Research Article

Viewing trauma as a developmental process emerging from chronic repeated experience and reiterated meaning-making mental processes

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We want to provide an alternative view or perhaps a complimentary view to the idea of trauma seen as acute severe events and a major cause of psychopathology. To overstate the argument, we do not see trauma as *the* mechanism driving dysfunction or psychopathology. Rather, as developmental neuroscientists, we see development and the quality of lifelong functioning emerging from chronic repeated experiences and processes, primarily external interpersonal relational experiences and internal mental processes, mechanistically carried out by somatic and brain – neurosomatic – processes.

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Introduction

We want to provide an alternative view or perhaps a complimentary view to the idea of trauma seen as acute severe events and a major cause of psychopathology. To overstate the argument, we do not see trauma as *the* mechanism driving dysfunction or psychopathology. Rather, as developmental neuroscientists, we see development and the quality of lifelong functioning emerging from chronic repeated experiences and processes, primarily external interpersonal relational experiences and internal mental processes, mechanistically carried out by somatic and brain – neurosomatic – processes. Framing our view of development, we adhere to a biological view of humans (any organism) as a

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dynamic, open system that must apprehend (appropriate) environmental resources – energy and information – on a continuous basis. The extent to which the child is successful or unsuccessful in acquiring these resources over time, at what rate, and in what form sculpts their neurosomatic systems, experience and ways of being for good or ill (Hunter & Tronick, 2018; Tronick, 1998; Sander, 1977; Harrison, 2003).

Additionally, the lack of a developmental perspective, along with the dominant psychopathological perspective framing our thinking about trauma, silos our understanding of trauma, the value of trauma theory, and trauma-informed practices. The perspective also limits the inquiry into other features – healthy or problematic – of the child's functioning. Indeed, we object to the view that a traumatic event, the event we note in our language, diagnoses and reports (e.g., sexual abuse at age 9), as *the only dangerous outcropping* in a (psychic) landscape as if it were the only dangerous feature of an otherwise pastoral (homeostatic) landscape. From our perspective, the outcropping is only a larger, easily identified feature of a grim, rugged landscape of more subtle and hard-to-identify discordant, dangerous and toxic features. Rather, picture an environment with one large slippery outcropping, otherwise covered with ruts, rocks, slick mud tracks, fallen trees, obstacles

large and small. Furthermore, typical of landscapes experiencing climatic stress, it is a dynamic and constantly changing landscape. Even if there was only one outcropping, its contours would weather and change.

Are events inescapably traumatic?

Critically, though most clinicians and diagnostic manuals see the outcropping as having a fixed meaning and a determinant effect, we see the child who is experiencing the event as making a unique meaning of it. For example, we need to recognize that the meaning made by one child of an event may be radically different than the meaning made by another child. The game of infants being tossed high in the air by a parent, caught and tossed again, leads to joyous excitement for some and terror for others. The experience is different from one child to another. The meaning made is individualized. A child may experience being fondled as pleasurable, while another child experiences it as intrusive. These individual differences may be related to temperament or the operating characteristics of a child's neurosomatic systems, such as a system's threshold of reactivity, its upper and lower thresholds, and the form of its reactivity. For example, an infant with a low threshold for reactivity of the amygdala may find an event fear-inducing, whereas another infant with a higher threshold may hardly react at all. In essence, the

reaction observed is related to the event and mediated by organismic neurosomatic processes (Porges, 2011).

Furthermore, in addition to individual differences, there are also developmental changes. Think only of the stages of Piaget's (1954; 1972) theory of development or any other theory, including neurobiological theories (Teicher et al., 2016; Wiesel & Hubel, 1963; Gunnar et al., 2015; Packard et al., 2021; Eslinger et al., 1992), that view development as involving qualitative changes. The infant to Piaget makes meaning using sensorimotor processes and a few years later using concrete operations. Stechler (Stechler & Latz, 1966) additionally said that meaning was sensory-affective in infancy, as well as in later development. Though hard for an adult to imagine, for Stechler, the meaning of an object or event could be joyous, scary, pleasurable or another affective reaction. Importantly, with development, new systems of meaning-making emerge, such as language and symbolic thought. However, language does not overcome the problem of the complexity of meaning. As Madison wrote in the *Federalist Paper No.37* when commenting on originalism (fixed meaning) in the US Constitution, no language is "so correct as not to include many equivocally denoting different ideas" and their meaning can only be obtained from interpersonal engagement with the words. Indeed, in the context of therapeutic work, the clinician, in collaboration with the patient, has to explore the meaning words mean to the patient. Furthermore, with the development of meaning-making systems, the meaning and recall of earlier events change. That is, when new language and cognitive capacities emerge, the memory of recalled events changes and changes the current experience of what had occurred.

Certainly, neurobiological theories focusing on brain development emphasize the radical changes in the structure and function of neurological architecture and processes. Developmental cognitive neuroscience tells us that while most children won't be able to reliably form autobiographical memory until they are roughly four years old, infants are capable of conditioning, as are fetuses in the latter stages of fetal development, a process that influences their predictions about the extra-uterine world. Perry (2008, 2009) characterizes the malleability of regulatory processes early in development and their changes with maturation and experience. These changes or the operational forms taken on by the regulatory process modify other higher-order processes and the meaning made of events. All told, the intersection of individual differences, developmental changes, and actual experience engender a vast untold variety of dynamic changes in the meaning of events.

It follows that we disagree with the argument made by some clinicians and researchers, and reified in some of our diagnostic manuals that specific events are inescapably traumatic. Of course, some events

are more likely to generate a traumatic-like experience, but still, the meaning of it will be different for different children. Moreover, the meaning is not fixed. Once made, the meaning will continue to evolve in different ways for the different children, even if the event is never experienced again. And while we recognize that in rare cases of an event, such as a once-in-a-lifetime slap of a child or inadvertent neglect of a child, such as leaving a child alone at home for too many hours, may actually only happen once, nonetheless, it is never experienced only once. Primary mental processes continue to operate on the meaning made and change it each time it is operated on and re-experienced. Again, the meaning is not fixed.

Stress, acute and chronic

The operation and interplay of these processes have long been observed in the field of stress neurobiology. Chronic stress exposure differs substantially from acute stress in

impact on both physiology and behavior (McEwen, Bowles, et al., 2015). Most animals, ourselves included, are well adapted to handle acute, fight-or-flight events, which helps explain both the high levels of resilience observed in the general population to single traumatic events. Such singular events may only weakly initiate internal repetitive mental processes, may have few triggers, and fewer dysfunctional regulatory effects because the child's caretakers/social partners provide ameliorative regulation, and because the meaning made by the child makes the event benign. Thus, most of us will be exposed to a traumatic event in our lives, but only a minority will develop a lasting disorder like PTSD as a consequence (Hunter, Gray, McEwen, 2018).

In contrast, chronic stressors tend to produce lasting effects on our brains and bodies.

These effects operate from the molecular epigenetic level to the systemic and behavioral. Epigenetic changes can have long-lasting effects on gene expression in a number of stress-sensitive brain regions, and these, in turn, likely contribute to persistent changes in cognitive flexibility, threat assessment, and reward systems, to name a few (Griffiths, Hunter, 2014; Bartlett, Lapp, Hunter, 2019). Chronic stress can also alter mitochondrial dynamics in the brain both directly through the actions of stress hormone receptors and indirectly through alterations in the neuroendocrine axis (Picard, McEwen, et al., 2018; Hunter, Seligsohn, et al., 2016; Lapp, Bartlett, Hunter, 2019). As mitochondria play a vital role in energy availability in the brain, changes in their function have an immediate and lasting impact on the brain regions affected. Chronically high levels of glucocorticoid stress hormones can also lead to persistently elevated levels of blood glucose, which can, in turn, contribute to decreased insulin sensitivity, metabolic

syndrome and type 2 diabetes (Seal, Turner, 2021). Similarly, glucocorticoids act acutely as immune suppressants; more chronically, they can cause a variety of immunological dysfunctions (Goldschen, Ellrodt, et al., 2023; Picard, Juster, McEwen, 2014). The burden of chronic disease that results from high levels of childhood adversity likely results from a combination of these factors acting in concert (Felitti, Anda, et al., 1998). The chronic, stabilized nature of traumatizing childhood environments is a key to understanding their pernicious effects. In sum, attempting to conceptualize trauma as a universally discrete, acute event obscures these linkages, and prevents us from seeing the powerfully biologically embedded nature of trauma. Obviously, to some extent, our view raises questions about the use of the term trauma. However, for now, the term is with us; it is sticky. While we are stuck using it, we argue for a more developmentally informed perspective. It is not having to climb the steep outcropping that results in the damage, but having to walk the rutted, rugged landscape that is damaging and, in turn, makes the climb more difficult. In other words, the damage – the trauma – emerges from the accretion of meaning continuously made by reiterated mental processes and repeated events.

Uncertainty, prediction, fear conditioning and trauma as a "game"

While it is somewhat a simplification of the complexity of how a meaning is made of events, an alternate way to conceptualize how even single acts of abuse can take on a chronic character, one can look at these events from the perspective of learning theory, specifically fear conditioning. All learning is ultimately about prediction, and fear conditioning is an overdetermined process in that successful fear learning is necessary for survival. Predicting violent or abusive interactions has obvious survival value, not just in an abstract evolutionary sense, but in the very real world of the traumatized child (see the extensive work of the Center for the Developing Child). Therefore, most mammals can learn a fearful association with a single exposure. In the absence of extinction, these memories will cause the person to activate an autonomic fear response each time the conditioned stimulus (the abusive caregiver) appears. This sort of learning is also prone to generalization, such that particular aspects of the stimulus (for example, a specific odor, like a cologne) can also provoke a response. The implication is that even one frightening interaction with a parent or caregiver can make every future interaction a fearful one. Of course, if an act of abuse is truly singular, one pathway is that the fear memory may be extinguished with time. However, in humans, even infants, extinction is unlikely. Rather, if the event is intense or if it is carried out by a significant other (a parent), the experience/memory of the event is likely to be repeated by unconscious and conscious mental processes and be self-amplified by internal meaning-making processes. Moreover,

if the event per se is repeated, which is also extremely likely, even if it is only at a very low frequency, the fear reaction becomes a persistent part of how the child makes sense of the world.

To employ metaphor, while becoming traumatized is hardly a game, the process of making meaning of a traumatic event and of a childhood game, such as peek-a-boo, is similar (Perry 1999; Tronick. 2017). Learning peek-a-boo, becoming a skilled peek-a-boo-er takes months and hundreds of repetitions, along with facilitating developmental changes. At the heart of the similarity is the likelihood that both events are repeated multiple times. The exogenous and endogenous repetitions instantiate the game and, if you will, the trauma into the child's way of experiencing and being in the world.

To take the metaphor one additional step beyond repetition and context, we must consider the power of parental relations during development to shape the meaning the child makes of an event. We have already noted the particular significance to a child of an event carried out by a parent, be it a game or a slap. A critical influence on the meaning made by the child is how the parents relate to the child *after* a presumptive traumatizing event a child experiences. We know from acute events, such as a car crash, a child may have an acute reaction. However, chronic effects typically emerge when the parents experience ongoing anxiety about the event. Their anxiety colors and is embedded in their parenting and maintains and exacerbates the child's initial reaction. It is not necessarily the parents referring to the event, which some do, but the ongoing anxiety the parents are experiencing that distorts their parenting practices. The anxiety of their parenting is detected by the child and consequently triggers their own anxiety tied to the event.

For example, in our study of the maternal acute stress paradigm, we had all the mothers in the study interact playfully with their infants face-to-face (Mueller, et al., 2021). Following that playful interaction, mothers were randomly assigned to either hearing infant cries and seeing photographs of distressed infants or hearing infant positive vocalizations and seeing photographs of smiling infants. Infants could neither see nor hear their mothers during the exposure. Following the exposure, the mothers and infants interacted again. We expected to see differences in the behavior of the mothers, with mothers who heard the cries interacting problematically with their infants compared to the mothers who heard the positive vocalizations. However, despite several ways of evaluating mothers' behavior with different coding systems, we did not see significant differences between the groups of mothers. Nonetheless, the infants whose mothers heard the cries reacted with negativity and distress during the interaction compared to the infants whose mothers heard the positive vocalizations. The finding speaks to the powerful, but

perhaps cryptic effect of stress on the mothers' behavior for the adult coders. However, it was not cryptic to the infants whose reactions demonstrated their sensitivity to the effect of the stress on their mothers.

One more point: The focus of our clinical and research work is on infants and young children and their parents. Our perspective will draw on work with children, including work on the still-face paradigm, face-to-face interactions of parents and infants, cross-cultural studies of parenting, and research on the effects on the infant of maternal depression and anxiety. (Tronick, 2007) Though infants are obviously not adults, we think the work is quite relevant to adults because the regulatory processes and meaning-making systems established in infancy are still operating in adults. In particular, the focus is on ongoing processes, external events and internal mental processes that organize experience. We won't be providing you with new techniques, but hopefully, a challenging, evocative developmental framework emphasizing quotidian engagements of a child with other individuals and with the inanimate world. As a consequence, we will challenge but hardly dismiss the notion of trauma as it relates to attachment or the idea of trauma-informed clinical work and intervention.

Meaning-making is neurosomatic and never just one-and-done.

Our thinking focuses on the formulation by Bruner (1990) that humans are makers of meaning. The term '*makers*' is critical. It emphasizes that humans actively engage in the process of making meaning. I see meaning-making about one's self in relation to the world of people and things, as well as to one's own self, as a core organizing concept in therapeutic approaches as varied and contentious as body psychotherapies, psychoanalysis, psychodynamic, CBT, dialectical cognitive therapies, dyadic therapies, attachment, relational therapies, and others (Tronick, 2007; Harrison, 2007; Ogden, 1997; Modell, 1993).

Meaning is central to the phenomenon of trauma. Typically, when discussing trauma, the focus is on the event (e.g., sexual abuse by a sibling; see the Zero to Three Diagnostic Manual) or physiology and brain processes. Certainly, some events, such as a too-long time out or a spanking for a misdeed, are likely to be traumatic to some children but not to all. And there are events seen as likely to be mild and mundane, which may be traumatic to some children, such as a parent walking away from a distressed child, but again, not to others. Or think if a 4-year-old child might experience genital fondling by an older sibling as sexual abuse or perhaps as playful and exciting. Indeed, what would a clinician think? Most likely, that the fondling *is* a trauma. For us, it is the meaning made of the event by a child, its context, and its effects on the meaning of other events that must be explored and might lead to seeing the event as trauma or not. Also, how the meaning changes over time because of developmental changes is critical. The playful

fondling experienced by the sibling at age four may become a trauma for the 'victim' when he reaches puberty or adolescence. Just as critical is how others in the child's life make meaning of the event, especially in how the meaning made by others of the event affects the child's relations with them. To continue the example, the sense of horror experienced by parents discovering what they decide is abuse by the older sibling and their deep and anxious concern for the 4-year-old, along with their punitive reaction to the sibling, will likely lead to changes in the playful meaning made of the event by the younger child.

Meanings are made continuously and simultaneously, in real-time, at multiple levels of somatic and neurologic systems, that is, by neurosomatic meaning-making systems. Loss of any of these meanings – the meaning about oneself to oneself, or the relation of one's self to the world – results in serious psychological dysfunction and psychopathology. Modell (1993) argues that the failure to 'make meaning' of one's private self is a psychic catastrophe, which is typically labeled as trauma. From a developmental perspective, however, more common than failures to make meaning are the meanings made about the mundane, quotidian events that distort one's sense of the world and sense of one's self. The sneering, mocking look from a parent when a child somehow fails to fulfill the parent's unspecified desire can lead to the child making the meaning that she is defective and ineffective, and her experience of the world is filled with contempt. The sneer is not a traumatic event per se, but the meaning the child makes of it can become one as she brings the meaning she made of it into more and more daily exchanges with people and even things and events.

From the example, keep in mind that the process of making meaning of the sneer is not just of the moment; it is *not* one-and-done. The experience is sticky. Neurosomatic meaning-making processes go on internally and operate continuously. They, like the Energizer Bunny, keep on going and going, affecting the meanings made as life moves on. Worse still, the initial meaning made goes on to affect the next meanings made. The later emerging meanings generate further distortions and increasingly insidious debilitations that may indeed be far more derailing than the initial meaning made of the first sneer. There is an elaborating and intensifying cascade of effects.

A developmental open systems perspective

The continuous process of meaning-making conforms to the larger framework of open systems (Tronick & Beeghly, 2011; Tronick, 2003). A first principle of open systems – all biological organisms – is that they must gain resources, energy and information to maintain their organization, to grow, and to develop.

Failing to gain energy leads to the dissipation of organization, aka death. A child consuming milk thrives, builds muscles, increases brain cell number, energizes growth-promoting bodily processes, explores the world and garners information. A child consuming potato chips builds fat, diminishes brain cells, and activates short and long-term debilitating bodily processes, such as diabetes. The need for nutrients for physical growth is obvious and necessary, just as it is for the child's mental development and growing understanding of her world, except that the nutrients for growing mental capacity to make sense of the world are information. It is the information actively appropriated during the child's continuous engagement with the world. Meaning-making processes then operate on the information available, and, in turn, enhance or constrict the child's sense of self in the world. Think only of the primate deprivation studies or the human sensory deprivation studies to understand how a poverty of information distorts and disrupts development (Weisel & Hubel, 1963; McKinney et al., 1972). In regard to trauma, think about the effects of neglect, a form of deprivation of social-emotional relational information. The damaging effects were powerfully and poignantly demonstrated in Harlow's work with socially deprived macaques (Harlow & 1970) and the social deprivation of humans in orphanages (Spitz & Cobliner, 1965; J.Robertson's film, A 2-year-old goes to the hospital, 1989, and Bowlby. 1960)

A consequence of the first principle of open systems requires that a child *must* actively and continuously engage with the world in order to gain necessary resources, since additional resources only exist externally. Indeed, the child requires gaining a positive balance of "excess" energy beyond that required to maintain their organization if they are going to develop, qualitatively change, and engage their endogenous meaning-making processes. For example, a child suffering starvation is apathetic motorically and mentally.

They cannot maintain their organization or appropriate resources. The meaning they make is about the threat of dissipation of their self, what Melanie Klein called annihilation (1929). By contrast, the active appropriation of resources allows the child to integrate the new meaning with past meaning into their current and ongoing evolving meanings (Tronick & Beehgly, 2011).

Keep in mind that meaning-making is neurosomatic. In infants, meanings about the world, such as "this person is scary and strange," are formed without language and advanced cognitive processes due to an immature brain and still-developing regulatory systems. Consider a five-year-old child whose autonomic nervous system's set point for threat is low, causing small stressors to trigger full-fledged fear reactions (Tronick & Beeghly, 2011). As a result, the unceasing ambient meaning of the world is one of danger and

threat. And the lulls of fearfulness are likely short-lived because the process is ongoing, and the meaning lingers. The low threshold even affects the meaning of what would be benign events to other children.

It is worth noting that a persistent bias towards threat detection in ambiguous stimuli can crowd out learning about important positive social cues or even internal cues. The phenomenon of alexithymia, or the inability to identify and articulate one's own emotions, is common in people who have been exposed to chronic childhood abuse and neglect. If one lives in a state of constant fear, one may not develop a capacity to experience other emotions fully, much as a kitten raised in darkness may never develop full vision.

A developmental open systems perspective holds to a view that *all* current experience affects the meaning made by a child and, to the extent possible, the child should – must – have *agency* to determine her engagement with the world and with others on a moment-by-moment basis (Sander, 1977). Thus, the child can take hold of information to internally create new psychobiological meanings and ways of being in the world.

We also see the meanings of the world and the self as assembled into a neurosomatic state of consciousness (Tronick, 1998; Tronick, 2003; Tronick & Beeghly, 2011). A state of consciousness, an integrated state of the brain and embodied processes, holds the meanings which guide the child's engagement with the world. But it is not static. For example, descriptions of the still-face paradigm refer to its 'signature' effect – the infant turning away, being distressed and fearful, yet the infant still feels effective – "*I can get you back*" – and keeps trying to elicit the mother. But that state of consciousness changes over time with longer exposure to the still face. The infant stops eliciting the mother, her posture collapses, and she generates a helpless state of consciousness, "*I can't change what is happening".* The meaning of the Still-Face changes over the typical 2 or 3 minutes of exposure. An implication is that the typical view of trauma that sees it as static, its meaning is its original meaning when first experienced, is incorrect. More likely, there is a change in its meaning brought about by its ongoing external and internal reiteration, which modifies the meaning made of the experience over the course of daily living and ontogenetic development. Moreover, its meaning at any moment in time affects the meaning made of the next emerging meaning, as well as the meanings made of other events and of the self.

The principles of reiteration and messiness

Nonetheless, though it is a bit of hyperbole, a typical view of the singularity and power of trauma is that it affects all experiences and is the primary event leading to psychopathology. Though a view held by many, the idea that there is only one primary cause of psychopathology is farfetched. In contrast, however, a developmental perspective not only invokes multiple casual factors, but also qualifies them *all* with the principle of reiteration: the *all of* an experience that affects the meanings made by the child are chronic reiterated experiences (Perry, 2008; Tronick, 2007). We will come back to this "*all",* but what do we mean by the reoccurrence of experience?

The developmental view, as well as the plasticity view of brain development of reoccurrence, is that the experiences of events have their effects because of their reiterated occurrence and the child's repeated neurosomatic making meaning of them. Not to be fatuous, but events that shape a child's meaning about the world are like learning to play peek-a-boo. How does a child come to know the game of peek-a-boo (Bruner & Sherwood, 1976; Commons et al., 1998)?

The game of peek-a-boo is a dynamic interplay of actions and information between a child and an adult. The game is rule-governed but flexible in its enactment. Often, there are unique individual, familial and cultural variations. Despite our saying that a four-month-old plays peek-a-boo, we recognize that a young infant does not actually play peek-a-boo. At first, he has no idea what is going on, though it does have some indecipherable meaning for him. After all, he reacts to adults' actions with a smile, crying, looking or turning away.

The game is played 'at' infants by an adult, who initially plays *all* the sides of the game. The infant makes a large number and variety of behaviors. He has lots of varying intentions and meanings about what is going on, many of which are unrelated to the adult's game-playing actions. The infant looks away when he 'should' be looking toward, or he raises his shoe or looks at his hand. What he is doing is messy – variable, unstable, disorganized. Yet, with reoccurrence over time, the infant attends and begins to anticipate the coming "boo," and some of the messiness is repaired and pared away. With more re-occurrences and developmental advances, the infant begins to become agenic and to control some of the elements and the pace of the game. He comes to signal the timing of the "boo," and his reactions become more coherent and contingent. As the game is acquired, the infant begins to learn pieces of how to be the 'surprisee' and then the 'peek-a-boo-er.' Sequences and rhythms emerge.

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While all that is going on for the infant, the adult continuously makes adjustments (e.g., holding positions longer) in relation to the infant's actions and intent. Bruner calls these adjustments scaffolding (Bruner, 1990). Such scaffolding is intuitive and implicit. The selective assembling of the infant's self-organized actions and intentions, *and* his apprehension of the adult's actions and intentions, *and* the adult's reciprocal apprehension become incrementally more coherent. Their mismatches get repaired. And so on through endless repetitions until the game is entirely 'within' the child and, at the same time, fully within the child-adult dyad.

Simply put, coming to know peek-a-boo is a messy process that is slowly co-created over repetitions by repairs of the messiness. Moreover, its meaning for the child changes from (perhaps) something exciting and fun to something done with the carer, to a game done with others, to (finally) a boring game: "*I don't want to play anymore*." And none of this knowing is explicit until the second year, but before that, it is embodied in multiple neurosomatic systems.

A few points about the process of acquiring the game. Fundamentally, it requires doing it in a relationship. Acquiring a game depends on the infant being in interaction, in a relationship with a person who not only knows the game but also must be willing to 'teach' the infant the game (Bruner, 1990; Vygotsky, 1978). Infants cannot teach themselves the game. At any age, the learning of the game depends on the repetition of the game and the development of different capacities at multiple levels (neurologic, regulatory, motor, emotional, and cognitive) that make the acquisition of a game possible. A three-month-old does not have the capacity to learn the game, regardless of how frequently it reoccurs. The game is also individualized. The adult who is playing it with the infant plays the game in a unique way, and the infant acquires that unique way. Better said, they co-create a unique way of doing the game together. In an important sense, they co-create a unique game of their own (Tronick, 2017). Like all children's games, the game is arbitrary, in the sense that it has a history in a cultural context. It is not built-in by evolution. It is a canonical cultural artifact, played in the way it is played in a particular culture (Bruner, 1990). Other cultures play other games in their own cultural form, though they are acquired in a reiterated relational context.

To return to learning theory, these games are about prediction. One of the more well-established models of classical conditioning is the Rescorla-Wagner model (Rescorla and Wagner, 1972). This model posits that conditioning is built around accurate prediction via error correction (repairs) each time a particular contingency is presented. In the case of peek-a-boo, initially, the error factor is near 100%, as the infant has no way to grasp what is going on, or even if their caregiver will reappear. As the game is presented

over and over, the prediction error for the infant declines to zero and perhaps becomes uninteresting, as more complex games become possible as learning capacities develop. Of course, getting these predictions right becomes even more pressing when the situation ceases to be a game and is more threatening.

More generally and importantly, we see the acquisition of a game by an infant as no different than the infant coming to know any other cultural form of behavior or any form of procedural knowing that involves spontaneous – "natural" – interaction; that is her way of being with others and acting in the world. The infant comes to know the "game" of cuddling, the 'game' of feeding, and the "game" of greeting a stranger. Infants develop the "game" of being demanding, the "game" of taking a bath, and the "games" of changing, nursing, and going to sleep. Each of these 'games' reoccurs 10's, even hundreds, of times a month. Each has a form that is individualized and culturated ("culturated" is a neologism meaning fully, inherently and inescapably imbued with culture, a phenomenon developmentalists are only beginning to gain traction on). Each is dynamic and changes with experience and the development of new capacities. The process of acquisition is messy and requires repairs. And each involves repeated experiencing of the 'game' with another person to finally get it into the infant's state of consciousness. And the form it takes in the infant reflects the form of the "game" in the adult's state of consciousness because that form guides how the adult plays the game. To jump ahead, the infant who comes to know the particular form of the "game" of being the victim of abuse also eventually comes to know how to be an abuser.

The "game" of being slapped

We hope that this account of the normal developmental process of learning "games" – actually learning ways of being in the world – is starting to have some linkage to our understanding of trauma. Let us make the linkage of this kind of developmental process to a child coming to know the "game" of being slapped. Again, being slapped is not a game, and peek-a-boo is far away from trauma, but for our purposes, it is not. Getting slapped is clinically relevant as such, and it is an exemplar for thinking about the trauma associated with any event, including the interplay of multiple factors.

To begin, the physicality of slaps is not consistent (Tronick & Perry, 2014). Slaps vary in intensity, and they vary as to the target. Here, think about a slap to the face of moderate intensity. The first slap a child receives is not experienced the same way as the tenth; it is unique. It changes the child's state of consciousness about the world and meaning-making. But so does the tenth slap, as it must because the child has made meaning of the nine preceding slaps, and the meaning of the tenth has to be integrated

with the meaning of those that came before it. By the tenth slap, the child's prediction error is less than a 10^{th} than it was for the first, and the association between the slapper and the slap is much more firmly and lastingly established. Another way to speak of prediction error is to think of it as uncertainty, and the uncertainty of an event adds stress to an event. The first slap is an uncertain, unexpected event, but the tenth slap further confirms the certainty of it happening, and perhaps has less force. The child knows what is coming.

Moreover, the slaps are not the same depending on the motivational state of the child. Its meaning is different if the child is slapped when concentrating on a game and feeling safe, or hiding and in a fearful state, or in an angry state. Moreover, in the next moment after the slap and then for succeeding moments, the child's state will change, and with it, the meaning of the slap will change. Perhaps the metaphor is gratuitous, but the first slap is like the big bang, a process that changes "everything" in the very next moment and then more slowly in each succeeding moment.

Critically, with mental and physical development, the 'same' physical slap is experienced differently at two years of age, at five, or at ten years. It is also different if it was last experienced at two years, or five years, the week before, or never experienced before. Furthermore, whatever agentic actions the child takes– fighting back, running away, freezing –will change the nature of the experience of the slap. Just imagine the difference in experience between a three-year-old kicking the slapper or alternatively running away and hiding behind a couch. To further complicate the picture, the context matters. Was the child in and around the slapper much of the time? Was the slapper a stranger? Was the slapper a parent, a carer, a babysitter? In a word, the details, even micro-details, of the event matter in determining the event's meaning and effects.

Yet there is more. First, suppose the slapper is someone who regularly cares for the child. In that case, we know that the slapper's non-slapping caretaking will be, at the very least, problematic, if not even continuously derailing of the child. Slappers don't parent well; they are angry and threatening, demanding, neglectful, falsely apologetic, or whatever. How the slapper is, what they do or don't do, what their intentions or mood are affect the child's experience of a slap. A slap in anger is not the same as an apologetic slap (whatever that might be). Thus, it is critical to recognize that the child is under continuous pressure from the slapper's *non*-slapping distorted caretaking. The experience of the slapper's nonslapping problematic caretaking fills the time in between the slaps, and it exacerbates the effects of a slap when a slap occurs. Even a single slap in the context of disturbed parenting could be enough to disrupt the child's development. Moreover, when we say a particular event is traumatic – a slap

– our view is that it might not have had so debilitating an effect except for the already vulnerable state of the child given the in-between disturbed nonslapping caretaking she has received. So, we ask, is a slap, a fast physical event taking only milliseconds, really an acute singularity?

And still, there is more. The factors in play are multiple and complicated. It is not only the occurrence of the slap or the disturbed parenting that will derail the child. We all know about the triggers of trauma that are present all around the child all the time that reignite the experience. They are often unavoidable everywhere. However, the current emphasis on banning triggers is almost a parody: ban specific words, canonical pictures, or plays and movies as if they were universal fuses illuminating a dark, hidden event. However, triggers are unique to the child and unique to the original experience. The spilled and broken coffee cup, or the crushed beer can, or the flowers in the room where the beating took place, or the stuffed lovey the child was holding all can be triggers.

Critically, aside from external triggers, the children will trigger themselves. Saying that is not blaming the child; it is blaming how evolution has organized how humans make meaning. The child will make meaning of the slap and caretaking, and she will keep on processing it. It is not one-and-done. She will re-experience its vagal and HPA effects, repeatedly memorialize it, perseverate on it, re-examine what happened and what she did. She will lock in associations to it, the triggers we wish we could banish. Most insidiously, she will anticipate it happening again. The self-generated mental reprocessing occurrence of it, the self-generation of triggers will go on and on with continuous, never-ending meaning-making processes, changing the meaning and fueling and self-amplifying them. Even more insidiously, she may make a self-conception that she is someone who should be slapped, a destructive meaning that will have profound consequences for her expectations and interactions with the world in the future: “The world will always slap me. It will happen. No need to worry about it.”

These self-generated meaning-making processes with an older child or adult may be explicit and in awareness, as well as in the body (Van der Kolk, 1994). In an infant or younger immature child, they will be neurosomatic, the embodied processes that make meaning completely out of awareness and without language. For example, a lower activation threshold and a slow recovery pattern of the HPAA axis will generate the experience of fear of unexpected events that, in turn, lead to more internal fear and anxiety. We often see these embodied forms of trauma in our patients when they only have the vaguest sense or awareness of an event. They do have the attendant feeling of it, but cannot provide details, a timeline, or a narrative. The lack of a narrative occurs because neurosomatic forms of memorializing do not generate

timelines, narratives, or reflection. The gut biome does not track dates and details of events, but how it digests an event; that is, how it generates the meaning of the event is the memorial process.

The brain and getting slapped

For those of you who focus on the brain, let us give a brain-oriented account of the meaning-making of the experience of a slap (Tronick & Perry, 2014). The primary mechanism in meaning-making by the brain is the capacity to create associations. When patterns of neural activity co-occur with sufficient frequency, intensity or pattern, they become 'connected' at a synaptic level. But these synaptic connections are not 'empty'; they have content. Perry's neurosequential model (Perry, 1999, 2008, 2009) makes it clear that the capacity to weave content – the complex array of sensory, somatic, and cerebro-modulatory patterns of activity – into a coherent form, a state of consciousness, is one of the remarkable qualities of development. Indeed, development requires the sequential creation of associations – essentially, sequential meaning-making – from outside the body to inside the body to the brainstem to the cortex. Note, while internal signals from the body are *internal* in some way, they are processed by the brain as if they were actually *external*, perhaps one could say as foreign.

Beginning *in utero*, the meaning-making systems (typically, but artificially referred to as "body and brain," a linguistic dichotomy, not a physiological reality, and a term we don't hold to) weave together seamless, multiple interactive dynamic systems through multiple molecular mechanisms. These mechanisms include the creation of "activityorganized" synaptic nets that begin to create meaning for the developing organism, often the internal rhythms of activation, even when external stimuli are absent. The sensory and somatic "external" input from the intrauterine environment (warm, fluid embracing, nutrient and hormonal flows, ever beating maternal heart sounds, voice, along with external stimuli of other voices and noises) experienced by the fetus become associated with the activityorganized neural activation. For the fetus, this informational flow carries the meaning of being "safe and regulated" (i.e., not hungry, thirsty, cold, or threatened). Of course, to say 'safe and regulated' reflects how we, as writers and readers, are colonized by language. By contrast, for the fetus, it is the form of operation of its neurosomatic systems with their reoccurring neural activation rhythms that make and hold the meaning.

Later in the ex-uterine environment, rhythmic rocking, for example, may have a primordial meaning of "safe," a meaning inherent in a coherent somatosensory organization. Moreover, the meaning of rocking may be carried forward and elaborated in extra-uterine life. A frightened or overwhelmed child may self-

soothe by rocking in the fetal position as an attempt to recapture or to actually create that fetal primordial meaning of 'safe.' Similarly, other meanings, such as "the world is a dangerous place," are also held by somatic processes, such as the immune system, the autonomic nervous system (ANS), gut biome, HPPA, as much as by the brain, especially when the child (or adult) is unable to generate coherent patterns of neural activity (Porges, 2011). And like the plasticity of the brain in response to environmental input, these other neurosomatic processes are organized and sculpted by the early experiences.

One additional note, especially for those who have doubts about the concept of neurosomatic meaning-making without language. Research on the Barker hypothesis has found that the fetus generates predictions about the nature of the extrauterine world that affect how they act in the world (Lester et al., 2018; Barker & Osmond, 1986). For example, fetuses exposed to high levels of maternal stress in utero have epigenetic changes and behavioral changes during interactions compared to non-stressed fetuses. That fetuses can make predictions about the extra-uterine environment also highlights an organism can make meaning using neurosomatic embodied systems even though they not only lack language and symbols but have an underdeveloped, immature brain.

Even though the conscious mind does not have access to the early experience that created the meaning because the meaning is held in neurosomatic systems lacking time markers, narratives, and images. Neurosomatic meaning-making makes it clear that even though the young child's somatic and neurophysiologic systems are far from fully developed, she is a meaning-maker. She has states of consciousness, though with no implication of awareness. As such, the infant, even the preterm infant, can fully organize a motivated and embodied state of distress, perhaps even an emotionally fearful state, or a motivated state of pleasure that organizes her actions in the world (Montirosso et al., 2010. 2014a, 2014b). The former state leads to withdrawal and demands for regulatory support, the latter to engagement and self-directed action on some object or communication with another person.

Thus, the process of meaning-making begins with the first experience to create the primary associations (i.e., neural connections) that organize the infant's world. And keep in mind that *all* of these neurosomatic systems continue to operate in the adult. They continue to make meaning: the wash of adrenalin after a near-miss car accident when you consciously know everyone is okay, the accelerated heart rate and fear of attack in a dark alley your friends say is absolutely safe, the flipping of the stomach at a sudden bump in a plane even though you know it can fly (or can it?). These systems continue to bring the meaning of events in the past into the adult present: the feeling of terror with an ocean wave curling at you from an unremembered thumping by a wave when you were 5, even though now you know you are

safe. Experimentally, we see it in the fearful and panicky reactions of adults who role-play the still-face, even when they are fully informed that it is a role-play (Tronick, 2005).

Returning to the case of a slap, the first time the infant is slapped, the image of a hand moving swiftly across the visual field has not yet been associated with pain. If the slapper is always the same person and others never slap the child, the set of neurosomatic associations may generalize to the properties of those other individuals, or the place where the slapping occurs (i.e., the bedroom). The child may begin to feel fearful with the sound of the slapper's voice, the smell of his aftershave, the image of his face, the sound of a door closing, etc. The child also may generalize from the slapper's hand to all hands moving quickly near his face – even if the person is a nurturing caregiver, moving to gently caress her face. These associations and the resulting threat-related neurosomatic reactions and behaviors are mediated by the simpler, lower somatosensory and action–motor–regulatory systems involved in stress and the threat response.

These more generalized and undifferentiated responses can be quite troubling and mystifying to a child experiencing them, even though such formative experiences are part of the "known but unremembered" aspects of a person's life. Though unavailable in conscious memory (no narrative, no time marker, no representational content), they are nonetheless stored in the brain and body's operating patterns, activation preferences, set points, thresholds, duration, shape and refractory period of the response, and other response features, throughout the embodied somatic systems. This implicit coding or forming of neurosomatic reactivity is remarkably durable over the life span. Traditional talk therapy may not be sufficient to access these sub-cortical and other somatic organizers of experience. Directing attentional processes to the body, a core feature of sensorimotor psychotherapy, can stimulate neural circuits associated with these unrecallable memories, providing opportunities to encode new experiences that support a shift in meaning and, subsequently, a shift in experience (Ogden & Fisher, 2014). Keep in mind that developmental cognitive neuroscience tells us that while most children won't be able to reliably form autobiographical memory until they are roughly four years old, they are capable of organizing neurosomatic memorial processes of experiences as early as the later stages of fetal development.

The sculpting of neurosomatic and regulatory systems through early experience and long-term effects.

This picture of what is going on during development gives us a critical idea of why early experience has such long-term effects. The meaning-making process in infancy is developmentally robust because so many meanings are connected to fundamental regulatory processes and experiential sculpting effects on the operating characteristics of neurosomatic systems. Thus, many of the associations created early in life are directly linked with neurosomatic processes – primary regulatory neural networks and primary physiologic processes – that continue to shape and influence the meanings made throughout life unless they are re-tuned by later experience or interventions. Compared to the adult, however, the infant has less capacity to modulate or shift the meaning because the higher areas of the brain are not yet fully organized, and regulatory processes are still unstable. That is, for example, the infant does not yet have complex time-telling capabilities or abstract cognition to allow her to make a more "abstract" or differentiated meaning about the one abusive slapper compared to other nurturing carers. While these gaps in capacity make the infant more vulnerable, it must not be forgotten that the organization of the meaning-making process is not as fixed and constrained as the systems will be in adults. Thus, infants and young children are simultaneously more vulnerable and more flexible.

As the child becomes older and the limbic and cortical areas of the brain and other neurosomatic systems become more sculpted, the meaning of the slap, the slapper, and the toddler's potential to act in relation to the slapper change. The behaviors that appear to increase or decrease the probability of slapping become more coherent and complex. The infant 'learns' (comes to know at an implicit pre-conscious level), for example, that crying (a "fight-flight" stress-related behavior that should bring a carer to meet the infant's distress:

i.e., hunger, thirst, cold, pain, etc.) will actually increase the likelihood of slapping, whereas dissociating (and not crying) will decrease its likelihood. As a toddler, she may also learn that overly compliant, almost seductive behavior will reduce slapping. She may modify her meaning about slapping. For example, let's say her mother – a loving but overwhelmed and frustrated caregiver who never slapped before – slaps her in frustration when she is noncompliant (non-compliance is *not* possible for her with her actual repeated slapper, but it is with this mother, given their history). Almost immediately, there will be a physically nurturing and intimate interaction as the guilty mother attempts to repair the empathic rupture (not an unusual dynamic with an overwhelmed mother and an abusive partner – the initial

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slapper). This change in meaning is now possible because of the ongoing developmental advances of neurosomatic systems previously unavailable to the infant and the subsequent behaviors of the mother. The 'meaning' of the slap evolves.

This process of changing and creating new associations, new ways of being requires plasticity of neural networks and other neurosomatic systems. Fortunately, neurons and neural networks and other neurosomatic systems are not only capable of change, but they are specifically "designed" to change in response to experience. The plasticity underlying both developmental as well as therapeutic change has features that will enhance and others that will inhibit meaningful change (Kleim & Jones, 2008). Two primary principles of plasticity are specificity and pattern. Simply stated, neural networks that are not being activated with sufficient repetition in a significant pattern will not change or may even be pruned away. On the other hand, networks that are activated repeatedly will become stronger. Thus, if a child or infant has built a fear association around a slapping caregiver, that neural network can become stronger, not only with each subsequent slap, but with every interaction where the network is turned on by the child's fearful prediction of a possible slap. Let's emphasize again that plasticity, adaptation of systems to significant events, applies to all neurosomatic meaning-making systems, such as the ANS and HPPA axis, that are sculpted by early and ongoing repeated experience.

Trauma never occurs only once

The repetition principle underlying plasticity or sculpting brings us back to our view of trauma. The principle of repetition implies that there is no such thing as an acute singular traumatic event, an event that happens only once. It is an ongoing process. Not to be difficult, the principle is both false and true. Allow us to state the point in the extreme: singular acute traumatic events are not different from repeated events. The meaning of an event is internally reiteratively processed by a child over time, maybe over a lifetime: it lingers, pokes, prods, intrudes. Second, the meaning of the event is affected by and affects the meaning the child makes of other events; their meaning is not static or fixed. Take an example other than a slap, the acute event of a never-to-be-repeated one-time sexual abuse of a young girl by a stranger never to be seen again. It happens only once; it is singular, but is it really? Certainly, it is what we point to as *the* trauma (e.g., in our case report), and yes, it *can* have lifelong effects, but not in the sense that it is a 'thing,' a lesion, an object deep in the psyche of the child. From a developmental meaning-making perspective, the trauma is not singular. The occurrence of abuse *is* singular, but the meaning of it is not

anchored like a crystalized rock in the psyche. The processing of the it is ongoing; in that sense, it is repeated and can have life-long detrimental effects.

To start, there are internal neurosomatic meaning-making processes – autonomic nervous system, HPA axis, and brain processes of memory, rumination, perseveration, and dissociation – that continue to operate on the meaning of the event. Infants become more distressed when seeing the Still-Face two weeks after seeing it the first time. (Montirosso, et al, 2014a) Its meaning has been repeatedly *re*processed. The operation of these neurosomatic meaning-making processes actually alters the meaning over time, even if the child is not aware of the change. In the case of children, the meaning-making processes develop (e.g., cortical processes come online; the operation of the HPA axis stabilized), further changing the meaning of the event.

Second, the meaning of the acute event affects the meaning of other experienced events. One obvious process is how the young girl's initial meaning of the event – "*I was too trusting*"— affects and is affected by future interactions. Perhaps that meaning disrupts her relations with others, which in turn makes her even more distrustful. Then, those newly emerging meanings have their effects on the meaning made of subsequent events. Third, the acute event itself does not exist in isolation. It is affected by "*all*" current and ongoing experiences. The "*all*" includes what was going on when the event occurred, the meaning being made of other events, and the evolving context over time of the event. Perhaps the young girl's other ongoing relationships may so robustly contradict the distrust and give her a sense of safety and certainty, which in turn makes her more trustful, or one of the adults in her life resembles the abuser, and his presence repeatedly triggers her fear and distress. Just as likely, some other outcome emerges from the wide variety of experiences that she may have. Simply put, we cannot know or predict what meanings will emerge over time, given her ongoing experience and development. To refer to the event as a trauma does not give us any traction on what it means to her now. In a word, the details, the moment-by-moment flow of events and meanings matter in how the experience will play out.

This account of what we refer to as a single-one-time-only traumatic event when we talk about our patients should, I hope, make it clear that an event is repeatedly experienced and transformed. Nonetheless, there are differences between the singular and repeated events. An event that is repeated triggers the host of processes again and again. Its effects are more likely to accumulate, be more intense, affect a wider range of experiences and the child's sense of their world. Nonetheless, the repeated event is in the context of other events, and there is a high likelihood that they, too, are repeated and that they are distorted and pathologized. As with the slap, if the young girl is repeatedly abused, the likelihood that the

rest of her world is 'normal' is vanishingly small. In fact, the distortions of the rest of her experience further exacerbate the consequences of the "event." Escaping their effects will be more difficult.

Multiple therapies for the meaning of an event(s) by multiple meaning-making systems

How does the evolution of the complex archeology of the meaning of the slap, peek-a-boo, being with another, or any way of being related to therapy? For us, therapy is about changing meanings. How do we see the change process? Obviously, a myriad of driving forces and systems are involved. These systems are inherent to making and changing meaning, including somatic and regulatory systems, neural systems and action systems; the list of somatic processes could go on and on. Our view of therapeutics is very much Vygotskyan (1978): optimal development in any domain (e.g., neural, regulatory, motor, sensory, etc.) occurs when the child is given opportunities and expectations, usually by or with another person, that are neither too familiar and simple, nor too unfamiliar and complex (Perry, 2009; Tronick, 2007). The child with a psychic dysfunction has to be allowed to select or guide the information that she is presented with such that it fits and can be worked on by her meaning-making capacities to make new meanings. Presenting something, doing something that is beyond her ability to operate on it, what Piaget referred to as assimilation, will not lead to new meanings; the item can't be "digested".

We would emphasize (Tronick & Beeghly, 2011) that therapeutic work with infants and young children must aim to deeply understand their intentions, the multi-level meanings that children are making about themselves, how they are making them within themselves, by themselves when engaging the world of things, and, most importantly, with others. In adults, it is critical to determine where the meaning 'resides.' It may reside in the prefrontal cortex (as is presumed by cognitive therapies). Still, we believe much of it resides lower down in the brainstem, and regulatory and somatosensory processes (as presumed by somatic therapies). This multiplicity of neurosomatic processes demands forms of therapy that reorganize those processes through re-occurrent experiences. With success, some of the distorting experiences emerge in a communicable form with awareness.

One implication of the multiple kinds of meaning-making systems is that therapy cannot simply or solely focus on just one system, be it the somatic, or neural, or action, or cognitive, or emotional systems. What development tells us about meaning-making and changing it is that it involves multiple systems simultaneously operating as a messily organized ensemble. More specifically, change involves a child

who has agency to organize her engagement with the world, especially the world of people, with every level and every meaning-making system she possesses. But development also tells us that therapeutically induced change in meaning must enact the first principle of reoccurrence. The child must have the opportunity to engage and reengage in new external and internal experiences that can generate new associations and operations of the systems, which are at the core of meaning-making.

The demand for enough experience to engender change is especially critical when we consider early meanings that are interwoven with fundamental somatic and regulatory processes. Admittedly, we don't know what "enough" is, but we do know that seldom is there enough re-occurrent experience in those systems (e.g., the bedrock associations created by our earliest somatosensory experiences in the lower areas of the brain). Also, most targeted therapeutic efforts do not adhere to the core principle of specificity; *non*somatic therapies in-and-of-itself will not directly and repetitively activate the foundational somatosensory systems (and related associations) made in early life and localized in the lower systems in the brain. Somatic therapies will not directly affect and repetitively activate higher-order brain systems. Thus, as argued from the beginning, meaning-making and therapeutic change involve a simultaneity of systems at all levels of the hierarchical organization of the brain and body. More specifically, our emphasis is on the implications the multi-level psychobiological nature of meaning-making has for therapeutic interventions for trauma. No single therapeutic approach, no matter how powerful, will be an adequate therapeutic intervention. Trauma therapy, as well as any therapy for any problem, must employ selected multiple methods of therapeutic approaches. The available methods include somatic, verbal, neurophysiologic, medication, drugs, relational, experiential, narrative, video, and all therapies that are alphabetically identified (CBT, DBT, EMDR), and others too numerous to mention. With respect to all our colleagues, claims to the contrary about this or that particular therapy treating trauma are like the claims about snake oil: "step right up folks, the elixir will cure everything." Whether or not you accept the concept of multiple psychobiological processes making meaning, you must admit that trauma is complicated and simple solutions, quick solutions, singular solutions will not – cannot -- be adequate.

At the same time, choosing therapeutic methods is not simply a matter of being eclectic. The developmental perspective of neurosomatic meaning-making presented here can guide the selection. The challenge of a multiple-method therapeutic approach is to initially figure out what the neurosomatic form – the meaning – of the trauma is. In particular, to figure out in which system the meaning might "reside", and then to specify a therapeutic approach that gets at that form. For example, in many cases,

Perry (2009) finds that the trauma resides in the diencephalon, but not always. Sometimes, he finds it resides in cortical areas. Teicher and colleagues (2016) have shown changes in a number of other brain regions associated with age and developmental changes in adults with a history of childhood abuse and neglect. Earlier, we discussed associative learning and epigenetic changes. Porges (2011), by contrast, would emphasize the role of ANS and the vagal system. Analysts would emphasize unconscious processes. Tronick (2011) and others (Harrison, 2003; Seligman, 2017) would look at relational processes. Of course, figuring out which system to initially focus on is not a simple task. However, there are emerging methods for making an initial target. Perry (2009) suggests an evaluation of different behaviors to identify the brain area that was affected by trauma. Porges (2011) suggests methods for the identification of vagal reactivity and arousal related to safety. Other techniques, including EEG, MRI, genetic analysis, as well as somatic, play and dyadic evaluations, and even projective techniques, can also be used.

Second, once the putative system is identified, specific therapeutic techniques are available. Perry (2009) found a problem in the lower brain structures that would emphasize rhythmic therapeutic activities. High vagal reactivity would lead Porges (2011) to focus on neural exercises, generating a feeling of safety. A somatic problem, such as anxiety generated by a violation of the person's relational space, would be treated by Ogden and Fisher (2014), with activities modulating the distance between the patient and therapist. van der Kolk seeing EEG distortions might suggest neurofeedback (Kolk, Hodgdon, Gapen, et al., 2016). An epigeneticist might aim to generate a molecular signal by using a drug, such as propranolol, that works on the extinction of memorial processes (Davis, Myers et al., 2006; Pizzimenti, C. & Lattal, K. 2015; Bernardi & Lattal, 2010). A psychoanalyst seeing unconscious issues would suggest play therapy (Harrison, 2003). Seeing relational problems, relational therapists would focus on dyadic therapy (Seligman, 2017; Tronick, 2007; Lieberman, Ippen, Van Horn, 2015).

The therapeutic work does not end with the initial identification and initial treatment. As the therapeutic work proceeds, it is necessary to track the dynamics of the change induced by the intervention. The neurosomatic form of the trauma will change. For example, an out-of-awareness of a somatic problem that comes into awareness as an autobiographical memory with successful somatic treatment will require a change from the somatic therapeutic approach. Perhaps, neurofeedback to work on the weakening of the autobiographical memory that now resides in various parts of the cortex. And so on, because these changes are dynamic and *ongoing,* it may become necessary to figure out what the next intervention is that will gain traction on the changed representation of the trauma.

But what we know about identification and multiple forms of therapy and how to move through an array of therapies should not be overstated. To get at this multiple approach, we need far more research and a change in training away from a one-size-fits-all approach. We could think of therapists trained in multiple distinct therapeutic approaches and/or a team approach to therapy. At the core, the challenge for research and therapy is to figure out what to work on, what approach to use to change it, and when to change again to another approach.

From a developmental perspective on social interaction as the foundational mechanism of change, it is also fundamental to therapeutic change. Children and adults live in a world where an hour of any kind of therapy is lost in the welter of all the other hours of their lives. If the people in the child's life are not part of the process of change, then change will not occur. The therapeutic effects become diluted, overridden even with several hours of weekly therapy. Children need an immersion with therapeutic others. Thus, what makes sense for us as a guide for therapy is to take our cue from the development of meaning: Approach therapeutic change like learning peek-a-boo. Do it often, do it in multiple ways that fully engage every level of the child, and let the child's agency control the process. To only be trauma-informed and wedded to one approach and one outcome is to fail to understand the need to be developmentally informed to gain traction with the whole dynamically changing child.

Summary and key points

In this paper, we provide an alternative view to the idea of trauma seen as acute severe events and as a major cause of psychopathology. The view is anchored in developmental neuroscience, which sees lifelong functioning resulting from repeated experiences and processes. The metaphor of learning a game through repeated reiterated experience and developmental changes in capacity was suggested as a way to better understand the nature and effects of chronic experience. The game metaphor makes it clear that the effects of experience are individualized, relational, and culturated. More formally, as biological open, dynamic systems, humans must continuously appropriate environmental resources. The developmental functioning of the child and the quality of the resources available for appropriation affect and shape the typical or atypical form and quality of that functioning (Hunter & Tronick, 2018; Tronick, 1998; Sander, 1977; Harrison, 2003). The nature of experience, aspects of brain development and mechanisms of the incorporation of environmental resources and how these shape typical and atypical development were discussed. Furthermore, we argued that trauma-informed viewpoints, as contrasted to

developmentally informed perspectives, limit our understanding of how events, traumatic or quotidian, affect functioning, resulting in psychopathology.

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