

# Does the Neuroscience Research on Early Stress Justify Responsive Childcare? Examining Interwoven Epistemological and Ethical Challenges

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**Abstract** This paper examines interwoven ethical and epistemological issues raised by attempts to promote responsive childcare practices based on neuroscience evidence on the developmental effects of early stress. The first section presents this “neuroscience argument for responsive early childcare”. The second section introduces some evidential challenges posed by the use of evidence from developmental neuroscience as grounds for parental practice recommendations and then advances a set of observations about the limitations of the evidence typically cited. Section three highlights the ethical implications of the neuroscience argument for responsive early childcare. It argues that the neuroscience argument, first, fuels unwarranted parental anxiety by unduly raising the stakes of families’ early childcare choices and, second, threatens public confidence in developmental science’s potential to inform childcare practices and policy that enhance children’s health and well being.

**Keywords** Neuroethics · Responsive early childcare · Developmental neuroscience · Parenting · Translational research · Attachment theory · Neurodevelopmental disorders · Depression · Anxiety · ADHD · Autism

The promises of beneficial applications of contemporary neuroscience have reached stakeholders and the public far beyond the clinical sciences and the context of healthcare [1, 2]. The use of functional neuroimaging in the American legal context, for example, has been attempted (but dismissed) in two recent decisions [3, 4]. Other areas are economics and marketing [5] where the promises of knowledge from neuroscience applied to publicity campaigns have left powerful impressions and elicited strong reactions among the public [6, 7]. The enthusiasm for translational neuroscience within and beyond healthcare has been critiqued as being unwarranted and may have taken some neuroscientists themselves by surprise. The propensity to oversell neuroscience’s import has been described by Morse, for example, as the “brain overclaim syndrome”, as “neuro-realism” [8], and more bluntly as “brain scam” by the editors of *Nature Neuroscience* [9]. The phenomenon has several probable causes including the misinterpretation of the promises of neuroscience but also excitement about the sheer novelty of neuroscience in the eyes of both experts and public stakeholders [10–14]. Given the ethical perils of underestimating or overestimating neuroscience’s contribution to various fields of research [39], it is worth examining closely claims made based on neuroscience and their educational implications.

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In education and early childcare as well, the media, popular science and some neuroscientists have heralded the promises of “brain-based” interventions and the revolutionary promises of more scientific and objective understandings of learning and developmental processes [15–18]. Although the hope for more enlightened education and child care practices is laudable, the eagerness to translate basic neuroscience research to the educational setting raises important general questions about the scientific soundness of doing so and about the downstream educational and ethical consequences of overreaching neuroscientific evidence. This connection between epistemological issues and ethical questions is reinforced by a wide array of underlying concerns related to the philosophy of neuroscience and the uncertainties surrounding current neuroscience research. An exemplary case illustrating this relationship surfaces in research based on functional Magnetic Resonance Imaging (fMRI), a technique which has generated expectations far beyond the uncertainties related to its limitations [56]. Further, this link between epistemic and ethical issues is strengthened by the epistemic weight that neuroscience explanations presently carry in comparison to more traditional psychological, behavior or even folk understandings [2, 19]. Understanding and examining neuroscience’s potential contribution to education is therefore both an epistemic and an ethical enterprise. To be done adequately, it calls for an appreciation of the multifaceted interactions between educational practice, neuroscience and societal expectations. A fair appreciation of the ethical challenges demands sensitivity to such complex issues as the epistemological underpinnings of neuroscience research in this area (e.g., use of animal models of learning and development), the social and policy consequences of early translation of research (e.g., the sound use of neuroscience evidence to confirm or discredit educational practices), and the role that values play in informing decisions made by neuroscientists, policy-makers, and parents in this translational effort (e.g., the implicit prioritization of efficiency, competitiveness, and increased productivity and performance). In sum, neuroscientists and other stakeholders confronted by the promises of neuroscience in education and parenting face a range of decisions and challenges in determining the epistemological credibility of neuroscience-based explanations as well as acting upon them in responsible and value-sensitive ways.

This paper examines a general claim that has emerged at the forefront of the translation of developmental neuroscience in education and childcare: namely, that “responsive early childcare” significantly benefits children’s social development and, more specifically, is a protective factor against developmental problems such as autism, anxiety disorder, attention deficit and hyperactivity disorder (ADHD), and depression. Our aim is to describe and examine critically some of the epistemological and ethical challenges raised by the way that neuroscience research has been interpreted in both “offshore” (i.e., non-specialist or popular) writings in applied psychology as well as in the scientific (i.e., specialist, peer-reviewed) literature to advocate the adoption of “responsive” practices by new parents and others responsible for the care of infants. To pursue this aim, we adhere to an interdisciplinary and empirically informed conceptual approach to understanding the impact of the application of neuroscience research and the use of neuroscience technologies on societies, institutions, practices, and both parents and children. We are particularly interested in understanding the relationship between epistemic and ethical issues in the form of a meta-inquiry into the epistemological and ethical soundness of translational research to the discourse on early childcare. Questions about the hasty introduction of novel neurodevelopmental interventions may currently be marginal in neuroethics but, far from being new, such concerns lie at the historical roots of neuroethics as proposed by Anneliese Pontius in the nineteen seventies [27].

The first section of the paper overviews several versions of what we will refer to as “the neuroscience argument for responsive early childcare”. Section two begins by introducing some specific evidential challenges posed by the use of evidence from developmental neuroscience as the basis for parental practice recommendations. It then presents a set of observations about the evidence cited by the neuroscience argument for responsive early childcare that raise doubts about this evidence’s conclusiveness and applicability to the families to which the argument is ostensibly addressed. The purpose of the third section is to highlight two ethical issues raised by the neuroscience argument for responsive early childcare. Specifically, we argue that, first, because it increases the stakes of the choice of responsive childcare higher than the existing evidence allows, the neuroscience argument fuels unwarranted

parental anxiety. Second, after pointing out how a number of writers invest in the neuroscience research on the effects of stress on the developing brain as a means of reinvigorating Attachment Theory, we argue, based on our reading of this research presented in section two, that this is a misplaced strategic bet. Here, as elsewhere in parenting advice literature, pronouncements that go beyond the limits of the knowledge base threaten public confidence in developmental science's potential to inform childcare practices and policy that enhance children's health and well being.

### Neuroscience-Based Advocacy of Responsive Early Childcare Practices

"Responsive early childcare" describes prompt, consistent, and sensitive reactions to an infant's distress on the part of its caregiver. Viewed as a social process, responsive childcare comprises three elements described in a review published in the *Bulletin of the World Health Organization*. First, caregivers observe signs of distress or discomfort. Second, they interpret those signs by accurately assigning a proximate cause. Third, they act rapidly, reliably, and appropriately for the sake of addressing the infant's immediate needs that are causing distress and discomfort [20].

In this schema, "appropriateness" is the most manifestly value-laden concept and requires special attention. Some common ways that parents and other caregivers respond to infant distress, while likely to be regarded as appropriate by those caregivers themselves, would not be considered appropriate interventions in the sense that the term "responsive childcare" is typically used in the parenting ethics literature. For example, many new parents employ the extinction method of sleep training (i.e., allowing babies to "cry themselves to sleep") because they believe that it will help their child learn to fall asleep quickly and without adult intervention. Similarly, some caregivers adhere to a rigid feeding schedule and will delay feeding even though they believe the infant is showing signs of hunger. A parent might do this out of concern for "spoiling" an infant by letting his desires dictate the household schedule or because the parent believes that babies "need structure". Both practices are appropriate from the perspective of caregivers to the extent that they are consistent with caregivers' beliefs about good parenting. From

the perspective of responsive childcare as it is normally conceived, by contrast, neither practice is appropriate. Responsive childcare implies prioritizing the immediate relief of infant distress and the infant's present comfort in childcare choices.

Reflecting the strong perennial interest in developmental science among the public and in the media [26], a body of literature has emerged in recent years that attempts to draw practical conclusions about childcare from the new field of affective and social neuroscience. The purpose of this literature, as characterized by Sunderland, is to inform caregivers "about the impact of different ways of parenting on a child's brain" [28]. Along with frequent child-caregiver physical contact, nursing on demand, late weaning and co-sleeping, "responsiveness", "responsive parenting, or "responsive early childcare" is an abiding element in a package of early childcare practices almost universally advocated in this literature on the grounds that it has a positive impact on the development of the infant's "social brain" [28–32].

The accounts of the supposedly beneficial effects of responsive childcare on neurological development to be found in the new translational literature on the neuroscience of parenting are, in terms of their content and scientific rigour, as varied as can be expected from an intellectually diverse group of writers approaching such a large volume of potentially relevant scientific research. Whether aimed at a broad audience of professionals, new parents, or a specialized audience of researchers, a basic argument recurs in the translational literature on the neuroscience of parenting. Simple enough to seem to offer clear practical guidance for infant care, the argument advances that responsive childcare, by helping to maintain low levels of stress hormones in the infant's brain, is conducive to the "normal", "healthy" or "optimal" development of the neurological systems involved in stress regulation. Although we do capture this translational effort under the umbrella term of a "neuroscience argument", readers should bear in mind that the argument is not the subject of consensus among neuroscientists who research the effects of stress on brain. Although some neuroscientists do seem to endorse the essence of the argument, it is has mainly been developed and promoted by non-neuroscientists interested in understanding the practical import of this research.

The argument is discernable, for instance, in Sonia Lupien and colleagues' [33] recent review article on

the deleterious effects of stress on the brain published in *Nature Reviews Neuroscience*. Humans, they state, give birth to relatively immature young and the larger part of neuroendocrine maturation, including the development of the stress response system, occurs *ex utero*. Next, the authors claim that because of human babies' extreme physical vulnerability, they may have a species-specific predisposition to anticipate the threat posed by being left unattended by an adult and to become psychologically stressed in the absence of constant care. The stress response system is highly sensitive to environmental stressors through at least the first year of life and possibly well into childhood. Lupien and colleagues conclude by throwing down the gauntlet to move to a phase of translational research on responsive early childcare. "After more than 30 years of research on the negative effects of stress on the brain," they write, "it is now time to turn our attention to the potential positive impact of early intervention on brain development" [33]. One intervention that they identify as being an especially salient means of limiting the activation of the stress response in infants is "sensitive and supporting care".

A simpler form of the neuroscience and responsive parenting argument appears in the popular parenting writer Penelope Leach's latest book, the *Essential first year* [32]. Without quoting specific studies, Leach claims that neuroscience research has shown that when babies are left alone to cry for long periods the level of the stress hormone cortisol in their brains rises and that repeated exposure to high levels of cortisol causes permanent negative alterations to the neurological systems involved in stress management. Parents, she urges, must understand that babies cry when they are left alone for a reason. Their nervous systems are immature and, because they cannot yet comfort themselves, they need a caregiver's help. Responsive childcare and more specifically the avoidance of the extinction method of sleep training, Leach concludes, favours the development of a nervous system which reacts appropriately to life's stresses and may protect children against the risk of neuropsychological conditions such as anxiety and depression later in life.

A final example of the neuroscience argument for responsive early childcare can be found in Sue Gerhardt's book, *Why love matters* [30]. Gerhardt's analysis also focuses on the evidence from developmental neuroscience on the "corrosive" effects of

cortisol on infants' brains. Summarizing her interpretation of this evidence, Gerhardt writes: "[e]ssentially, the stress response system is affected by how much early stress it has to deal with, and how well the system is helped to recover. It seems that what you put in to the system is what you get out—a well-resourced and well-regulated infant becomes a child and adult who can regulate himself or herself well, whilst a poorly resourced and poorly regulated infant becomes a child who cannot regulate herself well". By permanently structuring the neurological pathways underlying stress regulation, responsive early childcare becomes, for Gerhard as for Leach, a protective factor against anxiety and depression.

### Evidential Issues in the Neuroscience of Responsive Parenting

The new knowledge that neuroscience promises to contribute to our understanding of the influence of early experiences on psychosocial development are insights into the biological mechanisms by which, as Steve Hyman put it, early experiences might "get under the skin" [25]. The scientific study of the influence of a child's early experience on its behaviour and dispositions as an adult has long taken for granted that any personological traits attributable to early experiences have a biological substrate, in particular in the body's neuro-endocrine system [24]. Lacking the means to study these underlying mechanisms directly in humans, developmental scientists have sought to understand the influences of early experience on developmental outcomes using the methodological resources available to them, namely the elaboration and validation of cognitive-behavioural theoretical models through correlational studies, and animal research [21]. As Eschel and colleagues' recent meta-analysis of research on the relationship between responsive parenting and child health and development reminds us, links in the cognitive-behavioural literature between responsive early care and various aspects of child health and development (including language, cognitive as well as psychosocial development) are well established and already operating as a point of reference for the justification of public health interventions aimed at promoting responsive parenting in developing regions and elsewhere [20]. The neuroscience research on the effects of early stress on the

stress-response system can be read as not only triangulating with this conclusion. It also suggests a powerful explanation at the biological level for the association between an absence of responsive early childcare and poor behavioural and cognitive outcomes: the effects of early life stressors on key neurological systems account for the observed negative developmental sequelae [33, 40].

The marriage of neuroscience explanations and parenting advice literature in attempts to advocate responsive early childcare on the basis of evidence on stress and brain development poses a double evidential challenge. First, there is a widespread suspicion that developmental science is frequently manipulated to promote particular scientists' or science writers' personal views about good parenting. Articulating this perception, Helen Barrett writes that, especially in texts addressed to a general audience of parents and professionals, authors tend "to oversimplify or, at times, to misrepresent theoretical arguments and research findings, to lack any substantial critique of the ideas they present and to present rather one-sided views which, though engaging, may be of dubious evidential status" [21]. Second, the rhetorical appeal of neuroscience-based explanations has been observed both in studies of media coverage of neuroscience [8, 42] and in research in social psychology on how non-experts evaluate the evidential strength of neuroscience explanations [43, 44]. In media reports, the phenomenon of neuro-realism captures how neuroscience evidence, especially from functional neuroimaging techniques, has been portrayed as providing powerful insights into the mechanisms of the mind. Often, neuroscience evidence is suggested to have more "reality" than what is revealed by common sense or by social sciences and the humanities. [8, 42] Neuro-realism therefore describes a form of naive realism propelled by public fascination for contemporary neuroscience. From a psychosocial standpoint, Weisberg and colleagues' study [43] add caution to this phenomenon of neuro-realism. Their study revealed that explanations with superfluous neuroscience information tend to be regarded as more credible than explanations based only on behavioral-cognitive information. Furthermore, when bad explanations included neuroscience information, non-experts found it more difficult to perceive the weaknesses of those explanations, and were thus more likely to judge a bad explanation as convincing.

Given what has come to light on the rhetorical appeal of neuroscience explanations (e.g., neuro-realism, seductive allure of neuroscience explanations), and against the background assumption among the reading public that developmental science is often manipulated to promote scientists' and science writers' personal views about good parenting, particular vigilance seems warranted in assessing the validity of the neuroscience-based argument that responsive parenting may be a protective factor against psychodevelopmental disorders.

The work of discerning the practical significance of neuroscience research on the effects of early environmental stress on the stress-response system poses significant interpretive challenges for both non-experts/interpreters and the experts/scientists doing the research themselves. For example, the basic biological research tends to operationalize "negative developmental effects" in terms of measures that do not easily map onto meaningful concepts for non-scientists. Parents/care givers are interested in knowing socially meaningful effects like "secure", "calm", "happy", etc. Whereas researchers try to assess "pathophysiological changes" by measuring the effects on things like growth rates (weight and height), cognitive performance (learning impairments), "reduced hippocampal volume", "behavioural disturbances", hormone levels in parts of the brain regarded as significant for stress regulation, and "basal HPA axis activity", slower shutdown of the HPA response to acute stress (a sign of a dysregulated stress response system) [33, 35]. Furthermore, the question of what is meant by a "well regulated stress response system" tends to be glossed over in the neuroscience of parenting literature with the assumption that "psychosocial problems" themselves constitute evidence of a dysregulated stress response system. The view that there is a single universally "healthy" or "normal" stress response system for humans, however, is hard to square with the key concept of "brain plasticity" in developmental neuroscience. The stress response system, like other neurological systems, undergoes structural changes in response to its environment such that the "adaptiveness" of a neurological system is a function of the environment in which that system operates. A stressful environment of early life, for instance, will tend to favour the emergence of a stress response system that is adaptive in a stressful life environment but which may be maladaptive in low-stress environments. Finally,

while meta-analyses like Lupien and colleagues' [33] and Dawson and colleagues' [35] indicate that stress affects various measures of development and on brain systems involved in cognition and associated with mental health, the heterogeneous research sources on which claims about the effects of early stress on the stress response system invariably create a highly complex picture. As comprehensive analysis of this research is beyond the scope of this paper, our more modest aim in this section is to briefly present a set of observations about the evidence cited that raise doubts about its conclusiveness and its applicability.

Our first observation is that the evidence for three common claims that in the neuroscience argument for responsive parenting are inconclusive: (1) that chronic high cortisol levels affects behavioral outcomes, (2) that the more stressed the child becomes the higher his cortisol levels rise, (3) that the effects of cortisol on the stress-regulatory system is largely irreversible. For example, Lupien and colleagues [33] cite research which shows that the levels of the stress hormone glucocorticoid of all toddlers in all-day daycare progressively rise during the day. However, increases vary not only according to how "sensitive" the available care is but also according to toddlers' individual emotional and behavioural profile. Despite these findings, they assert that "there is no evidence that the elevated glucocorticoid levels associated with being in day care affect development". In contrast, several studies on children exposed to severe deprivation or neglect experience have reported hypocortisolism—i.e. chronically *low* levels of glucocorticoids in chronically stressed children. Finally, and contrary to Gerhardt and Leach's more popular versions of the neuroscience and responsive parenting argument, Lupien and colleagues point out that what is known about the longitudinal effects of this neuro-physiological reaction to situations of chronic high stress indicates that the effects of environmental stress on the stress response system are not permanent. "Sensitive and supportive care", they write, "normalizes [these children's] their basal glucocorticoid level after only 10 weeks" [33]. To sum up, some kinds of experiences associated with high cortisol levels (i.e., attending all-day daycare) appear not to be a risk factor for the emergence of developmental problems, some stressful experiences—especially very stressful ones—do not always lead to raised cortisol levels, and finally there is evidence to suggest that the effects of

some stressful experiences on stress-regulatory systems are reversible, not permanent.

Our second observation about the epistemological limitations of the evidence cited in support of the neuroscience argument for responsive parenting concerns its applicability to the context of most families. The biological research concerned with investigating the influence of stress on specific neuro-endocrinal pathways is experimentally contrived and highly technical. A significant portion of it is also animal-based owing to necessary ethical restrictions on manipulating children's social environments for hypothesis testing about the effects of different external stressors on neuroendocrinal mechanisms. The specific animal research that has been key to understanding the effects of stress on the functioning of neuro-endocrinal pathways associated with the mammalian stress-response system (esp. the hypothalamus-pituitary-adrenal or HPA axis) typically involves subjecting newborn rodents and primates to severe maternal deprivation: prolonged or "repeated, unpredictable separation from the mother, unpredictable maternal feedings, or spontaneous maternal abusive behaviour" [33]. That is to say, hypotheses about the effects of stress on the developing brain are in this body of research addressed negatively, with the key neuroscience research tending to look not at the beneficial effects of responsive infant care but the negative effects of abuse and neglect [41]. Typical relevant human studies identify potentially stressful conditions (all-day day-care, being cared for by a clinically depressed mother, etc.), measure the effects of these conditions on cortisol levels, and extrapolate the developmental effects of high cortisol on the children's activity of the HPA axis or other pathway. The underlying biological model of the effects of exposure to high levels of cortisol on the body's stress-regulatory system is, again, derived from animal studies [33].

In our reading of the evidence, two related limitations stand out. The first is that responsive parenting is not a factor directly studied in the research linking severe abuse and neglect to poor developmental outcomes. When the implications of this research for parenting practice and policy are considered, the responsive parenting construct plays the role of an interpretive lens through which to assess the research's significance. This use of the responsive early childcare construct may be sound if,

as some interpreters seem to assume, the stress induced by being exposed to unresponsive parenting were comparable in kind and in degree to that induced in situations of extreme abuse and neglect. Second, even if one brackets the complexities identified above about generalizing across types of stressful situations, the operative comparison between the circumstance of children or animals exposed to extreme conditions of deprivation, neglect and abuse and those of most human infants seems doubtful. The question is how well conclusions about the effects of social abuse and neglect on the mammalian stress response system apply to the situations of human infants exposed to varying degrees of “unresponsive early childcare” within average contemporary family environments in developed countries that are otherwise reasonably predictable, caring, safe and healthy. Claims about the relevance of the evidence from animal studies depend on an implicit comparison between the social environment of such “normal” families and conditions of extreme stress studied in the laboratory. This comparison is obviously treacherous.

An exception to the typical animal studies cited in support of the neuroscience argument for responsive early childcare is Meaney and colleagues’ research programme on the epigenetic effects of “high-caring environments” on the stress response systems of rat pups. What is distinctive about this research is that responsive early childcare—or at least a closely analogous construct—does appear as a variable in the experimental design. In effect, “responsive early childcare” is tacitly operationalized in terms of naturally occurring variations in patterns of maternal licking and grooming and arched-back nursing on the part of female rats. It is this feature of these protocols that renders interpretive comparisons with human families more suggestive and helps to explain also why the Meaney studies are so widely cited by authors making the neuroscience and responsive early childcare argument.

Considering the limitations of the current research on the effects of environmental stressors on the development of the human stress-regulatory system and of its applicability to the circumstances of most families, we conclude that the notion that the “unresponsive” practices which some parents commonly use in caring for infants (e.g., the extinction method of sleep training, rigid care scheduling, forward-facing prams) is a significant factor in the

emergence of common psychological disorders remains at best a reasonable hypothesis [36]. The findings about the effects of stress on brain development, that is to say, suggest avenues of inquiry that, if pursued, might in the future uncover clear links between responsive early childcare and more effective responses to environmental stress. Good intentions are undoubtedly behind efforts to defend policy and practice recommendations based on neuroscience research about the effects of stress on brain development. We advance, however, that, pending more specific and extensive knowledge about the effects of the associated stress experiences on brain development, parents and policy makers would be right to regard as alarmist statements such as Penelope Leach’s to the effect that “the kind of anxiety induced by the extinction method of sleep training may relate to anxiety right through adult life” [32].

#### **Ethical Issues Raised by the Neuroscience Argument for Responsive Early Childcare**

As a number of writers have pointed out, when it comes to translational research on child development, epistemological and ethical issues are tightly interlinked [26, 36, 45]. The rhetorical appeal of neuroscience justifications for educational interventions and family policy is not innocuous hype. First, policy or practice proposals which are poorly grounded epistemologically risk diverting resources away from more effective strategies for promoting child welfare and positive development [45–47]. A flagrant example of the impact of the seductive allure of neuroscience explanations on child policy is was the former Georgia State governor Zell Miller’s provision of several million dollars in the 1998 state budget to fund the purchase and delivery of a recording of classical music to for families of all newborn children. The legislation, now widely considered an embarrassment, was based on a hasty interpretation of neuroscience research on benefits of exposure to classical music on cognitive development, or the so-called “Mozart effect” [48]. Second, the way that neuroscience research findings are interpreted, presented and their policy implications drawn out becomes an ethical issue when parents and educators are sold dubious or even harmful interventions (e.g., “brain-based” educational DVDs for toddlers [52]) and when

simple neurological explanatory accounts of complex social problems (e.g., the effects of exposure to violence in the media on violent behavior [36]) come to gain widespread public credibility. In this section we would like to present and discuss two ethical issues that are specific to the neuroscience argument for responsive early childcare. First, we will argue that the neuroscience argument for responsive early childcare unduly raises the stakes of care choices for parents and, in this way, introduces a source of unwarranted distress into family life. Second, we point out that such hasty use of neuroscience evidence in parenting advice literature is counterproductive to building public trust in developmental neuroscience's capacity to contribute to child health and well being.

### The Neuroscience Argument Casts Parental Choice as High-Stakes

If the correlational behavioural-cognitive research on the benefits of responsive parenting to child health and development are reasonably solid, one might reason, the tenuousness of the neuroscience-based argument for responsive parenting is of little consequence from a policy and practice perspective. If we already know that responsive parenting practices improves various aspects child health and well-being, in other words, it may seem to make little difference why these practices gain favour in the eyes of parents and policy makers. At worst, future research on the effects of early stress on brain development will give the lie to the currently hypothetical link between “unresponsive” early childcare and psychological health. In this eventuality, parental choice or family policy wrongly based on neuroscience evidence would have nevertheless contributed improving the quality of early childcare by helping to make responsive parenting practices more widespread in the population.

The validity of the specific neuroscience argument for responsive parenting, however, is ethically salient because it raises the stakes of individual parents' choices about whether or not to adopt responsive parenting practices. By casting the choice as being highly consequential for their children's future health and well-being, the neuroscience argument can fuel unwarranted parental distress and anxiety.

The potential distressing consequences of the neuroscience argument stem partly from the fact that

it depends on the basic theoretical apparatus of critical periods found in developmental neuroscience. Comprising a set of assumptions about how early experiences affect brain development, this framework weighs heavily in favour of the basic claim that the influence of early experiences are significant and irreversible. Well established in developmental neurobiology, and acknowledged very generally (albeit to varying degrees of explicitness) in recent offshore writings on the neuroscience of parenting, this framework can be summarized in the following four points:

1. The number of synapses in the brain increases dramatically during the first months of life (i.e., “synaptogenesis”);
2. Synaptogenesis is followed by period of significant decline in the number of synapses (i.e., “synaptic elimination” or “synaptic pruning”);
3. The maturation of some neurological systems depends on environmental input, the absence of which results in the loss or permanent deficiency of the corresponding function (i.e., “experience expectancy”);
4. The environmental input required for the maturation of a neurological system must be present during a specific window of time in the organism's development (i.e., “a critical period”) [26, 45].

According to this framework, human beings are born neurologically premature, the first months of life are a unique and formative period of neurological development, and the neurological changes that occur during infancy are the product of interactions between genetic influences—i.e., of the gene-based neurological structures with which the child is born—and environmental factors. Seen through this framework and in light of human infants' dependency during this unique period of neurological development the claim that caregivers' interventions have a wide-ranging, significant and possibly irreversible impact on children's psycho-social development may seem established a priori. Once these assumptions are taken on board, in other words, the question becomes not *whether* the stress regulatory system has a schedule of sensitive periods comparable to those observed, for example, in the development of the neurological systems involved in seeing and hearing or language proficiency but *what* that schedule is and precisely *what kind* of “environmental



input” is necessary for the normal maturation of the stress regulatory system?

Against this background of critical periods, it is imminently foreseeable that parents and offshore translators of neuroscience research will perceive the choice of whether to adopt the practices associated with “responsive parenting” as having significant consequences for their children’s future health and well-being. As noted above, reliably assessing the effect of stress on the developing brain is a complex affair. Numerous critical studies on the translation of neuroscience to education and early childcare have documented how the theoretical framework of critical periods is misapplied to domains other than the ones in which the framework was initially conceived (i.e., in the development of the sensory system and language acquisition) [15, 26, 45] Typical points of misunderstanding relate to overlooking the evidence that critical periods may be exceptional, not typical, in brain development and that there is not one “right kind” of environmental input that each neurological system “needs” to develop “normally”. Rather, because the environmental input plays the role of steering the maturation process by fine tuning neurological systems to the organism’s specific environment, the range of “expectant” environmental input for any organism, and in particular for socially complex, culture-bearing, and ecologically adaptable mammals like humans, is extremely wide. The claims repeated in the offshore literature on the neuroscience of parenting to the effect that insufficiently responsive early childcare is potentially “toxic” to the brain and that “responsive parenting” constitutes a protective factor against disabling psycho-developmental disorders like autism-spectrum disorders, anxiety, depression, and ADHD, then, are at best apt to create unwarranted anxiety in parents. But the consequences of over-estimating the neuroscience-based link between responsive parenting and healthy brain development are especially pernicious for the parents with children suffering from severe developmental disorders. They may come to believe that if only they had been more “responsive”—if during the child’s infancy they had eschewed the extinction method of sleep training and opted instead for co-sleeping—that their child would today be healthy and normal. Although further research on the specific real-world effects of the critical period framework on parental

behaviour would be needed, a psychosocial study has pointed to tangible behavioural and psychological effects of deterministic explanations [57].

In sum the grounds on which responsive parenting is prescribed, far from being solely an epistemological issue, has significant ethical import. The neuroscience argument for responsive early childcare seems driven by the deterministic framework of critical periods and yet some of what developmental neuroscientists know about the effects of stress on the brain, as reviewed in the foregoing section, largely contradicts the suggestion that this framework applies neatly to socio-emotional development. When viewed from the perspective of parents having to make choices about infant care, the problem with the argument is not simply its epistemological weakness but the foreseeable impact that it will have on their perceptions of the extent to which the fundamental, long-term well being of their children is at stake in such choices.

#### The Neuroscience Argument, Attachment Theory and the Issue of Public Trust in Developmental Neuroscience

It appears that one of the reasons why the neuroscience of the effects of stress on brain development has attracted the interest of parenting science writers is because this research seems to provide new and scientifically credible grounds for prescribing “responsive parenting”. The concept of responsive childcare in contemporary discourse on parenting is largely a legacy of Attachment Theory [21].

The result of collaboration in the middle decades of the twentieth century between John Bowlby and Mary Ainsworth, Attachment Theory posits that unresponsive childcare—that is to say, childcare practices that involve the strategic or haphazard delaying of responses to signs of infant distress or ones that involve ignoring or reacting inappropriately to such signs—is a determinant of low quality infant-caregiver attachment. According to Attachment Theory, low quality attachment initially has repercussions for the infant’s motor and sensory development. Being preoccupied with their caregiver’s unresponsive or inconsistent responsiveness to their needs, anxiously attached children, for instance, are distracted from engaging in developmentally important life tasks like play and exploration [22]. As children enter adulthood, attachment patterns established in infancy are thought to form the basis of

“internal working models” about one’s own worthiness of love and affection and about how loving and affectionate significant others are [21, 22]. In this respect, early caregiver/child relationships have a long-term impact on the child’s prospects for experiencing fulfilling relationships in later life and may mediate a wider range of forms of maladjustment or psychopathology [23]

Following the lead of Alan Schore [29] and Peter Fonagy [34, 52], a number of popular writers advance that Attachment Theory and basic neuroscience research on the effects of stress on the brain systems seem to triangulate in support of responsive parenting [28, 30, 31]. Sue Gerhardt, who is especially candid on this point, writes:

We have arrived at a moment in which different disciplines are converging to produce a new understanding of emotional life. [...] For the first time, a full biological explanation of our social behaviour is becoming available—by understanding human infancy and the development of our ‘social brain’ and the biological systems involved in emotional regulation [30].

As Gerhard goes on to suggest, both the theoretical and practical interpenetration between Attachment Theory and the growing evidence about the effects of stress on the body’s stress-regulation systems is thorough and remarkable. With respect to theoretical frameworks, Attachment Theory and the neuroscience argument for responsive early childcare share a basic psycho-biological account of why responsive childcare practices are species-typical for humans: infants have a developmental need for responsive care grounded in a physical and emotional vulnerability that is specific to human beings as living creatures. Where Bowlby saw the infant’s drive to seek proximity to caregivers as a strategy to promote survival [22], Narvaez sees responsive parenting as a coevolved behaviour that favour the normal development of stress regulatory systems in the brain [53]. With respect to the hypothesis about the longitudinal sequelae of responsive childcare, both Attachment Theory and the neuroscience and responsive early childcare argument hold that the absence of responsive parenting “hard wires” the organism, giving rise to refractory and negative longitudinal sequelae for social functioning. Where Peter Fonagy sees insecure attachment in infancy as a psychological cause of

unfulfilling relationships in adulthood [34], for instance, Sunderland, Leach and Gerhardt see responsive parenting as protective factor against neuro-psychiatric disorders [28, 30, 32]. Finally, Attachment Theory and the neuroscience case for responsive parenting hypothesise that parenting practices are passed forward to future generations but each approach posits its own discrete transmission mechanism. Where Alan Stroufe sees adults unconsciously transmitting to their children “internal working models” acquired in infancy [23], Micheal Meaney and colleagues see exposure to high stress in infancy altering stress-regulatory systems through epigenetic mechanisms [25].

Attachment Theory continues as a comprehensive research programme that aims to explain both healthy psychosocial development and psychosocial adaptation difficulties in terms of the quality of care individuals receive in the first months of life [22]. However, the credibility of Attachment Theory has for some time been seriously challenged on both the scientific and ideological front and these challenges are relevant to the contemporary neuroscience argument for responsive early childcare given affinities between Attachment Theory and current developments.

On the scientific front, starting in the 1960s, a key scientific development outside psychology disrupted the broad consensus in developmental psychology that building blocks for future personality development are laid in early life experience [24, 50]. Possibly the most socially and culturally significant scientific event since the publication of Darwin’s *On the origin of species*, this was the discovery of DNA the subsequent rise of molecular genetics. Perceiving the potential implications of genetics for understanding personality development, psychologists quickly mounted a campaign against Attachment Theory which was at that time was the dominant school of infant determinism in academic psychology [50]. The field of behaviour genetics was consequently propelled by a meta-theoretical framework inspired by biological science and coinciding with increased public awareness of the influence of genes on health outcomes. Under the aegis of Jerome Kagan’s longitudinal studies on temperament and Thomas Bouchard’s research programme on identical twins, a mass of striking and highly publicized evidence emerged that the impact of early childcare on developmental outcomes was overwhelmed by genet-

ically rooted individual temperaments [50]. The central issue of the so-called temperament debate of the 1980s, as perplexing as it was emotionally charged, seemed to be the validity of attachment theory's key claim that the quality of attachment between an infant and its primary caregiver, as this construct is defined by attachment theory, is the primary determinant of a person's personality, as defined by temperamentals [21, 24].

On the ideological front, Attachment Theory has long faced accusations of being both anti-feminist—because of Bowlby's insistence that women should stay home with their infants rather than enter the workforce—and guilty of “mother-blaming”—by attributing developmental difficulties to the quality of care provided by the primary caregiver (usually the mothers) [54]. Moreover, Attachment Theory has the dubious honour of being a prime example of the duplicitous use of scientific evidence to lend a false air of legitimacy to what are ultimately one person's personal views about how to raise children properly [21]. One of the most poignant instances of this accusation comes in a memorable passage in the most polemical chapter of Jerome Kagan's notoriously combative book, *Three Seductive Ideas* [24]. Here, Kagan argues that the doctrine of infant determinism—again, the common belief, with which Kagan closely associates Attachment Theory, that an absence of stable, attentive care by loving parents imperils children's future well being—is based on little more than an “ethical judgement as to which maternal behaviours [...] are considered the most virtuous” [24].

In sum, these scientific and cultural pressures have combined to make the concept of responsive parenting a victim what Augusto Blasi has called a “mixed argument”, a pervasive but invalid form of argument in psychological discourse where scientific claims, hypothesis or even whole schools of thought are dismissed because they are associated with some unpopular theoretical perspective [55]. Employing this type of argument, one might infer, to paraphrase Blasi, that the developmental benefits of responsive parenting must be grossly exaggerated because responsive parenting is prescribed by Attachment Theory and Attachment Theory has no scientific credibility, as everybody knows.

This analysis of the connection between Attachment Theory and the current neuroscience argument exemplifies how the translation of research on human

development, practice and policy is a highly complex and often politically charged affair. Jack Shonkoff [36] has argued that, in this context, effective translation of the results of research on child development to the realm of policy and practice requires that careful attention be paid to the distinction between established knowledge, reasonable hypotheses, and unwarranted or irresponsible assertions in the field of investigation. It is the very nature of scientific knowledge about human development, Shonkoff reminds us, to be provisional and limited. The base of established knowledge is in constant evolution. Mirroring more recent calls for translational prudence in the neuroethics literature and commitment to integrity and accountability [37–40, 58], Shonkoff advocates a cautious approach to policy not only because it enhances developmental science's potential contribution to the advancement of human health and well being but also because, without it, public trust in psychological science's role in developing sound child and family policy risks being undermined. By fuelling the growth of public scepticism and cynicism towards the possibility of reliable or well established knowledge in child development, imprudent interpretations of child development research weaken developmental science's potential to enhance human health and well being [36].

The attempt to promote responsive parenting in the public domain by using the neuroscience research on the effects of stress on the developing brain as a *prima facie* more credible alternative to Attachment Theory is, from the point of view of public trust, a risky bet. Since parenting science writers are one of the key points of contact between science and the public, they can render an important public service by helping to nurture trust and voice careful messages. Against this background, however, writings that make hasty appeals to neuroscience evidence to support attachment theory may hinder the cause of responsive parenting. A cursory familiarity with the history of encounters between science and parenting reveals an unsettling continuity between the neuroscience argument for responsive early childcare and an influential movement in the developmental psychology community on the harmful effects of parental “indulgence”. Ironically, the very practices that current proponents of responsive parenting now argue are detrimental to brain development—namely, the extinction method of sleep training, the imposition of a highly structured care regime, minimal caregiver-child physical contact,

etc.—were popularized by offshore parenting literature produced in the first half of the 20<sup>th</sup> with the active support of developmental psychologists and like-minded physicians [49]. The juxtaposition of these two historical moments underlines how developmental neuroscientists can assume a highly public role in attempting to challenge the popular culture of early parenting and that they can exert a mass influence on the way adults care for very young children. The new opportunities that neuroscience presents for understanding the effects of the early environment on human health and, though this understanding, potentially improve the quality of early childcare offers a window of opportunity for a break with this past of “science’s encounters with the child”. With respect to writings on the neuroscience of parenting, this means capitalizing on the current public fascination with brain science to explore more productive and transparent ways for developmental scientists and science writers to engage with the public about child development, childcare and family policy. As commented by neuroscientists Joy Hirsch in a *New York Times* article regarding the eagerness of parents to apply neuroscience to childcare, “[t]hose are questions that people have always been asking, those are questions they will continue to ask and of course we won’t be able to provide any further answers. The time course of science is geological, while the time course of parenting is immediate” [59].

## Conclusion

This paper’s purpose was to assess and to consider from an ethical perspective a recurrent claim in the translational literature on neuroscience and parenting, namely that, because responsive early childcare practices are conducive to a well regulated stress response system, it may be a protection factor against common neuro-developmental disorders like depression, anxiety, ADHD, and autism. Denying neither that early stressors have negative consequences on various measures of developmental outcomes, nor that a significant body of cognitive-behavioural evidence that responsive early childcare has a wide ranging positive impact on child development, we challenged the conclusiveness and applicability of the neuroscience evidence cited in support of the link between early stress attributable to “unresponsive”

parenting practices and the later emergence of psychological troubles. We then explained why translational research in the neuroscience of parenting carries with it an ethical responsibility to adopt a cautious approach to handling evidential claims. To support this account, we pointed to the neuroscience argument for responsive early childcare’s potential to cause undue distress in families, especially those with children affected by severe neuro-psychological troubles, and to the need to enhance developmental neuroscience’s credibility as a source of knowledge about how early childcare practices may contribute to or frustrate children’s health and well being. To this extent, this study strongly supports previous calls for a clearer acknowledgement of the ethical responsibilities of neuroscientists in communicating and discussing sensitive areas like parenting practices [58]. Our analysis is also consistent with recommendations to develop programs to train writers, teachers, and other scholars in the use of neuroscience evidence education and human service intervention and to encourage neuroscientist to engage in research that would favour evidence-based communication practices [51]. To advance ethical use of translational research in parenting neuroscience, further research should examine the potential value of translational research frameworks already well established in biomedical ethics, the relationship between social and normative aspects of early childcare, and concrete interdisciplinary approaches that foster critical epistemological thinking and self-reflection.

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