Play as a neural exercise: Insights from the Polyvagal Theory

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We often think of play as an amusement or a diversion from the "real" work in our lives. When we observe children playing, we might judge the time engaged in play as a distraction from opportunities to learn. This view, denigrating play and revering classroom learning opportunities, is consistent with our cultural view of education. Educational systems attempt to maximize opportunities for classroom instruction and to minimize opportunities for social interactions available during recess and other interactive forums such as team sports, music, and theater. From an educator's perspective, play is the antithesis of learning; play steals the precious time that could be dedicated to learning. This perspective is based on assumptions derived from learning theories that were outlined by behaviorists about 100 years ago. What if this perspective, prevalent in our society, is outdated? What if play, rather than displacing learning experiences, actually provides a neural exercise that would facilitate learning?

Is our conceptualization of play inadequate? Are our views of play restricted interpretations dependent on a limited understanding of learning embedded in our educational institutions, parenting styles, and expectations of socialization? Can we take a different perspective and emphasize that play provides opportunities to exercise features of our nervous system that would foster learning and social behavior? If play were perceived from this perspective, then play, as a neural exercise, might foster state regulation, enabling individuals to transition efficiently from active to calm states. Consistent with this perspective, the ability to move rapidly into a calm state would facilitate efficient learning and optimize spontaneous and reciprocal social behavior.

The importance of play is dismissed in the cognitive-centric world of education. Within theoretical models of learning, little importance is placed on how bodily feelings, as an intervening variable, influence the ability to learn. Although we may want to sit and attend, at times our body may want to run, fight, or hide. Calmly sitting enables us to attend and to efficiently learn. However, when our body wants to run, fight, and hide, we are in a physiological state that supports defense. During these physiological states, neural feedback from our body to the higher brain structures will interfere with cognition and learning. Missing from the cognitive-centric perspective is the role that play may have in strengthening the neural circuits that can rapidly down regulate defense systems to foster learning by enabling us to sit calmly and attend.

The roots of play are linked to the evolution of a neural mechanism that enables mammals to shift between mobilized fight/flight and calm socially engaging states. From an evolutionary perspective, mammals had to rapidly detect whether a conspecific was safe or dangerous. If the interaction was dangerous they needed to be in a physiological state that would produce sufficient energy to defend (fight) or facilitate an instantaneous escape (flight). If the interaction had cues of safety, then the physical distance could be reduced and physical contact might ensue and terminate with mating behaviors.

To mate or to be in close contact with a conspecific, defense reactions have to be inhibited before cues of aggression or fear are expressed. An immediate decision has to be made to distinguish potential mate from potent threat. This process was so important to survival of both the individual and the species that the neural mechanisms were subjugated to brain processes outside the realm of conscious awareness.

Within the context of the Polyvagal Theory, the instantaneous process of evaluating risk outside the realm of awareness is called neuroception. Neuroception is the neural process through which our body reacts to features in the environment and shifts physiological state to deal with potential risk. Neuroception is not perception, because the process does not require awareness. If the cues trigger a neuroception of safety, our physiological state calms immediately, then we can easily socially engage or attend. If the cues trigger a neuroception of danger, our body prepares for movement. If the cues trigger life threat, then we lose social contact and immobilize. Although we are not aware of the "stimuli" that trigger our sense of danger or safety, we can become aware of our bodily responses triggered by neuroception. Thus, the cues from our body influence our personal comfort, which will vary as contexts and interactions with people change.

Functionally, play is a neural exercise in which cues triggering neuroception alternate between danger and safety. As an example, we can think of the simple game, peek-a-boo, that a mother may play with her infant. By hiding her face and removing the cues of safety normally generated by the social engagement system (prosodic voice, facial expressions), the mother is creating a state of uncertainty in the infant. This state of uncertainty is followed by the mother startling the infant by showing her face and saying "peek-a-boo!" The sequence of the peek-a-boo game is ended, when the mother uses a prosodic voice with warm facial expressions to calm the startled infant.

Deconstructing the behavioral sequence involved in "peek-a-boo," we see the neural exercise embedded in this play behavior. First, the initial hiding of the mother's face elicits a state of uncertainty and vigilance. This state is associated with a depression of the infant's social engagement system including a withdrawal of the myelinated vagal pathways to the heart. This puts the infant in a vulnerable state in which a "startle" stimulus could easily recruit sympathetic activity to support mobilization (i.e., fight/flight behaviors). The mother provides the startle stimulus by showing her face and stating "boo" in a relatively loud and monotonic voice. The acoustic features of the mother's vocalizations support the unpredictable presentation of the mother's face, since the vocalizations of "boo" have acoustic features that are associated with danger and lack the prosodic features that would be calming. The cues of this sequence trigger a neuroception of danger, which recruits increased sympathetic activation. The next step in the sequence of this game provides the opportunity for a neural exercise that would promote resilience and enhance the infant's ability to calm.

After the infant is motorically and autonomically activated by the "boo," the mother needs to calm the infant with her social engagement system using a prosodic voice with warm facial expressions. The prosodic voice and warm facial expressions trigger a neuroception of safety and the infant calms as the social engagement system comes back online and the myelinated vagal pathways down regulate the sympathetic activity. When effectively implemented, "peek-a-boo" provides opportunities for the infant to "neurally navigate" through a sequence of states (i.e., from calm, to vigilant, to startle, and back to calm). Repeating this game provides opportunities for the social engagement system to efficiently down regulate, via social interactions, sympathetic activation. The child will need this "neural" skill to adapt in the classroom. In fact, the ability to have the neural resources to regulate biobehavioral state is as important as IQ and motivation in predicting classroom performance.


> We as mammals have a social engagement system that evolved to employ cues from face-to-face interactions to efficiently calm our physiological state and shift our fight/flight behaviors to trusting relationships.

Kittens playing provide a translatable example. I recall what I had been taught about the play of cats and other mammals in graduate school. In courses in comparative psychology and animal behavior we were taught that kittens were practicing their hunting and aggressive skills. However, when I revisited these images from a Polyvagal perspective, the behaviors may have served another purpose. Visualize kittens playing, they are in bouts of rough and tumble play. They are using their claws and teeth, but rarely will injure each other. In fact, if you have a kitten you may be surprised that they know when to retract their claws and relax their jaws once they make a gentle bite. However, an extremely important feature often goes unnoticed. The kittens maintain face-to-face interactions during most of the "play." If a bite hurts, there is an immediate face-to-face interaction in which their social engagement systems interact and they cue each other that there was no intention to injure. But kittens, like children, vary in their ability to be aware of the other in a play scenario. If the awareness of other is poor, then injury may occur. In primate social groups, the juveniles who enthusiastically engage but, due to a lack of awareness of other, may injure peers are ostracized and marginalized from social groups.

Similar "play" sequences occur with dogs. Dogs will play a structured game of chase. One dog runs and is chased by another. When the dog chasing catches the other dog, the dog may bite the rear leg to inform the dog being chased that it is caught. The caught dog turns towards the other dog to initiate a face-to-face interaction to determine whether the "bite" was aggressive or play. If it is play the two dogs interact via their social engagement systems (i.e., face to face) and then the game continues with a role reversal. If it is aggressive, then face-to-face is replaced with a face to neck attack.

We can observe similar situations on the playground. For example, when playing basketball, players are often shoved and fall. If the social engagement system is employed following this event, aggressive behaviors will be dampened. For example, aggression is defused, if the person, who did the shoving, makes eye contact with the person on the floor, helps the other person off the floor, and asks if the person is OK. However, a fight might be triggered, if the person who did the shoving just walks away. In my talks I use an example from a professional basketball game in which this sequence results in a fight between Larry Bird and Julius Irving (Dr. J.).

By deconstructing the play of mammals, whether we are observing kittens, dogs, or children on the playground, we see a common feature of behaviors that simulate features of fight/flight that are actively inhibited by social engagement behaviors (e.g., facial expressions, head gestures, prosodic vocalizations). In the examples above we can see that play transitions into aggressive behaviors, if the social engagement systems are not employed to down regulate any potential neuroception of danger.

The process of play is about active inhibition of the neural circuit that promotes fight/flight behaviors. Play functions as a neural exercise that improves the efficiency of the neural circuit that can instantaneously down regulate fight/flight behaviors. If we translate this into the classroom, we can identify children with difficulties in down regulating the neural circuits that promote fight/flight behaviors. These children have difficulties in sitting, in attending, in listening, and in socializing. If we watch these same children on the playground, we might see deficits in their ability to play with others. They may not accurately anticipate the behaviors of others and instead of a reciprocal interaction in which there is reciprocal inhibition of fight/flight behaviors, they may functionally be physically bouncing off their peers.

When we are in neurophysiological states supporting mobilization and shutdown, our cognitive processes are greatly compromised. However, we have a neural circuit that can rapidly down regulate mobilization behaviors to foster the calm states that optimize learning and social behavior. Although play is frequently characterized by movement and often recruits many of the neural circuits involved in fight/flight behaviors, it may be operationally distinguished from defense, since it is easily down regulated by the social engagement system. However, the effectiveness of the social engagement system to down regulate fight/flight behaviors requires practice. This practice may start early in a child's development through play.

In this paper the definition of play requires reciprocal and synchronous interactions using the social engagement system as a "regulator" of mobilization behavior (e.g., fight/flight). This definition of play may differ from the world in which play is used to describe interactions between an individual with a toy or computer. Play with a toy or computer lacks face-to-face interactions and will not "exercise" the social engagement system as a regulator of the neural circuits that foster fight/flight behaviors. Thus, as mammals, we need to respect our phylogenetic heritage and appreciate the importance of synchronous face-to-face interactions as an opportunity to exercise our social engagement systems. As the neural regulation of our social engagement system improves, we gain resilience in dealing with disruptions in our lives. Many of the features of play are shared with psychotherapy. A deconstruction of a therapeutic session will find the client (and often the therapist) shifting states from calm to defense and back to calm. Fortunately, we as mammals have a social engagement system that evolved to employ cues from face-to-face interactions to efficiently calm our physiological state and shift our fight/flight behaviors to trusting relationships.

Stephen Porges, PhD is a Research Professor in the Department of Psychiatry at the University of North Carolina at Chapel Hill. His work on the autonomic nervous system and development of Polyvagal Theory has led to a new understanding of mechanisms involved in behavioral regulation and social engagement behaviors, and the key importance of neuroception, and influences clinicians in a range of healing professions. In addition to his major theoretical contributions, he has advanced scientific measurement of biobehavioral variables. This chapter is a preview from an upcoming book; a collection of his research is available in his first book, *The Polyvagal Theory*. Dr. Porges speaks throughout the world about Polyvagal Theory and its applications to typical and clinical populations. His website has great resources, including articles, videos, podcasts, measures, and an invitation to share your story about how the theory has helped you personally or professionally.