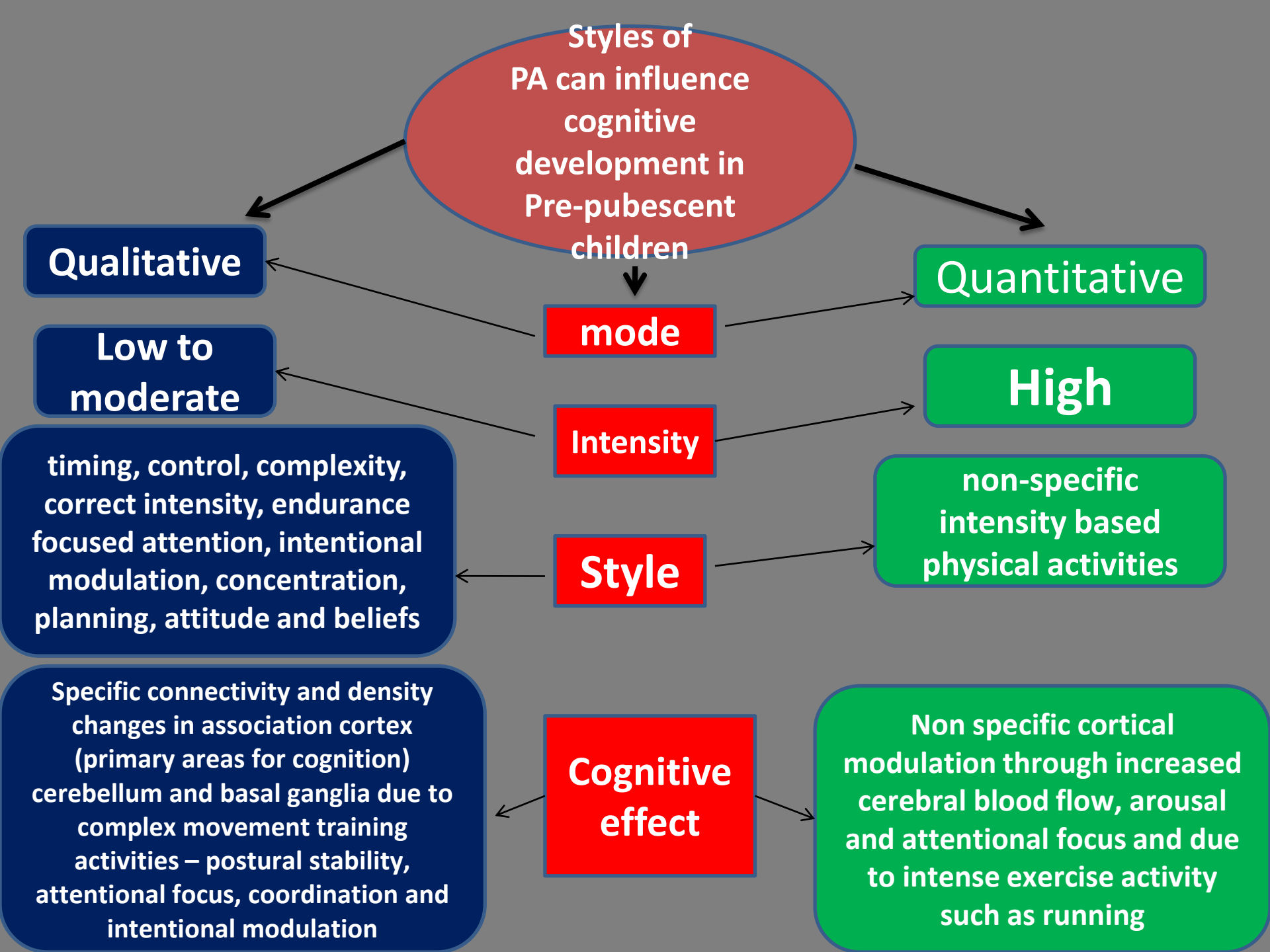


# Physical Activity and Cognitive Development

- ❖ From birth through early development interactions between environment and genes create prolific neural complexities in conjunction with biological growth influencing a dynamic construction of expanding functional competencies<sup>1,2</sup>.
- ❖ A Cascading Epigenesis<sup>3</sup> characterised by Variation and Variability in Development<sup>1</sup> and association with Neural Darwinism<sup>2</sup>.
- ❖ Development appears stage<sup>4</sup> like but has much inter-individual variation<sup>1</sup> LEADING TO THE POSSIBILITY OF IDSE and UU strategies<sup>5,6,7,8,9,10</sup> in EARLY ADULTHOOD and is proposed to be a foundational process in the unique qualities of human cognition<sup>11</sup>.
- ❖ PA is considered a foundational experience directing the dynamic construction of human cognitive skill



experience

Prolonged  
pre-  
pubescent  
neurogenesis

environment

Unlock and  
unlink

## Qualitative Style of PA

individual  
domain  
specific  
expertise  
(IDSE)

BOTTOM UP  
Disentanglement  
and Sensory  
Integration

INTERMEDIATE  
Sub cortical Nuclei  
and Cognition

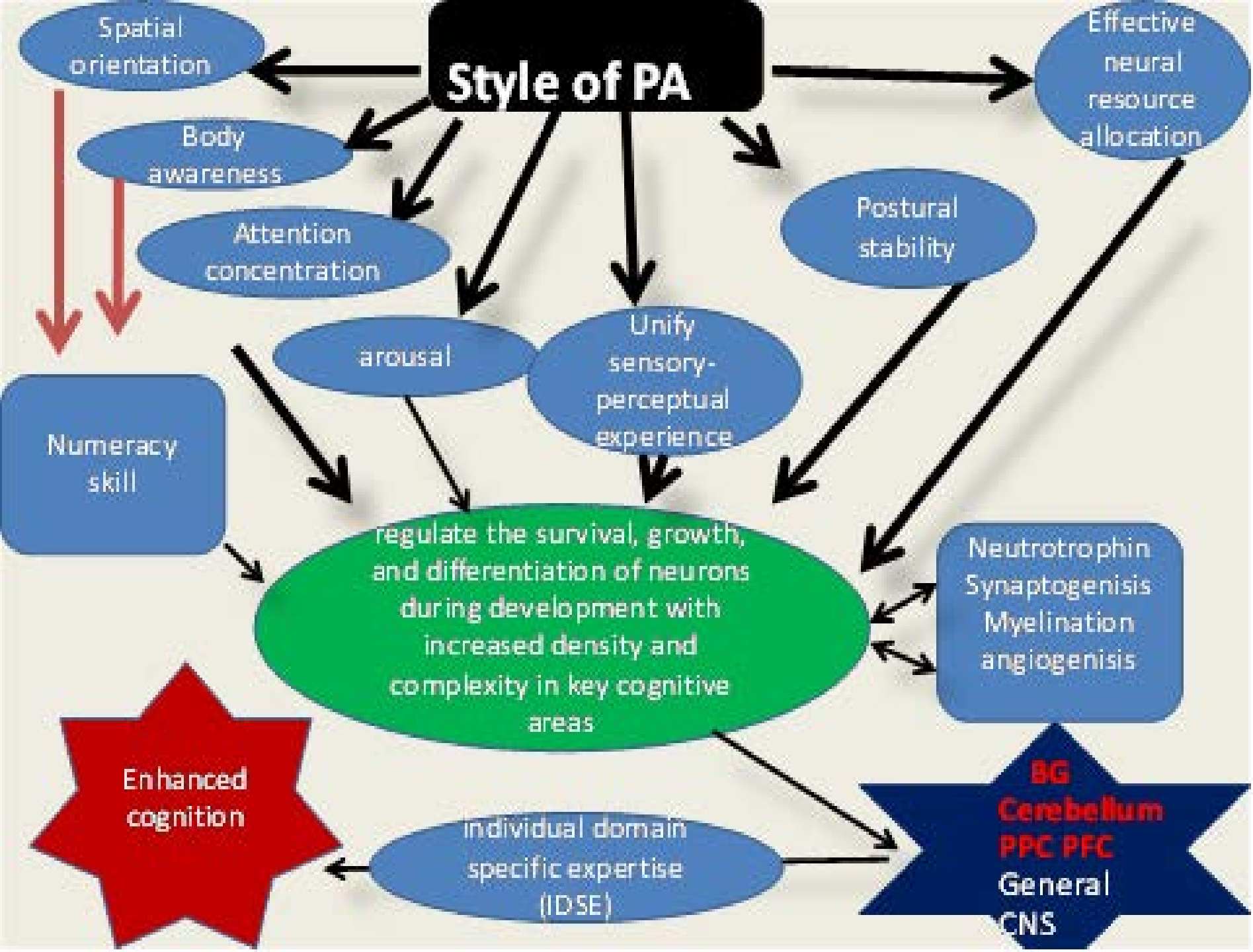
TOP DOWN  
Cognitive  
Unification

Effective  
neural  
resource  
allocation

Neurotrophin  
Synaptogenesis  
Myelination  
angiogenesis

regulate the survival, growth,  
and differentiation of neurons  
during development with  
increased density and  
complexity in key cognitive  
areas

Enhanced  
cognition



## Individual Domain Specific

### Expertise IDSE

human mental processing skills arose out of the capacity of the individual to adapt intentionally formulated movement abilities beyond proficiency and into expert level of skill in domain specific tasks,

## Unlock and Unlink UU

eyes hand foot spine breath and thought to plan and enact solutions to complex tasks. Postural control, bimanual dexterity, language, visual strategies and thought are integrated and articulating properties

Human expertise is developmentally individually heterogeneous and is a soft wired experientially directed mechanism

## IDSE and UU

assembled and moulded (rich environment and mentors) opportunity for “by chance” individual domain specific expertise (IDSE).

Childhood motor competencies build expertise in posture, eye movement, breathing/ language and dexterity allowing the success driven strategies for complex abstract thought and problem solving .

By chance opportunity to some for a particular skill but not all. By chance for others in other skill sets. By chance opportunity for basis of poor foundation – need extra help for proficiency to emerge

•A crucial factor in the emergence of human cognition is related to the unique human trait of Individual Domain Specific Expertise (IDSE) arising from and bound to the extended infant neuro-development and emergent in modern human social groups (and not in sub human hominids). In the tribal group many experts often emerged with specialised expertise in specific fields of tribal life (usually associated with PA endeavours). This process has evolved and adapted for changing circumstances over time and is still a foundational principal of modern human existence. Ancient human tribal groups exhibited generalised competencies for activities of daily living with numerous specific individuals expressing explicit capabilities beyond normal competency and into the realm of expertise (Individual domain specific expertise (IDSE) and is proposed by Skoyles (1999)<sup>19,20</sup> and Sternberg (1999) to be the underlying evolutionary pressure in the emergence of IQ. Cognitive processes supporting academic performance and IQ may have their origins in human evolutionary trait exposed in IDSE.

IDSE is fostered and moulded by the post birth highly plastic and uniquely expanded brain<sup>1</sup>. The plasticity of the human brain is most active from birth to puberty and relies on moderate to low intensity physical activity associated with qualitative exercise to mould and modulate neural functional densities and connectivity in the expanding brain This process then serves as the organisational template for more complex processing during later stages of development and adapted to adult cognitive tasks. The highly plastic human brain responds to enriched environments with improved cognitive function and supports the role of movement and experience acquisition with IDSE model of human cognition. Physical activities with meaning and consequence fuel the mechanisms for cognitive growth. Thinking, planning, acting and contemplating are interwoven phenomena separated only by temporal circumstance and bound by intention and the “deed”.

\* “By chance” natural abilities in children were noted and mentored so that future experts would emerge providing necessary expert skills for tribal survival . “By chance” innate proclivity in human infants is proposed to be bestowed as an evolutionary characteristic for the unique human ability to form IDSE. However, the “by chance” individual characteristic can also “fall to the other side” so that “by chance” the infant is provided with reduced competencies and lower advantages. In a small but important part this explains the heterogeneous nature of learning and behavioural problems in infants and adolescents when natural proclivities by chance “fall to the other side”.

•Humans are unique in the animal kingdom, in part because the fundamentals of intentionally directed movement and thought construction share common beds of neurones also responsible for the emergence of IDSE traits.

Human Infants also use a Lock and Link (LL) strategy essential for normal development known as “lock down” <sup>24</sup>. Both infant and animal LL strategies are based primarily on stereotypical and reflexive movement behaviours arising primarily from spinal cord, brain stem and midbrain structures, modulated by motor cortical zones. Animal and infant movement behaviours appear sophisticated and fluent but lack flexibility in application and adaptability when circumstances change and novel, complex environmental challenges emerge. Infants’ progress through this LL stage and it is through the activity of neural structures and the possible inhibition by the PFC and PPC (uniquely expanded and connected in humans) of motor and pre-motor cortical sites responsible for the transitional (lock down) postural control strategies that unlocking & unlinking in the performance of tasks of activities of daily living occurs. In this way the human is able to unlock & unlink thus allowing more sophisticated executive function

\* In children PFC and PPC neuronal beds activate in similar patterns for physical experiences and academic tasks (particularly numeracy), with activation patterns notably different to those exhibited in healthy adults. It is the authors’ contention that intentionally guided specific movement tasks as part of a group activity, in pairs or individual lessons may enhance cognitive development, executive control and academic performance, over time.