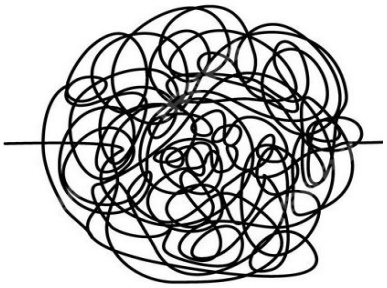
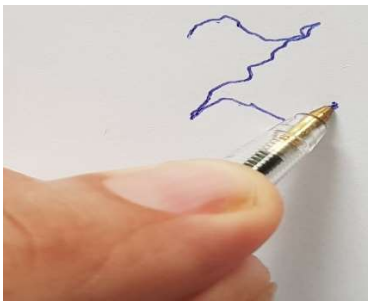
The complete clarification of all functional perception processes within writing



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

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July 2024 ©

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Introduction

In 2016, a comprehensive explanatory model was developed that offers the possibility to appoint all functional perception processes involved in any conceivable goal-directed motor action. It provides a universal explanation, demonstrating that the execution of any action always requires the simultaneous perception of three autonomous foci. Whether it involves catching a ball, grabbing a coffee cup, or writing texts, one autonomous focus remains engaged with (the movement of) the ball, the cup, or the writing paper (screen, sand, etc.) as environmental object, which universally represents a catching action. The two other autonomous foci are involved in perceiving the movement within the egocentrically executed action: specifically the movement of the hand (fingertips) or the pen tip (stick, chalk, pointer, etc.) along an action trajectory shape (towards the ball, coffee cup, or writing paper (screen, sand, etc.), which universally represents a throwing action.

So the essence of the perception processes encompasses the fact that two autonomous movements, as part of a catch and a throw action, must be combined. In relationship to which it compels a fact that, within our worldly dimensions, the sequential positions P of any conceivable object are always interconnected c.q. must always sprout from each other. This factually means that, i.e., with an incoming tennis ball within a catching action, the perceptions of all positions P of the tennis ball will always form a line c.q. will always represent solely one line segment shape. This constrains the perception to such an extent that we can already precisely know within which global fluctuation boundaries the actual catching will have to take place. According to which it is important to realize that all manifest positions of the tennis ball create the line shape, but more essentially, the latent part of the tennis ball's action trajectory shape must (!) emerge from the manifest part.
This applies not only to catching actions but equally to all throwing actions. Thus, when writing, all pen tip positions will always be interconnected and form one entire action trajectory, will the actual position of the pen tip always represent the precise division between the manifest and latent parts of that line, and must (!) the latent part of the action trajectory also emerge from the manifest part. Which facts are clearly not to be refuted.

The explanatory model is based on the paradigm that, in its evolutionary development, the perceptual organ first functioned as a comparison mechanism that could record the autonomous movement of the animal and the autonomous movement of the environment c.q. the environmental objects in line segment shapes. In relationship to which it is important to emphasize that the ability to perceive movement arose long before the more advanced cognitive skills were developed that gave us insight into the

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nature of what exactly moves[1]. Thus, perceiving movement essentially has nothing to do with perceiving what exactly moves, and it can also be established that perceiving mere movement must be placed close to the origin of the evolutionary development of the perception processes.

This premise aligns entirely with the findings of J.J. Gibson, who, in addition to indicating the autonomy of the animal, also indicates the autonomy of the environment, while also showing that in the execution of every action, a touching process between the animal and the environment always takes place. If we then take the aforementioned paradigm as a starting point for the execution of a goal-directed action, it can be shown that the animal and the environmental object must at least come into contact with each other first in most motor actions. Which within our perception processes means that 1. a perceptual image of the movement of the environmental object within an action trajectory shape of the catching action, and 2. a perceptual image of the egocentric movement of the animal within an action trajectory shape of the throwing action, will at least have to lead to a perceptual image of a latent intersection point of those two line segment shapes.

As within any conceivable action then solely two universal possibilities arise:

1. **The environmental object (e.g., the writing paper or the tennis ball) is standing still[2].** The perception records this as a zero-movement within a zero-line segment shape within the catching action, and a perceptual image of a latent egocentric action trajectory shape of the pen tip within the throwing action must be formed to construct a perceptual image of an intersection point of the two involved action trajectory shapes.
2. **The environmental object (e.g., the key or the tennis ball) is moving towards us.** The perception records this as a movement within an incoming action trajectory shape within the catching action. This also necessitates forming a perceptual image of a latent egocentric action trajectory shape of the pen tip. Which finally should lead to the creation of an autonomous perceptual image of a future (latent) intersection point sprouting from the two latent parts of the involved action trajectory shapes that are constructed separately.

This explanation demonstrates that, contrary to the current state of science, the explanatory model shows that the perception processes within any conceivable motor action originate much more from a single universal source and illustrates that in all actions, an intersection point c.q. contact point between the animal and the environmental object must first be realized, and that after this contact, a pressing or pushing process usually follows. The model shows that the perception processes involved in the contact process when grasping objects are identical to the perception processes when pressing a button (e.g., piano key, touchscreen, elevator buttons, electric stove, light switch, etc.), pushing away a billiard ball, or kicking a football towards a goal. The contact process is perceptually identical in all cases. When grasping a coffee cup, however, a pressing or pushing process must follow the contact process within the relevant fingertips, resulting in a total zero vector. Conversely, pressing a piano key requires the creation of an actual movement vector to press the key down. This also applies to the other mentioned objects (buttons), and thus the contact process in writing requires the same identical perception processes as in ordinary grasping. However, after the contact process within writing, a specific pushing process within the pen tip must occur to create the special line segment shapes of letters, words, or word parts.

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[1] Two important remarks: 1. Of course it is very important within evolutionary development of the perception processes that you can distinguish a lion from a zebra., and 2. Even till this day our visual perception processes observe the (external) movement of our body parts in the exact same way as they observe the movement of any other (external moving) environmental object. Solely due to internal perception processes in relationship to a causal connection with this external movement provides us the difference between the two.

[2] In part 1 (page 4), the explanatory model of the motoric movement action demonstrates that perception always observes stationary objects moving in time, but through an active comparison process can conclude that the object in question is stationary. Therefore, even though it is concluded that the coffee cup is stationary, zero-movement is indeed observed on a timeline, which can create an intersection point with an egocentric action trajectory shape in relationship to the grasping hand.

This overview document specifically addresses those aspects of the throwing and catching action in writing tasks that are barely recognized within science. A small part focuses on the perception of the writing paper within the catching action, but the vast majority of new insights are revealed concerning the egocentric throwing action that specifically focuses on the movement of the tip of the pen. It shows the scientific evidence that 1. a perceptual image of a latent action trajectory shape from the pen tip to, and over, the paper is always first created, and 2. how this action trajectory shape can only be filled with the help of two autonomous foci. This overview document now summarizes all phenomena ever found within the movement sciences and forges them into one universal explanatory model. Based on logic, it can be concluded that this forms the complete and definitive explanation of the functional perception processes within all writing tasks.

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Part 1 - Writing with the other hand unequivocally exposes the presence of two foci - The act of writing requires the compelling collaboration between an internal and an external focus

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Introduction

Traditionally, science has assumed that one motor action encompasses one focus. This assumption has seemingly been so logical that it has never been questioned. However, this has led to the absence of a plausible explanation for the functional perception processes underlying the execution of all motor actions, even after 150 years of movement sciences. In 2016, an explanatory model was found that is capable of identifying all functional perception processes within any imaginable motor action. Beyond any reasonable doubt it conversely demonstrates that every motor action can only be executed through a compulsory coupling of two foci: an internal (secondary) focus must always be directed at an external (primary) focus. In which it should be explicitly noted that these two foci represent entities that fundamentally differ from current scientific terminology.
The explanatory model emphasizes that the essence of a motor task always involves the movement of an action object outside our body along an action trajectory shape, but that the action object will never be capable to move on its own along that line. The action object is often an inanimate object (spoon, tennis racket, ball, letter, pointer (pc) etc.) that we hold during an action, and even though the fingertips, during a grasp action with the hand on the outside, consist of living cells, we absolutely aren't capable of moving them there. The explanatory model unequivocally shows that initiating the movement of an action object outside our body is only possible by using secondary perception of autonomous movements within our body.
Compared to the current state of science, the explanatory model represents a revolutionary breakthrough, revealing that two foci must enter into an obligatory connection simultaneously, and this universal stacking of two perceptions of two autonomous movements occurs in every motor movement action. They are clearly autonomous because they belong to two incompatible worlds. Observations of movement inside and outside the body are actually never able to overlap.

This article focuses entirely on the motor action of writing. It is a rare type of action because the action trajectory shape becomes partly visible. The article convincingly demonstrates that only the pen tip c.q. the movements of the pen tip, similar to a marble in a marble run, executes this action trajectory shape. Solely this movement encompasses the essence of the task. For this reason, primary attention should be directed towards the external movement of the pen tip. The tip of the pen can only be moved with completely different movements within the body that only reach the outside of the pen. The attention required for this should serve the main goal and is therefore referred to as secondary (internal) focus. Furthermore, the explanation shows that all conceivable motor actions are based on these same two foci. Due to this universal nature, the explanatory model creates the most ultimate conceivable ecological argument. The article does not delve deeply into the differences with the current state of science because there is still no clear consensus on this subject within the scientific community.

The primary focus in relationship to the movement of the tip of the pen encompasses the perception of movement outside the body

The explanatory model of all motor movement actions, as demonstrated in writing, shows that only the pen tip, or the movements of the pen tip, will execute the essence of the task and therefore represents the primary focus within this action. The explanatory model provides scientific evidence that a motor

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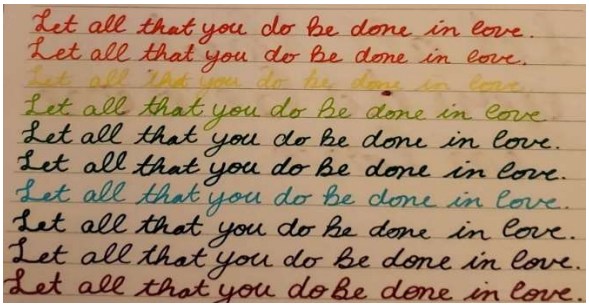
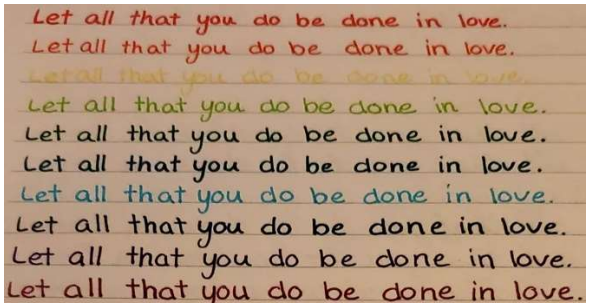
movement action always involves two successive autonomous phases. The tactical consideration first aims to create a perceptual image of a latent action trajectory shape over which, in this case, the tip of the pen or the movements of the tip of the pen promises to become successful, and only then proceeds to actual action.

Images: Writing is a process centered around the creation of text. So the essence of this task is exclusively accomplished through the autonomous movements of a pen's tip and that is why this is the main process we need to behold with our attention. Typically in a ball-point pen a small ball is situated at the end of the pen which releases a continuous flow of ink drops, shaping specific letters, words, or word parts within a line segment shape. The motion of this rotatable ball exactly resembles a moving marble navigating through a marble run. The marble-marble run relationship unequivocally shows that within any imaginable motoric action the actual position of the marble c.q. the action object will always represent the exact boundary between the manifest and latent part of the action trajectory shape. Within most motoric actions the action trajectory remains invisible but within the act of writing the shape becomes partly visible. So the red part of the word in the left image is thus the visible segment, and the invisible part is represented in pencil, containing the perceptual image of the still latent action trajectory shape. However, during handwriting exercises (right image), the perceptual image in pencil is utilized to reinforce and/or enhance the quality of the (cognitive) perceptual image.

When we factually start the action, we use the pen tip to fill in the perceptual image of the latent action trajectory shape. So within the primary focus, this is the essential process that our perceptual systems must guide, and surprisingly, science has overlooked this process entirely until now. In upcoming articles, it will become evident that the pen tip's completion of the action trajectory shape provides the crucial *tau*-value, which is intricately linked to the secondary focus and will be explained how the cortical streams have to mediate this process.





Images: The explanatory model demonstrates that within every imaginable motor action, an autonomous internal focus must be directed towards an autonomous external focus. This insight reveals the scientific evidence that we can never execute any action trajectory shape identically, as it involves the stacking of observations from autonomous movements that belong to two incompatible worlds. For instance, you have never picked up a coffee cup in the exact same way or performed a free throw in basketball in an identical manner. Similarly, you will never be able to produce one letter, word, or

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word part identically. As to which the explanatory model right away emphasizes that this was never the intended goal. Creating form similarity is so much more efficient and effective that a parsimonious resourceful organism would never have developed otherwise.

Within the tactical action we maybe construct perfect sleek perceptual images of the words we intend to write within sentences. However, due to the fact that the movement of the pen tip can only be executed through the observation of an entirely different autonomous movement, the pen tip will inevitably deviate from that "*perfect*" original perceptual image at any position P within the action trajectory shape. This process, therefore, needs to be guided by the dual and mutual interaction of the cortical streams, which represents the brilliant ecological solution of the body to execute every motor action in the most efficient and effective manner. The ventral stream and dorsal stream continuously interact to correct the inevitable deviations, but this interaction requires a small reaction time[3]. As a result, we (conform Bernstein) can never execute one motor action identically and the tip of the pen will always follow a constantly varying zigzag pattern during writing.

The secondary focus in relationship to the movement of the tip of the pen encompasses the perception of movement inside the body

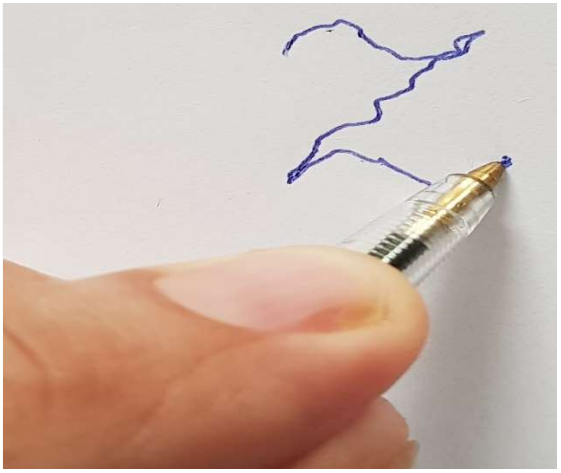
When one starts to realize that the primary focus solely concerns the movements of the tip of the pen, it implicitly becomes evident that the pen itself isn't capable to move at all. This analogy is strikingly similar to a ball during a free throw in basketball or various other inanimate objects like tennis rackets, cricket bats, spoons, knives, bottles, pointers (pc) and more, which clearly never move on their own. But even when we grasp a coffee cup with our hand, the explanatory model demonstrates that the hand, and consequently the relevant fingertips, must also be considered as lifeless action objects.

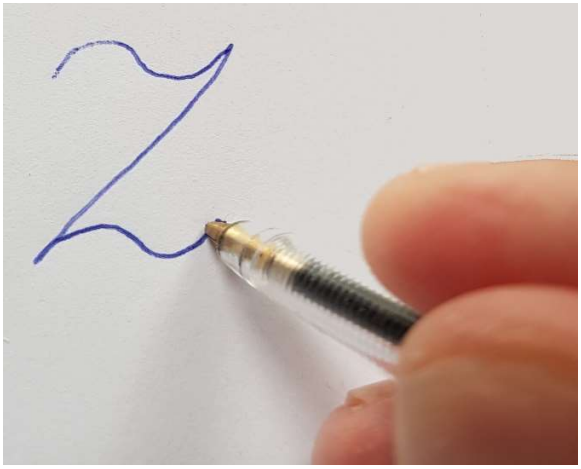

Images: A pen is merely a tool used for a particular type of writing. We can also write with a finger, stick, paintbrush, and so on. And even if we write directly in the sand with a finger it doesn't matter. The stacking of two autonomous foci will always exhibit the same universal cooperation. Although you could remark that when using a pen, stick, or brush, there might be a longer distance between the secondary and primary focus, which could potentially result in a greater degree of deviations.

The outer layer of the fingertips does comprise living cells, but it is absolutely incapable of moving the fingertips in an action trajectory shape outside the body with those living cells. We can only induce movement in the outer layer of the fingertips through internal body movements. While they may approach the outer surface of the fingertips, they will always remain within the confines of the body.

[3] The specific reaction time concerning cortical streams in relation to the explanatory model has never been examined. General information and empirical experiences provide an indication that the reaction time is estimated to be around 0.1 seconds; "It takes about one-tenth of a second for information about the visual scene to reach the back of the brain or the occipital lobes. During the next tenth of a second, the visual information is analysed in two separate ways. Figure 2 shows the two pathways of the dorsal stream and the ventral stream. The dorsal stream runs from the occipital lobes to three locations, the back of the brain at the top (called the posterior parietal lobes), a vertical strip of brain in the centre (called the motor cortex) and the front of the brain (called the frontal cortex). The ventral stream runs from the occipital lobes to the back of the brain at the bottom (called the temporal lobes)": Cerebral Visual Impairment - Working Within and Around the Limitations of Vision; Gordon N Dutton; http://www.liv.ac.uk/~pcknox/Publications/trimble/CVI%20chapter%20for_hers-Dutton.pdf

In the case of a writing action, we can only haptically perceive the (outer surface of the) pen with the (outer surface of our) fingertips, and we can only proprioceptively[4] sense how movements within our body influence the haptic contact with the pen.
The purpose of the task within a motoric action is implicitly connected to the observation of the primary focus, leading us often to be unaware of the secondary focus during many motor actions, especially when they involve simple observations like within writing. However, in highly complex motor actions, such as a tennis serve, attention is conversely only directed towards the secondary focus c.q. the serving technique. Completely ignoring the fact that the primary focus compels the realisation of an outgoing ball trajectory shape (OBT). Which is the sole essence of a tennis service.



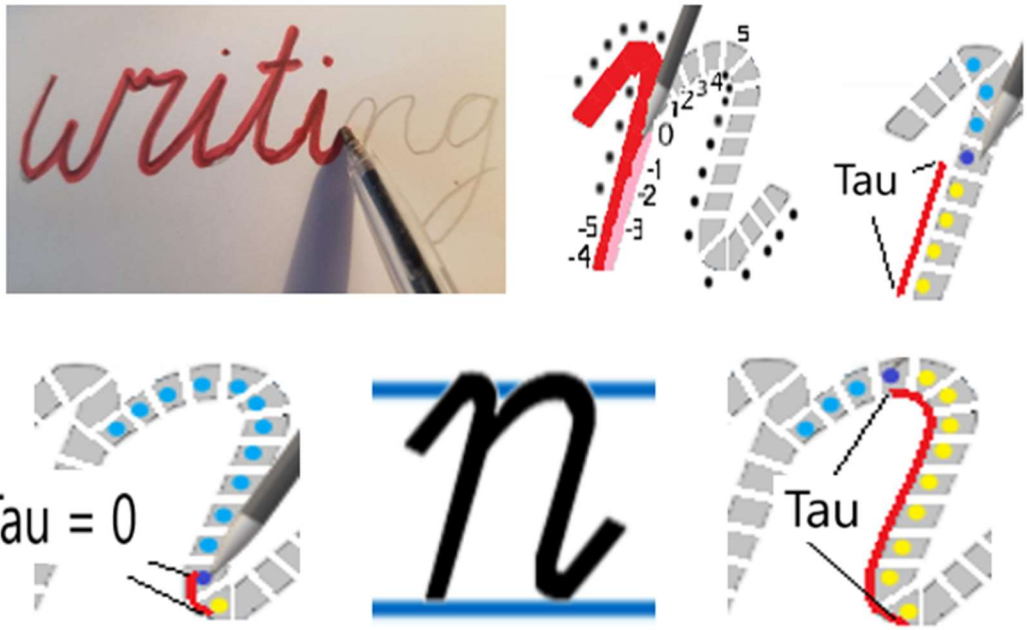


Images: Writing with the other hand clearly exposes the presence of two foci which can be noticed within any imaginable motoric action

With some practice, you can consciously perceive the two foci simultaneously within many motor actions. For instance, in a grasping action, you can perceive the movement trajectory on the outside of your body while also focusing on movements on the inside of your body. Which exactly includes ordinary writing tasks as well. Furthermore, you can try to find examples that deliberately confront you with the autonomy of the internal and external focus within motoric actions. In the case of a writing action, this search is rather simple. If you attempt to write with your non-dominant hand, you will quickly become aware of the two autonomous foci. It will definitely require much more effort to execute the same perceptual image of the letter, word, or word part in a somewhat readable manner.

[4] Proprioceptive perception comprises two autonomous aspects: Limb Position and Movement. The explanatory model makes a clear connection between these two proprioceptive phenomena and their relation to using the pen effectively. The overall pen displacement technique is influenced by our awareness of limb position, allowing us to control the general movement of the pen on a piece of paper. On the other hand, where perception is specifically transferred to the exact movement of the tip of the pen is essential for precise writing actions.

Part 2 - Within writing the essence of the task is solely executed by the external interconnected movements of the pen tip; Within the primary focus the tip of the pen is captured within an action trajectory shape providing several *tau*-values



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Introduction

Traditionally, science has assumed that one motor action corresponds to one focus. This assumption was likely so intuitive that it was never challenged. However, this has led to the situation where, even after more than 100 years of movement sciences, a plausible explanation for the underlying functional perception processes guiding the execution of all motor actions had never been found.
In contrast, in 2016, an explanatory model emerged that has the capability to identify all functional perception processes within any imaginable motor action. It demonstrates, beyond any reasonable doubt, that each motor action can only be executed through a mandatory coupling of two foci: an internal (secondary) focus that must always be directed towards an external (primary) focus. In which it should be explicitly noted that these two foci represent entities that fundamentally differ from current scientific terminology.
With regard to the external (primary) focus, it can be noted that science has, until now, truly missed everything. Therefore, it is now being explained within a wide spectrum of motor actions, and this publication now reveals all facets of the primary focus within the motoric movement action *writing*.
Writing is a unique motoric action because representing the entire action trajectory shape is the essence of the task. Just like in any conceivable action, we create an action trajectory to move the pen tip to the end of a letter, word, or word part, but in writing, the entire action trajectory shape must also become visible. Within this publication, it will become clear that the action trajectory shape within writing also consists of one continuous sequence of positions P of the tip of the pen. This should also serve as evidence that this phenomenon occurs within any conceivable action.

Solely the movements of the tip of the pen encompass the essence of the task c.q. the external (primary) focus

The category of motor actions discussed by the explanatory model pertains the conscious actions where it is assumed that there is always an initial formulation of an egocentric intent (an egocentric formulated will). Before picking up a coffee cup, for instance, there is always the desire to do so. The explanatory model of all motoric movement actions recognizes this as an undisputed factual aspect but

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adds a caveat. The egocentrically formulated intent does not, for example, concern picking up the coffee cup itself. The explanatory model reveals that this is factually incorrect and that we can only move our fingertips toward the coffee cup. Therefore, the movement of the fingertips toward the coffee cup constitutes the essence of that action.
In writing, we may indeed aspire to write a brilliant book, but the egocentrically formulated goal solely pertains the movement of the pen tip along an action trajectory shape[5]. Only that aspect defines the essence of the task c.q. the act of writing itself, and therefore, it should be regarded as the external (primary) focus.

The tactical movement action (TMA) within writing

Images: First and foremost an egocentric intention must be formulated that we want to move a pen from a very specific position A to position B along an action trajectory shape. Subsequently, starting from the current position of the pen tip, we create a perceptual image of a latent action trajectory shape between position A and position B (on the left). This occurs as part of a tactical action where two important goals are considered. Firstly, it should lead to a successful action, and secondly, ecologically evolved organisms aim to perform actions as parsimonious as possible. While it might appear that we would not create a perceptual image of a latent action trajectory shape without the delineating lines due to a defined signature box (on the right), because there seemingly are no obstacles, that is categorically incorrect. The tactical consideration does not focus on the lines of a box but solely on the "empty" positions P within an environment where the pen tip can proceed undisturbed. Our visual perception always focuses on positions P where nothing is obstructing, as these positions ensure an unhindered passage of the pen tip.

The explanatory model of the motoric movement action indicates that after formulating an egocentrically expressed goal, we always start with a tactical consideration[6] of how to move the action object to the goal location within successive positions P. In the current action, we always create a perceptual image of an action trajectory shape, over which the pen tip can be successfully moved from position A to position B.

The factual movement action (FMA) within writing the letter “n”

After determining a perceptual image of a latent action trajectory shape, we proceed to actually perform the action. This essentially begins with bridging the current position P(0) of the pen tip to the

[5] Essentially the objective of writing solely compels to depict symbols on a surface to which readers attach the same (cognitive) meaning as intended by the writer.
[6] The scientific evidence has been unequivocally provided for all grasping actions and all throwing actions, and can be easily universally extrapolated to any conceivable action. N.J. Mol; *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 trajectory shape.*

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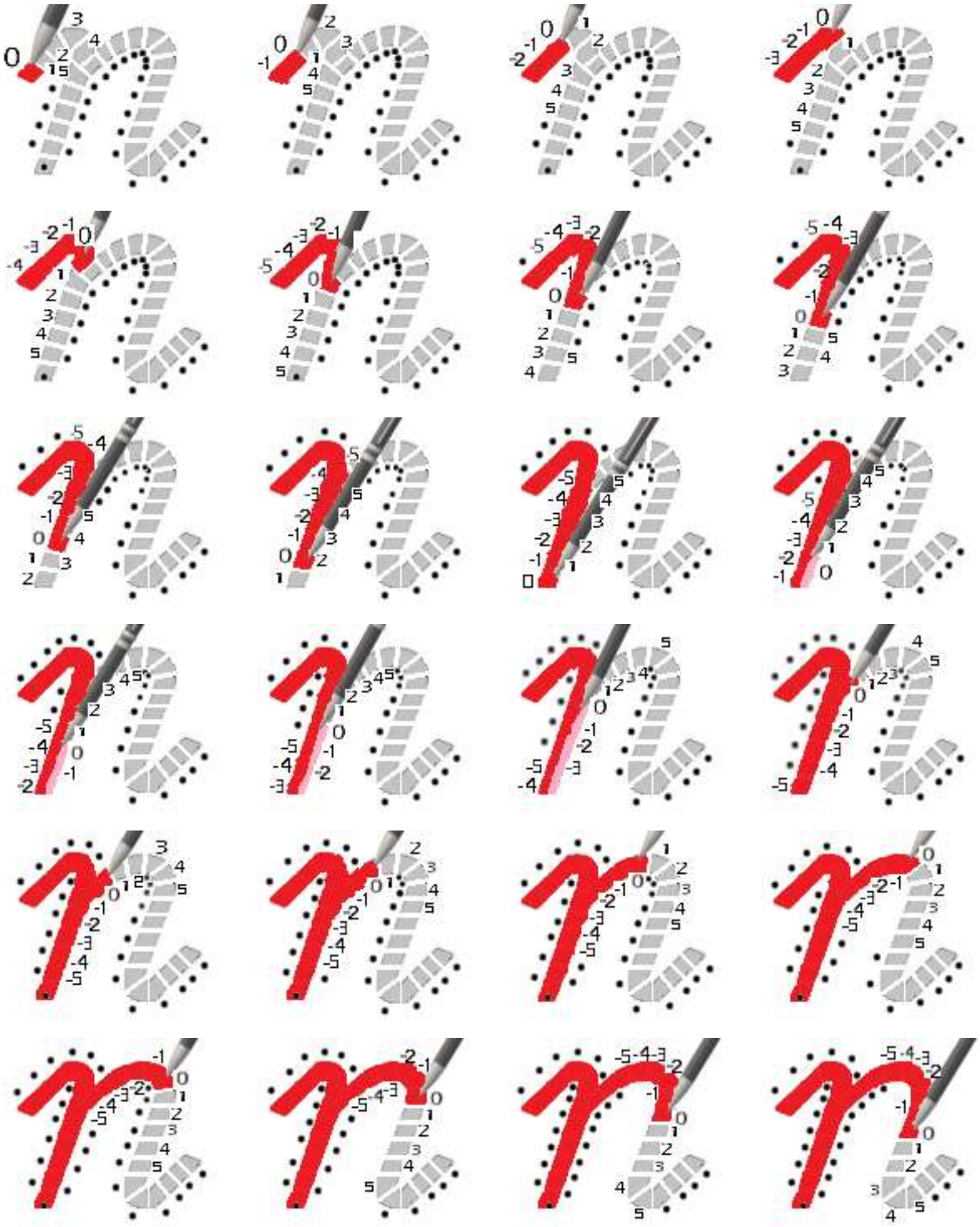
next position P(+1) within the action trajectory shape. Although, of course, we ultimately want to reach the end of the letter "n" because there are many more letters to be written, the explanatory model clearly shows in this phase that our perception processes are solely focused on bridging the empty space between the beginning and the end of the letter. So essentially, on a micro-level, only the positions P(-1), P(0), and P(+1) are relevant to us during this bridging phase.



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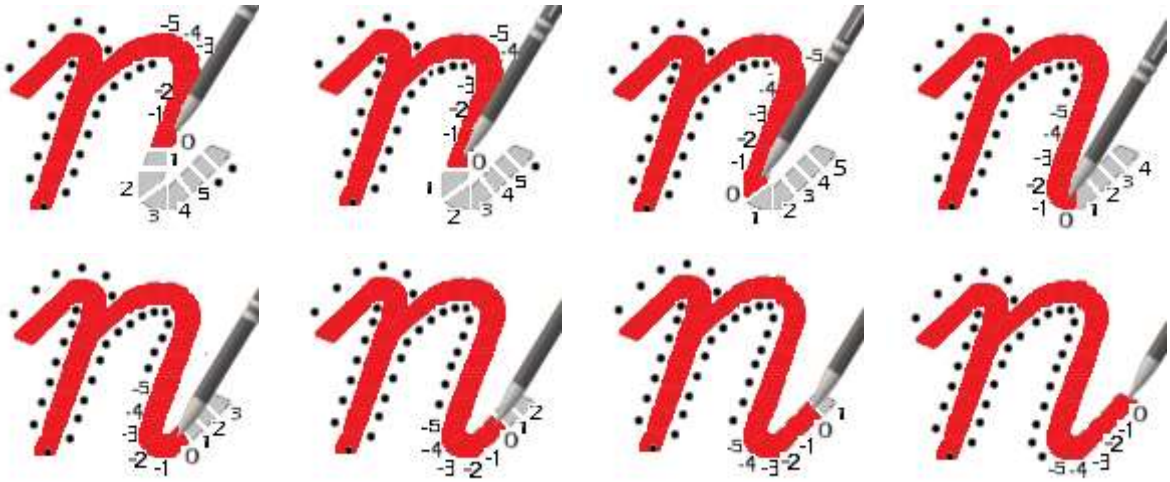

Images: In an animation, the progression within an action trajectory shape can be depicted as follows. Within any conceivable action, the action object (the tip of the pen) can successfully execute the action only by first occupying the next position P(+1) within the action trajectory. The current position P(0) then shifts one step forward, and a manifest position P(-1) is added. This process repeats with every new position P(0) until the end of the action trajectory is reached. Writing is a very special act because the manifest locations P(-x) remain visible. This is in stark contrast to most other motor actions where the manifest locations P of the action line shape disappear. Within writing, it becomes evident that the yet latent positions P(+x) must stem from the manifest positions P(-x). This crucial fact should be extended to all actions where nothing of the action trajectory shape becomes visible.

The perception-action coupling within writing

With the preceding argumentation, the explanatory model of the motoric movement action now provides a comprehensive and universal explanation of how perception is linked to the action within any conceivable task. The animations in the previous section illustrate that the tip of the pen c.q. the action object maintains a fixed relationship with the perceptual image of the action trajectory shape. This becomes easier to comprehend when envisioning a marble in a marble run. In this analogy, you will become much more aware that the perception-action coupling is one unified c.q. one complete phenomenon where only a single change occurs every ongoing time span. Within the marble run it becomes quite visible that during the actual execution, each position P(0) serves as the precise separation between all already manifested positions P(-x) and the latent positions P(+x) yet to be traversed.
Through this explanation of the perception-action coupling, the explanatory model can precisely demonstrate how organisms must have evolved within an ecological framework. However, delving into this subject exceeds the scope of this publication. Only a single remark will be dedicated as it is relevant in regard to the functional perception processes within this motor action.
It should be noted that the action of the pen tip can be clearly observed, but no fixed unit of time can be attributed to it. Each unit of time can be subdivided into 1000 smaller time units, and these time units, in turn, can be further divided. This argument suggests that the action essentially occurs within such a brief moment of time that it only gains meaning in relation to observations within adjacent time units. In other words, the perception of the current position of the pen tip only acquires meaning through the adjacent future "actual" positions P(+x) and the adjacent manifest "actual" positions P(-x) of the pen's tip. The main idea here is to illustrate that observations within any conceivable action primarily pertain to a single phenomenon in which the perception of the action also generates a perceptual image, but most importantly, they are entirely interdependent and cannot exist without each other.

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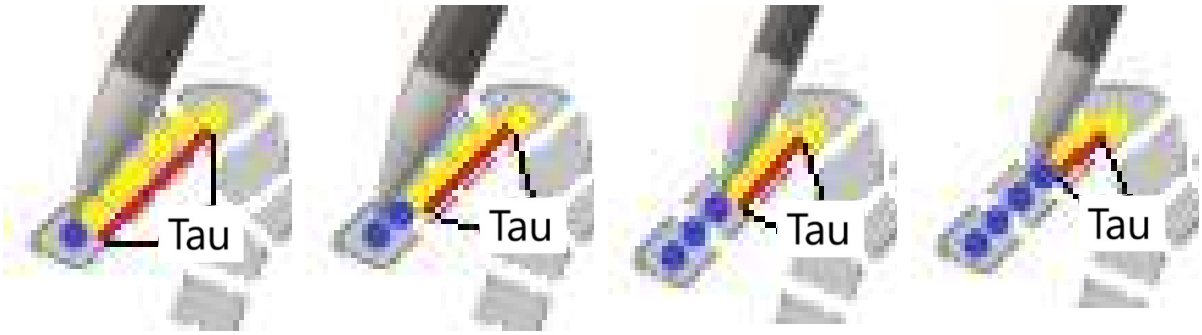
Images: Within many motoric actions the action trajectory shape will not become visible, making it challenging to depict with animations. Writing makes it somewhat easier because the manifest part remains visible. However, the perceptual image of the latent part remains invisible. Conversely, the marble within the marble run, is capable to vividly illustrate this concept. It clearly showcases one single phenomenon wherein the marble, at each position P, delineates the precise separation between all already manifested positions P(-x) and all latent positions P(+x). Additionally, it exemplifies one of the essences of the (perception-action) coupling. If there were no marble run to see, the movements of the marble would lack a framework, and conversely, if there were no marble to see, we could not perceive the coupling either. Without each other, they have no meaning whatsoever.

The *tau*-values in writing the letter "n"

The explanatory model of the motoric movement action, as demonstrated by the perception-action coupling, shows that the perception of each position of the pen tip c.q. the action object within the action trajectory shape is equally important. Which especially becomes apparent in the case of writing. In the vast majority of motor actions, the ultimate objective is to reach the end of the action trajectory shape. Then the task c.q. the egocentrically formulated intent will be finalized. When that happens, the entire latent action trajectory shape will be filled with manifest locations P and no more latent positions P will be left. Within his *tau*-coupling theory, D.N. Lee referred to this phenomenon as the *tau*-value approaching to zero.
In writing, this ultimately occurs as well when we reach the end of a letter, word, or word part. However, because making the entire action trajectory shape manifest is the essence of writing, the entire writing action is essentially a continuous *tau*-coupling. A detailed explanation of this is omitted here, and we will suffice by mentioning five distinct *tau*-values that arise solely when writing the letter "n".

Tau-value 1

Within the perception-action coupling, the tip of the pen will traverse all latent positions P that have been strategically determined beforehand within a perceptual image of an action trajectory shape. With each successive position P of the pen tip, the *tau*-value will decrease



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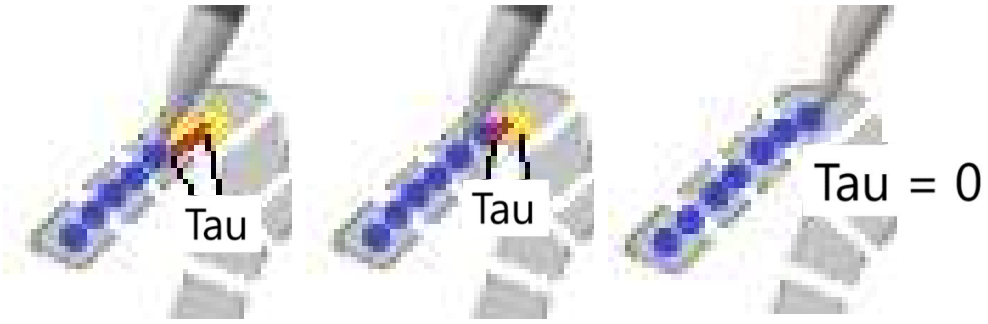
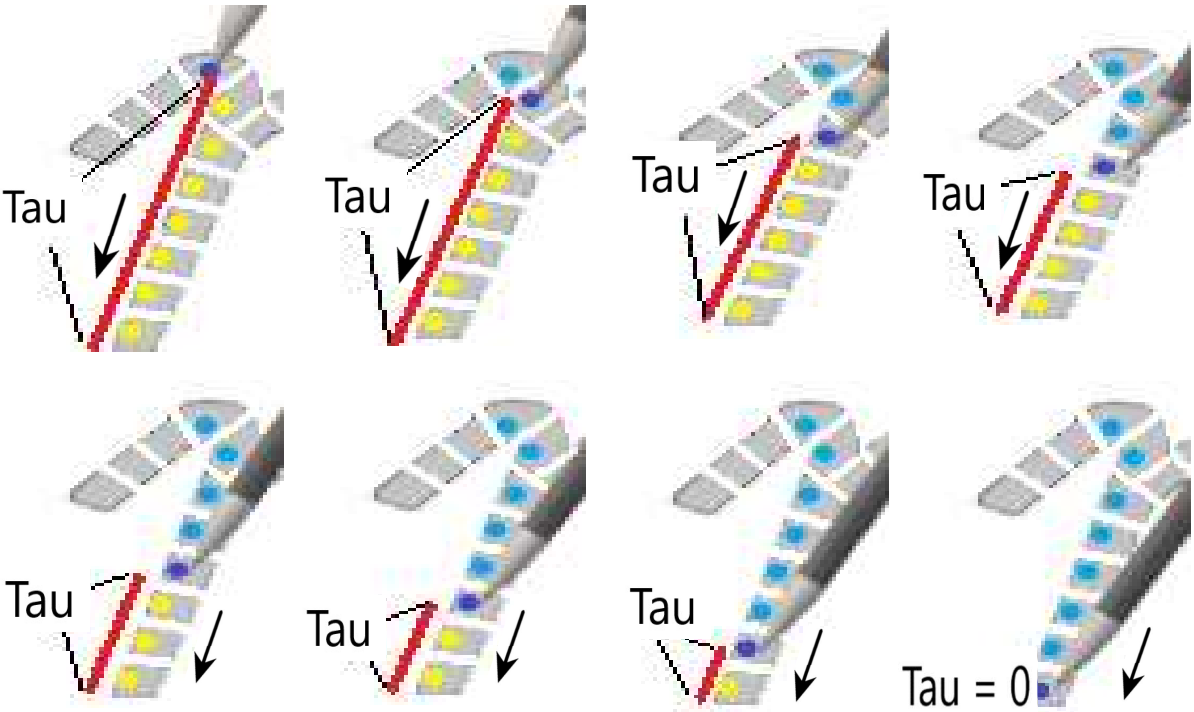


Image: From the beginning of the letter "n", you must perceive the first *tau*-value in the ascending line segment shape, approaching zero for the first time as you reach the curve. The ascending movement of the pen tip must then, within the curve, transition precisely in time to the descending movement of the pen tip. The *tau*-value can be perceived in two autonomous ways. You can observe how the manifest locations P of the pen tip take over the latent action trajectory shape[7], or you can observe at an even more fundamental level at what speed the latent part of the action trajectory shape disappears. Which means that you only need to perceive how the latent "*gap*" is closing.

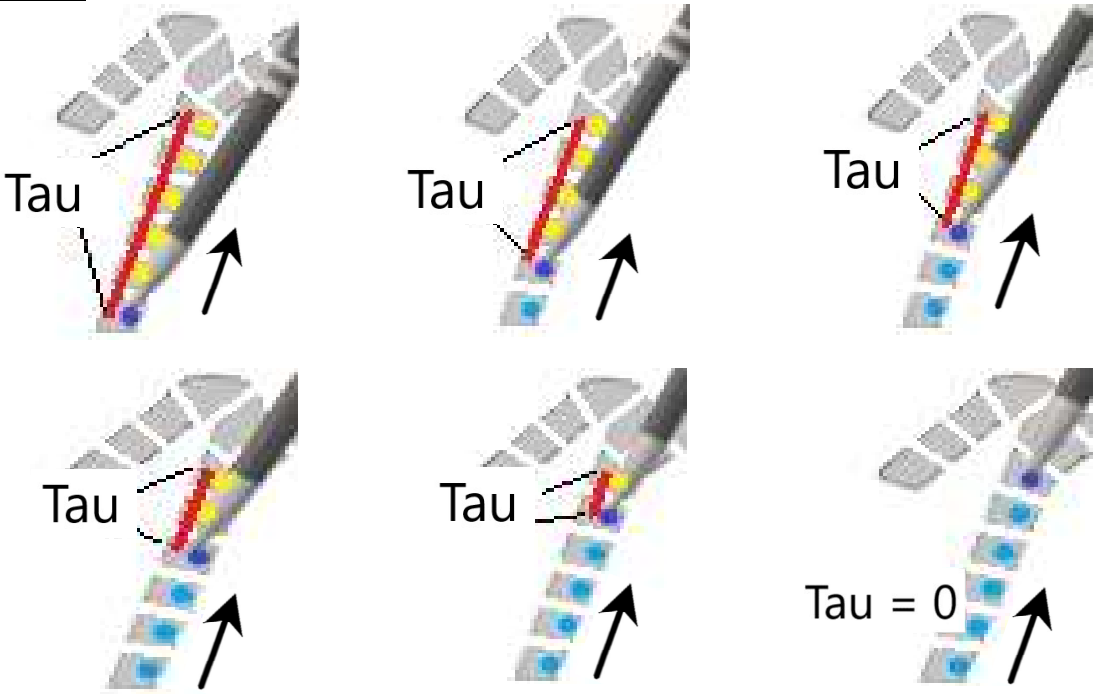
Tau-value 2



Images: From the first curve to the end of the first leg of the letter "n", you must perceive a *tau*-value approaching zero for the second time. This pertains to the long downward line when creating the first leg of the letter "n". At the bottom of the leg, the descending movement of the pen tip must be precisely and completely halted in time, and the pen tip must initiate the mirrored return journey to the third *tau*-value. The *tau*-value can be perceived in two autonomous ways. You can observe how the manifest locations P of the pen tip take over the latent action trajectory shape[8], or you can observe at an even more fundamental level at what speed the latent part of the action trajectory shape disappears. Which means that you only need to perceive how the latent "*gap*" is closing.

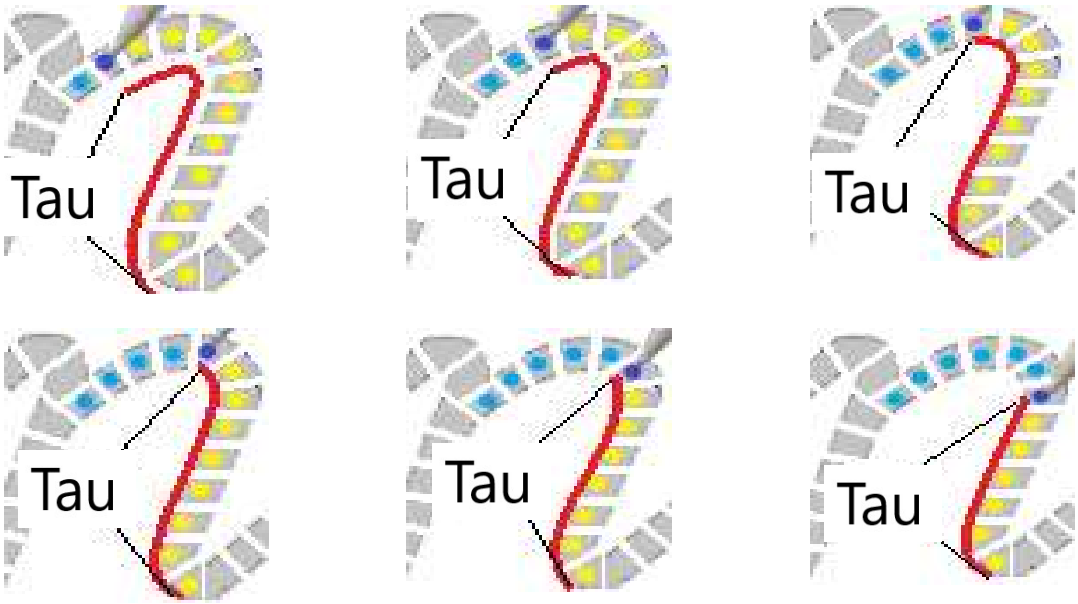
[7] Yellow dots and red line.
[8] Yellow dots and red line.

Tau-value 3

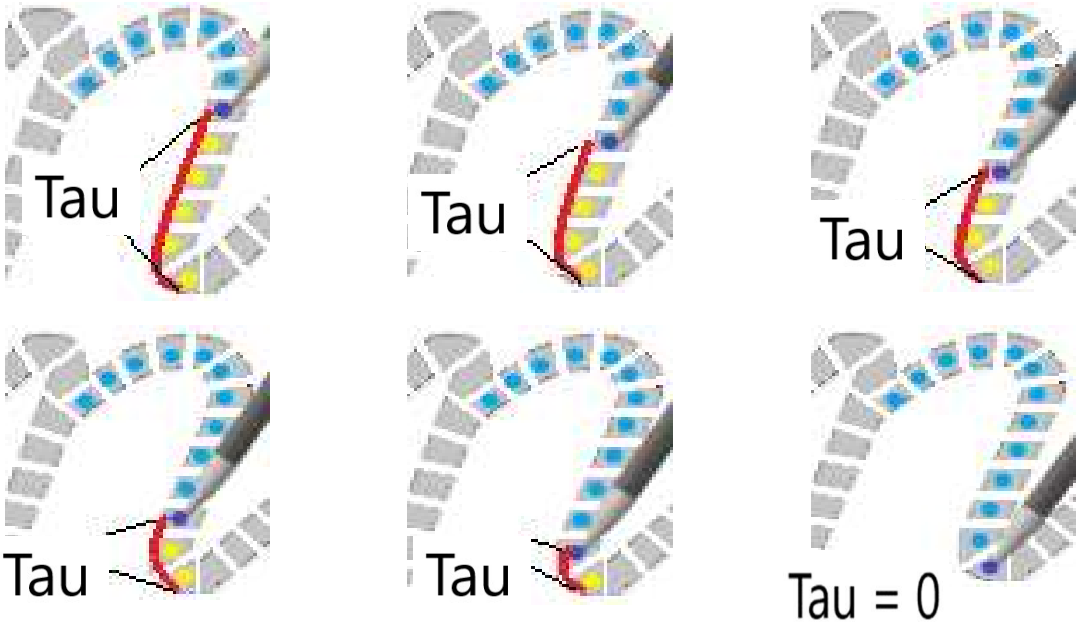


Images: The journey back upward determines the third time when you must perceive a *tau*-value and watch it approach zero. At the precise moment when you observe that the actual position P(0) of the pen tip reaches the initial height of the beginning of the letter "n", you must make the pen tip curve towards the connecting arc with the second leg. The *tau*-value can be perceived in two autonomous ways. You can observe how the manifest locations P of the pen tip take over the latent action trajectory shape[9], or you can observe at an even more fundamental level at what speed the latent part of the action trajectory shape disappears. Which means that you only need to perceive how the latent "*gap*" is closing.

Tau-value 4

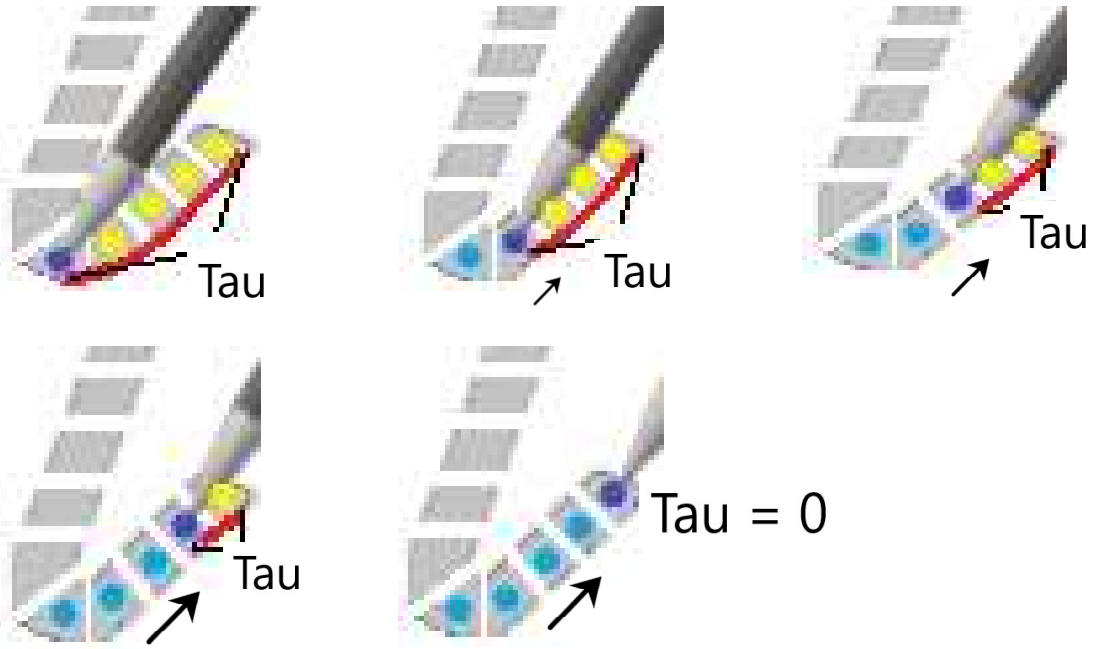


[9] Yellow dots and red line.



Images: The connecting arc to the end of the second leg of the letter "n" determines the fourth time when you must perceive a *tau*-value and watch it approach zero. At the precise moment when you observe that the actual position of the pen tip aligns with the end of the first leg (of the letter "n"), the action trajectory shape must be bent in such a way that the end of the letter can be initiated. This involves a reverse curve that is the subject within the first *tau*-value. The *tau*-value can be perceived in two autonomous ways. You can observe how the manifest locations P of the pen tip take over the latent action trajectory shape[10], or you can observe at an even more fundamental level at what speed the latent part of the action trajectory shape disappears. Which means that you only need to perceive how the latent "*gap*" is closing.

Tau-value 5

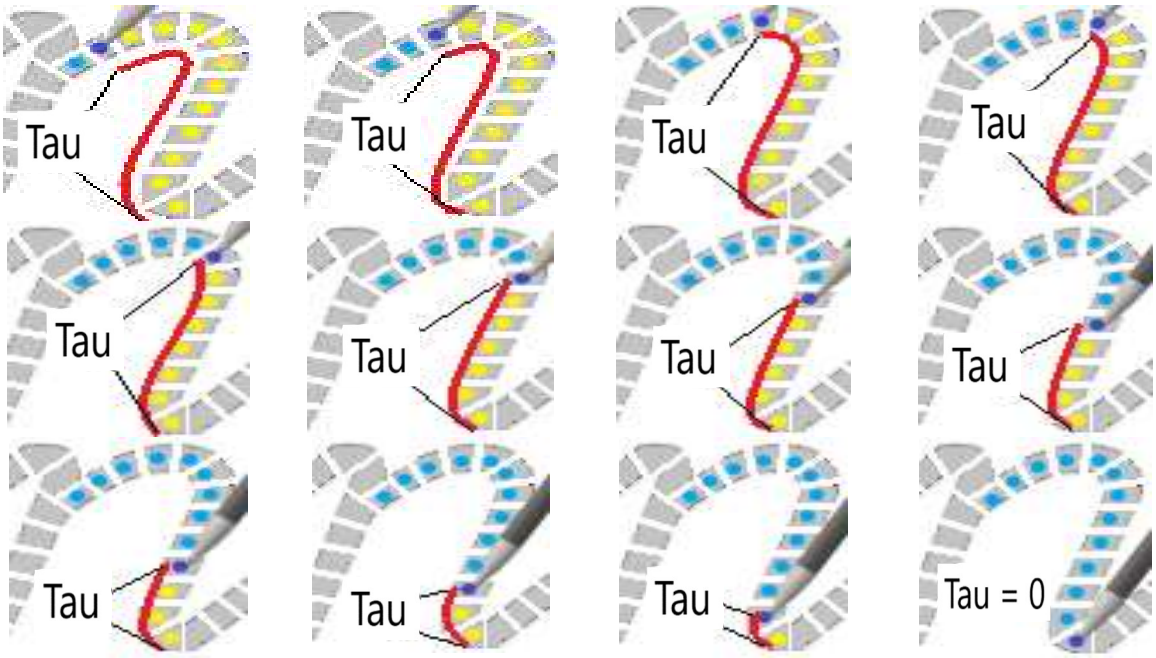


[10] Yellow dots and red line.

Images: Reaching the end of the second leg, within the perception of the fourth *tau*-value, to the end of the letter "n" determines the fifth time when you must perceive a *tau*-value and watch it approach zero. When you observe that the current position of the pen tip is nearing the end of the letter "n", the pen tip must be decelerated and precisely removed from the paper at the right moment. The *tau*-value can be perceived in two autonomous ways. You can observe how the manifest locations P of the pen tip take over the latent action trajectory shape[11], or you can observe at an even more fundamental level at what speed the latent part of the action trajectory shape disappears. Which means that you only need to perceive how the latent "*gap*" is closing.

[11] Yellow dots and red line.

Part 3 - The execution of an external action trajectory shape over which the tip of the pen moves dictates all internal sensorimotor perception processes; The *tau*-coupling process within writing shows that we absolutely do not need a motor plan



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

N.J. Mol
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Introduction

When writing, our aim is to create letters, words, or parts of words on paper. Which essentially involves moving a pen tip from point A to point B along one precise shape of an action trajectory. Within which the explanatory model of the motoric movement action demonstrates that the (ongoing) movement of the pen tip compels the sole core of the task and embodies the essence of our egocentric intention. In regard to which scientific evidence has been provided that underpins the fact that prior to the actual execution of any conceivable action, we first construct a perceptual image of an entire latent action trajectory shape over which we can successfully move (all the dimensions of) the action object[12], in this case, the pen tip, to point B[13].
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 c.q. effectively always have to originate from the manifest part of the action trajectory shape.

[12] 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.
[13] https://www.researchgate.net/publication/372719694_When_moving_a_pointer_on_a_computer_screen_you_are_mainly_attentive_to_where_'nothing'_is_-_The_scientific_evidence_regarding_visual_perception_within_each_motor_action

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 perceptual image of the latent action trajectory shape c.q. the *tau*-value approaching to zero[14].
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 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 current action, where a pen tip moves well outside the body, this insight will be easily recognized, and it will also be straightforward to determine that the tip of the pen can only be moved along an external action trajectory shape using movements within the body that extend only up to the outer surface of the pen[15,16].


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, passively and obediently, 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 and this explains why we can write with any object.

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 upcoming 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

[14] https://www.researchgate.net/publication/373735469_The_external_primary_focus_within_bicycling_solely_encompasses_the_movements_of_the_bike_-_Within_any_imaginable_motoric_action_the_essence_of_the_task_is_solely_executed_by_the_action_object
[15] https://www.researchgate.net/publication/372862496_Writing_with_the_other_hand_unequivocally_exposes_the_presence_of_two_foci_-_The_act_of_writing_requires_the_compelling_collaboration_between_an_internal_and_an_external_focus
[16] 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.

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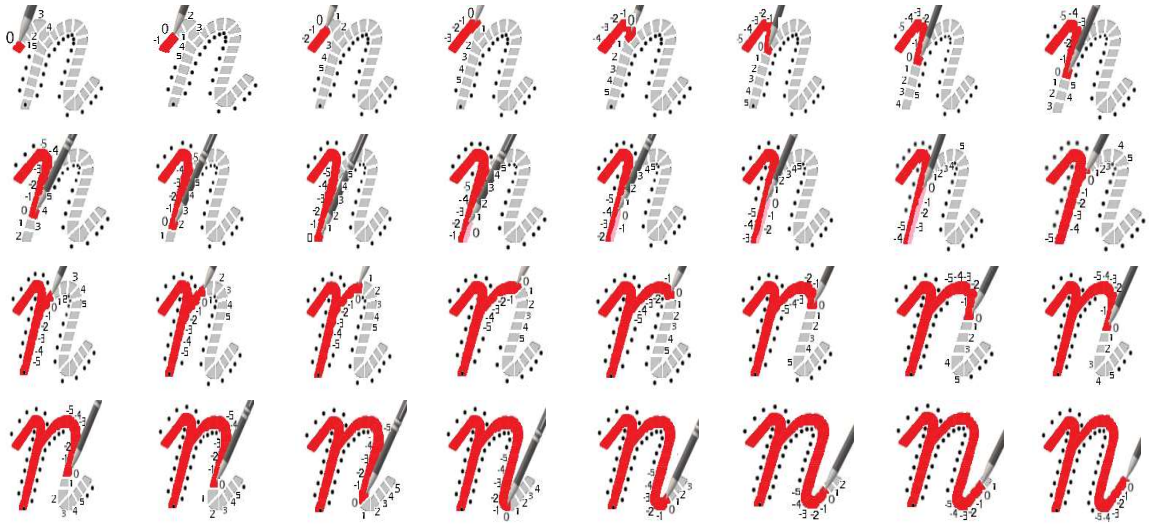
to the internal (secondary) focus and extensively discusses the consequences this has for the perception processes within the internal (secondary) focus c.q. for all sensorimotor activity.

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 actual position of the action object and the end goal[17] gradually approached zero and eventually completely disappeared. While Lee's discovery 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 one 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 the tip of the pen from A to B within the letter “n”



Without any exception the explanatory model of the motoric movement action provides a universal explanation for every conceivable motor action. So within the the act of writing, we also first construct a perceptual image of an entire latent action trajectory along which the action object, in this case, the pen tip, will need to move prior to the actual execution. Then, with great care, the pen tip will proceed to traverse all planned latent positions P, much like a marble moves within a marble run. In which the current position P(0) of the pen tip always represents the precise boundary between the manifest and the latent part of the action trajectory shape.
So, as we progress through the letter "n," the universal process of perception-action coupling will occur as well like in any conceivable motoric action. Due to this perception-action coupling we can perceive that, at the end of the letter, the *tau*-value will approach to zero and this will have to cause that

[17] 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.

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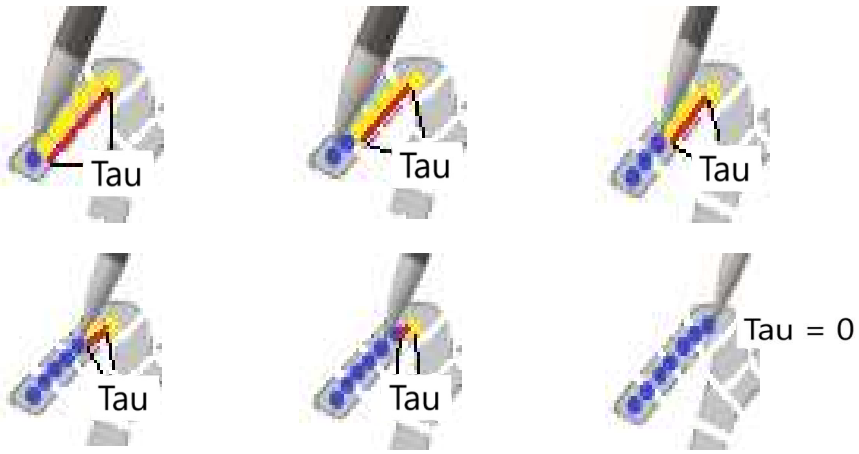
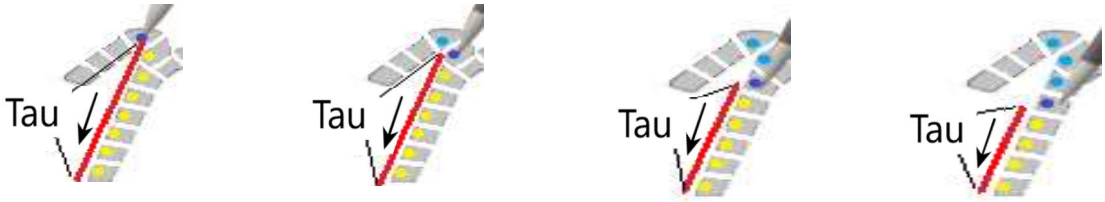
we lift the pen tip from the paper in a timely manner. However, there is a significant distinction from other motor actions. The unique aspect of writing is that the task requires that all positions P between the starting point A and the endpoint B of the letter "n" become visible. Thus, much more attention must be given to all positions between A and B. Writing essentially involves an ongoing *tau*-coupling process. In this explanation it is not relevant to provide a detailed clarification of this phenomenon and will be sufficed with mentioning the *tau*-coupling process within the five most prominent *tau*-values that will arise within just writing the single letter "n".

a. *Tau*-coupling process 1



From the beginning of the letter "n," one must perceive a *tau*-value approaching to zero for the first time in the ascending line segment, up to the little loop. The upward movement of the pen tip must then precisely transition into a downward movement. During this phase, adjustments within the internal (secondary) focus need to be made, towards the outer surface of the pen so that the *height* (!) (of the perceptual image) of the latent action trajectory shape is approached smoothly and evenly. So within many motor actions, it can be concluded that after a phase of relative acceleration during the transition phase, a relative deceleration of the action object occurs as a *tau*-coupling process within an action will be finalized[18].

b. *Tau*-coupling process 2



[18] The explanation in this section 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.

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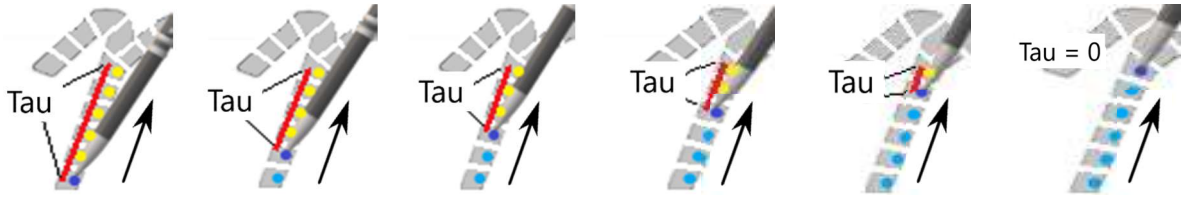
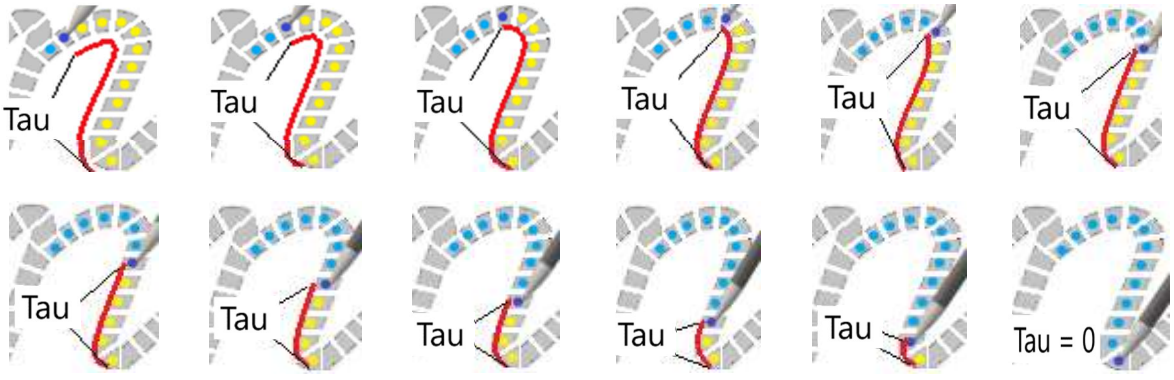
From the first loop to the end of the first leg of the letter "n," one must observe a *tau*-value for the second time as it approaches zero. This pertains to the long downward stroke when creating the first leg of the letter "n." During this phase, adjustments within the internal (secondary) focus need to be made, shifting to the outer surface of the pen so that the downward movement of the pen tip is brought to a complete, smooth and even, stop as it approaches the bottom (of the perceptual image) of the latent action trajectory. So within many motor actions, it can be concluded that after a phase of relative acceleration during the transition phase, a relative deceleration of the action object occurs as a *tau*-coupling process within an action will be finalized[19].

c. *Tau*-coupling process 3



From the bottom of the first leg, going upward, marks the third time that, when writing the letter "n," one must observe a *tau*-value approaching zero. This pertains to perceiving the action trajectory shape moving upward until it reaches the initial height of the first part of the letter "n." During this phase, adjustments within the internal (secondary) focus need to be made, shifting to the outer surface of the pen so that the movement of the pen tip, smoothly and evenly, recreates the same shape as the beginning of the letter, and the same height as the initial part of the letter. So within many motor actions, it can be concluded that after a phase of relative acceleration during the transition phase, a relative deceleration of the action object occurs as a *tau*-coupling process within an action will be finalized[20].

d. *Tau*-coupling process 4

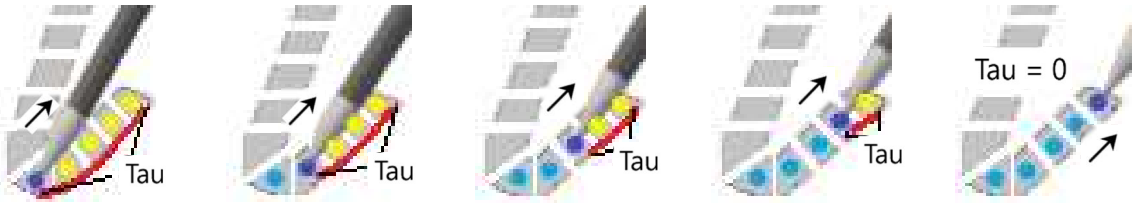


From the connecting loop to the end of the second leg, marks the fourth time that, when writing the letter "n," one must observe a *tau*-value approaching to zero. This again pertains to perceiving the

[19] See note 7.
[20] See note 7.

action trajectory shape towards the base of the entire letter. During this phase, adjustments within the internal (secondary) focus need to be made, towards the outer surface of the pen so that the downward movement of the pen tip, smoothly and evenly, ends at the exact same level of the first leg of the letter. So within many motor actions, it can be concluded that after a phase of relative acceleration during the transition phase, a relative deceleration of the action object occurs as a *tau*-coupling process within an action will be finalized[21].

e. *Tau*- coupling process 5



From the bottom of the second leg to the end of the action trajectory shape marks the fifth time that, when writing the letter "n," one must observe a *tau*-value approaching to zero. This pertains to perceiving the finalization of the entire letter. During this phase, adjustments within the internal (secondary) focus need to be made, towards the outer surface of the pen so that the pen tip is taken from the paper, smoothly and evenly, at precisely the right height. So within many motor actions, it can be concluded that after a phase of relative acceleration during the transition phase, a relative deceleration of the action object occurs as a *tau*-coupling process within an action will be finalized[22].

The perception of the sensorimotoric movements when manipulating the outer surface of the pen within the internal (secondary) focus

The explanatory model of the motoric movement action presents a completely new paradigm. It's based on the factual observation that an autonomous internal movement of any organism will implicitly induce an autonomous external movement on 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[23]. Which factually means that those connected positions on the outside of the body will always create an external line segment shape. So the most important conclusion reveals that the internal and external movements are implicitly connected, but that the perception processes mediating these movements are completely autonomous and independent of each other[24].
The previous explication does not concern the paradigm itself, but rather its foundation. The explanatory model notes that the mentioned phenomena will emerge regardless of which focus you centralize. The new paradigm, however, involves the novel concept that you can complete a motor action entirely

[21] See note 7.
[22] See note 7.
[23] If you, for example, isolate your arm and make random internal movements, all outer parts of your arm will start to move as well. So the fingertips, the knuckles of your hand and the elbow will randomly move as well about which can solely factually be remarked that, within our worldly dimensions, they will always construct only one line segment shape. The movements of all action objects c.q. all environmental objects are always caught in a line.
[24] 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.

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by focusing solely on creating and completing the aforementioned external action trajectory shape. In contrast to the idea that the earliest organisms began with an emphasis on arbitrary motor movements within the body and then experiencing what external results they would have, the explanatory model asserts that these roles have now been entirely reversed. When writing, we mainly perceive, within the external (primary) focus, the movement of the tip of the pen and guide its progression with motor movements as part of the internal (secondary) focus, which extend only to the outer surface of the pen. 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. 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[25,26]. Consider activities like clapping your hands behind your back, unlocking 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[27].
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

[25] 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.
[26] 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.
[27] 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

(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.

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[28]. 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

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 altering situations.

[28] 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.

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 pen tip while creating a letter, word- of word part[29]. 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. Which essentially 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. Sensorimotoric movements to the outer surface of the pen are proprioceptively perceived

The explanatory model clearly demonstrates that the internal (secondary) focus is exclusively perceived within the body and, therefore, visual perception can never be involved. The internal (secondary) focus can only be perceived proprioceptively. You can practically confirm this while writing by covering everything except the pen tip. As long as the pen tip remains visible, it will have no impact on the writing action.

g. Hybrid (proprioceptive) perception processes

A significant shortcoming in current 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. Visual perception will certainly play a dominant role, but proprioceptive perception will always remain present in a hybrid form. So, even though visual perception is dominant within the external (primary) focus while writing, we are always carrying out the action with proprioceptive perception. This means that we not only see the creation of a letter, word, or part of a word, but we also distinctly *feel* (!) the process of shaping it[30].
Within the internal (secondary) focus, it is no different. You can quickly ascertain for yourself that you could move a pen using only torso action, or even solely leg movements if you were to rigidly hold the pen. In fact, you could make it move with just upper arm and/or forearm action if you maintain to just rigidly hold that pen. But even when it comes to more typical motor movements used for pen control, you can readily observe that you could relatively use more hand or more finger action.

[29] https://www.researchgate.net/publication/373603599_Within_bicycling_the_essence_of_the_task_is_solely_executed_by_the_external_displacement_movement_of_the_bike_Within_the_primary_focus_the_bike_is_caught_within_an_action_trajectory_shape_providing_th

[30] Think also of "Writing on the back." It is a well-known children's game in which one person writes words or messages on another person's back with their finger, without the receiver seeing it. The receiver must then guess what has been written on their back based on the touch and movements of the finger. This game illustrates the importance of tactile and proprioceptive perception in understanding written text without visual input. It also emphasizes how our brain is capable of processing information based on different sensory inputs, even when the visual aspect is absent.

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In short, you may have developed your own preferred motor skills to execute a writing task, but they will always consist of a constantly changing constellation 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 is 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 pen move in an identical manner. 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[31]. 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 current writing action, 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.

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

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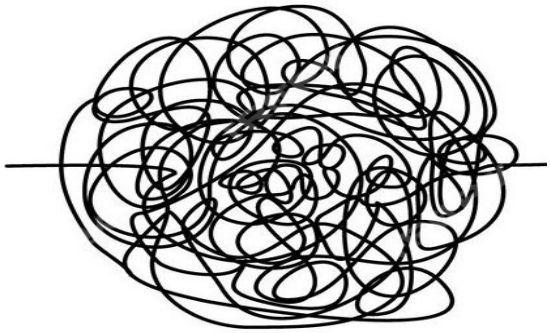
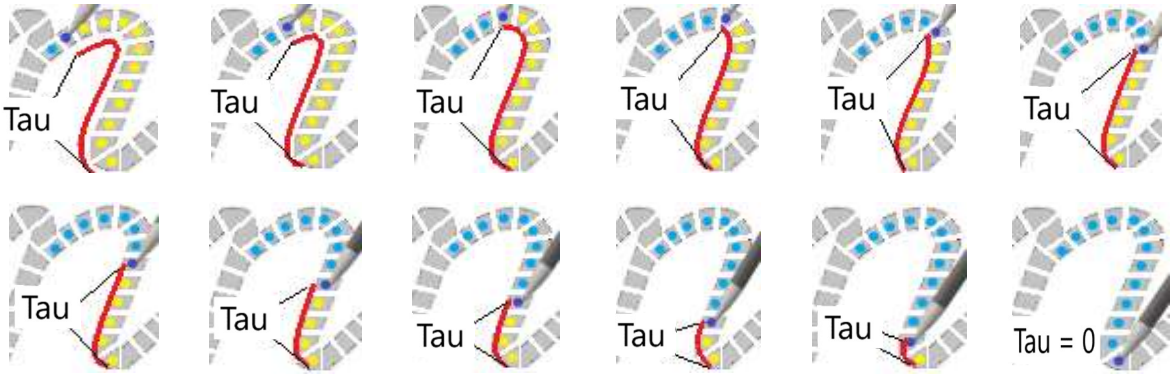
Part 4 - From random motor activity to the execution of deliberate actions demands shifting the internal and external focus; Scientific evidence of the origin of two autonomous foci and how their roles have evolutionarily reversed





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

N.J. Mol
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Introduction

The explanatory model of the motoric movement action is capable of delineating all functional perception processes within any conceivable action. Nevertheless, challenges are encountered in its implementation within the scientific community due to the intrinsic nature of a new paradigm within a complex dynamic system. The explanatory model demands the simultaneous integration of multiple innovative mind steps.
In order to facilitate those necessary subsequent steps in science, a series of new articles is introduced, each time focusing on a different motoric action which will be assessed within the complete spectrum of (general) motor activity. The aim is to provide a broader perspective on specific motor activity required for goal-directed actions. Additionally, they universally demonstrate that motor activity always leads to the simultaneous autonomous perception of both internal and external movements, which can be appointed as primary or secondary, and finally, they elucidate all elements underlying the explanatory model of the motoric movement action.
This article centers around the essential task of writing. The explanation consists of three parts. The first part exclusively focuses on general motor activity and not on specific actions. Here, an action is defined as deliberate motor activity aimed at performing a specific task as a result of an egocentrically formulated intention. At the end of this part, writing is fully explained in relation to general motor activity. In contrast to the first part, the second part addresses deliberate c.q. specific actions where an egocentrically intention is formulated to construct a letter, word a word part with a pen. Two action strategies are highlighted in this part, logically stemming from the general motor activity mentioned in the first part. The concluding part emphasizes the relationship between the discussed motor activities and the explanatory model of the motoric movement action.

Part 1 - Internal motor (movement) activity when no deliberate goal-directed action is involved

The explanatory model of the motoric movement action identifies all functional perception processes within any conceivable action. In which the fundamental assumption encompasses that the action arises from explicitly formulating a particular egocentric will. However, in this paragraph, we do not assess a specific motor action with an egocentric intention yet. In here we solely focus on general motor activity. The distinction between mere motor activity and conscious actions provides valuable insight into the broad spectrum of motor (movement) activity.

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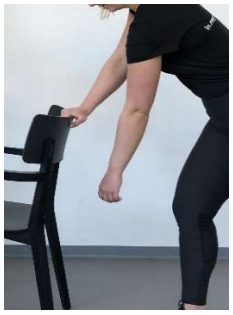
a. Basic exercise (passive arm without a spoon)

The entire explanation is built upon a basic exercise, involving a forward-leaning posture with one arm hanging passively downward. This posture is often used in physiotherapy exercises to allow isolated movement of the arm. That is strenuously not the intention of this exercise. It is essential to keep the arm entirely passive during the execution of the basic exercise.



Images: The basic exercise illustrates a forward-leaning position with a passive arm. Despite the apparent action in the images, the primary goal is to develop and observe other body actions and notice how they laterally influence the movement of the passive arm.

Although the hanging arm is prominently present, you are now asked not to focus on it specifically. Conversely, the emphasis must be put on developing other than arm activities (knee, torso, head, foot action, etc.) and observing whether the passive arm is going to move.

Conclusion of the basic exercise (passive arm without a spoon)

It can be conclusively observed that you are capable to (secondarily) perceive movement of all separate positions P of the outside of a passive arm by directing (primary) attention to an entirely different internal motor activity. This observation carries the following factual conclusions:

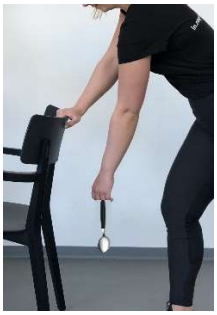
1) While there is nothing predictable about where the passive arm will move, as random internal motor activity will always result in random or chance movements of the passive arm, there is, on the other hand, a very essential fact to note. All individual points/positions P of the arm will always have to be connected c.q. will always have to emerge from each other. If we, for example, were to focus on three points of the arm, such as the fingertips, knuckles of the fist, and the elbow[32], you cannot escape the factual conclusion that all those points always move in a line segment shape and that it always involves only one (!) line segment shape[33]. So, this applies to all places on the arm, and within there it can also factually be established that each position P of the arm will move like a marble in a marble run[34]. The current position P (0) of each piece of the arm will always mark the separation between the manifest positions P (-x) and the future positions P (+x).
2) The second very essential conclusion encompasses the fact that the two movements have a causal connection, but the perception of the movement of internal motor activity (knee, torso, head, foot

[32] Hence, you must also realize that when grasping a coffee cup, where we typically focus on the movement of the fingertips, all other mentioned body parts also move in linear forms. This demonstrates that the related perception processes are entirely subjective and depend on the chosen focus.
[33] Indeed, you can factually ascertain that your own body, from birth to the end of life, is also confined within one extensive line segment shape. Your body at every position P(0) is, in fact, bound to the penultimate position P(-1) and the subsequent position P(+1). There is, in fact, simply no escaping it: *Caught In A Line.*
[34] https://www.researchgate.net/publication/336880958_The_explanatory_model_of_all_motoric_movement_actions_-_The_Marble_Run

action, etc.) has absolutely nothing to do with the perception of the movement within the linear form where all separate parts of the arm become part of[35].

b. Basic exercise (passive arm with a spoon)

A crucial aspect of the preceding conclusion involves the fact that internal sensorimotoric movements implicitly lead to a movement of, for example, the fingertips over an external line segment shape outside the body. There is, therefore, a direct causal relationship between these two movements, with the remarkable phenomenon that, without internal motor activity, an action trajectory shape of the fingertips is just not capable to occur. However, it is essential to establish that the perception of the movement of the fingertips over an action trajectory shape outside the body, in spite of this crucial causal relationship, has no connection with the perception of internal sensorimotoric movements. To further clarify this intriguing duality, the basic exercise is repeated, with the sole difference that the hand of the passive arm is holding a spoon. The entire exercise proceeds identically to the description above.



Images: In the repetition of the basic exercise, only a spoon is added, while the exercise remains unchanged. It is crucial, once again, not to develop conscious arm action but merely to observe how other bodily actions influence the entirely passive arm with the spoon. Now you can factually establish that all separate positions P of the arm but also all separate positions of the spoon will start to move in line segment shapes. Due to the fact that all those separate positions can only emerge from each other c.q. they will always be interconnected.

Conclusion of the basic exercise (passive arm with a spoon)

Like in the first version of the basic exercise it can be factually established that you are capable to (secondarily) perceive movement of all separate positions P of the outside of a passive arm, now holding a spoon, by directing (primary) attention to an entirely different internal motor activity. This observation carries the following factual conclusions:

1) While there is nothing predictable about where the passive arm with the spoon will move, as random internal motor activity will always result in random or chance movements of the passive arm with the spoon, there is, on the other hand, a very essential fact to note. All separate points/positions P of the arm and all separate points/positions P of the spoon will always have to be connected c.q. will always have to emerge from each other. Once again, the three previously mentioned arm positions (the fingertips, the knuckles of the fist, and the elbow) will create a line segment shape, but also all the separate positions of the spoon also form separate lines. If you focus, for example, on the handle or the bowl of the spoon, you cannot escape the factual conclusion that all those points always move in a linear form, and that, too, always involves exact one (!) entire line segment shape[36]. So, all separate positions of the arm and of the spoon are going to traverse a

[35] The explanatory model of the motoric movement action demonstrates in numerous articles that the two perceptions of two types of movements are autonomous because they belong to the incompatible worlds of inside and outside the body. Therefore, there can never be a blending of the two.

[36] Hence, you must also realize that when eating soup, where we typically focus on the movement of the spoon-bowl, all other mentioned body and spoon parts also move in line segment shapes. This demonstrates that the related perception processes are entirely subjective and depend on the chosen focus.

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linear form and within there it can also factually be established that each position P of the arm and of the spoon will move like a marble in a marble run. The current position P (0) of each piece of the arm and spoon will always mark the separation between the manifest positions P (-x) and the future positions P (+x).

2) The second highly essential conclusion, as mentioned in the first version of the basic exercise, remains fully intact here as well. The perception of the movement of internal motor activity (knee, torso, head, foot action, etc.) has absolutely nothing to do with the observation of the line segment shape that all parts of the arm and now the spoon become a part of. However, the new aspect introduced by the spoon concerns the fact that a spoon is an inanimate object. What leads to the astonishing factual conclusion that, for instance, we can observe the movement of the spoon's bowl over a line, but we can only generate motor activity up to the outer surface of the handle of the spoon. The perplexing aspect of this realization may be the fact that the movement of the spoon's bowl over a line segment shape is entirely dependent on a completely different internal motoric movement. Without this source of action, the spoon's bowl will never move. Additionally, the confirming aspect of this realization may concern the conviction that the perception of the movement of the spoon's bowl over a line has absolutely no connection with the perception of internal motor movement activity.

c. <u>The basic exercise in relation to motor activity moving a pen</u>

If we define an action as a conscious motor activity in which a specific goal is pursued from an egocentrically formulated will, then the explanation in the entire first part of this article falls outside the framework of actions. In this paragraph, we still do not assume a conscious goal-directed action, but rather build upon what the basic exercise regarding the movement of a spoon demonstrates.

Images: The basic exercise can be translated into a motoric action in which a tip of a pen is moved. You should primarily focus on manipulating the barrel of the pen c.q. your main focus should be on proprioceptive perception towards the outer surface of the pen, with only a secondary awareness of whether and how the pen tip moves on the paper. Even if you only engage in upper-arm, forearm, hand, or even just internal finger movements, the consequences remain the same[37].

As the previous paragraph illustrates, the basic exercise can easily be translated into an action involving an external (lifeless) object, such as a pen. To maximize the distinction between the (perception of) the movement of the spoon bowl/pen tip and the (perception of) the movement of internal motor activity, and thus make the principles easily accessible, you were specifically asked not to perform any arm activity. However, the distance between the spoon bowl/pen tip and internal motor activity doesn't matter at all. Even if you focus primarily on (internal) motor arm activity, you can observe that the (perception of the external) spoon bowl moves randomly through the air or that the (perception of the external) pen tip moves randomly across the paper. You can develop only upper or lower arm activity, but even if you develop only hand or even solely finger action, the same principles will still apply. It

[37] There is an essential omission in the animations: only a limited number of positions P of the pen tip are depicted. If you were to engage in a few minutes of random motor activity, the entire paper would be almost filled with pen tip positions, and the entire paper would be nearly black.

should be reiterated that you can only empirically determine that the position P(0) of the pen tip, in the present action, must always result from the preceding positions, and that all positions P of a pen tip are always confined to one line segment shape.

Conclusion basic exercise in relation to motor activity moving a pen

In actions involving lifeless objects, such as a pen, it becomes immediately clear that you (secondarily) can make the tip of the pen move by focusing entirely on a different (primary) motor activity, which can only reach up to the outer surface of the barrel of the pen. This is the only thing necessary to draw the following factual conclusions:

1) Although there is nothing predictable about where the pen tip will move, as random internal motor activity will always result in random or chance movements of the pen, there is, on the other hand, a very essential fact to note. All separate points/positions P of the tip of the pen will always have to be connected c.q. will always have to emerge from each other. Due to which one can conclude that all those points always construct a linear form, and that, too, always involves exact one (!) entire line segment shape. The pen tip will move in that linear form in the same universal manner as a marble moves within a marble run. In which the current position P (0) of the tip of the pen will always serve as the precise separation between all manifest positions P (-x) and all future positions P (+x).
2) Once again, the second highly essential conclusion follows the explanation as in the case of the other basic exercises. The perception of the movement of internal motor activity has absolutely nothing to do with the perception of the movement of the pen tip within the line segment shape that all positions of the tip become a part of.
   The perplexing aspect of this realization may be the fact that the movement of the pen tip over a line segment shape is entirely dependent on a completely different internal motoric movement solely reaching the outer surface of the barrel of the pen. Without this source of action, the pen will never move. Additionally, the confirming aspect of this realization may concern the conviction that the perception of the movement of the tip of the pen over a linear form has absolutely no connection with the perception of internal motor movement activity.

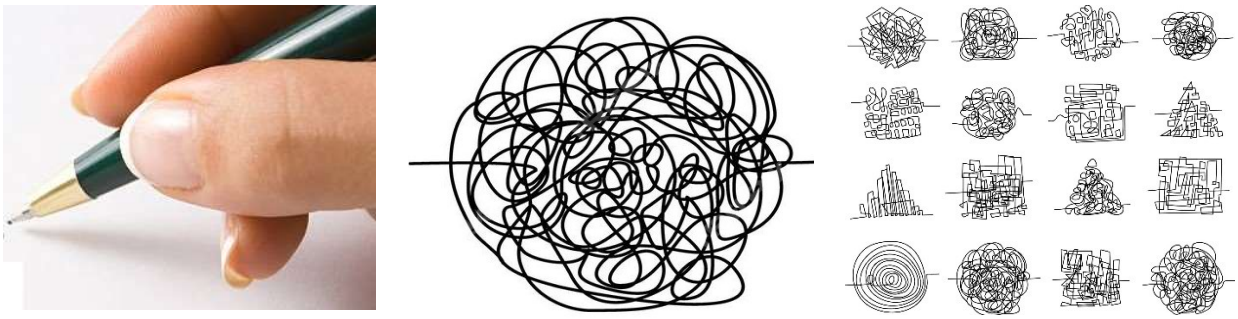
Part 2 - Internal motor (movement) activity when a deliberate goal-directed action is involved

The explanatory model of the motoric movement action encompasses the clarification of all functional perception processes within any conceivable action, assuming that these are conscious actions driven by an egocentrically formulated will, with a clearly defined specific goal. So, the motor movements in the first part specifically did not involve actions aimed at placing motor activity in a larger context. Conversely within the second part, general motor activity will now be translated towards specific motoric actions. Although the explanatory model of the motoric movement action is emphasized more in this part, the explanation within this section still aims to clarify the entire spectrum of motor (movement) activity.
So, within the second part we do assume deliberate goal-directed actions where an egocentric will is formulated to achieve a specific goal and in this chapter the producing of letters, words or word parts with a pen encompasses the key issue. The basic exercise clearly shows that two possible action strategies c.q. execution perspectives can be pursued in this regard.

a. Execution perspective 1 – Primary focus on the internal movements towards the outer surface of the barrel of the pen and secondary focus on the movement of the pen tip

The basic exercise from the first part clearly demonstrates that with primary attention on internal motor activity, focused on the exterior of the pen, we can cause the pen tip to move randomly across a piece of paper. However, this random movement becomes problematic when one formulates the egocentric intention to create a representation of a letter, word, or part of a word that a reader associates with the same meaning. While we can, with primary attention on internal motor activity, cover a considerable amount of the paper with pen tip positions in a few minutes, it is simply impossible to

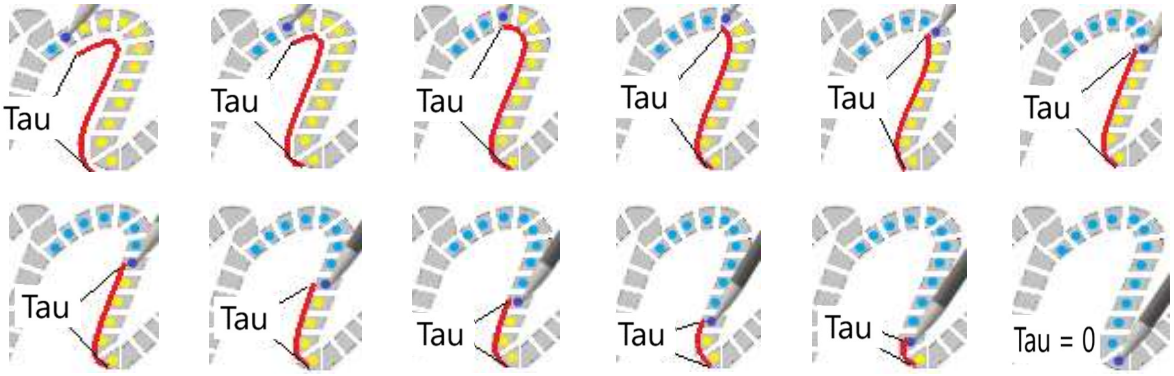
produce complex characters in this way. Although it remains an option to perhaps produce very simple characters, it is by no means an economically efficient alternative.



Images: Even when attempting to move a pen tip within a conscious action, one can always, with primary attention focused on the exterior of the pen casing, secondarily perceive whether the pen tip produces a recognizable mark. However, for complex characters, such as letters, words, or word parts used in our written language, this is absolutely not a viable strategy.

b. <u>Execution perspective 2 – Primary focus on the movement of the pen tip and secondary focus on the internal movements towards the outer surface of the barrel of the pen</u>

Contrary to the description of random motor activity within the basic exercises within the first part of this article and also in contrast to the previous action strategy, when it comes to the emergence of a deliberate action, one can adopt a completely different execution perspective. It would be by far the most parsimonious (ecological) solution to first conceptualize and later on actually construct an action trajectory shape, of a letter, word or word part.



Images: The most economical approach is to first create a perceptual image of an (efficient and effective) latent action trajectory shape over which the pen tip will successfully form a letter, word, or part of a word, and then proceed to fill it in factually.

In the second execution strategy, the roles of attention are reversed. The primary focus now has the goal to track the progress of the tip of the pen within the action trajectory shape, and this must be followed secondarily by motor activity. In which you now have to observe, similar to the basic exercise in the first part, that motor activity passively follows the primary focus.
It would, of course, be by far the most parsimonious execution strategy, but the reversal of roles requires significantly more cognitive capacity. While the first execution perspective allows for a straightforward initiation of the action, the second one demands the following essential cognitive skills:

a. It demands that first a perceptual image of a latent action trajectory shape is constructed over which the pen tip can be successfully moved constructing a letter, word or word part.

b. There needs a significant complex system to be present which must be capable of mediating the (perception of) the movement of the pen tip within the action trajectory shape. While the roles of attention can be reversed, will not change the fact that the pen can only be moved by (the perception of) a completely different autonomous (internal) phenomenon. Even if we try to enforce that the pen tip actually fills in the perceptual image of the latent action trajectory shape, the autonomy of the motor activity will cause the tip to deviate from that perceptual image of the latent action trajectory shape at every position P.

Part 3 – General conclusion

The explanatory model of the motoric movement action is capable of appointing all functional perception processes within any conceivable action. However, its implementation in the scientific world encounters several challenges. It represents an entirely new paradigm and involves an explanation within a complex dynamic system where multiple new conceptual mind steps must be combined simultaneously. Therefor the goal is to try to enhance the insights around the explanatory model, and for that purpose, the preceding paragraphs zoomed in on the entire spectrum of motor activity. From a generally recognizable image, a translation was made to the core concepts and thought processes demanded by the explanatory model of the motoric movement action.
In the end, within this article, two possible action perspectives were identified based on general motor activity. Without any reasonable doubt it becomes clear that the second perspective, where the primary focus is pointed at the construction and execution of a perceptual image of a latent (external) action trajectory shape, will be far more superior to the first mentioned action strategy. However, this ultimate parsimonious solution also reveals which additional conditions the most superior action strategy should meet:

a. Firstly, an organism must have the cognitive ability to create a perceptual image of a latent action trajectory, over which, in the present action, the tip of the pen will be capable to successfully construct a letter, word or word part. Regarding this first condition, the explanatory model of the motoric movement action has provided universal scientific evidence that we create such a perceptual image within every conceivable action. This has been specifically addressed within computer[38], grasping[39] and throwing[40] tasks, but it can easily be adapted to any conceivable action.
b. Secondly, an organism must have the cognitive ability to mediate the movement of the pen tip within that perceptual image of a latent action trajectory. The mere quintessence of this article encompasses namely that motor activity is a completely autonomous phenomenon and although it has a direct causal relationship with the movement of the tip of the pen within an action trajectory shape, the pen will never be able to move by itself. So, we might be intensely motivated to reverse the roles of the primary and secondary focus and envision very neat and smooth (optimally economical) letters, words, or word parts, but due to the autonomy of the perception of both movements, we simply cannot execute them in that way. The autonomous (mainly visual) perception of the movement of the pen tip will eagerly try to follow the perceptual image of the latent action trajectory shape, but the autonomous proprioceptive perception of the movement of the exterior of

[38] https://www.researchgate.net/publication/372719694_When_moving_a_pointer_on_a_computer_screen_you_are_mainly_attentive_to_where_'nothing'_is_-_The_scientific_evidence_regarding_visual_perception_within_each_motor_action
[39] 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_trajectory?_sg%5B0%5D=cjBGD1Dj5IxR2T4se38lo9o1z_MKwSU49eb_oQsTOUjibSgy5M67E9dyDJ2vYL6jmizwVBbPYrgk9NU6pmmALDQpNZJERFlrXLCWSXY.BBjj_0oQKGMN_JQZfSCEjGE1eN9IjRkkPyAjEjWIaxLJGM1U2MeX-LYMQPb3Fz_XmE18jNVnKKf8WfOSPcG4l1w&_tp=eyJjb250ZXh0Ijp7ImZpcnN0UGFnZSI6ImhvbWUiLCJwYWdlIjoicHJvZmlsZSIsInBvc2l0aW9uIjoicGFnZUNvbnRlbnQifX0
[40] https://www.researchgate.net/publication/371912704_The_scientific_proof_that_we_primarily_start_with_the_construction_of_a_perceptual_image_of_an_outgoing_ball_trajectory_shape_prior_to_the_factual_execution_-_The_complete_explanation_of_the_free_thro

the pen casing will actually cause the pen tip to deviate at every position P within the perceptual image of a latent action trajectory shape.
The explanatory model of the motoric movement action thus concludes that there must be a very heavy significant system to mediate the ever-deviating movements of the tip of the pen within an ever-deviating action trajectory shape each consecutive time frame. Regarding this second condition the explanatory model finds that this very heavy system is present within the processing processes of the perception c.q. is present within the functioning of the cortical streams and, based upon current scientific literature, it asserts that there is a double and mutual relationship between the dorsal and ventral stream. In the present writing task, the dorsal stream is mainly related to the processing of perceptions concerning the specific position of the tip of the pen, and the ventral stream is mainly related to the processing of perceptions concerning the perceptual image of the whole action trajectory shape. However, this must be seen as mutual. At any time frame *t* or at any point P (0) of the action, one perceives the pen tip relative to the action trajectory shape and vice versa. So, the dorsal stream mainly processes the position of the pen tip, but this is always related to the action trajectory shape, and conversely, the ventral stream mainly processes the progression of the action trajectory, but this is always related to the specific position of the tip of the pen.

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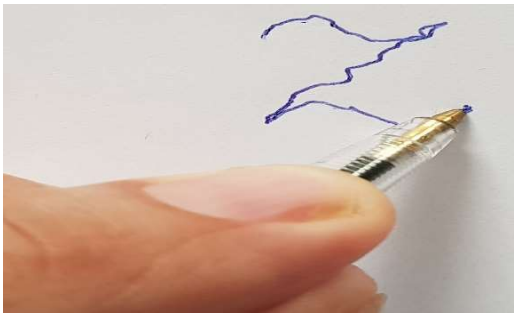
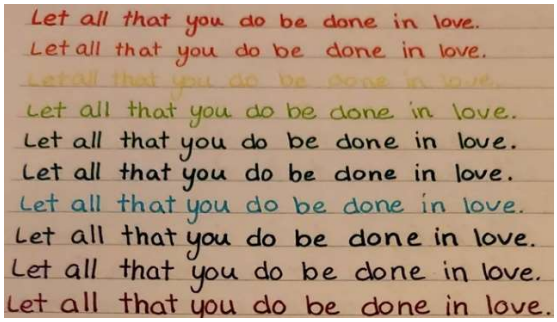
Part 5 - The explanation of the emergence of the cortical streams - We can only guide a tip of the pen with a zigzag movement, yet the ingenious mediation by the cortical streams creates the delusion of a straight action trajectory shape





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 motoric goal-directed 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 move the tip of the pen.
2. The understanding of the necessity of a compelling collaboration between an internal and an external focus in every motor action. Within a writing task the movement of the pen tip within the action trajectory shape can only be perceived outside the body and is solely caused by perception of movements within the body which only reach up towards the housing of the pen. Due to their exclusive domains these perceptions are incompatible.
3. The assumption of the crucial role of the movement of the pen tip 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 pen tip across a sheet of paper from the beginning to the end of the letter, it is a subjective choice from the perspective of the tip of the pen. With the same arm action, the wrist, knuckles, elbow, etc., all move in a unique action trajectory shape along with all other parts of the pen. This demonstrates that when moving a pen , there is a causal relationship between the perception of internal and external movements, but an explicit relationship only arises when we have "chosen" the pen tip as the action object.

As a concluding step, this chapter delves into the functioning of the cortical streams when we aim to construct the letter “n” when writing. It provides a comprehensive understanding of why they must play such a pivotal role c.q. why they are ecologically/evolutionarily developed. Additionally, it is precisely explained how they mediate two autonomous deviation processes within every motor action, namely the zigzag process and the accordion process[41].

1. The main goal of the tactical movement action (TMA) encompasses the construction of a perceptual image of a latent action trajectory shape between the beginning and the end of the letter “n”

[41] In previous publications, this has been referred to as the harmonica process.

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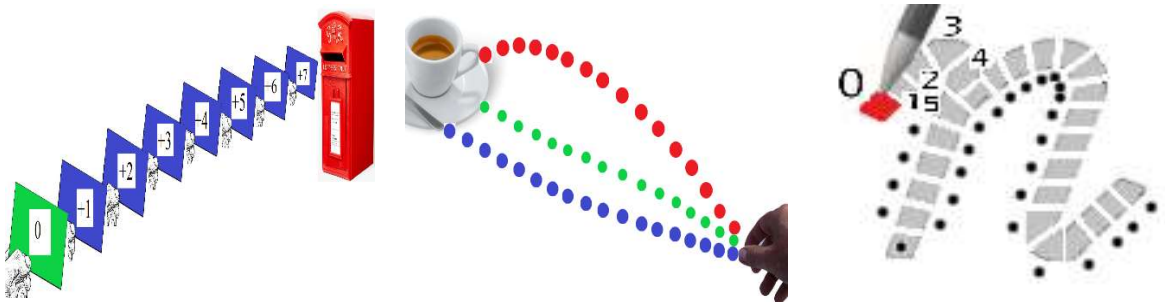
Supported by scientific evidence[42], the explanatory model delineates that the execution of any motor action involves two distinct sequential phases: the tactical movement action (TMA) and the actual movement action (AMA). The tactical movement action is focused solely on planning the upcoming action and must be finalized before any actual execution occurs. An essential part of the tactical movement action within writing the letter "n" is to create a perceptual image of a latent action trajectory shape between the starting and ending point of the letter we aim to produce. The explanatory model demonstrates that in this phase, we are indeed primarily focused on all physical dimensions of the endpoint of the letter, aligning with much scientific research. However, with the recognition that a perceptual image of a latent action trajectory shape is formed, the explanatory model also reaches a conclusion not yet acknowledged in the scientific community. Forming a perceptual image of a latent action trajectory between the beginning and end of the letter "n" also reveals that tactically, we determine whether the space between the starting and ending point (in the very near future) can be filled or bridged by a continuous line shape comprising all dimensions of the pen tip.



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 tip of the pen, one must perceive the movement of the action object during the bridging process, as only the pen tip, 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 tip of the pen, 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.

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 tip of the pen from the beginning to the end of the letter “n”. During the actual movement action (AMA), our main concern is the egocentric bridging process of the pen tip, 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 letter itself is not any longer the focal point, but rather the movement of the tip of the pen towards it c.q. the bridging of the void (!) between the beginning and the end of the letter 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 can be filled by a continuous line of all dimensions of the tip of the pen. This means that all latent positions P between the beginning and the end of the letter 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

[42] 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

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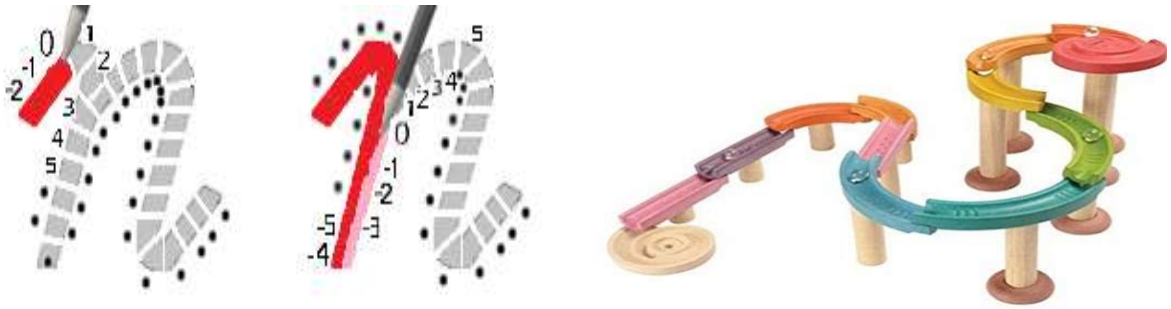
P(x), for example, somewhere midway along the action trajectory, we are mainly focused on the perception of three positions: position P(x-1), where we just came from, position P(x), where the pen tip is now, and position P(x+1), the perception of the next position where we need to move the tip of the pen. 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 letter “n” is closing. This also reveals another essential ecological novelty, showing that during the actual movement action, we are indeed not concerned with the end of the letter itself, but only with reducing the number of latent positions P between the beginning and the end of the letter.

2. The reciprocal dependency between the internal and external focus results in absolute deviations of the tip of the pen within the perceptual image of the latent action trajectory shape

The explanatory model of the motoric movement action unequivocally illustrates within the context of writing that two foci always arise. We can only guide the tip of the pen along an external action trajectory (from A to B) 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. In this motor action, it becomes immediately apparent that the perception of internal motor movements in relation to the pen, of which we only touch the outer casing, has absolutely nothing to do with the perception of movements of the pen tip forming the letter "n".
However, as the explanatory model now demonstrates that the movement of the tip of the pen within the external action trajectory shape is going to fulfil the essence of the task, an intriguing phenomenon of reciprocal dependency emerges. Only internal motor movements towards the outer casing of the pen can lead the pen tip externally along an action trajectory shape, yet the progression of the tip of the pen within that action trajectory shape will, as the primary focus, dictate those internal motor movements. The inevitable consequence of this observation encompasses that it is not a matter of whether the pen tip will deviate within the perceptual image of the latent action trajectory shape, but rather that this is an absolute certainty. In which this absoluteness logically stems from the factual nature of the autonomous perception of both foci.

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

If we now combine the two preceding paragraphs and proceed to actually move the tip of the pen, our main endeavour will primarily become to initiate the bridging process of the pen tip in which the perceptual image of the latent action trajectory shape serves as an open yet compelling guiding[43] phenomenon. This means that we aim to *step by step* (!) reduce the distance between the beginning and the end of the letter “n”, starting with the first step of moving the pen tip from position P(0) to position P(+1).



[43] Upon perusing the explanatory model, one will start to realize that the construction of a perceptual image of a latent action trajectory shape is necessary to initiate any motor action, but it doesn't need to be followed precisely. That's the essence of a highly economical system. In the initial stages of an action trajectory shape, it's not a problem at all if the pen tip deviates, as long as it comes closer to the endpoint. However, without a (precisely global) perceptual image of a latent action trajectory shape, motor actions cannot commence and the explanatory model introduces the term "precise global" in this context. The perceptual image of the latent action trajectory shape must precisely indicate the global (fluctuation boarders of the) direction it should take.

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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. Although all this remains partly invisible when writing the letter “n”, it is present in an equivalent manner. Because in our worldly dimensions, it is just a mere fact that all positions P of any moving object, including the tip of a pen, must emerge from each other, meaning that the perception of the pen tip’s movement is always captured in one single line segment shape when writing. In which the current position P(0) of the pen tip 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 pen tip positions prior to the current position P(0).

The perceptual image of the entire latent 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 tip of the pen 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 pen tip will inevitably deviate[44] from the perceptual image. It is an absolute factual given that cannot be avoided, and it would quickly lead to chaotic action trajectories[45] if there were not a system capable of mediating these deviations.

Images: The perceptual image of a latent action trajectory shape, constructed within the tactical movement action (TMA), depicts a smooth line segment shape representing the letter "n".. However, during

[44] As stated in footnote 3, this precisely illustrates an optimal parsimonious model, where nothing needs to be executed very precisely, but only gives a general (albeit compelling) direction. If you were only able to move a pen tip in an identical manner writing the letter “n” would become a neigh impossible task. 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.

[45] 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.

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the actual execution, the tip of the pen, akin to a ring in relationship to a nerve spiral[46], 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 pen tip 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[47]. Similar to a marble in a marble run, the tip of the pen in relationship to the whole 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 pen tip towards the action trajectory shape, and vice versa the ventral stream primarily monitors the action trajectory shape towards the actual position of the tip of the pen. The nerve spiral clearly demonstrates that this double reciprocal coupling inevitably leads to deviations or touches of the ring with the spiral, causing the pen tip to follow the action trajectory shape in a zigzag[48] movement. However, the ingenious mediation of the cortical streams ensures that the action trajectory shapes appear 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[49]. Therefore, it ideally presupposes a mutually reinforcing system that continuously monitors the relationship with the action trajectory shape from the current position of the pen tip, and conversely, constantly monitors the actual position of the pen tip from the perceptual image of the action trajectory.
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 tip of the pen, while the dorsal stream does so vice versa, primarily from the actual position of the pen tip 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. The cortical streams mediate two autonomous groups of deviations within every conceivable action

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[50], 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

[46] 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
[47] You can speak of micro-adjustments or of updating c.q. renewing the perceptual image of the remaining latent action trajectory.
[48] This is clearly demonstrated by writing with the non-dominant hand.
[49] One must be able to stop at the right distance behind the waiting car and not bump into it, one must be able to push away an opponent in a precise *tau*-coupling process at just the right moment, and not a moment earlier or later; one must bring food precisely to the mouth, and the fingertips must also stop precisely at the coffee cup without knocking it over repeatedly.
[50] 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.

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[51] 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 when writing

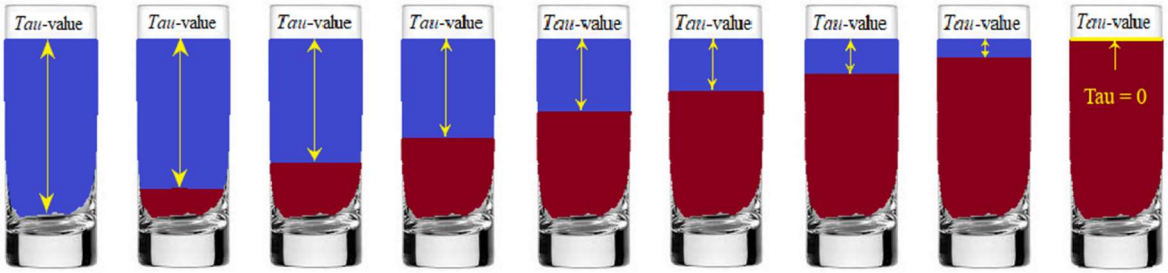
The explanatory model of the motoric movement action reveals that the zigzag process and the accordion process are inherent in every conceivable action[52]. However, in other actions, demonstrating this is much more challenging than within the aforementioned cycling or car driving. Nevertheless, in all 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.

[51] https://www.researchgate.net/publication/375121264_The_tau-coupling_process_when_clicking_an_icon_shows_that_we_absolutely_do_not_need_a_motor_plan_Executing_an_external_action_trajectory_shape_within_the_external_primary_focus_dictates_all_internal_s

[52] 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.

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 tip of the pen, the pointer, and the spoon bowl) will definitely deviate from the perceptual image of the latent action trajectory shape in width.

The accordion process (the pedal process) when moving a pen tip within writing is difficult to depict in an animation because it involves compressions and elongations of time[53]. Nonetheless, similar to the aforementioned car driving or bicycling, you must realize that you can never move the tip of the pen identically in time along an action trajectory shape. 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.

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

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