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ORIGINAL ARTICLE

"Does the Montessori Approach To Healing Trauma-Affected Children Align with the "Regulate, Relate, and Reason" Phase of the NME? A Thematic Analysis

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Abstract
Given the pervasiveness of childhood trauma, there is a move to create models to support trauma-affected children in schools. The *Regulate*, *Relate and Reason* (3R's) phase of the Neurosequential Model in Education (NME) is an example. However, historical models such as Montessori, have largely been ignored. The aim of this study was to compare the 3R's of the NME with the Montessori model, (which historically was reputed to be effective in healing trauma-affected children) and examine whether Montessori's model aligns with the neuroscientific principles and practices undergirding the 3R's of the NME. Braun & Clarke's reflexive thematic analysis was used. The three themes identified were: - how Montessori (a) intentionally incorporated activities into the curriculum that provided repetitive neural input to the brain-stem thus helping children to regulate; (b) intentionally created a rich relational environment (a non-traditional teacher, mixed age groups and peer teaching); and (c) explained that children are neurobiologically unable, rather than unwilling, to use reason when they are distressed. This paper suggests that the century year old Montessori model aligns closely with the neuroscientific principles undergirding the NME (3Rs), and that evidence of this alignment could be empowering for the thousands of contemporary Montessori educators globally (who are increasingly facing the task of supporting trauma-affected children), because it will provide them with further scientific backing for the uniqueness of the Montessori model and may enhance their professional practice and confidence giving them a 'head-start' in relation to their ability to support trauma-affected children.

Keywords Neurosequential model in education · Montessori method · Sequence of engagement · Regulate · Relate · Reason · Trauma-informed practice

Introduction

The purpose of this study was to (a) examine whether or not the century year old Montessori educational model (Montessori, 1912/1964) aligns with the neuroscientific principles and practices underlying the "Sequence of Engagement - *Regulate*, *Relate and Reason*" (3Rs) phase of the NME and (b) to argue that evidence of such an alignment, could be beneficial and empowering for the thousands of Montessori educators globally who are increasingly facing the task of supporting trauma-affected children. Firstly, such evidence will enhance their interdisciplinary knowledge about the neurobiological implications of trauma so that they understand why repetitive activities work so effectively with trauma-affected children and help them to regulate. Secondly, it may improve their practice by giving them a greater understanding of relational neurobiology and why positive relationships are healing for trauma-affected children. Thirdly, it may improve their understanding of children's behaviours by explaining the neurobiological science behind the fact that very distressed children cannot reason or engage rationally with either adults or peers and need to become regulated before they can reason, or access certain brain functions such as memory and executive functions that are mediated by the cortex and are vital for learning (Perry,

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1999). Fourthly, it may boost their confidence in relation to supporting trauma-affected children because evidence that the Montessori model embodies a framework very similar to the (3Rs) of the NME, would arguably make it likely that Montessori schools would have a 'head-start' in relation to their capacity to support trauma-affected children.

Childhood adversity and trauma are prevalent and found in all socio-economic groups (Felitti et al., 1998). Research shows that they can have a detrimental impact on children's mental and physical wellbeing as well as their capacity to learn, relate to others, and function at home and in school (Craig, 2016). *Childhood adversity* includes exposure to neglect, abuse, and other negative experiences such as poverty, homelessness, discrimination, and racism (Felitti et al., 1998; Merskey et al., 2017) and *childhood trauma* refers to exposure to either single or multiple overwhelmingly stressful experiences that can leave children psychologically and biologically damaged (Burke Harris, 2019; Perry & Szalavitz, 2017; van der Kolk, 2014). Research also shows that exposure to trauma is pervasive with up to two thirds of children exposed to a traumatic event before the age of 16 (National Child Traumatic Stress Network, 2020). Such exposure has been shown to lead to problematic emotional, social, and cognitive functioning in children with attendant behavioural issues in classrooms (Craig, 2016). Given the pervasiveness of trauma, and its negative impact on children, there has been a move among trauma experts to create models to help teachers to cope with trauma-affected children in schools (Perry & Graner, 2018). However, despite the fact that trauma "has shadowed humankind since our earliest days" (McSherry, 2021, p.1), there has been a failure among trauma researchers to examine historical approaches to healing trauma-affected children, thus leaving a gap in our knowledge about the effectiveness (or not) of such approaches. One of the aims of this paper is to fill that gap by examining the century year old Montessori approach to healing trauma-affected children and its recorded effectiveness or ineffectiveness; and exploring whether or not this approach aligns with modern approaches, specifically the *Regulate*, *Relate and Reason* phase of the Neurosequential Model in Education (NME).

The "Sequence of Engagement -Regulate, Relate and Reason" phase of the NME

The NME is a model developed by Dr. Bruce Perry, (the world-renowned child and adolescent psychiatrist, developmental neurobiologist, and senior fellow of the Child Trauma Academy), to help teachers to cope with trauma-affected children in schools (Perry & Graner, 2018). The NME is a non-therapeutic adaption of the Neurosequential Model of Therapeutics (NMT) also developed by Perry (Perry, 2006, 2009; Perry & Hambrick, 2008). The NME draws upon the NMT which Perry defines as "a developmentally sensitive neurobiologically informed approach to clinical work" (Perry & Hambrick, 2008, p. 39). The NME is Perry's recommended approach for teachers trying to cope with the needs of children who have been affected by childhood trauma (Perry & Graner, 2018). The aim of the NME is not to ask teachers to become therapists, neuroscientists, or psychologists, but rather to educate school staff about the sequential nature of brain development and the impact of developmental trauma, and then guide teachers in how to apply that knowledge in their work with children (www.neurosequential.com). The NME principles apply to all children but are especially beneficial to children who have been affected by childhood adversity or trauma. The NME can guide teachers in developing strategies to reduce difficult behaviours in such children and increase their capacity to engage successfully in developmentally appropriate educational activities (Perry & Graner, 2018).

The "Sequence of Engagement - *Regulate*, *Relate and Reason* is based on neuroscientific principles (Perry, & Graner, 2018). It recognizes that when the stress response is activated as a result of exposure to trauma, or re-activated because of a trauma trigger, a child becomes dis-regulated, causing the temporary "shut-down" of certain cortical areas in the brain (Perry & Graner, 2018) and the fundamental need of the child is to get back into a state of homeostasis or internal balance/stability. Perry explains that this is best achieved through engagement in what he calls "patterned, repetitive, somatosensory activities" such as singing, dancing, walking, running, breathing and other rhythmic activities (Perry, 2009, p. 252). Following the use of rhythmic activities to regulate and calm the child the next step in the sequence of engagement is to "relate". Dr Perry and colleagues have documented the crucial role of "positive relational interactions" in the healing process for children who have been affected by trauma (Ludy-Dobson & Perry, 2010, p. 27), and explained that "The more healthy relationships a child has, the more likely he will be to recover from trauma and thrive" (Perry & Szalavitz, 2017, p. 258). For a teacher in a school situation, "relate" can simply take the form of (a) using a warm, friendly tone of voice when talking to children, (b) greeting children with a smile or a high five on arrival and throughout the day, and (c) using non-threatening body language such as getting down low when talking to young children so as not to tower over them. Relate always involves having an emotionally attuned adult, (someone who recognises, understands, and engages with another's emotional state) available to the child. Following the use of rhythmic activities to regulate and calm the child, and positive, relational interactions to relate to the child, the next step in the sequence of engagement is "reason", ie

cortical engagement. Perry's research shows us clearly why cortical engagement, for example answering questions such as "why did you do that?" cannot happen until the first two steps in the sequence of engagement happen i.e., firstly the child needs to be in a state of calm and secondly, they need to have the opportunity to relate to an emotionally attuned adult, who is also regulated. At this point, cortical engagement can happen, and it often takes the form of a dialogue between the now calm (regulated) child, who has started to respond (relate) to a compassionate, non-judgmental, emotionally attuned adult, and can now talk about the issues that are upsetting them (reason).

The Neuroscience behind Perry's 3R Model and the Principle of Specificity

Perry explains that in children who have been exposed to trauma which was significantly overwhelming for them "there will be a high likelihood of poor organisation and functioning in lower parts of the brain" especially in the brainstem and diencephalon (MacKinnon, 2012, p. 213). He points out that one of the most recognised effects of exposure to trauma is to "alter the functioning of the brain's stress-response systems", which emanate from the brainstem and diencephalon" (MacKinnon, 2012, p. 213/214). Despite this alteration, he explains that the human brain has the capacity to be altered by the property known as *neuroplasticity*, but he adds that "*a key principle of neuroplasticity is specificity"* (Perry & Ablon, 2019, p. 21). He explains the principle of *"specificity"* as the need to target specific neural networks if we wish to change them (p. 21). For example, in a recent publication, he states that, if you want to learn to play the piano, it is not sufficient to simply read about piano playing or watch other people playing the piano, he emphasises that you must physically put your fingers on the keys and play the piano yourself. The reason for this is that "you have to stimulate the parts of the brain involved in piano playing in order to change them" (Perry & Winfrey, 2021, p. 74).

He further points out that to change any neural network in the brain we need to provide "some form of patterned, repetitive activity" and he emphasises that one of the basics of neural change is activity or *"use-dependence"* (MacKinnon, 2012, p. 214). In other words, we must *repetitively* activate the neural networks we wish to modify. He states that, "Any neural network that is activated in a repetitive way will change" (MacKinnon, 2012, p. 214). He sums up this concept of 'targeting' specific neural networks by saying that if we want to provide re-organising, patterned, repetitive input "to reach the dysregulated or poorly organised neural networks involved in the stress response", we need to provide "patterned, repetitive rhythmic somatosensory activity" (MacKinnon, 2012, p. 213/214).

The Concept of 'Targeting' Specific Neural Networks

The idea of 'targeting' specific neural networks may easily be misunderstood. When asked to explain the concept of "targeting the brainstem" Perry stated that this is a frequently misunderstood aspect of his work (MacKinnon, 2012, p. 213). He reiterated that, although it is a fact that because of the interconnectedness of the brain, it could be argued that it is an oversimplification to localise function to any specific area, at the same time, "the final mediating parts of the brain for any function can be localised" (MacKinnon, 2012, p. 213). For many years, Perry has argued that conventional clinical approaches to developmental problems in children (e.g. speech and language problems, learning difficulties, poor control of emotions) are often ineffective because they ignore the fact that the origin of these problems lies in disruptions to the development of brainstem and diencephalon monoamine neural networks. Consequently, he says, many clinical approaches to treating these problems are frequently ineffective because they do not target the source of the problem which is disruption to the development of "brainstem and diencephalon monoamine neural networks" (Perry, 2009, p. 243). Perry compares these ineffectual approaches to treating developmental problems in children, with the very effectual approaches to treating stroke victims. He writes: "the target of the intervention should be the innovating neural systems and not the area or the system that is the final mediator of the function/dysfunction" (Perry, 2009, p. 244). For example, he points out that, "physical exercise helps stroke victims recover speech" (Perry, 2009, p. 244). Perry also points out that even when the appropriate systems in the brain are "targeted", clinicians "rarely provide the repetitions necessary to modify organized neural networks" (Perry, 2009, p. 244). He summarises the ineffectual approach to the treatment of many children as being due to two specific failures. Firstly, he says there is a failure to 'target' the correct brain areas, for example, he states that "clinical interventions often provide experiences that primarily target the innervated cortical or limbic (i.e. cognitive and relational interactions) regions in the brain and not the innervating source of the dysregulation" (Perry, 2009 p. 244). Secondly, he says that even when the correct brain areas are correctly 'targeted', there is still a problem because he argues that "we rarely provide the repetitions necessary to modify organized neural networks" (Perry, 2009, p. 244) so there is an insufficient number of 'repetitions' to modify existing neural networks making it unlikely that neural systems will change, because neural systems can only be modified by repetitive activation. To put it simply, Perry's argument is this: if we want to effect changes in the brain, we must specifically 'target' the neural networks we wish to modify and supply enough 'repetitions'

to effect neural change. This paper aims to demonstrate that historically, Montessori did exactly this.

The Montessori Model

Montessori education is "the largest alternative pedagogy in the world" (Debs, 2023, p. 283), appealing to poor, middle-class and wealthy families alike. It also appeals to the diverse belief systems of "Christians, Jews, Muslims, Hindus, and Buddists" (p. 283). In addition, research shows that in an age when school choice is available in both the private and public sectors, interest in Montessori education is growing (Debs, 2019). The Montessori Method began in Rome, Italy. Its founder, Maria Montessori (1870–1952)

was one of Italy's first female psychiatrists with a particular interest in child mental health (Babini & Lama, 2000; De Stefano, 2022; Kramer, 1976; Standing, 1957). Graduating from the University of Rome in 1896, she immediately joined the staff of the Clinica Psyciatrica, (Psychiatric Clinic) as a voluntary assistant doctor. Her early work involved her, first of all, in the care of children who were mentally challenged (Gutek & Gutek, 2017; Kramer, 1976) and later in the care of children who had been exposed to significant adversity and trauma (Phillips et al., 2022). In late 1906, as a consequence of her extremely successful experimental work with mentally challenged children, she was invited to direct the educational aspect of a potentially large social housing project in the impoverished district of San Lorenzo, in Rome (Foschi, 2008). This work developed into what very quickly became known as "The Montessori Method" (Montessori, 1912/1964). This paper postulates that from its inception, the Montessori Method used an approach very similar to the NME's "regulate relate and reason" model with trauma-affected children, but that Montessori's approach was unique in that that (a) she purposely built into her curriculum specific activities (that are now recognised as providers of neural input to the brainstem), and thus helped the children to *regulate*, (b) she purposely introduced a non-traditional type of teacher, mixed age groups, and peer teaching (in accordance with the principles of what we now call relational neurobiology), and thus created and maintained a rich relational environment in her schools which helped trauma-affected children to *relate*, and (c) she purposely explained in her publications that dysregulated children are neurobiologically *unable* rather than *unwilling* to use reason or engage in activities which demand the use of higher level faculties when they are seriously distressed (Montessori, 1936). Consequently, she instructed her teachers not to try to reason with children when they were unreceptive to reason (Montessori, 1967) but instead, to offer regulatory activities and provide warm relational interactions (Montessori, 1936, 1967, 2008). Applying this approach, she first of all helped 'mentally challenged' children who had been expelled from schools because they were regarded as unteachable, to pass their State Examinations, and then, applying the same approach, witnessed a transformation in the emotional, social, and cognitive functioning of a large number of children living in an impoverished district in Rome, arousing worldwide interest in her pedagogical approach (Montessori, 2008).

Method

The research question underpinning this study is - Does the Montessori Approach to Healing Trauma-Affected Children Align with the "Regulate, Relate, and Reason" Phase of the NME?

To answer this question, firstly, an analysis of available sources on the NME was conducted. These sources comprised of articles, books, seminars, interviews, and online courses relating to the NME. Secondly, an analysis of four of Montessori's major publications, *The Montessori Method*, 1912/1964, *The Secret of Childhood*, 1936, *The Absorbent Mind*, 1967, and *The California Lectures*, 2008, was conducted. These four publications were selected because they are generally recognised as being reliable sources of Montessori's core concepts. In addition, publications of eyewitnesses to Montessori's early schools who commented on (a) the use of rhythmic exercises and activities, (b) the creation of rich relational environments and (c) the biologically respectful approach to children, were included in the analysis (Bailey, 1915; Cromwell, 1916/2006; Fisher, 1912; George, 1911). A Table of Data Sources is provided below (Table 1).

These combined sources yielded a large amount of data. Braun and Clarke's reflexive thematic analysis was used (Braun & Clarke, 2006, 2022). Thematic analysis is the process of identifying themes (patterns) within qualitative data. It is a method rather than a methodology which means it is not tied to a particular epistemological or theoretical perspective. This makes it a flexible method. It involves an iterative process consisting of six steps which are (a) familiarization (reading and re-reading the literature/data to become familiar with the content and to generate further insight into the topic), (b) generating initial codes (initial coding reduces large amounts of literature/data into small chunks of meaning in a systematic fashion), (c) searching for themes (a theme is a pattern that captures something significant or interesting about the literature/data, this step involves collating codes into potential themes and gathering all literature/data relevant to each potential theme), (d) reviewing the potential themes (here the aim is to review, modify and develop the potential themes that were identified

Table 1 List of Data Sources

Author and Date	Title of Document	Document
Perry B.D. (2006)	The Neurosequential Model of Therapeutics:Applying principles of neuroscience to clinical work with traumatized and maltreated children. In N.B. Webb (Ed.) *Working with traumatized youth in child welfare* (pp. 27–52).	Book Chapter
Perry B.D. (2009)	Examining child maltreatment through a neuro development lens: Clinical applications of the Neurosequential Model of Therapeutics.	Article
Perry & Graner (2018)	*The Neurosequential Model in Education:* Introduction to the NME Series: Trainer's Guide (NME Training Guide).	Book
Perry & Ablon (2019)	CPS as a Neurodevelopmentally Sensitive and Trauma-Informed Approach	Book Chapter
Perry & Hambrick (2008)	The Neurosequential Model of Therapeutics.	Article
Perry & Szalavitz (2017)	*The boy who was raised as a dog*: And other…	Book
Perry & Winfrey (2021)	*What Happened to You?* …	Book
Mac Kinnon, L. (2012)	The Neurosequential Model An Interview with Bruce Perry	Article
Montessori, M. (1912)	*The Montessori Method.*	Book
Montessori, M. (1936)	*The Secret of Childhood*	Book
Montessori, M. (1967)	*The Absorbent Mind*	Book
Montessori, M. (2008)	*The California Lectures*	Book
Bailey, C. S. (1915)	Montessori Children	Book
Cromwell, M. R. (1916)	The Montessori MethodAdapted to the Little French and Belgian Refugees	Pamphlet
Fisher, D. C. (1912)	A Montessori Mother	Book
George, A. E. (1912)	Dr. Maria Montessori: The Achievement and Personality of an Italian Woman whose Discovery is Revolutionizing Educational Methods	Article

in step three and consider whether the potential themes work in the context of the entire data set and ascertain that the data supports the themes), (e) defining and naming themes (here the aim is to identify the essence of what each theme is about and to generate clear names for each theme), (f) writing up the report, (usually in the form of a report, journal article or dissertation).

Results

The analysis identified three themes – (all of which contain sub-themes) and all of which answer the research question by demonstrating that the Montessori approach aligns with the neuroscientific principles underlying the Regulate, Relate and Reason (3R) phase of the NME. These themes are (1) The intentional use of *regulating* activities in early Montessori schools (2) The intentional provision of *relational* richness in early Montessori schools and (3) The biologically respectful approach to *reason* in early Montessori schools. These themes and sub-themes are now examined.

The Intentional Use of *Regulating* Activities in Early Montessori Schools

The first theme identified from the analysis, relates to the intentional use of *regulating* activities in early Montessori schools. This theme has three sub-themes: (1) Rhythmic exercises and activities; (2) Patterned exercises and activities; (3) Repetitive exercises and activities.

During the decade 1907 to 1917, Montessori and her teachers (called directresses) worked with diverse groups of children who had been *psychologically harmed* by exposure to both chronic and acute experiences of adversity and trauma. Specifically, she and her teachers worked with – (1) the extremely impoverished San Lorenzo children who had grown up exposed to both physical and emotional neglect; (2) child survivors of the devastating Messina earthquake (1908) which left them orphaned and homeless); and (3) child survivors of WW1 - French and Belgian child refugees who witnessed horrendous atrocities when their land was invaded, leaving them homeless and mostly orphaned (Phillips et al., 2022). The behaviours of these children (documented by Montessori, and eyewitnesses – (Bailey, 1915; Cromwell, 1916/2006; Montessori, 1913/2013; 1936) indicated that their traumatic experiences had left them with high levels of anxiety and stress which today would be referred to as PTSD. While working with these diverse groups of children, Montessori and her teachers found that one factor that appeared to have a remarkably regulating effect on them was engagement in activities that involved patterned, repetitive, rhythmic movements.

Sub-theme 1: Rhythmic Exercises and Activities

Eyewitnesses commented on the regulating effect rhythmic activities had on the children. These activities included balancing exercises, practical life exercises, music, movement, and dance, colouring outline drawings and 'metal insets', and working with clay (Bailey, 1915; George, 1912; Cromwell,

1916/2006). Bailey wrote that the children became calm from physical exercises such as – "Climbing up and down a very short ladder"; "Stepping through the rungs of the ladder as it is laid upon the ground or the floor"; and "Ascending and descending a short flight of circular steps" made for the purpose (Bailey, 2015, p. 24). Montessori designed many types of balancing apparatus, which she saw as a first step towards helping the trauma-affected children she encountered in her schools (Montessori, 1912/1964). Bailey described how rhythmic musical exercises were used with the children. She wrote that the children: "keep time to rhythmic music" (p. 26) such as marching to a piano tune "over and over again" (p. 22).She said exercises were introduced "in which the little ones sing in time to the rhythmic movement of their feet" (p. 25). Other rhythmic activities that were provided to children (who in some schools such as the school on the via Guisti which was set up for survivors of the Messina earthquake were nearly all trauma-affected children) were called Montessori practical life exercises. These included activities that invited repetitious and rhythmic movements such as sweeping courtyards, raking leaves, digging soil, moving to rhythmic music, walking heal-to-toe on a chalk line, modeling with clay, working with cylinder blocks, and sequential cubes, all of which required patterned, repetitive movements (Montessori, 1936).

Sub-theme 2: Patterned Exercises and Activities

One early eyewitness commenting on the calm that arose in the children when they worked with the Montessori sensorial materials which all involve repeating patterns of actions, (e.g., matching two identical colour tablets by using the sense of sight, matching two identical sounds by using the sense of hearing, matching two similar fabrics by using the sense of touch, matching two similar qualities, e.g. sweet, sour, salty, etc. by using the sense of taste), stated – "Nervousness gives way to tranquility. The happy tranquility to which children come after a few weeks of independent work with sense-training exercises is perhaps the most notable feature" (George, 1912, p. 26). Many other Montessori exercises involve *patterned* activity (Phillips, 2022).

Sub-theme 3: Repetitive Exercises and Activities

Montessori wrote, *"I noted a peculiar behaviour that was common to all, and practically the rule in all they did – which I later called - "repetition of the exercise"* (Montessori, 1936, p. 127). For example, she described a child of about three years who repeated an exercise (involving putting cylinders in and out of holes in a wooden block) forty-two times (Montessori, 1936, p, 127). Crucially, Montessori noticed that following these repetitive exercises, children became calm and serene. For example, this child (when she suddenly ended the exercise after forty two rounds, showed by her facial expression that she was calm and anxiety free – "She smiled as if she were very happy" and "Her eyes shone" (Montessori, 1936, p.127). It was at this point that Montessori began to recognise the effectiveness of what Perry would later refer to as "patterned, repetitive, rhythmic activities" (Perry, 2009, p. 252) in moving a child from a high anxiety state to a calmer more cognitive state, simply because such activities are rhythmic and rhythm regulates the dysregulated brain (Perry, 2009).

This paper suggests that Montessori augmented the power of these activities to provide repetitive neural input to the brainstem by offering them to children when they were under the influence of the sensitive period for movement, which Montessori saw as being most acute between birth and 5 years and was characterized by an urge to *repeat* the same physical movements over and over, e.g. opening and closing buttons, tying and untying lace frames, filling and then emptying buckets or wheelbarrows using soil or sand (Montessori, 1936). Montessori's and other eyewitness's comments on the children would suggest that the repetitive activities (described above) helped to reduce anxiety in these trauma-affected children and brought regulation (Montessori, 1936; Bailey, 1915). We now understand from Perry's work the science behind this - because as Perry states "interventions that provide patterned, repetitive, neural input to the brainstem… would be organising and regulating input that would likely diminish anxiety" (Perry, 2009, p. 243). It is therefore reasonable to state that Montessori's approach (i.e. providing repetitive, rhythmic activities) aligns with the neuroscientific principle of specificity. In this case, since many of the children were trauma-affected, there was a need to target the brain stem where the dysregulation is centred (Perry, 2009; MacKinnon, 2012) The need to provide *repetitive* neural input to the brain stem was facilitated by the fact that Montessori deliberately offered these activities to children when they were going through a sensitive period for movement which is characterised by a compulsion to *repeat* exercises (Montessori,1936). Montessori claimed that "we ourselves, in our schools and by observing the life of children in their families, were the first to discover the sensitive periods of infancy, and to respond to them from the standpoint of education" (Montessori, 1936, p.35). One of the early eyewitnesses to Montessori's early schools, Ellen Yale Stevens, the most experienced and respected authority on early childhood education at that time, appeared to understand that Montessori was attempting to use (an early understanding of) neuroplasticity to help to modify the brain functioning of the children in her care, because she stated categorically that Montessori "realises the plasticity of the nervous system and the importance of building into

its tissues" (Stevens, 1912, p. 81). Although it is arguable that Montessori may not have fully understood (as neuroscientists now understand), the neuroscientific principles behind *why* repetitive, rhythmic movements calm the brain, this does not change the fact that her promotion of activities that use repetitive rhythmic actions reduced anxiety in the trauma-affected children she worked with and calmed them. In this respect, her approach aligns with the first of the 3Rs – *regulate.*

The Intentional Provision of *Relational* Richness in Early Montessori Schools

The second theme identified from the analysis, relates to the intentional provision of *relational* richness in early Montessori schools This theme contains three sub-themes – (a) A New Kind of Teacher, (b) Mixed Age Groups, and (c) Peer-teaching.

From the outset of her work with children, most of whom had been exposed to some level of adversity and or trauma, Montessori understood the need to make children feel physically and psychologically safe by *relating* to them with gentleness, kindness, and genuine love. Describing her approach with the first group of (partly homeless) mentally challenged and trauma-affected children she worked with, she said, "When these children from the streets and from the asylums entered my schools they were greeted with hearty manifestations of welcome and with genuine cordiality. For the first time they were made to feel that they were wanted and desired" (Montessori, 2008, p. 264). She utilized three factors in her schools which created and maintained a rich *relational* environment, these factors were – a new kind of teacher, mixed age groups, and peer teaching.

Sub-theme: A New Kind of Teacher

At the outset of her career in education, Montessori made it clear that she was advocating for a new type of education with a non-traditional, new type of teacher, and she stated overtly that this new type of teacher would give priority to the *relational* aspect of teaching. She stated, "what really makes a teacher is love for the human child" (Montessori, 1913, p. 34). Montessori's early emphasis on the importance of love in any effort to aid the development and subsequent education of children, especially trauma-affected children, owes much to the profound influence on her thinking of the works of her predecessor, Dr. Eduoard Seguin (1812–1880), who influenced Montessori's understanding of the vital importance of love and positive relationships in child development and human flourishing (Montessori, 1967). Seguin believed that "*affection*" could be taught just as anything else could be taught, he wrote, "To develop their sense of affection … does not demand new instruments … but the extension of the same action upon their feelings" (Seguin, 1866, p. 244). In other words, if you want children to *learn* how to love, you must love them first and Seguin and later Montessori believed that teachers were in a unique position to do this first, by being loving, kind and relational towards their students, and second, by integrating into the curriculum exercises that literally teach children how to relate to others and be kind and loving. Sequin and Montessori's understanding that affection can be taught anticipates Perry's statement that the principle of "specificity" applies to all brain mediated functions, including the capacity to love. Perry writes - "If you have never been loved, the neural networks that allow humans to love will be undeveloped … given love, the unloved can become loving" (Perry & Winfrey, 2021, p. 74). Modern neuroscience therefore confirms Seguin's and later Montessori's belief that "*affection*" or positive relational interactions can be taught. In order to help children to *learn* how to relate positively to others, (which we now understand actually means developing the 'neural networks' that allow humans to love), Montessori devised specific activities known (now rather quaintly) as exercises of Grace and Courtesy. These exercises which were essentially 'mini-dramas' involving role-play (e.g., how to wait, take turns, or resolve a disagreement) were designed to promote social and emotional learning (SEL) and were effective in helping children, especially trauma-affected children to learn to relate to others. This paper suggests that Montessori augmented the power of these activities to provide repetitive neural input to the brain by offering them to children when they were under the influence of a sensitive period for the social aspects of life which Montessori saw as being most active between 2 and 6 years and was characterized by an acute attunement to how people treat each other socially, coupled with an urge to repeat words and actions that represent positive social behaviors. For example, children in this age group like to say 'hello', 'bye', 'thank you', and in Montessori classrooms they enjoy 'role-playing' and acting out the Montessori exercises or 'mini-dramas' referred to above. These exercises enable a child to *embody* kindness, respect, and love towards others. The exercises apparently (because of their repetitious nature) have the effect of developing the neural networks involved in social and emotional learning, and ultimately have the effect of helping children to learn how to have positive relational interactions with both their peers and their teachers (Phillips, 2022). Since, research shows that "positive relational interactions" are healing for trauma-affected children (Ludy-Dobson & Perry, 2010, p. 27), it is certainly likely that "positive relational interactions" (p. 27), intentionally promoted by the "new type of teacher", through carefully devised exercises in the early Montessori classrooms would have played a

major role in the healing process for the trauma-affected children that Montessori worked with in the decade 1907 to 1917. It is also arguable that these same exercises can still contribute to the promotion of "positive relational interactions" in contemporary Montessori schools.

Sub-theme 2: Mixed Age Groups

From the outset of her work with children Montessori had mixed age-groups in her classes and she was quick to observe the benefits of this arrangement from the point of view of what is now called relational neurobiology. She said "What matters is to mix the ages. Our schools show that children of different ages help one another" (Montessori, 1967, p. 226). She further stated that "To segregate by age is one of the cruelest and most inhuman things one can do" (Montessori, 1967, p. 226). She added that it is "a fundamental mistake" because it "impedes the development of the social sense" (p. 226). The mixture of ages in the early Montessori schools clearly promoted a feeling of connectedness and kinship (Montessori, 1967). Feeling connected has been shown to be healing for trauma-affected children because it helps to offset the feeling of being "disconnected or separate from others" frequently felt by children who have been exposed to trauma (Craig, 2016, p. 82). Montessori pointed out that the mixture of ages in some of her schools has the potential to span several years. She wrote - "The classroom for those of three to six is not even rigidly separated from that of the children from seven to nine … Our dividing walls are only waist high partitions, and there is always easy access from one classroom to the next" (Montessori, 1967, p. 227). She adds that children are free to go in and out of these adjoining classrooms. As a consequence, children spend time in an environment that is more like a typical family with siblings of differing ages, different abilities, and preferences, all held together by a sense of belonging and kinship. This arrangement is, according to Montessori respectful of our biological need as human beings to live in communities and collaborate with others (Montessori, 1967).

Ervin and colleagues, 2016, explain that 'Up until the beginning of the 20th century American public schools were primarily one-room schoolhouses in which a single teacher taught all levels, but as rural agrarian society shifted to a largely urban, industrialized model, our schools changed as well. The model for these changes was the same factory model which had transformed our economy" (Ervin et al., 2016, p. 1). However, they point out that in Montessori schools, "this trend toward single grade education was not adopted" (Ervin et al., 2016, p. 1) and they elucidate the many cognitive, social, and pedagogical advantages of multi-age classrooms. From the point of view of creating a rich relational milieu for children, especially those affected by trauma, the Montessori model appears to be a unique educational model because it is biologically respectful of the needs of human beings in the course of development.

Sub-theme 3: Peer Teaching

Dr. Montessori was quick to recognize the value of peer-teaching from a relational point of view. She wrote "a child of three will take an interest in what a five-year-old is doing, since it is not far removed from his own powers" (Montessori, 1967, p. 226). She describes the positive aspects of this for both the older and the younger child - "All the older ones become heroes and teachers, and the tinies are their admirers" (p. 226). She explains the details of how the partnership works - "These look to the former for inspiration, then go on with their work" (Montessori, 1967, p. 226). She commented on the traditional school's lack of understanding of what we would now refer to as relational neuroscience and how their structure causes them to miss out on opportunities for social development in children. She said, "in the other kind of school, where children in the same class are all of the same age, the more intelligent could easily teach the others, but this is hardly ever allowed" (p. 226). She adds "The only thing they may do is to answer the teacher's questions when the less intelligent cannot" (p. 226). She points out that the outcome of this practice is often a negative one – "The result is that their cleverness often provokes envy" (p. 226). By comparison, she points out that in the Montessori schools, positive and uplifting attributes begin to develop and flourish - "in our schools the five-year-old feels himself a protector of the younger one" and she adds "It is hard to believe how deep this atmosphere of protection and admiration becomes in practice" (p.227). She says that this leads to real bonding among the classmates – "The class gets to be a group cemented by affection" (p. 227). These three factors, a new kind of teacher, mixed age groups, and peer teaching, all contributed to creating rich relational environments in Montessori's schools. In this respect, Montessori's approach aligns with the second of the 3Rs – *relate.*

The Biologically Respectful Approach to *Reason* in Early Montessori Schools

The third and final theme relates to Montessori's understanding that children are neurobiologically unable rather than simply unwilling to 'reason' when they are distressed or dysregulated and it is therefore useless to try to reason with them or try to make them learn when they are in this state. This theme contains two sub-themes – (1) Children are biologically unable to *reason* when they are distressed, and (2) Children can use *reason* when they have become regulated and can relate to even one emotionally attuned adult.

Sub-theme 1: Children Are Biologically Unable To Reason when They Are Distressed

In her book, *The Secret of Childhood*, (1936), Montessori vividly describes children who because of distress show an inability to reason or have any type of cortical engagement with others. She said, "A kind of curtain comes down over the child's mind, making him psychologically evermore deaf and blind" (Montessori, 1936, p.166). She understood that this is not a conscious response, on the child's part, it is something he/she has no control over. She said it is "a psychic defense wholly outside the domain of the will" (p. 167). She understood that this state of mind prevents a child from being able to respond to anyone's attempts to get through to him using logic or reasoning. She said, "it represents a subconscious impediment to the reception, and hence to the comprehension, of ideas imposed from without" (p. 166). She added "It is as though the subconscious mind were to say: you speak, but I am not listening; you repeat things, but I do not hear you" (p.167). She says that a child in this state "does not possess his mind" (p.166). In a later book, she advised that when this state of mind is present "It does not help to reason with the children" (Montessori, 1967, p. 202). These comments, written many years ago show Montessori's biologically respectful approach to human development. Stevens, a child development expert and eyewitness to Montessori's early schools stated, "I think she can claim to be the first one to give the world a rational theory of education based upon true biological, anthropological and sociological laws" (Stevens, 1913, p. 19). Montessori's comments convey an understanding strikingly similar to Perry's explanation of how the cortex "goes off-line" when a child is deeply distressed and in a state of hyper or hypo-arousal (Perry & Graner, 2018). Perry explains that when children are in a dysregulated state of mind, they cannot access their cortex to give rational consideration or rational answers to those trying to reason with them. The cortex is temporarily 'shut down' during these times of distress therefore reasoning is not possible, until *regulate* and *relate* have done their job and the child has reached a state of homeostasis or internal stability (Perry, 2009). This also means that a child in a state of dysregulation cannot learn and even the best of teachers cannot get to their cortex. The most serious consequence of this fact is that a child in a state of dysregulation "can sit in a classroom and not learn" (Perry, 1999, p.10; 2002, p. 11). These children often are referred to as being "learning disabled" (Perry, 1999, p. 10).

Sub-theme 2: Children Can Use Reason When They Have Become Regulated and can Relate

Montessori's first educational work was with children who were regarded as being uneducable (Montessori, 2008). They were expelled from their schools because they could not learn (Montessori, 1912/1964). Yet when Montessori began to work with them and gave them activities which helped them to become regulated (Montessori, 1912/1964), and provided continuous doses of positive, relational interactions (Montessori, 2008), these so called 'uneducable' children suddenly learned to read and write and actually passed their state examinations, making Montessori look like a 'wonder-worker' (Montessori, 1912/1964; Tozier, 1911). It is clear that with Montessori's provision of regulatory activities, and a rich relational environment, these children moved successfully through a cycle fundamentally similar to the NME 's Sequence of engagement - 'regulate, relate and reason' and ultimately, they were able to access their cortical brain, and were able to learn. The story was the same for the impoverished San Lorenzo children, the numbed, terrified children who survived the Messina earthquake and the French and Belgian child refugees, who were traumatised from exposure to war. Most of these children, many of whom, at first, appeared to be learning disabled, showed extraordinary emotional, social, and cognitive development, and even learned to write and then read at an extraordinary speed, when given regulatory exercises and activities and were related to with kindness and love (Tozier, 1911). This sudden onset of academic abilities which hitherto had appeared to be non-existent, demonstrated to Montessori that children can access their cognitive abilities when they first become regulated and second are supported in the development of positive relationships (Montessori, 1912/1964; 1936). In this respect, her approach aligns with the third of the 3Rs – *reason.*

Discussion

This paper offers an important original contribution to knowledge in that it asks the question "Does the Montessori approach to healing trauma-affected children align with the *Regulate*, *Relate and Reason* phase of the NME?" and it finds, through thematic analysis, that there is a significant alignment between the two models. This is important because currently, trauma related problems in children are widespread and there is a need for the intentional creation of strategies to support trauma-affected children in schools. Recent events remind us that human beings, despite all our advances are still prey to wars, natural disasters and pandemics, and the inevitable trauma that arises from this. Maria Montessori lived through two world wars, a flu pandemic, and other turmoils. This paper shows that the original Montessori approach was from its inception, a model that recognized the realities of human life and so developed an approach that supports children to *regulate* their

emotions when they are triggered by trauma or memories of past traumatic events; *relate* with emotionally attuned adults and with other children when they have calmed down; and consequently be enabled to use *reason* and use other higher level functions that are mediated by the cortex, such as memory, speech and language in order to learn while in school. The paper also shows that historically, using this approach, Montessori enabled large numbers of children who were labelled unteachable to pass their State Examinations, (Montessori, 1912/1964) and hundreds of independent visitors to her schools witnessed the emotional, social, and cognitive transformation of impoverished and neglected children, as well as children traumatised by wars and natural disasters, through her approach (Bailey, 1915; Cromwell, 1916; Fisher, 1912; George, 1911). These facts are made all the more important by the evidence contained in this study showing that Montessori's approach aligns with the neuroscientific principles undergirding the NME, especially the principle of 'specificity' (Perry & Ablon, 2019). This paper suggests that this evidence could be empowering for thousands of Montessori educators globally, who are increasingly facing the task of supporting trauma-affected children, because it provides further scientific backing for the uniqueness of the Montessori model and may enhance their professional practice and confidence, giving them a 'head-start' in relation to their ability to support trauma-affected children. Essentially, the study shows that the Montessori model embodies a framework very similar to the neurobiologically respectful NME (3Rs) framework which has been shown to be remarkably successful in helping teachers to calm, relate to and enable cognitive functioning (i.e., reason) with children have been affected by traumatic experience (Perry & Graner, 2018). This paper suggests that contemporary Montessori schools therefore already have the built-in infrastructure to provide trauma-affected children with neurobiologically-based strategies to help them. This infrastructure consists firstly of a curriculum that encourages the use of regulatory exercises and materials, freely available at all times to the children, so that the children can regulate themselves as needed. This includes offering materials and activities that provoke repetition which is so necessary to provide repetitive neural input to the brainstem in order to reduce anxiety (Perry, 2009). Secondly, this infrastructure consists of a relationally rich environment (the school itself) which provides (a) a new kind of teacher who is trained to understand the biological importance of love and positive relational interactions for human flourishing (Montessori, 1913); (b) mixed age groups, which promote a sense of kinship, family, belonging and community within which children are accepted and loved, (Montessori, 2008), which contemporary research shows is vitally important to all children but especially to those who have been affected by trauma (Treisman, 2017), and (c) peer teaching as a normal part of the learning process. Peer teaching may help trauma-affected children to find their strengths, e.g., helping younger children with tasks. Thirdly, this infrastructure consists of a biologically respectful understanding of children's inability rather than unwillingness to use reason when they are in a distressed state, or access certain brain functions such as memory and executive functions that are mediated by the cortex and are vital for learning (Perry, 1999) while in this state. This biologically respectful approach in Montessori means that teachers understand *why* children find it impossible, when in a state of dysregulation, to apply themselves to academic tasks and realise that such states are frequently caused by triggers of past trauma, and thus they leave children incapable of rational thoughts and unable to find sensible solutions to problems or disagreements.

The findings outlined in this paper are important firstly for theory, in that they show how the Montessori approach is aligned with the 3Rs of the NME and how Montessori (intentionally or otherwise) utilized the principle of 'specificity' and so provided neural input to the dysregulated brainstems of the trauma-affected children she worked with and witnessed firsthand the consequent reduction in anxiety, and stress in these children. Secondly, the findings are important for practice in that they provide contemporary Montessori schools with the knowledge that they may have a unique advantage in that they already have the infrastructure in place to apply themselves to the intentional and deliberate creation of trauma-informed practice in their schools. Thirdly, the findings are important for other researchers who may wish to test the Montessori approach to supporting trauma-affected children in contemporary Montessori schools using, for example, large scale mixed methods research and follow up assessments. Further research in this area may go a long way to improving the lives of children enduring the effects of traumatic experience which sadly, but realistically, is a fact of human life.

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