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NEUROSCIENCE-INFORMED COUNSELING

Nonhierarchical, Multidirectional, and Oscillatory Processing in Neuroscience-Informed Cognitive-Behavior Therapy

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Since the first neuroscience-informed cognitive-behavior therapy (nCBT) article was published in the Journal of Mental Health Counseling *in 2015, the model has evolved to reflect developments in the scientific literature. In this article, we describe a more integrated and consilient framework that reflects the harmonious, synergistic, and complementary relationship among nervous systems and brain structures in which no single system or structure has dominance or primacy over another. We review literature on nonhierarchical and multidirectional understandings of the dual process model and oscillatory transitions between the two processing systems. We also discuss current thinking regarding brain development and unsupported theories. We propose an updated nCBT model to support new information regarding brain processing. A case study is woven throughout, to provide an example of how these concepts might be applied in clinical practice.*

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The neuroscience-informed cognitive-behavior therapy (nCBT) research team published the first conceptual article on nCBT in a 2015 issue of the *Journal of Mental Health Counseling* (Field et al., 2015). Since then, the research team has published a series of early studies examining counselor and client perceptions of credibility and outcome expectancy (Field et al., 2016, 2017), treatment fidelity (Field et al., 2019), and training outcomes (Miller et al., 2019). During this time, basic and translational neuroscience have evolved, and similar models have expanded to capture the dynamic interactions of top-down and bottom-up processes in assessment and intervention (e.g., Barfield et al., 2012; Tabibnia & Radecki, 2018). These advancements have informed our conceptual updating of nCBT. In this article, we describe updates and modifications to nCBT, organized by the following four approaches: (1) moving from an emphasis on hierarchical top-down processing to a focus on oscillatory transitions, (2) updating conceptualizations of brain development and evolution, (3) reconsidering assumptions of consciousness, and (4) discussing delivery considerations such as the counseling relationship as a preconscious intervention. We thread a case study of a fictional client named Ashley throughout the manuscript, to demonstrate how these concepts might manifest in clinical practice. Table 1 depicts the changes between the initial nCBT model and subsequent adjustments to the model, to assist the reader with following the organizational flow of the manuscript.

Table 1 *Summary of Conceptual Refinements to Neuroscience-Informed Cognitive-Behavior Therapy (2015–2025)*

Original model (2015)	Refinements (2025)
Oversimplified roles of brain structures, favoring higher cortical regions. Example: The goal of Wave1 bottom-up interventions is to build capacity for later Wave2 top-down interventions (i.e., hierarchical).	Emphasizing oscillatory transitions between Wave1 (bottom-up) and Wave2 (top-down). Shifting from emphasis on hierarchical processing and the primacy of top-down strategies.
Wave1 regions and structures are described as more primitive and reptilian compared with Wave2 regions and structures.	Rejects evolutionary superiority of the prefrontal cortex, emphasizing integrated networks and multidirectional relationships.
Assumes that top-down Wave2 processing involves conscious awareness.	Recognizes that conscious awareness is not always present during appraisal or response.
No mention of multiple Wave1 responses potentially occurring before Wave2.	Multiple Wave1 processes often occur before Wave2. Bottom-up processing is faster, more intuitive, and primary in enacting responses, although both are equally important.
Limited focus on the counseling relationship as a Wave1 intervention.	The counseling relationship is a Wave1 intervention that can foster regulation and awareness via affect modeling.

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CHALLENGES TO THE PREVAILING HIERARCHICAL PROCESSING MODEL

Since our initial conceptual article in 2015 (Field et al., 2015), an increasing number of papers have been published that detail neuroscience applications to cognitive-behavioral therapy (CBT) models (e.g., De Raedt, 2020; Månsson et al., 2020). Although these advancements acknowledge the importance of bottom-up processes, most continue to emphasize the primacy of strengthening rational, conscious cognition to regulate thoughts and feelings (e.g., Månsson et al., 2020). From this perspective of hierarchical top-down processing, an essential mechanism of cognitive-behavioral counseling interventions is the targeting of prefrontal cortex (PFC) regions to control overactivation in limbic regions (e.g., the amygdala).

We developed nCBT in part to counter dominant narratives about the primacy of rational, conscious cognition and thought in people's development of behavioral, emotional, and physiological responses (Field et al., 2015). Neuroscience studies have found evidence for the "amygdala hijack" theory posited by Goleman (1998) and referenced in other theories of attention and processing, such as the attentional control theory (Eysenck et al., 2007). Warren et al. (2020) studied the impact of reappraisal on emotional regulation of anxiety and stress in 37 children. They found increased right amygdala to dorsolateral PFC connectivity during states of anxiety and stress, whereas the opposite pathway (dorsolateral PFC connectivity to amygdala) did not have a negative correlation with anxiety and stress. In short, the findings from Warren et al.'s study appear consistent with Dixon and Dweck's (2022) contention that top-down PFC-amygdala control is ineffective at downregulating stress response. Raio et al. (2013) have demonstrated that cognitive emotional regulation control is impaired following cortisol release. In their experimental study, participants submerged their arms in either lukewarm or ice-cold water, triggering a stress response in the latter group. Both groups received cognitive emotional regulation training, with cortisol measured at submersion, and at 10 and 20 minutes post-submersion. The lukewarm group showed minor cortisol reductions, while the ice-cold group experienced a spike and no significant decrease. Raio et al. concluded that cognitive emotional regulation did not rapidly downregulate elevated cortisol.

Researchers in recent years have proposed that the PFC and amygdala have a more harmonious, synergistic, and complementary relationship (De Neys, 2021; De Neys & Pennycook, 2019). For example, the amygdala provides value computations about valence and salience, which the PFC interprets when a person plans future actions to meet current and future needs (Dixon & Dweck, 2022). The amygdala contributes to tasks that are

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typically considered to be executive functions, such as attentional moderation and working memory. Top-down decision-making is thus not localized to the PFC and does not necessarily involve the PFC ignoring information from the amygdala (De Neys, 2021; De Neys & Pennycook, 2019). Instead, the PFC works in tandem with the amygdala and other structures to make decisions and plan actions that involve emotional and experience-based/memory-laden information. This harmonious relationship is multidirectional. Dixon and Dweck (2022) argued that people do not overcome emotional dysregulation through PFC top-down control; rather, reregulation and parasympathetic recovery occur when the amygdala-PFC circuit is working together to shift a person's situational goals (e.g., calming down rather than protecting oneself through aggression or withdrawal).

Network Models

Alternative models of information processing have emerged in addition to the dual process model. Menon (2011) and Messina et al. (2016) proposed a triple network model for psychopathology, in which alterations to three intrinsic connectivity networks are associated with mental disorders and thus also targets of change in psychotherapy. These three networks include the default mode network (DMN), the central executive network (CEN), and the salience network (SN). The DMN involves connections between the medial PFC, precuneus, and posterior cingulate cortex, with additional connections to the thalamus and parahippocampus. The DMN is involved with self-referential processing and preconscious mental processing such as mind wandering. The CEN comprises the dorsolateral PFC and posterior parietal cortex, with functions pertaining to working memory and executive functioning. While the DMN is active in resting states and inactive during cognitively demanding tasks, the CEN is oppositely active during cognitively demanding tasks and inactive at rest. The SN has nodal connections between the anterior insula and dorsal anterior cingulate cortex, as well as to the thalamus and amygdala. The SN detects and processes internal and external stimuli, with additional roles in emotional regulation, sympathetic nervous system activation, and homeostasis. In the triple network model, the SN assists with regulating dynamic interactions between the DMN and CEN. Together, these structures are associated with attention, awareness, internal and external sensory processing, emotional regulation, memory consolidation, and learning. Outcomes studies, especially within the mindfulness-based therapy literature, are emerging to support these contentions. For example, H. Li et al. (2022) found increases in PFC-limbic connectivity following mindfulness-based

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cognitive therapy (MBCT), and Zimmerman et al. (2019) found decreases in functional connectivity between the DMN and amygdala following MBCT.

We argue that the triple network model emphasizes the dynamic interactions between networks (i.e., DMN, CEN, SN) alongside the importance of facilitating among and between network processing, with no one network given primary importance as the target of intervention. We propose that the dual-process model should be interpreted similarly; both bottom-up and top-down processing have importance in a person's adaptive response to their environment. Maladaptive response is marked by overemphasis, overreliance, or "stuck-ness" in one of the two processing states (i.e., bottom-up or top-down) without enough shifting between states. The nCBT model states that both aspects of the dual-process model, bottom-up and top-down processing, are crucial to understanding behavioral, emotional, and physiological responses and are both targets of intervention. In comparison with conventional CBT, nCBT emphasizes early assessment of both processes to guide the selection of interventions to promote flexibility and ease in shifting from one process to another as context and experience require.

Case Application: Network Models

The dynamic interactions between bottom-up and top-down processing in the dual processing model can be further described through a clinical case study. Ashley is an adult client who is experiencing distress related to recurrent conflict in a romantic partner relationship. A frequent topic of conflict is their partner's perception that Ashley is "defensive" and rarely, if ever, takes responsibility for their actions. During early sessions, the counselor observes that Ashley seems stuck in a reflexive and dysregulated emotional state whereby they cannot process past conflicts without becoming overwhelmed by guilt and fear of abandonment. They seem to change the subject of conversation to avoid discussing past conflicts. Ashley seems stuck in a bottom-up activation state, preventing any top-down appraisal. This may indicate potential issues with amygdala-PFC connectivity. The counselor's first task is to help Ashley attune, accept, and cope with their emotional and physiological activation rather than avoid these emotions.

Sensory Processing

Attunement to a person's sensory processing that includes both interoception (awareness of bodily feelings) and exteroception (perceiving the external world) is an important component of emotional regulation. Sensory processing emphasizes the interconnected and integrated nature of brain and body structures. Neuroscience literature (e.g., Chrobok et al., 2017) reports that multiple

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brain structures work in synchrony to process information. The vast majority of sensory experiences involve information inputs from most of the five major sensory organs of the body. Each of these sensory experiences involves numerous brain structures. Visual processing, for instance, involves the eyes, optic nerve, thalamus, occipital lobe, and autonomic nervous system (Chrobok et al., 2017). Sound processing involves the auditory cortex, inferior colliculus, and cortical areas, with sound waves transmitting vibrations to the cochlea and converted into electrical signals sent through the auditory nerve. These multisensory inputs are initially sent from each sensory organ to brain processing centers such as the thalamus. This processing is fundamental to perception, constructing a unified representation of the external world from different sensory inputs, thereby shaping our perception of sensory information. In short, the processing of sensory information demonstrates how different structures of the brain and body work as a connected and integrated system, with all structures having important roles and no single structure having primary responsibility for the system. Each structure therefore must be considered within the context of the collective system in which it functions and cannot be adequately understood when isolated from its network.

Case Application: Sensory Processing

Returning to our clinical example, Ashley gradually recalls sensory experiences during conflict. Ashley reports auditory information from the other person's verbal input, noise from their surroundings, and visual information from the other person's body language and the environment where the conflict takes place. They may also receive meaningful sensory information such as olfactory input from smells in the environment that recall past experiences.

Oscillatory Transitions

One of Ashley's central challenges is being stuck in a state of bottom-up processing. Recently authors have suggested an overreliance on one type of processing (i.e., top-down or bottom-up) is actually problematic and an indication of maladaptive processing, a form of stuck-ness. Rolls (2021) and LeDuke et al. (2023) argued that ongoing oscillatory transitions between bottom-up and top-down processing (in nCBT terms, Wave1 and Wave2) is healthy for overall adaptive adjustment to one's life circumstances and environment. Those authors proposed that being stuck in one of those two modes without oscillatory transition is associated with maladaptive adjustment such as anxiety and depression. One could thus argue that an overemphasis on cognitive restructuring and processing may actually detract from healthy adjustment to environ-

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mental events, as it may foster behaviors such as rumination that are themselves associated with clinical issues like depression (Olatunji et al., 2013).

In the nCBT model, we encourage a balance between bottom-up and top-down processing. During situations of threat and stress, a person adaptively processes information that incorporates bottom-up and top-down processes in both a sequential and an oscillatory manner. In Wave1, a person processes information in a bottom-up manner as preconscious sensory stimuli related to environmental events (A1) are processed by limbic structures (thalamus, amygdala, hippocampus, hypothalamus) that have directional pathways to the pituitary gland (B1), which releases cortisol and adrenaline at the adrenal cortex/medulla in anticipation of threat (C1). The person is typically not consciously aware of these processes, which occur very quickly and reflexively. In Wave2, a person processes information in a top-down manner as they become consciously aware of this physiological activation (A2) and start to appraise (and reappraise in the case of subsequent waves) their situation and emotional response (B2), resulting in subsequent physiological and emotional consequences (C2). The early treatment goal during Wave2 is to help clients to predict, understand, and tolerate/accept their physiological responses as adaptive to survival (e.g., "my body is keeping me safe"). As time passes, the person continues to experience oscillatory transitions between bottom-up and top-down processing in response to the environmental stimuli (i.e., threat, stress) and also when processing their behavioral, emotional, and physiological response. In this sense, the goal is not to promote cognitive control, but rather to increase flexibility in the oscillations between the ongoing momentum of the waves of one's experiences.

Case Application: Oscillatory Transitions

Ashley's stuck-ness in Wave1 bottom-up processing is an important target of intervention. Ashley feels overwhelmed when discussing past conflicts (Wave1). This overwhelm appears to prevent Wave2 cognitive processing. The counselor recognizes that oscillatory processing is blocked and needs to facilitate transitions between Wave1 and Wave2 processing. The counselor asks Ashley to observe and "sit with" those emotions and physiological feelings and then share what they notice. The counselor then moves into conscious processing of the experience (Wave2) by helping Ashley to make sense of these emotions and physiological feelings and discuss what it was like to talk about them with their counselor (metacognition). The counselor encourages Ashley to identify and accept aspects of their emotional and physiological responses as means of self-protection. This results in secondary emotional and/or physiological responding, such as appreciation, relief, relaxation of muscle tension, and self-compassion. Eventually, Ashley can return to broaching the initial

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topic content of the interpersonal conflict, with the counselor encouraging ongoing awareness of activation during the discussion. Eventually, Ashley is encouraged to make meaning of how their experience in the session might translate to a resource for handling future interpersonal conflicts when they feel overwhelmed.

In this example, the content of the client's initial topic (i.e., interpersonal conflict and defensiveness) is not immediately addressed; their activation and responding in vivo and in retrospect take precedence. The focus on emotional and physiological processing, as much as cognitive understanding of spoken verbal (conscious) content, reflects the respect afforded to bottom-up experiences, not just top-down experiences. The top-down techniques focus on using the client's in-session experience of regulation to create new cognitions rather than using Socratic dialogue to dispute the rationality of thoughts.

BRAIN DEVELOPMENT AND EVOLUTION

Overvaluation of top-down processing and the PFC can also be seen in theories of brain development and evolution. Conceptualizations of brain and nervous system evolution and functioning within the mental health field have historically relied heavily on translations of Paul MacLean's triune-brain theory (Cesario et al., 2020; Dixon & Dweck, 2022; MacLean, 1990). In fact, in our first writings on nCBT, we referred to certain brain regions as being more or less evolutionarily primitive in relation to other brain regions (Field et al., 2015). According to this theory, the first part of the brain, the brain stem, developed in reptiles, followed by the limbic system in lower mammals, and most recently the neocortex in humans (Cesario et al., 2020). With each evolutionary progression (e.g., new species emerging), earlier-formed brain regions were retained, and newer brain regions were layered on top with increasingly complex abilities and functions. Following this line of thinking, modern-day humans then have a reptilian complex comprising the brain stem and cerebellum that governs basic survival functions; a paleomammalian complex comprised of limbic structures that drive social, emotional, and reward-based motivation; and a neomammalian complex consisting of the neocortex that directs conscious thought and executive functioning (MacLean, 1990). Preconscious thought is deemed to occur in the reptilian and paleomammalian complexes and is associated with basic survival functions such as breathing, heart rate, and hunger (reptilian complex) and sympathetic activation related to survival response (paleomammalian complex; MacLean, 1990). MacLean's model inadvertently perpetuated beliefs about the distinction between brain structures (Field, 2019). MacLean's triune brain model may also have reflected

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cultural beliefs about the neocortex being the superior brain structure to the reptilian and paleomammalian complex because it separated humans from other animals (Field, 2019).

Despite the widespread popularity of the triune brain model and its practical translations, contemporary evolutionary biologists largely discredit this theory (Cesario et al., 2020). Cesario et al. (2020) offer a full analysis of the misconceptions underlying the triune brain theory. Some key themes of this analysis include the ideas that evolution did not occur in linear progression of species, that the mere size of a brain or brain structure does not equate to functional complexity, and that evolution did not consist of layering on newer brain regions to create capability for more complex functions; rather, evolution consisted of changes within existing brain regions over time. Cesario et al. also sought to correct a very common misunderstanding, "even the prefrontal cortex, a region associated with reason and action planning, is not a uniquely human structure" (p. 257). Therefore, the existing translations of MacLean's model (e.g., the hand model of the brain; Siegel, 2012) can be updated to include oscillations, multidirectional relationships, and networks of integration rather than evolutionary superiority and primary duties in isolation.

Neuroscience conceptualizations of brain and nervous system development and functioning continue to evolve as technology enhances the way these organs and systems can be studied and researchers become more nuanced in their observations and conclusions (Bassett et al., 2020). Increasingly, scientific dialogue in neuroscience is transitioning from discussing discrete "parts" of the brain and their individualistic functions to talking about neural networks and interconnected systems. Brain regions still play a role in contemporary conversations about brain and nervous system functioning, but there is greater recognition that many parts of the brain, from subcortical to cortical structures, are critically involved in most elements of human experience (Bassett et al., 2020; Dixon & Dweck, 2022; W. Li & Keil, 2023).

ASSUMPTIONS OF CONSCIOUSNESS

A central problem of privileged top-down processing is the assumption of conscious awareness being accessible in most situations. In Ellis's (1991) conventional ABC model, beliefs were conceptualized as the filters that alter our experiences to produce consequences. The nCBT model was developed to help conceptualize the importance of preconscious bottom-up processing in addition to top-down processing, recognizing that consequences often do not require a specific belief system to be activated. In the nCBT Wave1 and Wave2 ABC model described above, a person first processes external sensory informa-

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tion and internal signals preconsciously, resulting in behavioral, emotional, and physiological responses. The person eventually becomes consciously aware of the situation and their preconscious behavioral/emotional/physiological responding (A2 awareness) and appraises the situation and their responding (B2 appraisal of awareness).

Yet in our experiences of implementing nCBT, we have observed that conscious awareness is not necessarily present when a person appraises a situation and their response. For example, imagine a person is in an interpersonal conflict and they become physiologically activated. They may appraise this activation and the situation as threatening (B2) and either withdraw or shut down (avoid response) or lash out verbally in response (approach response; C2). These patterns might be so ingrained that these behavioral, emotional, and physiological responses and consequences occur preconsciously; the person might not be consciously aware of how they are responding until a while later. Therefore, there may be multiple Wave1 processes that occur before entering into a Wave2 process, thus indicating the potential need for more flexibility in the oscillations between Wave1 and Wave2. When working with such a client, a useful approach might be preventative emotional regulation work such as ensuring adequate sleep, hunger satiation, and exercise to reduce the potential for a reflexive Wave1 response during conflict (Wave1 intervention) and helping the client to become consciously aware of interoceptive signals of activation alongside triggers to sensing threat during interpersonal conflict and responding defensively (Wave2 intervention). Thus, the oscillations between Wave1 and Wave2 can become more fluid, allowing for a greater range of possible reactions. Once awareness is present and Wave2 begins, additional top-down strategies can commence. We emphasize here that the bottom-up processing pathway is typically stronger, more intuitive, and more frequently occurring than top-down processing pathways. While we regard both as equivalently important, it could be argued that bottom-up processing is actually the more primary pathway, or at least gets the first chance, to enact behavioral, emotional, and physiological response rather than top-down processing.

RELATIONSHIP AS A PRECONSCIOUS INTERVENTION

Social neuroscience research affirms the brain and nervous system rely on relational information, largely at a bottom-up and preconscious level, to inform cognitive, affective, and behavioral functioning (Cacioppo et al, 2014; Cammisuli & Castelnuovo, 2023; Hambrick et al., 2019). Theorists offer research and frameworks describing the underlying neurological mechanisms of relational connection and interpersonal neurophysiological regulation,

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including social baseline theory (Beckes & Sbarra, 2022), polyvagal theory (Porges, 2022), and neural coupling or interpersonal synchrony (Hasson et al., 2012; Koole & Tschacher, 2016). These theories highlight the importance of relationships in influencing physiological arousal, regulation of emotion, decision-making, and behavioral reactivity throughout the lifespan. A critical takeaway is the notion that optimal human functioning occurs when individuals perceive connection and support from trusted others.

The counseling relationship can initially prompt a Wave1 response, as clients may code the early phases of counseling as a threat. However, as counselors use their skills, the therapeutic relationship can intentionally be conceptualized as a Wave1 intervention to enhance physiological regulation and cultivate greater receptivity, openness, and awareness of experience (Field et al., 2017). Many clients' symptoms stem from experiences of relational poverty or relational traumas, and thus the safe and trusting therapeutic relationship can in itself serve as a disconfirming experience at the neurological level, building over time new implicit templates for relational connection and regulation (Ecker & Bridges, 2020; Hambrick et al., 2019). Supporting clients' development of new healthy relational templates and greater regulatory capacity requires counselors to be aware of their own internal states (e.g., signs of autonomic reactivity, such as increased heart rate, shallow breathing, muscle tension, bodily sensations and movements) and the signals their nervous system may be sending to their clients' nervous systems. Counselors cultivate safety through consistent expressions of warmth, acceptance, attuned presence, and empathic reflections, as well as verbal and nonverbal communication. For example, Porges (2022) noted that prosodic vocalizations, warm facial expressions, gentle gestures, and calm breathing communicate a sense of safety to individuals' nervous systems. Additionally, counselors can use immediacy to help clients gain awareness of their physiological functioning in the here and now.

Understanding the social nature of the brain can also help counselors select interventions with greater intentionality. For example, Perry and Ablon (2019) described the value of the sequence of engagement (e.g., regulate, relate, reason, and reflect) when interacting with clients, noting that cognitive training is most effective when it follows emotional regulation and relational connection. Additionally, the work of Brody et al. (2013) and Miller et al. (2015) highlighted the physiological cost of exerting active coping and self-control in the face of stressors. Their research followed low-socioeconomic status (SES) African American youth over many years and found that although youth with higher self-regulation capabilities emerged into adulthood with fewer psychosocial struggles (e.g., depression, substance use, aggression),

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participants with greater self-control had accelerated epigenetic aging and higher rates of cardiovascular health concerns (e.g., high blood pressure, obesity). These findings support social baseline theory tenets (Beckes & Sbarra, 2022) that assert an overreliance on self-regulation strategies in the face of perceived or actual threats is metabolically costly to the brain and body, resulting in physical health impacts over time.

Preconscious Affective Modeling in nCBT

The relationship between counselor and client is another excellent example of how some of the most central aspects of information processing occur preconsciously and bottom-up. The counseling relationship has important implications for early interventions that model affect regulation, ground the client, and enhance client expectancy. The counseling relationship is often a Wave1 intervention in that the client (and sometimes the counselor) is not consciously aware of its effects that are occurring regardless of conscious recognition.

Case Application: Preconscious Affective Modeling in nCBT

The counselor's own affect modeling and emotional regulation serve as the holding container for the client. In session with Ashley, the counselor models inner calmness and non-judgment through nonverbal stillness rather than fidgeting; models appropriately expressive facial affect, such as calm modeling of a grimace or wince; and uses soothing paralanguage ("mmmm") with low vocal tonality spoken with slow cadence. Ashley preconsciously responds to this affect modeling by developing their own inner calm, self-acceptance and self-compassion, regulated breathing, and expression of affect (e.g., anger, joy, sadness). As counseling progresses, Ashley's shift between bottom-up and top-down processing facilitates an enhanced ability to sit with their own emotional and physiological responding, when it is safe to do so, rather than avoiding the experience. In session, the counselor regularly transitions the dialogue to Wave2 conscious emotional processing, such as asking Ashley to observe their improved ability to sit with observations of feelings and sensations in different parts of the body.

ADJUSTMENTS TO THE NCBT MODEL

What does this new information mean for the continued refinement of the nCBT model? We have refined the treatment manual and associated materials (e.g., fidelity checklist) to incorporate several updates. We have further emphasized how various brain structures, regions, and neural networks func-

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tion in an interconnected and dynamic manner rather than oversimplifying roles and responsibilities and insinuating greater value or preference for higher cortical regions over lower cortical regions. We have emphasized the nonhierarchical and multidirectional nature of bottom-up and top-down processing and have directly challenged hierarchical unidirectional primacy of top-down control strategies. We have adjusted the nCBT model to further accentuate the integrated synchronicity in the complete nervous system that includes the processing of external sensory information and internal physiological signals. We encourage the use of interventions that can be used to facilitate oscillatory processing, rather than singular activation of component parts with no attention given to multidirectional communication.

For example, the conventional Ellis (1991) ABC model emphasizes PFC control of behavioral and emotional response via modifying irrational beliefs. In this model, top-down processing is given hierarchical importance over structures associated with emotion such as the amygdala. There is little attention given to facilitating emotional and physiological activation and processing via structures like the amygdala in Ellis's model. Furthermore, Ellis's model does not consider the relationship between consequences and beliefs other than for reinforcement purposes, thus emphasizing singular directional pathways. In the revised nCBT model, counselors emphasize emotional and physiological experiencing and preventative bottom-up processing interventions, such as lifestyle change strategies and affective modeling, in addition to appraisal of these experiences via top-down processing. The counselor would also help the client to oscillate between bottom-up and top-down processing frequently to build flexibility. In the interpersonal conflict example above, the counselor helped the client sit with emotional and physiological activation (Wave1), make meaning of this activation (Wave2), sit with the secondary emotions and physiological feelings arising from self-acceptance (Wave1), make meaning of how this might translate into a useful resource for handling future interpersonal conflicts when they become defensive (Wave2), and so on. This approach facilitates multidirectional oscillatory processing between PFC and amygdala in addition to other structures, generating new cognitions through multidirectional processing.

In the first draft of the nCBT treatment manual (Beeson et al., 2017), we developed assessment techniques for appraising whether a person has predominant response sets (i.e., Wave1 or Wave2; approach, avoid, freeze, fawn). We have updated this schematic to now incorporate the importance of assessing whether a person is stuck (over-prefers) in a bottom-up or top-down processing state (Wave1 or 2) and/or behavioral response (approach, avoid, freeze, fawn). A person's overreliance on one of these processing types and response sets

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indicates the absence of oscillatory transition, and this "stuck-ness" may be an indicator of clinical problems. During the counseling process, the counselor would assess for the presence of both Wave1 and Wave2 processing and also the extent to which a person prefers Wave1 versus Wave2 processing as their predominant response in a manner that precludes oscillatory synchrony and transition.

The valuing of a balanced Wave1/2 processing approach extends beyond case conceptualization to intervention. In the first draft of the nCBT treatment model (Beeson et al., 2017), we provided guidance on how to facilitate both Wave1 and Wave2 processing in a single session and across multiple sessions in the treatment process. Although we have recognized the adaptive nature of Wave1 responses, at least in their early developmental phases, there are times when counselors might focus on the harmful consequences of these Wave1 responses, since that is often what prompts clinical interventions. However, Wave1 processes with positive valence (e.g., activation of dopaminergic and oxytocinergic systems post-exercise or in quality friendships) should also be attended to and elevated. In both cases, counselors can facilitate oscillatory Wave1/Wave2 processing in a single session by following a similar procedure recommended by De Raedt (2020), with some modifications. For example, the counselor could facilitate bottom-up/Wave1 processing by first preparing and then engaging the client in controlled exposure to a physiologically activating stimuli (e.g., imaginal exposure, virtual reality) and asking the client to self-monitor physiological activation during exposure (e.g., by counting their pulse or using a pulse oximeter). The counselor could observe and share information about the client's physiological and emotional responses to draw the client's attention to their physiological signals to facilitate interoceptive exposure and awareness. To facilitate oscillatory processing, the counselor could then direct the client's attention to the emotional content of the situation to facilitate top-down processing and appraisal (Wave2 processing). The counselor can help the client use experience to dispute unhelpful cognitions (e.g., challenging "I have no self-control" with examples when the client demonstrated agency and emotional regulation in the session). Eventually, the client can be reminded to engage in soothing/calming parasympathetic activities such as breathwork and sensory-based coping to further engage Wave1 processing. Following this, the counselor can help the client again notice physiological signals and interoceptive experiences that emerge from parasympathetic activation and to appraise these physiological and emotional reactions (Wave2 processing). This example demonstrates the oscillatory rhythm between Wave1 and Wave2 interventions. Counselors can also use interventions across multiple sessions in the treatment process that incorporate principles of oscillatory

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synchrony. For example, counselors can spend a greater proportion of session time in exposure-based or capacity-building activities such as lifestyle changes, biofeedback, or neurofeedback (Wave1) before devoting a greater proportion of sessions to appraisal of Wave1 changes and/or cognitions that prevent progress on Wave1 processing changes (Wave2) and eventually returning to using outside-of-session exposures to further enhance state-dependent learning and generalization (Wave1).

We are also moving away from using language that labels parts of the brain as more or less primitive and removing reference to concepts such as the "reptilian brain" or "mammalian brain." We are also emphasizing different trajectories of structural and functional changes within brain regions and neural networks across development, rather than describing brain development primarily in a linear, hierarchical manner.

IMPLICATIONS FOR CLINICAL PRACTICE

When developing materials for training and client use, we are intentional that information does not reflect biases that privilege top-down unidirectional processing and control. For example, our training materials emphasize using preconscious processing techniques in Wave1 initially before addressing conscious cognitive change strategies in Wave2 interventions. Our Wave2 interventions are grounded in Wave1 experiences; we want clients to reappraise their situation and behavioral, emotional, and physiological responding by using prior Wave1 experiences as a disputation tool rather than logic alone. A client might be encouraged to reflect on their preconscious development of affect regulation via the counseling relationship (Wave1) as evidence that they are indeed capable of affect regulation in other external relationships. The counselor can provide affective modeling and facilitate reflections on these experiences during Wave2 reappraisal. We also encourage preconscious Wave1 strategies in our client handouts and worksheets, such as lifestyle habit changes (e.g., sleep, diet, physical activity) alongside interoceptive awareness (e.g., body scanning, taking pulse). These techniques prevent emotional dysregulation and develop preconscious capacity to notice activation sooner.

FUTURE RESEARCH DIRECTIONS

We have identified several types of future research studies that are needed to directly validate adjustments to the nCBT model. Future studies could compare the updated nCBT model with conventional top-down unidimensional and non-oscillatory CBT for a variety of clinical problems. In such

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studies, we would expect equivalency rather than superiority, because some clients may prefer a more top-down approach to counseling, and a very small proportion of outcome variance is typically due to the therapeutic model (Wampold, 2015). Qualitative studies could be used to examine whether participants prefer nCBT or conventional CBT and why. Stronger inferences from experimental studies may be drawn if they contain control variables such as therapeutic alliance ratings and perceptions of credibility and improvement expectancy. We see value in single-subject and nested group design studies to explore and understand within-group as well as between-group differences. Follow-up qualitative studies may prove useful in understanding client perceptions of the intervention, as well as which factors influence client experiences of fully processing and working through a clinical issue versus feeling stuck and not making progress. We also see a need for future studies that examine therapeutic outcomes and client perceptions of nCBT when transposed and translated into another language.

CONCLUSION

The prevalent emphasis in CBT literature continues to be reinforcement of unidirectional top-down conscious control by the PFC over preconscious emotional processing in limbic structures such as the amygdala. The nCBT model differs substantially from this approach, because both bottom-up and top-down processing are crucial to understanding behavioral, emotional, and physiological response and are both targets of intervention. Our refined nCBT model emphasizes multidirectional bottom-up/top-down oscillatory processing of preconscious and conscious states, with the intention of assisting clients to more fully process their emotional and physiological experiences rather than becoming stuck in a single processing mode. Maladaptive responses are characterized by an excessive overemphasis, reliance, or stagnation in either the bottom-up or top-down state and by related neglect of the necessary shifts between states.

We presented clinical within-session examples whereby a client, Ashley, became tearful when discussing an interpersonal conflict. Our intent for this case study was to assist practicing counselors to use their principles in their counseling practice with clients. Through the case study, we demonstrated how the counselor leveraged the therapeutic relationship to facilitate the client's oscillatory processing of emotional and physiological reactions.

We proposed adaptations to the nCBT model based on these principles. We recognize these changes reflect our most current understandings of the

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workings of the brain and body and should be updated as new information from extant research emerges.

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