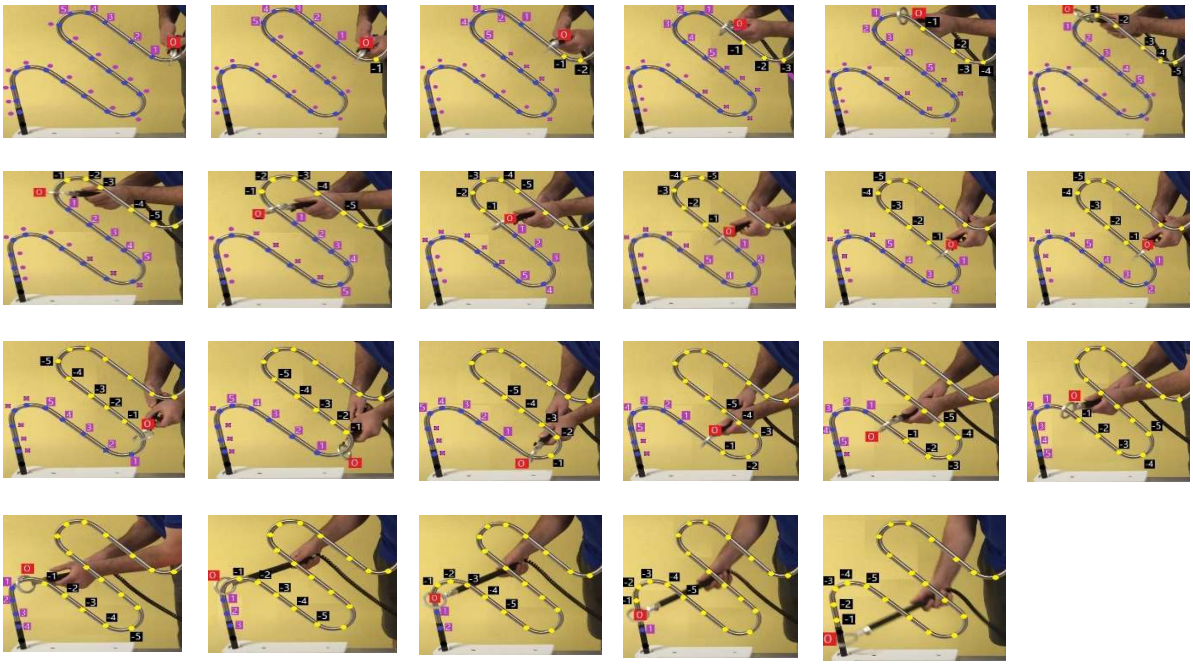
The execution of an external action trajectory shape over which the ring moves dictates all internal sensorimotor perception processes within the nerve spiral; The *tau*-coupling process shows that we do not need a motor plan



Caught In A Line
The explanatory model of all motoric movement actions

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Introduction

If, within the game of nerve spiral, we want to move a ring attached to a stalk over a spiral, the explanatory model of the motoric movement action has demonstrated that solely the movement of the ring embodies the core of the task and of our egocentric intention. Within there scientific evidence has been provided that, prior to the actual execution of any conceivable action, we first create a perceptual image of an entire latent action trajectory shape over which we can successfully move (all the dimensions of) the action object[1], in this case, the ring, from the beginning to the end of the spiral[2]. Although it may seem that this doesn't happen in this game due to the already physical presence of a spiral, that is incorrect. Creating a perceptual image of a latent action trajectory shape is an implicit part of our perception processes because without such an image, you simply wouldn't be able to begin the actual execution.
However, science has so far completely missed all the essentials in regard to the action trajectory shape and only indirectly noticed that (action) paths are formed between the end effectors c.q. the action object, and the goal of the action. While it can be quickly established that all positions P of an action object are invariably constrained within one single line segment shape within any conceivable motor action. This should have led to several revolutionary insights:

1. Factually, the action object invariably fills an action trajectory shape in the same way as a marble moves within a marble run, in which the perception of the marble's current location always marks the exact boundary between the manifest and latent parts of the perceptual image of the action trajectory shape.

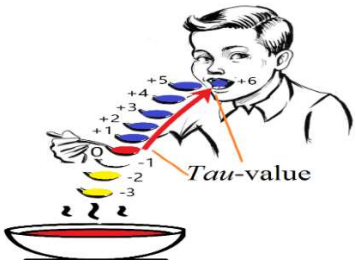
2. All latent positions P of the action object effectively always have to sprout from the manifest positions P, or effectively always have to originate from the manifest part of the action trajectory shape.

3. Within the action trajectory shape, it factually always becomes apparent when the action is coming to its end due to the perception of the disappearing of the complete latent action trajectory shape c.q. the *tau*-value approaching to zero[3].

So, although the explanatory model demonstrates that the perception of the movement of the action object within the perceptual image of a latent action trajectory shape encompasses an autonomous

[1] Science and the explanatory model of the motoric movement action use the terms 1. end effector and 2. action object for the same phenomenon. For example, in eating with a spoon, science refers to the spoon bowl as the end effector, whereas the explanatory model designates the spoon bowl as the action object.
[2] https://www.researchgate.net/publication/372290282_Grasping_encompasses_two_consecutive_autonomous_phases_-_The_scientific_proof_that_we_tactically_construct_an_action_trajectory_shape_prior_to_the_factual_execution_of_that_exact_same_action_trajector
[3] https://www.researchgate.net/publication/374288678_Within_the_nerve_spiral_the_essence_of_the_task_is_solely_executed_by_the_movements_of_the_ring_Within_the_primary_focus_the_ring_moves_like_a_marble_in_a_marble_run_producing_the_tau-value

phenomenon and thus exclusively is going to perform the essence of the task, the explanatory model also clearly shows that the action object itself absolutely isn't capable to move. Even when grasping with the fingertips, the explanatory model shows that the movement of the fingertips along an external action trajectory shape on the outside of the body can't be moved by the outside of the fingertips themselves. So even within grasping, the movement within the external (primary) focus can only be executed with movements that must always be perceived within the body, within the internal (secondary) focus. In the present action, where a ring moves at an obvious distance from the body, which shows obvious commonalities with the spoonbowl during eating, this insight will be easily recognized, and it will also be easy to determine that the ring can solely be moved along an external action trajectory shape with movements within the body that solely reach up to the ring's handle[4,5].



Images: The explanatory model of the motoric movement action shows, beyond any reasonable doubt, that there is no need for a motor plan to initiate an action. It demonstrates that all sensorimotor perception processes within the internal (secondary) focus simply need to follow the lead of the external (primary) focus. This clarification, which does not require any hierarchy, underscores our freedom from being tied to specific sensorimotor movements and this perspective is in perfect alignment with an ecological approach to motor actions.

In summary, this leads to the conclusion that the phenomenon of the perception-action coupling is solely related to the perception of movement within the external (primary) focus. Only within this focus, a perceptual image, consisting of the future positions P of the action object, is filled by the future actual positions of that exact same action object. Also, only within this focus, the *tau*-value can be perceived. This publication now explains how the perception of the *tau*-value should be linked to the internal (secondary) focus and extensively discusses the consequences this has for the perception processes within the internal (secondary) focus c.q. for all sensorimotor actions.

A universal *tau*-coupling is present within every conceivable motoric action

The explanatory model, in conjunction with previous publications, demonstrates that the *tau*-value can be universally observed within any conceivable action. This aligns with the findings of D.N. Lee, who showed that in many actions, a gap c.q. a line segment shape between the action object and the end goal[6] gradually approached zero and eventually completely disappeared. While Lee's discovery

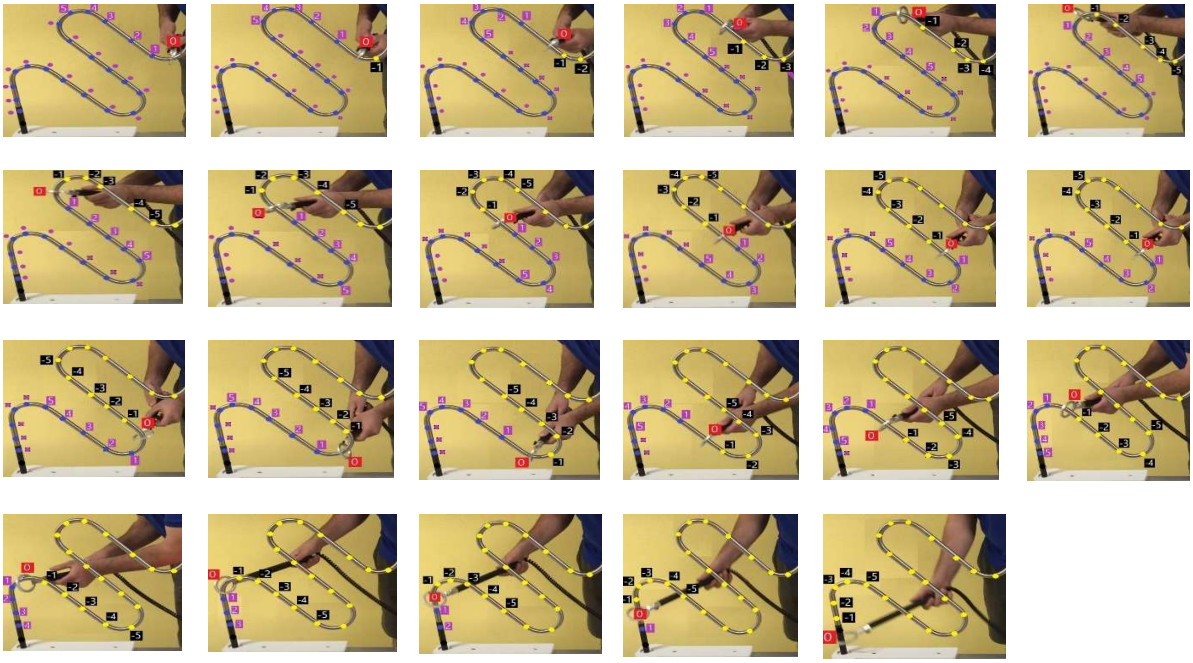
[4] https://www.researchgate.net/publication/373195543_The_execution_of_a_nerve_spiral_requires_the_compelling_cooperation_between_an_internal_secondary_and_an_external_primary_focus_-_The_clarification_of_all_grasping_actions

[5] This intriguing dualism demands our utmost attention as it presents the essence of our perception processes. The internal (secondary) focus not only meticulously tracks the movement of the action object within the action trajectory shape but is also the instigator of this movement. It might sound paradoxical that the very action you initiate creates your own reliance. However, this is precisely what occurs because it is an implicit fact that when you move something inside your body, an external part of your body will inevitably move within an action trajectory shape on the outside of your body.

[6] In the original work, examples include a long jumper leaping towards the take-off bar, a Northern Gannet diving toward the water surface, and a bee heading towards a flower.

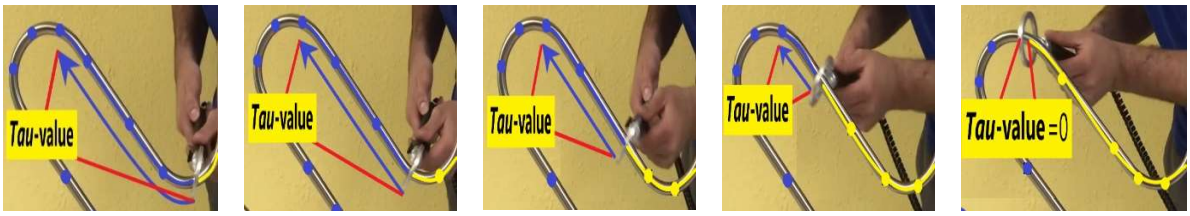
generated significant interest in the scientific community, a major breakthrough remained elusive. Lee connected this crucial *tau*-value to various irrelevant other possible *tau*-values without realizing that multiple foci could be distinguished and linked within a single motoric action.
However, this insight proved to be highly relevant for the explanatory model of the motoric movement action. By understanding that the movement of an action object along an action trajectory shape outside the body is a completely autonomously observable phenomenon, and can only be executed by a completely different autonomously observable phenomenon within the body, it is now possible to explain precisely which phenomena should be connected and how the *tau*-coupling is established. The perception of the *tau*-value approaching zero within the external (primary) focus should ultimately guide the observations within the internal (secondary) focus.

The *tau*-coupling when moving a ring over a nerve spiral



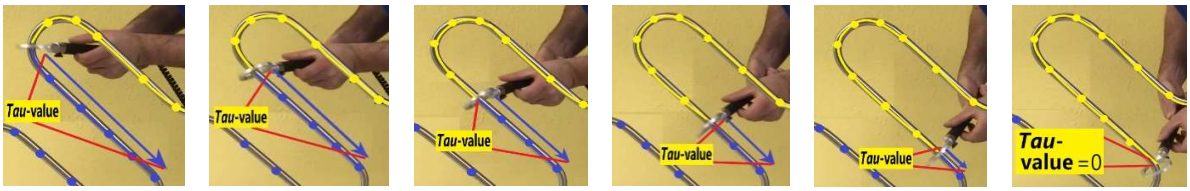
The explanatory model of the motoric movement action encompasses a universal explanation of any conceivable motor action and knows no exceptions. So, also within the nerve spiral, we first construct a perceptual image of an entire latent action trajectory shape over which the action object, in this case, the ring, will have to move, and only then do we actually execute it. The ring will then, carefully traverse all planned latent positions P, similar to a marble moving within a marble run, in which the current position P(0) of the ring will always mark the precise separation between the manifest part and the latent part of the action trajectory shape.
So, in the same universal way, the traversing of the spiral will cause the perception-action coupling and the approaching of the *tau*-value to zero at the end of the spiral will ensure that the ring comes to a halt in time. However, there is a significant difference compared to other motor actions. The task within the nerve spiral involves the unique aspect that all positions P between the starting point A and the endpoint B of the action trajectory shape are very compellingly present in the nerve spiral. The crucial point of the game is that the ring is not allowed to touch the spiral. If it does, a bell or buzzer goes off, and you are disqualified. So in this action, much more attention must be paid to all positions between A and B, making this game actually host a continuous *tau*-coupling process. The complete designation of this process is not relevant in this explanation and has been omitted for the sake of brevity. Solely the *tau*-coupling process of the most noticeable *tau*-values that clearly arise in this demonstrated game will be clarified.

a. *Tau*-coupling process 1



From the moment we commence the execution of the nerve spiral, as shown in the images, the ring first ascends a portion of the action trajectory shape until a bending point occurs in the spiral. At this point, it is crucial for the first time to observe a *tau*-value and see it approach zero. The straight path is relatively easy to traverse with a constant shape of the ring. However, as we reach the curve, the autonomous components of the line and shape of the ring's action trajectory shape, at each progressing position P, must be precisely adjusted to the spiral. This means that the entire first curve must be navigated very carefully because, during the movement, the ring also needs to be rotated. Within the internal (secondary) focus, adjustments to the handle, where the ring is attached, must be conveyed so that the ring can smoothly and evenly approach that challenging curve. In many motor actions, it can be concluded that, after a phase of relative acceleration during the bridging phase, there is a relative deceleration of the action object being manipulated as a *tau*-coupling process within an action is finalized[7].

b. *Tau*-coupling process 2

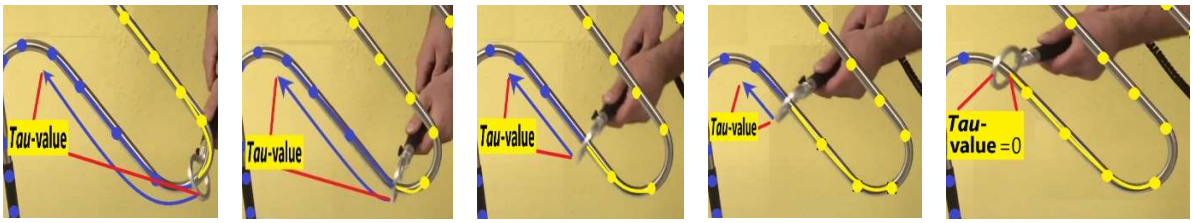


However, after this first curve, there is another straight section, and the movement of the ring can be accelerated again. Until the next curve, it becomes crucial for the second time to observe a *tau*-value and see it approach zero, as the challenging process in the next curve repeats itself afterward. Within the internal (secondary) focus, adjustments to the handle, where the ring is attached, must be conveyed so that the ring can once again smoothly and evenly approach that challenging curve. In many motor actions, it can be concluded that, after a phase of relative acceleration during the bridging phase, there is a relative deceleration of the action object being manipulated as a *tau*-coupling process within an action is finalized[8].

c. *Tau*-coupling process 3

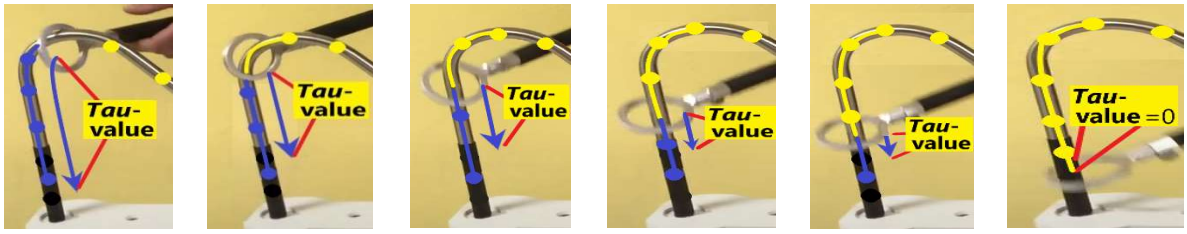
[7] As explained in this section, the explanatory model underpins the notion that within many motoric actions a bell-shaped profile is capable to occur when plotting the execution speed of an action against time in a graph. In many actions, it is indeed typical that after a short initiation phase, a smooth and faster bridging phase occurs, followed by a more precise phase towards the end. Although the model generally supports these principles, it doubts the emergence of a highly proportional bell shape in all cases. Additionally, the explanatory model illustrates that this is certainly not the case for all actions. In situations where you need to create a crescendo at the end of the action, such as clapping your hands or defending against an attacker with a punch or a kick, you must accelerate the relevant body parts in the final phase. Similarly, in many ball sports, achieving a necessary "crescendo" can only be accomplished if, after an initial relatively slower catching phase, you maximize acceleration of the ball towards the end of the action trajectory shape.

[8] See note 7.



The second curve must also be navigated very carefully because, during (!) the movement, the ring must be rotated. However, after the curve, there is another straight section, and the movement of the ring can be accelerated again. Until the next curve, it becomes crucial for the third time to observe a *tau*-value and see it approach to zero because afterward, the challenging process repeats itself in the next curve. Then, within the internal (secondary) focus, adjustments to the handle, where the ring is attached, must be conveyed so that the ring can once again smoothly and evenly approach that challenging last curve. In many motor actions, it can be concluded that, after a phase of relative acceleration during the bridging phase, there is a relative deceleration of the action object being manipulated as a *tau*-coupling process within an action is finalized[9].

d. <u>*Tau*-coupling process 4</u>



After the third curve, the final part is a straight section, and the movement of the ring can be accelerated again until the end of the spiral. When the ring reaches the isolated (black) section of the spiral, it can no longer touch the spiral, and the entire action is completed. Then, there is no need to slow down the ring anymore, and in that regard, there are no more observations required within the internal (secondary) focus towards the handle.

<u>The perception processes within the internal (secondary) focus in regard to the sensorimotoric movements towards the outer surface of the handle attached to the ring</u>

The explanatory model of the motoric movement action presents a completely new paradigm. It's built on the factual observation that an autonomous internal movement of any organism will implicitly lead to an autonomous external movement of the outside of that organism. In which it is also a fundamental fact that the movement of any given position P on the outside of that organism will need to sprout from each other c.q. that all those positions P will always be interconnected. Which factually means that they will always create a line segment shape. So the most important conclusion reveals that these two movements are implicitly connected, but that the perception processes mediating these movements are completely autonomous and independent of each other[10].

[9] See note 7.

[10] While the explanatory model of the motoric movement action has a strong suspicion that the earliest organisms initially engaged in random motor movements, it demonstrates that after millions of years of evolution, the roles of internal and external have reversed. It's much more efficient for organisms to work from an action trajectory shape rather than relying on random motor movements. Creating an action trajectory shape, for instance, from fingertips to a coffee cup or from a spoon to a soup bowl, is by far more effective and efficient than repeatedly generating random internal movements with the hope that the fingertips will reach the coffee cup or the spoon will reach the soup.

This aforementioned clarification doesn't pertain to the paradigm itself but to its foundation. In regard to which the explanatory model notes that these phenomena occur regardless of which focus you centralize. However, the new paradigm lies in the novelty that you can fully execute a motor action by focusing solely on creating and completing an external action trajectory shape. In contrast to the idea that early organisms primarily started by emphasizing arbitrary motor movements within the body and then observing the external result, the explanatory model states that these roles have now been completely reversed after millions of years of evolution. So within the nerve spiral, we primarily perceive the dominant movement of the ring within the external (primary) focus and guide its progress with motoric movements within the internal (secondary) focus, which only reach the outer parts of the handle attached to the ring.
Thanks to this new paradigm, the explanatory model of the motoric movement action is now capable of identifying all functional perception processes within any conceivable motoric action, thus enabling it to describe all sensorimotor perception processes within any conceivable motoric action. In this section, a list of the most crucial insights will be outlined, with a focus on challenging many prevailing assumptions within the scientific community.

a. Visuomotoric perception processes

Of course, science views both visual perception and motor action as essential in executing actions, assuming they share a close relationship. Which, out of a single-focus perspective, led to the rather artificial birth of the term *visuomotoric* perception processes. While one might argue that the term provided some direction in scientific thinking, its content remained vague and never led to any significant consensus.
The explanatory model now emphatically reveals that this term represents an erroneous way of thinking within the scientific community and that it must be expunged from the realm of scientific discourse. The explanatory model effectively illustrates that, in practice, when visual perception comes into play, its exclusive role is to contribute to the perception-action coupling taking place within the external (primary) focus, and has no bearing whatsoever within the internal (secondary) focus. In plain terms, visual perception, by itself, will never induce any movement.

b. Sensorimotoric perception processes

Just like the concept of visuomotoric perception processes, science introduced the term *sensorimotoric* perception processes. In contrast to the previous paragraph, the explanatory model provides a significantly broader description in regard to those sensorimotoric processes than previously presumed in the scientific community and shows unequivocally that we even can execute motoric actions solely through proprioceptive perception, expanding our capabilities beyond what science has traditionally acknowledged. Many actions can be executed with ease, albeit less efficiently, in complete darkness or without any visual input[11,12]. Consider activities like clapping your hands behind your back, unlocking

[11] Motoric displacement actions from point A to point B, such as walking, cycling, rowing or car driving, can hardly be executed without visual input. However, a person with 100% visual impairment is perfectly capable to navigate through their home freely and by foot travel significant distances outside using a cane. This cane vividly demonstrates that our perception processes are not solely focused on reaching point B but are also deeply engaged in the bridging process. With the cane, the individual is essentially "observing" (feeling) whether the next position P (+1) within the perceptual image of the latent action trajectory shape, is accessible and can be occupied by their body. This observation mirrors what was mentioned earlier regarding the spoon's journey towards the mouth or towards the plate of soup.
[12] Think also of inserting a car key into the ignition. In an unfamiliar car, we need visual perception several times initially to create an action trajectory shape, but after a few repetitions, we do it entirely blindly.

a door with a key at night, or swatting an annoying mosquito behind your ear. In all these actions, the *tau*-value within the external (primary) focus can be entirely perceived proprioceptively[13]. Additionally, the explanatory model unmistakably reveals that within any conceivable action, an external (primary) focus, operating within a strict *tau*-coupling process, can only be executed by an internal (secondary) focus. It highlights that this secondary focus is exclusively perceived within the body, and therefore, all perceptions within this focus are inherently of a sensorimotoric nature.

c. The internal (secondary) focus has an indispensable interdependent relationship with the external (primary) focus.

So, the explanatory model revolves around an entirely new paradigm, which reveals that within the execution of a single action, implicitly two autonomous foci arise in relation to two autonomous movements. These two autonomous foci must enter into a mandatory collaboration to accomplish the action successfully. The collaboration involves the motor processes within the internal (secondary) focus, which alone can enable the action object to move, compellingly following the movement within the external (primary) focus. When one is first confronted with this concept, it may evoke an extremely paradoxical feeling. How can a phenomenon that is inherently essential to the action and only solely can ensure the action's success be so dependent on another autonomous phenomenon that it itself brings to life? However, with further contemplation, one will come to realize that it is a remarkable evolutionary discovery and that it provides an explanation for all functional perception processes within any conceivable motor action. Moreover, the explanatory model clearly elucidates how this phenomenon must have developed from the earliest stages of evolution, but further details are omitted here for the sake of brevity[14]. It is emphasized that these two phenomena are entirely interdependent, and without either one, no motor action can be successfully executed.

d. No motor plan and no hierarchy

If the scientific community were to acknowledge that the perception of the movement of an action object within an action trajectory shape, within the external (primary) focus, has the capability to guide the entire execution of any conceivable motoric action, several challenges within science would be resolved immediately. If it were accepted that, prior to the execution of a motor action, we create an all-encompassing and directing perceptual image of an external latent action trajectory shape, the need for a motor plan would instantly disappear. Which would lead to the understanding that all sensorimotor movements simply serve the external (primary) focus, and as a result, there would be no need to recognize hierarchy within the sensorimotor structure. Then all sensorimotor activity can hierarchically be regarded at the exact same level which just obediently have to carry out the task within the external (primary) focus.

e. The explanatory model reflects an optimal ecological approach

[13] https://www.researchgate.net/publication/342715828_The_complete_functional_explanation_of_limb_position_and_movement_in_relationship_to_the_proprioceptive_perception_-_The_behavioural_perception_processes_within_clapping_behind_your_back

[14] In future publications, where the precise role of the cortical streams in regard to this phenomenon will be explained, this evolutionary development will be further elucidated. In brief, the explanation will demonstrate that organisms initially started with just random (!) movements within their bodies to move a part of the external body somewhere. After millions of years, we 1. realized that this specific external body part, like a marble in a marble run, fills an external action trajectory shape, and 2. gained a solid understanding of the involved motoric movements. This understanding allowed us to reverse the roles, shifting from initiating movements from inside the body to initiating them from the outside. This line of thinking even goes so far as to suggest that the cortical streams within an organism have evolved evolutionarily to precisely mediate this relationship of a marble-marble run in a double and reciprocal process.

In the current scientific paradigm, there is a consensus that motor planning exists, but there is absolutely no agreement on how such a motor plan is developed. While it's acknowledged that creating a motor plan demands more cognitive capacity from an organism, it essentially reveals that, even after many decades, there is no clear answer to this question. An important, unanswered scientific question is how a motor plan adapts when a sudden change occurs during an action. Which also leads to the pressing follow-up question of how more primitive organisms can cope with such situations.
The explanatory model of the motoric movement action demonstrates that perceiving the *tau*-value, despite its inherent complexity, can be distilled into a very simple universal phenomenon. Which is also explained in the context of moving a ring along a spiral[15]. To perceive the *tau*-value, all you need to do is register the speed at which the latent part of the perceptual image of the entire action trajectory shape disappears. Essentially, this amounts to a straightforward observation of the disappearance of a two-dimensional line segment.
Subsequently the explanatory model reveals that the internal (secondary) focus can align itself with the external (primary) focus as a whole, without any rigid hierarchy. This simplifies the observation of the *tau*-coupling process to such an extent that, within an ecological framework, it's hard to surpass and which concept can also be applied to the earliest organisms.

f. The sensorimotoric movements when manoeuvring the outside of the handle connected to the ring within the internal (secondary) focus are proprioceptively perceived

The explanatory model clearly demonstrates that the internal (secondary) focus is perceived exclusively within the body, thereby showing that visual perception is never involved in this process. The internal (secondary) focus can only be perceived proprioceptively. You can practically confirm this within the nerve spiral by covering everything except the ring and the spiral. As long as these remain visible, there will be no impact on this nervous action.

g. Hybrid (proprioceptive) perception processes

A significant shortcoming in scientific research pertains to the notion that motor actions are always executed with roughly the same sensorimotor perception processes. The explanatory model reveals a universal framework, but it clearly demonstrates as a novelty that often multiple constellations of perception processes are involved within the execution of the same motoric action and that we are capable to endlessly, *ecologically* (!), vary within this realm.
For example, when in pitch black darkness, we bring our (non-key-holding) hand to a lock, we can successfully move the key to the lock using solely proprioceptive perception within the external (primary) focus c.q. we can successfully move the key along a perceptual image of a latent action trajectory shape using solely proprioceptive perception processes. So even if it then appears that we perform this motoric action with only visual perception in broad daylight, that's factually incorrect. In broad daylight visual perception processes may dominate, but proprioceptive perception processes will never disappear and so will always be present in some hybrid form. So actions we perform during the day with relatively many visual perception processes are always executed proprioceptively as well.
Within the internal (secondary) focus, the situation is no different. You can quickly ascertain for yourself that, in the case of a nerve spiral, you can move the ring solely with torso action or even with just a walking action if you hold the handle rigidly. In this way, you could even move it with just upper arm and/or forearm action. However, even when you consider more common motor actions used to

[15] https://www.researchgate.net/publication/374288678_Within_the_nerve_spiral_the_essence_of_the_task_is_solely_executed_by_the_movements_of_the_ring_Within_the_primary_focus_the_ring_moves_like_a_marble_in_a_marble_run_producing_the_tau-value

move the ring, you can quickly observe for yourself that you could use relatively more hand or relatively more finger action.
Which, in short, indicates that you might have developed your own preferred motor skills within the nerve spiral, but they will always consist of an ever-evolving combination of hybrid sensorimotor perceptions. Due to the fact that such a complex phenomenon is involved will never allow an identical configuration of perception processes to arise. Upon which the explanatory model of all motoric movement actions again hastily wants to add that these hybrid possibilities in the utmost harmony align within an ecological approach and that a parsimonious organism would never have strived to achieve identical executions.

h. Optimization process

The explanatory model of the motoric movement action demonstrates that a motor action can only be executed by the stacking of two autonomous foci and shows within the previous paragraph that the perception of movement within the internal (secondary) focus is inherently of such a high complex nature that it will definitely prevent the occurrence of an identical internal configuration to occur. Consequently this will cause that the action object is capable to and definitely shall deviate from the perceptual image of the latent action trajectory shape at each progressing point P and even though the cortical streams ingeniously mediate this process, it's empirically evident that an identical execution of any action trajectory shape is unattainable. This unequivocally portrays that performing any conceivable action can only be viewed as an optimization process. Hence, you will never be able to make a ring move identically. Instead, you solely can optimize the perceptions within both foci, which also allows you to perform actions in a very successful manner but in ever-varying ways.

i. Within the internal (secondary) focus the line and shape within the line segment shape of the action trajectory demand autonomous perception processes; Solely the line generates the *tau*-value

The explanatory model of the motoric movement action demonstrates, beyond any reasonable doubt, that we do not (need to) create motor plans and that all sensorimotor processes can be compellingly guided by the external (primary) focus. But if a motor plan would have been necessary, science would still have remained remote from a breakthrough, as sensorimotor processes must accompany two autonomous phenomena within the action trajectory shape that have never been recognized in science. The frequently used compound term "action trajectory shape" is in fact a line segment shape and encompasses two autonomous components: the line and the shape. The explanatory model illustrates that they are perceived entirely separately but simultaneously. For experts, this is clearly recognizable within any conceivable action. However to make it comprehensible for everyone, these phenomena are explained within the context of the motoric movement action *car driving* (or riding a bicycle) since this action inherently contains the scientific evidence of these two autonomous perceptions.

Images: In the case of a car and a bicycle without hand brakes, only the steering wheel can compensate for deviations in the width of the action trajectory shape, and the pedals can only compensate for deviations in the length of the action trajectory shape.

When driving a car, it becomes immediately evident that one can exclusively influence the movement within the shape (!) of the action trajectory with the steering wheel. This defines the explanatory model as mediating the deviations in the y-axis. Additionally, it should also become immediately clear that with the pedals, one can exclusively influence the movement within the line (!) of the action trajectory. This defines the explanatory model as mediating the deviations in the x-axis[16].
So, when driving a car, it becomes crystal clear that perceiving (and controlling) the shape has absolutely nothing to do with perceiving (and controlling) the line. In which it is essential to mention that perceiving the filling of the latent line (within the x-axis) by the manifest places P of the action object within the external (primary) focus solely involves the *tau*-value which within car driving is solely executed by the pedals. Solely the speed with which the line is filled determines the duration of the action c.q. determines the finalization of the action.
The explanatory model of the motoric movement action demonstrates that the perception of movement within the internal (secondary) focus in any conceivable action, including the execution of the nerve spiral, contains the same x- and y-axis components. Although it places greater demands on the development of an organism, conversely, it can be shown to fit perfectly within an ecological approach. The dichotomy, where a separate x- and y-axis component is distinguished, can actually deliver the final breakthrough in the understanding of why we are capable to reduce very complex perception processes to the perception of such trivial and simple phenomena. The mere perception of the x-axis can be traced back to simply perceiving how the latent part of the perceptual image of the latent action trajectory disappears.

[16] The same explanation naturally applies when considering a bicycle with coaster brakes.