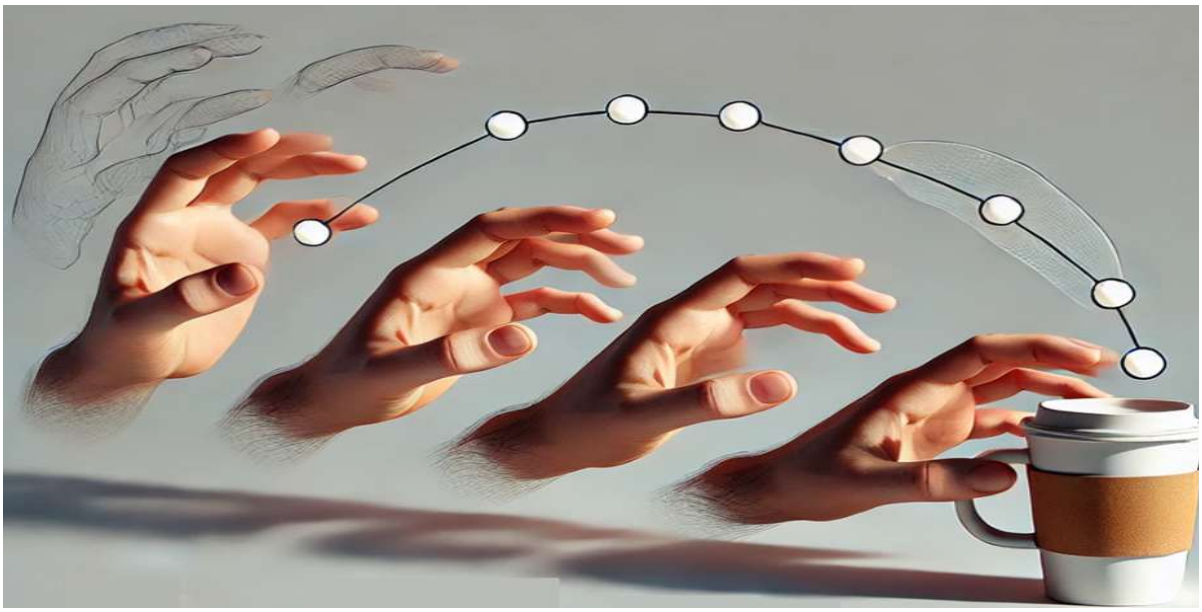
The Complete Clarification of All Functional Perception Processes Within Grasping

A Complete Perceptual Foundation of Ideomotor Action



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

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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. This model 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 or grasping a coffee cup, one autonomous focus continuously tracks the movement of the ball and/or cup as the environmental object, universally representing a catching action. The other two autonomous foci are concerned with perceiving the movement within the egocentrically executed action: i.c., the movement of the hand (fingertips) along an action trajectory shape (towards the ball and/or coffee cup), which universally represents a throwing action.

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 means that, for example, with an incoming tennis ball within a catching action, the perceptions of all positions P of the tennis ball will always construct an action trajectory shape, and this phenomenon will always represent solely one line segment shape. This limits 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 also to all throwing actions. So also when grasping a coffee cup or catching a ball, the relevant fingertips are confined to one action trajectory shape, will the current position of the fingertips always represent the precise division between the manifest and latent parts of the action trajectory shape, 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 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.

[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.

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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 coffee cup or 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 catching c.q. grasping hand 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 coffee cup or 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 catching c.q. grasping hand. 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 clarification shows that the explanatory model, in contrast to the current state of science, indicates that the perception processes within any conceivable motor action originate much more from one universal source and shows that within all actions, an intersection point c.q. contact point between the animal and the environmental object must first be realized, followed by a pressing action upon the actual contact. So the model shows that the perceptual processes within the contact process of grasping objects are identical to the perception processes when we want to press a button (e.g., piano key, touchscreen, elevator buttons, electric stove, light switch, etc.) or when we want to move a billiard ball or kick a football towards the goal. The contact process in terms of perceptual processes is identical in all cases. When grasping a coffee cup, a pressing action must follow upon contact within the relevant fingertips, resulting in a zero vector. Conversely, pressing a piano key requires creating an actual movement vector, within the relevant fingertip, to press the key down. The same applies to the other mentioned buttons, and so the contact process in all ball sports also require the exact same perception processes as in grasping. For example, in volleyball, we also first create a perceptual image of a latent contact point c.q. intersection point between the incoming ball trajectory and the action trajectory shape of the fingertips and execute that first. Then, at the moment of actual contact, we execute the intended pressing process (smash, pass, etc.), just like a movement vector must be created in relationship to the fingertips when pressing a button.

This overview document specifically addresses those aspects of the throwing and catching action in grasping a coffee cup that are barely recognized within science. A small part focuses on the perception of the coffee cup 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 fingertips. It shows the scientific evidence that 1. a perceptual image of a latent action trajectory shape from the fingertips to the coffee cup 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

[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.

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 perceptual processes in grasping.

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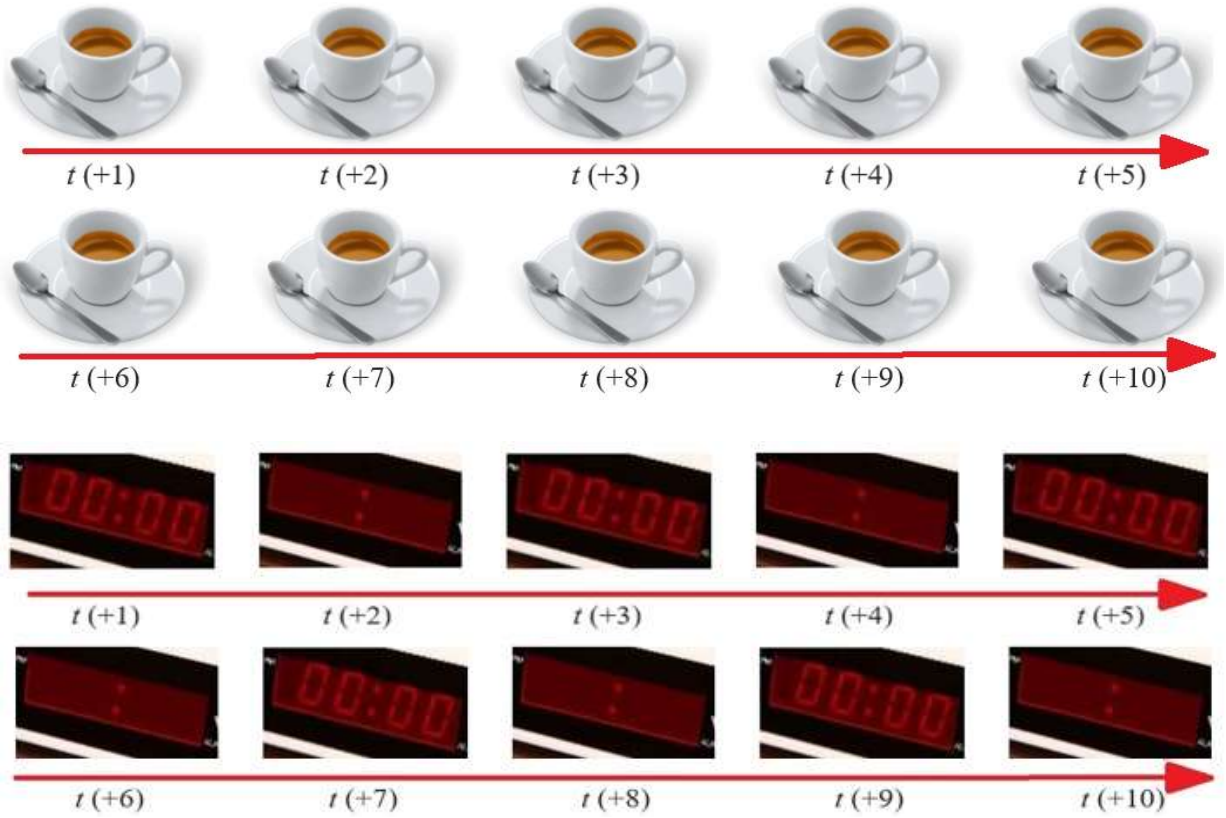
Part 1 - Einstein, the Stationary Coffee Cup, and the Digital Clock: The Visual Perception Observes Stationary Coffee Cups Moving in Time



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Introduction

In the dynamic world of visual perception and theoretical physics, seemingly simple objects like a stationary coffee cup and a digital clock reveal surprising insights. This article explores how our visual system always perceives all environmental objects moving in time but can interpret them as static objects. By examining examples such as the blinking zeros of a digital clock and the static edges of a coffee cup, we discover that our brains perform complex computations to understand stability and motion. The major ecological breakthrough encompasses the fact that stationary environmental objects are perceived in an identical manner to moving objects within the vista. These discoveries have profound implications, not only for visual cognition but also for our understanding of space and time, as outlined in Einstein's theory of relativity. This introduction invites you to explore the fascinating cross-pollination of psychology and physics, where the boundaries between perception and reality blur.

The Example of the Digital Clock

Consider the example of a digital clock where the zeros flash after a power outage. When the clock starts working again, the zeros blink on and off in exactly the same place. This example illustrates an important principle. The visual perception of the first set of zeros has no relationship with the later perception of the zeros, except for their identical position. This phenomenon illustrates how we perceive zero-movement in timeline segment shapes. Stillness can only be perceived through the active comparison of all observations over time, which allows us to deduce that stationary environmental objects within a vista are perceived as actively as moving environmental objects.

Perception of a Stationary Coffee Cup

We perceive a stationary coffee cup in an identical manner to the flashing zeros on a digital clock. The coffee cup's edges and contours do not change position over time. This lack of movement signals to our brain that the cup is stationary. Just as with the zeros on the clock, the perception of the coffee cup at any given moment *t*(x) in time has no direct relationship with the perception of the coffee cup at subsequent moments *t*(x+n) in time. Each moment is perceived independently, yet the consistency of the cup's position reinforces the perception of stillness.

1. Static Line Segments:
    - The static nature of the edges and contours of the coffee cup creates a visual perception of stillness. These features remain in the same position, indicating zero movement.
2. Positional Data Consistency:

- Each point on the coffee cup's surface is linked to its previous and subsequent positions in time. This consistent positional data ensures that the cup appears stationary, as there is no disruption in its positional continuity.

3. Perceptual Continuity:
   - Our visual system continuously processes these stable elements, reinforcing the perception of the cup as stationary. This perpetual perception is key to understanding how we interpret zero-movement within zero-movement line segment shapes.

Ecological and Visual Perception

According to Gibson's theory of affordances, the physical properties of our environment provide opportunities for action and perception. Our visual system has evolved to take advantage of these affordances. Light and moving space are intrinsic parts of our surroundings, and organisms have ecologically and organically developed mechanisms to interact according to these elements. The key idea is that every environmental object's actual position P(0) at time *t*(0) within a vista is connected to its manifest positions P(-x) at time *t*(-x) and future (latent) positions P(+x) at time *t*(+x), and thus is always confined within a line segment shape c.q. always is confined within a timeline. This continuity helps us perceive objects as stable and unchanging when they are at rest.

The Visual System as a Comparing Organ

Our perception system functions as a comparing organ, utilizing logic to interpret and understand our environment. Here's how this works:

1. Comparison Over Time:
   - Our visual system compares the positions of objects at different moments in time. For example, when looking at a stationary coffee cup or the zeros on a digital clock, our brain continuously compares their positions at *t*(0), *t*(+1), *t*(+2) etc., in time. Despite perceiving each moment independently, the consistent positional data across these moments leads to the interpretation of stability and zero movement.
2. Logical Consistency:
   - The brain uses logic to make sense of the visual information. If an object appears in the same place repeatedly without any perceived movement between these instances, the brain logically concludes that the object is stationary. This logical processing allows us to understand and navigate a complex environment.
3. Pattern Recognition:
   - Our visual system is adept at recognizing patterns and regularities. By comparing the spatial and temporal patterns of objects, it can determine whether something is moving or still. This pattern recognition relies on logical assessment of the consistency and changes in the visual input.

Zero-Movement within Action Trajectory Shapes

The concept of zero-movement within action trajectory shapes can be further illustrated through the perception of a stationary coffee cup. Similar to the flashing zeros on a digital clock, the coffee cup is

perceived as being at rest because each point on its surface is linked to its previous and subsequent positions in time. This creates a continuous action trajectory shape that indicates no movement. However, it's essential to note that while the coffee cup appears motionless in space, the entire explanation hinges on its movement in time.

Relationship with Relativity Theory

In the context of relativity theory, particularly as articulated by Einstein, the distinction between space and time becomes crucial. Objects can remain spatially stationary (zero-movement) while still undergoing temporal changes. This concept aligns with our perception of the coffee cup: although it occupies a fixed spatial position, its temporal trajectory is dynamic. The coffee cup's state evolves through time, even though it remains static in its spatial coordinates.
This interpretation resonates with Einstein's insight that space and time are interwoven into a single continuum, where objects move through both dimensions simultaneously. The perception of the coffee cup's zero-movement line segment shapes reflects our visual system's ability to discern spatial stability amidst temporal progression. This dual perspective underscores the intricacies of perception and the deeper philosophical implications of how we understand movement and stillness in the universe.

Summary

The perception of a stationary coffee cup and the zero-movement within a timeline illustrates a fundamental aspect of both visual perception and theoretical physics. While the coffee cup appears static, acknowledging its temporal evolution highlights the complexity of our continuous active perception processes. This duality not only enhances our understanding of visual cognition but also deepens our appreciation for the interconnected nature of space

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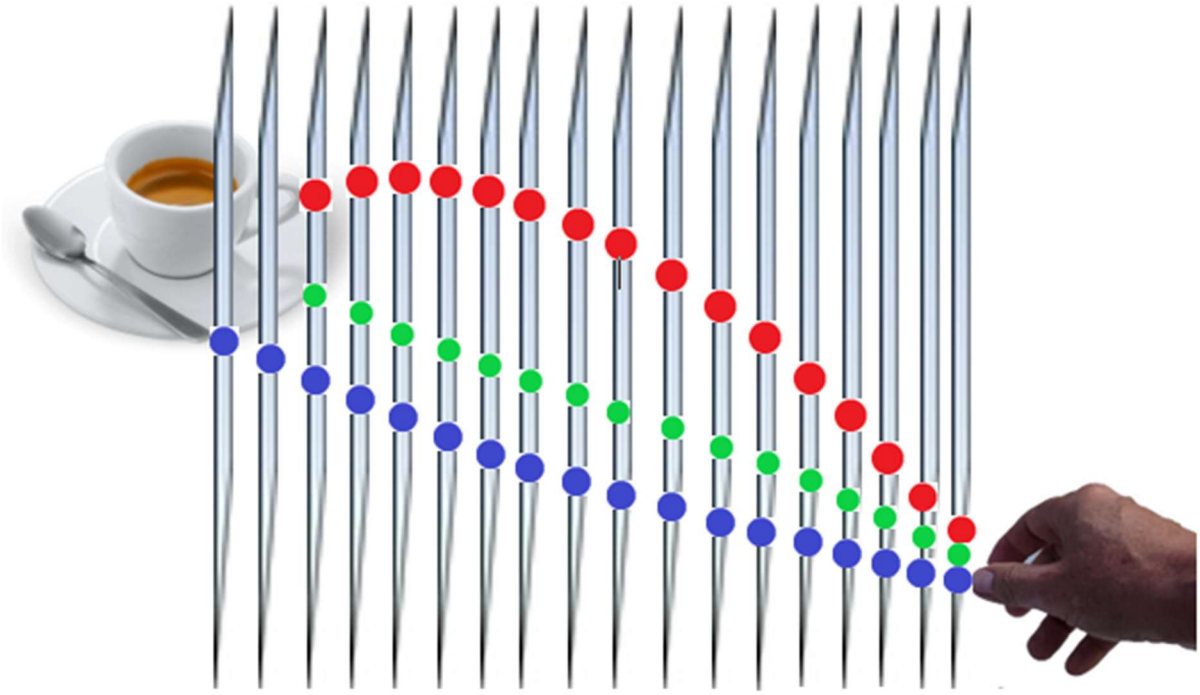
Part 2 - Within the grasping of a coffee cup we always first construct a perceptual image of a latent action trajectory shape out of the perspective of the fingertips – The scientific evidence



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Introduction

The explanatory model of the motoric movement action provides a universal explanation of all functional perception processes within all goal-directed actions. It demonstrates that performing any conceivable action always requires the simultaneous perception of three autonomous foci[3], in accordance with J.J. Gibson's theory, which includes both the movement of the animal/organism and the movement of the environment. When grasping a coffee cup, one autonomous focus remains engaged with (the movement of) the cup as the environmental object, universally representing a catching action. The other two autonomous foci are concerned with the perception of movement within the egocentrically executed action, i.e., the movement of the fingertips along an action trajectory shape (toward the coffee cup), which universally represents a throwing action.
This article specifically focuses on the two foci belonging to the egocentric throwing action of the fingertips in relation to grasping of, for example, a coffee cup. The explanatory model shows that every conceivable throwing action requires a compelling cooperation between an autonomous internal focus and an autonomous external focus. This insight, that two autonomous foci are present instead of a single undivided motor action, not only allows a final and ending specification of all perception processes individually but also reveals as a novelty that a coupling within the egocentric throwing action itself is capable to occur[4].
The explanatory model of the motoric movement action thus provides a complete description of the *tau*-coupling process, wherein the essence of the task, the primary focus, is executed through (the perception of) the movement of the fingertips over a pre-planned action trajectory shape between the current position of the fingertips and the coffee cup[5]. This perceptual image is therefore determined in advance within a tactical consideration and involves identifying the future sequential positions the fingertips must occupy to achieve a successful action. Sequential positions of any object effectively always create line segment shapes, and when the action is actually executed, the current position of the fingertips is going to fill in that perceptual image step by step. Thus, it can be observed within a line segment shape that the gap of the latent positions P gradually disappears and, in full accordance with the findings of D.N. Lee, produces the *tau*-value, which plays a crucial role in the completion of the motor action in cooperation with the secondary focus[6].
The explanatory model of the motoric movement action partly relies on logical reasoning but also presents scientific evidence. This chapter provides scientific proof that in grasping, we always first create a perceptual image of a latent successful action trajectory shape before we actually perform any action.

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[3] The cortical streams mediate the grasping of a cup equal as they mediate within the nerve spiral (youtube.com) https://www.youtube.com/watch?v=QP4vPVAw-Yg
[4] D.N. Lee did indeed identify the *tau*-value associated with the primary focus, but he considered the egocentric action as one indivisible whole. His lifelong quest to find the phenomenon it should be connected to remained unsatisfied because he never realized that the coupling occurs within the egocentric action itself.
[5] https://www.researchgate.net/publication/379270667_Random_motor_arm_activity_implicitly_induces_an_internal_and_an_external_focus_-_The_scientific_evidence_how_two_autonomous_foci_arise_within_grasp_actions_and_how_their_roles_evolutionarily_have_reve
[6] https://www.researchgate.net/publication/375591596_The_tau-coupling_process_in_grasping_demonstrates_that_we_absolutely_do_not_need_a_motor_plan_The_sensorimotor_perception_processes_within_the_secondary_focus_must_obediently_follow_the_external_actio

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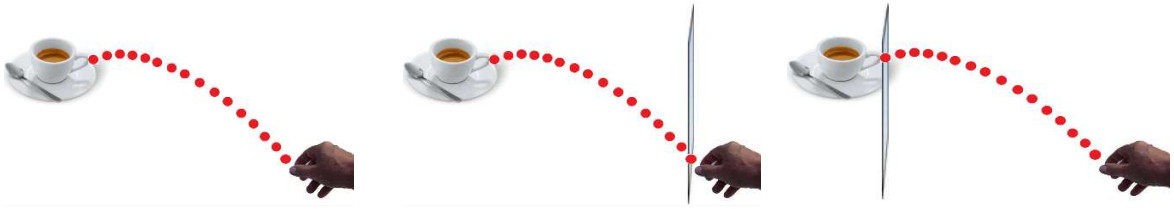
The scientific proof

The evidence is quite straightforward and can be easily verified through a simple empirical investigation. You can either conduct the experiment yourself or ask a test subject to repeatedly try to grasp a coffee cup. The only instruction given to the subject is to attempt to grasp the cup only if they genuinely believe they have a realistic chance of successfully holding it.

Images: The scientific proof is based upon the competence to visualize a giant huge glass shopping window. The left image shows a normal dimension of such a window. In relationship to the scientific proof you need to magnify that image 10 to 20 times. Like in the right image.

Pick a random table with a random placed coffee cup and create the following circumstances:

Situation 1:	Do not alter the environment (zero measurement). Let the test subject execute ordinary grasp actions.
Situation 2:	Place a giant huge glass shopping window (height 20 meter x width 30 meter) between the test subject and the coffee cup, close to the test subject.
Situation 3:	Place a giant huge glass shopping window (height 20 meter x width 30 meter) between the test subject and the coffee cup, close to the coffee cup.
Situation 4:	Place a giant huge glass shopping window (height 20 meter x width 30 meter) between the test subject and the coffee cup, at any random position P.



Situation 1 Situation 2 Situation 3

Images: In situation 1, a test subject will simply attempt to grasp the coffee cup. In situations 2 and 3, a giant glass shop window is placed between the hand and the cup, and the test subject will not initiate a grasping movement with the intention of actually getting hold of the coffee cup. Due to the fact that the perception processes solely notice one (!) position P that prevents a full undisrupted course of the fingertips (hand) to pass.

Conclusion:

In situation 1, you and/or the test subject will simply pick up a coffee cup. In situations 2, 3, and 4, you and/or the test subject do not initiate a grasping action with the intention of getting hold of the coffee cup. Situations 2 and 3 do not provide significant insight on their own, but situation 4 clarifies

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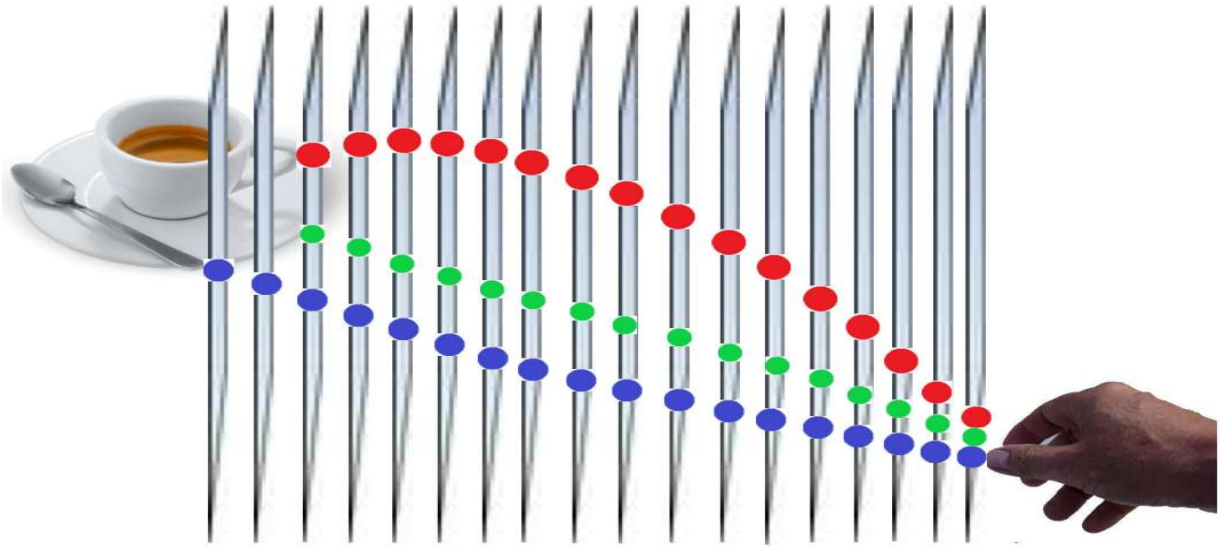
everything. Whether the giant glass shop window is placed near the hand or near the coffee cup makes no difference to the test subject. If there is a large shop window anywhere clearly present, the test subject will not initiate a grasping action with the intention of getting hold of the coffee cup. This applies to every conceivable position P of the shop window, from the very first position P(0) near the test subject to a shop window occupying the last position P(n) just before the coffee cup.



Situation 4

Image: In situation 4, it becomes clear that prior to the actual execution, we consider all consecutive *future* (!) positions of the hand/fingertips. It doesn't matter where the shop window is positioned between the hand and the coffee cup; the grasping action is not performed. Mathematically, one can argue that an uninterrupted series of consecutive positions P creates a line segment or line segment shape (action trajectory shape). The image provides a perfect visual representation that within the grasping action, we first form a perceptual image of the entire latent action trajectory shape before we actually execute anything. In the animation, you can clearly observe the subtle differences in action trajectory shapes when we want to grasp the saucer instead of the coffee cup handle or when we first want to pick up the spoon to stir the coffee.

This means that we assess every position P(0-n) between the fingertips and the coffee cup beforehand, clearly determining whether each position P allows the hand to pass through so that it can ultimately reach the coffee cup. In relationship to which it can be observed that if one position P is not *empty* (!), the mission is aborted. Upon which you can draw the factual conclusion that we will have to look at (!) c.q. we will have to perceive every position P(x) between the hand and the coffee cup beforehand if that specific position P(x) is also allowing the physical dimensions of the hand to pass. Mathematically, an uninterrupted series of consecutive positions P can be designated as a line or line segment shape (action trajectory shape). This completes the scientific proof that within a grasping action, we first form a perceptual image of the entire latent action trajectory shape before we actually execute anything.

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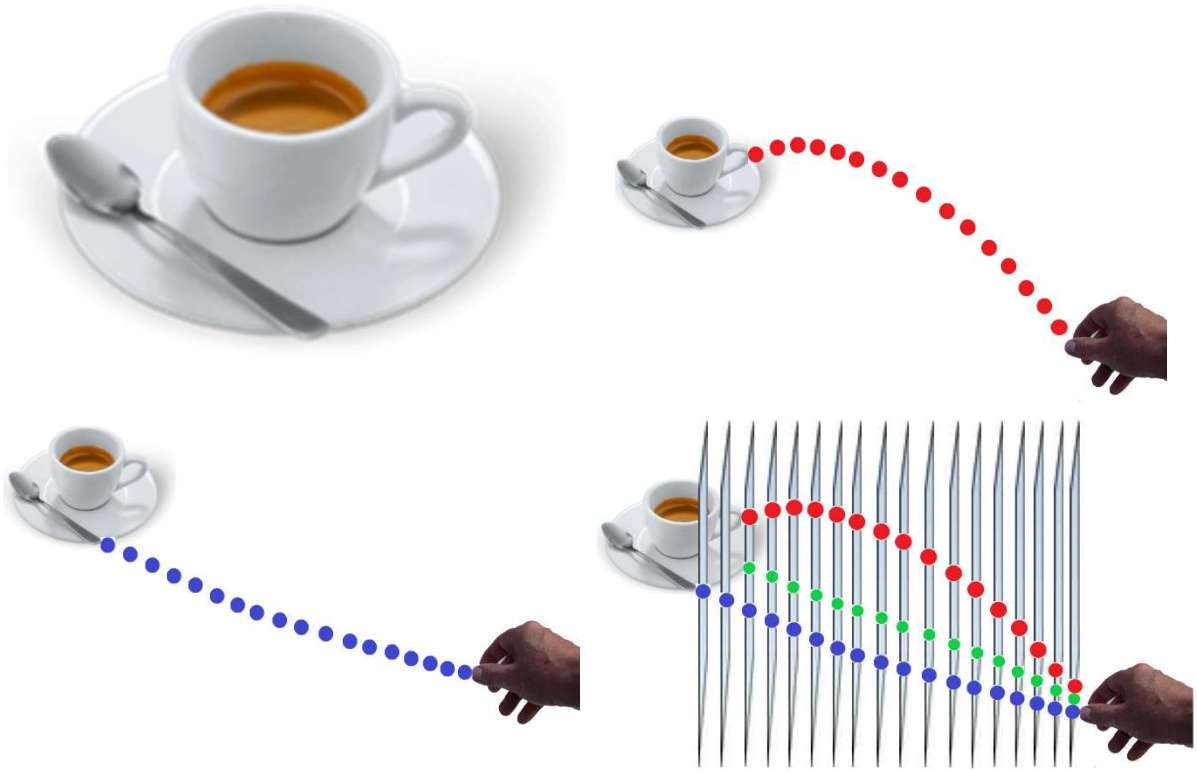
Part 3 - Grasping requires a compelling collaboration between an internal and an external focus – The external displacement of the fingertips along an action trajectory shape can only be accomplished through entirely different internal movements



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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 (pen, needle, key, tennis racket, bicycle, ball, spoon, 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 along a perceptual image of a latent action trajectory shape on the outside of our body. 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 is entirely focused on the motoric movement action *grasping* c.q. reach-to-grasp actions. The article convincingly demonstrates that only the fingertips, or rather the movements of the fingertips, akin to a marble within a marble run, execute this trajectory of action and thereby accomplish the essence of the task. For this reason, primary attention must be directed towards the external movement of the fingertips. The fingertips can only be moved with completely different movements within the body which only reach the outer surface of the fingertips. The attention required for this should serve the main goal and is therefore referred to as the 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.

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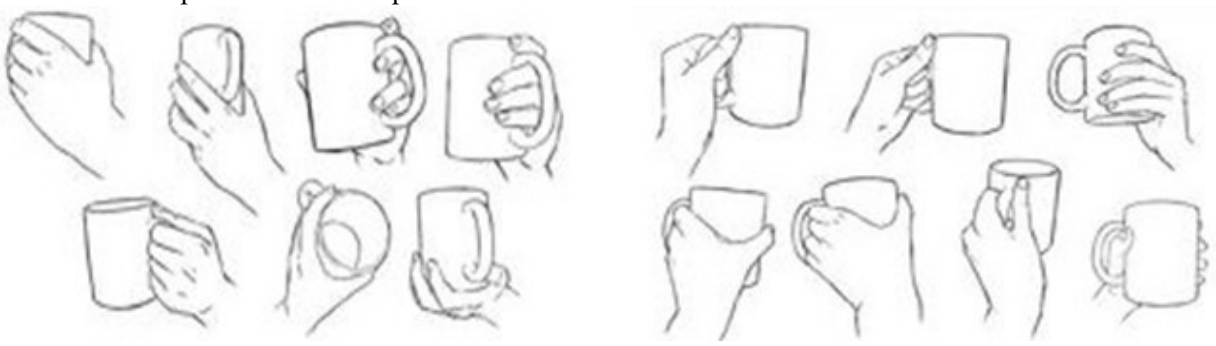
The primary focus within grasping encompasses the perception of movement outside the body

The explanatory model of all motoric movement actions, as demonstrated within grasping, shows that only the fingertips, c.q. the movements of the fingertips, will execute the essence of the task and therefore represents the primary focus within this action. The explanatory model provides scientific evidence[7] that a motoric 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 fingertips, c.q. the movements of the fingertips promise to become successful, and only then proceeds to actual action.

Images: Grasping solely encompasses moving the fingertips toward an intended target (handle, spoon, saucer of the coffee cup). The essence of this task is thus carried out exclusively by the autonomous movements of the (outer part of the) fingertips, and that is why it is the main process that we need to observe. In doing so, the fingertips follow an action trajectory shape just like a marble follows a track in a marble run. Within any conceivable motor action, the actual position of the marble, or the action object being manipulated, will precisely mark the separation between the manifest and latent parts of the action's trajectory.

When we factually start the action, we are going to fill in the perceptual image of the action trajectory with the fingertips. So within the primary focus, this is the essential process that our perception processes must guide, and surprisingly, science has overlooked this part entirely until now. In subsequent articles, it will become evident that filling in the action trajectory by the fingertips yields the crucial *tau*-value to which the secondary focus is compellingly linked, and the mediating role of the cortical streams in this process will be explained.



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

[7] 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?_sg%5B0%5D=S6QcfWOrAN5tp5uWEHPcpcYnJvsQycEUJ47I6kjDG6kVrJbH6HD9gGuL_CSPeFonRFI0-Wt7Cv2WKkT3LrUuwJtzKZJM35_I2Z6npSHp.I-Tz-28OcL3jw-TqQRNUI_uaYsU5d9J3GyeeqFBMc_eOPkcYAWZ5cTtCnF-H51TCD7eKrzi0sfp79PF-gwynzg

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 example, you have never executed a free throw in basketball in an identical manner. Similarly, you will never be able to produce an identical action trajectory when grasping a coffee cup. Within which the explanatory model hastily emphasizes that it has never been the objective to achieve such perfect uniformity. Creating a similar form is far more efficient and effective, to the extent that a resource-conscious (parsimonious) organism would have never evolved otherwise.

Maybe we do construct perfect straight action trajectory shapes when we create perceptual images of the future positions of the fingertips within grasping. However, due to the fact that you can only execute the movement of the fingertips along an action trajectory shape with the perception of an entirely different autonomous movement, the fingertips will inevitably deviate from that "perfect" original pre-perceptual image at every position P within the action trajectory. This process is, therefore, guided by the double and mutual process of the cortical streams, representing the brilliant ecological response of the body to execute every motor action in the most efficient and effective way possible. The ventral and dorsal streams continuously interact with each other to correct the inevitable deviations, but this interaction does require a (very short) reaction time[8]. As a result we can never perform one motor action identically (conform Bernstein) and the fingertips will always follow a different zigzag pattern while grasping a coffee cup.

The secondary focus within grasping encompasses the perception of movement inside the body

When one starts to realize that the primary focus solely concerns the movements of the fingertips, it implicitly becomes evident that the fingertips themselves aren'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. 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. So in the case of grasping a coffee cup, we can haptically perceive (the outer surface of) the cup solely with (the outer part of) our fingertips, and we can only proprioceptively[9] perceive how movements within our body influence that haptic contact with the coffee cup.

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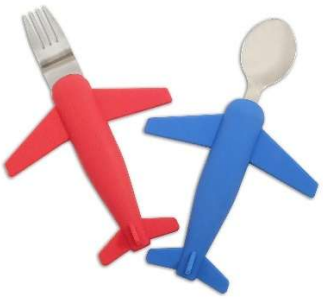
[8] The specific reaction time concerning cortical streams in relation to the explanatory model has never been examined. General information and empirical experiences provide an indication that the reaction time is estimated to be around 0.1 seconds; "It takes about one-tenth of a second for information 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

9 Scientific research has demonstrated that proprioceptive perception encompasses two autonomous phenomena, namely: 1. Limb Position (perception of limb position) and 2. Movement (perception of motion), which the explanatory model within grasping clearly links to the overall grasping technique and the specific location where, in this case, that perception must specifically be directed towards the haptic contact between the hand and the coffee cup.

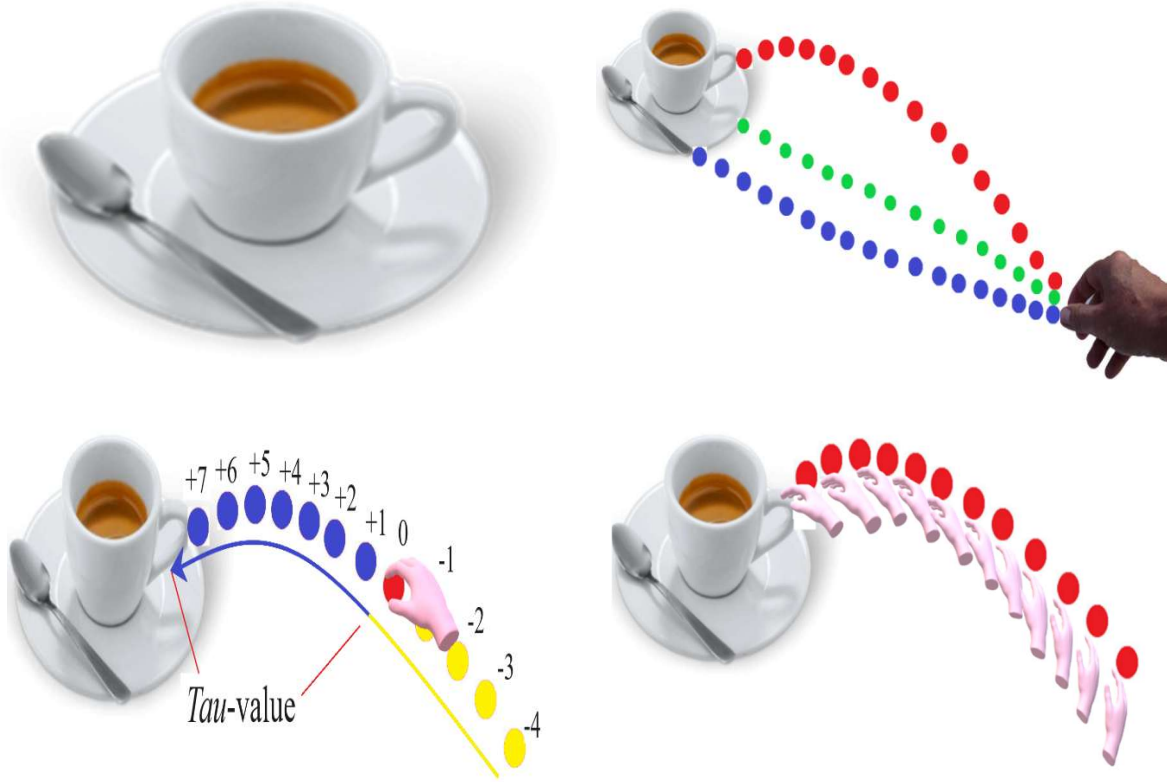




Images: Grasping with the hand serves as the foundational form for numerous other actions. In activities like eating[10], for example, one may extend the role of the fingertips with a tool for various reasons. But it compels only a dislocation of the fingertips and so it makes no difference in relationship to the functional perception processes. Regardless of the motoric movement action one assesses, the stacking of two autonomous foci will always reveal the same universal collaboration.

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 grasping. 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.
With some practice, you can consciously perceive the two foci simultaneously within many motor actions. Also within a grasping action, it is very well possible to perceive the movement of the fingertips within an action trajectory shape on the outside of your body while also focusing on movements on the inside of your body.

[10] https://www.researchgate.net/publication/372862585_Eating_requires_the_compelling_collaboration_between_an_internal_and_an_external_focus_-_Getting_the_bowl_of_the_spoon_to_the_food-mouth_along_an_action_trajectory_shape_is_the_sole_essence_within_eati?_sg%5B0%5D=5sYWF5EByxJR1rwugwmSiOCqtID3YM3N36UYXSaVWiLSuC98yPmO-AyGvwo5XCiszgUjxPya25GRsF3sy_ygS_IojqoLvYc5IdqegyFXl.IdwhypTzBNNa6U-OQI-R8PqADqbqM29bqa__DfVY4a5dQXaXrpD6f7-RUGXwMfafJ0z4Ce5rlzbtwkf0dB7o9A

Part 4 - Within grasping the essence of the task is solely executed by the movements of the fingertips toward a coffee cup; Within the primary focus the fingertips are constrained within an action trajectory shape providing the *tau*-value



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

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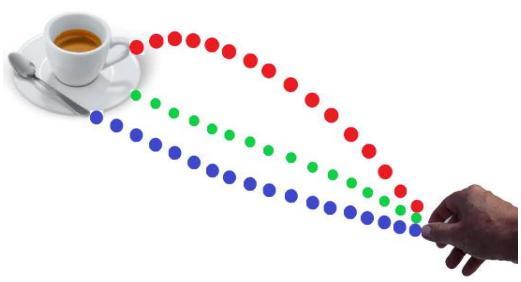
Introduction

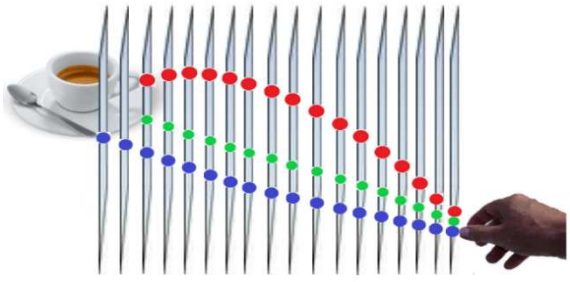
Traditionally, science has assumed that one motor action corresponds to one focus. This assumption was likely so intuitive that it was never challenged. However, this has led to the situation where, even after more than 100 years of movement sciences, a plausible explanation for the underlying functional 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 observed that science has so far truly missed everything. Therefore, it will now be discussed comprehensively within a broad spectrum of motor actions, and this publication now reveals all facets of the primary focus within the motoric movement action *grasping*.

Solely the movements of the fingertips encompass the essence of the task c.q. the external (primary) focus within the motoric movement action *grasping*

The category of motor actions assessed within the explanatory model includes conscious actions, where it is assumed that there is always an egocentric intent (egocentric formulated will) formulated first. For instance, when it comes to eating, there is a need to express the desire to satisfy hunger, and in writing, there must be a desire to, for example, write a brilliant book prior to any action. Therefore, before picking up a coffee cup, there is always the initial desire to do so. The explanatory model acknowledges this as an undisputed factual given but adds a caveat. The egocentrically formulated will in eating, for example, is not essentially about satisfying hunger, and in writing, it's not primarily about writing a great book. The explanatory model shows that this is factually incorrect and that we can only move food and a pen tip along an action trajectory shape, respectively, towards the mouth and across the paper. Analogously, we can only move our fingertips toward a coffee cup, which determines the essence of that action, and therefore, only that aspect should be considered as the external (primary) focus.

The tactical movement action (TMA) within the grasping of a coffee cup





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Images: First and foremost, an egocentric will must be formulated regarding our intention to perform any motor action in relation to a coffee cup. From the current position of the fingertips, we then create a perceptual image of a latent action trajectory shape, showing how (a part of) the coffee cup will be reached (left). This occurs as part of a tactical action in which 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. Within there the explanatory model of the motoric movement action provides scientific evidence[11] that, while we are indeed looking for obstacles (which could hinder a successful action) within the environment (right), our visual perception is primarily focused on creating an action trajectory shape that enables a continuous trajectory of future positions P of the fingertips. In other words, we mainly perceive the positions P where there is nothing (!) to see, and this is also the essence of the tactical action in the left photo, where there appear to be no physical obstacles on the (action) path.

The explanatory model of the motoric movement action demonstrates that after formulating an egocentric goal, we always engage in a tactical consideration[12], prior to any execution, to determine how we can bring the action object to the goal location within successive positions P. In the context of the discussed action, we always create a perceptual image of a latent action trajectory shape, allowing the fingertips to be moved successfully toward the coffee cup.

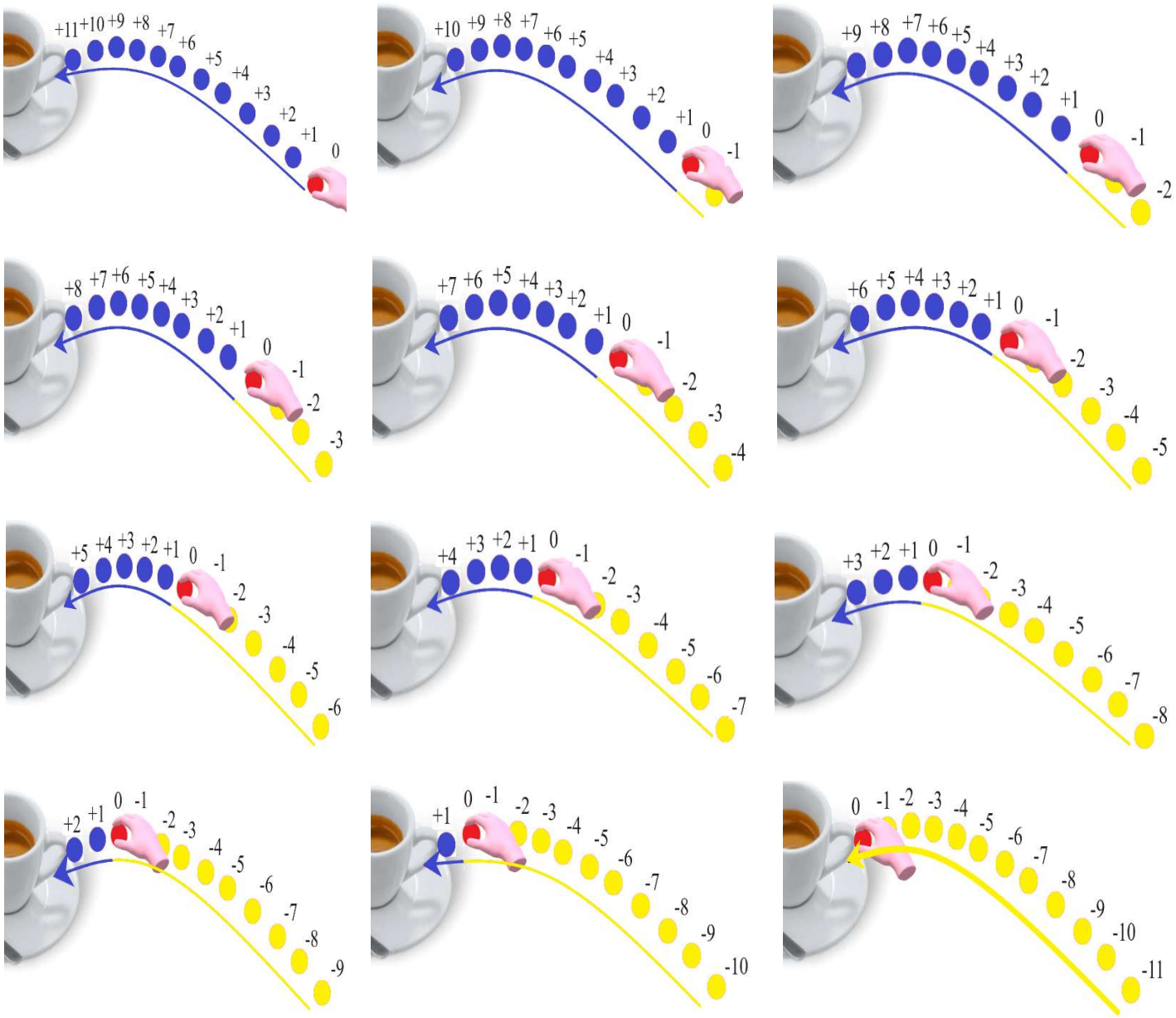
Images: It is not straightforward to present an animation that accurately represents the latent action trajectory shape being constructed. The image on the left very clearly displays the shape of the trajectory, in which all contiguous points P are distinctly weighed. However, it does not illustrate that within the construction of the trajectory shape, all dimensions of the fingertips/hand are also precisely incorporated, as shown in the image on the right. The perceptual image we pre-construct of the trajectory might possibly contain a hybrid blend of these two animations.

<u>The factual movement action (FMA) within the grasping of a coffee cup</u>

After determining a perceptual image of a latent action trajectory shape, we proceed to actually carry out the action. This process effectively starts with bridging the gap from the current position of the fingertips P(0) to the next position P(+1) within the action trajectory. Although our ultimate intention of course is to reach the coffee cup, the explanatory model clearly demonstrates that our perception processes in this phase are solely focused on traversing the empty space between the fingertips and the coffee cup. Which at a micro-level shows, that essentially only the positions P(-1), P(0), and P(1) matter to us during this bridging process.

11

12 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.*



Images: In an animation, the progression within an action trajectory shape can be depicted as follows. Within any conceivable action, the action object 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. To comprehend the perception processes at the most fundamental level it is of the utmost importance that you start to understand that the latent part of the action trajectory shape will factually need to sprout out of the already manifest positions P(-x).

The perception-action coupling within the grasping of a coffee cup

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 action within any conceivable task. The animations in the previous section illustrate that 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

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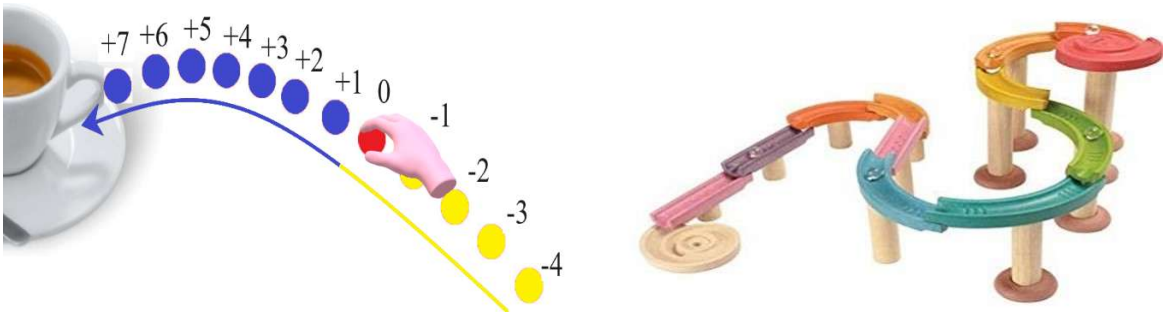
that the perception-action coupling is a unified phenomenon where only a single change occurs every ongoing time span. Within the marble run it becomes quite visible that during the actual execution, each position P(0) serves as the precise separation between all already manifested positions P(-x) and 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. Instead, several crucial points will be highlighted concerning the functional perceptual processes within this motor action.
It's imperative to recognize that while the ultimate goal is to reach the coffee cup, during the execution of the action, we are solely engaged in bridging empty space where seemingly nothing is happening. It can be observed within any conceivable action that we spend relatively more time bridging this nothingness than in actual observable activity. The explanatory model, however, unequivocally shows that not only the end goal matters, but all positions P between the fingertips and the coffee cup are equally significant.
Additionally, it must be remarked that the action of the fingertips at P(0) can be perceived distinctly, yet no fixed unit of time can be attributed to it. Each unit of time can be divided into a thousand smaller units, and these units can be further subdivided, leading the explanatory model to argue that the action at P(0) fundamentally takes such a brief time span that it only gains significance in relationship to perceptions of the adjacent time frames. In other words, perceiving the current position of the fingertips solely gains meaning through the adjacent future "actual" positions P(+x) and the adjacent manifest "actual" positions P(-x) of the fingertips. Within which the overarching idea is to emphasize that perceptions within any conceivable action mainly pertain to one single phenomenon wherein the perception of the action also compels a perceptual image, but primarily that they are absolutely interdependent.



Images: Within many motoric actions the action trajectory shape will not become visible, making it challenging to depict with animations. 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 coupling. If we couldn't see the marble run, the movements of the marble would lack essential context, and conversely, without the marble, we would be completely unable to perceive any coupling as well. There is a compelling interdependent relationship, and without that coupling, we would never, under any circumstances, be able to execute any motoric movement action.

The *tau*-value within the grasping of a coffee cup

The explanatory model of the motoric movement action demonstrates with the aforementioned perception-action coupling that the perception of each position of the fingertips c.q. the action object within the action trajectory shape is equally important. However, as the fingertips approach the end of the action trajectory shape, the task c.q. the egocentrically formulated goal starts to become finalized. Within

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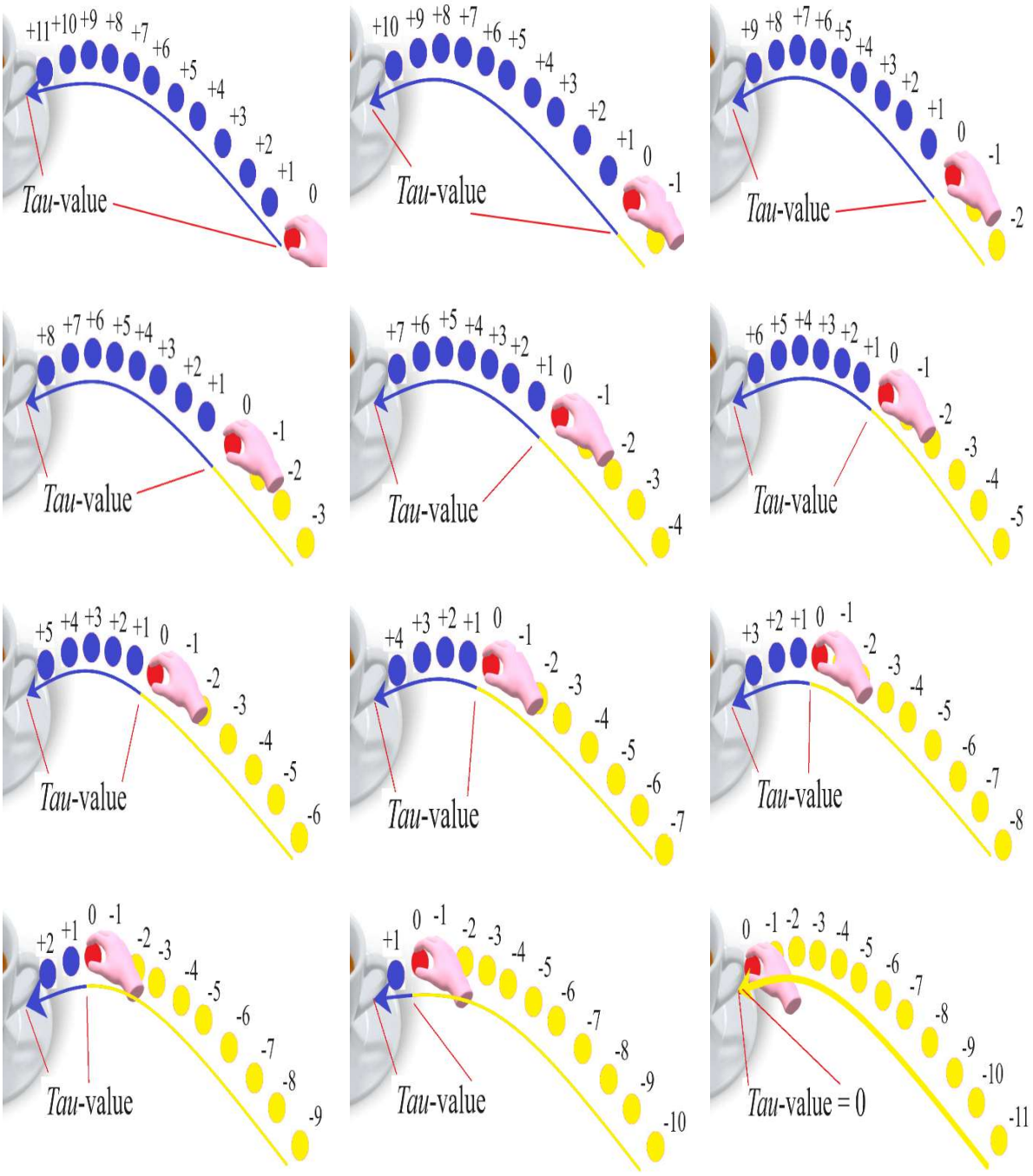
any imaginable motor action, the action object will universally traverse the action trajectory shape until there are no latent positions P left. Within his *tau*-coupling theory, D.N. Lee referred to this phenomenon as the closing of the gap c.q. as the *tau*-value approaching to zero.

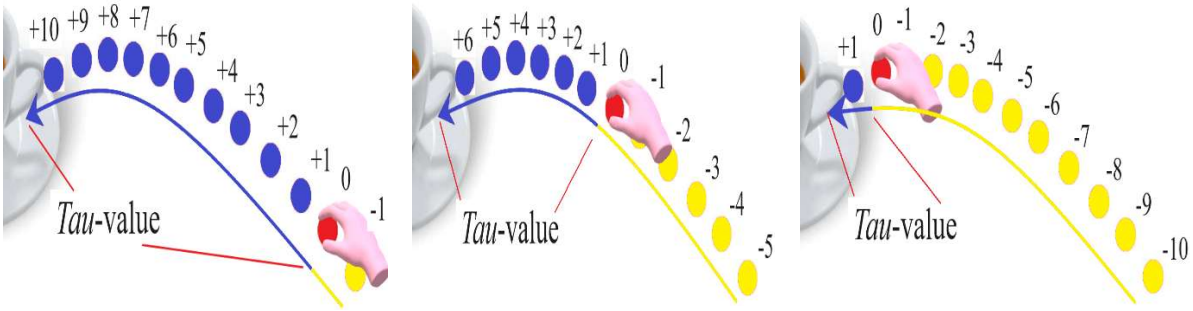


Images: Within the perception-action coupling, the fingertips will traverse all latent positions P that are tactically predetermined within a perceptual image of an action trajectory shape. With each successive position P of the fingertips, the *tau*-value will decrease, until it eventually approaches zero c.q. becomes zero.

<u>The perception of the *tau*-value in relationship to the grasping of a coffee cup</u>

The perception of the *tau*-value within the external (primary) focus is an essential process, as it must establish a compelling relationship with the internal (secondary) focus within a strict *tau*-coupling to

ensure the successful execution of an action. When it is perceived that the fingertips are approaching the coffee cup, the perception within the internal focus, or rather, the perception of the movements on the inside of the fingertips, must take charge of slowing down and adjusting the outside movement of the fingertips within the action trajectory shape in such a way that they precisely end up at the handle of the coffee cup.



Images: The *tau*-value can be perceived in two autonomous ways. You can either observe how the yellow manifest action trajectory shape takes over the blue line or at the most basal level you could solely observe with what speed the blue line, representing the still latent action trajectory shape, is disappearing. Within which you factually solely observe how the latent (blue) gap is closing.

Perceiving the *tau*-value approaching to zero can be observed in two autonomous ways. The first way involves filling in the perceptual representation of the entire latent action trajectory shape with the manifest positions P of the fingertips. In animations, this should be depicted as the yellow line taking over or filling in the blue line. The other way involves a much more fundamental way of perceiving the *tau*-value. In contrast to the first way, this is solely based on the disappearance of the latent positions P from the perceptual representation of the entire latent action trajectory shape. Which means that you solely observe with what speed the blue line disappears.

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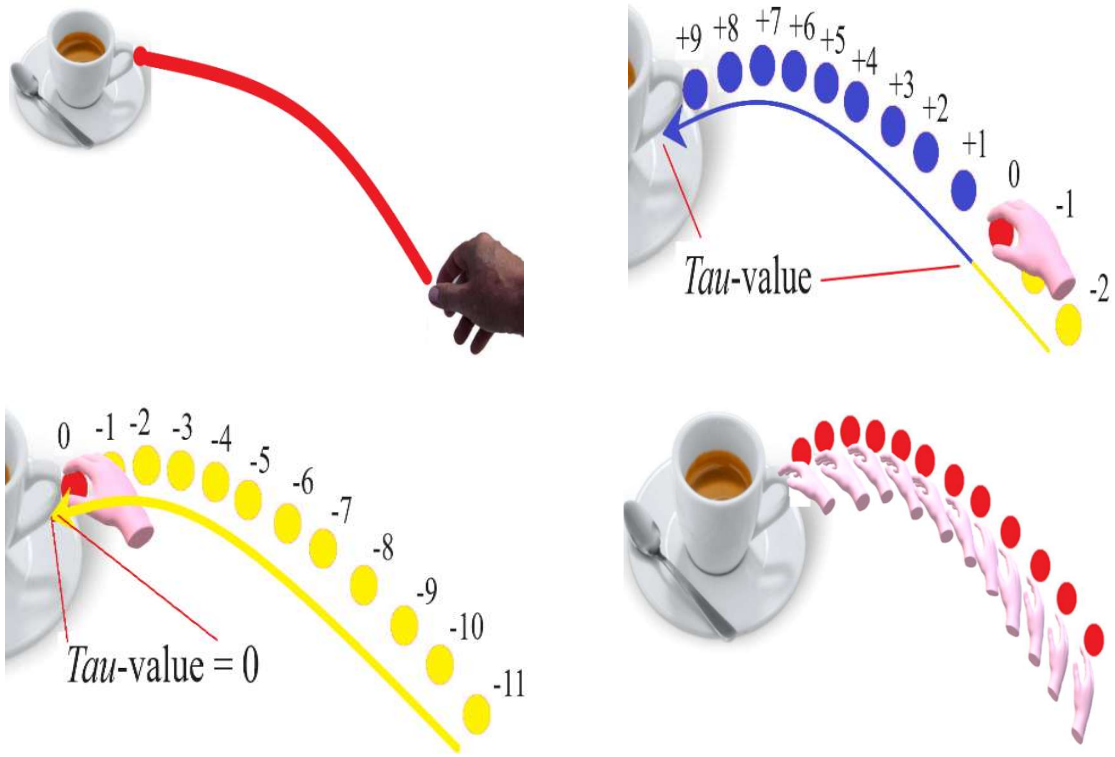
Part 5 - The *tau*-coupling process in grasping demonstrates that we absolutely do not need a motor plan; The sensorimotor perception processes within the secondary focus must obediently follow the external action trajectory shape within the primary focus



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November 2023

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Introduction

When we want to pick up a coffee cup, the explanatory model of the motoric movement action has demonstrated that only the movement of the fingertips embodies the core of the task and, therefore, the essence of our egocentric intention. Scientific evidence has been provided to show that for the actual execution of any conceivable action, we first construct a perceptual image of an entire latent action trajectory along which we can successfully move (all dimensions of) the action object[13], in this case, the fingertips, towards a coffee cup[14].
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.

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[15].

While the explanatory model demonstrates that perceiving the movement of the action object within the perceptual image of a latent action trajectory is an autonomous phenomenon that exclusively executes the essence of the task, it also clearly shows that the action object itself cannot move at all. Even when grasping with the fingertips, the explanatory model reveals that the movement of the fingertips over an external action trajectory on the outside of the body cannot be initiated by the outer part of the fingertips themselves. When grasping, the movement within the external (primary) focus can only be

[13] 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.
[14] 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
[15] https://www.researchgate.net/publication/373862466_Within_grasping_the_essence_of_the_task_is_solely_executed_by_the_external_movements_of_the_fingertips_toward_a_coffee_cup_Within_the_primary_focus_the_fingertips_are_constrained_within_an_action_traj

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executed with motions that must always be perceived within the body, within the internal (secondary) focus[16,17].

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.

In summary, this leads to the conclusion that the phenomenon of the perception-action coupling is solely related to the perception of fingertip 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 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[18] 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

[16] https://www.researchgate.net/publication/373113498_Grasping_requires_a_compelling_collaboration_between_an_internal_and_an_external_focus_-_The_external_displacement_of_the_fingertips_along_an_action_trajectory_shape_can_only_be_accomplished_through_e

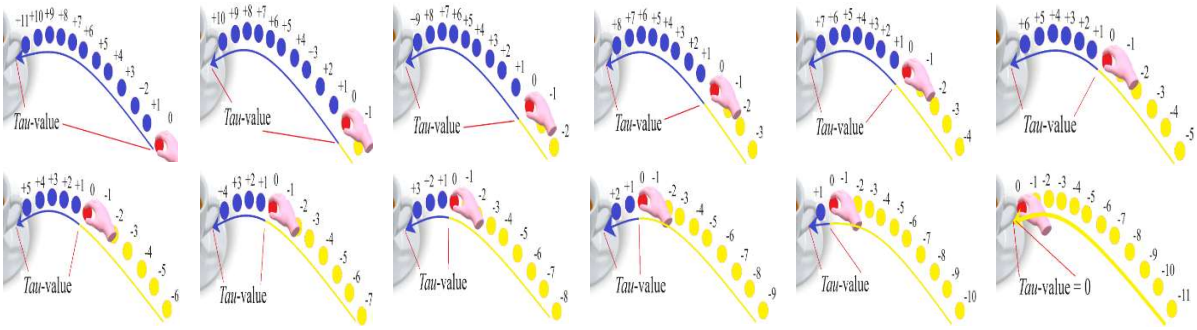
[17] This intriguing dualism demands our utmost attention as it presents the essence of our perception processes. The internal (secondary) focus not only meticulously tracks the movement of the action object within the action trajectory shape but is also the instigator of this movement. It might sound 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.

[18] 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.

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 process when grasping a coffee cup

Frequently, at the outset of this motoric action, the fingertips are initially situated at a distance from the coffee cup such that, following a brief initial phase, potentially executed at a slightly reduced velocity, the digits must traverse[19] a relatively long distance during which it appears that nothing noteworthy occurs. Although the explanatory model of the motoric movement action shows that this bridging process of what seems like an idle phase demands active engagement from our perception processes, with the cortical streams playing a pivotal role, the egocentrically formulated will reach its culmination only at the end of the action trajectory shape.



Images: Prior to the actual movement of the fingertips, a perceptual image of the shape of a latent action trajectory is always created first, which allows all the dimensions of those end effectors to successfully reach the coffee cup. Within the images, you can ascertain for yourself that factually only the fingertips will fill this action trajectory shape and, therefore, only the fingertips will fulfill the essence of the task. It is also evident that the fingertips move like a marble in a marble run, with the current position P (0) of the fingertips (in red) always marking the precise boundary between the manifest (in yellow) and the latent (in blue) parts. The disappearance of the latent part of the action trajectory shape can be perceived in two autonomous ways. One can observe how the yellow (manifest) part takes over the blue (latent) part of the action trajectory, or, in a more basic sense, one can solely perceive the speed at which the blue line segment disappears c.q. at which the blue gap closes.

While it may appear that only the end of the action trajectory is crucial, the explanatory model is clear: the bridging process of every position P between the fingertips and the coffee cup is equally vital for success. The finalization of the action and the bridging process are, in fact, two distinct phenomena that must be successfully executed sequentially. One can never reach a successful conclusion if the bridging phase has not been successful.
However, the successful execution of the ending is also crucial for a motoric action to succeed. The success of a motoric action depends on observing that the *tau*-value within the external (primary) focus approaches zero. Then, within the internal (secondary) focus, adjustments to the movement of the fingertips must be made so that they come to a sort of standstill precisely at the handle of the cup, without knocking it over. In many motor actions, it can be observed that after a phase of relative

[19] In contrast to current scientific beliefs, the explanatory model of the motoric movement action demonstrates that, contrary to prevailing thought within the scientific community, the essence of the task is indeed finalized at the end of the action trajectory shape. However, it also asserts that the transitional phase is equally integral to the task. Both phases hold equal significance, and they must both be executed successfully for the entire motor action to have any chance of success.

acceleration during the bridging phase, there is a relative deceleration of the action object as the end of the action approaches[20].

The perception of the sensorimotoric movements on the inside of the body within the internal (secondary) focus when moving the outside of our fingertips along an action trajectory shape

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[21]. 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[22].
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 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, after millions of years of evolution, have now been entirely reversed. When grasping we primarily perceive the movement of the outer part of the fingertips, within the external (primary) focus, and guide that progression with internal motor movements, within the internal (secondary) focus, which only extend *within the body* (!) up to the outer part of the fingertips[23].
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

[20] As explained in this section, the explanatory model underpins the notion that within many motoric actions a bell-shaped profile is capable to occur when plotting the execution speed of an action against time in a graph. In many actions, it is indeed typical that after a short initiation phase, a smooth and faster bridging phase occurs, followed by a more precise phase towards the end. Although the model generally supports these principles, it doubts the emergence of a highly proportional bell shape in all cases. Additionally, the explanatory model illustrates that this is certainly not the case for all actions. In situations where you need to create a crescendo at the end of the action, such as clapping your hands or defending against an attacker with a punch or a kick, you must accelerate the relevant body parts in the final phase. Similarly, in many ball sports, achieving a necessary "crescendo" can only be accomplished if, after an initial relatively slower catching phase, you maximize acceleration of the ball towards the end of the action trajectory shape.
[21] 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.
[22] 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.
[23] So, within grasping, the internal and external focus come very close to each other but will never overlap. Observations inside and outside the body belong to two incompatible worlds.

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[24,25]. 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[26].
Additionally, the explanatory model unmistakably reveals that within any conceivable action, an external (primary) focus, operating within a strict *tau*-coupling process, can only be executed by an internal (secondary) focus. It highlights that this secondary focus is exclusively perceived within the body, and therefore, all perceptions within this focus are inherently of a sensorimotoric nature.

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

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

[24] 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.
[25] 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.
[26] 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

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[27]. 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. 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 the fingertips towards a coffee cup[28]. 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.

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[27] 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.

[28] https://www.researchgate.net/publication/373862466_Within_grasping_the_essence_of_the_task_is_solely_executed_by_the_external_movements_of_the_fingertips_toward_a_coffee_cup_Within_the_primary_focus_the_fingertips_are_constrained_within_an_action_traj

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 within the internal (secondary) focus of grasping are perceived proprioceptively

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 grasping a coffee cup by covering the whole arm except for the fingertips. As long as the (index, thumb) fingertip remains visible, it will have no impact on the grasping action whatsoever.

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 will be dominant within the external (primary) focus while grasping a coffee cup, we are also carrying out this action with proprioceptive perception processes. This means that we not only see the movement of the fingertips approaching the coffee cup, but we also distinctly *feel* (!) the process of shaping the action trajectory as well.
Within the internal (secondary) focus, it is no different. You can quickly ascertain for yourself that you could move the fingertips using only torso action, or even solely leg movements if you were to rigidly hold the arm. In fact, you could make the fingertips move with just upper arm and/or forearm action if you maintain to just rigidly hold the hand. This also allows you to quickly ascertain whether you might use a relatively greater amount of hand action or a relatively greater amount of finger action.
In short, you may have developed your own preferred motor skills to execute the task of grasping a coffee cup, 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.

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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 your fingertips 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[29]. 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.

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

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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 grasping 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.

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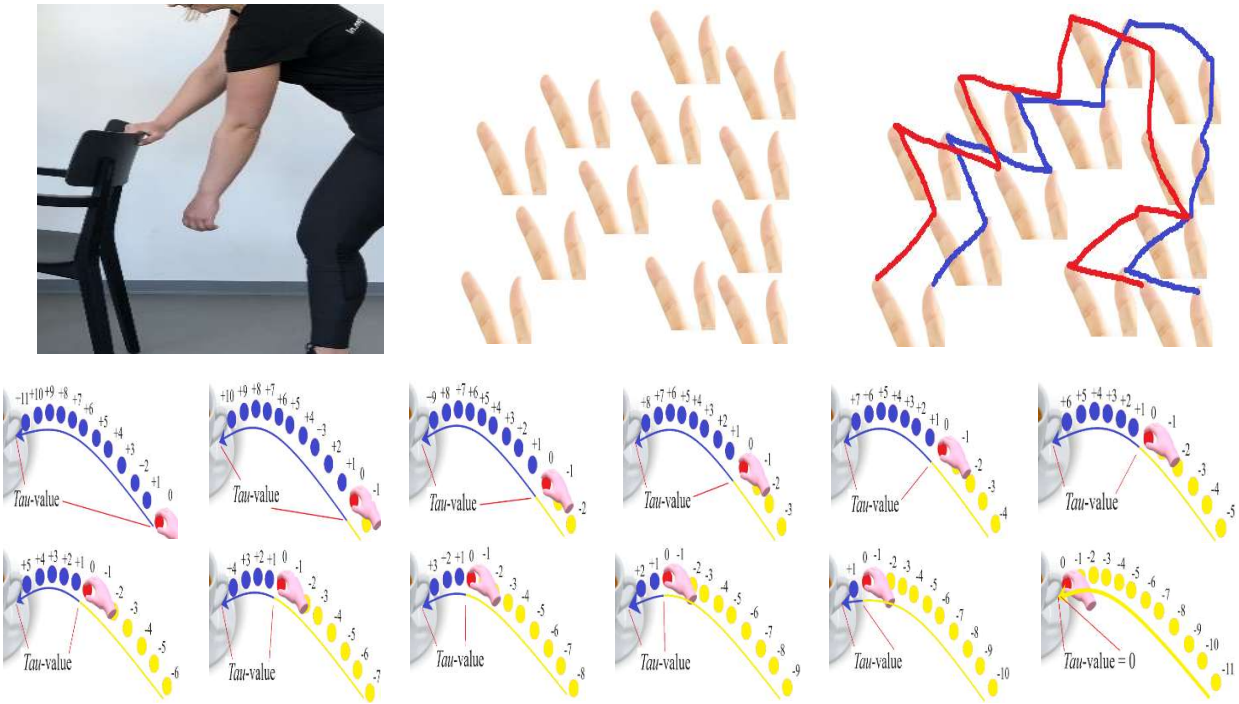
Part 6 - Random motor arm activity implicitly induces an internal and an external focus – The scientific evidence how two autonomous foci arise within grasp actions and how their roles evolutionarily have reversed



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

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March 2024

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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 motoric action of grasping. 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, grasping is fully explained in relation to general motor activity. In contrast to the first part, the second part addresses deliberate c.q. specific goal directed actions where an egocentrically intention is formulated to for example grasp a coffee cup. 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 goal-directed action. In which the fundamental assumption encompasses that the action arises from explicitly formulating a particular egocentric will. However, in this part, 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 goal-directed actions provides valuable insight into the broad spectrum of motor (movement) activity.

a. Basic exercise (passive arm without a spoon)

The entire explanation is built upon a basic exercise, involving a forward-leaning body 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.

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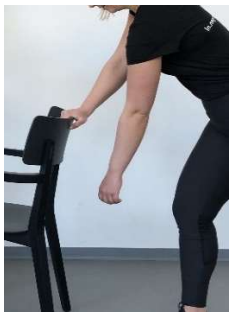


Images: The basic exercise illustrates a forward-leaning body position with a passive arm. Despite the apparent action in the images, the primary goal is to develop and observe other body actions and notice how they laterally influence the movement of the passive arm.

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)

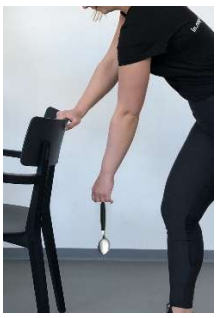
It can be conclusively observed that you are capable to (secondarily) perceive movement of all separate positions P of the outside of a passive arm by directing (primary) attention to an entirely different internal motor activity. This observation carries the following factual conclusions:

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 external 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[30], 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[31]. 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[32]. 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 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 a part of[33].

b. Basic exercise (passive arm with a spoon)

[30] 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.
[31] 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 simply no escaping it. You are factually "*Caught In A Line*".
[32] https://www.researchgate.net/publication/336880958_The_explanatory_model_of_all_motoric_movement_actions_-_The_Marble_Run
[33] 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.

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:

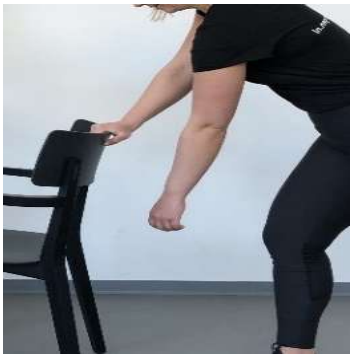
1) While there is nothing predictable about where the passive arm with the spoon will move, as random internal motor activity will always result in random or chance movements of the passive arm with the spoon, there is, on the other hand, a very essential fact to note. All separate points/positions P 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[34]. So, all separate positions of the arm and of the spoon are going to traverse a 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,

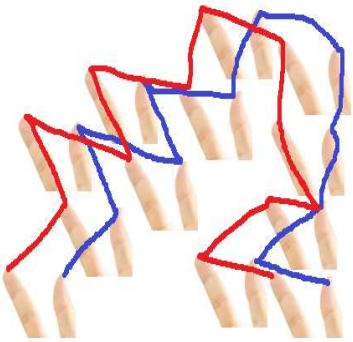
[34] Hence, you must realize that when eating soup, where we typically focus on the movement of the spoonbowl, all other mentioned body and spoon parts also move in line segment shapes. This demonstrates that the related perception processes are entirely subjective and depend on the chosen focus.

torso, head, foot action, etc.) has absolutely nothing to do with the observation of the line segment shapes that all parts of the arm and now also all parts of 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 segment shape, 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 relationship to motoric arm activity inducing movement of the fingertips</u>

If we define an action as conscious motor activity in which a specific goal is pursued from an ego-centrically 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 exercises demonstrate.





Images: The basic exercises entail the manipulation of a passive arm through distinct motor activities originating elsewhere in the body. However, the explanatory model of the motoric movement action illustrates that the internal source of movement initiation for, say, the fingertips, is inconsequential. Should one choose to concentrate solely on, for instance, the thumb and ring finger, their manipulation could be solely orchestrated by corresponding internal finger actions. Which also underscores the critical observation that not only the fingertips will become part of a linear trajectory, but all components of the finger as well[35].

As the preceding paragraph demonstrates, the basic exercise can be readily translated into an action aimed at moving the fingertips. To maximize the distinction between the perception of fingertip movement and the perception of internal motor activity, thereby elucidating the principles, participants were initially instructed to refrain from engaging in any arm activity.
However, the distance between the fingertips and the internal motor activity doesn't matter at all because even if you direct your primary focus to internal motor arm activity, you will effectively observe that the outer surface of the fingertips moves randomly through the air. Whether you engage in upper

[35] Two essential omissions should be noted in the animations: 1. Only a limited number of positions of fingertips are represented. If you engage in a few minutes of random motor activity, the entire environment should be filled with rings. 2. The connection of successive positions P of fingertips cannot be captured in an animation. The perception of the fingertip movement involves a continuous (smooth) line of fingertips. The red and blue line represents this continuous connection but does not actually show fingertips. Therefore, you need to create a hybrid perceptual representation, which you can only really perceive by actually grasping an object.

or lower arm activity, or solely hand or even finger action, the same principles apply. Once again, you can only factually observe that the position P (0) of the fingertips, in the current action, must always derive from preceding positions, meaning that all positions P of the entire finger (and so also the tips of the fingers) are always confined to one single line segment shape.

Conclusion basic exercise in relationship to motoric arm activity inducing movement of the fingertips

So, also during motor actions where one primarily focuses on any (internal) motor arm activity, it is possible to secondarily perceive movement of the outer surface of the fingertips constructing line segment shapes. This observation alone is sufficient to draw the following factual conclusions:

1) Although there is nothing predictable about where the fingertips will move, as random internal motor activity will always result in random or chance movements of the fingertips, there is, on the other hand, a very essential fact to note. All separate points/positions P of the fingertips 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 fingertips 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 fingertips will always serve as the precise separation between all manifest positions P(-x) and all future positions P(+x).
2) The second crucial conclusion follows the same logic as the other basic exercises. The perception of movement in relationship to internal motor arm activity has absolutely nothing to do with the perception of the movement of the fingertips within the line segment shape that all parts of the fingers become part of.
   The perplexing aspect of this observation could be the realization that the movement of the fingertips along a line segment shape is entirely dependent on a completely different internal motor movement. Without this source of action, the fingertips would never be able to move. Additionally, the confirming aspect of this observation could be the conviction that the perception of the movement of the fingertips along a line is absolutely unrelated to 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 goal-directed actions. Which 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 movement of the fingertips towards the handle of a coffee cup encompasses the main 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 internal motor movements reaching to the outer surface of the fingertips and secondary focus on the movement of the fingertips along an external action trajectory shape

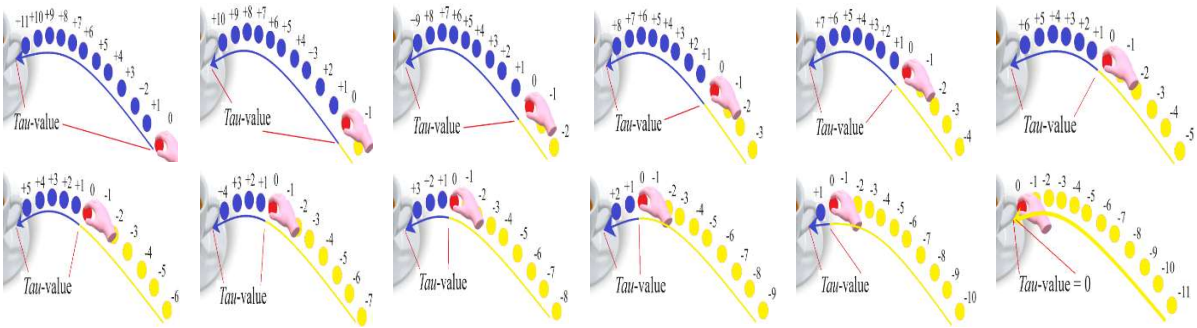
The basic exercises from the first part clearly demonstrate that with primary focus on internal motor activity, we can randomly move our fingertips (externally) through the air. However, this random

movement poses a problem when one formulates the egocentric intention to precisely grasp a coffee cup by its handle. We can, with primary focus on internal motor activity, make our fingertips cover a tremendous amount of space in the air within a few minutes, but it is far from efficient and effective (parsimonious).

Images: Even when you consciously want to manoeuvre your fingertips towards a coffee cup, it remains a strategy to primarily focus on internal motor activity, while secondarily observing whether the fingertips will eventually reach the handle of the cup. Although this approach may require a considerable amount of luck and/or patience[36], it is a plausible action strategy. However, it is not an economical one, and it becomes evident quite quickly that organisms would not choose to develop ecologically in this manner.

b. <u>Execution perspective 2 - Primary focus on the movement of the fingertips along an external action trajectory shape and secondary focus on internal motor movements reaching to the outer surface of the fingertips</u>

Contrary to the description of random motor activity within the basic exercises within the first chapter of this article and also in contrast to the previous action strategy, when it comes to the emergence of a deliberate goal-directed action, one can adopt a completely different execution perspective. It would indeed be by far the most parsimonious (ecological) solution to first construct a perceptual image of a latent action trajectory shape and then proceed to execute it.



Images: It is most parsimonious to first create a perceptual image of an (efficient and effective) latent action trajectory shape along which the fingertips can be successfully moved towards a coffee cup, and then proceed to actually execute it.

In the second execution perspective, attention roles are reversed. Here, the primary focus shifts to tracking the fingertips' progress within the action trajectory shape, while internal motor activity becomes the secondary focus. This is a complete reversal from the basic exercise in the first part, where

[36] Each additional position P to be bridged will result in an exponential increase in deviation possibilities.

one must passively observe that motor activity should now passively follow the primary focus. Although it would be the most economical action strategy, reversing roles demands significantly more cognitive capacity. Unlike the first execution perspective, where starting the action is straightforward, the second perspective requires mastering the following essential cognitive skills:

a. It demands that first a perceptual image of a latent action trajectory shape is constructed over which the fingertips can be successfully moved towards the coffee cup.
b. A highly intricate system must be present to mediate the (perception of) movement of the fingertips within the perceptual representation of the latent action trajectory shape. Even if we reverse the roles of focus, it remains true that the fingertips can only be propelled by (the perception of) an entirely different autonomous (internal) process. While we may aim to compel the fingertips to accurately align with the perceptual representation of the latent action trajectory, the autonomous nature of motor activity means that the fingertips will inevitably deviate from this representation at every point 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 fingertips will be successfully moved towards a coffee cup. 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[37], grasping[38] and throwing[39] 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 fingertips within that perceptual image of a latent action trajectory. The mere quintessence of this article

[37] 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
[38] 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?_sg%5B0%5D=cjBGD1Dj5IxR2T4se38lo9o1z_MKwSU49eb_oQsTOUjibSgy5M67E9dyDJ2vYL6jmizwVBbPYrgk9NU6pmmALDQpNZJERFlrXLCWSXY.BBjj_0oQKGMN_JQZfSCEjGE1eN9IjRkkPyAjEjWIaxLJGM1U2MeX-LYMQPb3Fz_XmE18jNVnKKf8WfOSPcG4l1w&_tp=eyJjb250ZXh0Ijp7ImZpcnN0UGFnZSI6ImhvbWUiLCJwYWdlIjoicHJvZmlsZSIsInBvc2l0aW9uIjoicGFnZUNvbnRlbnQifX0
[39] 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

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encompasses namely that motor activity is a completely autonomous phenomenon and although it has a direct causal relationship with the movement of the fingertips within an action trajectory shape, the outside of the fingertips will never be able to move by themselves. So, we might be intensely motivated to reverse the roles of the primary and secondary focus and envision very neat and straight (optimally economical) action trajectory shapes 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 fingertips will eagerly try to follow the perceptual image of the latent action trajectory shape, but the autonomous (internal) proprioceptive perception towards the outer surface of the fingertips will externally cause the fingertips to deviate at every position P within the perceptual image of the 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 fingertips 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 goal-directed motoric action, the dorsal stream is mainly related to the processing of perceptions concerning the specific position of the fingertips, 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 position of the fingertips relative to the action trajectory shape and vice versa. So, the dorsal stream mainly processes the position of the fingertips, but this is always related to the action trajectory shape, and conversely, the ventral stream mainly processes the progression within the action trajectory shape, but this is always related to the specific position of the fingertips.
This dual and reciprocal collaboration leads to random deviations of the fingertips from the perceptual image of the latent action trajectory shape at every position P(0). As a result, the ventral stream promptly needs to renew c.q. update the perceptual image of the remaining latent action trajectory shape, which immediately becomes the compelling new output situation in relation to the dorsal stream. This process repeats with each new deviation. This inevitable consequence causes the fingertips to move involuntarily in a zigzag[40] or jerky manner within the perceptual image of the action trajectory shape due to the (very small) reaction time inherent in this dual and reciprocal collaboration.

[40] The zigzag collaboration is vividly illustrated in the execution of the nerve spiral, which legitimacy is solely based on this jerky phenomenon. While you may successfully traverse a spiral, you can quickly empirically determine that you will never be able to construct straight action trajectory shapes because the ring will always deviate randomly, and the reactions of the cortical streams demand essential reaction time. Additionally, you will soon conclude that you simply cannot create an identical action trajectory shape for any conceivable action.

Part 7 - The explanation of the emergence of the cortical streams - We can only guide the fingertips to a coffee cup 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 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 that, as part of a tactical (ecological) consideration, we always first create a perceptual image of a latent action trajectory shape prior to the actual grasping of the coffee cup.
2. The understanding of the necessity of a compelling collaboration between an internal and an external focus in every motor action. During grasping the movement of the fingertips within the action trajectory shape can only be perceived outside the body and is solely caused by perception of movement within the body. Due to their exclusive domains these perceptions are incompatible.
3. The assumption of the crucial role of the movement of the fingertips over the action trajectory shape as the essence of the task within grasping, 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 it is a subjective choice when we move the fingertips towards a coffee cup with for example arm action. With the same arm action, the wrist, knuckles, hand back, elbow, etc., also move in a unique action trajectory shape. This demonstrates that there is a causal relationship between the perception of internal and external movements during grasping, but an explicit relationship only arises when we have (subjectively) "chosen" the fingertips for grasping a coffee cup.

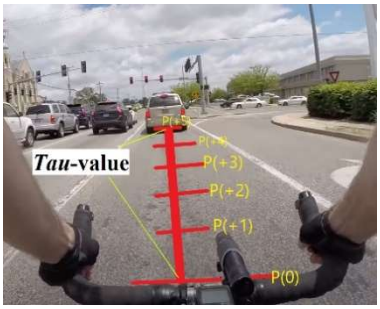
As a concluding step, this chapter clarifies the functioning of the cortical streams. It provides a comprehensive understanding of why they must play such a prominent role c.q. why an evolutionary need arose for them to occur, and additionally, it precisely explains how within each motor action, they mediate two autonomous processes, namely the zigzag process and the accordion process[41].

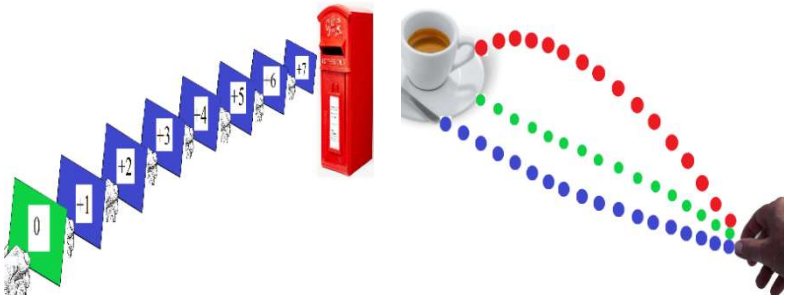
1. The main goal of the tactical movement action (TMA) encompasses the construction of a perceptual image of a latent action trajectory shape

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

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

movement action (AMA). The tactical movement action is focused solely on planning the upcoming action and must be finalized before any actual execution occurs. A crucial aspect of the tactical movement action is the creation of a perceptual image depicting the latent action trajectory shape between the current fingertip position and the intended target, such as the handle, saucer, or spoon[43] of the coffee cup. Within which the specific target significantly influences this process.
While the explanatory model aligns with existing scientific research, it also introduces a novel conclusion not yet acknowledged by the scientific community. It suggests that the creation of a perceptual image of the latent action trajectory shape between the fingertips and the coffee cup involves tactical consideration of whether the space between them can be bridged by a continuous line segment shape encompassing all fingertip dimensions. This proposition is substantiated by incontrovertible scientific evidence but one can empirically arrive quickly to the same conclusion[44].





Images: Within cycling and letter posting 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 bike and the letter) will enable the action to succeed. During the actual execution within the actual movement action (AMA), akin to the fingertips when grasping a coffee cup, one must perceive the movement of the action object during the bridging process, as only the bike, the letter, and the fingertips are going to move c.q. can be moved. Within the images, it is particularly noticeable that we actively perceive whether the entire path through all dimensions of the fingertips, the bike, 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 empty void there is (empty) space to 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 fingertips towards the coffee cup. This contrasts with the traditional perspective of science, which remains constantly focused on the coffee cup itself. During the actual movement action, our main concern is the egocentric bridging process of the fingertips, guiding them over the perceptual image of the latent action trajectory shape which is solely determined during the tactical movement action[45]. So when the factual execution starts the coffee cup itself is not any longer the focal point, but rather the movement of the fingertips towards it c.q. the bridging of the void (!) between the current location of the fingertips and the coffee cup 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 grasp a coffee cup, the explanatory model, supported by scientific evidence, demonstrates that we also tactically determine beforehand whether the entire (!)

[43] Within scientific research, participants are often tasked with grasping unfamiliar objects. The explanatory model acknowledges that individuals still attempt to estimate, based on general cognitive knowledge, how to approach the special features before actually executing the grasp.
[44] The action trajectory shape of the fingertips towards the coffee cup will vary significantly when an obstacle like a large shopping bag is situated in front of the cup. Moreover, in scenarios where the coffee cup is obscured by a substantial shopping window, no action trajectory shape can be formed at all.
[45] The explanatory model emphasizes this semantically by replacing the phrase "grasping a coffee cup" with the phrase "moving the fingertips towards the coffee cup."

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space between the fingertips and the coffee cup can be filled by a continuous line of fingertip dimensions. This means that all positions P between the current location of the fingertips and the coffee cup are observed as actively and as crucially as the endpoint of the action trajectory. This realization provides a solid foundation for the fact that during the actual movement action (AMA), we are solely focused on traversing the latent positions P associated with the action trajectory shape. This implies that upon reaching position P(x), for example, somewhere midway along the 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 we are now, and position P(x+1), the perception of the next position where we need to move the fingertips. In this phase, we are primarily engaged in the aforementioned bridging process and only monitor whether the gap between the fingertips and the coffee cup is closing. This also reveals another essential ecological novelty, showing that during the actual movement action, we are indeed not concerned with the coffee cup itself, but only with reducing the number of latent positions P between the fingertips and the coffee cup.

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

The explanatory model of the motoric movement action illustrates within the context of grasping a coffee cup that two foci always arise. We can only guide the fingertips[46] along an external action trajectory toward a coffee cup 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.
However, as the explanatory model now demonstrates that the movement of the fingertips within the external action trajectory shape are going to fulfil the essence of the task, an intriguing phenomenon of reciprocal dependency emerges. Only internal motor movements can lead the fingertips externally along an action trajectory shape, yet the progression of the fingertips within that trajectory 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 fingertips 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 grasp a coffee cup, our main endeavour will primarily become to initiate the bridging process of the fingertips in which the perceptual image of the latent action trajectory shape serves as an open yet compelling guiding[47] phenomenon. This means that we aim to *step by step* (!) reduce the distance between the current position of the fingertips and the coffee cup, starting with the first step of moving the fingertips from position P(0) to position P(+1).

46 The outer surface of the fingertips is composed of living cells, but they definitely cannot ensure movement of the fingertips within an external action trajectory shape.
47 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 fingertips deviate, as long as the fingertips come 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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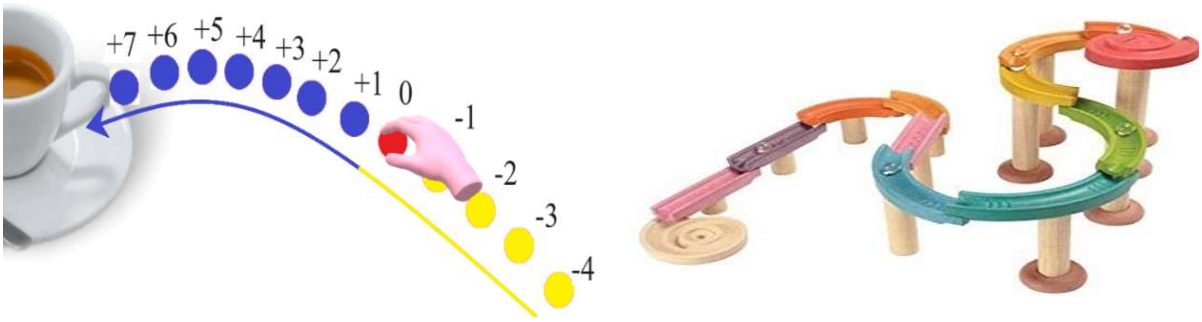
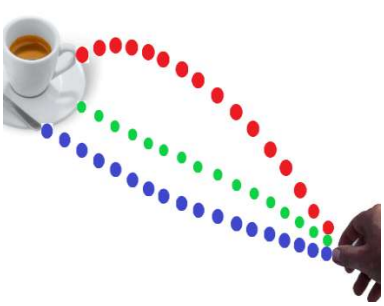


Images: The explanatory model of the motoric movement action provides a tangible example with the marble in the marble run, illustrating the continuous reciprocal perception-action coupling within any conceivable motoric action. From the perspective of the marble's current position, one can perceive 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 invisible when grabbing a coffee cup, 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 fingertips, must emerge from each other, meaning that the perception of fingertip movement when grasping a coffee cup is always captured in one single line segment shape. In which the current position P(0) of the fingertips 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 fingertip 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 fingertips 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 fingertips will inevitably deviate[48] from the perceptual image. It is an absolute factual given that cannot be avoided, and it would quickly lead to chaotic action trajectories[49] if there were not a system capable of mediating these deviations.



[48] As stated in footnote 4, this precisely illustrates an optimal parsimonious model, where nothing needs to be executed very precisely, but only provides a general (albeit compelling) direction. If you had to approach a coffee cup with your fingertips identically every time, drinking coffee would become a neigh impossible task. The task, where you only need to reduce the distance, offers countless more possibilities and demonstrates that the bridging process is just one aspect of the task at hand.

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

Images: The perceptual image of a latent action trajectory shape, within the tactical movement action (TMA), depicts a smooth line segment shape from the fingertips to the coffee cup. However, during the actual execution, the fingertips, akin to a nerve spiral[50], 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 fingertips 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[51]. Similar to a marble in a marble run, the fingertips 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 fingertips towards the action trajectory shape, and vice versa the ventral stream primarily monitors the action trajectory shape towards the actual position of the fingertips. This ingenious mediation of the cortical streams creates the delusion of a straight action trajectory shape. Although the execution of a nerve spiral unequivocally shows the opposite.

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[52]. Therefore, it ideally presupposes a mutually reinforcing system that continuously monitors the relationship with the action trajectory shape from the current position of the fingertips, and conversely, constantly monitors the actual position of the fingertips 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 neuroscientifically 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 fingertips, while the dorsal stream does so vice versa, primarily from the actual position of the fingertips to the perceptual image of the entire action trajectory. 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.

[50] 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
[51] You can speak of micro-adjustments or of updating c.q. renewing the perceptual image of the remaining latent action trajectory.
[52] 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.

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[53], which relate to the words *line* and *shape* in the compound word *line segment shape*. The explanatory model demonstrates that they are observed and processed completely separately, yet simultaneously. Driving and cycling (without hand brakes) show, beyond any reasonable doubt, that the 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 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. 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 perceiving the shape has absolutely nothing to do with perceiving 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 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 shape of the action trajectory 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 grasping a coffee cup

The explanatory model of the motoric movement action demonstrates that both the zigzag process and the accordion process occur within any conceivable action[54]. However, it's much harder to demonstrate

[53] 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.
[54] 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

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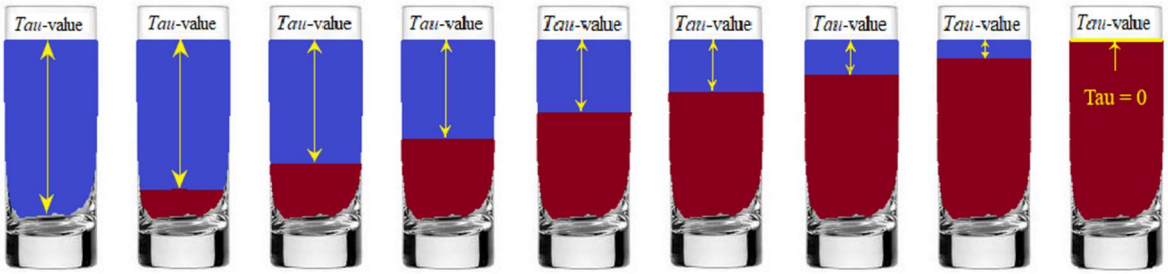
this when grasping a coffee cup compared to, for instance, driving a car. Yet, even when grasping, one must consider separate pedals and a steering wheel that autonomously influence the filling and mediating of the latent action trajectory shape between the fingertips and the coffee cup, which will now be processed through hybrid forms of these phenomena. The zigzag process (the steering process) is easy to capture in an animation, but not the accordion process.

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 fingertips, 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 grasping a coffee cup is difficult to represent in an animation because it involves compressions and elongations of time[55]. Yet, just like within car driving, you must realize that you can never move the fingertips identically in time along an action trajectory shape. You are quickly capable to empirically establish that the fingertips will infinitely vary within certain fluctuation boarders.

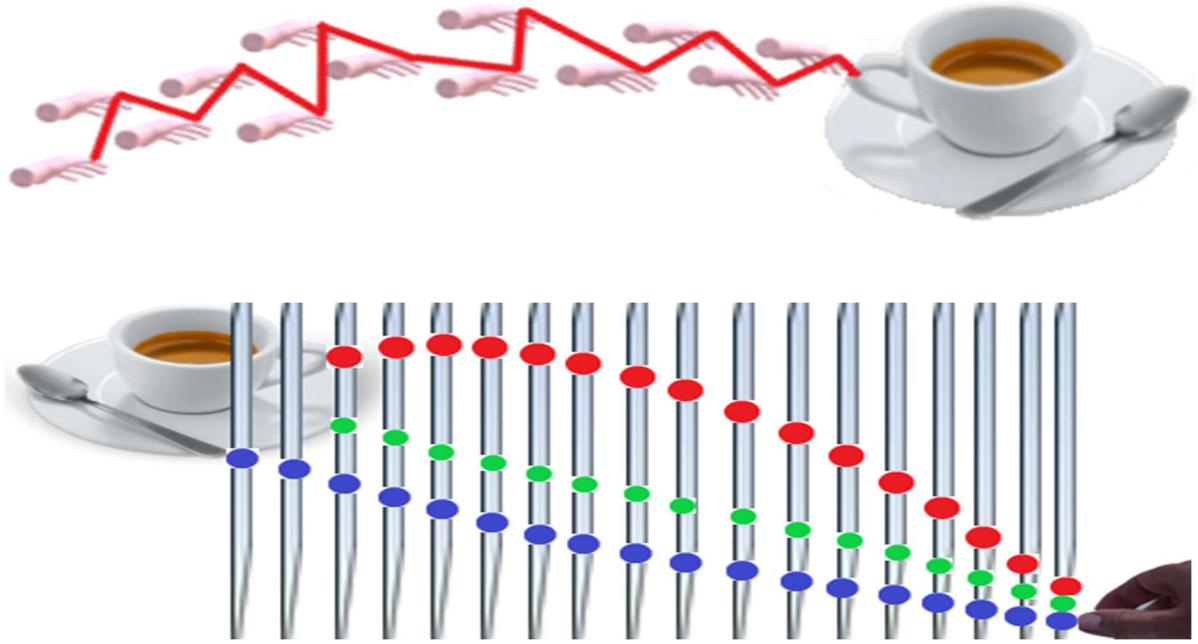


Images: In the motoric movement action *pouring*, the accordion process is still difficult to capture in an animation. However, it can be factually stated that when filling a glass, as a very rare exception, there are absolutely no deviations within a zigzag process. The cortical streams are fully dedicated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

separate x- and y-axis component actually constitutes the breakthrough that allows us to reduce highly complex perception processes to such seemingly simple phenomena.

[55] Wherein it should be noted for the record that the fingertips do not move back within the action trajectory shape.

Part 8 - The cortical streams will have to mediate grasping because we are solely capable to transfer the fingertips toward the coffee cup with an egocentric zigzag movement



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Introduction

Current science views the execution of motor actions as a single and indivisible process because it assumes that only one focus can be present during the execution of one motor action. It assumes that when catching a ball or grasping a coffee cup, the perception processes are primarily concerned with these objects, upon which a motor plan (movement plan) is then formulated to get them into the hand. This explanation thus presupposes a considerable degree of automation of the hand's (fingertips') movement as a result of the dominant c.q. leading perception of the ball or the coffee cup. After all, only one focus can be assigned and this has led to the fact that in scientific research, the (perception of the) movement of the hand has so far occupied a subordinate place.
Since 2016, however, an explanatory model has been developed that sheds a completely different light on the execution of motor actions. It concerns a universal explanation and shows that the execution of any conceivable motoric action always requires the simultaneous perception of three autonomous foci[56], in accordance with the theory of J.J. Gibson, which includes both the movement of the animal/organism and the movement of the environment. When catching a ball or grasping a coffee cup, one autonomous focus remains engaged with (the movement of) the ball and/or the cup as the environmental object, which universally represents a catching action. The other two autonomous foci are concerned with the perception of the movement within the egocentrically executed action: specifically, with the movement of the hand (the fingertips) along an action trajectory shape towards the ball and/or the coffee cup, which universally represents a throwing action. In this way the explanatory model confirms the autonomy of perceiving (the movement of) the ball and/or the coffee cup, conform the current scientific mindset, but conversely also reveals the novelty that the throwing action of the hand (fingertips) is also an entirely autonomously perceived part of the action.
Precisely because the scientific relevance of this aspect has never been recognized, this article specifically focuses on the two foci that belong to the throwing action of the fingertips within an egocentrically executed action trajectory shape in relation to, for example, the catching of a ball or the grasping of a coffee cup. It convincingly shows that the fingertips can only be moved autonomously and in a zigzag manner towards a ball or a coffee cup. Whereby the cortical streams, entirely in accordance with the current scientific literature, must compulsorily mediate this process, and this explanation can only be understood if one realizes that our perception processes must be egocentrically directed towards the autonomous guidance of the fingertips along an action trajectory shape towards the coffee cup.

6. The main goal of the tactical movement action (TMA) encompasses the construction of a perceptual image of a latent action trajectory shape

Supported by scientific evidence[57] 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. A crucial aspect of the tactical movement action is the creation of a perceptual image depicting the latent action trajectory shape between

[56] The cortical streams mediate the grasping of a cup equal as they mediate within the nerve spiral (youtube.com) https://www.youtube.com/watch?v=QP4vPVAw-Yg
[57] 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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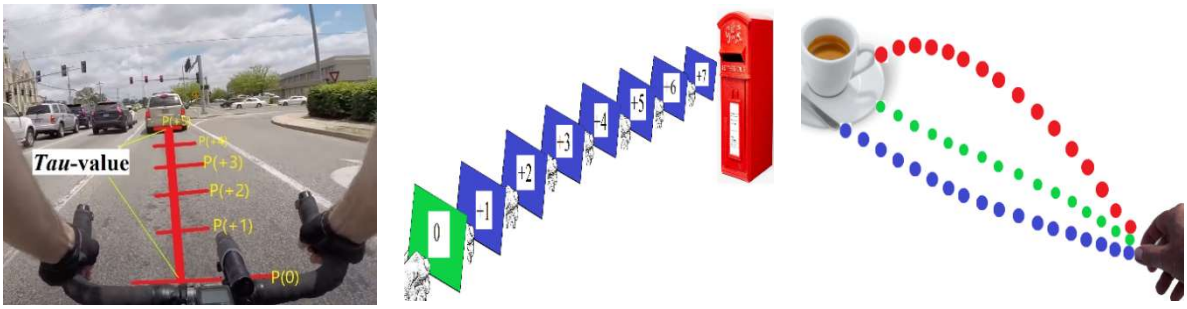
the current fingertip position and the intended target, such as the handle, saucer, or spoon[58] of the coffee cup. Within which the specific target significantly influences this process.
While the explanatory model aligns with existing scientific research, it also introduces a novel conclusion not yet acknowledged by the scientific community. It suggests that the creation of a perceptual image of the latent action trajectory shape between the fingertips and the coffee cup involves tactical consideration of whether the space between them can be bridged by a continuous line segment shape encompassing all fingertip dimensions. This proposition is substantiated by incontrovertible scientific evidence but one can empirically arrive quickly to the same conclusion[59].



Images: Within cycling and letter posting 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 bike and the letter) will enable the action to succeed. During the actual execution within the actual movement action (AMA), akin to the fingertips when grasping a coffee cup, one must perceive the movement of the action object during the bridging process, as only the bike, the letter, and the fingertips are going to move c.q. can be moved. Within the images, it is particularly noticeable that we actively perceive whether the entire path through all dimensions of the fingertips, the bike, 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 empty void there is (empty) space to 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 fingertips towards the coffee cup. This contrasts with the traditional perspective of science, which remains constantly focused on the coffee cup itself. During the actual movement action, our main concern is the egocentric bridging process of the fingertips, guiding them over the perceptual image of the latent action trajectory shape which is solely determined during the tactical movement action[60]. So when the factual execution starts the coffee cup itself is not any longer the focal point, but rather the movement of the fingertips towards it c.q. the bridging of the void (!) between the current location of the fingertips and the coffee cup 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 grasp a coffee cup, the explanatory model, supported by scientific evidence, demonstrates that we also tactically determine beforehand whether the entire (!) space between the fingertips and the coffee cup can be filled by a continuous line of fingertip dimensions. This means that all positions P between the current location of the fingertips and the coffee cup

[58] Within scientific research, participants are often tasked with grasping unfamiliar objects. The explanatory model acknowledges that individuals still attempt to estimate, based on general cognitive knowledge, how to approach the special features before actually executing the grasp.
[59] The action trajectory shape of the fingertips towards the coffee cup will vary significantly when an obstacle like a large shopping bag is situated in front of the cup. Moreover, in scenarios where the coffee cup is obscured by a substantial shopping window, no action trajectory shape can be formed at all.
[60] The explanatory model emphasizes this semantically by replacing the phrase "grasping a coffee cup" with the phrase "moving the fingertips towards the coffee cup."

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are observed as actively and as crucially as the endpoint of the action trajectory. This realization provides a solid foundation for the fact that during the actual movement action (AMA), we are solely focused on traversing the latent positions P associated with the action trajectory shape. This implies that upon reaching position P(x), for example, somewhere midway along the 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 we are now, and position P(x+1), the perception of the next position where we need to move the fingertips. In this phase, we are primarily engaged in the aforementioned bridging process and only monitor whether the gap between the fingertips and the coffee cup is closing. This also reveals another essential ecological novelty, showing that during the actual movement action, we are indeed not concerned with the coffee cup itself, but only with reducing the number of latent positions P between the fingertips and the coffee cup.

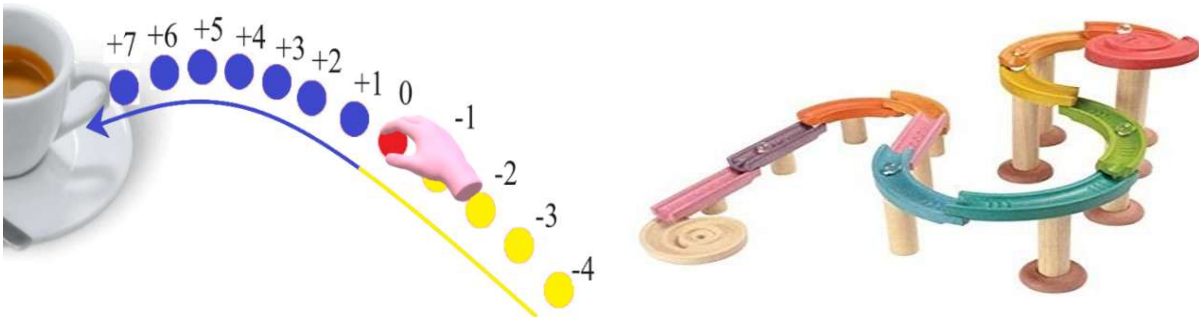
7. The reciprocal dependency between the internal and external focus results in absolute deviations of the fingertips within the perceptual image of the latent action trajectory shape

The explanatory model of the motoric movement action illustrates within the context of grasping a coffee cup that two foci always arise. We can only guide the fingertips[61] along an external action trajectory toward a coffee cup 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.
However, as the explanatory model now demonstrates that the movement of the fingertips within the external action trajectory shape are going to fulfil the essence of the task, an intriguing phenomenon of reciprocal dependency emerges. Only internal motor movements can lead the fingertips externally along an action trajectory shape, yet the progression of the fingertips within that trajectory 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 fingertips 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.

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

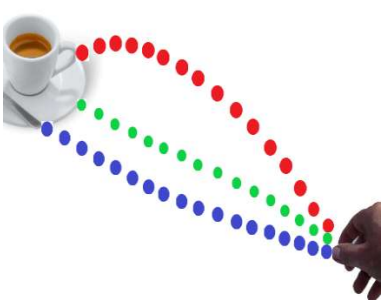
If we now combine the two preceding paragraphs and proceed to actually grasp a coffee cup, our main endeavour will primarily become to initiate the bridging process of the fingertips in which the perceptual image of the latent action trajectory shape serves as an open yet compelling guiding[62] phenomenon. This means that we aim to *step by step* (!) reduce the distance between the current position of the fingertips and the coffee cup, starting with the first step of moving the fingertips from position P(0) to position P(+1).

61 The outer surface of the fingertips is composed of living cells, but they definitely cannot ensure movement of the fingertips within an external action trajectory shape.
62 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 fingertips deviate, as long as the fingertips come 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.



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 invisible when grabbing a coffee cup, 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 fingertips, must emerge from each other, meaning that the perception of fingertip movement when grasping a coffee cup is always captured in one single line segment shape. In which the current position P(0) of the fingertips 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 fingertip 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 fingertips 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 fingertips will inevitably deviate[63] from the perceptual image. It is an absolute factual given that cannot be avoided, and it would quickly lead to chaotic action trajectories[64] if there were not a system capable of mediating these deviations.



[63] As stated in footnote 7, this precisely illustrates an optimal parsimonious model, where nothing needs to be executed very precisely, but only provides a general (albeit compelling) direction. If you had to approach a coffee cup with your fingertips identically every time, drinking coffee would become a neigh impossible task. The task, where you only need to reduce the distance, offers countless more possibilities and demonstrates that the bridging process is just one aspect of the task at hand.

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

Images: The perceptual image of a latent action trajectory shape, within the tactical movement action (TMA), depicts a smooth line segment shape from the fingertips to the coffee cup. However, during the actual execution, the fingertips, akin to a nerve spiral[65], 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 fingertips 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[66]. Similar to a marble in a marble run, the fingertips 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 fingertips towards the action trajectory shape, and vice versa the ventral stream primarily monitors the action trajectory shape towards the actual position of the fingertips. This ingenious mediation of the cortical streams creates the delusion of a straight action trajectory shape. Although the execution of a nerve spiral unequivocally shows the opposite.

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[67]. Therefore, it ideally presupposes a mutually reinforcing system that continuously monitors the relationship with the action trajectory shape from the current position of the fingertips, and conversely, constantly monitors the actual position of the fingertips 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 neuroscientifically 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 fingertips, while the dorsal stream does so vice versa, primarily from the actual position of the fingertips to the perceptual image of the entire action trajectory. 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.

[65] 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
[66] You can speak of micro-adjustments or of updating c.q. renewing the perceptual image of the remaining latent action trajectory.
[67] 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.

9. 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[68], which relate to the words *line* and *shape* in the compound word *line segment shape*. The explanatory model demonstrates that they are observed and processed completely separately, yet simultaneously. Driving and cycling (without hand brakes) show, beyond any reasonable doubt, that the 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 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. 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 perceiving the shape has absolutely nothing to do with perceiving 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 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 shape of the action trajectory involve deviations of the movement of the action object within the shape and can be characterized as a zigzag process.

10. The zigzag process and the accordion process when grasping a coffee cup

The explanatory model of the motoric movement action demonstrates that both the zigzag process and the accordion process occur within any conceivable action[69]. However, it's much harder to demonstrate

[68] 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.
[69] 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

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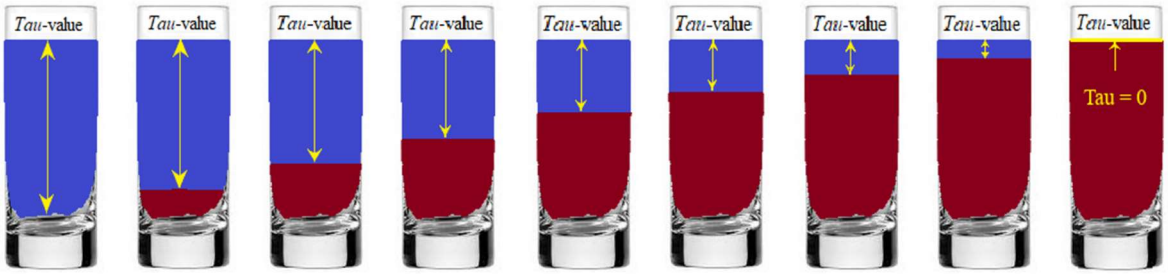
this when grasping a coffee cup compared to, for instance, driving a car. Yet, even when grasping, one must consider separate pedals and a steering wheel that autonomously influence the filling and mediating of the latent action trajectory shape between the fingertips and the coffee cup, which will now be processed through hybrid forms of these phenomena. The zigzag process (the steering process) is easy to capture in an animation, but not the accordion process.

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 fingertips, 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 grasping a coffee cup is difficult to represent in an animation because it involves compressions and elongations of time[70]. Yet, just like within car driving, you must realize that you can never move the fingertips identically in time along an action trajectory shape. You are quickly capable to empirically establish that the fingertips will infinitely vary within certain fluctuation boarders.



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.

separate x- and y-axis component actually constitutes the breakthrough that allows us to reduce highly complex perception processes to such seemingly simple phenomena.

[70] Wherein it should be noted for the record that the fingertips do not move back within the action trajectory shape.