The explanation of the emergence of the cortical streams - We can only guide a ring along a nerve spiral with a zigzag movement, yet the ingenious mediation by the cortical streams creates the delusion of a straight action trajectory shape

Caught In A Line

The explanatory model of all motoric movement actions

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Introduction

The explanatory model of the motoric movement action provides a profound understanding of all functional c.q. behavioural perception processes occurring within any conceivable goal-directed motoric action. Nonetheless, challenges arise in its implementation within the scientific community, given the intrinsic nature of a new paradigm within a complex dynamic system. It necessitates the simultaneous integration of several innovative mind steps, including:

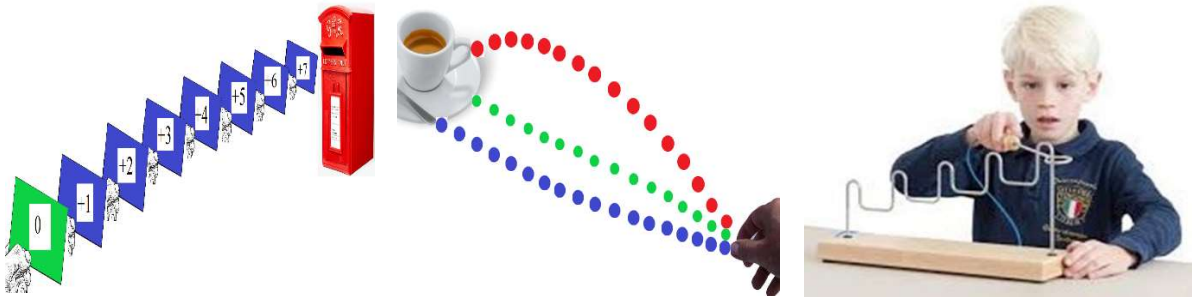
1. The scientific evidence showing that, as part of a tactical (ecological) consideration, we always first create a perceptual image of a latent action trajectory shape before we actually start to transport a ring from A to B along a spiral.
2. The understanding of the necessity of a compelling collaboration between an internal and an external focus in every motor action. The movement of the ring, within the game of the nerve spiral, in relationship to the external action trajectory shape can solely be perceived outside the body and is only caused by perception of movements within the body, reaching only to the outer surface of the handle belonging to the ring. Due to their exclusive domains these perceptions are incompatible.
3. The assumption of the crucial role of the movement of the ring over the action trajectory shape as the essence of this task, wherein the external focus must be hierarchically considered primary. This assigns a secondary status to the internal focus and demonstrates that no motor plan is ever conducted.
4. The explanation of how the primary focus generates the *tau*-value and how the secondary focus needs to obediently follow the development of that *tau*-value within a strict *tau*-coupling process, providing the first ecological explanation for anticipating all unexpected events during an action.
5. The insight that when we move the ring within an action trajectory shape from the beginning to the end of the spiral, it is a subjective choice from the perspective of the ring. With the same arm action, all other parts of the arm (elbow, hand, upper arm, etc.) and all parts of the handle with the ring move in a unique action trajectory shape. This demonstrates that when moving an arm holding an action object, there is a causal relationship between the perception of internal and external movements, but an explicit relationship only emerges when we subjectively "choose" the ring as the action object[1].

[1] https://www.researchgate.net/publication/376888581_The_nerve_spiral_demonstrates_that_random_motor_activity_implicitly_generates_an_internal_and_external_focus_and_provides_scientific_evidence_that_the_external_focus_can_guide_the_action_due_to_the_in

As a concluding step in this chapter, we delve into the functioning of the cortical streams when playing the "nerve spiral" game in which the entire idea of the game is exactly based on how the cortical streams operate. It provides a comprehensive understanding of why they must play such a significant role and why they have evolved ecologically and evolutionarily. Additionally, it precisely explains how they mediate two autonomous deviation processes within every motor action: the zigzag process and the accordion process[2].

1. The tactical movement action (TMA) in relationship to the nerve spiral encompasses the construction of a perceptual image of a latent action trajectory shape between the beginning and the end of the spiral

Supported by scientific evidence[3], the explanatory model delineates that the execution of any motor action involves two distinct sequential phases: the tactical movement action (TMA) and the actual movement action (AMA). The tactical movement action is focused solely on planning the upcoming action and must be finalized before any actual execution occurs. An essential aspect of the tactical movement action within the nerve spiral game is to create a perceptual image of a latent action trajectory shape between the beginning and the end of the spiral over which the empty space within the ring needs to travel and will prevent the touching of the edge of the ring with the spiral.
The explanatory model demonstrates that during this phase, we are indeed largely focused on all physical dimensions of the end of the spiral, implicitly leading to the completion of the motoric action, aligning with much scientific research. However, with the recognition that a perceptual image of a latent action trajectory shape is being created, the explanatory model also arrives at a conclusion that is not yet recognized within the scientific community. The construction of this perceptual image of a latent action trajectory shape between the beginning and the end of the spiral also reveals that we strategically determine beforehand whether the space between these points can be filled or bridged by a contiguous line encompassing all dimensions of the ring.



Images: Within letter posting and grasping we also construct a perceptual image of a latent action trajectory shape during the tactical movement action (TMA) like in any conceivable motoric action, over which *all dimensions* (!) of the action object (i.e., the letter and the fingertips) will enable the action to succeed. During the actual execution within the actual movement action (AMA), akin to the ring in relationship to the nerve spiral, one must perceive the movement of the action object during the bridging process, as only the ring, the letter, and the fingertips are going to move c.q. can be moved egocentrically. Within the images, it is particularly noticeable that we actively perceive whether the entire path through all dimensions of the fingertips, the ring, or the letter can be filled in a continuous action trajectory shape c.q. we mainly perceive the "nothingness" in the vista in front of us. Because only in that void there is (empty) space to successfully execute an action.

[2] In previous publications, this has been referred to as the harmonica process.
[3] https://www.researchgate.net/publication/376051657_The_nerve_spiral_provides_the_scientific_evidence_that_our_primary_attention_is_directed_towards_the_movement_of_the_ring_within_a_perceptual_image_of_a_latent_external_action_trajectory_shape

In addition to unveiling this novelty, it is also revealed that when the tactical movement action has been finalized, we are primarily going to focus on the movement of the ring from the beginning to the end of the spiral. This contrasts with the traditional perspective of science, which remains constantly focused on the end of the spiral. During the actual movement action (AMA), our main concern is the egocentric bridging process of the ring, guiding it over the perceptual image of the latent action trajectory shape which is exclusively determined during the tactical movement action. So when the factual execution starts the end of the spiral itself is not any longer the focal point, but rather the movement of the ring towards it c.q. the bridging of the void (!) between the current location of the ring and the end of the spiral forms the essence of the action.
Another revolutionary novelty aligns with the previous thought. Although reaching the end of the action trajectory shape will eventually lead us to the completion of this task, the explanatory model, supported by scientific evidence, demonstrates that we also tactically determine beforehand whether the entire (!) space between the beginning and the end of the spiral can be filled by a continuous line segment shape of all dimensions of the ring. This means that all positions P between the beginning and the end of the spiral are observed as actively and as crucially as the endpoint of the action trajectory shape. This realization provides a solid foundation for the fact that during the actual movement action (AMA), we are solely focused on traversing the latent positions P associated with the action trajectory shape. This implies that upon reaching position P(x), for example, somewhere midway along the spiral, we are mainly focused on the perception of three positions: position P(x-1), where we just came from, position P(x), where the ring is now, and position P(x+1), the perception of the next position where we need to move the ring. In this phase, we are primarily engaged in the aforementioned bridging process and only monitor whether the gap between the beginning and the end of the spiral is closing. This also reveals another essential ecological novelty, showing that during the actual movement action (AMA), we are indeed not concerned with the end of the spiral itself, but only with reducing the number of latent positions P within the action trajectory shape.

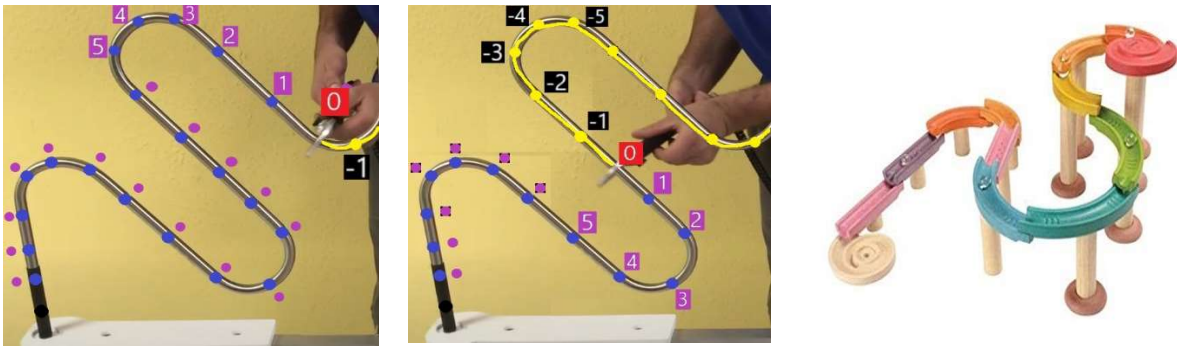
2. <u>The reciprocal dependency between the internal and external focus results in absolute deviations of the ring within the perceptual image of the latent action trajectory shape</u>

The explanatory model of the motoric movement action unequivocally illustrates within the context of moving a ring along a spiral that two foci always arise[4]. We can only guide the ring along an external action trajectory with a focus on internal movements. These foci are autonomous because the (perception of) movements occur strictly separated inside and outside the body, rendering them incompatible. As the explanatory model now demonstrates that the movement of the ring within the external action trajectory will fulfil the essence of the task, a peculiar phenomenon of reciprocal dependence emerges. Only internal motor movements, reaching only up to the outer surface of the ring's handle, will be able to move the ring externally along an action trajectory. However, the progress of the ring within that action trajectory will, as the primary focus, dictate the secondary focus. The inevitable consequence of this observation is that it is not a question of whether the ring will deviate within the perceptual image of the latent action trajectory, but rather an absolute certainty. This certainty is logically inherent in the autonomous nature of the perception of both foci, which essentially explains the entire essence of this game.

3. <u>Within the actual movement action (AMA) the cortical streams will have to mediate the continuous flow of absolutely emerging deviations</u>

[4] https://www.researchgate.net/publication/373195543_The_execution_of_a_nerve_spiral_requires_the_compelling_cooperation_between_an_internal_secondary_and_an_external_primary_focus_-_The_clarification_of_all_grasping_actions

If we now combine the two preceding paragraphs and proceed to actually execute this game, our main endeavour will primarily become to initiate the bridging process of the ring in which the perceptual image of the action trajectory shape serves as an open yet compelling guiding[5] phenomenon. This means that we aim to *step by step* (!) reduce the distance between the beginning and the end of the spiral, starting with the first step of moving the ring from position P(0) to position P(+1).



Images: The explanatory model of the motoric movement action provides a tangible example with the marble in the marble run, illustrating the continuous reciprocal perception-action coupling within any conceivable motoric action. From the perspective of the marble's current position, one can perceive the relationship within the entire marble run, and vice versa, one can perceive the relationship with the marble's current position from the perspective of the entire marble run. In the nerve spiral, this reciprocal phenomenon is also clearly evident and present in a similar manner. Because in our worldly dimensions, it is just a mere fact that all positions P of any moving object, including a ring attached to a handle, must emerge from each other, meaning that the perception of the ring's movement is always captured in one single line segment shape. In which the current position P(0) of the ring will always form the precise separation between the already manifest positions P(-x) and the still latent positions P(+x). In which could be further added that the perceptual image of the still latent action trajectory involves future projections that must arise from the observation of the movement of all subsequential manifest ring positions prior to the current position P(0).

The perceptual image of the entire action trajectory shape thus also represents an image of its very beginning, and at the outset of the action, we will try to guide the ring to follow that beginning. However, even during the bridging to this first position, due to the aforementioned mutual autonomous dependency of the internal and external focus, the ring will inevitably deviate[6] from the perceptual image. It is an absolute factual given that cannot be avoided, and it would quickly lead to chaotic action trajectories[7] if there were not a system capable of mediating these deviations.

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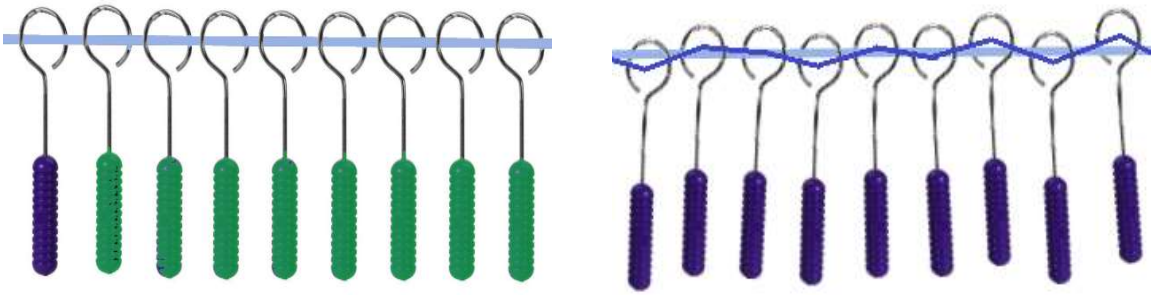
[5] When one delves into the explanatory model, it becomes apparent that creating an action trajectory shape is necessary to initiate any motor action, but it does not need to be precisely followed. This underscores the essence of a very frugal system. In the early stages of an action trajectory, deviations from the intended path are often acceptable as long as the endpoint is more accurately defined. However, with the nerve spiral, a continuous careful execution is required from the outset, making this task much more complex than most other motor actions.

[6] As indicated in footnote 5, this precisely exemplifies an optimal parsimonious model, where precision isn't necessary, but merely provides a general (albeit compelling) direction. The nerve spiral deliberately plays with this concept, demonstrating that precision is indeed required to avoid touching the spiral. However, the ratio between the ring and the spiral allows for some deviations, indicating that while you can execute action trajectory shapes very precisely, you can never produce an identical action trajectory shape. If that was required, the execution of this task would become impossible. The task, where you only need to reduce the distance, opens up countless more possibilities and shows that the bridging process is just one part of the task.

[7] The description of the cortical streams within the motoric movement action *car driving* is particularly notable in this regard. If deviations from the driving lane on a highway do not lead to corrections the exponential product will soon lead to accidents. Deviation upon deviation will cause an exponential grow due to the fact that they belong to two complex subsystems.



Images: The perceptual image of the latent action trajectory shape, constructed within the tactical movement action (TMA), depicts a smooth line segment shape. However, during the actual execution, the ring will definitely deviate at every position P within that perceptual image due to the autonomy of the internal and external focus. This necessitates redirecting the ring back to the original perceptual image to prevent a stacking of deviations. In practice, this means that a corresponding adjustment in the remaining part of the latent action trajectory shape must be made from the micro-deviation[8]. Similar to a marble in a marble run, the ring in relationship to the action trajectory shape will become a part of a continuous mutual perception-action coupling, in which the dorsal stream primarily monitors the actual position of the ring towards the action trajectory shape, and vice versa the ventral stream primarily monitors the complete action trajectory shape towards the actual position of the ring. In the nerve spiral, it is abundantly clear that this dual reciprocal coupling inevitably leads to deviations or touches of the ring with the spiral, and that the ring can only follow the action trajectory shape in a zigzag motion. However, the ingenious mediation of the cortical streams ensures that the action trajectory shape appears deceptively straight.

Within there the explanatory model of the motoric movement action illustrates that the execution of action trajectory shapes indeed encompasses the essence of motor tasks, and that success hinges on the meticulous management of deviations of the action object within the action trajectory shape. Therefore, it ideally presupposes a mutually reinforcing system that continuously monitors the relationship with the action trajectory shape from the current position of the ring, and conversely, constantly monitors the actual position of the ring from the perceptual image of the complete action trajectory shape. The explanatory model thus implies a rather heavy correction system, and based upon current scientific literature, it concludes that the conceptual steps within the explanatory model precisely presuppose what is described (neuro-)scientifically regarding the processing of perceptions: namely, the functionality of the dorsal and ventral stream. At every time *t* or at every position P, all observations are processed by the ventral and dorsal stream in such a way that deviations simply cannot escape attention. The ventral stream primarily processes deviations from the perceptual image of the entire action trajectory to the actual position of the ring, while the dorsal stream does so vice versa, primarily from the actual position of the ring to the perceptual image of the entire action trajectory shape. The mediation of these two processing streams leads to continuous micro-adjustments of the original perceptual image of the latent action trajectory shape, happening so ingeniously and swiftly that the absolute zigzag and accordion-like deviations barely stand out, making the executed action trajectory shapes appear deceptively straight.

4. <u>The cortical streams mediate two autonomous groups of deviations within every conceivable action</u>

[8] You can speak of micro-adjustments or of updating c.q. renewing the perceptual image of the remaining latent action trajectory.

The preceding paragraphs extensively delve into the fact that the action object will inevitably deviate from the perceptual image of the latent action trajectory shape, determined within the tactical movement action, when the action is actually performed. The occurring deviations of an action trajectory involve two autonomous phenomena[9], which relate to the words *line* and *shape* in the compound term *line segment shape*. The explanatory model demonstrates that they are observed and processed completely separately, yet simultaneously. Driving and cycling (without hand brakes) show, beyond any reasonable doubt, that the deviations in relationship to the line and shape are autonomously observed and processed.

Images: The deviations within each action trajectory shape involve two autonomous phenomena, as indicated by the explanatory model, referred to as the zigzag process and the accordion process. In car driving and cycling (without hand brakes), it becomes immediately apparent that steering exclusively influences the *movement within the shape* (!) of the action trajectory. This defines the explanatory model as mediating deviations along the x-axis and causing the zigzag process. Additionally, it becomes equally evident that using the pedals exclusively influences the movement *within the line* (!) of the action trajectory shape. This defines the explanatory model as mediating deviations along the y-axis and causing the accordion process. Therefore, in driving, it becomes crystal clear that (processing the) perceptions in relationship to the shape have absolutely nothing to do with (processing the) perceptions in relationship to the line. In which it is essential to note that processing observations regarding filling the latent line with the manifest positions P within the external (primary) focus solely involves the perception of the *tau*-value and is thus actually generated solely by the pedals of the car or bicycle. Only the speed within which the line is filled determines the duration of the action, thus finalizing the action.

Deviations along the length axis or y-axis of the action trajectory shape involve deviations of the movement of the action object over time. They are related to determining the *tau*-value[10] within a motor action, and deviations of the action object along the line can be characterized as an accordion process. Deviations along the width axis or x-axis of the action trajectory shape involve deviations of the movement of the action object within the shape and can be characterized as a zigzag process.

5. The zigzag process and the accordion process during the actual movement action (AMA) when executing the nerve spiral game

The explanatory model of the motoric movement action reveals that the zigzag process and the

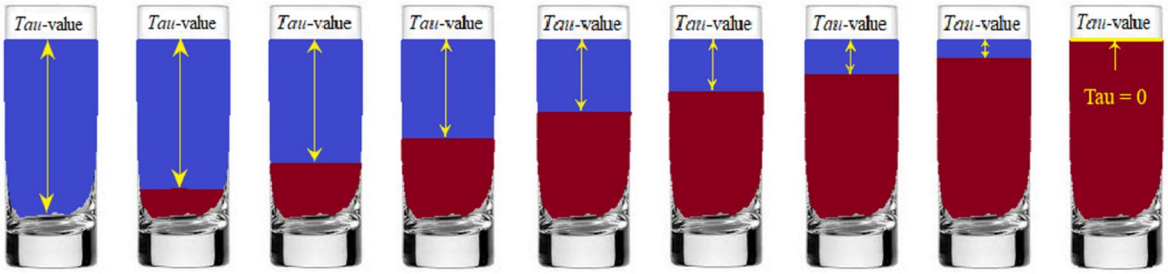
[9] In essence, they form two complex subsystems within the larger phenomenon of the whole cortical stream operation, revealing that perceiving deviations c.q. the processing of deviations leads to an unprecedented variety of hybrid perception processes. This article does not delve further into this complexity.

[10] https://www.researchgate.net/publication/375902347_The_execution_of_an_external_action_trajectory_shape_over_which_the_ring_moves_dictates_all_internal_sensorimotor_perception_processes_within_the_nerve_spiral_The_tau-coupling_process_shows_that_we_do

accordion process are inherent in every conceivable action[11]. However, in other actions, demonstrating this is much more challenging than within the aforementioned cycling or car driving. Nevertheless, in all actions, one must consider separate pedals and a steering wheel that autonomously influence the construction and mediation of the latent action trajectory shape, which will then be processed through hybrid forms of these phenomena. While the zigzag process (the steering process) can be adequately depicted in animations for most actions, the accordion process cannot.

Images: The zigzag process in any conceivable action can easily be represented in an animation. Due to the fact that the primary focus can only be executed by the autonomous secondary focus, the action object (respectively, the ring, the pointer, and the spoon bowl) will definitely deviate from the perceptual image of the latent action trajectory shape in width. Moreover, the essence of the game in relation to the nerve spiral is precisely the fact that a ring will "zigzag," making the nerve spiral just as convincing as driving a car or riding a bike concerning the explained phenomena.

The accordion process (the pedal process) when executing a nerve spiral is difficult to depict in an animation because it involves compressions and elongations of time[12]. Nonetheless, similar to driving a car, you must realize that you can never move the ring identically in time along a spiral. You can quickly observe empirically that they will vary infinitely within certain fluctuation boundaries.



Images: In the motoric movement action *pouring*, the accordion process is still difficult to capture in an animation. However, it can be factually stated that when filling a glass, as a very rare exception, there are absolutely no deviations within a zigzag process. The cortical streams are fully dedicated to the accordion process during pouring.

[11] While this imposes greater demands on organismal development, conversely, it allows for a compelling demonstration of its seamless integration within an ecological framework. The dichotomy that distinguishes a separate x- and y-axis component actually constitutes the breakthrough that allows us to reduce highly complex perception processes to such seemingly simple phenomena.

[12] Wherein it should be noted for the record that the pointer does not move back within the action trajectory shape.