INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH IN MULTIDISCIPLINARY EDUCATION

ISSN(print): 2833-4515, ISSN(online): 2833-4531

Volume 02 Issue 09 September 2023

DOI: 10.58806/ijirme.2023.v2i9n12

Page No. 449-460

Philosophy of Body: Movement and Thought

Jude Godwins, PhD

Associate Professor of Philosophy, Department of Philosophy, Seat of Wisdom Seminary, Owerri, Nigeria.
An Affiliate of Imo State University Owerri,
Pontifical Urban University Rome.

ABSTRACT: Human thinking is modeled on the body in much the same way as hominid thinking was (Sheets-Johnstone, 1990, 4, 25). The hominid experience of moving was the cornerstone of the experience of the precinct of *I can*. The experience of *I can* subsequently formed the basis for corporeal and topological concepts. These, in turn, generated analogical insights. One sees, accordingly, not only an intermingling of the bodily experience and discernment, but also everywhere indications of analogical thinking at the root of hominid tool-building. Self-movement is the mainspring of one's experience of oneself as an agent endowed with free-will-related activities. It is the creative fount of one's ideas of space and time. The phenomenon of moving oneself structures how one knows the world. Moving oneself is a manner of coming to knowledge. The Lives of species-specific bodies are built on thinking in movement. Studies provide ample evidence to show a fundamental correlation between motor and cognitive development. This developmental correlation is also found in both the prefrontal cortex and the cerebellum. Both cognitive and motor developments reveal a prolonged developmental timetable. Both the prefrontal cortex and the cerebellum attain maturity much later. Studies by Adele Diamond and others show that the cerebellum is not only involved in motor operations but also in cognitive functions. Conversely, the prefrontal cortex, with (the help of) its connection with the cortical and subcortical areas that are critical for movement control, is involved in both motor and cognitive functions. Thus both motor and cognitive behaviours seem to belong together; and the body appears crucially involved in the activities of the mind (Diamond, 2000, 44, 49; Bushnell & Boudreau, 1993, 1008, 1015-1017; Burns *et al*., 2004, 19-29)

1.0. How Thinking (is) May Be Embodied

Sheets-Johnstone establishes the fact that human thinking is modeled on the body in much the same way as hominid thinking was. Her thesis is that the living body functioned as a "semantic template" in the development of hominid elemental beliefs and practices as well as the concepts they implied and encompassed; concepts, which themselves were indicators of hominid thinking. The enduring link between hominid thinking and evolution is grounded in the living body. And it was hominid thinking that gave hominid evolution its shape, she argues (Sheets-Johnstone, 1990, 4). But for concepts that were topological and corporeal, there could hardly have been tool-construction, for instance (Sheets-Johnstone, 1990, 25).

Ancestral hominid tool-construction bears testimony not only to conceptual roots, but to a particular form of thinking, namely, the analogical. It reveals how thinking is patterned on the body, how the body serves as a "semantic template" in the emergence of pivotal novel practices, and how thinking is deeply rooted in the body. That the hominids apparently were able to link the teeth to stone, in first conceiving of and then fabricating tool implements, suggests a capacity to transfer meaning from one setting to another, characteristic of analogical thinking. Perceiving this similitude borders already on thinking (Sheets-Johnstone, 1990, 61).

Simply put, analogical thinking is not only fundamental to hominid thinking, but fundamentally bodily. It has its origins in a tactile-kinaesthetic system of cognition. This mode of thinking and this system of knowing combine to bear testimony to the genesis of and formation of concepts. They combine to inspire and shape hominid stone-tinkering (Sheets-Johnstone, 1990, 63).

Two concepts, one psychological and the other semiotic, expounding a thinking devoid of language, bear affiliations with the phenomenon of thinking in movement as a kind of rationality. They are: (1) Piaget's practical or sensory motor intelligence which he describes as logic of action; (2) Kristeva's primordial semiotic of gesture in which there is no distinction between signifier and signified, and in which a bodily doing establishes relationships without specifying objects within these relationships. Daniel Stern's vitality affects theory might also be useful here. Such a logic and semiotic clearly point toward a rationality which is active, that is, it indicates a kinetic intelligence, a systematic kinetic ordering of the world. Within this modality, thinking is not linguistically or symbolically reduced to an abstraction or mental construction. Also, the actions themselves do not point or refer to meanings beyond themselves but are of themselves intelligent and intelligible.

The hominid praxis of flaking and fracturing, indicative of an analogous awareness of "qualitative invariance" across transformation or sensibility for qualitative conservation is ostensibly behind the act of tinkering a stone into an implement (Sheets-Johnstone, 1990, 46). Thus, two factors account for the evidence of the topological concept of "qualitative conservation across change;" the first is the fact of remodeling in the invention of edges; the second, that stone-edges were invented is suggestive of a "creative intelligence" working, an adult one of course. Sheets-Johnstone objects to any likening of hominid intelligence in tool-construction to the evolving twentieth-century-child's logico-mathematical intelligence. A Hominid devising a novel instrument without any model to imitate, cannot, with any measure of justification, be likened to a kid ordering or reordering a thing, following an already existing model (Sheets-Johnstone, 1990, 49). Knowing on the order of the tactile-kinaesthetic may not fit into the category of a Piagetian styled logico-mathematical intelligence. It does, however, synchronize with the traditional explanation of the origin of numbers and the body-oriented mode of counting of the tactile kinaesthetic epistemologies already flourishing in non-Western civilizations (Sheets-Johnstone, 1990, 60).

Sheets-Johnstone dismisses the Piagetian topological concept of order as an improper standard for analyzing order in ancestral hominid tool-making. The ruling concept in the creation of stone tools was that of an edge, a corporeal concept, she insists. Placing flaking was carried out in line with this corporeal concept. Consequently, if operations such as "placings" bring about a notion of order, it is because primordially they encompass not a mathematical system of any sort, but a tactile-kinaesthetic system of knowing. It is this cognitive system of tactility and kinaesthesia that precipitates concepts. Evidently, both sequential and causal order constituted a working concept in hominid tool-fabrication. But, like all other concepts, they were anchored in the "working body itself" (Sheets-Johnstone, 1990, 58)

The hominid experience of moving was the cornerstone of the experience of the precinct of I can. The experience of I can subsequently gave footing to corporeal and topological concepts. These, in turn, generated analogical insights. One sees, accordingly, not only an intermingling of the bodily experience and discernment, but also everywhere indications of analogical thinking at the root of hominid tool-building (Sheets-Johnstone, 1990, 32).

To understand "hominid animate form and tactile-kinaesthetic body" is to understand the workings of the bilateral tie between hominid evolution and hominid thinking. Sheets-Johnstone defines animate form as a "species-specific body," the body's spatiality in all its spectra. The tactile-kinaesthetic body, she says, is the "sentiently felt body," the body which distinguishes and comes to know the world via moving and touching. Thinking is, thus, tied to "spatial and sentient-kinetic life" by the very postulate that models thinking on the body (Sheets-Johnstone, 1990, 5).

Historic evolutionary recasts in hominid beliefs and practices were made feasible by novel tendencies in thinking. Thus novel predispositions in perception and action, such as counting, tool-construction, sound-making, conviction about death, painting, and engraving came into being in moments of conceptual discernment (insights in numbers, edges, flaking, verbal language, interrupted life, and drawing respectively) generated via the experience of the very body that distinguishes and knows through moving and touching. The very "sensorially felt and sensorially feeling body," the experiencing and the experienced body, was the cognitive fountain of the basic and distinctively human concepts that patterned human thinking and evolution (Sheets-Johnstone, 1990, 6) Thought, therefore, is structured by a certain hitherto experienced meaning-complex (Sheets-Johnstone, 1990, 7). It is "founded on a bodily logos" (Sheets-Johnstone, 1990, 8).

Innovating surface, converting the unfamiliar into the conventional, and overlaying shape were the apparent motif for preoccupation with pictorial line in hominid cave art (Sheets-Johnstone, 1990, 260). Unraveling insides and innovating their exteriors, ancestral hominids started questing for the wonder of enclosure. In this way, they were transporting the marvel of pictorial line, a marvel fastened pre-eminently to a bodily ego rather than to a geometric look, to the limelight in hominid progressive transformation and thinking (Sheets-Johnstone, 1990, 270).

Counting too has its genesis in an "upright hominid posture." The advent of hominid upright posture awakened the essentially binary meanings of the binary forms: two swinging arms, two striding legs, two ears, two twitching eyelids. There were also the perceived spatial concurrences of up and down, side and side, back and front. These were obviously sensed as "felt qualitative magnitudes" or binary concurrences (Sheets-Johnstone, 1990, 84). It was manifestly a "recognition counting" - numerical awareness of corporeal similarities - where the object experienced as a count item was not differentiated from the object itself. Perceptual or "felt correspondences" rather than numbers per se provide the empirical and corporeal grounds, accounting for that which is central in counting.

The conceptual basis of numerical thinking is to be found in the one-to-one tactile-kinaesthetic, bodily, ratios. It was a preverbal thinking-pattern adapted, from the start, to a qualitative biosphere of felt correspondences. Hominid world was a qualitative universe of sensed correspondences, binary bodily occurrences - whose pervasive presence could hardly have escaped notice. The hominid could hardly have avoided experiencing itself as binate subject in a binate world, not with so prevalent, multiple similarities. This was in every sense pervasive: two perpetually interchanging magnitudes in movement, two incessantly zigzagging thrusts of feet on the earth's surface, and so on (Sheets-Johnstone, 1990, 83).

A basic biological matrix, corporeal representation, from sexual highlighting to gestural talking and to prehistoric language, is communication-oriented. At each moment of its instantiation the body is employed as a semantic template. This is the place of the pygmy chimpanzees who prior to actual copulation agree on a copulating position, place or movement through gestural discourse. The male's pushing of a limb and moving it in the direction he desires the female to move it, or his moving his hand toward a certain place to implore the female to go there, all have a semantic appeal. In these iconic representations, the male's gestures spatio-kinetically resonates his fancied spatio-kinetic change of the female (Sheets-Johnstone, 1990, 113)

The same, observes Sheets-Johnstone, is true of the female howler monkey's symbolic display of preparedness for the sexual act and the corresponding prompting of a fitting reaction in the male. Advancing toward a male, she styles her lips after the shape of an oval aperture and swiftly swings her projecting tongue inward and outward and upward and downward (Carpenter, 1963, 49-50). The mouth and tongue become at once iconic and symbolic spatio-kinetic analogues of the sexual organs, the former semantically mirroring the latter. There is this "analogical transfer of sense" from one part of the body to another. Previous behaviours and present conducts are also "semantically and iconically associated." Corporeal representation is thus a biological mode of meaning, with all the iconicity and semanticity thereof (Sheets-Johnstone, 1990, 115).

Animate bodies, Sheets-Johnstone asserts, are already a network of meanings. In their form and behaviour they are potential semantic template. They embody built-in meaning-laden visible and behavioural patterns that have relevance for the world around them. The "Tanzsprache" whereby the honeybee falls back on its dance-repertoire to inform its colleagues of honey sources, belongs here too (cf. Sheets-Johnstone, 1990, 122-123). Common signs exist, comsigns as Altmann would say, that combine with pre-reflective bodily experience. Contemporary language, prehistoric language, sexual parading, Tanzsprache, all are possible and significant to their referents thanks to their iconic anchorage in "species-specific tactile-kinaesthetic invariants" (Sheets-Johnstone, 1990, 129).

Aristotle's splitting of thought and speech (thought entailing the capacity to be either true or false, and speech not culminating in the division of language into propositional and expressive forms) becomes inadequate when placed side by side with animal pretense-deception. The animal that feigns death, remaining lifeless or frozen to the spot following a dive, is giving deceitful information, a morphological deceit of a sort. Playing animals that playact predatory hounding, contend something behaviourally untrue. These give evidence of behavioural propositionality and symbolism that argue for the presence of the propositional in the expressive (Sheets-Johnstone, 1990, 155). Thus propositional behaviour, understood as the potentiality to deceive, to assert something untrue, is neither a restrictively human potential nor is it necessarily bereft of the expressive content (Sheets-Johnstone, 1990, 158).

Evidence from our conceptual antecedents (from "reconstructed fossil hominid forms" and their artefacts, for instance) bear testimony to a bodily logos. Aversion to returning to our conceptual origins, and, by extension, to a bodily logos come from a cultural relativism as well as a dualistic thinking, a peculiarly divisional academic practice and biological reductionism.

Cultural relativism insists that because it is not possible to thoroughly detach oneself from one's culture, obtaining an outlook on it is equally impossible. And so, it contends, reaching out to the early beginnings is impossible.

Metaphysical dualism splits life into physical and mental domains. This split, a Western age-long heritage, is sustained by an "academically popular dogma" and practice, where philosophers treat minds; scientists, bodies. A physical body per se, dissected, always anatomically dissectible, and given to being doctored, belongs to western medical and biological sciences. This divisional academic scheme not only places mind far above body, but makes minds the exclusive preserves of human beings (limiting nonhuman animals to the physical) and has a tiny regard for movement. In this way it obstructs a getting-back to our evolutionary past and the mental powers of the "reconstructed fossil hominid forms" and artefacts (Sheets-Johnstone, 1990, 8).

A fallout of metaphysical dualism and a divisional academic practice, which among other things overrates mind, is yet another extreme: a biological reductionism that reduces virtually everything to body and emphasizes the physical out of all sane proportions. The argument of Sheets-Johnstone is that this "academic institutionalization of metaphysical dualism" not only makes thinking in "persistent wholes" impracticable but also violates the body and the living, intact organisms. In the end, what one has are "academically propagated creatures" and "unnatural species" with either disembodied minds or mindless bodies (Sheets-Johnstone, 1990, 9). In contrast, creatures of all kinds live their lives and experience themselves as animate and "persistent wholes." Movements and behaviours in hunting, for example, do not show any manifestation of discord between the physical and the mental (Sheets-Johnstone, 1990, 301).

Inquiring into human thinking demands beginning with a Darwinian body, namely, with "intact living creatures" in their everyday milieu. Darwin, says Sheets-Johnstone, shows how human beings' mental abilities, linguistic capacities, emotional powers, and other structures are on an evolutionary continuum with those of nonhumans (Sheets-Johnstone, 1990, 306). He preserves "persistent wholes,...lives of organisms,...essential unity of individuals" (Sheets-Johnstone, 1990, 307). By extension he ascribes analogical apperception to both 'higher' and 'lower' bodies.

Apperceiving analogically is a biological 'given,' with its roots in the biological propensity to employ one's body as a semantic template. Perceiving one another's behaviours, human beings "read in" - analogically apperceive - "cognitive and felt dimensions" of their own antecedent corporeal experiences (Sheets-Johnstone, 1990, 307-308). This, again, is the place of comsigns, signals shared by members of a species or class on account of shared behaviours. Invariant corporeal experiences, originating in the body that knows the world via moving and touching, give rise to comsigns. Feeling and thought are thus conspicuously on hand in corporeal features and behavioural modes. The mental, Sheets-Johnstone insists, is clearly discernible in the corporal (Sheets-Johnstone, 1990, 308). It follows then that the evolution of thinking is coincident with the evolution of doing.

Merleau-Ponty goes so near to the point when he affirms that the "rational being is also the one who holds himself upright" (Merleau-Ponty, 1962, 170). Incidentally he does not follow the matter all through, failing to show how the rational and the upright form the same form of being.

To account for thinking, Sheets-Johnstone insists, calls for tracing its evolutionary roots, getting at conceptual roots. She proposes a methodology of hermeneutical phenomenology, with both hermeneutical and genetic phenomenological strands. Heidegger's Dasein with its self-disclosedness and Sartre's freedom of the being-for-itself need grounding in evolutionary times. Heideggerian metaphysics needs grounding in a Husserlian epistemology. The Sartrean for-itself needs a phenomenological hermeneutics close to a genetic phenomenology (Sheets-Johnstone, 1990, 205). Sartre's discussion of the other leaves the body hardly lucid, the way one experiences one's body. The Piagetian way of identifying the origins of thinking with action by connecting it with the development of intelligence falls short of a holistic approach to the corporeal, reducing, as it does, the conceptual universe to the visual stretch. In Piaget's genetic epistemology, the merely tactile-kinaesthetic fails to take up a cognitive significance. He should have done well to recognize the conceptual cognates of the experiential scope of observed actions, the tactile-kinaesthetic operations of the touching and moving body (Sheets-Johnstone, 1990, 279).

Besides ending up missing out on bodily invariants, Merleau-Ponty's method, beginning with a pathological body and having an unduly visual bent, is also already flawed at take-off. Sheets-Johnstone accuses him of neglecting the complexity of the body in its species specificity and the vastness of the commonplace experience of the body that knows via moving and touching its way through the world. A pathological body, she argues, is something out of the ordinary, being atypical. A body with an optical bent, for its part, being invariably at a bodily distance away from the instantaneity of the world and the all-inclusively experienced body, runs short of instant bodily reverberations and can hardly bolster a complex system of knowledge (Sheets-Johnstone, 1990, 284).

By assuming that space could only be tracked within the realm of the unusual and not in the normal run of things, Merleau-Ponty misses his avowed target of tracking space at source (see Merleau-Ponty, 1962, 244). Again, making space primarily visual, and assuming understanding spatial concepts to be only possible by disrupting or inventing deficit in regular ocular perception, he makes understanding spatial concepts indirect. Such is the case that we now have a causal manner of reasoning from the pathological, that, from the start, stands in danger of being vitiated by drastic distortions in the normal. The attempt to fool the body is not a sure bet, for the body is prone to affirming that which is basic to it. Space at its fountainhead is not a fundamentally visual one. At source, space is a corporeal, species-specific space. It is delineated by the inherent spatiality of a body marked by its species specificity and the intrinsic spatial potentialities of a body that knows the world through moving and touching (Sheets-Johnstone, 1990, 286-287).

Confronted with the need to explain one's maiden spatial encounter with the world, Merleau-Ponty (1962) argues that one's history must be that which continues a prehistory. He contends that the contact of the bodily with the physical world is prior to thought. Sheets-Johnstone accuses him of putting forward "logical musts" amounting to a bodily history devoid of an evolutionary interval. Such logical musts collapse in the face of an evolutionary history of hominid tool construction, counting, cave painting, language, and so on. Ours is a hominid ancestral bequest of a bodily heritage which is "not more ancient than thought but coincident with it." The methodological tracks to the fundamental reference-frame of thinking is to be found not in an examination of that which is seen but of that which is basically felt by the body that knows as it touches and moves its way through in the world. Both of them are contradictory in themselves; "logical musts, like scenarios of the irrational," melt away in the face of the animate structures (Sheets-Johnstone, 1990, 288). Sheets-Johnstone wonders why Merleau-Ponty fails to show how the rational and upright form the same form of being. Perhaps partly for fear of going the Darwinian way, she says.

In Heidegger also, Sheets-Johnstone objects, though the somatic is always implied in Dasein, the body is literally glossed over. Despite Heidegger's reference to an involved connection between Dasein and corporeal nature, the avowed bond is so presumed that no account of origins are rendered. Not even the important somatic functions as thrownness and hammering, for all their reminiscence and resonance of tactile kinaesthesia and corporeality, could call attention to an explication of the already affirmed bond; a move that could have served to bridge the mind-body cleavage and stem the denigration of the body. For instance, directional concepts, though in every inch corporeal, are attributed to Dasein as if coming from nowhere. Both Dasein and objects are devoid of evolutionary and epistemological past. Even his Vorstruktur des Verstehens, the fore-structures according to which things are interpreted and understood, are not analyzed. Such is the case that not only that a great deal of the metaphysics "remains unexamined," but also searching structures ultimately foundational to modes of conceptualization one is left with only the ontological. Yet only epistemological inquiries can unravel the origins of concept formation. Ontological questions inquire into what is. Positing an ahistorical Being-unto-death and an ahistoric language, Heidegger makes his silence on historical anchorage most evident (Sheets-Johnstone, 1990, 288-290).

It has been asserted again and again that human symbols have also their anatomical sources. This further massively implicates the human body in the structuring of thought and undeniably affirms the corporeal sources of thinking (Sheets-Johnstone, 1990, 292).

Philosophy of Body: Movement and Thought

Giving up biology for cultural considerations, for all its recent advancement, is also not the way forward. Cultural universals are only tenable if the hominid body is taken as model. The body is the only one that meets all the conditions and common denominator outlined by George Peter Murdoch. The animate form meets the most "universal condition of human existence." The body is the most "biologically fundamental" of all there is. In the most rudimentary sense, the sensory-kinetic proportions of the experience of the body that knows through touching and moving remains to be rivaled in psychological resonance (Sheets-Johnstone, 1990, 293-294).

It is understandable, though, that the recent cultural-turn is a warranted reaction against "earlier pseudo-anthropologists." Relaying on reports by explorers and missionaries, these had flooded the intellectual world with unscholarly works in their unjustifiable distinction between primitive and civilized peoples. The progress generated by Wittgenstein's and Levi-Strauss's insights in linguistic philosophy and anthropology respectively could be furthered by making a bodily-turn. Continued accent on linguistics and divergences in culture-related concepts will not do. Rather than being language-contingent, thinking is concept-reliant. Thinking is at source anthropocentric. The body fashions meaning in its own likeness, to the point of a bodily semantics. This does not suggest a cultural matrix but a biological one. A bodily-turn, following on the heels of the linguistic one, is sure to attain heights (Sheets-Johnstone, 1990, 294-296).

Corporeal scanning and bracketing resolve the hard nut of describing "experienced meanings in creatures other than one's own immediate kind." With bracketing, present-day cultural meanings are suspended, allowing "sedimented physiognomic character of things" to surface. Sheets-Johnstone advocates a kind of bracketing akin to Husserl's phenomenological reduction, where one distils experience through the suspension of usual, commonplace inferences associated with it. Rather than taking anything for granted, things ordinarily read into the experience in question are highlighted. The emphasis is on putting aside the overlays of culture, going instead for perceptual and movement fundamentals. One is thus enabled to describe the experience at root, there where it is most primitively had. This form of description always analyzes moving and perceiving in the hope of ascertaining experienced meanings which are sensory kinetic. It begins normally with an inquiry into meanings that are species-specific. The hermeneutics associated with this is one of corporeal understandings. It is one which unveils the subject identified with hominid history, a subject revealed in the sensed relics of once living forms. The whole lot is a phenomenological hermeneutics that deconstructs contemporary bodily realities and uncovers primordial corporeal physiognomy (Sheets-Johnstone, 1990, 358-359).

Corporeal scanning investigates the tactile-kinaesthetic body and animate form to identify concepts spawned by the bodily facts of counting, tool-construction, and so on (Sheets-Johnstone, 1990, 14). Sheets-Johnstone says her corporeal scanning is something akin to the eidetic reduction of Husserl. Always tilling the ground in the backward direction toward the experiential beginnings of concepts, it seeks a historical unveiling of meanings. It a corporeal reduction that distils meaning down to its generation in the body that is experiencing and is experienced, giving rise to varied looks of a bodily logos. One achieves "corporeal reduction," she holds, through a combination of bracketing and corporeal scanning. Put together, both reflect the phenomenological and the hermeneutical strands of the phenomenological hermeneutics. This in turn helps one understand at source concepts induced by the corporeal facts of bipedal-walking, painting, sound-making, and so on (Sheets-Johnstone, 1990, 15).

Sheets-Johnstone takes exception to the fact that tactile-kinaesthetic body although being a body always in touch, always resounding with an intimate and immediate knowledge of the world about it, has been too frequently reduced to the visual stretch. She insists that the tactile-kinaesthetic origins of hominid tool-construction bears evidence of preoccupation with a felt-sense rather than a visual-sense. Feeling the surface or edge, she argues, would be the usual attitude of a creature seeking to construct or test a smooth edge, a round object, a sharp surface or a coarse finish. Though these are, in the final analysis, visually perceptible textures, they are basically tactile phenomena and are known to be so tested (Sheets-Johnstone, 1990, 37). Besides, whereas one impaired in tactile-kinaesthesia cannot build an implement, the blind can.

The primary sense of self is a corporeal concept, informed by tactile-kinaesthetic self-awareness. It is this that gives the visual, a secondary form of self-awareness, its meaning. This primordial bodily self-awareness is attested to by chimpanzees that scratch their backs without using mirrors. Again, touch and movement invariants, being prior to language, constitute the prerequisites of conceptualization rather than language. Tactile-kinaesthetic distinction, sensory distinction, is evidently potentially concept-loaded. Little wonder that hominid tool-construction preceded language formation (Sheets-Johnstone, 1990, 379). Again, present-day humans and ancestral hominids besides sharing neuro-anatomy and correlating functional capacities, also share basic sensory-kinetic experiences as well as concepts stemming from those basic experiences. Originating in the elementary behaviour of "noticing oneself," these concepts are latencies in tactile-kinaesthetic encounters (Sheets-Johnstone, 1990, 17). It goes without saying, then, that tactile-kinaesthetic discriminations and differentiations must have been at the centre of a developing, bodily articulate reason, generating concepts that are pan-cultural (Sheets-Johnstone, 1990, 380). Corporeal concepts so born are not only not language dependent, but also in no way lesser than their linguistic kith and kin.

Sheets-Johnstone suggests a four-way move toward doing a joint and proper philosophical anthropology. These are: giving evolution a thoughtful consideration; according the body and its tactile kinaesthesia serious attention; taking one another seriously, consulting paleoanthropological studies and their "sensed relics of once living forms;" carefully considering biology, in the knowledge that philosophy, anthropology and biology belong together in a proper science of man (Sheets-Johnstone, 1990, 314-330).

2.0. The Primacy of Motor Behaviour in the Experience of Oneself as an Agent.

Self-movement is the mainspring of one's experience of oneself as an agent endowed with free-will-related activities. It is the creative fount of one's ideas of space and time. The phenomenon of moving oneself structures how one knows the world. Moving oneself is a manner of coming to knowledge. The Lives of species-specific bodies are built on thinking in movement.

Cognitivist accounts of body and mind, neglecting self-movement, miss out on real alive-staying bodies. The reduction of real bodies to the mere neuro-physiological, leaves us with yet another academic aberration. We are now confronted with not only a mechanization of mind, mind-body estrangement, but also recently a mechanization of body, brain-body alienation. Since accounts such as these deny our animate heritage, Sheets-Johnstone seeks a restoration of our space in nature, reminding us that we too are a kind of life. How animate kinds evolve must be an issue. At the centre of life is animation (Sheets-Johnstone, 1999, xv). This should make the exploration of natural history and infancy a matter of course.

Aristotle appreciates the place of movement in the universal order of things. He observes the natural order and declares motion the basic principle of nature. Movement features prominently in both his anima and his cosmology. Husserl, investigating his own daily experience of the body that we are animate organisms, as he is wont to say, unearths a pivotal epistemological bearing of movement.

Merleau-Ponty (1968) works extensively on body, but fails to give movement a primal place. His treatment of body could lead to an impoverishment of both epistemology and ontology, following overt deterrents to a holistic consideration of the fundamental events of kinaesthesia and animation. The neglect of the kinaesthetic as a form of knowing is one fall-out of the instrumentalization of movement, and with it comes the eclipsing of the dynamics of movement. Conceiving the body in abstract terms bypasses the sensory-kinetic which a body-oriented analyses brings into focus. Giving up the day-to-day experience of movement in preference to a slavish attachment to a certain acquired culture portends some difficulties too. These are potential conceptual pitfalls which improper approaches to the body-question, such as that of Merleau-Ponty, could precipitate (Sheets-Johnstone, 1999, xvi).

Sheets-Johnstone aims at showing that movement provides the prospect of constructing an epistemology faithful to experiential facts and putting together a metaphysics consistent with the fundamentally animated and dynamic nature of living in the world (Sheets-Johnstone, 1999, xvii). She calls for a bodily turn in the direction of self-movement, in the direction of the animate. Her bodily reverse invites present-day philosophy to experience the marvel of movement and to following this encounter to contemplate the essential constitution of animation, and detect the epistemological quality of the intrinsic dynamism of movement. A bodily turn reveals that by analyzing "symbolic behaviour" and "mental symbolization" we come to analogical thinking, which has its origins in corporeal life. It demonstrates that not only that thinking is patterned after the body, but also that phenomenal mental adaptations are rooted in species-specific bodies. It illustrates that one's understanding of peoples outside of one's stock rests on the ability to picture oneself within certain corporeal parameters and to work out what living conceptually and kinetically within these parameters denotes.

Sheets-Johnstone attempts to show that animate forms have an in-built sensitivity to movement. Consciousness is essentially bodily. Organisms move primarily in line with their tactile-kinaesthetic responsivities (Sheets-Johnstone, 1999, xix). Within the evolutionary course the outward proprioceptive organs got internalized, resulting in a kinesthetically-bound bodily consciousness as well as in other cognitive and epistemological consequences. So it is that the notion of selves has its origins in a body-oriented consciousness rather than in language. Natural history holds corporeal truths which could be sensory-kinetically analyzed to yield knowledge of a consciousness grounded in animate form.

A true metaphysics should be faithful to life in its origination, maturation, dissolution, movement, and quiescence (Sheets-Johnstone, 1999, xx). At every instance projecting a principle of motion, nature is only understood when motion is understood. Aristotle is right on this point. Similarly to fathom perception is to fathom a dynamic phenomenon. It is to comprehend a motional (kinetic) process, in which the "sensible form of things without the matter" is grasped, to use the Aristotelian phrase. This enables one to experience qualities, for instance, hard, gentle, smooth, rough. Ostensibly, Aristotle has in mind here rather than a process of experiencing a universe of objects, per se, a world of diverse and mutating physiognomies, a "qualitatively dynamic" cosmos. Perception in Aristotle is motional, experiential, qualitative, sensorially confined to a definite area. It is a change in quality, which in effect is about movement. It is an experiential, qualitative, process metaphysics rather than a metaphysics of matter.

Following Aristotle's "Matter will surely not move itself," and his subsequent identification of movement as nature's fundamental principle, Sheets-Johnstone argues that investigating why we have movement instead of immobility is a more foundational metaphysical interrogation than any other. When consciousness is investigated as emanating from animate form, movement issues forth its four-fold qualities (foundational to the meaning formations and spontaneous behaviours of our kinetic power), namely, "tensional, linear, amplitudinal, and projectional." Movement is thus our cognitive birth place. It is the basis of our flair for concept-formation, our bodily concepts core (Sheets-Johnstone, 1999, xxi). Sheets-Johnstone takes exception to philosophy for concentrating almost exclusively on the qualia of pain and the color red, neglecting the foundational qualia of kinaesthesia and proprioception.

Husserl is right in underscoring the centrality of moving one's self in perception, the cardinal function of introspection, and the relevance of "self-evidence," making referring to one's own experience possible in the way one would refer to laboratory data. Science and phenomenology, sharing in some sense methodologies and not in essence disagreeing in terms of their aims regarding the truths of experience and behaviour, could be complementary (Sheets-Johnstone, 1999, xxiii).

In contradistinction of connectionist accounts of mind, Sheets-Johnstone advocates a dynamic-systems-theory-oriented account. The latter is best instantiated in the neurophysiology of Gerald Edelman and the infant-developmental-psychology of some contemporary research. Gerald Edelman detects anatomy, cells and morphologically structured mappings in the brain having "continuous electrical and chemical change, driving and being driven by animal movement." He also discovers that animal movement is "conditioned by animal shape and pattern, leading to behaviour." In this way he rightly adjoins the otherwise artificially disjoined aspects of the lives of creatures (Edelman, 1992, 15).

Movement and tactile kinaesthesia also assert their pre-eminence at the onto-genetic realm. The developmental train of the neural tissue of the embryo readily comes on hand here. Early enough in the beginning of life, precisely at the fourth week, the 'semicircular ear canals' are known to have developed. Through vestibular sensations, semicircular ear canals confer a sense of imbalance or balance. The same early development, namely at the fetal stage, is true also of receptors in the muscles. Receptors in the muscle furnish, through kinaesthetic sensations, a sense of movement and position. Already at the fourth month the sensory system for balance is established, although in its elementary form. At the dawn of the fourth month also reflexive behaviour is spotted. This means that the fetus coordinates its movement following stimulation.

When we add up the early development of neural tissue that has a bearing on movement and the physiological research that indicates that neural unfolding and the advancement of the motor cortex are prompted by the body movement of the fetus itself, we begin to see how self-movement plays a predominant role in reason. The implication is that form never develops unaided. Movement imparts on morphology. Myelinization research reveals that motor neurons acquire medullary sheath quite a bit earlier than acoustic-vestibular neurons do. There is a rich literature providing a good reading for prenatal development and behaviour (Hepper, 2015).

A dynamic-systems-theory oriented account is phylogenetically and ontogenetically historical. It acknowledges the centrality of movement, appreciating kinaesthesia and bodies. It also fosters the kind of cross-disciplinary attitude engendered by Husserl and found in our day (though these are not properly articulated) in the driving force of the cognitive sciences.

Self-movement is not a mere change of position or simply descriptive of an object in motion. It is, instead, fundamentally the mode through which one makes one's own body meaningful to one and interprets the world. Psychological and phenomenological data on infancy are consistent with each other. Psychology reveals that infants react to movement rather than to moving things. It reveals thinking in movement to be the infant's prototypical manner of thinking. It shows that infants comprehend objects "literally and epistemologically," via movement (Sheets-Johnstone, 1999, xxiv). It affirms the resonance of the body that knows through moving and touching and a bodily-reaction/motor-memory-oriented consciousness.

Merleau-Ponty attempts to construct a philosophy of an embodied humanity, one that promises to guide to foundational bodily-kinetic facts of the matter. It is not a speculative philosophy, and so one expects it to be verifiable and capable of being taken further. It is specifically about our being human, hence expected to be methodologically unclouded. It is a philosophical enterprise that seeks to conciliate the truths of philosophy and the facts of science, thus one with an across-disciplinary trust. Incidentally, for all his philosophy of the embodied human being, it is difficult to see how one could fruitfully follow on the methodological heels of Merleau-Ponty. How do we go from empirical facts (concerning the pathological) to existential ones (bordering on the normal)? How does one make the leap from the factual to the philosophical? How is a methodology of ontology predicated on fact feasible? (Sheets-Johnstone, 1999, xxv).

One is unable to find a conciliation of the natural and the ontological in his philosophical scheme. This seems, regrettably, to be the case despite his claim that one has a "natural bond" with one's world. How is this seeming nature-ontology disquiet to be overcome? Could it be a problem of differentiating fact from experience, reflection from data? If radical reflection is grounded in the fact that one is not a stranger to oneself, as he says (see VI., 65), then, is his radical reflection not founded on introspection? Why then does he make little of introspection simply because science does so? The tension is indeed quite evident between his hyper-reflection and perceptual faith and his earlier denial that philosophy could analyze our relation to the world (see Ph.P., xviii). What is more, he lets words fit, following a certain natural entwining of their significations. Sheets-Johnstone sees this as a linguistic plait that could be bypassed.

Sheets-Johnstone reaffirms wonder as the locus classicus of the enterprise of philosophy. Plato and Aristotle accord wonder this centrality of place. Wonder, in the most profound sense of the word, for instance, wondering about the phenomenon of life, of death, of love, of heroic self-giving is one tested and trusted method of liberation in a world where ignorance never tires taking on different casts. Even as contemporary Western science attempts to silence it, the sense of dread and longing which it precipitates is worth preserving. Methodologically, wonder continues to possess a certain timelessness that conjoins every personal act of philosophizing to the collective and unending task of philosophy (Sheets-Johnstone, 1999, xxvi).

At the heart of Sheets-Johnstone's thought is animation, namely, a moving, bodily subject; an organism that moves and acts; a creature that moves and makes sense. Animate form is the source of all elementary meanings associated with creatures. The body's anatomy is one sure place to go for phylogeny and meaning-network. This shows why the designate "animate form" characterizes more appropriately the experience one has when one experiences one's body and the bodies of others, namely, animation, pulsating and stirring life, progressively varying topology and shapes, forms having significant qualitative features. All this happens within the context of a world of space and time that is coincident with the aforementioned experiences. Animate form highlights aspects of our corporeality as well as our evolutionary history.

So long as the brain neither replaces the living body nor the mind, cognitivist analyses that give this impression remain untenable. An immoderate inflation of the role of language does not hold water, as long as, language is, for instance, claimed to mark the dawn of a consciousness whose origin is not explained. An 'exclusivist' materialism and a neurological mechanization of reality will also not do. For, if, for instance, all convictions or creed are only neurological events, how is it that some creed are held to be correct as against all others, given that all creed are equals in "putative truth?"

Improvisational dance is one instance of the phenomenon of thinking in movement. Two suppositions vitiate a descriptive account of improvisational dance as an exemplar of the phenomenon of thinking in movement. The first is the assumption that bodies are for doing while minds are for thinking, a Cartesian conjecture; the second, the popular belief in the impossibility of thinking beyond the confines of language or some symbolic system. Investigation of the experience of improvisational dance as one exemplar of the phenomenon of thinking in movement reveals that thinking and moving oneself rather than being two split events, are but "aspects of a kinetic bodily logos" adapted to an unfolding dynamic happening (Sheets-Johnstone, 1999, xxxi).

The earliest concepts in infants are bound up with dynamic events, to motional occurrences. Long before their crossing into the language world, their first concepts are attached to their experience of their own movements and movements in their milieu. They literally think in movement. Thus, instead of referring to the period preceding language as the pre-linguistic, one should describe the dawn of language as the post-motional or the "post-kinetic." Hence, ontogenetically, thinking in movement is our archetypical mode of thinking. Phylogenetically, also, studies on the lives of non-human animals reveal thinking in movement as prototypical. Researchers show how animals move in specific manners to protect their infants from certain dangers (Worldwildlife, 2023; Earth Reminder, January 9, 2023). Field biologists reveal that sand wasps display food-catering behaviours that reflect complexity in space and time (Tinbergen, 1968). Laboratory biologists report fascinating escape motor activities of animals (Evans, 1971; Branco, T. & Redgrave, P., July 2020;

In both of the instances given above, whether in human or nonhuman animal life, it is a "natural kinetic intelligence, a kinetic bodily logos," that is at work. It is a natural motional intelligence that cannot be waved away as an insignificant instinct. It is not to be taken as a petty adaptive mechanism either. This kinetic bodily logos is rather a basic biological quality of life, a "dimension of animate form." Such is the case that the works of primatologists, zoologists, ethnologists all bear the implicit attestation that animals do not think in relation to behaviour, but in relation to "kinetically dynamic patterns," in relation to movements. Behaviours evolve from movements, basically as ways of dynamically patterning movements (Sheets-Johnstone, 1999, xxxii).

3.0. Motor and Cognitive Development During the First Years of Life.

Scientists listening to movements and heartbeats of fetuses of stressed and depressed women establish that their responses vary from those of the fetuses of the emotionally healthy mothers. Fetuses of mothers with depression, anxiety, or stress problems show increased heart rates when their mothers are under stress-inducing situations. Their mothers' high level of stress hormones (cortisol) make them unusually jumpy, having been themselves exposed to an environment of increased stress hormones over the course of gestation. In contrast, under stress-inducing circumstances fetuses of emotionally healthy mothers do not show any changes.

Studies indicate that the infants of mothers with anxiety and stress symptoms reveal lingering effects of these pathologies, many months, if not years, after their birth. They have less sensibility for social stimulus, less capacity to calm themselves when agitated, and less developed learning skills. In rats, babies of stressed mothers manifest lasting alterations in brain chemistry and behaviour. In humans, research reveals that women who are stressed during pregnancy have a tendency of having pre-term births or low-birth-weight babies (Tarkan, 2004).

Researchers find, even among infants with no major disability, a high prevalence of motor deficiency (O'Callaghan et al., 1996). Investigations into the fine motor skills of apparently normal pre-term infants (weighing less than 1500g at birth and having no major disabilities) show that the majority (71 %) have fine motor deficits at five years of age (Goyen & Lui, 1998).

There is much documented evidence to prove that motor development during these formative years determines the infant's subsequent developmental time frame (Bushnell & Boudreau, 1993) and optimizes self-care, learning, memory, leisure and play. Being able to move oneself from one place to the other, and to reach-out to and manipulate objects with the hand are two motor milestones that are foundational events for developmental sequences in other domains. Self-locomotion develops in two basic shifts: a shift toward coordinating locations in terms of landmarks rather than in relation to self (cognitive-perceptual); and the capacity for social referencing (social-emotional). Visually guided reaching, hand-eye coordination, offers the infant similar experiences. The process of acquiring haptic perception and depth perception are two instances indicating how motor development determines developmental time tables. Depth perception refers to kinetic, binocular, pictorial information about spatial relations; whereas haptic perception indicates sensitivity to object properties acquired through touch.

Depth perception, the power to perceive the three dimensional layout of environmental objects and surfaces, is based on kinetic, binocular and monocular information. The infant develops sensitivity to depth through physical manipulation accompanied by looking when it develops motor control of the head, ocular motor control, and manipulates objects through hand movements or at least senses them being so manipulated. Bushnell and Boudreau (1993) note that movement of the head generates kinetic information associated with a three dimensional layout of objects. By means of "to-and-fro movements," we are able to have "optical expansion/contraction;" and through side-to-side movements, we have "motion parallax." These provide us with kinetic cues for depth perception. Between 2-3 months, infants overcome the possible motoric barriers to depth perception that come from kinetic information (Bushnell & Boudreau, 1993, 1015). This is followed by the infant's development of the capacity for binocular information. But then, to be able to perceive depth relations from the "retinal disparity" one needs the fixation of both eyes on the object. Yet the capacity for binocular fixation would require "vergence eye movements." It is then possible, argue Bushnell and Boudreau, that having the appropriate level of ocular control for effective vergence movements could be part of the ability to acquire depth information from binocular information. It is thus likely that the baby's poor ocular control does prevent "systematic binocular fixation," which in turn interferes with her developing binocular depth perception. This limitation is overcome between 4-5 months of age, when the infant develops the capacity for acquiring depth information from binocular data (Bushnell & Boudreau, 1993, 1015-1016).

A third category of depth perception, which the infant develops between 5 and 7 months of age, is the perception of depth from pictorial information. Static monocular or pictorial cues, Bushnell and Boudreau note, are shades of information present on a single eye's retinal image. These cues include relative sizes of objects, familiar sizes, linear views, interpositions, grades of textures, and so on. To obtain depth information from any of these, though, one needs further information or suppositions. This prior knowledge or assumption that is not contained in the cue, is, however only available to the infant between 5 and 7 months of age. At this period of their development, some people say the infants begin to acquire "sensitivity to configurational information," others say they obtain the ability to "process current stimulation and intrinsic" or prior knowledge conjointly (Bushnell & Boudreau, 1993, 1016).

Such is the case, Bushnell and Boudreau argue, that the visual information associated with the three dimensional structure of an object becomes clearer and more accessible when the object is inspected while one has it in one's grasp and manipulates it with the hand. Such an experience could acquaint children with the needed information on the actual sizes and shapes of objects that they could also exploit for future depth perception grounded in familiar sizes or interposition with familiar objects. When such an experience accumulates, following encounters with multiple and differing objects, it also becomes a source of information for future assumptions about objects in general (Bushnell & Boudreau, 1993, 1016-1017).

To sum up, Bushnell and Boudreau propose that depth perception grounded in kinetic information arises so early in infants because it involves proper motor control of the head, an ability the infant acquires between six and seven weeks of age. Depth perception grounded in binocular information presupposes proper ocular motor control that comes at approximately the age of three months. For this reason, when the infant is about 4 months old, he acquires the ability to perceive depth relations from the disparity of images on the retina surfaces. This, of course, comes only after the acquisition of the power to perceive depth information from kinetic cues. Depth perception grounded in static monocular indications presupposes mental processing with information and presumptions that we acquire by physically handling objects and investigating them with the hand. The motor development that facilitates such behaviours emerges between four and five months. Owing to that, depth perception grounded in static monocular information can only arise later, between the ages of five and seven months, following on the heels of other capabilities for depth perception. Bushnell and Boudreau maintain that there exists a significant measure of fit between the developmental timetables for sensitivity for the various aspects of depth perception and the periods at which their corresponding motor powers attain some measure of refinement.

One other instance of how motor development determines developmental time frames is the acquisition of the ability for haptic perception. Haptic perception is the power to obtain information about objects through handling them. It is about discriminating and recognizing objects through manual exploration, rather than by glancing at them only (Bushnell & Boudreau, 1993, 1008). The infant develops haptic sensitivity to various object properties with the development of appropriate hand movements, whereby he is able to exploit the hand's perceptual ability through the hand's exploratory procedures, thus haptically (through touch) perceiving object size, temperature, hardness, texture, weight, and finally, configurational shapes. Bushnell and Boudreau propose that the manual behaviour of babies towards objects progresses in three stages of their first year. First, between birth and three months, babies develop clutching behaviour similar to static contact and enclosure hand movements. This enables them to haptically perceive temperature, size and probably hardness. Second, between the ages of four and ten months they develop "rhythmic stereotypies," manual behaviour that is made up of repetitive movement of the fingers and hands, as they move their hands under visual control. Sometimes this is accompanied by close examination as they scratch the objects, rub, wave, bang, and turn them from one hand to the other. This manual behaviour perhaps enables them to perceive the hardness, texture and weight of objects. Third, as from the tenth month onwards infants begin to perform "complementary bimanual activities" characterized by using one hand to hold an object while the other hand explores the contours of the object. This enables a "contour-following" that facilitates configurational shape perception (Bushnell & Boudreau, 1993, 1012-1013).

Bushnell & Boudreau maintain that there are developmental stages in the evolution of manual behaviour, suggesting that motor development could determine developmental sequences of haptic perceptual capacities as with depth perception. Klatzky and Lederman (1985) show what relevance this kind of perceptual development has for mental development, that is to say, the link between hand-movement ability and object-property apprehension. What we learn from their study is that constraints and drawbacks in the infant's power to make hand movements limits and narrows what she could perceive about objects through handling them. Bushnell and Boudreau thus argue that lack of the experience of handling an object in a manner appropriate for feeling a certain object property could deny the child a proper and precise perception of that object property (Bushnell & Boudreau, 1993, 1008). It is when the infant attains these powers that she begins to acquire the experiences and knowledge they facilitate. Thus the development of motor abilities coincides with the development of mental powers.

In a longitudinal study Goyen and Lui (2002) investigate the development of motor skills in high-risk infants (born at less than 29 weeks gestational age or weighing less than 1000g) without any major disability. They find that a significant proportion of the infants continue to have fine motor deficits from eighteen months to five years (64 % at five years). This indicates underlying fine motor skills problems throughout this period. Over the study period, as the task demands increased, the proportion of children with gross motor deficits also significantly increased, especially for those born weighing less than 750g, the so-called "micropreemies." Goyen and Lui (2002) found that the influence of home quality (the environmental influence) was limited to gross motor skills. Researchers admit that parents accept that their pre-term babies are incapable of performing as much as their healthy counterparts. Thus parents scale down their expectations and recast their perception of the abilities of their pre-term babies. Hence, researchers attribute the finding that the power of the environmental influence was limited to gross motor skills to the fact that parents altered their perception of their pre-term babies' abilities. Parents are afraid of physically challenging their pre-term infants to attempt difficult tasks and to learn novel skills (cf. Bartlett & Piper, 1993). In contrast, the development of fine motor skills may be influenced by sensorimotor, cognitive and other factors occurring about the time of birth.

Whereas the relationship between major impairments and reduced cognitive abilities is widely recognized, the connection between motor development and cognitive development is less known. Yvonne Burns and colleagues (2004, 19-29) examine the relationship between movement and cognitive performance of extremely low birth-weight (ELBW) infants born weighing less than 1000g, at 1 and 4 years of age. Of these infants, 132 returned for follow-up checks at the ages of 1 and 4. They include infants born at 24-34 weeks of gestational age. The authors aim at ascertaining whether motor development at 1 year of age is predictive of cognitive performance at 4 years of age. They find that motor development of extremely-low-birth-weight children (tested at 12 months - corrected age) is "strongly associated with the general cognitive index" of the same infants at 4 years of age, irrespective of biological and social variables. This demonstrates that motor development at 12 months of age predicts later motor development, with 60% of its ELBW infants displaying motor impairment.

Their finding confirms the relation between early motor development and subsequent cognitive and academic functioning. It connects motor and cognitive advancement at 12 months and at 4 years of age. This study provides evidence for adding elaborate movement assessment to follow-up protocols of ELBW children for the early identification of neuro-behavioural impairments.

Adele Diamond (2000) provides ample evidence to suggest a fundamental interaction and correlation between motor development and cognitive development and of the prefrontal cortex and cerebellum. The popular opinion is that the dorsolateral prefrontal cortex is crucial for cognitive abilities, while the cerebellum is crucial for motor skills. Diamond (2000) shows how this may not be so. Both motor and cognitive developments, he contends, manifest protracted developmental timetables. As with the prefrontal cortex, the cerebellum reaches maturity late. Developments in motor functions manifest protraction too. Only in adolescence do "fine motor control, bimanual coordination, and visuomotor skills" attain full development. In much the same way, highly complex cognitive activities continue to show improvements in development right into the adolescent period; these include the accurate representation of transformations, the flexible manipulation of information retained in the mind, and the ability to consider multiple aspects of an issue simultaneously.

When cognitive development is perturbed, as in neuro-developmental disorders, there is also a concomitant disruption of motor development. Many cognitive operations that need the services of prefrontal cortex also need those of the cerebellum. Facts that prove these views include, evidence in functional neuroimaging of co-activations of the cerebellum and dorsolateral prefrontal cortex, evidence of deficits in motoric functions in cognitive developmental disorders, experimental evidence of congruence in the cognitive aftermaths of lesions in the neo-cerebellum and the dorsolateral prefrontal cortex, and evidence that in the same developmental disorders there are abnormalities in the cerebellum as well as in the prefrontal cortex (Diamond, 2000, 44).

Dysfunctions (disruptions,) genetic or environmental, affecting the motor system (as in developmental coordination disorder) or the cognitive system (as in the attention deficit hyperactivity disorder [ADHD]) affect both cognitive and motor functions, rather than simply one or the other of the two (Diamond, 2000, 49). Most cognitive disorders come with motor problems:
(1) 50% of children with attention deficit hyperactivity disorder have motor deficits that fit the diagnosis for developmental coordination disorder;
(2) attention-deficit-hyperactivity-disorder children tend to have problems linked to cerebellar disruption (e.g., balance difficulties, difficulty in producing movements consistently in correct distance or timing, weakness in speedily alternating movements);
(3) children with dyslexia or specific language disorders have also movement deficits (e.g., difficulty producing familiar hand postures comparable to those of developmental coordination disorder children);
(4) well over 50% of autistic children have clinically significant motor impairment (e.g., difficulty with simple goal-directed motor behaviour (Autism is a cognitive abnormality, or mental disorder, characterized, among other things, by extreme withdrawal into fantasy and self-absorption).
In a given disorder, we find similar abnormalities in both cerebellum and prefrontal cortex:
(1) ADHD children have both smaller cerebellum and smaller frontal cortex than their normal peers; (2) researchers find the cerebellum in autistic persons to be reduced in size; (3) they report pathology in the neo-cerebellum of autistic individuals; (4) they find in autistic boys decreased serotonin synthesis in the frontal cortex and increased serotonin synthesis in the contra-lateral cerebellum.
The caudate nucleus (a neuroanatomical structure of the motor system important for motor control) and the neurotransmitter, dopamine (a fundamentally cognitive system) both have functions in neural systems subservient to motor and cognitive functions (Diamond, 2000, 49). Studies in functional neuroimaging indicate the close co-activation of the neo-cerebellum (a motor system) and the dorsolateral prefrontal cortex (a cognitive system) during cognitive tasks. An increase of prefrontal activation on a task triggers off a similar increase in cerebellar activation in the contra-lateral hemisphere.
Similarly, a decrease in prefrontal activation triggers off a decrease in cerebellar activation in the contra-lateral hemisphere. In motor learning, the neurons of the cerebellum are at the peak of their activities at the early period of task learning (Flament et al., 1994) or when there is a change in conditions. For instance, the firing of purkinje cells is remarkably higher when a subject moves the handle of a new load than when he moves that of a familiar load (Gilbert & Thach, 1997).
In like manner, people with a cerebellar lesion manifest impairment in reaching with new visual stimuli that prisms provide (Weiner, Hallett, & Funkenstein, 1983). When a motor task is not new anymore, firing in the cerebellum falls. Similarly, cerebellar activities are at their highest when the task is new or when there are changes in the conditions; and the participation of the cerebellum declines as the task gets “familiar or practiced.” Clearly, it is when one has to be focused and show concentration, or when one is on the verge of learning a new thing for cognitive or motor behaviour, that utmost cerebellar engagement is required. The cerebellum is involved both in cognitive operations, such as shifting attention, and in motor activities (Diamond, 2000, 46; Ivry, 1993).
The study by Adele Diamond reveals that the cerebellum may not only be involved in motor operations, but may as well be engaged in cognitive functions. Inversely, prefrontal cortex, by means of its links with cortical and sub-cortical areas critical for the control of movement, may be engaged in both motor and cognitive functions (Diamond, 2000, 50). It therefore follows that cognitive and motor behaviours belong together. It is also the case that the body is crucially involved in the activities of the mind.

References

1) Bartlett, D. & Piper, M. C.,1993; Neuromotor Development of Preterm Infants Through the First Year of Life. PMID: 12(4):37-55.
2) Branco, T. & Redgrave, P., July 2020, The Neural Basis of Escape Behavior in Vertebrates, Annual Review of Neuroscience, Vol. 43:417-439 (https://doi.org/10.1146/annurev-neuro-100219-122527)
3) Burns, Y., O’Callaghan, M, et al., 2004, Movement and Motor Development in ELBW Infants at 1 Year is Related to Cognitive and Motor Abilities at 4 Years, Early Human Development, 80: 1, pp. 19-29.
4) Bushnell, E.W., Boudreau, J.P., 1993, Motor Development and the Mind, The Potential Role of Motor Abilities as a Determinant of Aspects of Perceptual Development. Child Development, 64, 1005-1021.
5) Carpenter, C.R., 1963, Societies of Monkeys and Apes, in Charles H. Southwick (ed.), Primate Social Behaviour, New York, Van Nostrand.
6) Diamond, A., 2000, Close Interrelation of Motor Development and Cognitive Development and of the Cerebellum and Prefrontal Cortex, Child Development 71:1, pp. 44-56.
7) Edelman, Gerald M., 1992, Bright Air, Brilliant Fire: On the Matter of the Mind, Basic Books, New York, NY.
8) Evans, S. M. (Dec. 1971), Behavior in Polychaetes, The Quarterly Review of Biology, Vol. 46, No. 4, pp. 379-405.
9) Flament, D., Ellermann, J., Ugurbil, K., & Ebner, T.J., 1994, Functional Gagnetic Resonance Imaging (fMRI) of Cerebellar Activation while Learning to Correct for Visuomotor Errors, Society for Neuroscience, Abstracts, 20:20.

10) Gilbert, P. F. & W T Thach, W. T., 1977 June, Purkinje cell activity during motor learning, Brain Res .10;128(2):309-28.
11) Goyen T.C., Lui K., 2002, Longitudinal Motor Development of Apparently Normal High-risk Infants at 18 Months, 3 and 5 Years, Early Human development 70, pp. 103-116.
12) Goyen T.C., Lui K., Woods, R., 1998 Feb. Visual-motor, visual-perceptual, and fine motor outcomes in very-low-birthweight children at 5 years. Dev Med Child Neurol 40(2):76-81.
13) Hepper, P., 10 February 2015, Behavior During the Prenatal Period: Adaptive for Development and Survival. Child Development Perspectives Volume 9, Issue 1 p. 38-43
14) Ivry, Richard, June 1993, Cerebellar Involvement in the Explicit Representation of Temporal Information a. Annals of the New York Academy of Sciences, Volume 682, Issue 1, pp. 214-230
15) Klatzky, R.L., Lederman, S.J., & Metzger, V. (1985). Identifying objects by touch: An "expert system". Perception & Psychophysics, 37 (4), 299-302.
16) Merleau-Ponty, M., 1962, Phenomenology of Perception, Colin Smith (trans.), London, Routledge.
17) Merleau-Ponty, M., 1968, The Visible and the Invisible, Claude Lefort (ed.), Alphonso Lingis (trans.), Evanston, Northwestern University Press.
18) Sheets-Johnstone, M., 1999, The Primacy of Movement, Philadelphia, John Benjamins.
19) Sheets-Johnstone, M., 1990, The Roots of Thinking, Philadelphia, Temple University Press.
20) Tarkan, L., 2004, Tracking Stress and Depression Back to the Womb. New York Times, Dec.7.
21) Tinbergen, N. (1968). On war and peace in animals and man. Science, 160(3835), 1411–1418
22) Worldwildlife, 2023, 5 Remarkable Animal Dads (https://www.worldwildlife.org/stories/5-remarkable-animal-dads)
23) Earth Reminder, January 9, 2023, 17 Animals That Protect Their Family and Young Ones (https://www.earthreminder.com/animals-that-protect-their-family-and-young/)