

The Māori model includes; wairua (spirit or spiritual), the role of the whānau (family) and the balance of the hinengaro (mind) as well as the tinana (body or physical manifestations of illness). Pulotu-Endemann's (2007) Pacific model includes even more domains that show the cultural links between health and well-being in ways that more closely reflect Aboriginal Australian cultures. If well-being is understood as positive psychosocial functioning, then self-regulation is an antecedent to well-being (Balzarotti et al., 2016), which in the above models fits into and impacts; relationships/family, spiritual, physical, and mental health, implying the benefits of self-regulation go beyond being able to behave in acceptable ways in school settings.

Individuals with neurodevelopmental disabilities are currently presenting with a higher risk of mental health disorders, possibly due to their interoception difficulties underlying their self-regulation difficulties. However, many mental health difficulties may remain underdiagnosed, potentially due to overshadowing of the initial developmental disability diagnosis (Holub et al., 2018). It has been estimated that approximately 30-50% of those with a developmental disorder have a co-occurring mental health issue (Holub et al., 2018). This underdiagnosis may be one of the reasons that individuals with neurodevelopmental disabilities may be perceived of as being dysregulated or deliberately naughty, as opposed to being in need of support to identify and manage their emotions.

One example of this is the high rates of anxiety seen in those on the Autism Spectrum, which is seen as a common symptom of the neurodevelopmental condition (Garfinkel et al., 2016). Furthermore, around 50% of autistic individuals also experience alexithymia, which is characterised by atypical emotional expression and recognition (Mul et al., 2018; Murphy et al., 2017). Thus, if interoception is involved in mental health disorders, and those with developmental disabilities are more at risk, they should be a target population for interoceptive activities in order to minimise future mental health issues.

On a neuroanatomical level, interoception has mostly been linked to two key cortical areas; the insular cortex (IC) and the anterior cingulate cortex (ACC) (Badoud & Tsakiris, 2017). The IC is thought to be the “hub” of interoception, integrating physiological and emotional perception whilst the ACC is also implicated in the perception of interoceptive signals (Couto et al., 2015). However, there is evidence to suggest that the IC and ACC are not the only areas involved in interoception, but that the medial temporal lobe is also critical in this sense. Berriman et al. (2016)’s animal lesion study supported this theory when it discovered that removal of the hippocampus was followed by dysregulation of hunger and satiety.

### **Behaviour and self-regulation**

Behaviour, including self-regulation of behaviours and emotions, are assumed to be a product of brain systems and thus can be changed through changing the brain systems according to neuroplasticity (Nahum et al., 2013). This Masters’ research is principally investigating how to effectively facilitate the development of self-regulation, using the concept of neuroplasticity, in students who are unable to manage their emotions and so exhibit behaviours that are challenging and/or harmful to themselves and/or others. Langner, Leiberg, Hoffstaedter, & Eickhoff (2018) suggest that self-regulation refers to the individual’s ability to control their own thoughts, emotions, and actions in the pursuit of higher order goals.

Due to the paucity of research concerning the role of poor or atypical interoceptive awareness in self-regulation, it has not been possible to confirm the role of interoception in difficulties in self-regulation or the presentation of challenging behaviour. The University of Southern Queensland’s library was searched, with the search restricted to title only for articles and books that contained both of the terms interoception and self-regulation in order to ensure that items would be focused on the interaction between these two terms. This search only found two

journal articles (Gannon, 1977, Weiss et al., 2014) and a book (Mahler, 2017). Mahler (2017) posited that interoception was a key skill in developing the ability to self-manage in areas of toileting etc. that occupational therapists focus on for children on the autism spectrum. Weiss et al. (2014) was only concerned with the link between interoception and pain perception and not a wider emotional regulation. This gap in the literature is surprising as Füstös et al., in 2012 stated that “one prerequisite of successful emotion regulation is the awareness of emotional states, which in turn is associated with the awareness of bodily signals [interoceptive awareness (IA)]” (p. 911).

Mehling et al.’s. (2018) research with war veterans with diagnosed PTSD, who were struggling to appropriately self-regulate, found that a 12-week integrative exercise program using aerobic and resistance exercise with mindfulness-based principles and yoga significantly improved mindfulness, interoceptive awareness, positive states of mind, and self-regulation. This research aimed to improve interoceptive awareness through a holistic approach centred on integrative exercise. The rationale for improving interoceptive awareness was the idea that this would lead to improved interoceptive processing, which is known to be altered in individuals with PTSD (Lanius et al., 2015; Nicholson et al., 2016; Simmons et al., 2009).

Gross and Thompson (2007) proposed a model of emotion regulation in which people rely upon the constant cognitive reappraisal of emotional state to modulate early emotional response tendencies, before these emotions become extreme and lead to more extreme emotional responses or expression. Theoretically, self-regulation should be able to be improved in individuals using a principle of neuroplasticity, of using directed attention to create and strengthen brain connections during activities that direct attention to internal body states (mindful body awareness or interoception). Neuroplasticity describes how the brain’s connectivity improves, and structural changes occur with new learning. Learning that is designed to support such brain changes in relation to individual challenges or difficulties. For example, Farb et al., (2013) found improved

functional connectivity between the posterior and anterior insula have also been observed following interventions. As the individuals improve their interoception they are therefore able to cognitively appraise and reappraise their emotional states, leading to improved ability to self-regulate. This may mean that young people with trauma or intergenerational trauma who frequently exhibit low levels of self-regulation, may be able to develop higher levels of self-regulation following focused interventions.

### **Interoceptive awareness and education**

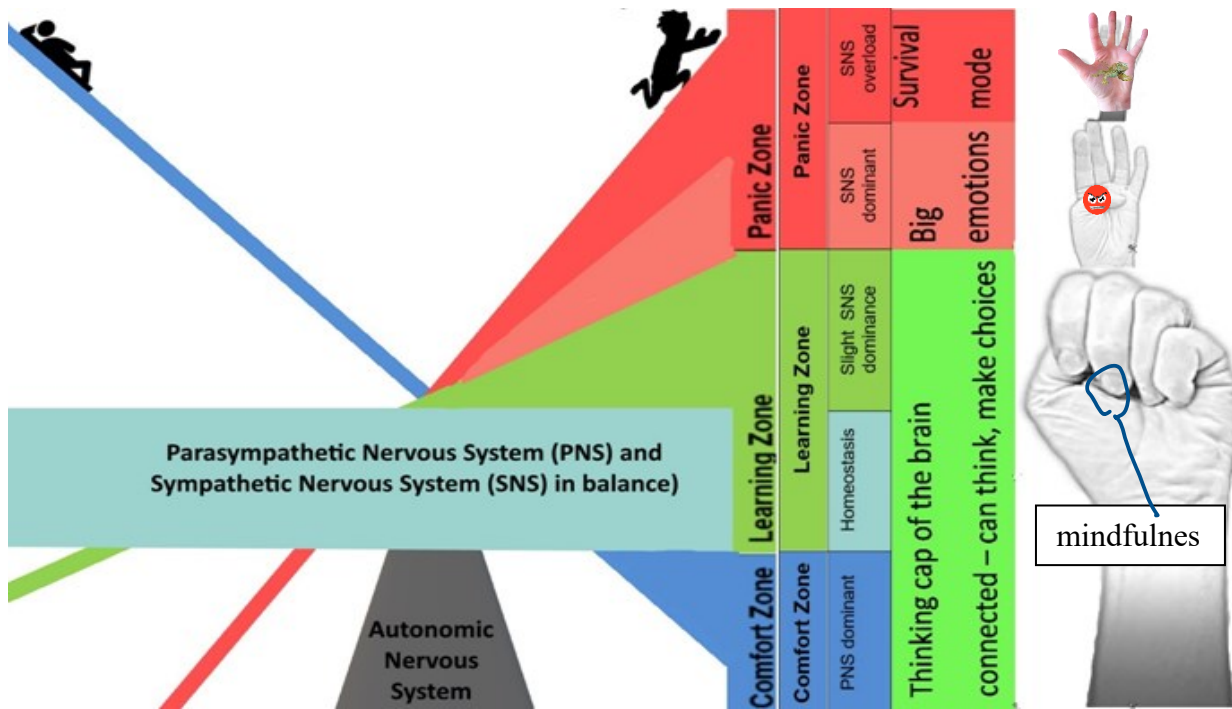
The current research aims to address part of this gap in the literature by tracking self-regulation and behaviour and interoceptive awareness in children and young people practising interoception activities. In previous work (see for example Goodall, 2019), observations of children and young people with complex needs indicated a lack of recognition of their own emotional states or feelings, until and unless these feelings were extreme. These observations and follow up conversations indicated poor interoceptive awareness in these children and young people. For example, not seeming to notice they were angry until they were enraged, nor noticing thirst until they were dehydrated. This lack of connection to self could be explained by either poor interoceptive accuracy or more likely poor interoceptive awareness. The link between interoceptive awareness and mindfulness, in relation to sense of self, can be found in research on the embodied sense of self (Cook-Cottone, 2015; Craig, 2003, 2009; Damasio, 1999). Damasio (1999) proposed that human awareness of and experience of emotional feelings are reliant on neural states that represent internal body signals, with collections of body signals evoking feeling states/emotions that influence both cognition and behaviour. If, for example, individuals were not noticing their emotional states, this would be why they didn't do anything about it, and once they were aware, it was too late to do anything about it as they were in sympathetic nervous system overload/survival mode (Goodall, 2019).

In Figure 4 below, the proposed theoretical link between emotional arousal, state of the autonomic nervous system, and Siegel's (2010) hand model of the brain are shown. In Siegel's model, the middle two fingernails represent the mindfulness part of the brain, which can only be engaged when the fist is fully closed and the 'thinking cap of the brain' is engaged. The thinking cap of the brain is how Siegel (2010) describes the neocortex when it is functioning optimally as it enables individuals to actively learn and make choices about how they respond to both their internal body signals and the external context around them. As interoceptive awareness is the conscious perception of internal body signals, this model equates it with mindful body awareness (Goodall, 2016). Theoretically, engaging in mindful body awareness (interoception) activities will engage the mindfulness part of the brain, leading to the thinking cap of the brain also being engaged and the parasympathetic nervous system being activated, which would enable self-regulation. When individuals are in sympathetic nervous system overload, otherwise known as survival mode, they cannot self-regulate their emotions as the brain's survival instinct takes over (Siegel, 2010). Figure 4 presents previous work done by Goodall (2019) combining the thinking cap of the brain, emotional brain and survival/reptile brain from Siegel's hand model of the brain with levels of autonomic nervous system activity. This figure puts forward a simple model, developed by Goodall (2019) in regards to how the two branches of the autonomic nervous system (ANS), the sympathetic nervous system (SNS) and parasympathetic nervous system (PNS), can impact on the brain resulting in changes in behavioural 'zones'; learning zone, big emotions and survival zone. In this model, students are unable to control their behaviours or regulate their emotions in the panic zone, as their survival instinct has overtaken conscious thought, resulting in behaviours that can be challenging to themselves and/or others. Interoception enables people to self-regulate as they know when they are heading towards the panic zone, enabling them to do something to prevent themselves entering the panic zone. Siegel (2010) put forward the idea that when the limbic brain or the survival brain are in control, they govern the



individual's behaviour, via instinct, with rational thought only possible when the neocortex is in control. Goodall (2019) suggested that this control was governed by the balance of the ANS, with strong SNS dominance activating the limbic brain and SNS overload activating the survival brain.

**Figure 4**



*Zones of regulation and understanding behaviour*

*Note.* Source Goodall, Department for Education (2019, p.3)

In interpreting the figure above, it is clear that one cannot experience mindfulness without the thinking cap of the brain being connected, implying that when being mindful, the PNS is activated and the person is neurologically calmed. Pascoe and Crewther (2017) found that meditation activates the PNS, reducing anxiety symptomology, whilst Zitron and Gao (2017) reported that mindfulness activates the PNS.

Research demonstrates that mindfulness leads to improvement for people with disabilities in relation to their experience of depression and anxiety, as well as improving self-compassion and compassion for others (see for example Idusohan-Moizer et al., 2015). In a pilot study, researchers

from the Center for Investigating Healthy Minds (CIHM) at the Waisman Center, University of Wisconsin-Madison taught teachers, children, and young people in the Madison Metropolitan School District mindfulness. Flook et al. (2015) reported that children and young people in the research group said they felt more in control and responsible for their actions. An explanation for this could be as per Siegel's (2010) hand model of the brain, that individuals are not in control of their actions when they are in 'big emotions or panic zone' and mindfulness can only occur when the thinking cap of the brain, the neocortex, is connected and active. Their teachers suggested that the children and young people in this mindfulness training research made fewer errors whilst demonstrating improved use of strategy in problem solving tasks involving working memory and improved emotion regulation. The CIHM also looked at preschools and teaching kindness and compassion through mindfulness and found that these children and young people showed greater improvements in social competence as well as higher levels of learning, health, and social-emotional development, whereas the control group exhibited more selfish behaviour over time (Flook et al., 2015). This suggests that it may be possible to teach emotional and behavioural self-regulation through mindful body awareness/interoception activities.

In seeking to improve psychosocial functioning through improving interoception in school students, it is accepted that this will require the students to learn new skills and create new brain connections at their current age, as opposed to during very early childhood. As a research field, neuroplasticity has challenged the prior belief that the human brain could not create new connections or neurons (neurogenesis) after very early childhood (Eriksson et al., 1998). The principle finding of research into neurogenesis and neuroplasticity is that the human brain can create new connections and in effect learn new skills throughout the lifespan, and that even significant damage to the brain can, with effective therapies, rewire itself to compensate or mitigate the damage. The brain's connectivity thereby improves, and structural changes can occur with new learning and that new learning can support such changes designed to address individual

challenges or difficulties. For example, improved functional connectivity between the posterior and anterior insula have also been observed following interventions (Farb et al., 2013).

There is however currently a lack of research literature investigating the implications or applicability of neuroplasticity in teaching and education systems, with Iuculano et al. (2015) being a notable exception. Iuculano et al. found that cognitive training for individuals with a diagnosed mathematical learning disability, in addition to improving individual mathematical skills, changed the structures of participants' brains, so that they were indistinguishable from their peers without mathematical learning difficulties. However, such cognitive training could have key implications for student learning and management of their own behaviour. Principles of neuroplasticity suggest that through feedback mechanisms within the brain, the representation of information selectively enables plastic changes that affect brain connections (Nahum et al., 2013). For example, the events held in and attended to by working memory, selectively guide individuals to certain activities which sharpen and refine brain connections through learning (Ahissar et al., 2009). Neuroplasticity is "primarily expressed by a change in connectional strength at the synapse level, achieved both by increasing the powers and the numbers of synapses specifically supporting a progressively improving behaviour (Nahum et al., 2013, p144). This idea is encapsulated in the iconic phrase "what fires together wires together", coined by Hebb (1949). These principles of neuroplasticity have also been implicated in teaching individuals with diagnoses of post-traumatic stress disorder to self-regulate behaviour (Mehling et al., 2018).

The literature review of interoception research in the areas of occupational therapy, psychiatry, and psychology led to the research questions for the current proposed research. The research is focused solely on interoceptive awareness, which is the ability to consciously perceive and process internal body signals. The current research proposes that increasing interoceptive awareness in children and young people in schools would lead to a decrease in challenging

behaviours and subsequently an increase in engagement with learning. This research therefore aims to evaluate whether teaching children and young people interoception through activities that guide them to notice their internal body signals will decrease challenging behaviour in schools in line with the research on self-management (Craig, 2007) and on self-regulation of emotions (Füstös et al., 2012).

In addressing these core aims to increase self-regulation of emotions and decrease challenging emotions, this thesis will analyse data from a year-long pilot and then a year-long trial of an interoception program involving 11 regional schools. The thesis presents a mixed-methods analysis of interoception training trials delivered in the twelve schools, the pilot and the other 11 schools. It will also present a theoretical framework as to why facilitating interoceptive awareness in children and young people seems to be an effective self-management and self-regulation tool. As self-regulation requires “awareness of one’s emotional and bodily state, it can be followed that a high awareness of interoceptive signals might facilitate emotion regulation by supporting the detection of early bodily reactions in response to emotional stimuli” (Füstös et al., 2012, p. 912). The thesis also proposes to evaluate whether these interoception activities may also increase engagement in learning in schools. This framework, illustrated in Figure 4, draws on existing fragmented neuroscience and neuroplasticity, psychology, and occupational therapy research to put forward a practical strategy for schools and families to support the development of self-regulation in children and young people with complex needs and behaviours. In the policies and programs of education systems in Australia there is limited conscious practical application of fundamental neuroplasticity principles. It is possible that prior research and knowledge boundaries between the fields of psychology and education may have fostered a sense that neuroscience is not relevant to educators. The data for the present thesis is gathered from schools following neuroscience research-based training sessions that aimed to foster a deeper understanding of why traditional approaches to behaviour have not worked for all children and young people and replace

these with positive interoception strategies, that may be able to prevent difficult behaviours occurring. In particular, schools were provided with professional development based around figure 4, explaining the hand model of the brain, and how increasing stress/distress, with increasing SNS activation can lead to survival behaviours that young people cannot control. It was observed how presenting survival behaviours; flight, freeze, flop/drop, and fight, are often perceived of as challenging at worst and dysregulated at best in the education setting. As a consequence, students were often removed from the classroom or school for the remainder of the day at best, or suspended or even excluded, interrupting their education. What follows is a mixed-methods study that presents the findings from 12 schools, the pilot and then 11 further schools, and the recorded impact on both individual reported perceptions and the behavioural consequences recorded over a complete school year.

The overall aim of the thesis is to present the proposed model of behaviour that links the hand model of the brain (Siegel, 2010) with a basic explanation of the autonomic nervous system and interoception, with specific research questions being:

1. Will engaging in interoceptive awareness activities increase self-regulation skills?
2. Will participation in the intervention improve self-regulation skills and decrease challenging behaviours and improve engagement in learning and education?
3. Will participation in the intervention decrease challenging behaviour across both primary schools and high schools?
4. Are teachers able and happy to teach students to improve their interoceptive awareness and self-regulation skills using the provided short interoception activities, designed to prompt conscious perception of internal body signals through body state change?

## Chapter 2: Research Methodology

The researcher analysed existing data in this mixed methods study. The data was gathered during the implementation of two, year-long interoception in education trials across a number of schools in South Australia. Accordingly, this thesis presents an initial year-long pilot study undertaken in one large regional primary school with encouraging results. Second, qualitative and quantitative elements of a year-long study that was then undertaken with all schools and pre-schools in a regional town in South Australia is presented. Since these studies interoception training has been rolled out to over 250 schools and preschools across the state and is also being used in schools in the Northern Territory and New Zealand.

Mixed methods research is that in which the researcher collects and analyses both quantitative and qualitative data to examine the research question from both a statistical and humanistic perspectives (Tashakkori & Creswell, 2007). The rationale for using a mixed methods design for the current research was to be able to methodologically triangulate the data sets using both qualitative and quantitative analysis to offset potential limitations or bias (Creamer, 2018). This approach sought to maximise the usefulness and interpretability of the research findings. An additional aspect for triangulation within this project was participant triangulation; the experience of users; students, teachers, and families. Analysing qualitative data, values, shares, and respects the diversity of input from participants, to enrich the research process (Sousa & Clark, 2018). Authenticity of diverse voices was assured through the use of member checking (Birt et al., 2016). Member checking ensured participants were able to check that the researcher has understood and represented the participants accurately.

Mixed methods are a strength in this work as qualitative data enables an exploration of the experiences of individuals, while the quantitative data provides an indication of the broader

impacts in terms of patterns of interoceptive improvement, such as the attitudes of the students and staff to doing the interoception activities and their interpretations of these. McCrudden et al. (2019) suggest that pragmatism is the main reason for choosing mixed methods in educational psychology inquiry. In this specific case, the mixed methods are useful for both data analysis to determine funding provisions and to inform training for schools going forward.

The research presented in this thesis comprised a pilot study followed by two other empirical studies:

- Pilot study – mixed methods analysis of the practical application of interoceptive awareness teaching in a large regional primary school;
- Study one: Quantitative analysis of behavioural incidents in 11 schools across a school year for each school; using a chi-square test as this enabled evaluation of both dichotomous independent variables, and of multiple group studies (McHugh, 2013)
- Study two: Qualitative analysis of the experiences of interoception activities amongst students, teachers, and parents through semi-structured interviews, field notes, and drawings and written information from the students.

Ethical approval was granted by the University of Southern Queensland, approval number H19REA177 (15th July, 2019). Data was collected as part of everyday work within the South Australian Department for Education, informed consent was collected for de-identified data to be used publicly.

### **Study design and development**

Initially, a pilot study was conducted with one large regional primary school, the leadership of whom negotiated with the researcher to trial the whole school implementation of interoception activities. This was to ascertain if such activities increased the ability of students to self-manage and self-regulate, with the aim of decreasing behaviours that were challenging. Leadership from

this pilot study school had approached the researcher, following their implementation of trauma informed teaching and learning pedagogy. Implementing this trauma informed pedagogy had not resulted in the improvements in learning engagement and decreases in externalising behaviours that they were seeking. The school selected for the trial decided that all class teachers would teach a couple of interoception activities daily as well as creating a bespoke interoception room, which they elected to call 'The Nest'. The Nest was set up in a previously unused classroom, which students were free to visit when they wanted to engage in more interoception in line with the fourth model of interoception in schools, which gave provision for in class teaching across whole school at least twice a day, plus use of an interoception room.

Following on from information about the pilot trial being given to Department for Education Principal Consultant,, all the schools in an entire regional town requested an interoception implementation trial citing significant levels of disengagement in learning. In this town this disengagement was demonstrated through by high numbers of take homes, suspensions, and exclusions and 'other consequences', such as time out or removal from class.

There are a number of different outcomes for behaviours identified by schools as problematic. Take homes are when the parent/guardian of a student is asked to come and collect them from school and take them home. These are seen as a lower level consequence than a suspension, which is a formal removal of a student from school for a set number of days. The days are determined by the principal and the parent is informed by letter. An exclusion is the most serious and significant consequence, which last for a period of weeks, often to the end of a current term. Sometimes an exclusion is permanent from that particular school, and the family or education department need to find the student another school. Other consequences are minor consequences that involve a student being removed from their classroom, thereby interrupting access to learning. For example, sitting outside the classroom or in the front office, talking to the principal, having time out etc. All schools provided their data on these outcomes to the researchers



as part of the monitoring and feedback process for the interoception implementation. Baseline data on these outcomes from these schools was also provided for the previous school year. Decreases or increases in challenging behaviour would be apparent in the school provided data for each type of behaviour outcome.

Prior to the implementation of the school wide interoception program there were meetings between the researcher and school leadership, regional support services, and regional education management. At these initial meetings the theoretical links between interoception and behaviour were explained, and the four models of implementation discussed (see next page for details of the four models of implementation). It was made clear that interoception is a complement to quality differentiated teaching and does not replace it. Once each school had chosen a model of implementation, whole school professional development and an interoception curriculum were provided for the schools. Ongoing implementation support was provided by the researcher via in-person visits to the school twice a term with supplementary professional development provided as needed. There was no financial cost to the schools.

School leadership voted at a regional level to sign up to the trial and individual staff were given opportunities to opt out during the initial stages of implementation. Each school chose the model of interoception implementation, that the staff in conjunction with leadership were most comfortable with, following on from the delivery of professional development and discussions with leadership at each school. Where schools chose to implement model four, they were supported by the researcher to set up the interoception room and monitor how it was run and managed.

The professional development for teachers was stylistically updated during the trial on an iterative basis, to ensure that the sessions were as engaging as possible, whilst enabling staff to develop an understanding of the biological basis of self-management and self-regulation, what interoception is, and how to teach interoceptive awareness. Schools were also provided with an

interoception explanation, tracking sheet and activities in hard copy and electronically; see Appendix A. Over the course of the trial, all school staff, including teaching assistants/school support officers, also received training to highlight the biological and neurological links to behaviour; Dan Siegel's 'Hand Model of the Brain' and a see-saw model of the autonomic nervous system, as represented in figure 4, chapter 1. The researcher delivered ongoing 'problem solving' professional development sessions twice a term where staff could discuss barriers to implementation and possible solutions.

All schools agreed to collect and share specific data with the researcher, to evaluate the efficacy and implementation of interoception teaching. Baseline data across a variety of aspects was collected for a minimum of ten students in each school, and a maximum of two students per class. This data will be presented for the pilot school, but not for the regional trial. This is because the transient nature of the student cohort was problematic in terms of collecting a year's worth of detailed data on specific students.

Students contributing to data collection were selected by the school due to their low engagement in learning and/or their difficulties with self-management and self-regulation. The number of students chosen were balanced with the limited amount of research time available for the project, but with a need to have a large enough sample that data collected was meaningful. The researcher was provided with de-identified data on these students at the trial school. Baseline and subsequent data collections included; interoception skills tracking sheet, behavioural data (behaviour incident outcome and incident) as recorded on the Department for Education and Child Development behaviour tracking software, and engagement as recorded via time trial observations in the students' classrooms on a proforma provided by the teacher that had 10 second intervals marked with choices of on task, off task, most of class off task and a space for context (lesson, teacher etc). Both quantitative and qualitative data were collected at the end of each school term across a year in both the pilot and the regional trial, with input from students and staff around

what they think interoception is and what, if any, impacts learning interoception has had on them/their students.

Data collection planned	Method/tool	Training needed	Time point to be used
Interoception - awareness	Bespoke interoception tracking sheet (in appendix B)	Researcher to model how to use with range of students	Baseline and ongoing over school year
Engagement in learning	Time trial observation proforma	Researcher to model how to use	Baseline and then once per term during same lesson with same teacher
Behaviour data	School's database of behaviour consequences and reports	None	Provided termly

### **The intervention**

In order to collect meaningful data, a decision was made within the South Australian Department for Education that the trial should have some consistent elements, even though the settings were varied. The consistent elements related to both the professional development used to introduce staff to interoception, the interoception activities provided, and the four models of implementation that schools could choose from. The aim of the intervention was to decrease behaviours that were negatively impacting teaching and learning as measured by school data on behaviour consequences. This data was recorded on software referred to as EDSAS. The consequences were; take homes, suspensions, exclusions, and 'other consequences'. More specifically the consistent elements for the implementation were:

- Whole of site staff training;
- Provision of a set of interoception activities to be used in implementation;
- Proforma for data collection;

- Termly ongoing support via face to face visits with the school, including classroom observations and meeting with the interoception trial lead teacher at each school.

These elements aimed to improve consistency and fidelity by ensuring that all school staff had a shared understanding of interoception and how it was related to self-regulation of emotions and behaviour as well as a shared understanding of the interoception activities and how to teach these.

The four models of delivery that schools could choose from were:

1. In class teaching for individual classes at least twice a day;
2. In class teaching across whole school at least twice a day;
3. In class teaching across whole school at least twice a day, with additional specific groups of intensive interoception;
4. In class teaching across whole school at least twice a day, plus use of an interoception room.

During staff training and on data collection forms it was made clear that the development of skills in interoception were complementary to quality differentiated teaching and not intended to replace this, through directly stating this. Pre-intervention discussions between the researcher and school principals indicated that the principals thought that challenging behaviour may increase when students' learning needs were not being met through quality differentiated teaching.

However, these discussions also highlighted a sentiment that no matter how well some teachers were teaching, some students were unable to manage their emotions and behaviour.

Additional resourcing was not required to implement models one and two, and existing additional funding was able to be used for models three and four to provide staffing for groups and/or an interoception room. Interoception rooms could be modified sensory rooms in schools that had a sensory room, or repurposed space if the school did not already have a sensory room. If

a site chose to open an interoception room, additional support was provided by the researcher to ensure the rooms contained specific elements and consistent data was collected across the state. The rooms needed to contain: a table at the entrance with a book for the students to sign in and the staff to note what time individual students arrived, what lesson from, if they brought work with them or not (and if they did, whether or not they understood that work), and how long the student stayed before going back to class; an area for guided/independent interoception activities; an optional sensory/fine motor activities area; and an area to complete the work the students had brought with them from their classroom.

Further training was provided to each site on how to use the room with an agreement made that:

- If a child/student requested to use the room they had to be allowed to;
- If a teacher wanted a child/student to visit the room they had to ask prior to the individual becoming overloaded/completely dysregulated (specific training was provided on how to identify this);
- The room was not to be used as a punishment or time out room;
- Once an individual arrives at the interoception room, they must be prompted to do interoception activities and then asked if they are ready to work yet, if not they must be prompted to do more interoception activities. Once they move on to their work they can be assisted with their work and then asked if they are ready to go back to class.

The following research questions were posed:

1. Will engaging in interoceptive awareness activities increase self-regulation skills?
2. Will participation in the intervention improve self-regulation skills and decrease challenging behaviours and improve engagement in learning and education?

3. Will participation in the intervention decrease challenging behaviour across both primary schools and high schools?
4. Are teachers able and happy to teach students to improve their interoceptive awareness and self-regulation skills using the provided short interoception activities, designed to prompt conscious perception of internal body signals through body state change?

These questions were answered using qualitative data from conversations with teachers, school leadership and students, the engagement in lessons time-trial data, the interoception tracking skills sheets and the schools' behaviour outcomes data.

Taking into account results from research in the USA (Mahler, 2016), which suggested that specifically teaching interoception is successful in effectively and efficiently developing self-regulation, self-awareness, and social understanding, a set of interoception activities were developed and provided to the schools in the trial. Staff were provided with professional development to enhance their confidence in teaching the activities. In order to evaluate if students were increasing their interoceptive awareness, staff were provided with access to the bespoke interoception tracking sheet (see Appendix B), which encompassed both conscious perception of muscle tension, pain, and temperature as well as more complex emotions and feelings that tend to be collections of internal body signals. The interoception tracking sheet asked school staff and/or students to record when they were able to recognise specific interoceptive signals and how they knew this to be the case. This enabled the staff and students to track how the student's interoception was or was not improving over time. Students could also choose to focus on interoception activities that would support development of interoception in specific areas, such as particular muscle groups or the experience of temperature. Data were collected through semi-structured interviews, field notes, and material produced by individual children and young people

in addition to quantitative measures. The analysis is presented as two studies. Study one comprising the quantitative data and study two comprising the qualitative data.

The pilot study school is reported on separately to the other eleven schools. For the other eleven schools, their quantitative data is presented in study one and their qualitative data in study two.

Table 2 on the next page, presents the information about the number of schools, staff and students who took part in the interoception pilot and regional trial that is analysed in this thesis.

**Table 2**

*Participant school summary information, using approximate numbers to prevent identification of schools:*

Type of school and which trial	Students	Teachers	Leadership	Teaching Assistants
PILOT Primary School	400	17	4	14
Trial High schools – three schools	1100	64	26	36
Trial Primary – seven schools	1510	91	17	84
Trial Special School (1)	55	8	2	12
<b>Total</b>	<b>3065</b>	<b>98</b>	<b>49</b>	<b>146</b>

### **Study one overview**

Quantitative data from 11 schools across a range of socio-economic settings and types of school; primary, high school and special school, were collected pre introduction of interoception teaching in the schools and then once a term on across the site behavioural incidents (number and type of consequence) for a school year. Additional quantitative data was then collected on targeted individuals whom the sites identified due to their difficulties self-regulating as evidenced by high numbers of recorded behaviour incidents. A maximum of ten students per site and a minimum of five were identified. For these participants data was collected pre-intervention and then termly for the school year. Each school year was comprised of 4 terms, with approximately ten weeks in each term. Data sets related to: engagement in learning (time trial observations completed by same person at each data point to ensure parity of judgement), interoceptive awareness (using a bespoke checklist developed by Goodall, 2016) and well-being of students and staff, as reported by



teachers in semi-structured interviews, in which they were asked a range of questions including how they were doing and how they were feeling.

### **Study two overview**

Qualitative data sets were gathered from impromptu and formal semi-structured interviews, conducted during termly site visits. Questions in the semi-structured interviews varied to incorporate a more naturalistic discussion style, although the research aimed to find out each discussion; if interoception activities were being incorporated daily and any barriers or challenges to this, how the staff member/student felt about the interoception activities and if they felt these activities had any impact or not, how the staff member/student was doing and how they were feeling and if there were any questions the researcher could answer. These semi-structured interviews were conducted over the whole year, with staff, parents, and students as well as pictures, short written texts, and videos from the children and young people on what they understood by interoception and what it meant to them and their lives. This data was gathered during visits to their school, as part of the researcher's everyday work, or as part of the students' normal school activities. In addition, the semi-structured interviews with parents, teachers, and other educators and leadership were either recorded or written down as they were occurring. Qualitative data was analysed using a thematic approach as described by Clarke and Braun (2013). Thematic analysis was chosen as it is a method "for systematically identifying, organizing, and offering insight into patterns of meaning (themes) across a data set. Through focusing on meaning across a data set, thematic analysis allows the researcher to see and make sense of collective or shared meanings and experiences" (Braun & Clarke, 2006, p. 57). Transcripts of the semi-structured interviews and the written and drawn qualitative data were grouped into themes that emerged whilst reviewing the data; positive feelings and reactions to interoception, interpretations of the effects of interoception, barriers to implementation, reasons for ongoing behaviour

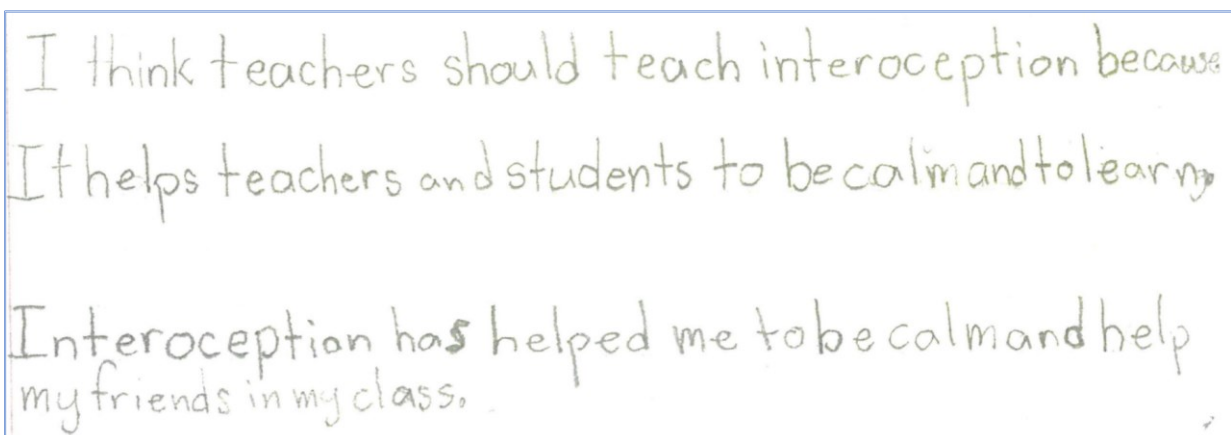
outcomes/consequences. Some of these themes had multiple comments, drawings or observational data collected from individual staff and students, whilst others had only a few from each individual.

## Chapter 3: Results

### Pilot school

All students that participated in the interoception tracking exercises increased their level of interoception from no interoceptive awareness/understanding to some/good, or from a baseline of some interoceptive awareness or understanding to good. This improvement was explained by both the students and observed by their teachers and the interoception room staff. The school used the fourth model of interoception in schools, which gave provision for in class teaching across whole school at least twice a day, plus use of an interoception room.

Teacher comments around the use of interoception activities and the interoception room included; “It has given all students the opportunity to identify ways they can manage stress / anxiety”, “A girl in my class (who has gone through severe trauma) has learnt to self-regulate (most of the time) using interoception strategies and visits to The Nest<sup>1</sup>”, “It helps the majority of my class to regulate themselves”, and “students are calmer and have a better ability to regulate their emotions in a positive way”. All of which highlight the perceived positive effects that the activities and dedicated room were considered to be having on the children. Similarly, the children also reported positive impacts of the intervention, as demonstrated in one example of a written account by a child below, preserved in its original format.



I think teachers should teach interoception because  
It helps teachers and students to be calm and to learn.  
Interoception has helped me to be calm and help  
my friends in my class.

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<sup>1</sup> “The Nest” was the name selected by the schools to refer to the interoception room.

Students and staff reported that, and it was observed that, in comparison with student behaviours prior to the introduction of interoception to the site, students were able to get along with their peers more consistently, with a higher sense of belonging and increased levels of kindness. Interestingly, after one term of interoception activities, many of the students self-reported higher levels of challenging behaviour through self-reports than they did on the baseline, despite their actual behaviour being observably less problematic. The researcher and teachers wondered if this might be due to the students being more aware of their behaviours, as their interoception tracking sheets evidenced an improvement in awareness of basic internal body signals and emotional awareness.

In semi-structured interviews with these students it was clear that they had initially had no clear concept of their behaviours and the impacts on self or others of their behaviours. Even when a behaviour had resulted in a take home, suspension, or exclusion, the students were unable to explain what had happened and why. However, within 8 weeks of engaging in interoception activities at least twice a day, most of these students became more aware of not only themselves but how their behaviour impacted on others. It was at this point that they self-reported most negatively. After another term, their self-perceptions more accurately reflected their ability to self-regulate and be positively co-regulated in most situations. One student with a diagnosed intellectual disability appeared to have made these changes in self-perception more slowly but with the same results over closer to a year. After about six months of doing interoception, this student self-reported that they hurt others when they were angry, even though recorded frequency of this type of behaviour had more than halved over the six months. After another term, they said “I don’t hit now. Now I do interoception. It makes me calm.” Staff confirmed the accuracy of this statement, and the student was able to demonstrate their favourite interoception activity, which they used proactively and reactively to self-calm and self-regulate.

Six months into the pilot, nearly all the students were making positive comments about interoception and how they perceived it had helped them to manage their anger in particular, for example saying; “now I can control my anger, before it, I just got so angry and then did things.” A junior primary student asked the Nest staff; “can I teach my mum interoception, so she can control her anger?” The complex impacts of the interoception activities were also seen, with some students demonstrating conflicting verbalisations and actions. For example, some students were vocalising that “interoception is useless”, but still taking themselves to the interoception room and engaging in interoception activities.

The researcher observed one of these students early in the third term of interoception implementation in the school. The student was sitting on the table in the Nest, as the researcher entered the room. Shortly after the bell went and the student left for recess. The Nest staff member disclosed that they had asked the student to “stop swearing before Dr Emma comes into the Nest, or it will make me look bad.” What was interesting and positive about this was that the student had stopped swearing whilst the researcher was in the room, something that staff member had previously struggled to gain the student cooperation. Previous requests were usually met with escalation into physical aggression. Instead, demonstrating increased self-regulation abilities and a positive regard for the Nest staff member, the student did stop swearing. It is also possible that the student had developed a level of empathy that they had not displayed previously, and modified their behaviour after the verbal request. Data collection about which students accessed The Nest and when and bringing what work with them provided a rich data set that highlighted decreasing levels of aggression and violence, as described by both teachers and students after the first term of interoception implementation in the classroom and The Nest. This decrease was both in terms of frequency and severity of aggression and violence. During a semi-structured interview with one of the school leadership staff, they talked about the types of behaviours being recorded on the

Department for Education reporting software for the students who had been viewed as most challenging by the school at the start of the year:

“Some of the reported incidents at the start of the year were things like; throwing chairs, hitting or kicking other students, turning over desks. By term three, these same students were still getting incidents reported, albeit fewer, but they are so low level, I can’t believe they are taking the time to record them. So, *Sam*, had incidents of swearing, whereas previously he was trashing the room, and *Jeb* was reporting for rude gestures in class, when he used to throw chairs.”

However, not all perceptions by the staff were initially positive. During the first term, some staff were concerned that the interoception trial was allowing students to avoid work. This was particularly around the perceptions of two students who initially visited The Nest frequently and for long periods of time. These students were completing work in The Nest so after leadership discussions, they were allowed to continue accessing The Nest whenever they wanted, despite the concern that they were ‘taking advantage’. The researcher had some difficult conversations with leadership about why the students might be preferring to work in The Nest and what the implications of this might be in the longer term. However, after a period of about six weeks, these students visited The Nest during lesson time with decreasing frequency.

There were also a few students who would say that they were not ready to go back to class but did not want to work. It was made explicitly clear that students in The Nest must be either engaged in interoception activities or working, or they have to return to class. Over a term this was accepted by all the students and it was rare for a student to refuse to engage in the Nest. However, the data collected through observation and interaction with the students in The Nest indicated that many of the students did not understand the work tasks that they had brought with them and required further explanation of the work. This led to data being collected at this school and all future schools on what work students brought with them to the interoception room, if any, and whether or not they understood the work. This data was fed back to the school leadership to form

the basis of coaching conversations and professional development around how to differentiate tasks to be accessible for all students, if leadership chose to address this issue.

A key moment in the trial was the request by two students for The Nest to be open just before school started to that they “would be ready for learning when school starts.” This indicated that those students, who had previously been unable to self-regulate and were not participating in learning activities regularly, had made significant improvements in self-awareness, self-regulation skills, and had developed a more positive attitude to learning. Engagement in learning was measured using a time trial observation for each student. The same person did each of the observations to avoid issues of bias around the question of what constituted engagement, which in the trial school was a member of leadership. For the purposes of this study engagement was defined as on task, whether through actual recording of answers/work or engaging in discussion around the task appropriately. The engagement with learning time trial at each data point was carried out in the student’s regular classroom when their regular teacher was teaching the same subject as was being taught in the initial time trial, e.g. if maths was being taught in the first time trial, the subsequent observations were also in the maths lesson.

Over time all students and staff participated in this pilot study. However, it was decided that in order to minimise the workload involved in detailed data collection that only 11 students would be reported on. The 11 were selected by the school leadership due to their high levels of difficulty accessing learning. This difficulty was demonstrated by high amounts of time spent outside of the classroom or school. Initially two teachers chose not to implement interoception activities in their classrooms.

After a term, leadership made the decision that all staff needed to implement the use of interoception activities at least twice daily. There were two reasons given to the researcher for this. The first was that observational time trials, by leadership, of time to engage in learning after recess and lunch breaks showed a positive difference:

“taking 15 minutes for students to be engaged in learning, whether actually working or actively listening to instructions on the mat in classrooms that were not doing interoception on return from recess or lunch to just 5 minutes for those that were. And that 5 minutes included the time taken to do the interoception activity.”

The other reason given was that:

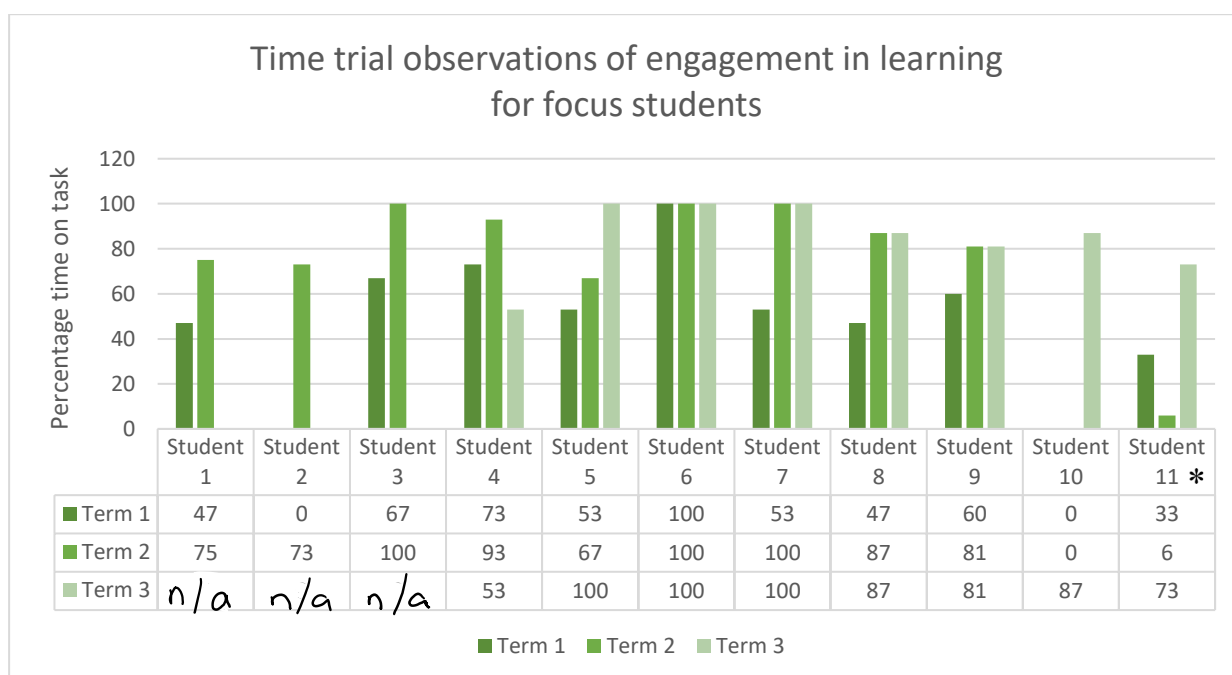
“in classrooms where interoception activities are not being used, we are seeing students from those rooms at the office, being sent to the principal etc way more than the other classrooms, and the EDSAS data input by staff shows behaviour is getting worse in those classrooms [*not using interoception*] but getting better in all the others.”

Figure 5, on the next page, illustrates the levels of engagement for each of the 11 focus students over the first three terms of the trial. Due to staffing issues within the school no data was collected in term 4, the last term of the trial. The percentage of time on task during the trial observation was calculated by counting up the number of ticks in ‘engaged’ categories during the time trial observation and dividing this by the total number of ticks, then multiplying by 100. Unfortunately, three of the students left before the third term observations took place. Two of these students were members of the same family who moved to a new house and the third student’s care placement changed so they also had to move schools. These three students are on the left of the graph. Student 4 was significantly impacted by a life event during term 3 which resulted in difficulty focusing on learning, due to anxiety about the impending death of a family member. Student 11 had a 1:1 teacher aide/school support officer in term one but did not in terms two or three. Staff reported that all these students had increased their interoception knowledge, as assessed by observations based on the bespoke interoception tool in appendix B, and reported through semi-structured interviews, by the end of term one.



**Figure 5**

*Engagement levels of focus students in the first three terms of the interoception pilot trial*



*Note.* \*student 11 had 1:1 support in term 1.

As can be seen in figure 5, generally students increased engagement in learning after a term. The students' interoception tracking sheets indicated that this was once their interoception had improved. These tracking sheets could not be included due to the detail making student's identifiable. The two students who had lower levels of engagement despite improved showing improved interoception skills on their interoception tracking sheets were students 4 and 11. These two students highlighted two different factors. Student 4 had a family member who became terminally ill in term three, causing them significant anxiety. This student was understandably spending a significant amount of time worrying about this family member, which impacted on their ability to actively engage in learning. Student 11 initially had a staff member sitting by their side during all lessons, to support them to engage in learning. This support was due to high levels of behavioural incidents during the previous few years. Even with this support, in term one, student 11 was only engaged with learning for a third of the time during the time trial observation.

However, due to a significant decrease in student 11's externalising behaviour over term one, the funding for support was withdrawn. This meant that in term two, the student was trying to engage with learning without 1:1 support for the first time in a number of years. Term two's lack of engagement in learning, at just 6%, illustrates that it may not have been just behaviour that the staff were supporting. However, by term three student 11's engagement in learning was up to 73% during the time trial observation. Student 11's teacher reported that the student:

“knows what to do in class now, it's like they spent term two just figuring out the nuts and bolts of organising how to learn without the SSO [*teacher's aide*] doing all that for them, and now they have got it and seem to see themselves as a successful learner now.”

The levels of stress/distress for students as indicated by the students themselves or their teachers using teacher reports indicated that stress/distress initially increased along with self-awareness for students with significant externalising behaviours that had resulted in temporary removals from classrooms or the school, but this then tracked down again over time. Where the stress levels increased in term 2 this was due to a significant increase in self-awareness of challenges in managing self and interacting with peers as evidenced in conversations with these students. For student 10 from figure 5, this increase in awareness took place in term 3 when they re-engaged with their class. In Terms 1 and 2 they refused to stay in class for more than a few minutes at a time, spending most of their day wandering around the school or in the office/with the principal or the school counsellor and being guided to spend time in the interoception room. In term 3 they decided to engage with their class and started to spend more and more time in their classroom participating in learning. One student initially told the researcher that “I'm not good, I am always angry and breaking things or doing the wrong thing,” reflecting their earlier behaviours had diminished as they learnt new ways to manage their anger. This growth was reflected in their comments in term 4:

“I used to be really bad, not listening and just leaving when I wanted, but now, if I don't understand I ask for help. If I am angry, I ask to do some interoception or go to the Nest, that calms me down then I can work again.”

Student 4 was more stressed/distressed in term three, understandably, but this stress/distress did not manifest in ways that disrupted the learning of others in ways that had been evident in the year prior. Student 4's teacher stated that:

“I thought this term we would be back to the violence like the beginning of this year and like last year. But, even though [student] isn't doing much work, they are still managing to self-regulate using interoception activities, even if I need to prompt it sometimes.”

Many staff talked about how the students were calmer and able to engage in learning more readily post interoception activities, though only a few used the term co-regulation to describe how they used prompting of and engagement with interoception.

Another factor that became clear in deeper discussions was an increase in kindness from term two onwards as teachers reported that students were engaged in more positive peer-peer interactions as well as student-adult positive interactions. Many of the students who visited The Nest talked about belonging to their classes and making friends during the second half of the year. It was found that these students visited The Nest with less frequency over time as they demonstrated, and the teacher and researcher observed, greater connection to themselves through improved awareness of their emotions and feelings and a stated improved connection to their peers. For example:

“I like to play with my friends from class, if I get frustrated I don't hit anymore, I just do my feet interoception, then I can keep playing. I didn't have any friends in class before.”

A new intake of students across the school in term two with histories of complexity, including harm to self/others, exclusions, and living in out of home care prompted the school to collect information on the types of incidents as well as frequency over term 2 and 3 for the six students that they identified as most likely to be suspended or excluded for behaviours that could be perceived of as violent and/or aggressive. This information was sourced directly from the school behavioural records and the summary data in table 3 below provided to the researcher. Semi-structured interviews provided contextual insight into this data. These six students were encouraged to use the interoception room as frequently as teacher judged would pre-empt potential

externalising behaviours. The researcher provided the following information to support teachers in making this judgement:

“If a student is unable to focus for more than ten minutes at a time, then every nine minutes you might direct them to do an interoception activity to help them with their focus. If a student becomes dysregulated every 15-20 minutes, then again, you can support them to do an interoception activity, so that they neurologically and physically calm down, every 13 or 14 minutes. Alternatively, if you know a particular task or subject, or even person usually results in the student exhibiting behaviours that are inappropriate for context, then prior to that event or that person arriving in the room, get the whole class or a group or students or even just yourself and the student to do some interoception. Off task is the first obvious sign that a student is moving through to panic zone, and we can only co-regulate up to big emotions, it’s too late at full on survival mode!”

The number of incidents for these six students, A-F, is depicted in table 3 on the next page,

the darker the colour box in the severity row, the more severe the behavioural incidents were.

These are different students to those in figure 5. The descriptions in table 3 are taken from field notes and semi-structured interviews with school leadership after they had reviewed the behaviour records.

**Table 3**

*Recorded behavioural incidents and severity levels for the six students of concern in terms 2 and 3, who were newly enrolled in term 2.*

Student	A	B	C	D	E	F
<b>Term 2:</b>						
Number of recorded incidents	2	4	8	7	8	13
Severity	Significant, resulting in injury	Significant, resulting in injury	Serious, hitting & swearing	Serious, throwing things, kicking	Serious, throwing chairs, hitting	Serious, throwing things, swearing
<b>Term 3:</b>						
Number of recorded incidents	2	3	7	3	2	1
Severity	Minor, not following instructions	Minor, not following instructions	Moderate. minor, leaving classroom, not following instructions	Moderate/ minor, disrespectful language and banging things on desk	Moderate/ minor, disrespectful language and leaving classroom	Minor, using a rude gesture

It can be seen in table 3 that for all students there were decreases in severity, even when there was little reduction in frequency. For students A and B, the term 2 incidents were critical incidents involving physical violence resulting in injury to others, whereas in term 3 the incidents were all ‘not following instructions’, recorded as such by their class teachers. For student C, the seriousness of the incidents also markedly decreased, from swearing and hitting peers repeatedly, to ‘leaving the classroom without permission’ and ‘not following instructions’. Students D-F all had clear decreases in frequency, but the semi-structured interviews highlighted significant decreases in severity. This highlighted the need for qualitative data when analysing the impact of the interoception activities in order to gain a full understanding. Without an understanding of the decrease in severity, it could have been assumed that there was little impact for students A-C.

Behavioural incidents in school occur within complex contexts of and interactions between student-peers-staff-buildings-family/carer etc. The complexity of just some of the students was evident during summary discussions with leadership, following their review of the data for particular individuals within the recorded whole school behaviour data. For example, in term 2 there were 5 critical incidents involving students from one family, where the children had just been placed into out of home care. These incidents involved both high impact physical and verbal violence. However, in term 3 there were no critical incidents involving these particular students as measures were put in place so that these children separately visited The Nest twice a week to learn about interoception and develop some interoceptive awareness and self-regulation strategies. Interoception activities could be used as the basis for an individualised intervention plan as evidenced by the results in this research.

The students responded positively to the interoception teaching and are were not represented in the behaviour data apart from two minor incidents not involving violence at all in terms 3 and 4. One of these students had been excluded in term one, along with one other student who was excluded in term 1 due to repeated high impact incidents. This student returned in term 2, along with the aforementioned newly enrolled students, all of whom demonstrated high needs in terms of behaviour support. Together, these students with complex behaviours exhibited the most frequency in terms of incidents involving violence in term 2. For example; the student returning from exclusion in term 2 had 19 incidents reported in term 2 and in term 3 this number had reduced to just 3 (with one of the violent incidents including a fight with a sibling).

Of the other students involved in physically violent incidents in term 2, only 1 student was still being represented in the school's computerised behaviour data records during term 3 and this student continued to visit The Nest twice a week. The other students in the newly enrolled complex cohort for term 2 visited The Nest twice a week during term 2 for intensive interoception teaching and then transitioned back into the classroom full time and used The Nest as they felt

they needed, or as requested by their teachers. No violent incidents were recorded for these complex students for the rest of the pilot. Over a period of four to six weeks of engaging in interoception activities,, all six of these students with complex behaviours became able to articulate what interoception is and how it helped them;

“Know what my internal body signals are trying to tell me and use the interoception activities to interrupt my train of thought so that I don’t get angry as much anymore, or for as long” (quote from student F).

“When I come to the Nest, sometimes I forget to ask Miss [their teacher], but when I am in the Nest and I do the interoception with Miss [Nest staff member], then I am not angry any more and I can go back to class and finish my work. Before I would just lose it and yell and swear and then if Miss [their teacher] got too close I would hit her and end up at the office.” (quote from student C)

Following this trial in one regional pilot school, the interoception program was implemented in other schools across South Australia, and the following sections present the findings of this larger dataset gathered from 11 schools across the state.

### **Study 1 – Quantitative results**

When looking at the data from the region wide trial, similar findings to the initial trial were identified. Both qualitative and quantitative data were collected from each school as in the initial trial. This section will detail the findings from the quantitative data collected. Quantitative data counted behavioural incidents by the response to them in decreasing order of severity; suspension, take home, undefined/other consequences. As explained earlier; exclusions are formal removal from a school for a period of weeks, sometimes permanently from one school though another is required to enrol them in the future, suspensions are the formal temporary removal from school for a period of days, take homes are unofficial suspensions whereby schools phone the parent and ask them to come and pick their child up and other consequences are more minor undefined consequences that all involve some temporary removal from the classroom, for less than one day, such as time out, sitting in the office/hallway/principal’s office.

The behavioural data is entered into reporting software at each school and then collated into one document by a regional manager. This document was then shared with the researcher as part

of the regional trial. Tables 4 -7 below and on the following pages present the raw data for the deidentified schools. The schools are classified by type and when and how they implemented the interoception.

**Table 4**

*High schools' raw data with contextual field notes*

High schools	Term	Exclusion	Suspension	Take Home	Undefined	All Consequence
<b>High school 1: some implementation with space</b> started interoception mid term	Term 1	1	33	26	4	64
	Term 2	0	27	24	28	79
	Term 3	2	16	19	1	38
	Term 4	1	16	15	7	39
<b>High school 2: late adopter (mid/end term 3)</b>  started interoception with space	Term 1	1	32	19	13	65
	Term 2	1	23	14	44	82
	Term 3	1	25	20	134	180
	Term 4	2	20	22	21	65
<b>High school 3: increasing implementation with space</b> started yr8 interoception opened interoception room	Term 1	0	34	15	443	492
	Term 2	4	19	19	418	460
	Term 3	0	8	17	397	422
	Term 4	0	19	22	378	419

Baseline	More Issues	Improvement term on term	Improvement since baseline	no change
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As can be seen in the table above, only High Schools 1 and 3 implemented interoception in term 1, although High School 1 opened their interoception room mid-term 2. High School two was a late adopter and only started to implement the strategy in mid to late term 3 with their interoception space opening in term 4. The data from High School 2 up to and including term 3 illustrates a typical school year prior to this intervention, with serious behaviours improving slightly in term 2 due to the suspension and/or exclusion of key student(s) and them massive increases in undefined and all consequences in term 3. Prior to the intervention these increases were seen again in term 4. The three high schools struggled to implement interoception across the



year as staff illness and movement meant that new staff needed to be upskilled more regularly than in the primary schools. This was a good learning point for the researcher, that each school needed more than a couple of key staff responsible for the implementation of the interoception intervention.

**Table 5**

*Primary schools' raw data with contextual field notes*

Primary Schools	Term	Exclusion	Suspension	Take Home	Undefined	All Consequence
<b>Primary school 1: good implementation</b>  interoception in classes	Term 1	0	19	42	0	61
	Term 2	0	16	38	2	56
	Term 3	0	15	37	0	52
	Term 4	0	10	26	0	36
<b>Primary school 2: good implementation</b>  mid-term 2 started interoception	Term 1	0	1	5	74	80
	Term 2	0	3	7	51	61
	Term 3	1	3	4	24	32
	Term 4	0	0	0	0	0
<b>Primary school 3: some implementation</b>  some interoception (room not open or accessible)	Term 1	1	22	83	233	339
	Term 2	1	21	102	123	247
	Term 3	0	20	130	238	388
	Term 4	0	7	65	253	325
<b>Primary school 4: interoception room</b>  started interoception Interoception room open most of the time	Term 1	0	23	37	506	566
	Term 2	1	18	36	176	231
	Term 3	1	33	43	137	214
	Term 4	0	40	44	130	214
<b>Primary school 5: interoception room</b>  begin to introduce interoception  interoception room open most of the time	Term 1	1	45	35	469	550
	Term 2	0	12	14	394	420
	Term 3	1	6	21	300	328
	Term 4	0	15	19	218	252
<b>Primary school 6: interoception room</b>  room closed periodically	Term 1	0	13	12	214	239
	Term 2	0	9	16	52	77
	Term 3	0	10	0	96	106
	Term 4	0	6	2	174	182
<b>Primary school 7: some implementation</b>  some class based interoception classes  JP Interoception space opened. Little implementation in UP	Term 1	0	23	11	135	169
	Term 2	0	10	18	143	171
	Term 3	0	24	20	104	148
	Term 4	0	20	17	160	197

**Table 6***Special school's raw data with contextual field notes*

Special School variable implementation		Exclusion	Suspension	Take Home	Undefined	All Consequence
started interoception	Term 1	0	0	3	120	123
interoception in most classes	Term 2	0	1	5	60	66
	Term 3	0	0	1	67	68
	Term 4	0	0	0	75	75

Baseline	More Issues	Improvement term on term	Improvement since baseline	no change
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**Table 7***Summary raw data for the 11 schools with contextual field notes*

Term	Exclusion	Suspension	Take Home	Undefined	All Consequence	% decrease from baseline
1	7	352	354	3,017	3,730	baseline
2	11	251	351	2,009	2,622	29.70%
3	6	160	312	1,498	1,976	47%
4	7	224	292	1,840	2,363	36.60%
<b>Total</b>	<b>31</b>	<b>987</b>	<b>1,309</b>	<b>8,364</b>	<b>10,691</b>	

*Note:* Term 3 demonstrated the best results. In term 4 many rooms were closed at various times often due to low staff numbers. The area where the schools are located has a very high staff turnover and operated with staffing levels below the norm in term 4. Pastoral care staff and those staff responsible for the implementation of interoception were moved to other duties or not present in schools for much of term 4 in many of the schools. Close analysis of the dates of behaviour consequence reports and the dates of interoception room closures revealed that in schools where rooms were closed for part/much of term, these dates were reflected in high behaviour consequence reports. On days the interoception rooms were open, there were very few behaviour consequence reports.

Table 4 contains the raw data for 3 high schools, Table 5 the raw data for the 7 primary schools Table 6 the raw data for the special school and table 7 the summary raw data for all 11 regionals schools. Semi-structured interviews provided a comparison from both preceding years, during which all consequences increased term on term throughout the year. In this case, all suspensions, take homes and undefined consequences all decreased from term 1 to term 2 to term 3, however there was an increase in term 4 from term 3. The researcher checked in with schools to ascertain if there were any possible changes in the implementation in term 4. A number of schools said they had closed their interoception rooms and/or decreased the implementation in term 4 due to decreased staffing. One school stated:

“In term two we only ever had behaviours that resulted in exclusion and suspensions occur when our interoception room was closed. It was run by a particular staff member, and when they were sick or at training etc, then it just stayed shut. That staff member asked to train a couple of other staff, so that it could be open at those times. This worked well in term 3, but we lost some staff in term 4 and needed those staff in classrooms.”

The statistical analysis of this data was performed using Chi Square analysis, reflecting the nature of the data collected. Results are presented in the following figures and tables, starting with the High School data and analysis and then the Primary School data. In all figures the black bar is the median.

### **High Schools Data and analysis**

In total three high schools contributed data for this research across four terms of a school year. However, one of the high schools was in a separate category as only a few staff implemented interoception. The student cohort attended both part time and full time in a range flexible and traditional educational offering. In addition, due to staff illness, this high school received very little support and follow up from the researcher over the year. When the researcher was visiting if the relevant staff were off sick, it was not possible to go back in a few days as there was significant travel involved. This meant that less qualitative data was collected at this school in comparison to all of the other schools in this research. For these reasons, the analyses for this school is presented separately.

Accordingly, Table 8 below shows a summary of the average number of combined behavioural incidences across the four terms at the two high schools with common implementation. The number of combined behavioural incidences across the four terms at the single high school with unique implementation was 492.00 in term 1, 460.00 in term 2, 422.00 in term 3, and 419.00 in term 4.

**Table 8**

*Total consequences by term; suspension, exclusion, take home and other in school consequences - common implementation High Schools, N = 2*

Term		Statistic	Standard Error
1	Mean / Median	64.5000	.50
2	Mean / Median	80.5000	1.50
3	Mean / Median	109.0000	71.00
4	Mean / Median	52.0000	13.00

Here the median is the same as the mean due to a sample size of two schools. When all consequences are grouped for high schools, the pattern is a little mixed reflecting the inconsistent application of interoceptive activities in the high schools and the decreased staffing in term 4, which negatively impacted the use of interoception activities with the high school students. This is further reflected when examining the range of scores as shown in figure 6 below, which depicts all behavioural consequences for the two high schools with common implementation.

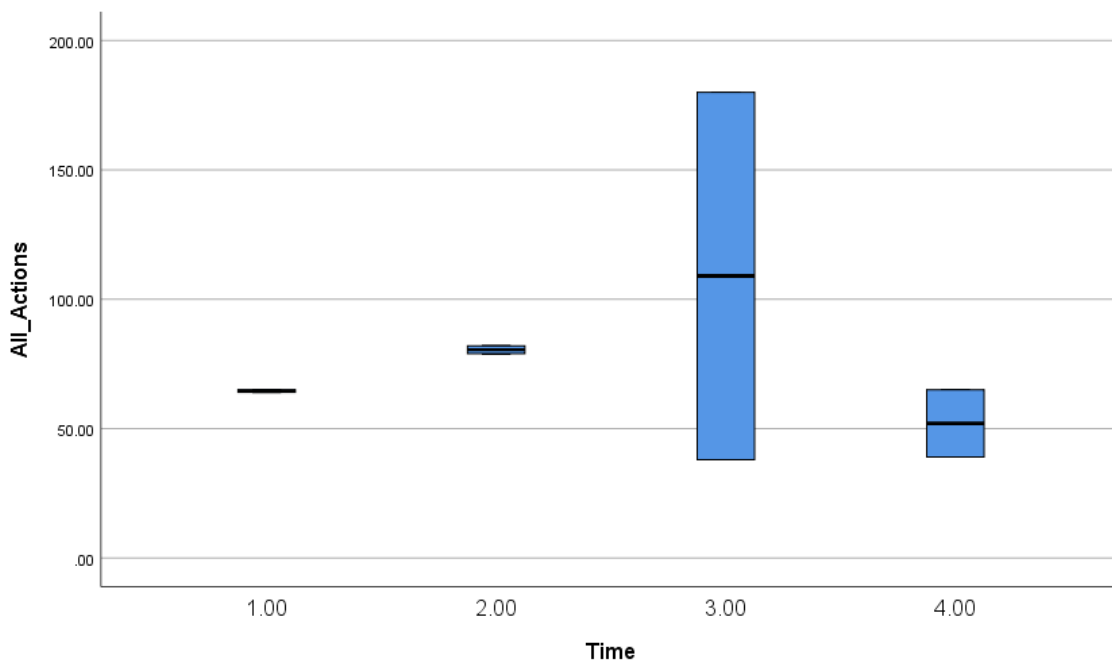
The standard error is the standard deviation of the distribution of the sample means. It provides an estimate of the variability expected in multiple samples from the same population. Term 3 had such a high standard error due to the large difference in size between the two high schools means for all consequences in term 3.

Given the very small sample size of  $N = 2$ , even with the use of non-parametric statistics all tests would be underpowered. Therefore, to better detect any true differences across the four time points, we chose to use a significant level of  $p < 0.10$ . Supporting this logic, Wasserstein and Lazar (2016), acknowledged that statistical significance as represented by  $p < 0.05$  is not equivalent to scientific, human, or economic significance which provide the context in which something is said to be significant. For this data set, the human and economic significance of reducing exclusions, suspensions and incidents requiring other consequences are at student, school and system levels.

As with the grouped results in Table 8, the pattern of data for the single School is a little mixed – although still showing a consistent downward trend. This is further reflected when examining the range of scores as shown in figure 7 below, which depicts all behavioural consequences for the single high with unique implementation.

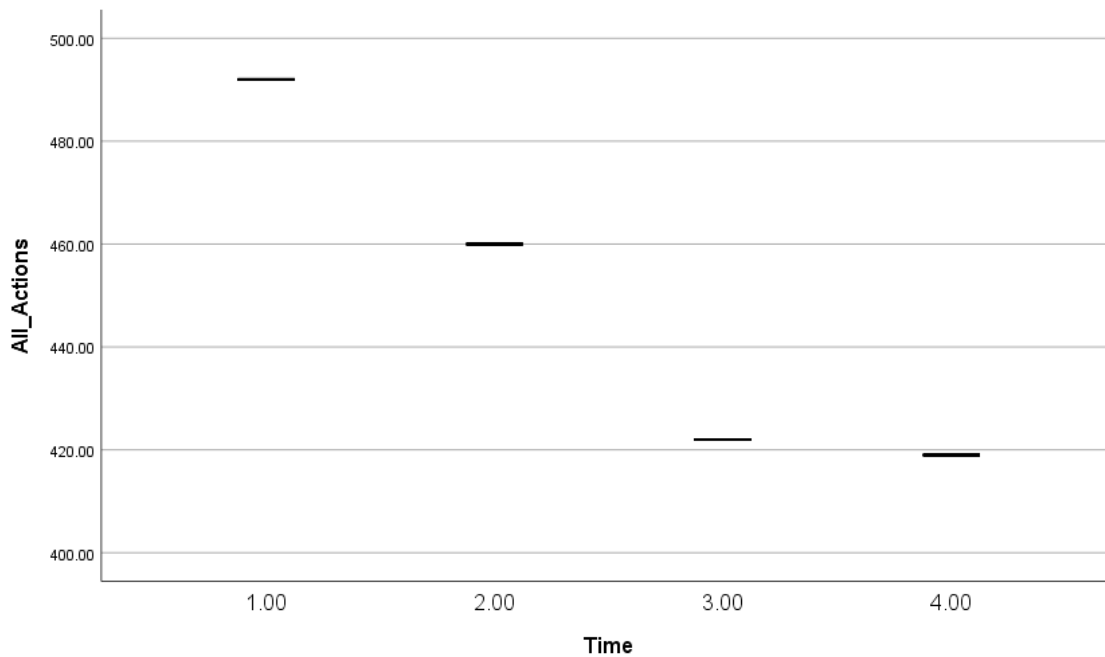
**Figure 6**

*Range of scores for total behavioural incidence consequences across two high schools with common implementation*



**Figure 7**

*Range of scores for total behavioural incidences across single unique implementation high school*



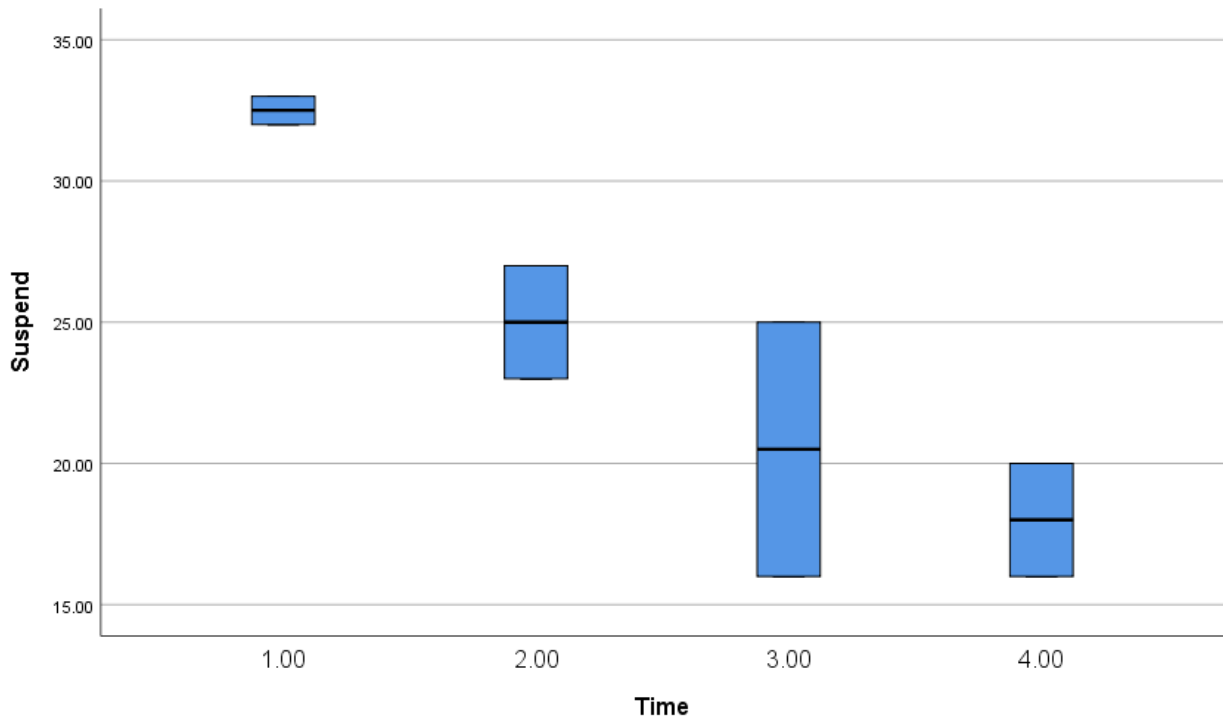
A non-parametric Friedman was conducted to test whether the trend seen above for ‘All-Actions/consequences’ was significant across the two high schools with common implementation. This reported a non-significant Chi-Square value of  $(\chi^2 (3) = 2.05, p = .562)$ . However, based on the extremely low sample of  $N = 2$  these results should be interpreted with caution. Wasserstein and Lazar (2016), acknowledged that statistical significance as represented by  $p < 0.05$  is not equivalent to scientific, human, or economic significance which provide the context in which something is said to be significant. For this data set, the human and economic significance of reducing exclusions, suspensions and incidents requiring other consequences are at student, school and system levels.

The data were then split into different dependent variables to better understand the trend identified, in order to consider each behavioural outcome category separately; suspensions exclusions, take homes, all consequences. Figure 8 below, Suspensions across common implementation, shows the data collected for suspensions within the two high schools with

common implementation. Figure 9 below, Suspensions in the unique implementation, shows the data collected for suspensions within the high school with unique implementation.

**Figure 8**

*High school suspension data across common implementation*



However, due to the extremely limited nature of the data from only two schools, the test statistic did not reach statistical significance. A non-parametric Friedman was conducted to test whether the trend seen above for Suspend was significant across the two high schools with common implementation. This reported a non-significant Chi-Square value ( $\chi^2(3) = 4.90, p = .180$ ). The resulting  $p$ -value of .180 was close to our chosen significance level of  $p < .10$ .

However, although this trend was not statistically significant, the differences between time points were practically significant in that the trend indicates that the interoceptive interventions are having a specific effect and influence on suspensions. Contextual field notes showed that the largest high school had implemented a card system for students accessing the interoception room in their school. Students who were known to be frequently or highly dysregulated were allowed to go to the interoception room for up to 40 minutes at a time, whilst other students could access the

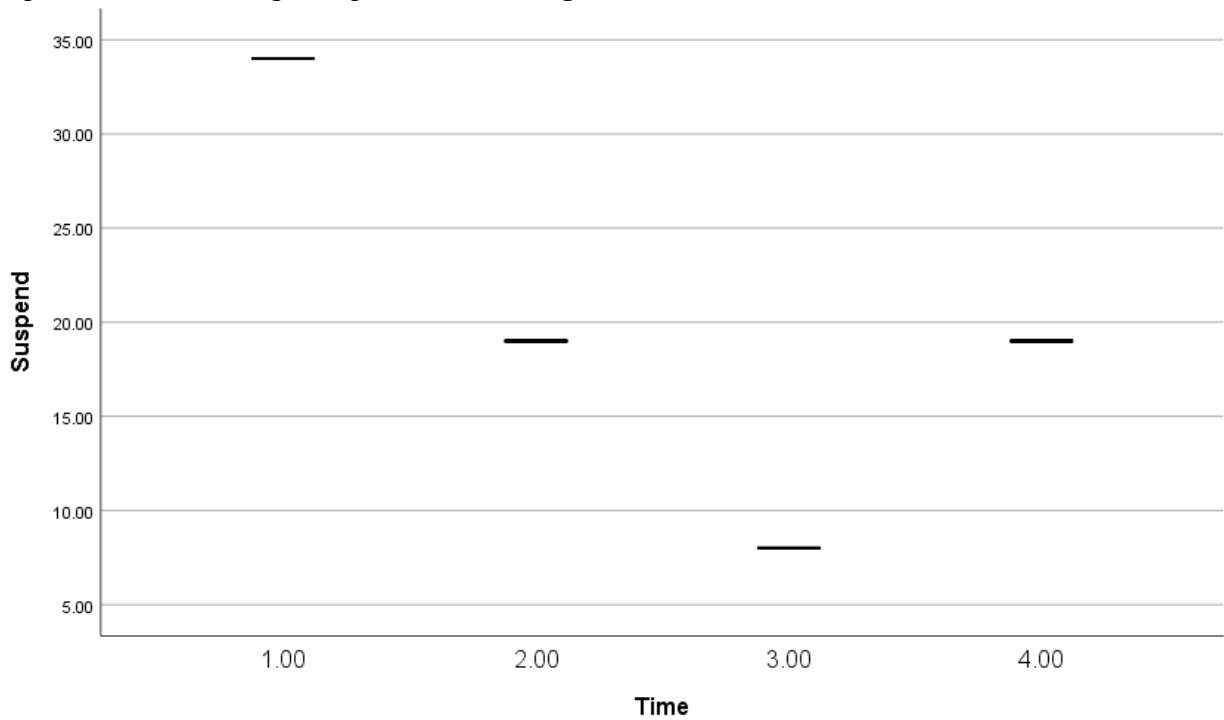


room for 10-20 minutes at a time, which the interoception room staff had indicated was sufficient to calm down and become ready to go back to class. For example:

“Our high fliers come in nearly everyday and some twice a day, but they are managing most of the rest of the time, whereas before they were regularly getting suspended.”

**Figure 9**

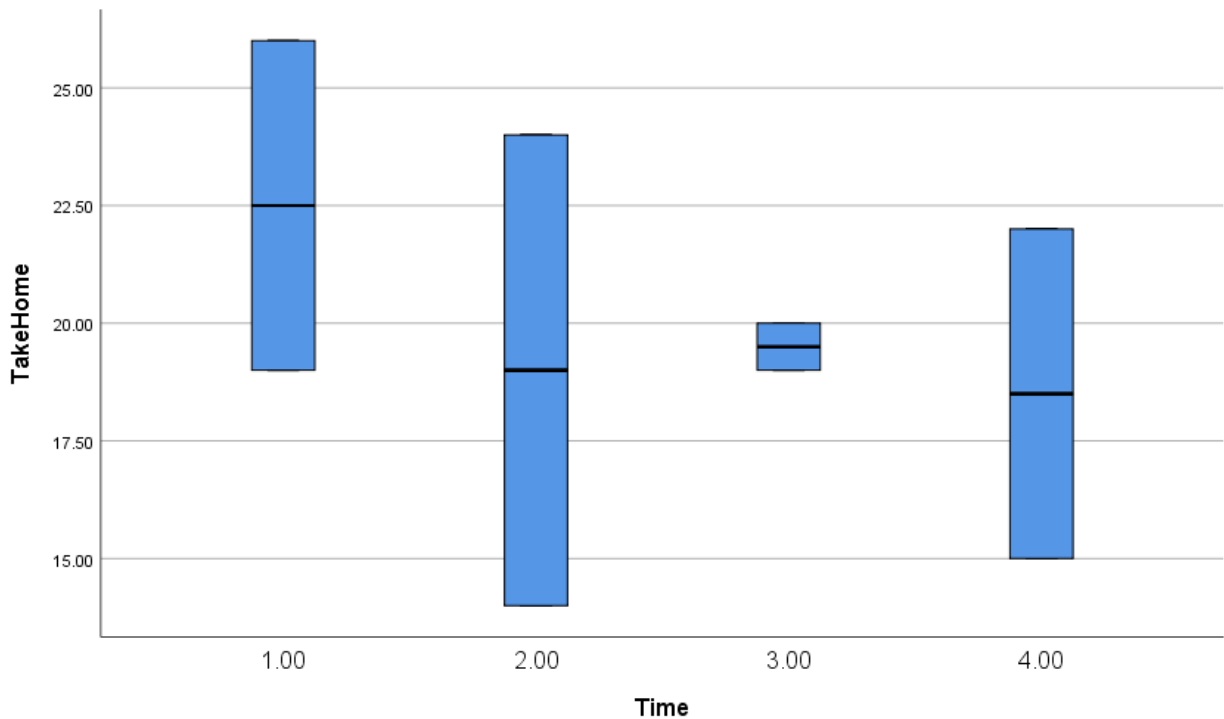
*Suspensions in the unique implementation High School*



The unique implementation high school shows a similar trend to the other two high schools, for suspension data. Although time four is different as a rising point, it does not rise to baseline.

**Figure 10**

*High school take home data for the two high schools with common implementation*

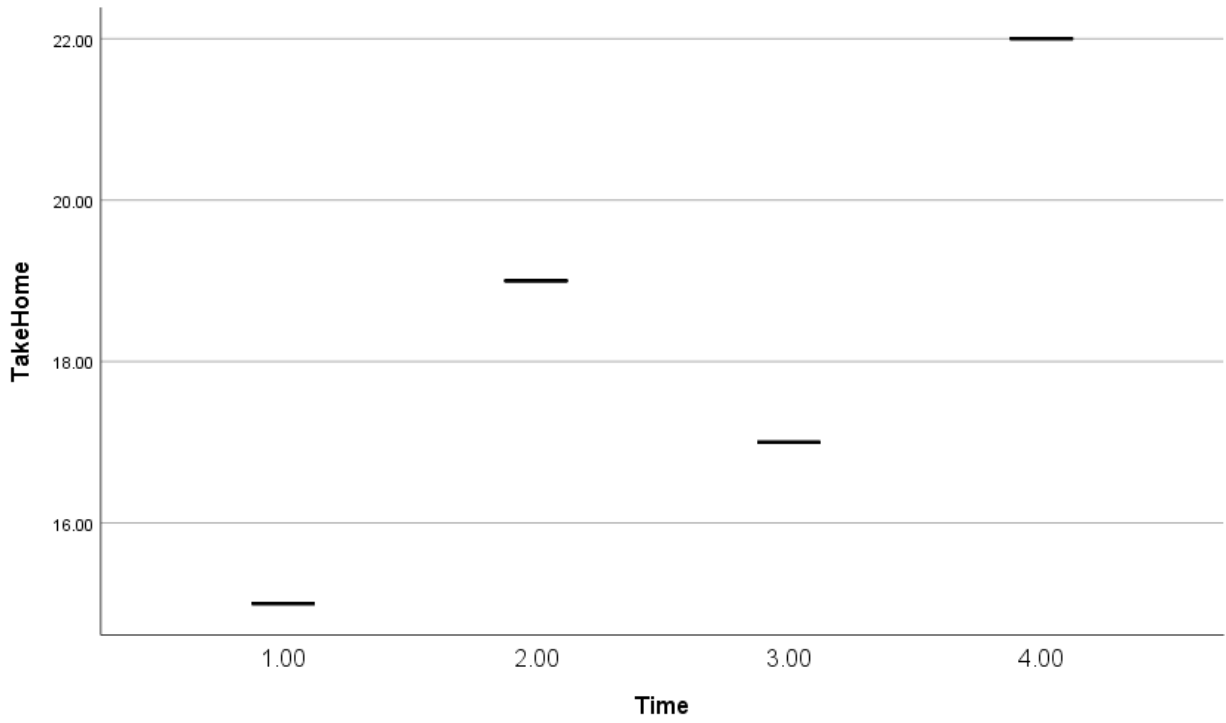


As can be seen in figure 10 for take homes in the two schools with common implementation above, the median number of take homes did not vary much across the term/times, with an exception of an initial decrease at time1 to time 2. The spread in terms of the actual numbers did change, with far less variable take homes at term/time 3. Data from take homes can be inconsistent, as take homes are an unofficial consequence, with no clear or consistent parameters around when and why they are used. This may be why the take home data is more inconsistent in terms of a pattern.

Figure 11, on the next page, the unique implementation High School take home data shows a similar trend for suspension data although time four is different to the point of being an outlier and should be interpreted with caution.

**Figure 11**

*Unique implementation High school take homes data*



**Figure 12**

*High schools' common implementation undefined/other consequences data*

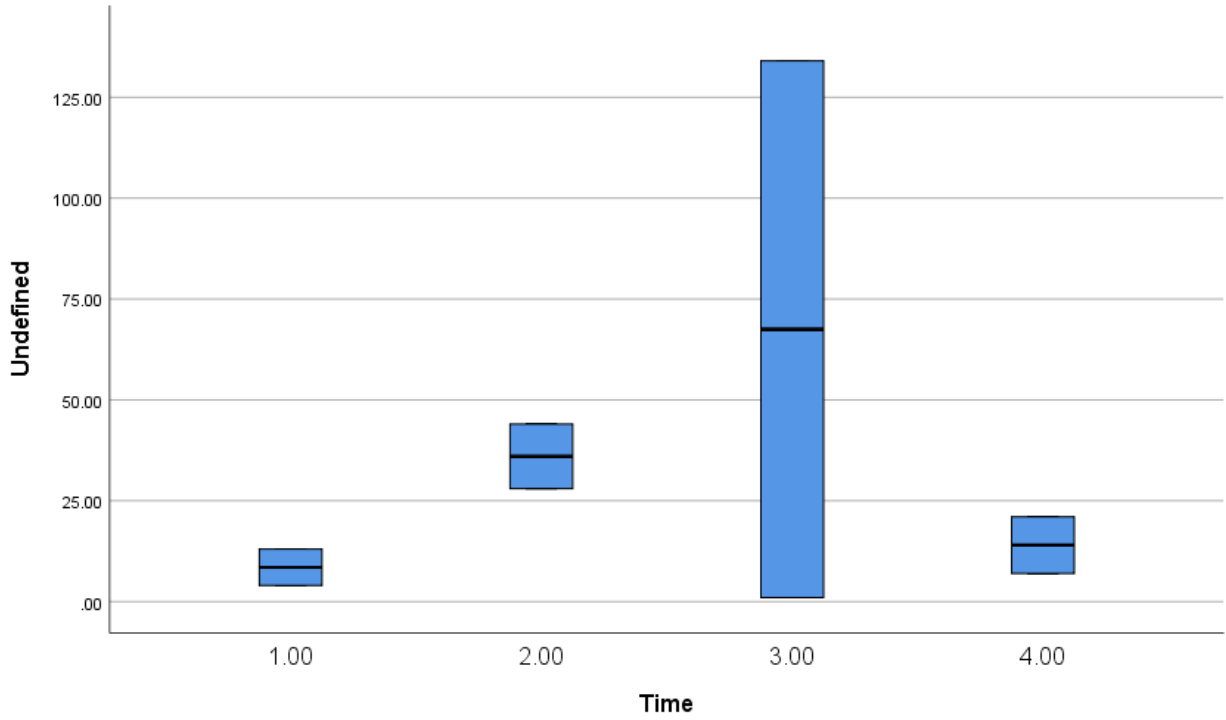
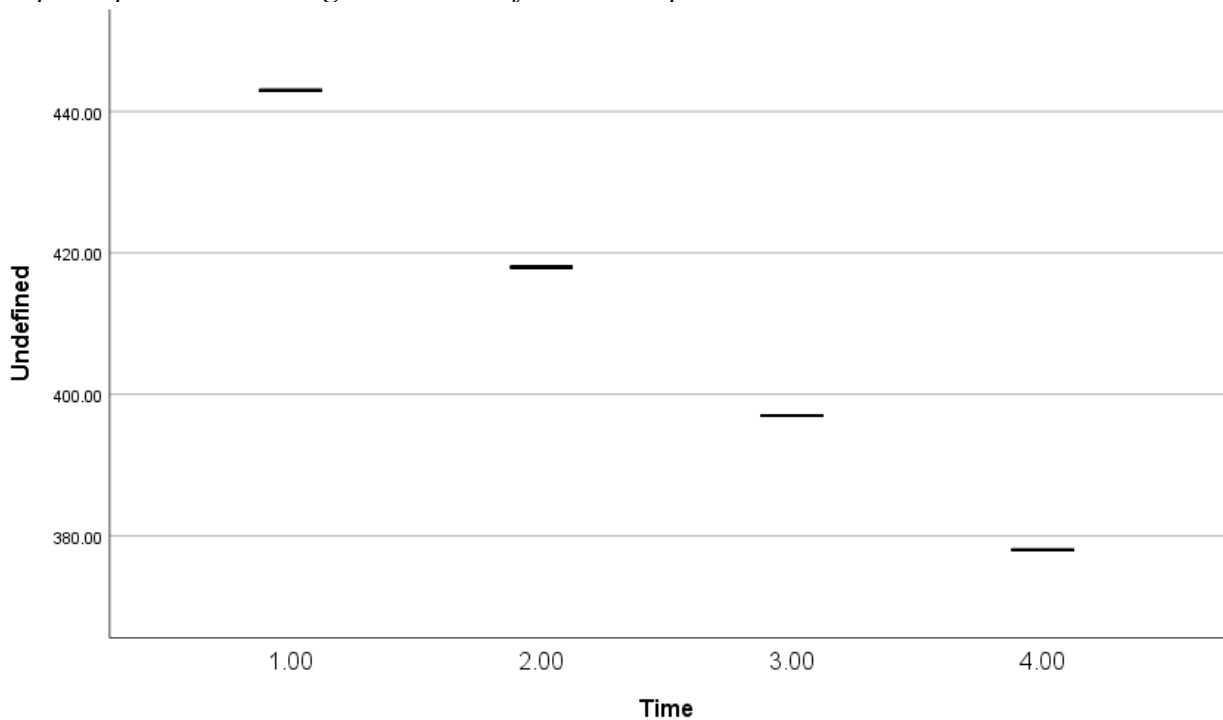


Figure 12 common implementation undefined consequences, above, illustrates more of a rising trend over the school year. There is increasing change to the median or the range and distribution of these consequences over the school year.

Figure 13 unique implementation undefined consequences, shows a similar trend for undefined consequences data although time four is different to the point of being an outlier and should be interpreted with caution.

### Figure 13

*Unique implementation High school undefined consequences data*



In summary, the analyses indicate that at high school the interoception activity interventions have a particular influence on suspensions rather than any other consequence. The high school that embedded interoception teaching into the Year 8 and 9 classes and enabled the most dysregulated students to spend longer in the interoception classroom, saw the most consistent decrease in recorded behaviour incidents over the year. The other two high schools had varied implementation across year levels and over the year, with less clear data. This analysis may provide evidence for

interoception activities having a different role in high schools to that in primary schools, where the analysis showed different results.

### Primary School Data Analysis

In order to understand if a similar pattern was evident across the primary schools, the behavioural consequences reported for each term were investigated. The overall summary of the reports from all the primary schools combined can be seen in table 9 below.

**Table 9**

*Total consequences by term; suspension, exclusion, take home and other in school consequences  
Primary Schools*

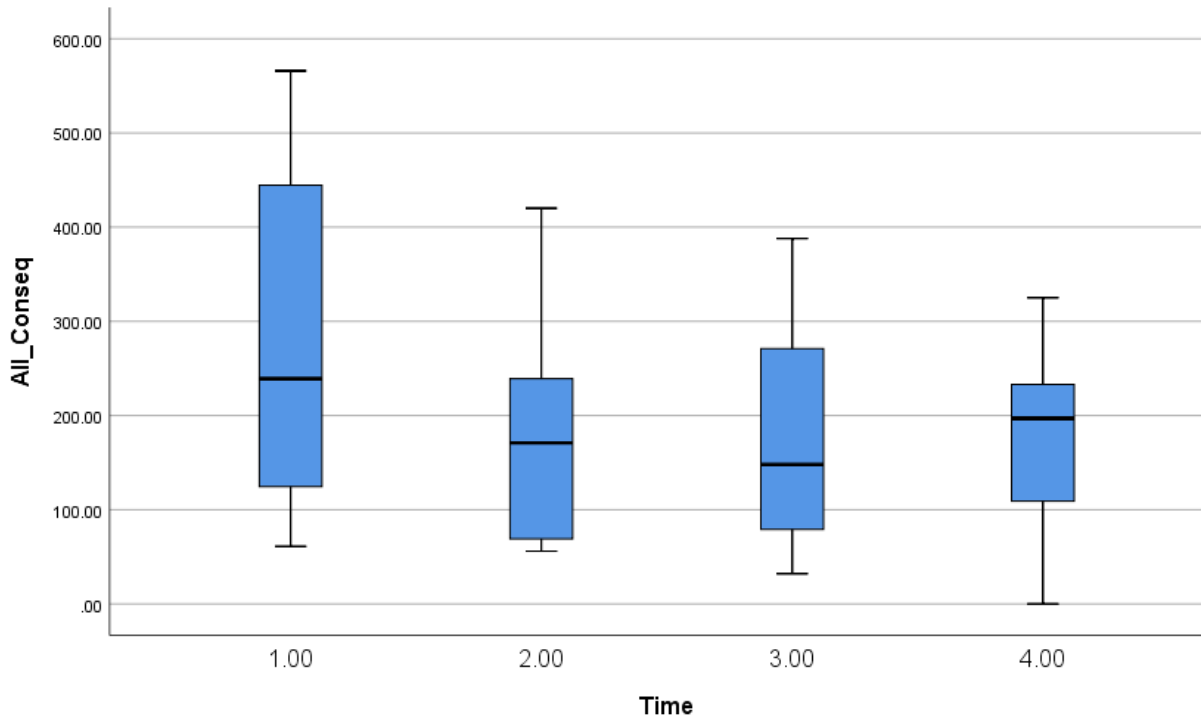
Term		Statistic	Standard Error
1	Mean	286.29	78.66
	Median	239.00	
2	Mean	180.43	49.98
	Median	171.00	
3	Mean	181.14	51.43
	Median	148.00	
4	Mean	172.29	43.75
	Median	197.00	

As with the data from the high schools, the median value, represented by the central horizontal black bar, in the blue box, is more reliable than mean, due to the low sample size. The median has therefore been presented in the table 9 above. The trend of decreasing medians across the 4 times (terms) is evident when all behavioural consequences are grouped and considered together. Although there is a slight rise in term 4, the amount of behavioural consequences never reaches initial baseline data, which was an unexpected bonus. In general discussions with the staff over the year, they made repeated reference to the typical trajectory of behavioural incidents

would be a slight drop in term two as the students settled in to the school year, then increases in term three and a spike in term four as the end of the school year approached along with staff shortages and increasing heat. In this part of South Australia, temperatures in December can be up to 40-44° centigrade.

**Figure 14**

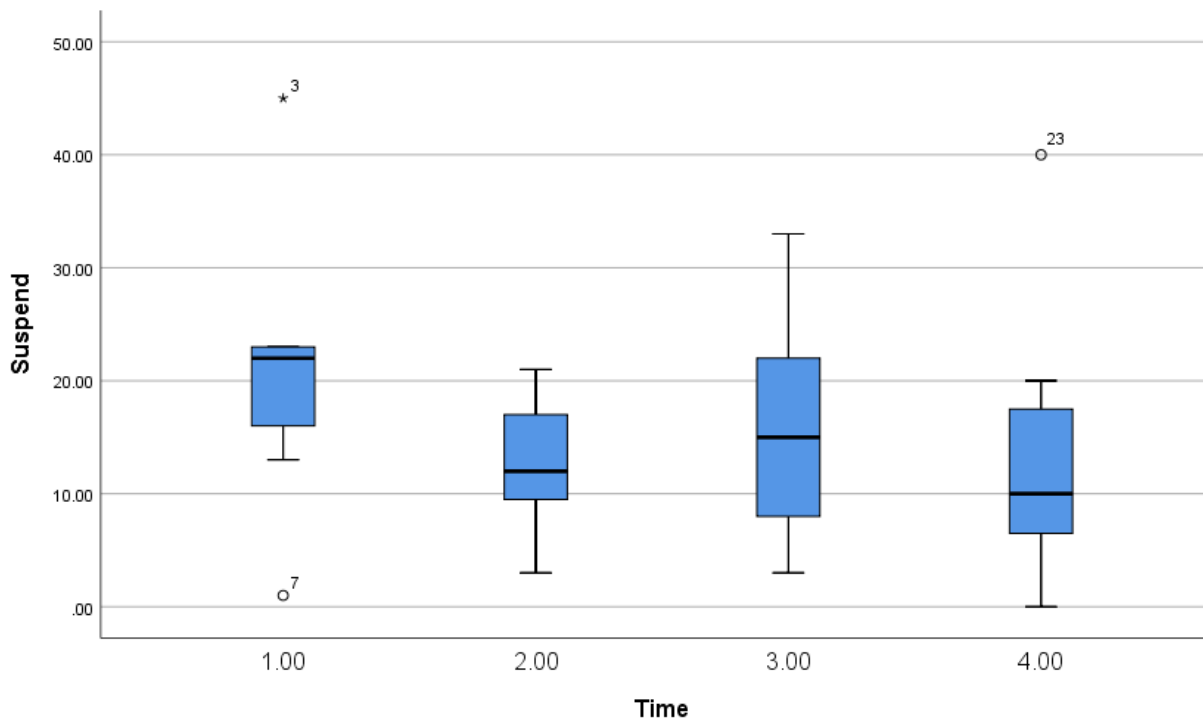
*Primary school summary of all consequences*



Like our analyses using the two high schools with common implementation, to better detect any true differences across the four time points, we chose to use a significant level of  $p < .10$ . Accordingly, for All Consequences, a non-parametric Friedman was conducted to test whether the trend seen above for All Consequences was significant across the seven primary schools. This reported a significant Chi-Square value  $\chi^2(3) = 7.09, p = .07$ .

**Figure 15**

*Primary School Suspension Data Analysis*

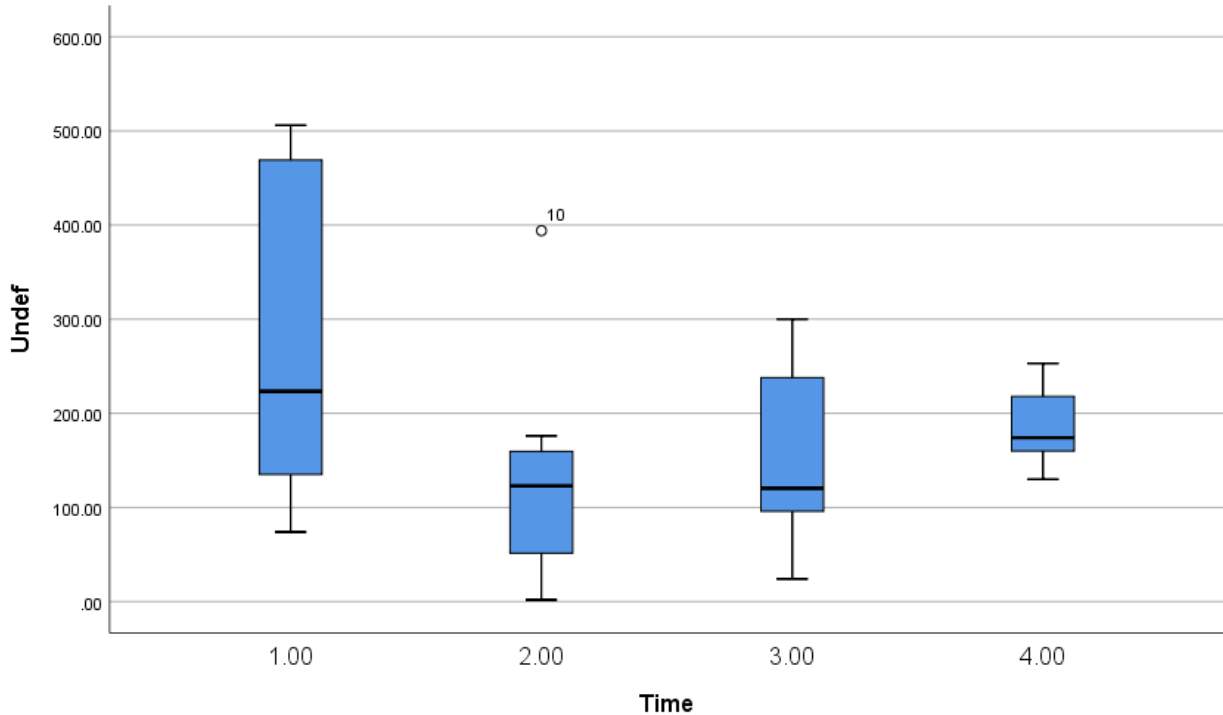


When suspension was isolated as a behaviour consequence, again there are reducing trends as shown by the median line. The initial drop from Term one to Term two is then followed by a steady flatline. There are some isolated outliers at times 1 and 3, which can be explained by a number of factors. Firstly, some of the schools did not implement interoception fully in every term, secondly during term three and four staff illness and absences, schools that had interoception rooms had days where these were closed in terms three and four. One of the schools reported to the researcher that students were “only suspended when the interoception room was closed, when it was open, there were no suspensions.”

Like our previous analyses, to better detect any true differences across the four time points, we chose to use a significant level of  $p < .10$ . Accordingly, for Suspend, a non-parametric Friedman was conducted to test whether the trend seen above for Suspend was insignificant across the seven primary schools. This reported an insignificant Chi-Square value  $\chi^2(3) = 4.86, p = .185$ .

**Figure 16**

*Primary School Undefined/Other Consequences Data Analysis*



When looking at the undefined/other consequences, it can be seen that this trend is more mixed. Other consequences are applied inconsistently both within and between schools, and the data is possibly a reflection of the inconsistent use and application of these techniques. For example, one school recorded every incident of time out or when a student was sent to a ‘buddy class’ as a behaviour consequence, whereas another school did not use this kind of consequence, preferring to get the students to do extra interoception activities when they were starting to lose focus. This variability in terms of spread within each time point probably also reflects the inconsistent application of undefined consequences.

Like our previous analyses, to better detect any true differences across the four time points, we chose to use a significant level of  $p < .10$ . Accordingly, for Undef, a non-parametric Friedman was conducted to test whether the trend seen above for Undef was insignificant across the seven primary schools. This reported an insignificant Chi-Square value  $\chi^2(3) = 3.60, p = .308$ .



In addition, as there were fewer more serious incidents, there was an increase in the reporting of less serious issues by teachers. For example, one teacher had been reporting incidents such as throwing chairs before implementing interoception. Once the class had interoception embedded, the incidents being reported were things like ‘putting up the rude finger’.

## Study 2: Qualitative analysis

Three themes clearly emerged from the data, as presented in table x below:

**Table 10**

*Data themes*

Data theme	From semi-structured interviews	From student drawings/writing	From researcher observation
interpretations of the effects of interoception	√	√	√
barriers to implementation	√	√	√
reasons for ongoing behaviour outcomes/consequences	√		√
other	Other ways to implement&/or embed interoception		

Through semi-structured interviews with staff and students and on occasion parents, it was clear that the interoception activities whilst perceived with scepticism initially, were reflected on positively from the middle of the school year onwards. Some of these initial comments are recorded below;

“Is this yet another thing that corporate think we should be doing?”

“Humm, and exactly how is this going to change the kid’s behaviour?”

“How many schools are doing this? Have they had any success yet?”

Primary and High School qualitative data is presented as a whole, partly because some of the staff worked across both over the year and partly because we were interested in a more holistic

overall understanding rather than specifically by school type. Towards the end of the school year, on the researcher's last visit of the year, a number of schools provided some student reflections on interoception in the form of drawings and/or writing. Together with the field notes and stories shared at the regional end of year interoception celebration, it became clear that the interoception activities had done more than decrease the level of suspensions in high schools and reduce the total behavioural consequences in primary schools over the school year. There were some students in some of the schools who preferred to watch on the side for much of the first term or two. Teachers suggested that in engaging in interoception activities in class as a whole class was useful, even students who struggled to join in. Teachers felt that these students were still able to benefit from observing the activities, being a normal part of class and seeing their friends participate and that this was useful in encouraging these students to participate 1:1 in an interoception room, and eventually join in with their peers in class. In schools where there was an interoception room, many of the students who were initially identified as "probably needing to use the interoception space, but unlikely to go as they don't want to do anything that singles them out" did start to use the interoception rooms within 6-10 weeks of the room being freely available for all students in the school and not just particular groups of students with identified needs.

School leadership across the pilot and the regional trial consistently reported back to the researcher that their jobs were able to be less focused on behaviour and more focused on running their school from mid-term two onwards.

"Interoception has changed our school culture and atmosphere. Before interoception, our school felt chaotic. After the implementation of the program, our students are settled, more engaged and our school culture has completely transformed." Primary School Principal

"Interoception has decreased our behaviour issues because students are able to self-regulate their emotions and don't get to the point anymore where Leadership needs to intervene, as they are able to self-manage before it gets to that point." Primary School Principal

However, uptake over the year was not uniform, with most schools initially having one or two staff members that were highly sceptical and who refused to implement the interoception

activities in their classrooms for the first one or even two terms. This was tackled across the regional trial in the same way by school leadership. Behaviour data from the EDSAS reporting system was reviewed by the school leadership using a class by class breakdown and this was then presented at a staff meeting in term two or early term three. It was made clear that those classes with increasing behavioural incidents were required to implement interoception teaching, as the classes that were had falling numbers of incidents. Interestingly, in some schools, uptake was driven by the school support officers (SSOs) in teaching assistant roles. Many of the SSOs in the area know each other socially and would often talk to the researcher about what other SSOs in other schools were doing in relation to interoception.

“Some of the SSOs [teacher assistants] have started to do interoception activities with the students at the start of any and all the withdrawal groups that they run. They have reported back that this has resulted in the students being able to focus more, engage better and that they are seeing more effective learning. I am not sure why some of the teachers are not fully on board yet, as it is clear that classes in which it [interoception] is embedded have less incidents of challenging behaviour than those where it is not.”

Primary School Principal

“When we start our session with a quick interoception activity, we are all calmer and the students seem to listen better and focus on their work more.” Primary School SSO

Some staff were concerned that doing whole class interoception activities would take up too much time and detract from their core business of teaching the curriculum. A number of strategies were devised by the researcher to respond to this valid concern. One of these was to work with schools to honestly and openly evaluate how much teaching and learning time was lost to off task or disengaged behaviours on a daily basis.

“When you [the researcher] asked us to time how long it took the students to settle down to work after recess and lunch, we were surprised that across nearly every classroom it was around 15 minutes. Once we implemented whole school interoception activity times as straight after recess and lunch, that time to settle down to work decreased to 5 minutes. Students gained 20 minutes a day of learning time through using interoception activities, that’s 100 minutes a week, 1000 minutes a term and 4000 a year. That’s over a week of extra learning time!” Pilot Primary School leadership

As more teachers revealed information about the increase in available learning time through

the use of interoception, this encouraged further discussions about proactively managing behaviours, in order to set students up for learning effectively.

Another strategy was to share feedback from staff about what they found useful about teaching interoception and why. This feedback was shared both formally during professional development sessions and informally during school visits by the researcher. For example, in classes or schools where there were concerns about students constantly leaving the classroom, saying they had been to the toilet, the comments shared were from a couple of teachers who were expressing the gains for their students. “My students are more aware what their bodies need now” Special School Teacher, or that students “were better able to anticipate needing to go and so would actually ask permission rather than running out of class” Primary School Teacher.

Feedback from the use of the Bristol Stool Chart and the Hydration Chart (see appendix A) were critical in increased use of these tools by teachers, combatting a reluctance for mainstream teachers and teaching assistants to talk about urine and faeces. When teachers heard from their peers, that using the provided the Bristol Stool Chart and the Hydration Chart was resulting in less toileting issues in school, more requests for water, students being able to self-regulate their water intake and increases in independent toileting across all ages, they were more willing to embrace a topic that was initially uncomfortable. Many of the schools put the Hydration Charts in the staff and student toilet areas, but only a few put the Bristol Stool Charts up too.

A further strategy was to include data collection on whether or not students using interoception rooms could do the work that they brought with them from class unaided, with support, or whether they were unable to access learning using that task. This data was fed back to leadership at those schools, by the staff running the interoception rooms. The researcher supported leadership to reflect on how to structure professional learning opportunities or coaching for teaching staff who were regularly providing work that some students were either totally unable to access or required significant support with.

“Every time that a certain group of students arrive from their NIT class [class taught by a different teacher whilst the class teacher has non-contact time], I just knew they would be bringing an Indonesian worksheet that they had no idea what to do with. These particular students were not able to read or write in their first language, let alone

Indonesian, I don't know why the Indonesian teacher thought that they were providing learning opportunities. These kids were so frustrated every NIT lesson, I wish they could have just come to the interoception room instead of going to Indonesian and getting frustrated and angry and then coming over here. I just worked on interoception and emotions with them, I couldn't even help with the worksheets as I can't read or write Indonesian either." Interoception room staff member at a Primary School

"Some of the students would always come to the interoception room when they had a particular teacher or a particular subject. The teachers would go on about these kids work avoiding in the staff room, but they wouldn't have done any of the work if they stayed in the classroom, they didn't have any idea what the teacher was going on about. At least in the interoception room they were not being destructive and not getting into serious trouble and getting suspended etc" Interoception room staff member at a High School

Each interoception room sign in sheet had space for the adult present to write in what class the student was coming from, what work they brought with them and if the student was able to do the work unaided or not. This information was then shared weekly with leadership. Following up on this information, leadership responses across the schools was to provide upskilling opportunities for staff to learn about how to differentiate tasks and plan for students with a range of support and learning needs. Subsequently, over the year, the perception of students' using the interoception room to avoid work decreased to virtually nil. In addition staff awareness developed that the requirement that students do classwork in the interoception room after they had done some interoception activities was in place and students were returning back to their class 'ready to learn'.

"I think interoception activities are so that you can calm down and refocus on your work. My favourite activity is when you trace around your fingers while breathing in and out slowly. I enjoy the interoception room because it is nice and relaxing, it helps you be able to come back to the classroom ready for learning" Primary School student

"Our Interoception room is very peaceful and calming which makes me feel good. Interoception helps us to destress and helps us get back on tasks so we can do our best learning." Primary School student

"Interoception has provided students with opportunities to connect their bodily responses to their emotions. This High School has seen a significant decrease in behaviour incidents since the opening of our Interoception room. We are proud to offer this approach for the students here." High School Staff Member

In all of the schools, students talked about interoception openly and frankly. Teachers were also very honest about their observations and learnings over the year. A number of teachers reported a positive shift in engagement with writing from 'avoidance' or 'reluctant' to 'willing to

write' in their students. These teachers also noted that these students' responses to interoception activities focused on hands, indicated increased awareness of muscle tension levels reflected in improved pen grip. A handful of students in each school said in various ways that interoception was useless for them. Interestingly, these students still participated in interoception activities, particularly ones framed as 'personal best challenges' and still visited interoception rooms by choice. The pilot school interoception room staff chose to use the interoception activities on pulse to work with their students who felt interoception offered them no benefit, when these students were in the interoception room. This tactic inadvertently highlighted one of the main biological benefits of interoception activities; the lowering of heartrate, which could only be possible with a decrease in SNS and an increase in PNS activity. The trial schools were all given this information, with some choosing to use it to help students understand how interoception could help them.

“When Alex [pseudonym] first saw their heart rate decrease after doing interoception, they were amazed, and even though they would still loudly tell you how useless interoception was, in not such polite words, they would come over to the interoception room and put on that smart watch and do interoception until they were calmer.” Pilot Primary School Interoception room staff member

As the trial progressed, field notes indicated that a number of students indicated a preference for the pulse taking interoception activities. The students were able to physically find their pulse in their wrist or neck, some smart watches with tap faces were available for students who were unable to find or count their pulse. Students were able to use this to recognise that they were becoming dysregulated, even if they were unable to recognise or name the emotional state that their body was experiencing. For example, a student reported that when their heart rate was “three numbers” (100 or over) when they were seated, they felt better after doing interoception activities and that after these activities their heart rate was “two numbers” (99 or less). Decreasing heart was associated by the students and teachers with increasing calm/decreasing stress/distress.

Emma I Like Introspection because it makes me calm focused ready for the next lesson also I think it makes teachers happy to see their students focused engaged happy and finally I would like to see all schools do introspection to help the teachers and maby it will help schools be more happy and have less bullying thank you and teachers please please please read things and teach introspection please thank you

My favrit introspection activity is the pots one

Pulse/heart rate is a very simple tool for students to learn about the variations in pulse signalling different states. Students can monitor their heart rate and use it as a guide that signals a change in their emotions, even if they are unable to recognise or name the emotional state that their body is experiencing. For example, a student may find that when their heart rate is up and they have not exercised, it is a signal to engage in an interoception activity that brings their heart rate down and this may prevent rage from building uncontrollably. For other students, exercise may decrease their baseline high-anxiety heart rate. In both these situations students reported being able to focus on work more effectively post interoception activity.

“Some of the students use the smart watches that you [the researcher] gave us and some like the pulse oximeter. When they enter the interoception room they put the watch or the pulse oximeter on and we note down their heart rate. It’s usually quite high. Then they do an interoception activity and then we check their heart rate again, and it has usually gone down quite significantly. Sometimes it is only a little lower and then we might encourage the student to do another interoception activity to lower it a bit more. The students got really into this for a while.” Primary School Interoception room staff member

In response to the students leaving the interoception room calmer than when they entered, one High School made the decision to offer yoga as a PE option the following year. Their interoception room had some mats in a corner with yoda yoga poses for the students to try. Yoga

had never been offered at the school before, but the staff were convinced that with growing interoceptive awareness, the students were calmer. Some of the other schools also then introduced various yoga poses with guidance on where to focus on noticing how their body felt.

“As long as you guide the students to notice how their bodies feel, then they are activating their body awareness, their interoception. They like choosing the yoga activities for their interoception activities. I think it is so exciting that so many students have chosen it for their PE option next year.” High School staff member

“I am a yoga teacher, if I do twenty minutes of adapted yoga with my class first thing in the morning, they are so settled for the rest of the day.” Staff member.

This particular staff member had perhaps one of the most dramatic observable changes in their class with the implementation of the morning adapted yoga. It was most baffling that they chose to stop doing this when a new student, with a reputation for extreme violence, joined the class. No rationale was given and the class gains were lost, which reaffirmed something discussed repeatedly in the pilot school around students who are living in traumatic situations and mentioned in all interoception focused professional development delivered by the researcher.

Interoceptive awareness is known to be decreased in individuals with PTSD, however a growing body of evidence also suggested that individuals experiencing trauma usually experience a decreased interoceptive awareness (Herman, 2015, Van der Kolk et al., 2014), manifested as a ‘sense of disconnection between their mind and body’ (Neukirch et al., 2019). In the pilot school, staff had noticed that students who were experiencing traumatic situations were losing the interoceptive awareness gains over holidays and if the interoception activities were not available to them for a few days. Students not living in trauma did not appear to lose interoceptive awareness gains, although some of these students did lose some of their gains over the school holidays, their interoceptive skills remained above baseline. This indicates that interoception activities need embedding into the school day and not just implementing for a term or so.

“Even though you [the researcher] said that interoception wasn’t a quick fix and we couldn’t just stop doing that activities once the kids were more emotionally aware, I didn’t think that they really would lose the benefits when they stopped doing interoception, but it makes sense, who wants to feel the trauma they are experiencing”  
Primary School D Principal



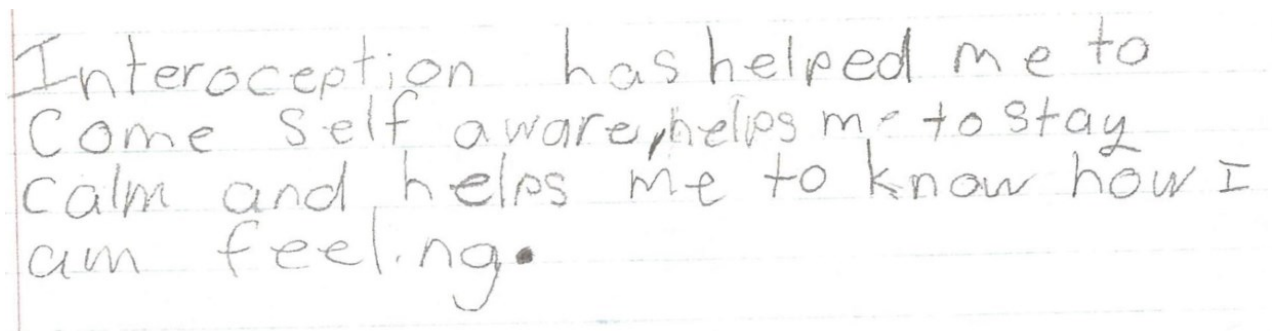
Field notes indicated the new student joining the 'yoga class' had no interoceptive awareness and sought out high levels of biofeedback through kicking, hitting, scratching, and head banging. Most of the students in the class where yoga had been being taught, were experiencing traumatic situations in their homes or their out of home care placements on a weekly or even daily basis. Some students may also have found school difficult or even traumatic, as evidenced by two field notes regarding two different students and a quote from a high school student:

Field note 1: conversation in public space with parent who approached the researcher to say that she had moved her child to a school where interoception was being fully implemented as other parents had said it was working for their children. This parent went on to explain that her daughter used to spend all day at her previous school hiding under the desk and would do no work, but now that she was doing interoception two to three times every day at school, she was sitting at her desk much of the day and joining in with class activities.

Field note 2: off hand remark from a staff member about how a student that previously required two adults to supervise him at all times in his own space away from other students, following a term of twenty minutes intensive interoception every school day on arrival, moved back into his regular classroom with just one adult supporting him. This adult did twenty minutes of interoception every morning with this student before entering the regular classroom.

"I used to put a lot of schools in lockdown. When someone would look at me or I would get angry, I would put them in lockdown. Now, the, with the interoception, I am in control, I control my anger. It doesn't control me, I do my interoception activity and it calms me down and I don't hurt anyone." High School Student.

The student above clearly had negative experiences within school environments and reported to the researcher whilst sitting alone, that he didn't like the number one, because one is lonely. On follow up with staff, it became clear that this student had attended a number of schools prior and been excluded from them, before starting at this High School at the start of the interoception trial. This student wrote the following towards the end of the school year:



Interoception has helped me to come self aware, helps me to stay calm and helps me to know how I am feeling.

Discussion with teachers and school leadership in this study has placed teaching new skills proactively at the heart of behaviour management and is changing the way teachers and principals react to students who exhibit fight/flight/freeze behaviours in education settings. The students have been observed requesting interoception activities to help them refocus, prevent them from “losing it” and “be ready for learning.” This happened, whether a student made significant interoceptive gains in a short period of time or if they made much slower gains.

“Interoception is an activity which can make you focus and calm you down. The class does interoception activities because it helps individuals regain focus on themselves and what they're supposed to do.” Primary School student

Due to a significant decrease in staff in some schools in the fourth term, some of the schools that were using model 4, whole school teaching of interoception in class and the use of an interoception room freely accessible to the students, had to close their interoception room completely or part time. Where this happened, there were increased behavioural incidents on the days that the room was closed in some of the schools.

“We have had a few suspensions this term, all of them on days the interoception room is closed. The students are all in classrooms where the teaching of interoception is not yet fully embedded.” Primary School C Principal.

“We lost a number of staff members this term and have had to prioritise having staff in classrooms, but when we saw how the behaviours were starting to climb again, we asked staff to include interoception in their planning.” School Leadership.

“Overall, the students are so much more engaged in learning, and even the classes that just focused on one aspect of interoception saw huge improvements in pro-social behaviour and their ability to self-regulate. So even though this term there has been less consistent implementation, we will certainly keep interoception next year.” School Principal

This illustrates that interoception would be a very valuable alternative to the “time-out” options that are typically offered in schools, as interoception instead scaffolds a student's understanding of their own needs and behaviours, and the impact on their environment, rather than simply removing them from the learning environment every time that they are unable to manage their behaviour.

The findings of both the qualitative and quantitative results therefore indicate positive impacts of the interoception intervention. Further consideration of these collective findings and

implications for teaching practices and school leadership will be considered in the following chapter.

## Chapter 4: Discussion

The findings have indicated that teaching children and young people to notice their internal body signals through short activities focused on prompting them to notice changes in body state does facilitate the development or improvement of interoceptive awareness. Following that development or improvement in interoceptive awareness, the data indicates that self-management and self-regulation noticeably improve across schools, as demonstrated by decreases in behaviour incidences recorded by schools and verbal reports of both school staff and students. In addition, the data indicates there were visible increases in engagement in learning, both immediately after doing an interoception activity and these continued in the longer term.

In terms of answering the research questions:

1. Will engaging in interoceptive awareness activities increase self-regulation skills?

The findings, both qualitative and quantitative indicate that as students engage in interoceptive awareness activities over a number of weeks, their self-regulation skills do increase. Students comments on their ability to control their emotions and behaviours after doing interoception activities were powerful indicators of the success of interoception in improving self-regulation.

2. Will participation in the intervention improve self-regulation skills and decrease challenging behaviours and improve engagement in learning and education?

The data indicated that the intervention was able to decrease challenging behaviours and increase engagement in learning. Drops in suspensions and exclusions indicated that students were more able to self-regulate than before and that there were fewer challenging behaviours in schools. This was confirmed by the qualitative data, notably school Principals remarking that they were not spending anywhere near as much time managing behaviour as they used to. The time trial observation data on engagement in learning found improvements in the target students, with confirmation from school staff and students in conversations over the

school year. It was of note that teaching assistants began to start withdrawal session across a number of school sites with a couple of minutes interoception without any input from the researcher or school leadership in any of the schools. Some of these teaching assistants reported that they chose to do this because of the reports from colleagues at other schools on the calming benefits and the increase in engagement in learning when students with complex learning and behaviour needs did interoception.,

3. Will participation in the intervention decrease challenging behaviour across both primary schools and high schools?

The findings were that participating in the intervention did decrease challenging behaviour across both primary and high schools as measured by the school's behaviour consequence data and confirmed in conversations with individual staff and students.

4. Are teachers able and happy to teach students to improve their interoceptive awareness and self-regulation skills using the provided short interoception activities, designed to prompt conscious perception of internal body signals through body state change?

The findings were initially very mixed, with some staff unwilling to try something suggested by 'someone from corporate'. However, over the course of the year nearly all teachers became confident and competent at teaching students the provided short interoception activities. Most staff expressed the opinion that these activities had resulted in improved interoceptive awareness and improved self-regulation.

Sustained off task behaviour decreased by over 50% in the first 8 weeks where all teachers were implementing the interoception activities, with lower but still observable decreases across all schools. Decreases in off task behaviour continued to be noted over the year by teachers and in targeted time trial observations. Major disruption of class learning, as reported by class teachers

decreased over 80% across the pilot school in two terms with students requesting interoception activities in order to facilitate their learning. Even though interoception was never taught in the yard/playground, incidents in these outdoor areas also decreased by over 50% with a continued decrease being noted in the data. This gives some evidence that the students can transfer their interoception activity and emotional regulation learning to a different context. The teacher observations, student self-report and teacher-report data indicated significant increases in kind and pro-social behaviours in students who had not previously been noted for displaying these attributes.

These findings were replicated with varying degrees of success, with variability attributed to the buy-in from staff and the amount of interoception activities being taught in school as indicated in the qualitative data.

“Some of the teachers really haven’t come on board yet and when we looked at the behaviour data by class, it was really clear that classrooms where interoception is fully embedded have much fewer issues with behaviour than the classrooms where it isn’t.”  
Primary School Leadership.

Less than twice a day resulted in less reduction of both off task behaviour and recorded incidents as reported by school leadership at all schools. However, it is a significant finding that the majority of educators in this research found interoception activities to be an effective and efficient proactive behaviour management tool and schools find it of wider benefit to the culture of learning. This is significant because attempts to manage students’ dysregulated behaviours cost education systems a large amount of time, energy and often money, without necessarily having a noticeably positive impact. In addition, if teachers do not believe something will work, rolling it out across an education system is far more difficult than rolling out a strategy that teachers are on board with.

## **Quantitative and Qualitative data reflections**

Goleman (1995) suggested that labelling feelings is the first step in developing social-emotional skills. However, without interoceptive awareness, it is not possible to notice the biological signals that indicate emotional states, and therefore not possible to label those feelings. This was illustrated through the qualitative data, which demonstrated that some students had no conscious awareness of body parts prior to starting the interoception activities during conversations and observations in term 1. These students all developed awareness, but at varying times, starting from mid-term 1 to during term 2, that did not appear to be correlated to the amount of interoception activities undertaken.

When designing the set of interoception activities for the staff to use whilst participating in this study, a decision was made that the first activity would relate to the stretching and relaxing of muscles in the hands. Students who are yet to develop, or are still developing their sense of interoception, may not know how to feel the difference between relaxed and tense hand muscles. This can lead to difficulties in writing for example when the pen/pencil is gripped too hard resulting in pain and/or tiredness whenever the student writes. If the student has very high sensitivity to pain and low awareness of muscle tension, they may experience a tight grip as painful very quickly and if guided will be able to open and close their hands to release excess muscle tension or cramp.

However, if students are not aware of the building pain until it is extremely painful, they can be observed throwing their pen/pencil down or across the room. Over time, without explicit explanation of the role of biofeedback/interoception in helping us regulate pain as well as grip tension, some of these students moved from appearing to be reluctant writers to students who refuse to write.

stretching my hand.



Field notes recorded that students who had poor interoceptive awareness of their hands, improved this during hand stretch interoception activities. Prior to starting the hand stretch interoception activities staff comments reflected as assumption of work avoidance, where students would not write, or poor motor skills, where students would drop pens/pencils or write with poor control. However, after doing the hand stretch interoception activities until the students were individually able to feel various parts of their hands stretched and relaxed, these same students were observed picking up and using writing implements with confidence and skill on a regular basis.

This was brought up for discussion during a professional development session looking at barriers to implementation and the staff struggled to understand how interoception or a lack thereof relates to students refusing to write. The researcher suggested that the students who drop or throw their pen/pencil after gripping it so tight that cramp has developed in their hand, may perceive their pen/pencil as dangerous, in the same way that people who burn their hand on a hot stove assume the hot stove top causes pain, so the pen/pencil becomes associated with danger. If a



student thinks their pen/pencil is dangerous or causes pain, they are as unlikely to want to write as people are to put their hand on a hot stove.

A number of staff found this discussion very useful and thought provoking with several teachers and teaching assistants voicing a wish that they had known about interoception earlier in their careers.

“It makes so much sense, I think about some of the students that I tried everything with, to get them to write. I thought it might be a sensory thing and I’d try different paper, so it wasn’t so shiny, different pens that were quieter, or larger and easier to hold. For some students one or more of these things would make a difference, but for a few, nothing at all. But when I think about it, they were also the students that weren’t able to regulate their emotions or even self-manage their food intake, so they might eat all their food at recess and have nothing left for lunch or they’d be wearing a sweater and if I asked if they were hot they’d say no. Now I know all these things are related to interoception and these students probably weren’t work avoidant at all!” Primary School Teacher

On a biological level, interoception activities activate the parasympathetic (calming down) autonomic nervous system as demonstrated by the students recording pulse/heart rate prior to and post interoception activities. The parasympathetic and the sympathetic (fight/flight/freeze) autonomic nervous systems cannot be active at the same time. The sympathetic system is activated by the excitatory neurotransmitter noradrenaline in the brain, whilst the parasympathetic system is activated by the inhibitory neurotransmitter acetylcholine, which is thought to have a role in the encoding of new memories and learning (Hasselmo, 2006). This means that even when students are unaware that their sympathetic nervous system is active and they are building up towards a fight/flight response, they can interrupt that chemical cascade and activate the parasympathetic nervous system, enabling them to learn more effectively. Observations demonstrated that students were able to engage in interoception activities in all states except panic zone/active survival instinct. Students seemed to feel as if these activities were useful or beneficial before teachers.

“If I forget to do the interoception activities with the class after research or lunch, one or more of the students will ask me to do them, or ask if I forgot.” Primary School Teacher  
“We had an overnight trip and the students asked if we could do some interoception activities after eating. The venue staff commented afterwards that the children all seemed so much more settled after.” Pilot Primary School Teacher

“The kids seemed to really look forward to interoception from about three or four weeks, but I didn’t notice any behaviour changes until about eight weeks. But they wouldn’t let me miss doing interoception, no matter what.” Primary School Teacher  
In the pilot the school it was identified that some students required more intensive

interoception teaching in order to acquire interoceptive awareness and develop self-regulation skills. To meet this need they asked some students to attend twice a week for small group and 1:1 interoception activities, as well as coming to the interoception room when they wanted to at other times. The data and field notes from the pilot, indicated that being able to access and undertake interoception activities as needed was clearly linked in student and staff’s thoughts as enabling the students to notice, recognise and control their emotions over time. The young student who asked if he could teach his mum interoception, so that she could control her emotions, being a good example of what these impressions were based on.

The implication of small group interoception sessions for the school system is that we can use flexibility of delivery to meet the needs of the students in each site. There are staffing costs involved in staffing an interoception room, which would be minimised if instead, interoception was taught in-class and in small groups intensively. However, it would be useful to do further research to compare and contrast similar schools using each of the four models to ascertain if one model has a bigger effect on not just behaviour, but also well-being and engagement in learning, as well as researching any possible longitudinal benefits.

Overall students and staff enjoyed the interoception activities and used them in a variety of ways; to specifically teach students to connect to themselves and so develop the ability to connect to others, as a proactive behaviour management tool, to help students refocus after breaks, and to help students gain an understanding not just that they can learn to self-regulate but how they can achieve that goal. The teachers who were not convinced of the usefulness of the interoception activities early in the trial did change their minds as they could see evidence of behaviour change in the playground as well as in the data. However, the biggest impact has been the discussions that have started across the state around interoception and the need for children and students to

develop their interoception in order to be able to develop the skills to self-regulate. Since the trial ended an additional 250 schools have started to implement interoception activities in their school.

### **Proposed contribution to the field of research**

Mehling et.al.'s (2018) study indicated that interoceptive awareness was able to be improved in war veterans with PTSD diagnoses through an integrative exercise program that combined mindfulness elements with exercise elements. This research provides a complementary contribution to the field of research by highlighting that improved interoceptive awareness in students is able to reduce complex behaviours in the classroom. A key contribution to new knowledge is this alternative way of engaging with children in the classroom, to effectively set students up for the best possible outcomes and enable them to develop and utilise self-regulation using strategies that are time efficient in a school setting and range in financial cost from free to low cost. This highlights that teaching interoception in schools is both a time and financially efficient and effective way of reducing behaviours that are challenging and/or disruptive to increase engagement in learning. In addition, interoceptive awareness teaching in the classroom built the teachers confidence in the management of students within positive educational environments. This may be best summarised by one of the Trial Primary School Principal's, who stated that;

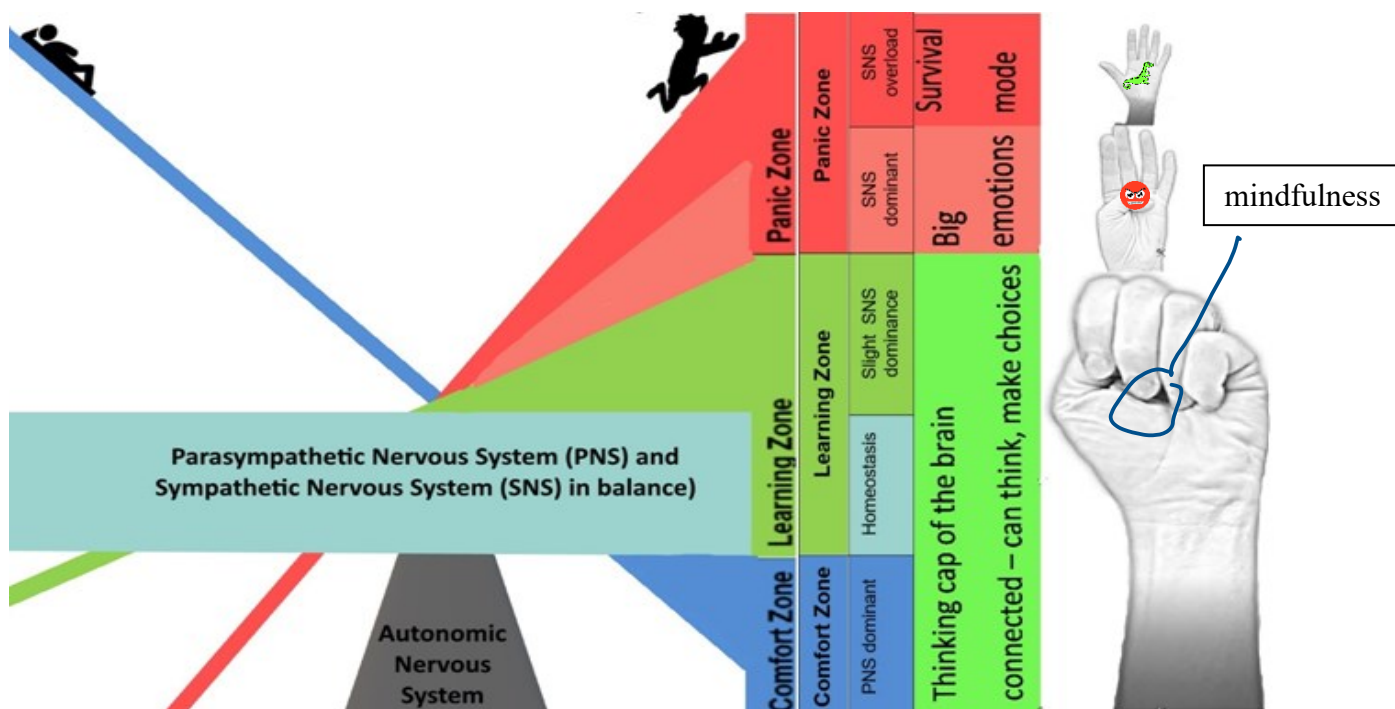
“interoception has been key to enabling our students to succeed and our teachers to understand that children cannot learn unless they are in the right emotional state. All the staff job descriptions have been updated to include a requirement to understand and use interoception activities with the students on a daily basis.”

A significant contribution to the wider community could be the proposed '*Zones of regulation and understanding behaviour framework*'. This framework is able to provide a theoretical reason for why a few minutes a day of interoceptive awareness activities seem so effective at improving behaviour and increasing engagement in learning. Figure 4 below visually represents this framework, which links Siegel's (2010) hand model of the brain to the functioning

of the human autonomic nervous system, and interoception, to illustrate that not all behaviour is a choice. This proposed ‘Zones of regulation and understanding behaviour framework’ clearly demonstrates that some behaviours are driven or controlled by aspects of the human brain that overrule choice making; such as the human survival instinct and that engaging the interoception part of the brain through mindful body awareness activities can neurologically and biologically calm individuals down. This framework is simple enough to teach young children, as evidenced by their ability to discuss and use the hand model of the brain with their teachers and the researcher. Staff were able to use the principles behind the framework to guide decision making about when to co-regulate students and to understand why this was necessary.

**Figure 4**

*Zones of regulation and understanding behaviour Goodall (2019)*



*Note.* Source Goodall, Department for Education (2019, p.3)

## **Limitations**

Some schools in South Australia have now been implementing interoception activities for four years. This research is limited by only having consistent data available for one year across twelve schools. Further data has been collected on individual schools and preschools that have been implementing interoception for up to four years. However, these schools and preschools applied various different methods to collect variable data sets that were inconsistent with the data in this thesis. In light of this, the anecdotal reports of consistently improved student engagement in learning and decreased incidences of challenging behaviour across all implementation settings, will need further research to confirm or deny outcomes. In addition, only qualitative, rather than quantitative, data was gathered on the impact of the interoception activities on the school staff. In hindsight, it would have been interesting to collect data on stress levels of staff both immediately following engaging in interoception activities and over the school year. This should be done via mobile data collection apps like Teamscope or ODK so that staff can respond real time while in the midst of stressful situations. It would also have been interesting to investigate the efficacy of teachers to support students displaying challenging behaviour before and after participating in interoception training and implementing interoception activities in their classrooms.

The focus was on interoception as an intervention but there are other variables that are outside of the researchers' control. This research did not seek to address whether any of these other variables such as teacher skill or student attendance levels impacted improvements in self-regulation and helpful behaviours in school. Another limitation of this research is that not all staff in every school was fully on board initially, with a couple of schools not coming on board until term two or even three. As a consequence, some schools had very inconsistent application of the interoception activities. This is reflected in the raw data table, which indicated when during the school year interoception activities were started. This could not have been foreseen, as the schools had all requested to be part of the trial, with the trial also being voted on and approved by regional

leadership. However, it was useful for the researcher to be able to reflect on data gathered and how this related to or was impacted by timing of school staff actively coming on board. This limitation led to implementation tweaks that were used in schools who asked for support from the researcher to implement interoception post-trial:

- The researcher would meet with leadership to discuss the four models, then the whole school staff would pick the model they would like to implement;
- Whole school staff would then receive professional development on interoception and how to implement the chosen model;
- Implementation was optional for the first term, then a staff meeting would be held to share anecdotes and school wide behaviour incident data, which so far has reported back to the researcher that classes implementing interoception activities have lower levels of disruptive and/or challenging behaviour than other classes. Following this staff meeting, all staff are required to do two or three 1-5 minute sessions of interoception daily;
- Following the whole school implementation termly staff meetings are held that focus on naturalistic ways to embed interoception into the school and updates on decreasing behavioural incident data.

In the region wide trial, there was massive staff turnover during the year. This impacted embedding of interoception in some schools. Interestingly, post-trial some schools have added interoception activity teaching into the job and person specifications for teachers at their school, to ensure that all staff, including new staff, do teach interoception activities at least twice a day going forward.

Counteracting some of these limitations was managed during twice termly, region wide professional development sessions where staff could share barriers to implementation and strategies to address these. Where schools who were not yet onboard with implementing

interoception already had a strategy in place for transitioning students from the yard to class, these strategies were used as a starting point to implement interoception. For example, schools using transition to class activities such as yoga or tai chi, discussed with the researcher how to make them interoceptive activities. The strategy used was to add the question; ‘where can you feel a difference in your body?’, and then repeat the yoga position or tai chi movement whilst trying to focus on what could be noticed about a specific part of their body. An example of students engaging in interoception through yoga during the trial is shown below in figure 17, illustrating downward dog and child’s pose.

**Figure 17**

*Students doing interoception through yoga poses*



After having segued into interoception through yoga, this school then started to use the activities from the ready to learn kit (appendix A) as illustrated in figure 18 below, where a student is doing one of the interoception breathing activities;

**Figure 18**

*Student breathing in and out, focusing on breath entering and leaving nostril*



This school summarised the difference that interoception has made in their school during the trial in this slide provided to the researcher:

**Figure 19**

*Slide presented to the researcher listing outcomes from implementing interoception in one school*

Here is just some of the great work our site has done with interoception:

- Hydration awareness. Charting drinking, temperature and weather.
- Using appropriate language to indicate heat when feeling hot. Our students can link warning signs such as 'red face' with the need to 'take your jumper off.'
- Knowing and identifying each part of the body and its movement.
- Being aware of 'breath' and the affect it can have on our emotional state.
- Creating interoceptive friendly spaces within our site.
- Fostering bodily awareness within our students.
- Modeling appropriate Interoceptive language and behavior.

Lastly, as there were no psychologists involved in the trial in any way, the implementation of all aspects of interoception activities and data collection, including using the bespoke interoception tracking sheet/skills record needed to be able to be done within the scope of practice



and skills of teachers, school counsellors, and teaching assistants. There were two incidents involving the tracking sheet about six months apart that led to an update in the guidance to schools on how to use the tracking sheet. Initially, schools were advised that a familiar staff member should discuss the areas of interoceptive awareness in the tracking sheet with the students. However, in each of these two incidents, the students became distressed that they did not have skills that some of their peers had. Prior to the students engaging in a discussion using the tracking sheet as a prompt, they were unaware that other people knew before they needed to go to the toilet, that they were going to need to go in a while and that other students knew when they were starting to get angry, rather than only knowing once they were extremely angry. These were the only two students who had this reaction and staff indicated that both students had significant trauma in their lives at the time of the trial. Field notes indicated that several hundred other students had been involved in discussions based on the interoception tracking sheet/skills record, without any negative reactions. Schools were advised that if students were known or reasonably suspected of currently experiencing significant trauma, then they should complete the tracking sheet for these students through observations only, and not discussion.

### **Future directions**

This research focused on using interoception activities to ascertain if these can decrease incidents of behaviour that negatively impact engagement in learning within schools. Theoretical links were made to the role of the autonomic nervous system in interoception and student's ability to be engaged in learning via the *Zones of regulation and understanding behaviour framework*. It would be interesting in future research to collect data on the cortisol levels of both children and adults engaging in interoception activities to ascertain reductions in cortisol short term and longer term when using interoception activities daily.

The positive impacts of this trial have significant implications for students, teachers, and schools aiming to improve belonging and well-being in education. The Department for Education

in South Australia has continued to trial interoception teaching in a variety of models across both pre-school and school sites since 2017 to evaluate if this data can be more widely replicated. This research has been encouraging for staff and students as well as their families, as students have demonstrated an acquisition of interoceptive awareness across the whole school cohort. The data indicates that it was beneficial for a much wider range of students than just those with an autism spectrum diagnosis, or high rates of behavioural incident notes on the department recording system. Students who have or continue to experience trauma have also benefited significantly with decreases in severity and frequency of disruptive behaviours in the school.

Future research could also investigate optimal amounts of interoception for different cohorts, for example anecdotally some staff in this research indicated that 20mins once a day was more beneficial for students who were living in traumatic situations, whereas most students were seen to become more able to self-regulate over 8-10 weeks with just 2-3 sessions of interoception activities of 1-5 minutes each session. Another area of potential future research is in the use of interoception activities in the areas of youth justice settings and as a support for self-regulation development for children and young people impacted by alcohol and/or other drugs in utero. A few of the students in this research were known to have been impacted by alcohol and/or other drugs in utero and were able to self-regulate in ways that decreased the frequency and severity of behaviour that negatively impacted their and their peer's engagement in learning in school after one to two terms of interoception activities. Similarly, many of the children contributing to this research experienced complex backgrounds and further research is needed to understand the potentially positive impacts of interoception activities beyond educational contexts such as within youth justice settings.

One of the most critical areas for future quantitative research is the methodological area, as a number of improvements can be made if data are again collected in schools. Within a School based multi-classroom setting it would be ideal to build into the research design a consideration of

how the data are to be nested at various levels. For example, each classroom within a common school could be investigated as a level of nesting with possible effects based on groups effects due to unique contextual factors within a classroom – such as class culture – teaching philosophy etc. and these variables could be associated with outcomes related to the interoception activities. Finally, more data from more diverse high schools and other geographic areas could help generalise the findings from the research.

## **Conclusion**

Both the quantitative and qualitative studies contributing to thesis have identified positive impacts of interoception training as reported by staff and students. Cost in time is not great and was recorded to be more than offset by increased focus and increased time for learning opportunities. Wide reaching impacts of improved interoceptive skills included not just decreasing dysregulated behaviour but increasing pro-social behaviour and on task learning. Personal highlights of the interoception trial for the researcher were being approached by students, staff, and family members in the community and being told that; “interoception makes my life better,” or “I am also to control myself now, when I couldn’t before” or “my child is so much happier now, they used to be so anxious about going to school that I was thinking of home schooling them.”

To build on these positive findings moving forward it will be important to see if these results are able to be replicated in other contexts where dysregulated behaviours are a significant issue such as violent offender rehabilitation programs and domestic violence prevention programs.

## References

- Aguiar, W., & Halseth, R. (2015). *Aboriginal peoples and historic trauma: the processes of intergenerational transmission*. National Collaborating Centre for Aboriginal Health Centre de collaboration nationale de la santé autochtone.
- Ahissar, M., Nahum, M., Nelken, I., & Hochstein, S. (2009). Reverse hierarchies and sensory learning, *Philosophical transactions of the Royal Society B*, 364(1515).  
<https://doi.org/10.1098/rstb.2008.0253>
- Badoud, D. & Tsakiris, M. (2017). From the body's viscera to the body's image: Is there a link between interoception and body image concerns? *Neuroscience & Biobehavioural reviews*, 77, 237-246. <https://doi.org/10.1016/j.neubiorev.2017.03.017>
- Balzarotti, S., Biassoni, F., Villani, D., Prunas, A., & Velotti, P. (2016). Individual differences in cognitive emotion regulation: Implications for subjective and psychological well-being, *Journal of Happiness Studies*, 17, 125-143. DOI 10.1007/s10902-014-9587-3
- Berriman, J., Stevenson, R. J., Thayer, Z. C., Thompson, E., Mohamed, A., Watson, J. D. G., Miller, L. A. (2016). Testing the importance of the medial temporal lobes in human interoception: Does it matter if there is a memory component to the task?, *Neuropsychologia*, 91, 371-379. <https://doi.org/10.1016/j.neuropsychologia.2016.09.005>
- Birt, L., Scott, S., Cavers, D., Campbell, C., & Walter, F. (2016). Member Checking: A Tool to Enhance Trustworthiness or Merely a Nod to Validation? *Qualitative Health Research*, 26(13), 1802 –1811. <https://doi.org/10.1177/1049732316654870>
- Blair, C. & Raver, C. C. (2015). School readiness and self-regulation: A developmental psychobiological approach, *Annual Review of Psychology*, 66, 711-731.  
<https://doi.org/10.1146/annurev-psych-010814-015221>
- Brewer, R., Cook, R., & Bird, G. (2016). Alexithymia: A general deficit of interoception. *Royal Society Open Science*, 3(10). <https://doi.org/10.1098/rsos.150664>

- Brown, K., Ryan, R., & Creswell, J. (2007). Mindfulness: Theoretical Foundations and Evidence for its Salutary Effects. *Psychological Inquiry*, 18(4), 211-237.
- Cali, G., Ambrosini, E., Picconi, L., & Mehling, W. (2015). Frontiers | Investigating the relationship between interoceptive accuracy, interoceptive awareness, and emotional susceptibility | Psychology. Retrieved 23 July 2019, from <https://www.frontiersin.org/articles/10.3389/fpsyg.2015.01202/full>
- Clarke, V., & Braun, V. (2013). Teaching thematic analysis: Overcoming challenges and developing strategies for effective learning. *The Psychologist*, 26(2), 120-123. <https://doi.org/10.1037/13620-004>
- Cook-Cottone, C. P. (2015). *Mindfulness and yoga for self-regulation: A primer for mental health professionals*. Springer Publishing Company. ProQuest Ebook Central, <http://ebookcentral.proquest.com/lib/usq/detail.action?docID=2166654>. Created from usq on 2019-07-11 05:51:10.
- Craig, A. D. (2002). How do you feel? Interoception: The sense of the physiological condition of the body. *Nature Reviews Neuroscience*, 3(8), 655–666. <https://doi.org/10.1038/nrn894>
- Craig, A. D. (2003). Interoception: the sense of the physiological condition of the body. *Current Opinion in Neurobiology*, 13(4), 500-505. [https://doi.org/10.1016/S0959-4388\(03\)00090-4](https://doi.org/10.1016/S0959-4388(03)00090-4)
- Craig, A. D. (2007). Interoception and emotion: a neuroanatomical perspective. In: Lewis M, Haviland-Jones JM, Feldman Barrett L, editors. *Handbook of emotions*. New York: Guilford Press. pp. 272–290.
- Craig, A. D. (2009). How do you feel--now? The anterior insula and human awareness. *Nature Reviews Neuroscience*, 10(1), 59–70. <https://doi.org/10.1038/nrn2555>
- Creamer, E. G. (2017). *An introduction to fully integrated mixed methods research*. SAGE Publications.

- Couto, B., Adolphi, F., Sedeño, L., Salles, A., Canales-Johnson, A., Alvarez-Abut, P., ... & Manes, F. (2015). Disentangling interoception: insights from focal strokes affecting the perception of external and internal milieu. *Frontiers in psychology, 6*, 503. <https://doi.org/10.3389/fpsyg.2015.00503>
- Damasio, A. (1999). *Feeling of What Happens: Body and Emotion in the Making of Consciousness*. New York, NY: Houghton Mifflin Harcourt.
- Department for Education (2019) *Ready to Learn Interoception Kit*. Adelaide: Department for Education.
- Department for Education, Regulation scale - HSP432. Adelaide: Department for Education.
- Duckworth, A. L., & Carlson, S. M. (2013). Self-regulation and school success. *Self-regulation and autonomy: Social and developmental dimensions of human conduct, 40*, 208.
- Durie, M. (n.d) *Te Whare Tapa Whā, Maori health model*. Ministry of Health – Manatū Hauora. Retrieved from <https://www.health.govt.nz/our-work/populations/maori-health/maori-health-models/maori-health-models-te-whare-tapa-wha>
- Eriksson, P. S., Perfilieva, E., Björk-Eriksson, T., Alborn, A.-M., Nordborg, C., Peterson, D. A., & Gage, F. H. (1998). Neurogenesis in the adult human hippocampus. *Nature Medicine, 4*(11), 1313. <https://doi.org/10.1038/3305>
- Evans, G. W., & Kim, P. (2013). Childhood poverty, chronic stress, self-regulation, and coping. *Child development perspectives, 7*(1), 43-48. <https://doi/10.1111/cdep.12013>
- Farb, N. A., Anderson, A. K., & Segal, Z. V. (2012). The mindful brain and emotion regulation in mood disorders. *Canadian Journal of Psychiatry. Revue Canadienne de Psychiatrie, 57*(2), 70–77. <https://doi.org/10.1177/070674371205700203>
- Flook, L., Goldberg, S.B., Pinger, L.J., & Davidson, R. J. (2015). Promoting prosocial behavior and self-regulatory skills in preschool children through a mindfulness-based kindness

- curriculum. *Developmental Psychology*, 51(1), 44–51. PMID: PMC4485612  
<http://centerhealthyminds.org/assets/files-publications/FlookPromotingDevPsych.pdf>
- Fox Lee, S. (2019). Psychology's own mindfulness: Ellen Langer and the social politics of scientific interest in “active noticing”. *Journal of the History of the Behavioral Sciences*, 55(3), 216-229. <https://doi-org.ezproxy.usq.edu.au/10.1002/jhbs.21975>
- Furman, D. J., Waugh, C. E., Bhattacharjee, K., Thompson, R. J., & Gotlib, I. H. (2013). Interoceptive awareness, positive affect, and decision making in Major Depressive Disorder. *Journal of Affective Disorders*, 151(2), 780–785. Retrieved from [https://www.academia.edu/30715453/Interoceptive\\_awareness\\_positive\\_affect\\_and\\_decision\\_making\\_in\\_Major\\_Depressive\\_Disorder](https://www.academia.edu/30715453/Interoceptive_awareness_positive_affect_and_decision_making_in_Major_Depressive_Disorder)
- Füstös, J., Gramann, K., Herbert, B. M., & Pollatos, O. (2012). On the embodiment of emotion regulation: interoceptive awareness facilitates reappraisal. *Social cognitive and affective neuroscience*, 8(8), 911-917. <https://doi-org.ezproxy.usq.edu.au/10.1093/scan/nss089>
- Gannon, L. (1977). The role of interoception in learned visceral control. *Biofeedback and Self-Regulation*, 2(4), 337–347. <https://doi.org/10.1007/BF00998621>
- Garfinkel, S. N., Tiley, C., O’Keefe, S., Harrison, N. A., Seth, A. K., & Critchley, H. D. (2016). Discrepancies between dimensions of interoception in autism: Implications for emotion and anxiety, *Biological Psychology*, 114, 117-126.  
<https://doi.org/10.1016/j.biopsycho.2015.12.003>
- Goleman, D. (1995). *Emotional Intelligence: Why it can matter more than IQ*. New York: Bantam Books.
- Goodall, E. (2016). Interoception 101 Activity Guide, Department for Education, South Australia
- Goodall, E. (2016/17) Models of interoception for DECD sites – internal working document, Department for Education and Child Development, South Australia.

- Goodall, E. (2019) *Helping Children Understand and Express Emotions.: A practical interoception activity book*. Adelaide: Healthy Possibilities
- Grecucci, A., Koch, I., & Rumiati, R. I. (2011). The role of emotional context in facilitating imitative actions. *Acta Psychologica*, 138(2), 311–315.  
<https://doi.org/10.1016/j.actpsy.2011.07.005>
- Gross, J.J. & Thompson, R.A. (2007). Emotion regulation: conceptual foundations. In: Gross, J.J., editor. *Handbook of Emotion Regulation*. New York: Guilford, pp. 3–24.
- Hebb, D.O. (1949). *The Organization of Behavior*. New York: J Wiley.
- Heatherton, T. F., & Tice, D. M. (1994). *Losing control: How and why people fail at self-regulation*. San Diego, CA: Academic Press.
- Herman, J. L. (2015). *Trauma and recovery: The aftermath of violence--from domestic abuse to political terror*. Hachette UK.
- Holub, A., Horne-Moyer, L., & Abar, B. (2018). Mental Health Considerations in Developmental Disabilities: Associated Issues, Impacts, and Solutions. *Families in Society*, 99(1), 11–15.  
<https://doi.org/10.1177/1044389418756368>
- Idusohan-Moizer, H., Sawicka, A., Dendle, J., & Albany, M. (2015). Mindfulness-Based Cognitive Therapy for Adults with Intellectual Disabilities: An Evaluation of the Effectiveness of Mindfulness in Reducing Symptoms of Depression and Anxiety. *Journal of Intellectual Disability Research*, 59(2), 93-104.
- Iuculano, T., Rosenberg-Lee, M., Richardson, J., Tenison, C., Fuchs, L., Supekar, K., & Menon, V. (2015). Cognitive tutoring induces widespread neuroplasticity and remediates brain function in children with mathematical learning disabilities. *Nature communications*, 6, 8453.



- Kanbara, K., & Fukunaga, M. (2016). Links among emotional awareness, somatic awareness and autonomic homeostatic processing. *BioPsychoSocial Medicine*, 10(1), 16.  
<https://doi.org/10.1186/s13030-016-0059-3>
- Khoury, N. M., Lutz, J., & Schuman-Olivier, Z. (2018). Interoception in Psychiatric Disorders: A Review of Randomized, Controlled Trials with Interoception-Based Interventions, *Harvard Review of Psychiatry*, 26(5), 250–263.  
<https://doi.org/10.1097/HRP.0000000000000170>
- Kuhn, M. A., Ahles, J. J., Aldrich, J. T., Wielgus, M. D., & Mezulis, A. H. (2018). Physiological self-regulation buffers the relationship between impulsivity and externalizing behaviors among nonclinical adolescents. *Journal of Youth and Adolescence*, 47(4), 829-841.  
<https://dx.doi.org/10.1007/s10964-017-0689-1>
- Langner, R., Leiberg, S., Hoffstaedter, F., & Eickhoff, S. B. (2018). Towards a human self-regulation system: common and distinct neural signatures of emotional and behavioural control. *Neuroscience & Biobehavioral Reviews*, 90, 400-410.  
<https://doi.org/10.1016/j.neubiorev.2018.04.022>
- Lanius, R. A., Frewen, P. A., Tursich, M., Jetly, R., & McKinnon, M. C. (2015). Restoring large-scale brain networks in PTSD and related disorders: A proposal for neuroscientifically-informed treatment interventions. *E Psychotraumatol*, 6, 27313.  
<https://doi.org/10.3402/ejpt.v6.27313>
- Lewis, M., Haviland-Jones, Jeannette M, & Barrett, Lisa Feldman. (2008). *Handbook of emotions* (3rd ed.). New York: Guilford Press.
- Lynch, S. A., & Simpson, C. G. (2004). Sensory processing: Meeting individual needs using the seven senses. *Young Exceptional Children*, 7(4), 2-9. .
- Mahler, K., (2017). *Interoception: The eighth sensory system*. Lexena: AAPC Publishing.
- Mayer, J. D., Salovey, P., & Caruso, D. R. (2008). Emotional intelligence: New ability or eclectic traits?. *American psychologist*, 63(6), 503.

- McCrudden, M. T., Marchand, G., & Schutz, P. (2019). Mixed methods in educational psychology inquiry. *Contemporary Educational Psychology*, 57, 1–8.  
<https://doi.org/10.1016/j.cedpsych.2019.01.008>
- McHugh, M. L. (2013). The chi-square test of independence. *Biochemia medica*, 23(2), 143-149.  
<https://doi.org/10.11613/BM.2013.018>
- Mehling, W. E., Chesney, M. A., Metzler, T. J., Goldstein, L. A., Maguen, S., Geronimo, C., Neylan, T. C. (2018). A 12-week integrative exercise program improves self-reported mindfulness and interoceptive awareness in war veterans with posttraumatic stress symptoms. *Journal of Clinical Psychology*, 74(4), 554–565.  
<https://doi.org/10.1002/jclp.22549>
- Meessen, J., Mainz, V., Gauggel, S., Volz-Sidiropoulou, E., Sütterlin, S., & Forkmann, T. (2016). The relationship between interoception and metacognition: A pilot study. *Journal of Psychophysiology*, 30(2), 76–86. <https://doi.org/10.1027/0269-8803/a000157>
- Morrow, S. L. (2005). Quality and trustworthiness in qualitative research in counseling psychology. *Journal of counseling psychology*, 52(2), 250. <https://doi.org/10.1037/0022-0167.52.2.250>
- Moses, L.J. & Baird, J.A., (1999). Metacognition. In Wilson, R.A., & Keil, F.C. (Eds.). *The MIT encyclopaedia of the cognitive sciences* (pp. 533-535). Cambridge, MA:MIT Press.
- Mul C.L, Stagg S.D, Herbelin B., Aspell J.E. (2018) The Feeling of Me Feeling for You: Interoception, Alexithymia and Empathy in Autism. *J Autism Dev Disord*. 48(9):2953-2967. doi:10.1007/s10803-018-3564-3
- Murphy, J., Brewer, R., Catmur, C., & Bird, G. (2017). Interoception and psychopathology: A developmental neuroscience perspective, *Developmental Cognitive Neuroscience*, 23, 45-56. <https://doi.org/10.1016/j.dcn.2016.12.006>

- Nahum, M., Lee, H., & Merzenich, M. M. (2013). Chapter 6—Principles of Neuroplasticity-Based Rehabilitation. In M. M. Merzenich, M. Nahum, & T. M. Van Vleet (Eds.), *Progress in Brain Research* (pp. 141–171). <https://doi.org/10.1016/B978-0-444-63327-9.00009-6>
- Nathan, P. (2019). Creating a safe supportive environment (CASSE): a psychodynamically-informed community intervention for Aboriginal communities in Central Australia. In *Contemporary Psychodynamic Psychotherapy* (pp. 361-372). Academic Press. <https://doi.org/10.1016/B978-0-12-813373-6.00025-8>
- Neukirch, N., Reid, S., & Shires, A. (2019). Yoga for PTSD and the role of interoceptive awareness: A preliminary mixed-methods case series study. *European Journal of Trauma & Dissociation*, 3(1), 7-15.
- Nicholson, A. A., Sapru, I., Densmore, M., Frewen, P. A., Neufeld, R.W., Theberge, J., Lanius, R. A. (2016). Unique insula subregion resting-state functional connectivity with amygdala complexes in posttraumatic stress disorder and its dissociative subtype. *Psychiatry Res*, 250, 61–72. <https://doi.org/10.1016/j.psychresns.2016.02.002>
- Nigg, J. T. (2017). Annual Research Review: On the relations among self-regulation, self-control, executive functioning, effortful control, cognitive control, impulsivity, risk-taking, and inhibition for developmental psychopathology, *The Journal of Child Psychology and Psychiatry*, 58(4), 361-383. <https://doi.org/10.1111/jcpp.12675>
- Pascoe, M., & Crewther, S. G. (2017). A systematic review of randomised control trials examining the effects of mindfulness on stress and anxious symptomatology. *Psychoneuroendocrinology*, 86, 152-168. <https://doi.org/10.1016/j.psyneuen.2017.08.008>
- Popham, M., Counts, J., Ryan, J. B., & Katsiyannis, A. (2018). A systematic review of self-regulation strategies to improve academic outcomes of students with EBD. *Journal of Research in Special Educational Needs*, 18(4), 239-253.

- Pulotu-Endemann, F.K. (2007). *A Pacific Model of Health: The Fonofale Model*. . Ministry of Health – Manatū Hauora. Retrieved from <http://apps.centralpho.org.nz/Permalink/MoM/General%20Documents/MoM/Published/Pacific%20Health%20Forms/Fonofale%20model.pdf>
- Schauder, Mash, Bryant, & Cascio. (2015). Interoceptive ability and body awareness in autism spectrum disorder. *Journal of Experimental Child Psychology, 131*, 193-200.
- Sher, M. L. (2016). How Getting a Lot Done Can Get in the Way of Major Success. *Canadian Manager, 41*(1), 29–31.
- Siegel, D. J. (2010). *Mindsight: The new science of personal transformation*. New York, Bantam Dell Publishing.
- Simmons, A., Strigo, I. A., Matthews, S. C., Paulus, M. P., & Stein, M. B. (2009). Initial evidence of a failure to activate right anterior insula during affective set shifting in posttraumatic stress disorder. *Psychosom Med, 71*(4), 373–377. <https://doi.org/10.1097/PSY.0b013e3181a56ed8>
- Sousa, B. J., & Clark, A. M. (2018). Sharing Diverse Voices: An Imperative for Qualitative Research. *International Journal of Qualitative Methods, 17*, 1–2. <https://doi-org.ezproxy.usq.edu.au/10.1177/1609406918822012>
- Tashakkori, A., & Creswell, J. W. (2007). The new era of mixed methods. *Journal of Mixed Methods Research, 1*, 3-7. <https://doi.org/10.1177/2345678906293042>
- Van der Kolk, B. A., Stone, L., West, J., Rhodes, A., Emerson, D., Suvak, M., & Spinazzola, J. (2014). Original research yoga as an adjunctive treatment for posttraumatic stress disorder: A randomized controlled trial. *J Clin Psychiatry, 75*(6), e559-e565.
- Wasserstein, R. L., & Lazar, N. A., (2016) The ASA Statement on p-Values: Context, Process, and Purpose, *The American Statistician, 70*:2, 129-133, <https://doi.org/10.1080/00031305.2016.1154108> Weiss, S., Sack, M., Henningsen, P., &

- Pollatos, O. (2014). On the interaction of self-regulation, interoception and pain perception. *Psychopathology*, 47(6), 377-382.
- Wellman, H.M., (1985). The child's theory of mind: The development of conceptions of cognition. In Yussen, S.R., (Ed.) *The growth of reflection in children* (pp 169-206) New York: Academic.
- Wilutzky, W. (2015). Emotions as pragmatic and epistemic actions. *Frontiers in Psychology*, 6. <https://doi.org/10.3389/fpsyg.2015.01593>
- Yehuda, R., Daskalakis, N. P., Bierer, L. M., Bader, H. N., Klengel, T., Holsboer, F., & Binder, E. B. (2016). Holocaust Exposure Induced Intergenerational Effects on FKBP5 Methylation. *Biological Psychiatry*, 80(5), 372–380. <https://doi.org/10.1016/j.biopsych.2015.08.005>
- Yoris, A., Esteves, S., Couto, B., Melloni, M., Kichic, R., Cetkovich, M. Sedeño, L. (2015). The roles of interoceptive sensitivity and metacognitive interoception in panic. *Behavioral and Brain Function: BBF*, 11, 14.
- Zamariola, G., Frost, N., Van Oost, A., Corneille, O., & Luminet, O. (2019). Relationship between interoception and emotion regulation: New evidence from mixed methods. (Report). *Journal of Affective Disorders*, 246, 480–485. <https://doi.org/10.1016/j.jad.2018.12.101>
- Zener, D. (2019), "Helping autistic women thrive", *Advances in Autism*, Vol. 5 No. 3, pp. 143-156. <https://doi.org/10.1108/AIA-10-2018-0042>
- Zitron, L., & Gao, Y. (2017). The Effects of Mindfulness Based Interventions on Physiological Regulation. In *Weaving Complementary Knowledge Systems and Mindfulness to Educate a Literate Citizenry for Sustainable and Healthy Lives* (pp. 387-400). Brill Sense.

## **Appendix A – Interception Activities provided to the schools**

## Interoception – Activities

### Feeling – muscles (hands)

- Sitting down, just rest your hands on the top of your thighs (demonstrate)
- Now stretch your fingers as wide apart as possible and hold them tense like that for 30 seconds
- Rest them back again, now they should be relaxed
- Where could you feel your muscles when your hands were stretched?



Image – hand relaxed, resting on thighs



Image - hand stretched out



Image – hand relaxed, resting on thighs



Image - hands stretched out with big question mark

### Feeling – muscles (feet)

- Sitting down, just rest your feet flat on the floor (demonstrate)
- Now stretch your toes as wide apart as possible and hold them tense like that for 30 seconds
- Now curl your toes under and hold them curled for 30 seconds.
- Rest them back again, now they should be relaxed
- Where could you feel your muscles when your toes were stretched and when they were curled?



Image – feet, toes relaxed



Image - feet with toes stretched out



Image – feet with toes curled under



Image feet one stretched, one curled with big question mark

**Feeling – muscles (arms)**

- Standing up put your hands flat on the wall and just hold them there (demonstrate)



- Now push the wall as hard as you can for 30 seconds
- Stop pushing and relax your arms by your side
- Where could you feel your muscles when you were pushing against the wall?

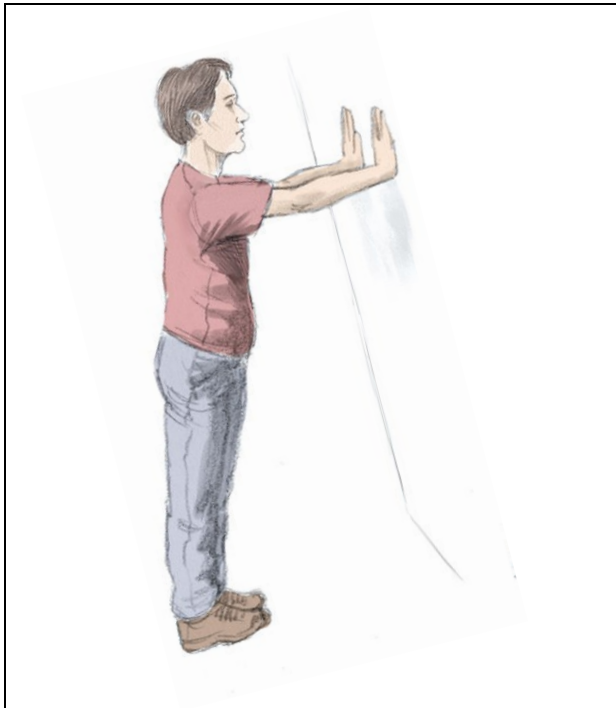


Image – arms out, hands flat on wall relaxed posture

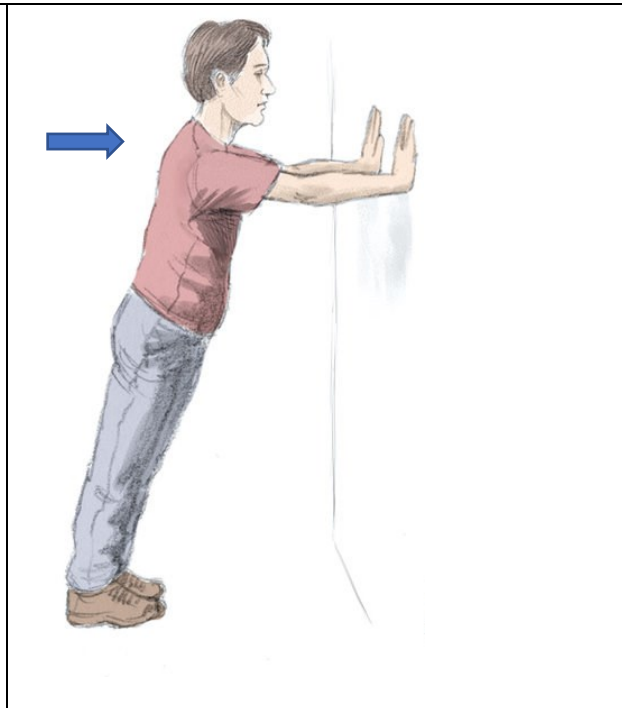


Image – arms out, hands flat on wall, pushing on wall



Image – arms down by sides relaxed



Image one arms out pushing, one down relaxed with big question mark

**Feeling – muscles (legs)**

- Standing up put one foot in front of the other with both feet facing forward and legs hip width apart, both feet flat on the floor (demonstrate)
- Now move the front foot so that it only has the heel touching the floor, where can you feel something? That is your muscle stretching on the back of your calf.
- Now point your toes on that front foot so only your toes are touching the floor. Can you feel something in your foot as well as your leg?
- Put your feet back flat on the floor and change which leg is in front, then repeat the heel touch and toe touch. Does it feel the same or different?
- What about if you stretch your leg behind and do heel touch or toe touch? Does that feel the same or different?



Image – Standing up put one foot in front of the other with both feet facing forward and legs hip width apart, both feet flat on the floor



Image – front foot heel touching floor



Image – front foot toes touching floor in point



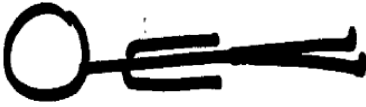
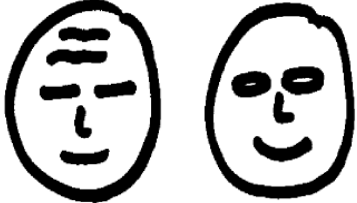





Image - back foot heel, back foot toes

***Follow on activity/exploration:***

- *Can you have one foot pointed and one heel touching the floor at the same time?*
- *Can you move your legs in other ways to feel other muscles in your legs?*

**Feeling – muscles – whole body**

- Lie down in a space on the floor, with your arms relaxed by your side, you can close your eyes if you want to. Breathe slowly.
- As you breathe in scrunch your eyes and forehead and then as you breathe out relax them again.
- As you breathe in open your mouth as wide as possible then as you breathe out relax your mouth.
- Keep breathing slowly.
- As you breathe in stretch your fingers apart as wide as possible, then as you breathe out, relax your fingers.
- Now stretch your fingers and your arms as you breathe in, stretch as much as possible.
- As you breathe out, relax your arms and fingers.
- As you breathe in curl your toes up to scrunch your feet, then relax your feet as you breathe out.
- Now as you breathe in scrunch your toes up and pull your feet in towards your body just using your leg muscles, and relax as you breathe out.
- Breathe slowly in and out for a few breaths and then when you are ready, breathe in and tense up your face, hands, arms, feet and legs and then slowly breathe out and relax all the muscles.
- Stay relaxed and breathe in and out slowly for a few more breaths.

	
 <p>in      out</p>	
	
	<p><b>Tense everywhere then relax</b></p>

## Feeling – temperature 1

- Stand still – concentrate on how hot, warm, cool or cold your hands feel. Touch your arms with your hands. Are your arms warmer or cooler than your hands?
- (after 10 -30 seconds) – Now, rub your hands together really fast for 30 seconds, I will tell you when to stop.
- Ok, stop now. Do your hands feel warmer or colder than before? Touch your arms with your hands. Are your your arms warmer or cooler than your hands?

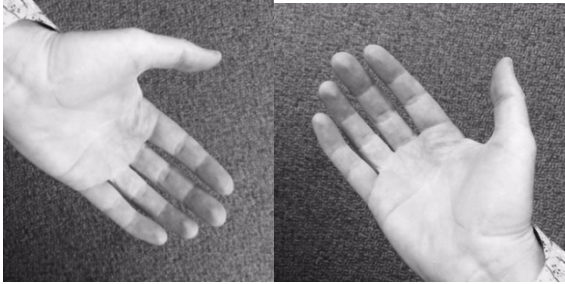


Image – hands



Image - hands touching arms



Image - rubbing hands and 30seconds



Image - hands touching arms

### *Follow on activity/exploration:*

- *How could we cool our hands down when they are hot?*
- *What is the safe temperature range for human bodies?*
- *How do humans cool down/warm up?*

## Feeling – temperature 2

- Stand still – concentrate on how hot, warm, cool or cold your body feels. Touch your face with your hands. How warm or cool does your face feel?
- (after 10 -30 seconds) – Now, run really fast on the spot for one minute, I will tell you when to stop.
- Ok, stop now. Touch your face with your hands. Does your face feel warmer or colder than before?



Image – hands on side of face



Image running & one minute



Image - hands on side of face



Thermometer

### *Follow on activity/exploration:*

- *How can we measure body temperature?*
- *Does your face get hotter or colder if you go outside?*

### Feeling – temperature 3

NB this requires a box of paperclips half of which have been in the freezer

- Give each student a room temperature paper clip.
- How does the paperclip feel? Is it hot, warm, cool or cold?
- Ok put the paper clip down and come and get one out of the box (from the freezer).
- How does this paper clip feel? Is it hot, warm, cool or cold?
- Now pick up the other paper clip in your other hand – does it feel warmer or cooler than it did before?

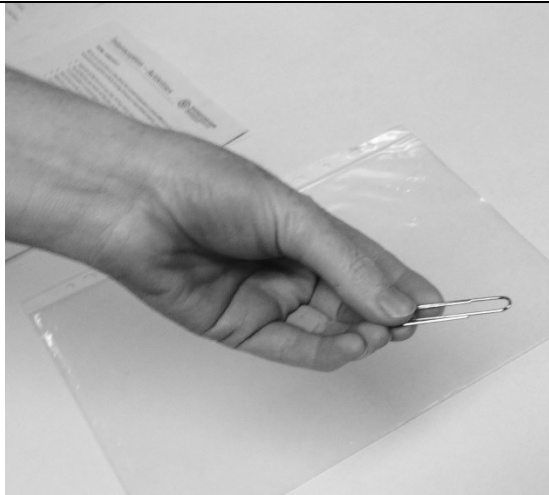


Image – hand holding paper clip



Image - other hand holding other paper clip



Image - hands each holding paper clip



Thermometer

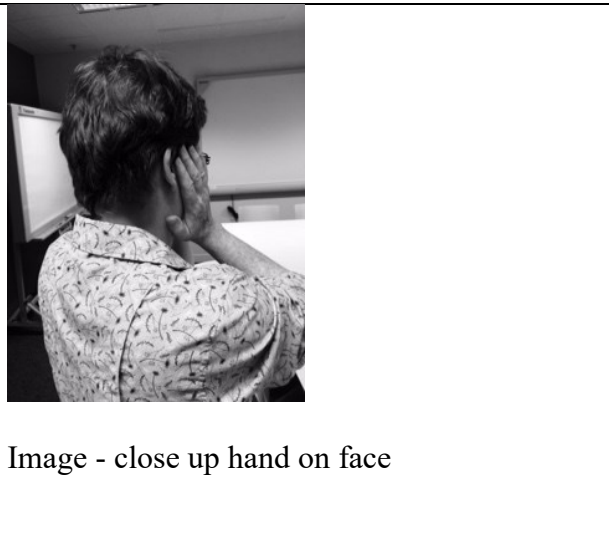
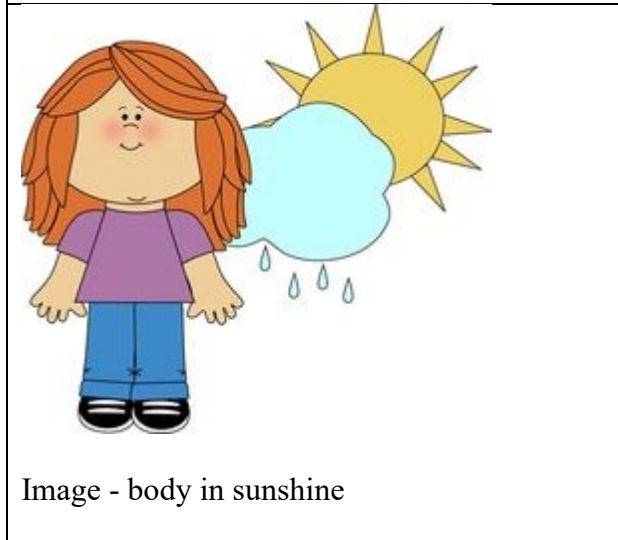
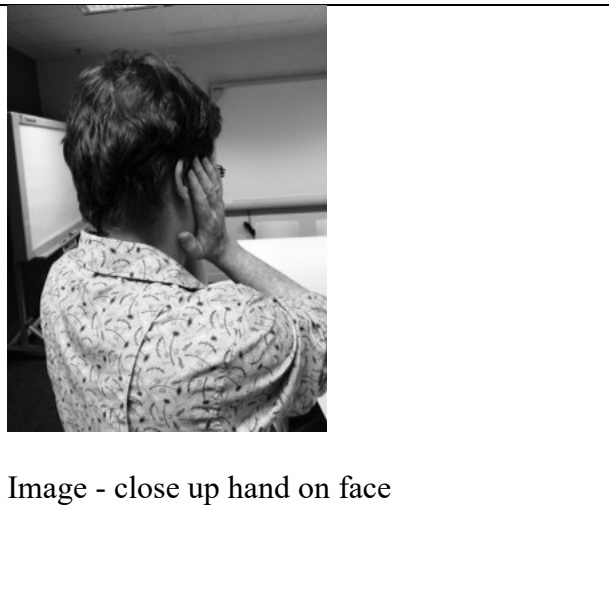
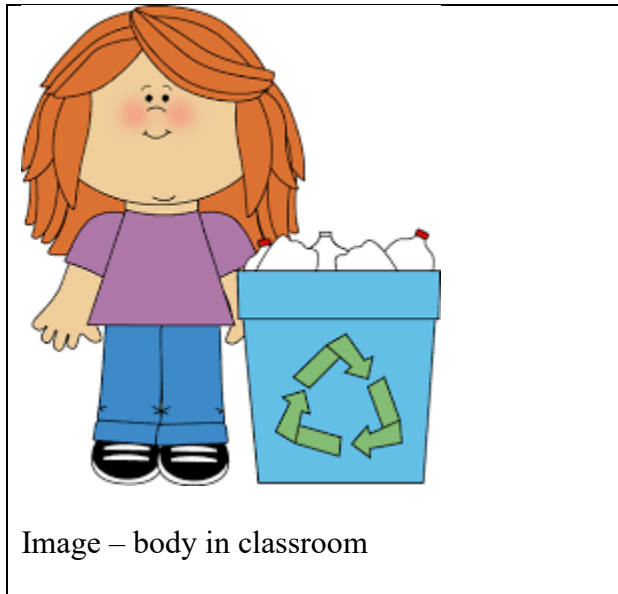
#### ***Follow on activity/exploration:***

- *Would the cold clip feel less cold if you wear gloves?*
- *How does having cold fingers make your body feel?*

## Feeling – temperature 4

NB this can only be done on a day where the outside temperature is quite different to the classroom temperature (can be done inside by turning off aircon or heat instead of going outside)

- Stand still and feel the air on your skin. Is it hot, warm, cool or cold?
- Try and feel how your hands and face feel, do they feel the same temperature or different? Is it comfortable or uncomfortable?
- Now let's go outside for a few minute (or turn the aircon/heating off for 5 minutes)
- Stand still and feel the air on your skin. Is it hot, warm, cool or cold?
- Try and feel how your hands and face feel, do they feel the same temperature or different? Is it comfortable or uncomfortable?
- Which air temperature did you prefer?

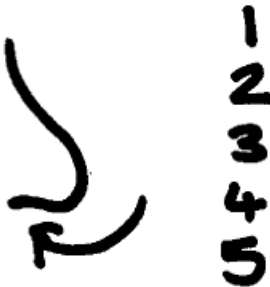

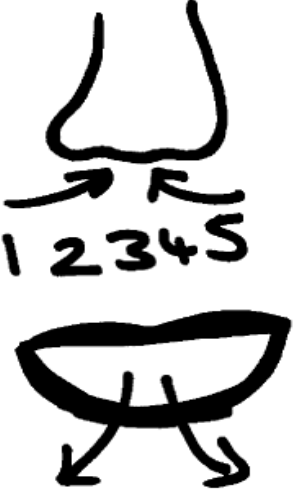



### ***Follow on activity/exploration:***

- *Why do people wear some clothes in some weather and not others? Explore clothing and response to temperatures across cultures.*

## Feeling – breathing 1

- Sit comfortably, on your chair or on the floor, close your eyes
- Breathe in through your nose whilst counting to 5 in your head (teacher to count out loud to support this initially)
- Then open your mouth and breathe out through your mouth
- Close your mouth and breathe in through your nose again whilst counting to five (teacher can say In, two, three, four, five, and open mouth breathe out)
- (Keep doing this for about a minute) How do you feel? Which parts of your body moved when you were breathing in? Did it feel different breathing in from breathing out?

	
<p>Image – arrows going into nose big 5</p>	<p>Image - arrows coming out of mouth</p>
	
<p>Image – arrows going into nose big 5 and arrows coming out of mouth</p>	<p>Picture - seated person and ?</p>

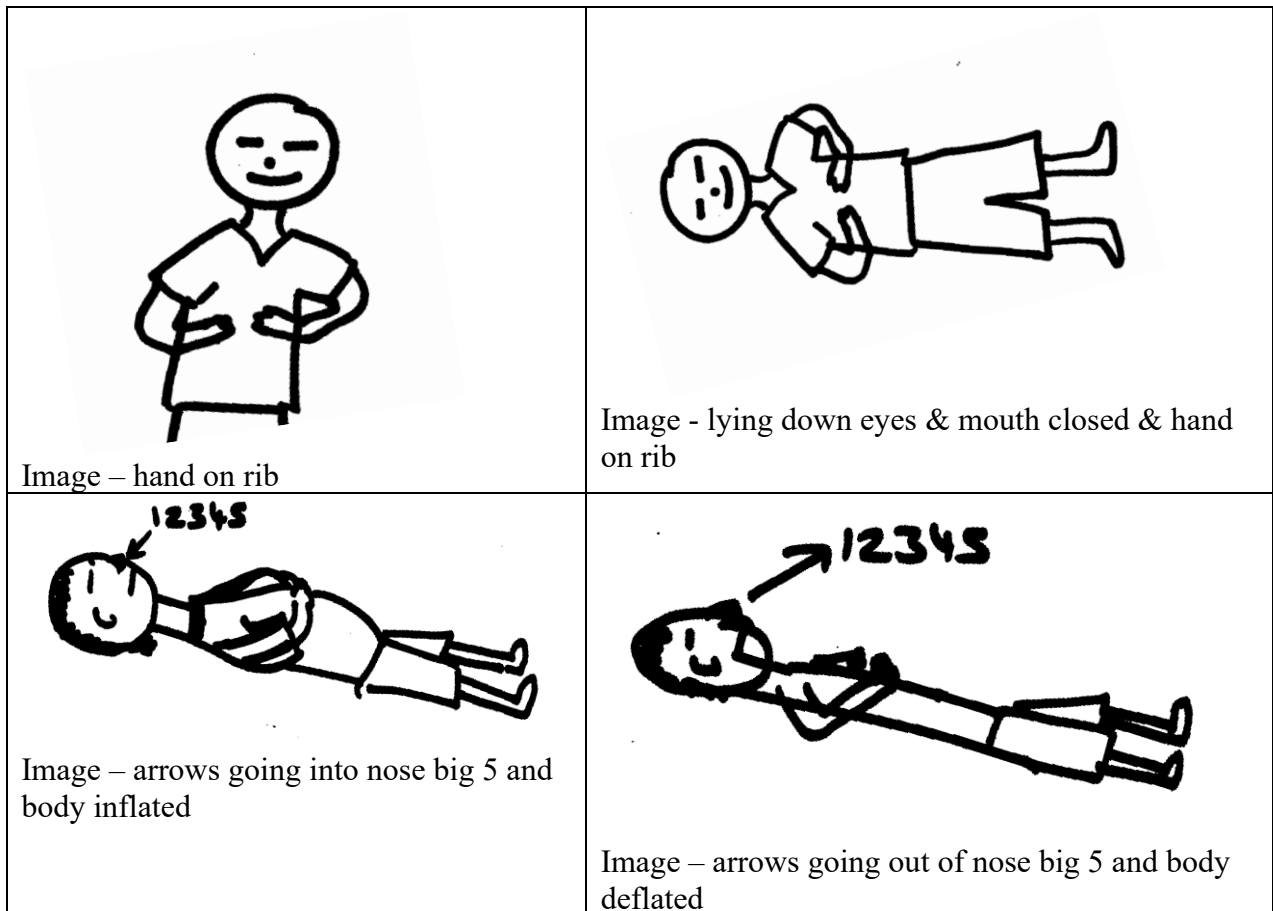
### Follow on activity/exploration:

- *Blowing balloons up – as they **inflate** explain that is like the air being breathed **INTO** our lungs and when the balloon lets air out, it is like us **exhaling** which is the other word for breathing out.*
- *What are we breathing? What is air? What is air made of? Why do we need it?*
- *Can you make your breathing faster or slower? How? What happens when you breathe fast? How does it make the rest of your body feel?*



## Feeling – breathing 2

- Place your hand over the centre of your ribs or just below your ribs (demonstrate).
- Lie down, relax and feel comfortable, close your eyes and keep your mouth closed.
- Make sure your hand is just resting on your ribs or just below and not pressing hard.
- Breathe in slowly and deeply through your nose, you should feel your hand rising as your lungs fill with air.
- Now breathe out slowly through your nose, keep breathing out, you should feel your hand moving back down as the air goes out of your lungs and your body deflates with your lungs.
- Keep practising this breathing in and out for about a minute, see if you can feel your body moving even if you move your hand off your ribs.



### *Follow on activity/exploration:*

- *Does your body rise and fall differently when you breathe in and out through your mouth?*
- *What do our lungs do? Where are they?*
- *How can we keep our lungs healthy?*

### Feeling – breathing 3

- Sit comfortably, on your chair or on the floor, close your mouth and your eyes
- For this exercise we are going to breathe in and out through our nose slowly and quietly
- Whilst you are breathing in and out focus on the feeling the air entering and exiting your nostrils, if you can't feel it yet, just keep breathing
- When you can feel the air going in and out of your nose, see how far into your nose and/or body you can feel the air entering
- If you get distracted, just return to focusing on your breathing, slowly and quietly and feeling the air passing into your nose and leaving your body



#### *Follow on activity/exploration:*

- *Do this breathing exercise after recess and lunch for a week – did it help you to focus on your work?*

## Feeling – pulse 1

- Your heart is a pump which pumps blood around your body through your arteries. Where the arteries are close to your skin you can feel the blood moving, the movement of your blood is called your pulse. You can feel your pulse in several places, by gently feeling an artery with your fingertips. You can also count how fast your heart is beating.
- The easiest place to feel your pulse is on your wrist. Sit down and rest your hand on your leg with your thumb up in the air and your palm facing up.
- With the first two fingers of your other hand, stroke from the top of your thumb down the side until your fingers reach your wrist.
- Move your fingers slowly onto the inside of your wrist, and gently feel for your pulse.
- When you have found your pulse you can count how many beats in 15 seconds (TEACHER TO TIME 15 SECONDS).
- Students who are able to can times their score by 4, which gives them their pulse rate per minute.



### *Follow on activity/exploration:*

- *How does your breathing change when you are trying to find your pulse?*

## Feeling – pulse 2

- Sit down and rest your hand on your leg with your thumb up in the air and your palm facing up.
- With the first two fingers of your other hand, stroke from the top of your thumb down the side until your fingers reach your wrist.
- Move your fingers slowly onto the inside of your wrist, and gently feel for your pulse.
- When you have found your pulse you can count how many beats in 15 seconds (TEACHER TO TIME 15 SECONDS).
- Students who are able to can times their score by 4, which gives them their pulse rate per minute.



- Now jump up and down or run on the spot for one minute



- Now find your pulse again and count the beats for 15 seconds. (TEACHER TO TIME 15 SECONDS).
- Students who are able to can times their score by 4, which gives them their pulse rate per minute.



- Is your pulse higher or lower than before you started jumping/running?

**Follow on activity/exploration:**

- *When else does your heart rate/pulse change?*
- *What happens if your run and/or jump for longer?*
- *What happens to your heart rate if you lie down and relax for a minute?*
- *What can you do to lower your heart rate/pulse? Why would you want to?*
- *Does your breathing change when you run/jump? Does it change again after you have stopped running/jumping?*

**Feeling – firm versus light touch 1**

- Sit down on a chair or on the floor.

- Rest two fingers on the top of your leg.
- What can you feel in your leg and in your fingers?
- Now push the two fingers into your leg hard.
- Are the feelings in your leg and/or fingers different?



***Follow on activity/exploration:***

- *What happens if you do this on your shin?*
- *Does this feel different on your arm to your leg?*

## **Feeling – firm versus light touch 2**

- Sit down on a chair or on the floor.
- With one finger stroke your cheek.
- Now stroke the back of your hand.
- Was the feeling in your finger tip the same or different?
- Did each body part feel the same temperature?
- Can you still feel anything in your body after these light touches?
- Now try dragging your finger hard across your cheek and then hard across the back of your hand.
- How did that feel?
- Can you still feel anything in your body after these firm touches?

### ***Follow on activity/exploration:***

- *What happens if you do this on the side of your leg?*
- *Does this feel different on your hand to your leg?*

**For all the following feeling activities the children/students require a body outline and may find the word bank useful too. They should only do these activities once they are able to do the previous interoception tasks successfully.**

At the beginning and end of each activity the children/students should discuss/draw/indicate how they think various body parts feel. Class/group discussions around the differences and similarities will help the children/students to understand the wide range of bodily sensations that exist and help them to identify what to look for in themselves.

### **Feelings – Hunger/fullness**

Introduce an experiment first thing in the morning by explaining to the class/group that you are going to try and discover how people know when they are hungry and when they know they have eaten enough. Fullness has a number of alternative words that could be introduced depending on the age of the students. This activity fits well with studies around war, famine and/or nutrition and keeping ourselves safe.

On this day miss out snack times (BUT ENSURE WATER IS READILY AVAILABLE), shortly before lunch ask the students how their bodies feel and if they can identify anything within their bodies that might be signalling to them that they are hungry. Once they have done this make some food with the class (or chop up fruit etc. in line with site policies) to share after they have eaten their lunches. Once they have eaten, give out the body sheets again and/or discuss how their bodies feel and if they can identify anything within their bodies that might be signalling to them that they are full now.

### **Feelings – Thirst/dehydration**

Introduce an experiment first thing in the morning by explaining to the class/group that you are going to try and discover how people know when they are thirsty and when they know they have

drunk enough. This activity fits well with water cycle activities. Prior to morning recess do some vigorous exercise with the class and then before the students drink ask the students how their bodies feel and if they can identify anything within their bodies that might be signalling to them that they are thirsty. Once they have had some water to drink give out the body sheets again and/or discuss how their bodies feel and if they can identify anything within their bodies that might be signalling to them that they have had enough to drink.

Children/students find it fascinating to track their hydration levels via the colour of their urine and this activity can lead into a discussion on this. Good hydration, particularly via drinking water rather than other drinks, can lead to improved focus, physical health including of eyes and skin and decreases the likelihood of headaches.

**CHILDREN/STUDENTS CAN LEARN A RANGE OF APPROPRIATE RESPONSES  
ONCE THEY ARE ABLE TO NOTICE AND RECOGNISE INTERNAL SIGNALS.**

Prior to having well developed interoception teaching responses to feelings/emotions and even external stimuli will be very difficult and is unlikely to support the children/students effectively.

For example:

**Responses to external sensory input** – a child/student who runs out of the classroom may well be reacting to external sensory input that they find extremely distressing but without an awareness of what being distressed ‘feels like’ they are unable to recognise that they are distressed and therefore they may not actually realise that that sensory input is problematic for them.

Once a child/student can recognise and understand their internal body signals for distress, they can begin to work out what distresses them and then how to respond to these distressors. The adults around that child/student may well have a good idea of what the child/student is feeling and why,



but without learning it for themselves the child/student will never be able to learn to self-regulate independently. If you are unsure of the level of interoception of a particular student it will be easiest to start off with activities that help the student to gain an awareness of their bodily reactions (internal signals) to noise and heat/cold.

### Responses to noise

Start off with some mindful listening activities that are suitable for the children/students that you are working with. Mindful listening is where the children/students stop all other activities and focus on actively listening to something/someone with a goal to hear as much as they can. Some ideas of things to listen to and for are:

Listen TO	Listen FOR
Music from The sorcerer’s apprentice	Which instruments they can hear
The general classroom or playground environment	Natural and created sounds
A poem or short story	Language rhythms and rhymes, number of words
Special effects eg from <a href="http://www.acoustica.com/sounds.htm">http://www.acoustica.com/sounds.htm</a>	Different sounds
Recordings of different environments	Natural and created sounds to try and identify the soundscape (place)
Contemporary music at different volumes	Instruments, voices, pitch, tone

Once the children/students have developed their active listening skills, these mindful listening activities can be followed up with questions relating to how different body parts FEEL/RESPOND to the different sounds. For children/students with strong physical/emotional reactions to some

sounds, the aim is to try and help them to identify what sounds trigger what reactions so that you can develop a collaborative plan to minimise stress, distress and anxiety in regards to those sounds whilst responding in a safe and effective manner.

Some strategies for responding to noise that may already exist are:

- Making noise to cover other noises
- Covering ears with hands
- Using headphones
- Running or moving away

Other possible strategies to explore are:

- Physical placement of children/students in relation to noise in class
- Pre-warning of known trigger sounds when possible
- Use of comforting sensory activity to compensate for uncomfortable noise – eg using a fiddle toy to distract from class noise (MUST BE SPECIFIC STRATEGY FOR EACH INDIVIDUAL)

## **Responses to cold/heat**

Some students/children may experience quite strong emotional reactions to changes in temperature that may have become apparent during prior interoception activities. For example becoming hot or cold can lead to distress, anger and even rage in some children/students, who may not be aware of their temperature reactions themselves. Because clothing can be used to keep warm or keep cool it is one strategy that should be employed but it is unlikely to be enough for the children/students with strong emotional reactions. In addition these children/students may need support to develop a good sense of temperature both internal and external, so that they can effectively use strategies. Hands, feet, face and body trunk may all feel at quite different temperatures in some people. For example, moving up from toes which are so cold they have turned purple, feet may be very cold,

but above the ankle may be warmer and the trunk quite warm. In other people this is not the case. Temperature regulation is complex and affected by a large number of individual factors. Seating should take temperature sensitivity into consideration as some children/students will learn most effectively close to the air conditioner/heater whilst others will find that highly problematic. Younger students and children should be explicitly taught about why and when to wear hats, coats, scarves, summer clothing etc, whilst older students may need reminding that it is hot and the sun can damage their skin, so they need to wear a hat etc.

Some strategies for responding to cold/heat that may already exist are:

- Wearing gloves inside
- Keeping hand warmers in pockets
- Sitting under the air conditioner and setting it to full fan

Other possible strategies to explore are:

- Having an indoor option at recess/lunch
- Keeping wet flannels frozen in zip-lock bags for children/students to hold to cool down

**Children/students have their own individual default energy level, some are very high energy or active, whilst others are more passive or low energy. It is important to help your children/students to identify and understand their typical energy level so that they can begin to develop an awareness of how their energy levels change and what effect this has on them. Only with an understanding of their own energy levels can children/students learn how and when to apply strategies to maximise their ability to learn as well as be comfortable in themselves and around others.**

Introduce the concept of energy levels through a simple quiz:

- Do you find it difficult to sit still at your desk/table?
- Do you struggle to wait patiently for things?
- Do you have difficulty sitting in the car or bus during long trips?
- Do you enjoy sports requiring lots of movement, like soccer and bike riding?
- During every day activities, like brushing teeth and getting dressed, do you like to move around rather than stand in one spot?

No scores 0 and yes 1 for each question

No						Yes				
0	_____	1	_____	2	_____	3	_____	4	_____	5
Low energy										Very Active

**Feelings – energy level – mind and body 1**

One way to help children/students identify their perceptions of their default energy levels is to ask them to choose the photographs that they think are most like the inside of their brain and most represent their energy levels from two sets of photos, or to bring in/choose their own images. A discussion about why they chose those particular images will help model the interaction between expression of self (communication) and awareness of self (interoception).

Repeat this activity when children/students are energetic and again when tired asking them to choose the photographs that they think are most like the inside of their brain and most represent their energy levels AT THIS MOMENT IN TIME. Direct the discussion to enable them to see the changes in their picture choices from default to energetic and tired, as well as to compare and contrast how these states are represented/experienced by their peers.

## Feelings – energy level – mind and body 2

Provide the children/students with their body outline and/or the word bank words first thing in the morning, preferably on a cold, wet, dark winter morning or after a long weekend in other seasons.

Ask the students to identify some of the descriptors that match how their bodies feel right now.

Repeat activity when children/students are energised and get them to compare and contrast.

## Feelings – angry 1



Ask the children/students to describe how their body feels when they get angry. You may need to help some of them to identify when they were angry to prompt memory of what was happening.

The students/children can do this through drawings/choosing images/completing their body outlines with words from the word bank. This can be done as a whole class, in groups or 1:1, but should not be attempted during a meltdown. However, if you can see a child/student becoming angry, you could engage in this activity by saying; “I can see that you are getting angry, can you explain how your body is letting you know you are angry?” If they are unable to do this, you can further explain why you think they are angry, what the physical clues are for you.

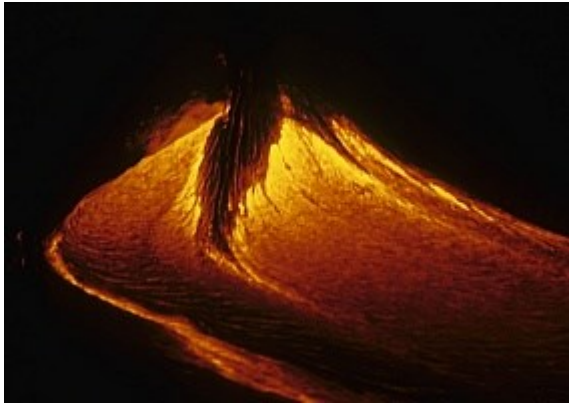
Below are some physical indicators of anger taken from

<https://www.mentalhelp.net/articles/recognizing-anger-signs/> :

- clenching your jaws or grinding your teeth
- headache
- stomach ache
- increased and rapid heart rate
- sweating, especially your palms
- feeling hot in the neck/face
- shaking or trembling
- dizziness
- rubbing your head
- cupping your fist with your other hand
- pacing
- getting sarcastic
- losing your sense of humour
- acting in an abusive or abrasive manner
- raising your voice
- beginning to yell, scream, or cry

### **Responding to anger with volcano breathing**


This is most useful with students at primary school or younger, older students may respond better to being prompted to use mindful breathing when angry. Volcano breathing works on the principle that anger is like lava inside a volcano and that it is going to come out sooner or later, so it would be safer for the lava to run down the sides rather than explode into the wider atmosphere!



This technique should be taught when children/students are calm and prompted when they are becoming angry. If children/students use the technique independently, it is helpful to compliment them for managing their anger positively.



The technique essentially consists of two parts; a story/visual and a breathing exercise. The following example is taken from Goodall (2013) pages 135-136.

**The volcano in my tummy.**


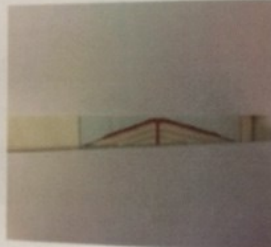


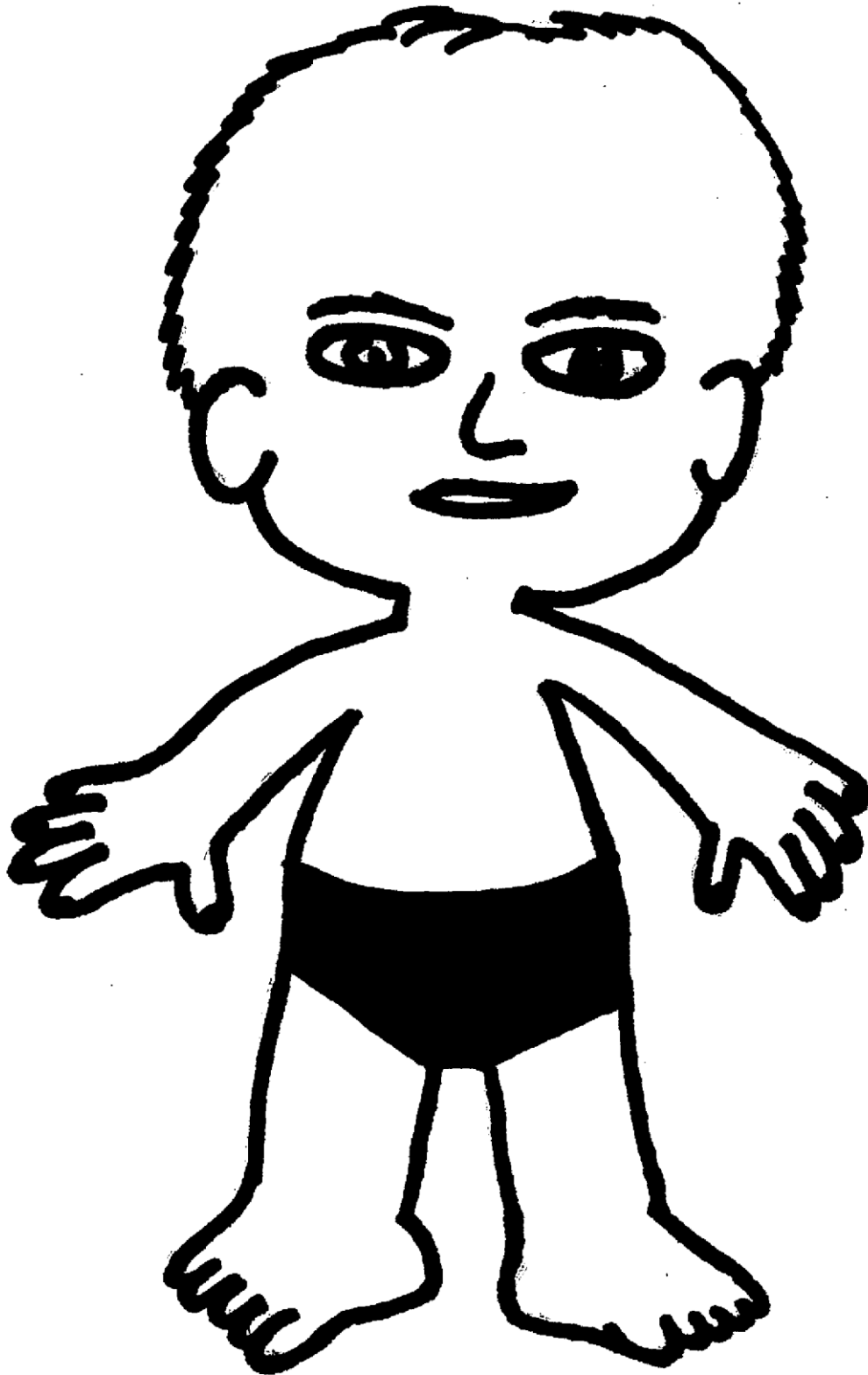
When I get angry it feels like there is a volcano in my tummy

When my volcano erupts my arms and legs go everywhere and my voice gets really loud. It is really dangerous just like a real volcano!

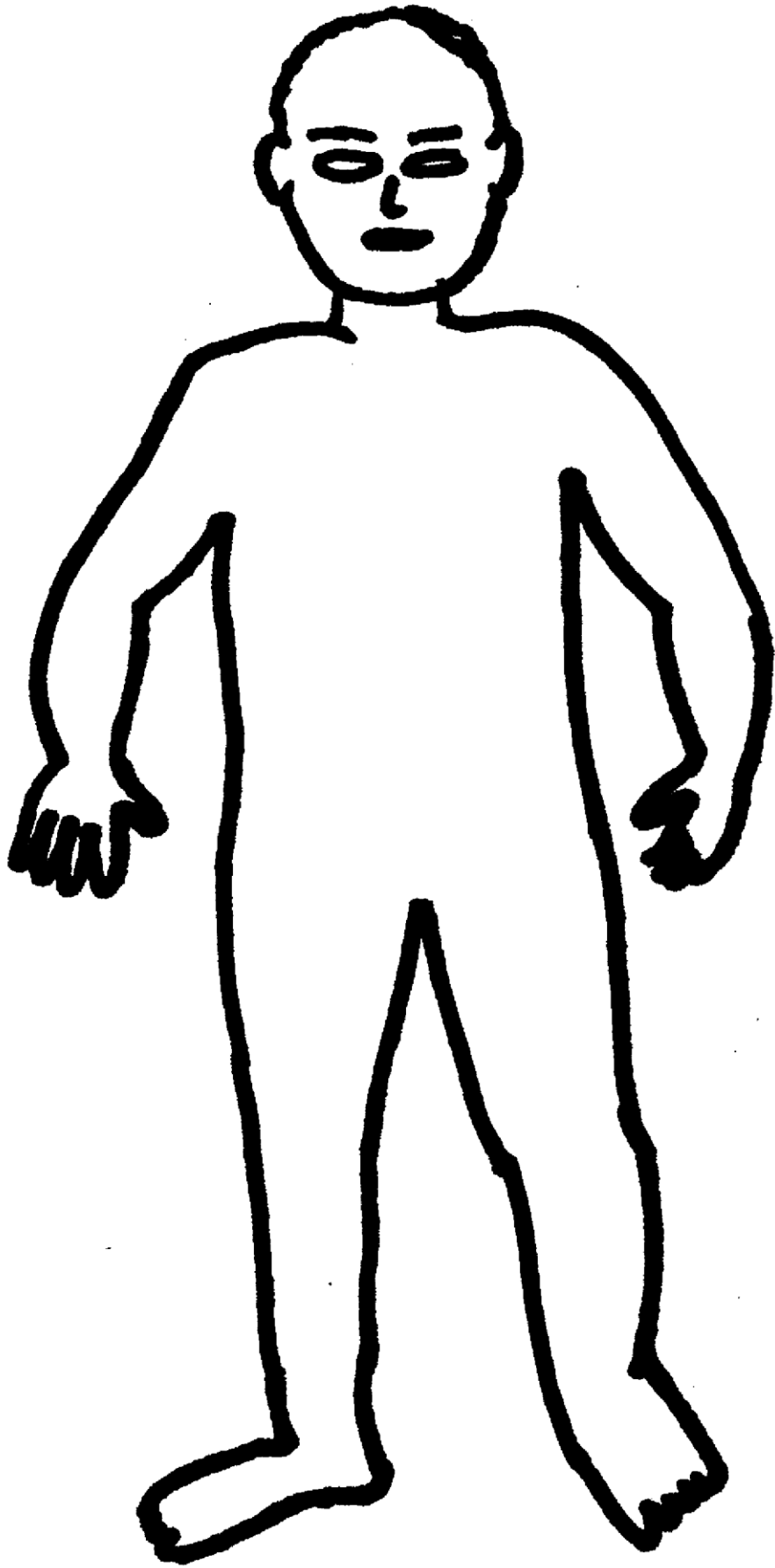


When I feel like I have a volcano in my tummy, I am going to try and breathe it out so the angry bits just go gently out of me.









Word bank

**Body parts**

head

forehead

eye brows

eyes

nose

nostrils

mouth

lips

teeth

tongue

jaw

ears

ear lobe

neck

shoulder

ribcage

ribs

diaphragm

arm

elbow

hand

fingers

thumbs

palm

leg	knee	ankle
foot	toes	heel
sole	skin	veins
artery	heart	lungs
throat	stomach	bladder
bowel	breath	voice
muscles	bones	tendons
mind	brain	shin

## Associated adjectives

boiling

hot

warm

cool

cold

freezing

stiff

tense

relaxed

tight

loose

floppy

stretched

light

heavy

wet

dry

itchy

runny

busy

cluttered

full

empty

blank

closed

open

still

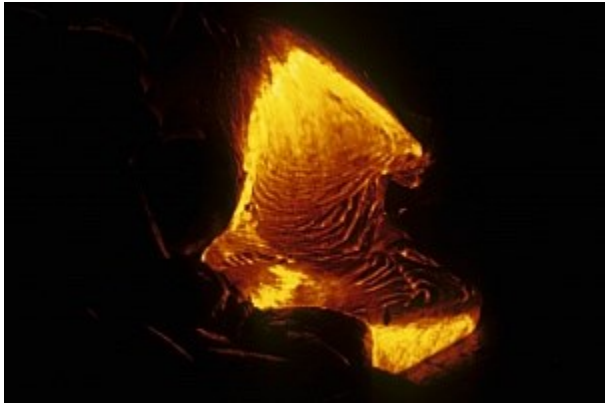
moving	wiggling	jerking
flapping	fidgeting	twirling
twisting	squeezing	pacing
clenching	shaking	tapping
short	fast	thin
quiet	loud	sore
sweating	sweaty	tired

# Default energy levels

## Mind photos









# Body photos





Photos courtesy of and copyright Free Range Stock, [www.freerangestock.com](http://www.freerangestock.com) or taken by and/or of Emma Goodall in 2013 and 2015.

## Appendix B - Bespoke Interoception tracking sheet provided to the schools

<b>BODY AWARENESS (Interoception)</b>	<b>Date when achieved</b>	<b>Internal signals that tell me</b>	<b>How I can respond to this in a helpful way</b>
I can feel my muscles tense and relax			
I can feel when I am cold			
I can feel when I am hot			
I know when I am thirsty			
I know when I am hungry			
I know when I need to go to the toilet			
I know when I am in pain			
I know where it hurts when I am in pain			
I know when I feel unwell			
I can explain what the problem is when I feel unwell			
I know when I am starting to get upset			
I know when I am starting to get anxious			

I know when I am starting to get frustrated			
I know when I am starting to get bored			
I know when I am starting to get angry			
I know when I am getting over excited			
I know when I am getting overwhelmed			
I know when I am tired			
I know when I am happy			
I know when I am calm			