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Neural Dynamics of Spontaneity and Creativity in Psychodrama: An Integrated Neuro-Psychodramatic Model

Psikodramada Spontanlık ve Yaratıcılığın Nöral Dinamikleri: Bütünleşik Bir Nöro-Psikodramatik Model

Pınar Kurt Combil[1]

[1]Beykoz University, Istanbul

ABSTRACT

Psychodrama is an experiential psychotherapeutic method whose effectiveness has been validated through extensive qualitative and quantitative research, finding broad applicability in both clinical and sub-clinical contexts. Contemporary theorists and authors agree that action and spontaneity-creativity, the two conceptual foundations of psychodrama, constitute the therapeutic core underlying its effectiveness. However, the existing literature lacks a comprehensive explanation of the neural mechanisms through which action, spontaneity, and creativity exert their therapeutic effects. The recent and growing dialogue between neuroscience and psychotherapy is likely to shed light on the neural mechanisms underlying psychodrama. On the other hand, the action-oriented nature of psychodrama, which distinguishes it from other psychotherapy approaches, necessitates examining it through the lens of another discipline—ecological psychology. This article proposes an integrated neuro-psychodramatic model to elucidate the neuroscientific and psychological mechanisms underpinning spontaneity and creativity in psychodrama, highlighting how the ecological psychology concept of affordances, situated within the perception-action cycle framework, mediates psychodramatic spontaneity-creativity, and demonstrating how the neural bases of cognitive/behavioral flexibility parallel those underlying spontaneity-creativity. This integrative model enhances theoretical understanding, guides future empirical research, and aims to optimize psychodramatic therapeutic interventions within contemporary neuroscientific and psychological paradigms.

Keywords: Psychodrama, interdisciplinary research, cognitive neuroscience

ÖZ

Psikodrama, etkililiği kapsamlı nitel ve nicel araştırmalarla doğrulanmış, klinik olan ve olmayan bağlamlarda geniş bir uygulama alanı bulan deneyimsel bir psikoterapi yöntemidir. Günümüz kuramcıları ve yazarları, psikodramanın iki temel kavramsal dayanağı olan eylem ve spontanlık-yaratıcılığın, yöntemin terapötik etkinliğinin özünü oluşturduğu konusunda hemfikirdir. Ancak mevcut literatürde eylem, spontanlık ve yaratıcılığın terapötik etkilerini hangi nöral mekanizmalar aracılığıyla gösterdiğine dair kapsamlı bir açıklama bulunmamaktadır. Son dönemlerde nörobilim ve psikoterapi arasındaki artan diyalog, psikodramanın altında yatan nöral mekanizmalara ışık tutma potansiyeline sahiptir. Öte yandan psikodramanın eylem odaklı doğası, onu diğer psikoterapi yaklaşımlarından ayırmakta ve psikodramayı, bir başka disiplin olan ekolojik psikolojinin perspektifinden incelemeyi gerekli kılmaktadır. Bu makale, psikodramadaki spontanlık ve yaratıcılığın altında yatan nörobilimsel ve psikolojik mekanizmaları açıklamak üzere bütünleşik bir nöro-psikodramatik model önermektedir. Bu model, algı-eylem döngüsü çerçevesinde konumlandırılan ekolojik psikolojiye ait afordans kavramının psikodramatik spontanlık-yaratıcılığa nasıl aracılık ettiğini vurgulamakta ve bilişsel/davranışsal esnekliğin nöral temellerinin spontanlık-yaratıcılığın nöral temelleriyle gösterdiği paralelliği ortaya koymaktadır. Bu bütüncül model, teorik anlayışı derinleştirmekte, gelecekteki ampirik araştırmalara yön vermekte ve psikodramatik terapötik müdahalelerin çağdaş nörobilimsel ve psikolojik paradigmalar çerçevesinde geliştirilmesini amaçlamaktadır.

Anahtar sözcükler: Psikodrama, disiplinler arası araştırma, bilişsel nörobilim

Address for Correspondence: Pınar Kurt Combil, Beykoz University Faculty of Social Sciences Department of Psychology, Istanbul, Türkiye
e-mail: pinarkurtcombil@beykoz.edu.tr
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Introduction

Psychodrama is an action-based group therapy that uses spontaneity and creativity to foster psychological change (Yaniv 2014). It promotes personal growth, self-awareness, and better interpersonal relationships (Lim et al. 2021). A growing body of empirical literature supports psychodrama's effectiveness, demonstrating significant therapeutic outcomes such as behavioral change, stress and anxiety reduction, and the adoption of healthier perspectives (Orkibi and Feniger-Schaal 2019, López-González et al. 2021). While Moreno (1953) and later theorists (such as Kellermann 1992, Krüger 2002, Orkibi and Feniger-Schaal 2019) have consistently identified spontaneity and creativity as essential components of therapeutic change in psychodrama, the specific psychological and neurobiological mechanisms by which these elements promote therapeutic transformation remain inadequately understood and empirically under-explored (Lim et al. 2021).

Notably lacking is a comprehensive theoretical framework capable of explicating the intricate interplay of action, cognition, emotion, and relational transformation inherent to psychodramatic methods. Recent interdisciplinary advances have notably enriched both neuroscience and psychotherapy, fostering dialogues that significantly deepen our understanding of human cognition, emotion, and behavior (Scorolli 2019). Within these dialogues, psychodrama emerges as a uniquely valuable methodological framework, providing ecologically valid contexts for neuroscientific investigation of embodied, affective, and relational phenomena (Hug 2007). Concurrently, cognitive neuroscience provides solid neurophysiological foundations and empirical methods, enabling a deeper understanding of psychodrama's therapeutic processes (Lim et al. 2024).

Building upon these interdisciplinary advances, this article proposes that the spontaneity—considered the dynamic core of psychodrama's therapeutic efficacy (Moreno 1953, Kipper and Hundal 2003)—can be systematically reframed through an integrative theoretical framework at the intersection of ecological psychology and cognitive neuroscience. Specifically, cognitive neuroscience elucidates neural substrates underpinning spontaneous adaptive behaviors (Talebi et al. 2024). We assume that cognitive flexibility, defined as the capacity to adapt cognitive and behavioral strategies to changing environmental demands, can be considered one of the gateways through which spontaneity intersects with cognitive-behavioral neuroscience. Besides, ecological psychology's concepts of affordances and the perception-action cycle, which conceptualize the organism and its environment as dynamically coupled systems interconnected at both mechanical and informational levels (Waren 2006, Withagen et al. 2017), illuminate how psychodramatic scenes facilitate embodied, dynamic interactions that foster spontaneous and contextually adaptive responses.

This study adopts a conceptual synthesis approach, integrating literature from psychodrama theory, cognitive neuroscience, and ecological psychology to construct an interdisciplinary explanatory model. Sources were selected based on their relevance to three central constructs: spontaneity, creativity, and cognitive-behavioral flexibility. Peer-reviewed journal articles published between 2000 and 2025 were given priority. However, seminal theoretical texts were also included to establish foundational concepts. Literature searches were conducted using databases such as PubMed, PsycINFO, and Scopus, using keywords including "spontaneity", "cognitive flexibility", "affordances", "perception-action cycle", and "psychodrama neuroscience."

Rather than conducting a systematic review, this work employed an integrative theoretical synthesis strategy (Torraco 2005). This involves analyzing findings from distinct fields for conceptual convergence and reorganizing them under a unifying neuropsychodramatic model. This approach enables the articulation of a novel framework grounded in theoretical depth and supported by empirical insights from multiple domains.

Theoretical Framework

The foundational conceptualization of spontaneity in psychotherapy originates from the pioneering work of Jacob L. Moreno, the founder of psychodrama (Moreno 1953). In seminal works such as "The Theatre of

Spontaneity" and "Who Shall Survive?", Moreno introduced the Canon of Spontaneity–Creativity, defining spontaneity as the initiating force and creativity as its outcome (Fox 2006). In Moreno's theoretical framework, spontaneity refers to the ability to respond to both new and familiar situations with adequacy and originality. Creativity, in turn, emerges through purposeful, embodied actions that arise from spontaneous impulses. This duality is central to the psychodramatic process, which unfolds across three distinct phases: warming up, role enactment, and integration. Thus, spontaneity is not merely impulsivity but a regulated, context-sensitive readiness, essential for therapeutic transformation.

Moreno highlighted that spontaneity arises within the status nascendi—a generative, transitional moment where habitual roles dissolve, paving the way for new insights and behaviors. Creativity, which follows spontaneity, is expressed through symbolic dramatization and role-play. This makes psychodrama more than just a cathartic technique; it becomes a rehearsal space for resolving internal conflicts, expanding role repertoires, and transforming identities. Moreno (1953) delineated the progressive unfolding of creativity through five interconnected stages: warming-up, spontaneous responsiveness, creative state, creative action, and the subsequent stabilization of these creative outcomes as cultural conserves, which are lasting cultural artifacts that influence future creativity (Moreno 1953, Holmes and Karp 1991, Blatner 2000, Kipper and Hundal 2003). In this framework, creative behavior is not a random outcome but the structured unfolding of a spontaneity-driven process, culminating in expressive acts that integrate emotion, cognition, and embodied meaning.

Moreno's conceptualization of spontaneity has been considered problematic due to its dual representation as both an energy and a skill, which creates a conceptual ambiguity (Kipper et al. 2009). Contemporary psychodramatic theorists have addressed this ambiguity by expanding and reinterpreting Moreno's ideas to incorporate a broader spectrum of psychological processes. Yaniv (2018) conceptualizes spontaneity as moment-to-moment responsiveness transcending rigid behavioral scripts, fostering authenticity and adaptive functionality. Holmes and Karp (1991) underscore spontaneity's critical role in emotional exploration and role expansion. Blatner (2000) defines spontaneity as a focused, improvisational readiness that unleashes creativity, rather than random impulsiveness. Schacht (2007) views spontaneity as a regulatory mechanism transitioning emotional arousal to goal-directed actions, integrating motivational dynamics with intentional behaviors via the Rubicon model.

To empirically ground the study of Morenian spontaneity, the psychodrama community created psychometric instruments like the Revised Spontaneity Assessment Inventory (SAI-R, Davelaar et al. 2008) and the State Spontaneity Scale (SSS, Biancalani and Orkibi 2025), demonstrating its measurability and psychological validity in therapy. These instruments allow tracking of spontaneity changes during psychodramatic interventions. The SAI-R comprehensively assesses trait spontaneity across cognitive, emotional, and behavioral domains. Conversely, the SSS captures the fluctuating nature of spontaneity in the present moment, reflecting an individual's capacity to respond in a given situation. These tools provide the field with a more profound understanding of how psychodrama cultivates spontaneity, advancing from mere observations to evidence-based insights. Furthermore, the neuroscientific basis of psychodramatic spontaneity has recently emerged as a focal point in theoretical and empirical research.

Neuroscientific Foundations of Spontaneity

Psychodrama is a powerful therapeutic method for exploring and integrating bodily experiences within a psychotherapeutic context. It encourages a deeper dialogue between psychotherapy and embodied cognitive neuroscience (Scorolli 2019). In this context, the works of Hug (2007) and Yaniv (2018) stand out as foundational contributions toward establishing a theoretical framework for understanding the neuroscientific basis of psychodrama. Hug (2007) posited a neuroscientific framework emphasizing right-hemispheric dominance in psychodramatic techniques, introducing frontal disinhibition as a neurological process enabling spontaneous emotional and creative expression. Frydman (2016) expanded this perspective by integrating cognitive neuropsychological constructs like working memory, attention, cognitive inhibition, and theory of mind, emphasizing their significance in successful role enactment and therapeutic transformation. Yaniv (2018) further elucidated psychodrama's cognitive dynamics, describing

the interplay of top-down and bottom-up neural processes that disrupt entrenched cognitive schemas, thus enhancing neural plasticity and therapeutic efficacy. Additionally, Yaniv (2012) emphasized the neural interconnections between empathy and creativity, correlating these processes with specific patterns of prefrontal cortical activity.

Empirical neuroscientific research further supports these theoretical constructs. Lim et al. (2024) employed functional near-infrared spectroscopy (fNIRS) to demonstrate reduced left prefrontal cortex activation during psychodramatic role-play, correlating with decreased self-referential processing and heightened empathy and role flexibility. Moreover, Kipper et al. (2009) empirically connected spontaneity with executive cognitive functions, specifically cognitive inhibition, reinforcing spontaneity's centrality in adaptive psychological functioning. These studies suggest that spontaneity in psychodrama involves complex neural mechanisms, including right hemisphere-dominant frontal disinhibition, specific patterns of prefrontal cortical activation, and dynamic interactions between top-down and bottom-up cognitive processes.

While these theoretical and experimental studies offer significant insights into the neuroscientific foundations of psychodrama, they lack a framework that integrates its action-based dynamics with the spontaneity and creativity at its core. We argue that constructing a theoretical framework capable of integrating psychodrama's focus on action, spontaneity, and creativity requires drawing upon the interdisciplinary dialogue referenced above. The first of these dialogues is ecological psychology, which views perception as a process emerging directly from action; the second is cognitive neuroscience, from which we can draw inspiration through its research on cognitive flexibility—a construct that closely parallels spontaneity.

This article introduces a model, viewed from the lens of ecological psychology and cognitive neuroscience, to elucidate the psychological and neural mechanisms underlying the spontaneity-creativity process in psychodramatic action. The model's framework builds on the perception-action cycle and the affordances hypothesis of ecological psychology. First, the discussion will explore the relationship between ecological psychology and psychodramatic action. Then, it will examine how research on cognitive flexibility in cognitive neuroscience helps clarify the neural underpinnings of spontaneity and creativity. Finally, the model applies this understanding to a representative protagonist-centered psychodrama scene.

Ecological Perspective to Spontaneity: Affordances and the Perception-Action Cycle

Affordances and the perception-action cycle constitute the core hypotheses of the ecological psychology approach, which addresses organism-environment interactions holistically and relationally, conceptualizing perception and action as a dynamic process (Gibson 1979). The perception-action cycle is defined as a continuous circular flow of information between sensory and motor areas of the cortex, integrating external sensory input and motor output (Fuster 2004). According to Gibson (1986), perception is inherently action-oriented; individuals perceive environments not as passive backgrounds, but as meaningful possibilities for action. Psychodramatic action, unlike traditional verbal therapies, involves the individual not only expressing their experiences through speech but also actively enacting them on stage (Yaniv 2018). Psychodramatists regard action as the primary means for exploring the Protagonist's inner world and relational dynamics. The stage set by the Protagonist and constantly changing throughout the play provides the environment in which the Protagonist will reveal meaningful, that is, spontaneous and creative, actions. The Protagonist, who produces appropriate and meaningful behavioral responses to the dynamically changing scene, exhibits at that very moment the spontaneous behavior that Moreno (1953) describes as "non-cumulative". The process that develops between the scene and the Protagonist's action, therefore, occurs following the perception-action cycle.

Affordances represent opportunities for action that the environment offers to the subject (Gibson 1979). They bridge the gap between an individual's subjective experience and the objective properties of the environment, underscoring perception as fundamentally embodied and driven by action. Moreover,

affordances have been conceptualized not only as potential actions but also as elements that invite individuals to act (Withagen et al. 2017). The dynamics within the psychodrama stage offer affordances that facilitate the Protagonist's generation of novel and contextually appropriate responses. Psychodrama makes these affordances particularly salient through techniques such as doubling, mirroring, role reversal, and the use of surplus reality. Each time the Protagonist shifts roles, engages with a carefully chosen auxiliary ego, adopts new perspectives through mirroring, or enacts imagined scenarios via surplus reality, they generate new affordances that support the emergence of creative and adaptive behaviors within the therapeutic context. In their review, Borghi and Riggio (2015) distinguished between stable and variable affordances, proposing that some affordances arise from an object's fixed physical properties, while others change depending on the context. From this perspective, a psychodramatic scene enacted through techniques like role-play and doubling not only provides the Protagonist with action possibilities but also actively invites and draws them toward spontaneity and engagement. From this perspective, the affordances presented by a psychodramatic scene enacted through role-play and doubling not only offer the protagonist action possibilities but also actively solicit or invite the Protagonist toward action and spontaneity. Closely related to this is the perception-action cycle, a continuous reciprocal process wherein perception guides action, and actions, in turn, reshape perceptual input. This cycle is dynamic, context-sensitive, and characterized by a continual interaction between organism and environment, facilitating adaptive behaviors (Hurley 2001). In a psychodrama session, the perception-action cycle of the Protagonist unfolds dynamically and continuously, shaped by the techniques and structural elements employed. As the Protagonist engages with the scene, their ability to generate context-appropriate responses increases. To better understand the Protagonist's behavioral patterns in this environment, ecological psychology's concept of behavioral dynamics offers a valuable theoretical foundation.

According to behavioral dynamics theory—which posits that the individual and environment are interacting systems connected both mechanically and informationally—behavior is shaped by three primary forces: attractors, which are stable states toward which the system naturally gravitates; repellers, which are undesirable states the individual avoids; and bifurcations, which are critical moments where the system's behavior undergoes qualitative changes (Waren 2006). It is possible to adapt these concepts to the psychodrama scene provided as an example. The Protagonist and the enacted scenes function as dynamic systems engaged in reciprocal interaction. Within this framework, spontaneity, creativity, and adaptive behaviors emerge from a behavioral dynamic field shaped by the Protagonist's ongoing engagement. Stable behavioral patterns guide the progression of the scene, reflecting the Protagonist's efforts to resolve relational conflicts, avoid distressing emotional-behavioral states, and navigate key decision points or perspective shifts. These dynamics collectively foster the emergence of spontaneity and the creation of adaptive, creative solutions within the scene.

Neural Mechanisms of Ecological Psychology Concepts

Neuroscientific research has shed light on the neural mechanisms that underlie the perception-action cycle and affordances. The perception-action cycle is mediated by frontoparietal cortical circuits, primarily through the interaction between the prefrontal and parietal cortices, which facilitates the continuous coordination between sensory inputs and motor outputs. According to Fuster (2004), the perception-action loop involves several neural structures engaged in close functional interaction across different hierarchical levels. At the base of this hierarchy are the vegetative and visceral structures of the hypothalamus and the autonomic nervous system, primarily reflexive and automatic. The limbic structures form the mid-level component, mediating emotional and value-based processing. At the apex lies the prefrontal cortex (PFC), which is responsible for top-down executive functions, including attention set, working memory, monitoring, and inhibitory control, with support from the posterior parietal cortex (PPC), which processes perceptual information (Fuster 2004). Bidirectional connections, particularly among the PFC, PPC, sensory cortices, and motor cortices, play a critical role in perception-action integration. Studies that utilize high temporal resolution neuroimaging methods like magnetoencephalography (MEG) to probe the neural mechanisms underlying the perception-action cycle have reported prominent low-frequency and high-frequency phase synchronizations among the somatosensory cortex, frontoparietal regions, and

motor areas during perception (Hirvonen et al. 2018). These findings suggest the presence of long-range phase-locking in delta/theta and gamma bands, indicating successful integration of sensory input into decision-making and motor execution stages.

Affordances are primarily associated with the mirror neuron system and the premotor cortex (PMC), brain regions implicated in automatically encoding potential actions related to perceived objects (Thill et al. 2013). Studies suggest that action affordances create a bias that influences value-based decisions and may also function as a separate system that competes with this process. In decision-making, the expected value and contextual appropriateness of an action are integrated with a dynamic metacontrol mechanism, in which the PPC is critical (Yi and O'Doherty 2023). The cerebellum, basal ganglia, and PFC dynamically interact to facilitate simultaneous decision-making and motor control in real-time, ecologically valid tasks (Gougelet et al. 2020). Additionally, the dorsal visual stream, particularly involving the PPC, plays an essential role by directly linking visual perception to motor action possibilities, thereby providing a robust neural basis for affordances (Cisek and Kalaska 2010). Empirical evidence consistently demonstrates activation in brain regions such as the occipito-temporal junction (OTJ), inferior parietal lobule (IPl), supplementary motor area (SMA), inferior frontal gyrus (IFG), and precentral gyrus upon viewing actionable objects (Grèzes and Decety 2002). This neural activity indicates an automatic activation of motor representations triggered by visual perception, even in the absence of an explicit intention to act, thus preparing the organism for potential interactions. Reciprocal interactions between the IFl and the PMC are considered essential for encoding the action possibilities, or affordances, provided by objects (Borghi and Riggio 2015). Empirical evidence suggests that stable affordances are predominantly represented in the dorso-ventral visual stream, particularly within the inferior parietal cortex and ventral premotor areas. In contrast, variable affordances appear to be processed in higher-order regions within the dorsal stream, likely involving the superior parietal cortex and dorsal premotor cortex (Sakreida et al. 2016). Affordance-based action selection involves a neural network primarily encompassing the PPC, pre-supplementary motor area (pre-SMA), anterior cingulate cortex (ACC), ventral premotor cortex (PMv), medial prefrontal cortex (mPFC), and occipital visual areas (V3 and V4), collectively integrating affordance perception with value-based decisions through dynamic arbitration (Yi and O'Doherty 2023).

In psychodrama, spontaneity arises from the interplay between perception and action within a specific environment, which is viewed not merely as a passive backdrop but as a dynamic field of possibilities that offer "affordances" for creative exploration and transformation. Given that affordances correspond to the dynamically changing psychodramatic stage through techniques such as role reversal, mirroring, and surplus reality, it can be argued that the neural mechanisms mentioned above are activated during the Protagonist's enactment. Psychodramatic scenes exemplify rich, continuous perception-action cycles, in which participants dynamically interpret and respond to sensory cues, actively reshaping their relational environment in real-time. As stated by Hug (2007), automatic activation of the mirror neuron system and dorsal visual pathways occurs during psychodramatic enactments, facilitating spontaneous motor responses to people, objects, and spatial configurations. The parallels between these neural mechanisms underlying the perception-action cycle and affordances, and the neural dynamics observed during psychodramatic actions, are particularly noteworthy. This alignment further underscores the idea that reciprocal exchanges facilitated through psychodramatic techniques enhance the recognition of previously unnoticed potentials, thereby promoting spontaneous, adaptive, and creative behaviors (Moreno 1953, Yaniv 2018). It can therefore be asserted that affordances and the perception-action cycle—mediated by neural mechanisms involving the mirror neuron system, premotor and posterior parietal cortices, as well as frontoparietal circuits modulated by the basal ganglia—form the neurobiological foundation underpinning psychodrama's emergent spontaneity and creativity. They achieve this by dynamically linking embodied perception with context-sensitive adaptive behaviors.

The perception-action cycle and affordances offer a robust theoretical framework for exploring the neural mechanisms that facilitate spontaneity during psychodramatic enactments. To further delve into the neural foundations of spontaneity, this study will examine relevant insights from cognitive and behavioral neuroscience research on cognitive and behavioral flexibility. As discussed in the following sections, the concepts of cognitive flexibility and spontaneity exhibit significant conceptual overlaps. Furthermore,

when cognitive flexibility is viewed not merely as an ability but as an intrinsic property of the cognitive system, it emerges as a feature of cognitive processes themselves, arising from the dynamic interplay of internal mechanisms and their interactions with external contextual elements (Grajzel et al. 2023). Given that spontaneity, like cognitive flexibility, manifests through the interaction of internal and external contextual factors, the theoretical framework's coherence with affordances and the perception-action cycle offers a valuable perspective for this investigation.

Spontaneity and Cognitive/Behavioral Flexibility

Experimental studies indicating that psychodrama enhances cognitive flexibility suggest a potential connection between this effect and spontaneity (Çataldaş et al. 2024). In contemporary psychological science, cognitive and behavioral flexibility, along with creativity, are recognized as fundamental mechanisms underlying therapeutic change across diverse psychotherapeutic approaches (Kashdan and Rottenberg 2010). Cognitive flexibility is broadly defined as the mental ability to switch between thinking about different concepts or to shift attention between tasks based on context (Uddin 2021). In contrast, behavioral flexibility refers to the adaptive change of behavior in response to changing environmental contingencies (Raggozino 2007). In practice, these constructs often overlap; for example, most cognitive flexibility tasks necessitate a behavioral adjustment, and most flexible behaviors imply some degree of cognitive shift. Both types of flexibility are considered essential for resilience and adaptive functioning in daily life, supporting problem-solving, emotion regulation, and creative ideation (Ionescu 2011). Empirical evidence indicates that cognitive flexibility mediates creative processes (Zabelina and Robinson 2010, Wu and Koutstaal 2020). This role closely parallels spontaneity in psychodrama, where it is also seen as a catalyst for creativity (Moreno 1953).

Spontaneity and cognitive flexibility share significant conceptual overlap, as both constructs emphasize adaptive responsiveness, openness to novel experiences, and the capacity to shift perspectives or behaviors fluidly in response to changing contexts (Ionescu, 2011, Yaniv, 2018). However, while both emphasize adaptability, they differ in scope and emphasis: spontaneity prioritizes originality and is directly linked to creativity within psychodrama, incorporating emotional and relational dimensions. Cognitive flexibility, in contrast, primarily involves the ability to adapt existing strategies for broader application and is often assessed through structured cognitive tasks. Moreover, psychodrama emphasizes experiential action and interpersonal engagement, whereas cognitive flexibility remains rooted in cognitive processes and executive functioning. Indeed, spontaneity, as defined by Moreno (1953), inherently incorporates aspects central to cognitive flexibility, such as dynamic adaptation, innovative responses, and context-sensitive actions. Although these constructs are theoretically interconnected, researchers have mainly examined their neurocognitive foundations in isolation. Integrating these research areas—particularly through the examination of the neural correlates of cognitive flexibility—offers a promising avenue to illuminate the neurobiological foundations of spontaneity. Such integration could enhance our understanding of the unified neural mechanisms that support adaptive creativity, especially within psychodrama and broader psychosocial contexts.

Neural Correlates of Cognitive Flexibility

Cognitive flexibility—typically assessed through tasks that require shifting mental sets or rules—has been widely studied in relation to executive functions such as set shifting, knowledge updating, and working memory monitoring to inhibit context-inappropriate responses (Uddin, 2021). These cognitive operations closely resemble key psychodramatic processes, where spontaneity plays a central role in therapeutic transformation (Kipper et al., 2009; Frydman, 2016). Neuroimaging studies have shown that set shifting, working memory updating, and inhibitory control involve the lateral prefrontal cortex, parietal cortex, mid-cingulate, and insular regions (Niendam et al., 2012). The inhibition of conventional task sets—critical for disengaging from outdated rules—is supported by the anterior frontal gyrus and adjacent subfrontal pathways (Aron et al., 2014).

Functional studies have demonstrated that areas associated with cognitive flexibility, such as the lateral fronto-parietal network (also known as the executive central network), the mid cingulo-insular network (also known as the salience network), and the medial fronto-parietal network (also known as the default mode network), are active during cognitive flexibility tasks (Kupis et al. 2021, Uddin 2021). Together with creativity, cognitive flexibility has been increasingly understood as an emergent property of these large-scale brain network dynamics involving the ECN, SN, and DMN (Beaty et al. 2019, Kupis et al. 2021, Uddin 2021, Cole 2024). Dynamically interacting, these networks collectively facilitate cognitive flexibility by integrating internal thought processes, external stimulus evaluation, and goal-directed cognitive control. The ECN, primarily consisting of interconnected regions in the frontal and parietal cortices, plays a crucial role in goal-directed cognition, decision-making, working memory, cognitive flexibility, attention shifting, and adaptive control. In contrast, the DMN is involved in internally focused processes such as mind-wandering and self-referential thought (Menon 2023). The DMN consists of brain regions such as the mPFC, posterior cingulate cortex (PCC), precuneus, angular gyrus, and hippocampus, and is most active during rest or introspection. It contributes to self-referential thought, episodic memory retrieval, and social cognition. The interplay between the DMN and ECN is crucial for creativity, enabling both the generation of novel ideas and their subsequent evaluation and implementation.

Furthermore, activity in the IFG, characterized by the activity of mirror neurons, is associated with imitation and understanding others, inhibiting inappropriate reactions, and evaluating the appropriateness and originality of ideas (Pick et al. 2025). In line with Yaniv's (2018) emphasis on bottom-up processes in spontaneity, the TPJ facilitates bottom-up processing and enhances cognitive flexibility through perspective-taking and schema updating, while the IFG appears to regulate top-down inhibitory control (Kupis et al. 2021). The SN primarily comprises the anterior insula (AI) and dorsal anterior cingulate cortex (dACC), along with functionally associated regions including the TPJ, amygdala, ventral striatum, and ventral tegmental area. Meta-analytic brain imaging research has demonstrated that the dACC and AI, which are integral components of the SN, are responsible for emotion and behavior regulation, functioning as crucial hubs for self-regulatory processes due to their widespread and efficient connectivity patterns (Zhang and Peng 2023). These insights highlight the significant role of these brain regions in enabling adaptive behaviors. Specifically, the SN monitors both internal and external stimuli, identifying salient events that demand attentional resources and initiating transitions between the DMN and ECN. fMRI studies indicate that the SN, particularly the anterior insula and anterior midcingulate cortex, is activated in conjunction with the ECN during task switching and set shifting, which is critical for task initiation and monitoring. Moreover, sliding-window connectivity and Hidden Markov model analyses have revealed that the dynamic connections within the SN can predict individual levels of flexibility, with more flexible individuals exhibiting more frequent transitions to frequently repeated brain states (Uddin 2021). By detecting emotionally and cognitively significant information from both the external environment and internal bodily states, the SN prioritizes this information by signaling its relevance to the brain. Consequently, cognitive control processes are initiated, including attention allocation, motor planning, and decision-making, particularly in contexts involving task-switching, adaptive responses, and rapid or urgent decision scenarios (Cole 2024).

Towards a Neuro-Psychodramatic Model

In psychodrama, the neural dynamics underlying spontaneity and creativity can be effectively explained through the interactions between the DMN, ECN, and SN. At the outset of a protagonist-centered psychodrama scene, the DMN becomes prominently activated as the Protagonist engages in introspection, self-referential thought, and emotional memory retrieval processes central to the initial stages of psychodramatic enactment. During this phase, regions such as the mPFC, PCC, precuneus, angular gyrus, and hippocampus facilitate the Protagonist's inward focus and creative imagination. As the Protagonist transitions into the enactment phase, the SN is activated by environmental cues and emerging affordances during role-play scenarios. Primarily through its core hubs—the AI and dorsal anterior cingulate cortex (dACC)—the SN detects emotionally and cognitively significant cues, dynamically evaluating external inputs and internal bodily sensations to signal their relevance and prioritize the most salient affordances for

action. Following the SN's salience signaling, the ECN is recruited to mediate cognitive control, goal-directed behavior, and adaptive decision-making, defined here as the capacity to evaluate options, update strategies, and select context-appropriate actions in response to dynamic and uncertain environmental demands.

As psychodramatic enactments unfold, the lateral prefrontal and parietal cortices within this network become active, facilitating cognitive flexibility, set-shifting, and working memory updating, all necessary for spontaneous creative responses. This neural activation enables the Protagonist to disengage from conventional or rigid behavioral scripts and adaptively explore novel behavioral alternatives within the psychodramatic space. Throughout the enactment, continuous interactions between the DMN and ECN are closely monitored by the SN, which acts as a regulatory hub. The SN sustains attention, monitors task relevance, manages emotional reactions, and initiates necessary motor plans and decision-making processes, ensuring ongoing coherence between internal and external demands. This integrated tri-network interaction thus supports the emergence and maintenance of spontaneous creative responses, empowering protagonists to experiment, adapt, and ultimately enact therapeutic change.

The Integrated Neuro-psychodramatic Model of Spontaneity–Creativity Canon in Psychodrama

The integrated neural model illustrates how psychodramatic enactments realize the spontaneity–creativity canon through the perception–action cycle. At its core, the model highlights a continuous interplay: the Protagonist perceives the psychodramatic scene, engages with the affordances provided by psychodramatic techniques, and performs corresponding actions (Figure 1).

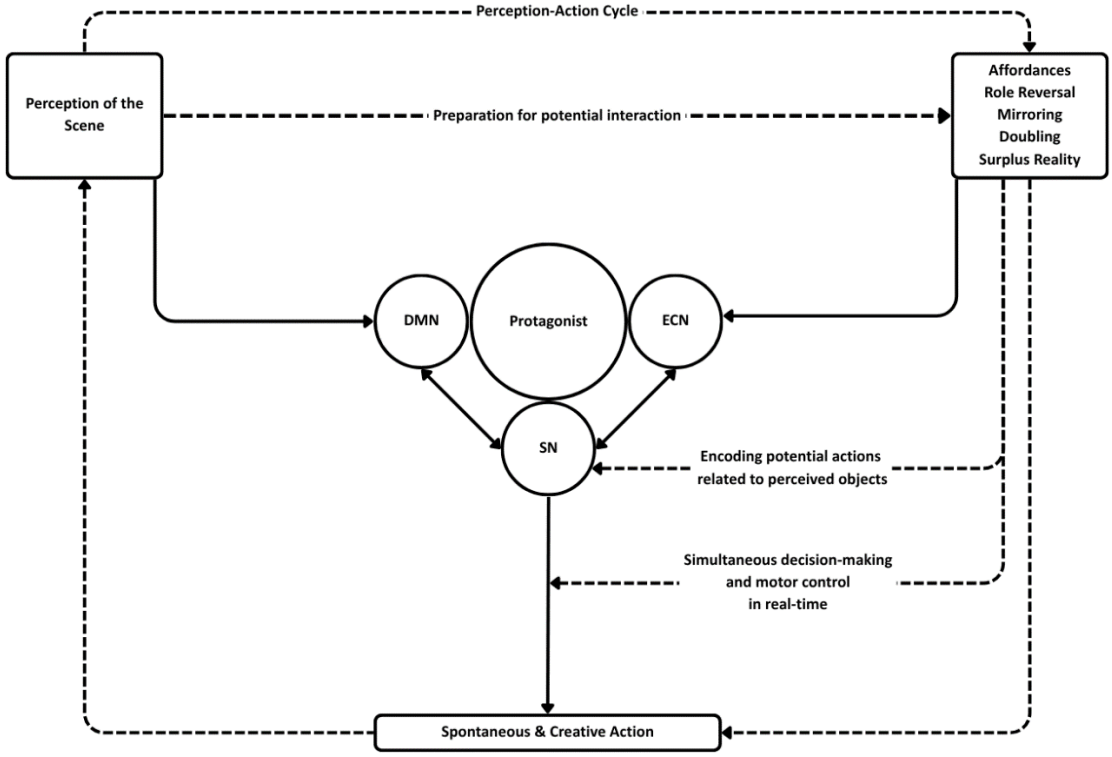

Figure 1. Integrated neural mechanisms of spontaneity and creativity in psychodrama

DMN: Default-Mode Network, ECN: Executive Control Network, SN: Salience Network

In this diagram, solid lines represent components rooted in cognitive neuroscience, while dashed lines signify elements derived from ecological psychology.

The Protagonist represents the acting individual engaged in a psychodramatic or interactive scene.

The Perception of the Scene refers to the initial awareness and sensory processing of the environment, which feeds into both the neural networks and affordance-related mechanisms.

The DMN is involved in self-referential thought, mental simulation, and autobiographical memory. The ECN contributes to goal-directed behavior, planning, and cognitive control.

The SN plays a critical role in detecting salient stimuli and mediating the switch between the DMN and ECN.

Core techniques of psychodrama—such as Role Reversal, Mirroring, Doubling, and Surplus Reality—facilitate the emergence of Affordances. These elements influence perception by shaping the action possibilities available to the Protagonist in the given context.

The Spontaneous & Creative Action block represents real-time behavioral output that emerges from the integration of perception, neural processing, and ecological interaction.

The Perception–Action Cycle completes as this action reshapes the scene and renews the perception, enabling a dynamic feedback loop.

The figure illustrates how potential actions are encoded concerning perceived objects, how decisions and motor control are executed simultaneously in real-time, and how preparation for interaction emerges through the coordination of both internal (neural) and external (environmental) processes.

Perception of the Scene

The model begins with the Protagonist's perceptual processes regarding the psychodramatic scene. During this phase, the Protagonist actively engages with sensory information perceived from the psychodramatic environment (e.g., the stage, roles, physical space). The perception-action cycle continuously renews itself, shaping the Protagonist's potential for interaction within the psychodramatic setting.

Role of the DMN

Upon engaging with the scene, the DMN is activated, prompting the Protagonist to focus inwardly and elicit past experiences, emotional memories, and reflective thoughts. Consequently, the DMN mobilizes the internal creative resources essential for psychodramatic spontaneity.

Interaction Between Affordances and the ECN

Within the psychodramatic process, affordances represent scene-based opportunities that directly influence the Protagonist's actions. These affordances stem from the Protagonist's perceptions of the scene and the interactive potentials they create. The SN detects and prioritizes these potentials, subsequently communicating them to the ECN. Following this, the ECN activates cognitive control functions, such as directing attention, updating working memory, and shifting mental sets, thereby preparing the Protagonist cognitively for spontaneous and creative actions.

Integrative Role of the SN

The SN assumes a central integrative role within the model, continuously monitoring the Protagonist's internal and external stimuli and encoding the scene's affordances to contextualize potential actions and select appropriate behaviors. In this process, the SN's primary function is to mediate transitions between the DMN and ECN, simultaneously managing the real-time decision-making and motor planning processes necessary to initiate spontaneous, creative actions within the scene.

Spontaneous and Creative Action

Spontaneous and creative actions emerge through the coordinated interaction of these networks. Content arising internally from the Protagonist's DMN activity combines with externally provided affordances, cognitively prepared by the ECN. Continuous monitoring and regulation of these interactions by the SN

enable the Protagonist to manifest adaptive, innovative, and therapeutically meaningful behaviors on the stage, thus facilitating cognitive flexibility.

Finally, executed actions are integrated back into the perception system through sensory-motor processing, engaging frontoparietal networks and perpetuating the perception–action loop. This iterative cycle, which features ongoing neural interaction across the DMN, ECN, SN, and affordance-sensitive circuits, is fundamental to psychodrama's capacity to stimulate and sustain spontaneous, creative behaviors conducive to therapeutic outcomes. To illustrate the functioning of the proposed model, the following section provides a brief psychodramatic enactment scenario.

"The Protagonist addresses a recurring conflict with their partner, characterized by repetitive arguments. Initially feeling emotionally stuck, the Protagonist seeks new solutions through enhanced spontaneity and creativity. After a brief warm-up, the Protagonist verbalizes the conflict while physically walking alongside the director, activating embodied memory. The Protagonist then vividly recreates the conflict, selecting group members as auxiliary egos to represent their partner and themselves, fostering interpersonal resonance. Role reversals and perspective shifting allow empathy and multiple possible responses to emerge. When emotional blockage occurs, the Protagonist reconnects with a related childhood memory, using bodily cues to recall unresolved experiences. Re-enacting these memories through surplus reality and mirroring techniques facilitates emotional catharsis. Returning to the initial scene empowered, the Protagonist tests newly discovered behavioral strategies, observing their partner's reactions until finding a satisfying resolution. The scene concludes as the Protagonist integrates this adaptive response into their everyday interactions."

The described psychodramatic enactment, following the outlined theoretical framework, can be systematically analyzed through the integrated neuro-psychodramatic model, which elucidates the neural underpinnings of spontaneous and creative therapeutic outcomes.

During the initial perception phase, the Protagonist actively engages in sensing the psychodramatic environment by utilizing robust frontoparietal sensory-motor networks to process visual cues from the stage, auditory inputs from dialogues, and proprioceptive feedback from bodily movements. This perceptual engagement activates the DMN, stimulating introspective reflection on personal memories, emotional responses, and cognitive schemas related to the recurring conflict. The embodied memory activation, initiated through physical walking alongside the director, highlights the DMN's role in internally retrieving and revisiting emotionally charged episodic memories, which are essential for subsequent creative insight.

When the Protagonist selects auxiliary egos to enact the conflict, the affordances inherent in psychodramatic techniques become prominent, presenting actionable opportunities shaped by perception of the ongoing scene. These affordances, revealed through techniques such as role reversal and mirroring, are detected and evaluated by the SN, which assigns emotional and cognitive significance to them. The SN then sends prioritized signals to the ECN, initiating cognitive adjustments, including shifting attention and updating working memory, which are essential for adapting to the dynamic demands of ongoing psychodramatic interactions. During moments of emotional blockage, the Protagonist accesses childhood memories using bodily cues, demonstrating a dynamic interplay among the DMN, SN, and ECN. Surplus reality techniques then allow the Protagonist to creatively reconstruct past experiences, embodying unresolved emotional states within an enriched psychodramatic context. These actions reflect ECN-directed cognitive flexibility, enabling the Protagonist to disengage from previously rigid interpretations and responses to emotional conflicts. The SN's integrative monitoring ensures smooth transitions between internally generated reflective content from the DMN and externally offered affordances, maintaining adaptive coherence throughout the enactment.

The spontaneous and creative actions emerging from this integrated neural activity lead to the Protagonist testing new behavioral strategies within the initial conflict scenario. This stage exemplifies how adaptive creativity is embodied and facilitated through affordance-sensitive psychodramatic enactment. Through iterative perception–action cycles, the Protagonist dynamically adjusts behaviors based on real-time feedback from auxiliary egos representing their partner. This neural coordination, continuously monitored

and updated by the SN, enables real-time decision-making, emotional regulation, and creative problem-solving, fostering effective resolution of previously repetitive and unresolved conflicts.

Finally, the successful integration of adaptive responses into the Protagonist's everyday interactions demonstrates the lasting therapeutic impact of psychodramatic spontaneity and creativity. Neurobiologically, this integration corresponds to the reinforcement of neural pathways, which are formed through repeated engagement in adaptive perception–action loops mediated by interactions among the DMN, SN, ECN, and affordance-related networks. This neural consolidation underpins sustainable behavioral and emotional changes, highlighting the therapeutic potency of the proposed neuro-psychodramatic model.

Implications for Empirical Testing and Methodology

The proposed neuro-psychodramatic model comprises both measurable and observable components. Observable components include therapist- or observer-rated in-session behaviors such as role reversals, creative enactments, and emotional responsiveness. These observable elements also allow for the examination of how affordances for creative behavior emerge and are actualized through spontaneity, ultimately leading to creative action. To empirically validate the measurable components of the neuro-psychodramatic model, a multimodal research design integrating both behavioral and neurophysiological measures is recommended. Behavioral assessment tools such as spontaneity scales (e.g., SAI, SSS) and cognitive flexibility tests (e.g., Wisconsin Card Sorting Test, Stroop Test), and inventories can be employed to capture psychological constructs central to the model. In parallel, neuroimaging techniques—especially EEG-based functional connectivity (FC) analyses—offer a non-invasive, temporally precise method to investigate the dynamic interplay among large-scale brain networks implicated in spontaneity. As detailed in recent literature, FC metrics such as phase-locking value, coherence, and graph-theoretical indices can quantify reorganization of brain networks during spontaneous behavior and enactment-based interventions (Khaleghi et al. 2024). These techniques, when combined with structured psychodramatic tasks in experimental or clinical settings, can offer compelling evidence supporting the neural mechanisms underlying spontaneity, creativity, and therapeutic change. Furthermore, longitudinal EEG studies could effectively track neuroplastic adaptations resulting from consistent psychodramatic engagement. Overall, this integrated approach aims to bridge subjective therapeutic outcomes with objective neural data, facilitating a rigorous validation of the proposed model's mechanisms.

A key implication of the neuro-psychodramatic model is its potential to promote neuroplasticity, the brain's capacity to reorganize its structure and function in response to experience. Through the repeated enactment of new roles, emotional expressions, and relational reprocessing, psychodrama can foster long-term changes in neural networks. These changes are associated with improved cognitive-emotional regulation and enhanced behavioral flexibility. Significantly, in clinical contexts, the expression and development of spontaneity may vary across patient populations. For example, in individuals with trauma-related disorders (e.g., PTSD), spontaneity is often suppressed due to hypervigilance and emotional dysregulation (Tarashoeva et al. 2017). Structured use of psychodramatic techniques such as role reversal, doubling, and surplus reality can help restore spontaneous responses by creating a safe space for corrective emotional experiences. Empirical findings have shown that psychodrama significantly increases spontaneity in clinical settings—e.g., up to 31.08% increase reported in inpatient trauma treatment settings—while also contributing to reductions in PTSD, depression, and anxiety symptoms (Orkibi and Feniger-Schaal 2019, Giacomucci and Marquit, 2020). These findings indicate that spontaneity is both a measurable and clinically modifiable variable, suggesting its potential to inform intervention strategies across various psychiatric conditions. Longitudinal studies are necessary to fully explore the long-term neuroplastic effects of psychodrama on spontaneity and creativity, as well as to analyze how individual differences influence therapeutic outcomes. Methodological clarification of how affordances can be defined, measured, and utilized within clinical psychodrama settings should be pursued, accompanied by process-oriented studies investigating the perception-action cycle.

Research exploring the neurocognitive impacts of social interactions and group dynamics through social neuroscience techniques (e.g., EEG hyperscanning) is necessary to understand the effects of group synchronization on spontaneity and creativity. Neuropsychodramatic intervention protocols derived from this model should be developed and evaluated through randomized controlled trials to assess clinical efficacy.

Comparative studies of psychodrama with other psychotherapeutic approaches, such as cognitive-behavioral therapy, Gestalt therapy, and mindfulness-based therapies, should be conducted, integrating innovative neuroscientific technologies (e.g., VR, fNIRS). Furthermore, cross-cultural validity studies and detailed investigations of emotion-cognition-body interactions within psychodramatic processes will further enrich future research directions in this field.

Conclusion

This article introduces an integrated neuro-psychodramatic model that elucidates the neural and psychological mechanisms underpinning spontaneity and creativity in psychodrama. By synthesizing ecological psychology's concepts of affordances and the perception-action cycle with cognitive neuroscience's findings on cognitive and behavioral flexibility, this integrative framework offers a nuanced understanding of psychodrama's therapeutic efficacy. Specifically, the dynamic interplay among the DMN, ECN, and SN, regulated through perception-action processes and affordances, emerges as central to facilitating spontaneous and creative actions within psychodramatic contexts.

This neuro-psychodramatic model enhances theoretical clarity by articulating a coherent neuroscientific account of psychodrama's core processes: spontaneity and creativity. It demonstrates that psychodrama's therapeutic effectiveness is deeply rooted in embodied perception-action interactions, which enable adaptive cognitive and behavioral shifts supported neurologically by dynamic network interactions. Crucially, the model emphasizes the role of affordances as active solicitations toward spontaneous and adaptive responses, thus providing a powerful theoretical lens for understanding psychodrama's unique experiential and relational characteristics.

Despite its theoretical comprehensiveness, this model has certain limitations. While it establishes a theoretical integration linking psychodrama with neuroscience and ecological psychology, specific neurocognitive hypotheses require further empirical validation through methods like EEG, fNIRS, or behavioral experiments. The inherent complexity of psychodrama, with its multitude of interacting variables, poses challenges in isolating specific neural mechanisms for empirical research. Furthermore, the existing neuroscientific evidence, while promising, relies predominantly on extrapolations from related cognitive tasks and general neuroimaging studies, rather than direct observations of psychodramatic enactments. This indirect evidence limits the specificity with which the proposed neural dynamics can be definitively attributed to psychodrama. Moreover, the reliance on general cognitive neuroscience constructs, such as cognitive flexibility, may oversimplify the nuanced nature of spontaneity as conceptualized in psychodrama, potentially overlooking emotional, relational, and contextual dimensions that extend beyond the scope of standard cognitive tasks.

In conclusion, the proposed integrated neuro-psychodramatic model provides a robust theoretical foundation for understanding psychodrama's mechanisms of action, highlighting fruitful avenues for interdisciplinary research and therapeutic innovation. By systematically exploring these neural and psychological processes, future investigations can significantly advance psychodrama's theoretical sophistication and practical effectiveness, firmly situating it within contemporary neuroscientific and ecological psychological discourse.

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