Chapter 2
CPS as a Neurodevelopmentally Sensitive and Trauma-Informed Approach

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The typical human brain is an amazingly complex organ with over 86 billion neurons, at least five times as many glial cells and more than 400 trillion synapses, all continuously active. These structures are organized in a hierarchical fashion, forming complex neural networks. Four developmentally distinct regions (brain stem, diencephalon, limbic, and cortical) are woven together by multiple neural networks that give rise to a host of functions ranging from regulation of heart rate to abstract cognition (see Fig. 2.1). The regulatory networks that originate in lower brain areas have widespread impact on

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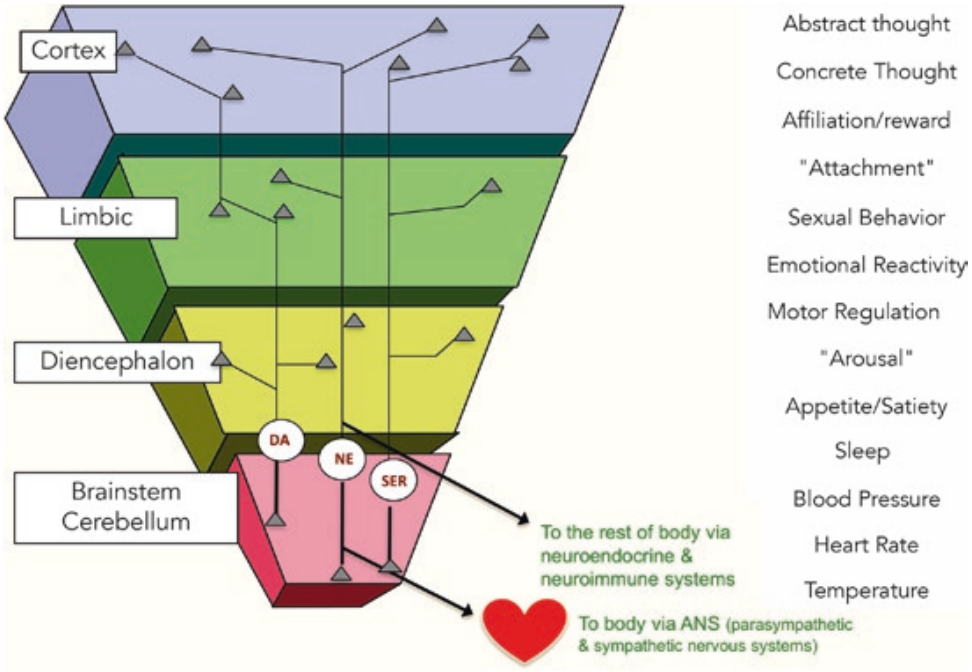

FIGURE 2.1 The four brain regions, neural networks, and associated functions. (Adapted with permission from Perry et al. [7])

upstream systems in the brain and downstream systems in the body. They play a role integrating, processing, and acting on neural input from the primary senses (which monitor the external environment) as well as the body's multiple internal sensory apparatus (which monitor both the inner world of the brain and the somatic environment in the rest of the body). This centralized orchestrating role makes these regulatory networks an essential element of the human stress responses (see [6]).

With attuned and responsive early caregiving, and with the expected moderate, controllable, and predictable challenges of healthy development, these key neural networks develop the capacity to orchestrate, integrate, and regulate the incoming sensory information from the outside and inside world. This allows individuals to demonstrate resilience when threatened or distressed. For these individuals, stressors of any kind – such as hunger, thirst, and interpersonal threat – will activate these networks and produce a set of responses that are proportional to the level of challenge and appropriate for

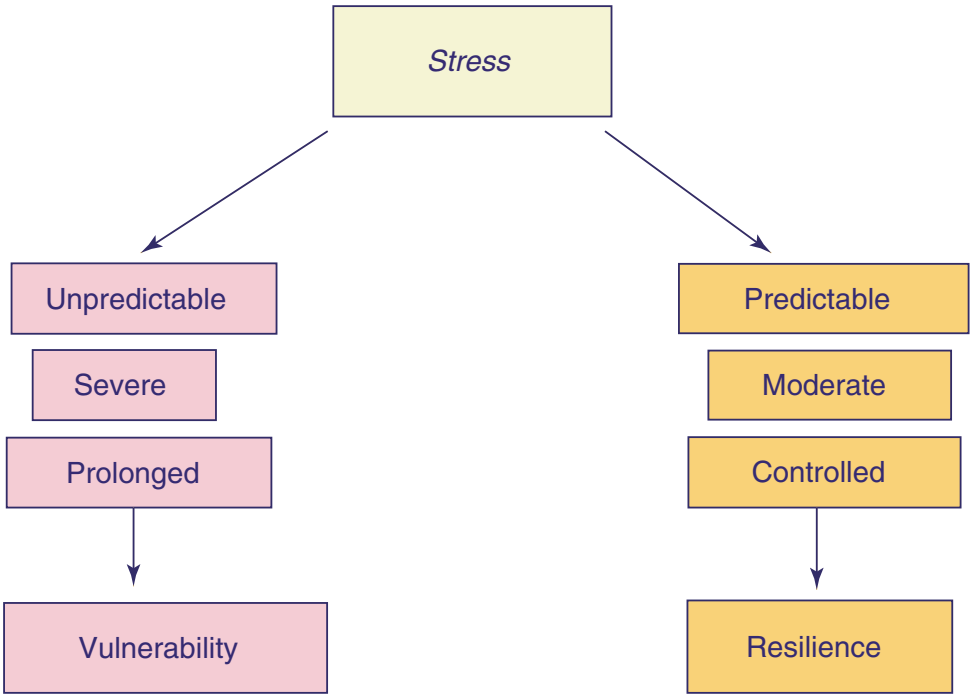

FIGURE 2.2 Effects of different types of stress on individuals' functioning

an adaptive regulatory response (e.g., to find food and eat if feeling hunger; to avoid or respond appropriately to an interpersonal threat). In contrast, if there is a pattern of unpredictable, uncontrollable, or extreme activation of these neural networks, an individual's stress response will become "sensitized," and they are more vulnerable to poor outcomes (see Fig. 2.2). When these neural networks are sensitized by previous experience, the networks themselves may become abnormally organized. The result may be a cascade of abnormal activity and compromised function in all areas that these networks innervate.

Developmental Trauma and Alterations in Stress Reactivity

There are multiple ways in which these important regulatory neural networks can be disrupted in ways that compromise normal development or functioning and result in a cascade of

risk [1, 4, 5]. Three of the most common are intrauterine insult (e.g., hypoxia, infection, maternal distress, prenatal alcohol, or drug exposure), disruptions of perinatal bonding that alter development of attachment capacity (e.g., overwhelmed depressed caregiver, preoccupied traumatized caregiver), and patterns of stress response activation that are unpredictable (e.g., housing or food insecurity, poverty), severe, or prolonged (e.g., exposure to domestic violence, sexual, or physical abuse).

The relationships between various developmental insults, trauma, and adversity have been documented in a wide range of studies. The most well-known are the epidemiological ACE studies (see [1]) which documented how developmental experiences of adversity increased risk for vast social, mental health, physical health, and learning problems. It is hypothesized that a major underlying mechanism is the alterations in these regulatory neural networks resulting from the "sensitizing" patterns of stress response activation.

Figure 2.3 illustrates two stress-reactivity curves; the black line indicates a neurotypical relationship between the level of

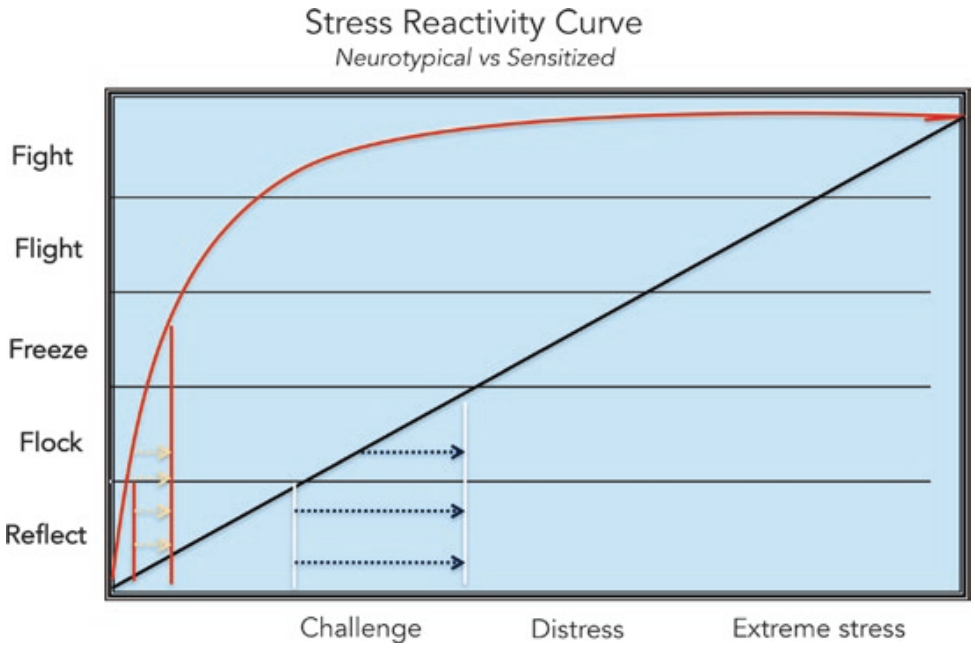

Figure 2.3 Neurotypical versus sensitized stress reactivity curve (All rights reserved © 2007–2018 Bruce D. Perry)

external challenge, stress, or threat and the appropriate proportional shift in internal state required to adapt, adjust, and cope with the level of stress. The red curve illustrates the distorted, sensitized stress-reactivity response that results from patterns of extreme, unpredictable, or prolonged stress activation such as seen in dysregulated children or youth. In this case, there is a significant overactivity at baseline and an overreaction even in the face of relatively minor challenges. All brain change (i.e., learning) requires exposure to novelty; a novel set of experiences that will, with repetition, ultimately become familiar and then internalized. Too little novelty leads to too little stress activation and minimal learning, while too much activation leads to distress and inefficient internalization of information. The dotted lines in Fig. 2.3 indicate the developmental window where enough – but not too much – stress activation occurs to promote optimal learning. This is the window in which a provider or caregiver endeavors to act during the Plan B conversations that are at the heart of Collaborative Problem Solving. You'll notice that the dotted lines for the sensitized individual are skewed to the left. This indicates that even a reasonable amount of challenge that would be appropriate to promote learning for a neurotypical individual is too dysregulating to promote learning in a sensitized individual.

CPS Adheres to the Principles of Neuroplasticity

Neuroplasticity is the brain's ability to change, especially in response to learning or experience. This change involves the creation and modification of neural networks involving various "molecular" processes including creating new neurons, making new neuronal connections (synapses), and sculpting existing synaptic connections (e.g., making them more efficient). As the brain is organizing and making sense of the individual's internal and external experiences, it makes associations (basically "connections") between patterns of

neural activity that happen together; or as cognitive neuroscientists say, "neurons that fire together wire together." In this way, an individual connects things like touch or sound with an image or a feeling, and the brain stores all these associations. When new information comes into the brain, it is processed through these existing neural networks (containing these associations – or "connections"), so that the brain can either assimilate that new information by creating new connections or modify the existing connections to account for the new information. We all will have interactions that will be influenced by our previous associations (see [9]); our first impression of a person is based on the triggering of some similarity in this new person to people in our past that we have associated with goodness, fun, or other positive qualities. A smell from the preparation for today's Thanksgiving dinner may elicit a positive (or negative) feeling based upon the associations created during previous Thanksgiving or family experiences. Thus, a person who has a history of developmental trauma can have a profound feeling of threat or fear triggered by any sight, sound, smell, or sensory input that was present during their original traumatic experiences. For individual's with developmental trauma, this is particularly troublesome when they a sensitized stress response. The key to healing starts with addressing this sensitization (a strength of CPS). Fortunately, the brain is plastic and malleable, and the stress response system can be changed through intentional patterns of interaction which heed basic principles of neuroplasticity [3]. Through this neuroplasticity, we cannot erase old associations in the brain, but we can create new associations that can begin to replace the older "default" connections. Below, we review six core principles important in neuroplasticity and therapeutics and briefly describe the ways in which CPS adheres to these principles to promote positive changes in the brain.

Principle #1: Relational Context

Perhaps the most basic principle of therapeutics (and healthy development) is that changing the brain is best done in a relational context. A child's development occurs best within

the context of strong relational bonds with adult caregivers. The brains of infants who are subject of deprivation do not develop neurotypically [8]. The Collaborative Problem Solving approach is intentionally relational as its core. Providers learning CPS are taught to stay attuned to, and adjust to, a child's arousal level while collaborating with the child to solve real problems in which they are both invested. Thus, the adult builds a relationship with the youth to provide a foundation on which learning can occur.

Principle #2: Specificity

A key principle of neuroplasticity is "specificity"; you cannot intentionally change a neural network unless you activate that *specific* network. Similarly, you cannot change a relational pattern unless you activate the same neural networks involved in that pattern of interaction. For this reason, approaches that simply try to approximate the situations in which the youth has difficulty displaying certain skills are largely ineffective. Anyone who has taught social skills or anger management groups knows about this problem of transfer of skills. Youth may appear to be gaining and displaying new skills in the group setting, but when asked to transfer those skills to a real-life situation in which the skills are needed, they are often nowhere to be found. This lack of generalizability of skills results from the fact that artificial circumstances do not recruit the *specific* neural networks involved in developing these skills. Thus, if one wants to change a child's stress response (e.g., when it has become sensitized from developmental trauma), one has to activate the stress response in a naturalistic manner. CPS does this by practicing problem-solving skills on naturally occurring problems with real adult caretakers in the youth's environment.

Principle #3: Pattern and Repetition

Like any learning, when we build cognitive skills such as social thinking skills, attention skills, or flexibility, we are creating new associations in the neural networks of the brain. Accomplishing this requires hundreds of repeated small

doses of interaction during which neurons fire together. Thus, a predictable, patterned, and repetitive interaction is necessary. Plan B is an iterative process that is often repeated, and sometimes with many repetitions, before a problem is solved. Once a problem is solved, the same process is used to address other problems. A child's experience of being asked to participate in a Plan B conversation may initially cause anxiety, but over time, with sufficient doses and repetition of the same pattern, it becomes comfortable, and their baseline stress level in that context decreases. After many repetitions, this pattern slowly shifts the baseline so that a sensitized stress response system can become more neurotypically organized (in Fig. 2.3, changing the red curve to the black line). While most clinical approaches tend to focus on the subject matter of an interaction, it is the patterned, repetition of a relational process that matters most when it comes to building new networks in the brain.

The requirement of repetition for change in the brain is often helpful for adults to understand so they do not lose faith in the Plan B process when problems require frequent attempts at Plan B before a stated problem is solved in a durable way. For example, if a traumatized child makes a prior association between relational intimacy and threat, simply engaging in the first ingredient of Plan B creates new associations between relational intimacy, empathy, and safety. Or alternating between the first two ingredients of Plan B engages the youth in repetitions of skills training in the skill domains of perspective taking and empathizing by modeling the skills and then asking the youth to try them. All of this occurs without even solving the particular problem under discussion. In fact, when an adult engages a youth in only the first two ingredients of the Plan B process and never gets to the point of generating solutions, that adult is still providing dozens of doses of small, patterned, repetitive interactions that build new associations in the brain and thus build skill (see Fig. 2.4). If adults understand that the process, rather than the outcome, is where new connections are formed in

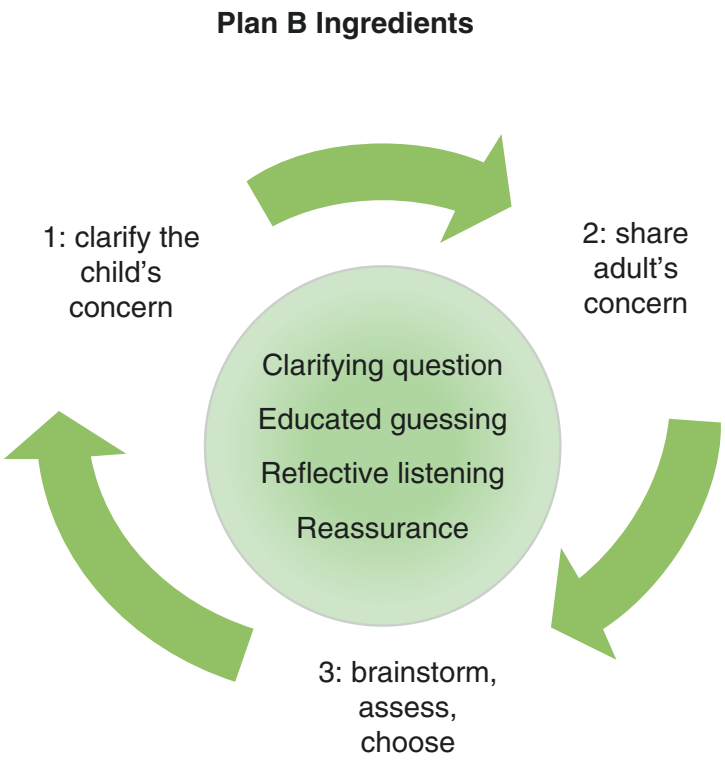

FIGURE 2.4 The repetitive cycle of Plan B builds new associations in the brain and thus builds skill. (Reprinted with permission by Think:Kids)

the brain resulting in skill development, it can be easier to remain regulated and effectively persist in the Plan B process.

Principle #4: Sensitivity to Stress Tolerance

Development interrupted by trauma or other forms of unpredictable stress can lead to a sensitized stress response systems where the normal linear relationship between external challenge and the internal response is altered. When youth experience chronic stress and trauma, their stress response is activated repeatedly before they have a chance return to their baseline. The result is a baseline that over time becomes elevated, which leads to their reactions to routine life challenges or trauma-related triggers becoming much more extreme. In

this case, even a moderate challenge or stress to the system, such as a request to transition from one activity to another, leads to dysregulation in the form of a fight or flight reaction (refer to Fig. 2.3).

As we have established, in order to change a neural network, one must activate that specific network. Thus, in order to modify an elevated stress response, one must activate the stress response. The challenge, particularly for traumatized youth, is how to activate the stress response safely. Thankfully, the stress response can be activated safely even with highly dysregulated youth if the dose of stress is moderate, controlled, and predictable.

Adults using CPS are taught to prioritize problems to solve using three plans and are encouraged to address easier problems first using Plan B. By choosing a fairly small and solvable problem first, the conversations introduce tolerable doses that desensitize the stress response over time. In the beginning, these interactions can be as quick as a few seconds. A therapeutic activation of the network might be as simple as momentary foray into a problem-solving conversation and a backing off to re-regulate the youth when their sensitized stress response gets activated. Ultimately, if a problem proves to be too overwhelming of a dose, the adult can default to Plan C and choose a less triggering problem to address next using Plan B (Video 2.1).

Many traditional therapies focus on the youth's challenging behavior itself – for instance, cursing, aggression, or defiance. Easily dysregulated youth predictably become defensive in response to such conversations because the dose of stress is too intense. In CPS, the focus is not on the challenging behavior but rather the triggers and expectations that lead to challenging behavior. This externalizing of the problem combined with judicious selection of which problems to address first maximizes the chances of achieving a moderate dose of stress. By avoiding the use of power and control (Plan A), using the regulating strategies in Plan B, and not pursuing expectations which are too dysregulating (Plan C), the adult

and youth together negotiate the appropriate dose that the youth can tolerate. This sensitivity to, and adjustment for, an individual child's stress tolerance is critical.

Principle #5: Predictability/Control

Activating the stress response in unpredictable and chaotic ways leads to adverse outcomes, whereas activating the stress response in controllable and predictable ways builds resilience. The fact that Plan B has three clear ingredients which are repeated sequentially in each conversation lends a predictable and controlled pattern to the interaction with adult authority figures. Along with the predictable pattern to the conversations, these qualities ensure a high level of control for the youth. Any trauma-informed approach must allow the youth to have a healthy amount of control in the process without sole responsibility for it. In Plan B, the youths' concerns are prioritized equally; they are asked first to generate solutions and have the right to reject potential solutions, thereby reducing the power differential which can be so dysregulating.

Principle #6: Spacing

A network will no longer respond if it is continually activated. After activating the stress response with a tolerable dose of stress, one must wait until the network is responsive again to be effective. Very few clinical approaches capture this therapeutic rhythm that we now know leads to actual change in the brain. For example, traditional therapies often attempt to expose the youth to doses of activation (the 50-min session, for example) that actually lead to a neural network becoming refractory. The recipe for building new patterns of activation in the stress response is frequent moderate, predictable, and controlled doses of good stress with spacing in between. The CPS approach respects this need for spacing between doses to change the brain. The average Plan B conversation is less than 10 min long, and it may last only a few seconds depending on the state of regulation of the youth.

CPS Follows the Essential Sequence of Engagement: Regulate, Relate, Reason

As we presented at the outset of this chapter, all information from our bodies enters through sensory experience. Internal sensory experiences tell us if we are hungry or cold so that we can act upon these needs. External sensory experience comes into the brain through tactile, visual, gustatory, auditory, and olfactory input. All of this critical feedback from the body and outside world go directly and first to the lower parts of our brain. The lower parts of our brain can then respond directly to this incoming information and/or send the information to higher parts of our brain for a response. The lower and more simple parts of our brain have far fewer options than the higher parts for how to respond, for example, with fight or flight impulses. The higher parts of the brain are where critical thinking and problem-solving occurs (refer to Fig. 2.1).

Thus, in addition to following the principles of neuroplasticity we have detailed, one must also respect this sequence with which our brains process information in order to be effective in promoting brain change. Most therapeutic approaches use top-down approaches, aiming to access the top part of our brain, or cortex, by engaging the youth in rational, practical discussion rather than respecting the reality that information only moves up to the top of the brain from the bottom. Any effective approach must instead follow this sequence of engagement: regulate, relate, and then reason (see Fig. 2.5). One must start by regulating the youth (a brain stem level activity) before the youth will be ready to engage relationally (a midbrain level activity), before they can finally be invited to reason (a cortical activity) to try to solve a problem collaboratively. If one violates this sequence or does it out of order, it is unlikely that there will be access to the cortex.

The process of Plan B provides a road map for respecting this sequence. The first ingredient is regulating, the second is

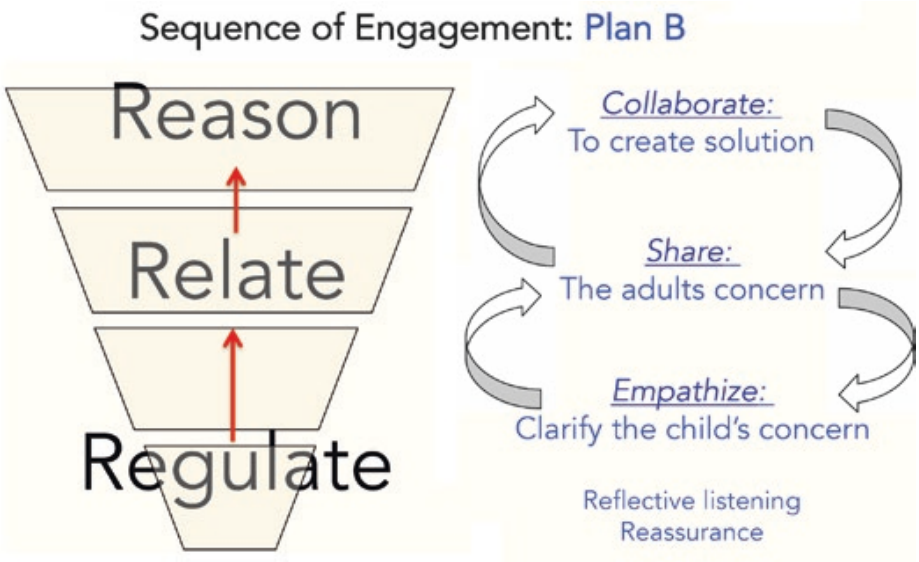

FIGURE 2.5 How Plan B maps on to the sequence of engagement for optimal information processing

relational, and the third involves reasoning. More specifically, the empathy ingredient uses reassurance and reflective listening to regulate the youth. Then the adult moves to the second ingredient, bringing up the adult concern and asking the youth to engage in shared empathy for one another's concerns, a highly relational task. Only once both sets of concerns are registered and the youth is regulated and related does the adult move to the third ingredient of Plan B. It is only in the third ingredient that the adult engages the youth in rational, cortical activity, by inviting them to brainstorm and assess possible solutions to the problem.

By repeatedly engaging in this process with youth, the therapeutic front moves up the brain over time. Initially, most of the activity in Plan B occurs low down in the brain by simply regulating the youth through repeated reassurance and reflective listening. As the adult becomes a more familiar presence and the process of Plan B becomes less novel and more predictable, the youth will feel more connected to the adult. The adult can then engage higher parts of the brain to relate and reason. The more connected the youth feels to the

adult caretaker, the more cognitive the process becomes over time, until much of the youth's work is done at the cortical level. However, the therapeutic front can shift from moment to moment and may require re-attuning in any particular interaction. Effective Plan B involves avoiding pushing forward when the youth becomes dysregulated but rather circling back and re-regulating the youth. Thus, the process of Plan B (three ingredients in a specific order, with the option to circle back when needed) provides guideposts for adults to follow in order to remain attuned and responsive to the youth's state of dysregulation. This stands in stark contrast to typical interactions with authority figures in which the adults decide when, where, how long, and what issue will be discussed. In this way, the CPS approach allows natural and healing patterns to take place.

Few therapeutic approaches provide a road map for adults to engage youth in patterned, repetitive, predictable activity that honor the sequence of engagement: regulate, relate, and then reason. For example, there is little evidence that the most popular contingency-based approaches to behavior management are effective with highly dysregulated kids, and the principles described above may explain why. With incentive-based approaches, there is an unspoken but very clear assumption that the youth's understanding of what is right and wrong (a cognition, thus based in the cortex) will guide behavior. However, this notion disregards the fact that behavior is driven from bottom-up processes. Only when a youth is well regulated can cortical processes effectively drive behavior. When a youth begins to become dysregulated and says or does something she shouldn't, most adults respond with some type of warning about impending consequences. This threat further dysregulates the youth, moving her even further away from rational, cortical level thinking, and responses. Thus, the use of mechanisms of power and control like motivational procedures which attempt to manipulate a youth's behavior is dysregulating and can cause developmental damage.

Furthermore, when youth become dysregulated and lower parts of the brain are left in charge, they typically respond impulsively and receive consequences for their behavior which are intended to deter them from behaving impulsively in the future. However, the sad irony is that impulse control is required for consequences to be effective in the first place. A youth must be able to control her impulses and access her cortex in the moment if she is going to be able to remind herself of a potential consequence and think of alterative options. Any novel, unpredictable, or threatening response to a youth that shuts the cortex down will ensure the youth will not be able to effectively reason or process and be capable of reflection. Adult caretakers often aspire to access the cortex, which makes top-down approaches appealing, but particularly with frequently dysregulated youth, effective intervention begins from the bottom up.

Finally, it is important to note that the effective sequence of engagement that we have delineated above applies to adults too. Adult caretakers cannot be expected to use the smart part of their brains to respond to challenging behavior unless they too are regulated. Even the best training in evidence-based approaches is useless unless adults can access their own cortical thinking when choosing how to intervene in the moment with youth. The CPS approach not only respects the neurobiological principles underlying the behavior of youth but also recognizes the very same principles govern adult responses to challenging behavior: a dysregulated adult will not be able to effectively intervene with a child. Fortunately, the CPS philosophy of *skill not will* is regulating for the adults contending with youths' challenging behavior. When adults view challenging behavior as a learning disability rather than as willful misbehavior, they are less likely to take the challenging behavior personally or to feel as if their authority is being challenged. Viewing challenging behavior through a compassionate rather than an affronted lens helps adults access their cortexes when responding to such behavior.

Conclusion

CPS represents an effective trauma-sensitive (see [2]) approach that operationalizes what is known about the neurobiological mechanisms underlying behavior change. The mind-set of CPS coupled with a simple framework for prioritizing problems (the three Plans) and the specific ingredients of problem-solving (Plan B) represent an effective way to slowly detoxify interactions between youth and authority figures which have led to challenging behavior in the past. The approach ensures the type of interactions that lead to enduring change at the level of the brain, especially when brain development has been impacted as a result of trauma. This is because CPS is a relationally mediated approach that allows for sufficient repetitions appropriately targeted to the areas of the brain where the most help is needed. Solving problems collaboratively with youth using the ingredients of Plan B involve all the core elements that make neural networks change in meaningful and specific ways. The process respects and operationalizes the principles of neuroplasticity and, as such, serves as a neuroscience-directed, intentional, and effective trauma-informed intervention.

References

1. Anda RF, Felitti VJ, Bremner JD, Walker JD, Whitfield C, Perry BD, Dube SR, Giles WH. The enduring effects of abuse and related adverse and epidemiology. Eur Arch Psychiatry Clin Neurosci. 2006;256:174–86.
2. Bloom SL. Advancing a national cradle-to-grave-to-cradle public health agenda. J Trauma Dissociation. 2016;17(4):383–96. https://doi.org/10.1080/15299732.2016.1164025.
3. Kleim JA, Jones TA. Principles of experience-dependent neural plasticity: implications for rehabilitation after brain damage. J Speech Lang Hear Res. 2008;51:S225–39.
4. Perry BD, Pollard R, Blakely T, Baker W, Vigilante D. Childhood trauma, the neurobiology of adaptation and 'use-dependent' development of the brain: how 'states' become 'traits'. Infant Ment Health J. 1995;16:271–91.

5. Perry BD. Child maltreatment: the role of abuse and neglect in developmental psychopathology. In: Beauchaine TP, Hinshaw SP, editors. Textbook of child and adolescent psychopathology. 1st ed. New York: Wiley; 2008. p. 93–128.
6. Perry BD. Trauma- and stress-related disorders. In: Beauchaine TP, Hinshaw SP, editors. Textbook of child and adolescent psychopathology. 3rd ed. New York: Wiley; 2017. p. 683–705.
7. Perry BD, Davis G, Griffin G, Perry JA, Perry RD. The impact of neglect, trauma and maltreatment on neurodevelopment: implications for the juvenile justice system. In: Beech AR, Carter AJ, Mann RE, Rotshtein P, editors. The Wiley-Blackwell handbook of forensic neuroscience. London: Wiley; 2018. p. 813–36.
8. Pollak SD, Nelson CA, Schlaak MF, Roeber BJ, Wewerka SS, Wiik KL, et al. Neurodevelopmental effects of early deprivation in post institutionalized children. Child Dev. 2010;81(1):224–36.
9. Tronick E, Perry BD. The multiple levels of meaning making: the first principles of changing meanings in development and therapy. In: Marlock G, Weiss H, Young C, Soth M, editors. Handbook of body therapy and somatic psychology. Berkeley: North Atlantic Books; 2015. p. 345–55.