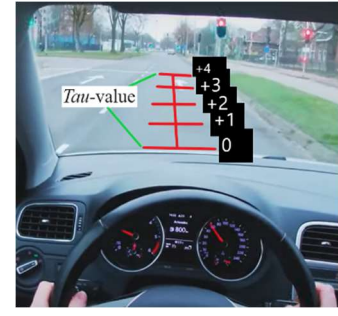
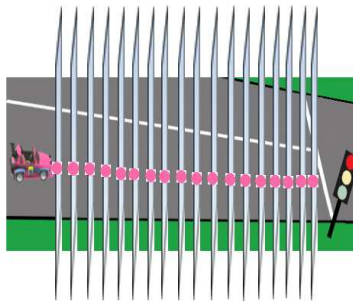


The complete clarification of all functional perception processes within car driving



Caught In A Line

The explanatory model of all motoric movement actions

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TABLE OF CONTENTS:

	Introduction	1
Part 1	Einstein, the Stationary Bridge, and the Digital Clock: The Visual Perception Observes Stationary Bridges Moving in Time	4
Part 2	Prior to driving toward a traffic light we always first construct a perceptual image of a latent action trajectory shape out of the perspective of the car – The scientific evidence	8
Part 3	Car driving requires a compelling coupling of a secondary (internal) focus to a primary (external) focus - Driving and bicycling encompass identical perception processes	12
Part 4	The external primary focus within car driving solely encompasses the movements of the car - Within any imaginable motor action the essence of the task is solely executed by the action object	17
Part 5	The execution of an external action trajectory shape along which the car moves dictates all internal sensorimotor perception processes; The <i>tau</i> -coupling process when car driving demonstrates that we absolutely do not need a motor plan	24
Part 6	Within car driving the transitioning from random motor activity to the execution of deliberate actions demands shifting the internal and external focus; Scientific evidence of the origin of two autonomous foci and how their roles have evolutionarily reversed	34
Part 7	The explanation of the emergence of the cortical streams - We can only guide a car towards a traffic light with a zigzag movement, yet the ingenious mediation by the cortical streams creates the delusion of a straight action trajectory shape	43

Introduction

In 2016, a comprehensive explanatory model was developed that offers the possibility to appoint all functional perception processes involved in any conceivable goal-directed motor action. It provides a universal explanation, demonstrating that the execution of any action always requires the simultaneous perception of three autonomous foci. Whether it involves catching a ball, the grasping of a coffee cup or car driving towards a bridge, one autonomous focus continuously tracks the movement of the ball, the coffee cup and the bridge 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.e., the movement of the hand (fingertips) or the car along an action trajectory shape (towards the ball, the coffee cup or the bridge), which universally represents a throwing action.

So the essence of the perception processes encompasses the fact that two autonomous movements, as part of a catch and a throw action, must be combined. In relationship to which it compels a fact that, within our worldly dimensions, the sequential positions P of any conceivable object are always interconnected c.q. must always sprout from each other. This factually means that, for example, with an incoming tennis ball within a catching action, the perceptual images of all positions P of the tennis ball will always form a line c.q. will always represent solely one line segment shape. This constrains the perception to such an extent that we can already precisely know within which global fluctuation boundaries the actual catching will have to take place. According to which it is important to realize that all manifest positions of the tennis ball create the actual 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 driving a car towards a bridge, all positions of the car will always be interconnected and construct just one sole action trajectory shape, will the current position of the car 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 moves¹. Thus, perceiving movement essentially has nothing to do with perceiving what exactly moves, and it can also be established that perceiving mere movement must be placed close to the origin of the evolutionary development of the perception processes.

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

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

1. The environmental object (e.g., the bridge or the tennis ball) is standing still². 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 car 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 bridge or the tennis ball) is moving (towards us). The perception records this as a movement within an incoming action trajectory shape within the catching action. This also necessitates forming a perceptual image of a latent egocentric action trajectory shape of the car. Which finally should lead to the creation of an autonomous perceptual image of a future (latent) intersection point sprouting from the two latent parts of the involved action trajectory shapes that are constructed separately.

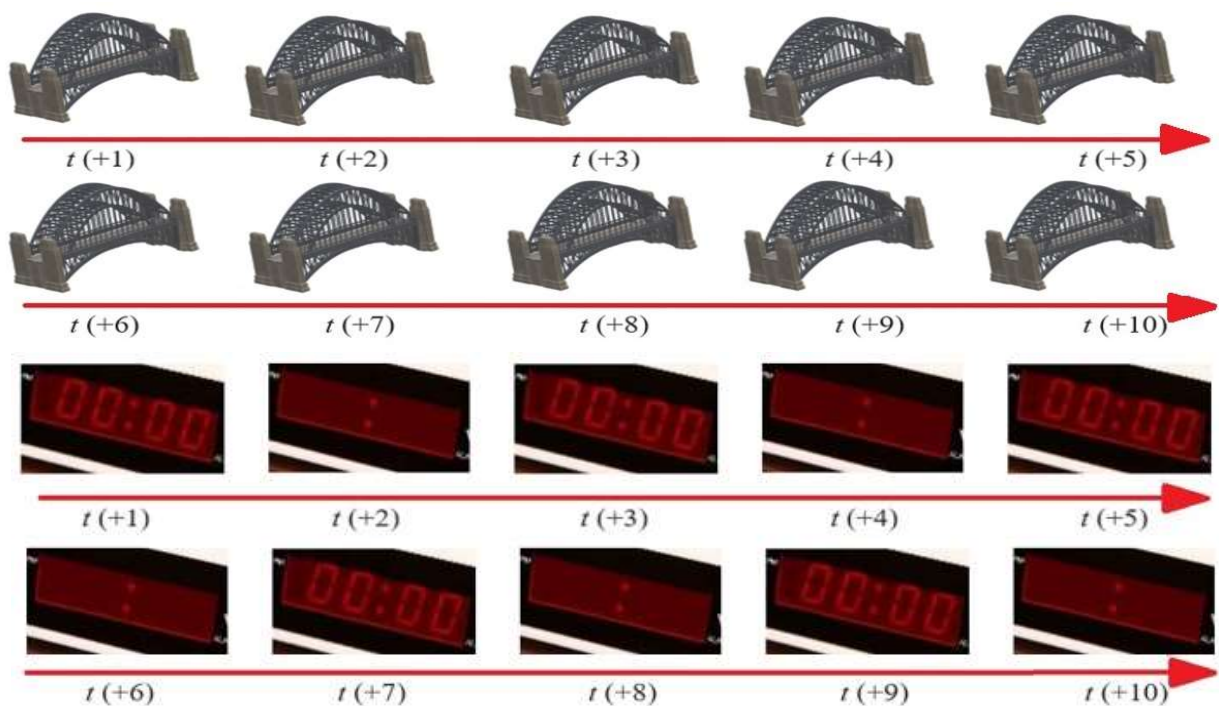
This explanation demonstrates that, contrary to the current state of science, the explanatory model shows that the perception processes within any conceivable motor action originate much more from a single universal source and illustrates that in all actions, an intersection point c.q. contact point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

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

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

This overview document specifically addresses those aspects of the throwing and catching action in driving a car that are barely recognized within science. A small part focuses on the perception of the environmental object (bridge, traffic light) 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 car. It shows the scientific evidence that 1. a perceptual image of a latent action trajectory shape from the car towards the environmental object is always created first, and 2. how this action trajectory shape can only be filled with the help of two autonomous foci. This overview document now summarizes all phenomena ever found within the movement sciences and forges them into one universal explanatory model. Based on logic, it can be concluded that this forms the complete and definitive explanation of all functional perceptual processes within car driving.

Part 1 - Einstein, the Stationary Bridge, and the Digital Clock: The Visual Perception Observes Stationary Bridges Moving in Time



Caught In A Line

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Introduction

In the dynamic world of visual perception and theoretical physics, seemingly simple objects like a stationary bridge 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 bridge, 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 Bridge

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

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

- Each point on the bridge's surface is linked to its previous and subsequent positions in time. This consistent positional data ensures that the bridge 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 bridge as stationary. This perpetual perception is key to understanding how we interpret zero-movement within zero-movement line segment shapes.

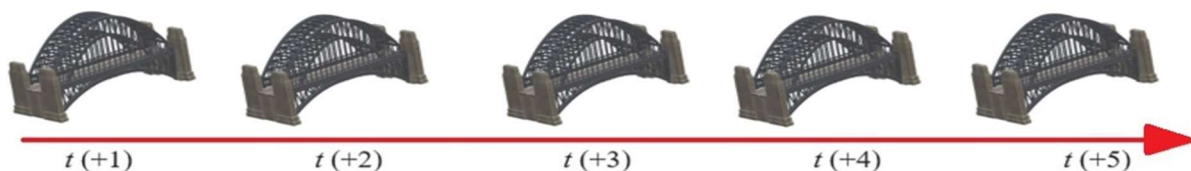
Ecological and Visual Perception

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 bridge 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 bridge. Similar to the flashing zeros on a digital clock, the bridge 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 bridge appears motionless in space, the entire explanation hinges on its movement in time.

Relationship with Relativity Theory

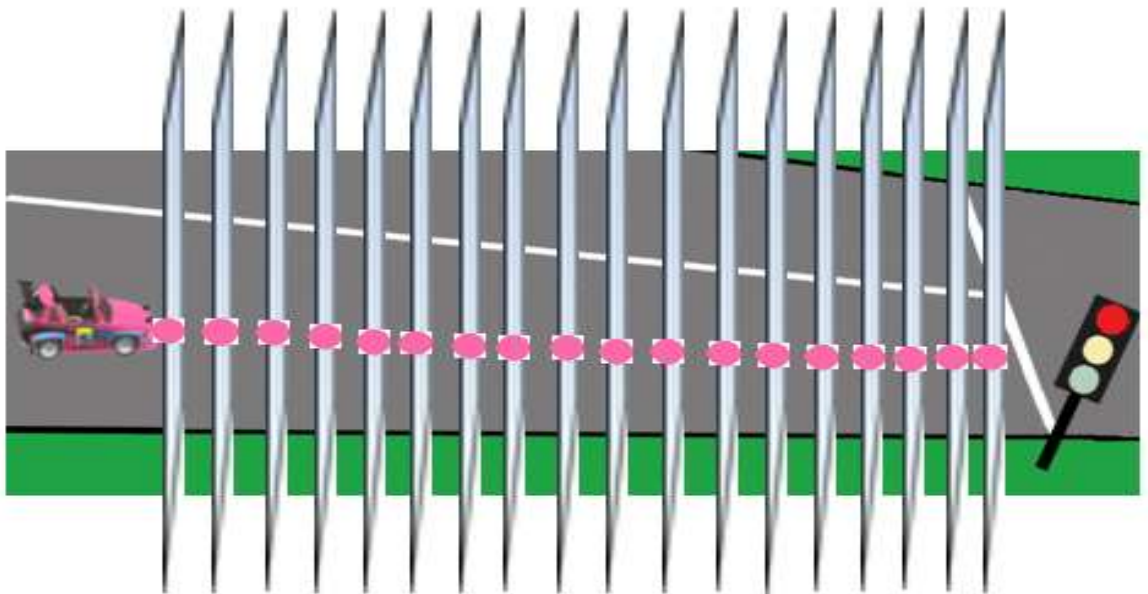
In the context of relativity theory, particularly as articulated by Einstein, the distinction between space and time becomes crucial. Objects can remain spatially stationary (zero-movement) while still undergoing temporal changes. This concept aligns with our perception of the bridge: although it occupies a fixed spatial position, its temporal trajectory is dynamic. The bridge'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 bridge'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 bridge and the zero-movement within a timeline illustrates a fundamental aspect of both visual perception and theoretical physics. While the bridge 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 and time, as explained by the theory of relativity.

Part 2 - Prior to driving toward a traffic light we always first construct a perceptual image of a latent action trajectory shape out of the perspective of the car – 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 foci³, in accordance with J.J. Gibson's theory, which includes both the movement of the animal/organism and the movement of the environment. While driving a car towards a traffic light, one autonomous focus remains engaged with (the movement of) the traffic light, which universally represents 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 car along an external action trajectory shape (toward the traffic light), which universally represents a throwing action.

This article specifically focuses on the two foci involved in the egocentric throwing action of guiding a car to, for example, a traffic light. 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 individual perception processes but also reveals as a novelty that a coupling within the egocentric throwing action itself is capable to occur⁴. 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 car over a pre-planned action trajectory shape between the current position of the car and, the stop line belonging to, the traffic light⁵. This perceptual image is therefore determined in advance within a tactical consideration and involves identifying the future sequential positions the car 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 car 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 focus⁶.

The explanatory model of the motoric movement action partly relies on logical reasoning but also presents scientific evidence. This chapter provides scientific proof that within car driving, we always first create a perceptual image of a latent successful action trajectory shape toward a traffic light out of the perspective of the car before we actually perform any action.

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](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/376784297_Rowingcanoeing_-_Scientific_evidence_that_random_motor_activity_implicitly_leads_to_the_factual_occurrence_of_an_internal_and_an_external_focus_and_how_their_dominancy_evolutionary_has_reversed

⁶ https://www.researchgate.net/publication/375689254_The_tau-coupling_process_within_rowing_demonstrates_that_we_absolutely_do_not_need_a_motor_plan_Executing_an_external_action_trajectory_shape_over_which_the_boat_moves_dictates_all_internal_sensorimotor_sg%5B0%5D=Vlut6BtQiZ-cBRHxFdyfMxIk9NSmk7yyGcH96M-jtiOsg07uR0T_lgq44dSnzfUkXkk0W5Gk1p4YKdcm-

The scientific evidence

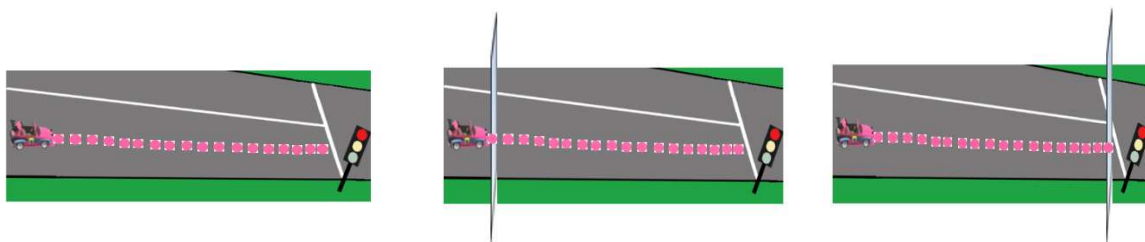
The evidence is very straightforward. You can verify it yourself through an empirical study where you are the test subject or you ask a test subject to drive towards a traffic light. The only instruction given is to drive the car only if the test subject believes there is a realistic possibility of actually passing the traffic light.



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.

Choose a random road with a traffic light and create the following circumstances:

- Situation 1: Do not alter the environment (zero measurement). Let the test subject drive the car normally.
- Situation 2: Place a giant huge glass shopping window (height 20 meter x width 30 meter) between the car and the traffic light, close to the car.
- Situation 3: Place a giant huge glass shopping window (height 20 meter x width 30 meter) between the car and the traffic light, close to the traffic light.
- Situation 4: Place a giant huge glass shopping window (height 20 meter x width 30 meter) between the car and the traffic light, at any random position P.

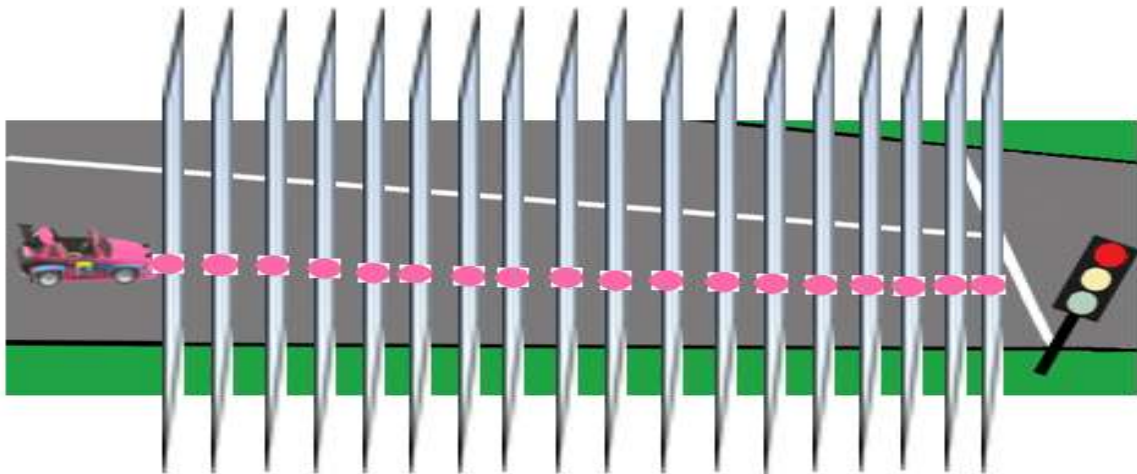


Images: In situation 1 a test subject will normally drive the car toward the traffic light. In situations 2 and 3, where a giant glass storefront is placed between the car and the traffic light, the test subject will not start a driving action with the intent to pass the traffic light. This is because there is *one* (!) position P that is perceived as blocking the car.

Conclusion:

In situation 1, you and/or the test subject will just drive the car towards and cross the traffic light. In situations 2, 3, and 4, you and/or the test subject do not initiate a movement action with the intent to actually pass the traffic light. Situations 2 and 3 do not provide significant insight on their own, but situation 4 clarifies everything. Whether the giant glass shop window is placed near the car or near the traffic light makes no difference to the test subject. If there is a large shop window anywhere clearly

present, the test subject will not initiate a car driving action with the intention to end up across the traffic light. This applies to every conceivable position P of the shop window, from the very first position $P(0)$ near the car to a shop window occupying the last position $P(n)$ just before the traffic light.



Situation 4

Image: In situation 4, it becomes clear that prior to the actual execution, we consider all consecutive *future* (!) positions of the car. It doesn't matter where the shop window is positioned between the car and the traffic light; the 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 driving action, we first form a perceptual image of the entire latent action trajectory shape before we actually execute anything.

This means that we assess every position $P(0-n)$ between the car and the traffic light beforehand, clearly determining whether each position P allows the car to pass through so that it can ultimately cross the traffic light. 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 car and the traffic light beforehand if that specific position $P(x)$ is also allowing the physical dimensions of the car 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 car driving action, we first form a perceptual image of the entire latent action trajectory shape out of the perspective of the car before we actually execute anything.

Part 3 - Car driving requires a compelling coupling of a secondary (internal) focus to a primary (external) focus - Driving and bicycling encompass identical perception processes



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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, spoon, needle, key, tennis racket, ball, letter, pointer (pc) etc.) that we hold during an action, and even though the fingertips, during a grasp action with the hand on the outside, consist of living cells, we absolutely aren't capable of moving them there. The explanatory model unequivocally shows that initiating the movement of an action object outside our body is only possible by using secondary perception of autonomous movements within our body.

Compared to the current state of science, the explanatory model represents a revolutionary breakthrough, revealing that two foci must enter into an obligatory connection simultaneously, and this universal stacking of two perceptions of two autonomous movements occurs in every motor movement action. They are clearly autonomous because they belong to two incompatible worlds. Observations of movement inside and outside the body are actually never able to overlap.

This article focuses entirely on car driving. It presents compelling evidence that only the car c.q. the movements of the car itself, akin to a marble in a marble run, executes this action trajectory shape, thus accomplishing the task's essence. For this reason, primary attention must be directed towards the external movement of the car. The car can only be set in motion by entirely different movements within the body that only extend to the outer part of the steering wheel and the pedals of the car. The

attention required for this must serve the main objective, hence referred to as the secondary (internal) focus.

What makes this publication particularly remarkable is that it vividly demonstrates that driving and cycling⁷ require identical perception processes. In both actions, the steering wheel can only correct deviations in width (zigzag process) of the action trajectory shape. The pedals, on the other hand, can only mediate the length (accordion process) of the action trajectory shape⁸.

Furthermore, the explanation shows that all conceivable motor actions are based on these same two foci. Due to this universal nature, the explanatory model creates the most ultimate conceivable ecological argument. The article does not delve deeply into the differences with the current state of science because there is still no clear consensus on this subject within the scientific community.

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



Images: Car driving solely encompasses moving oneself from point A to point B using a car. The essence of this task is exclusively carried out by the autonomous movements of the car, making it the primary process we need to observe. In this process, the car follows an action trajectory shape akin the movement of a marble within a marble run. In any imaginable motoric movement action, the current position of the marble c.q. the action object will serve as the precise demarcation between the manifest and latent parts within the action trajectory shape. It is abundantly clear that the fairground ride car will never start moving on its own, hence there will never arise a need to perceive an action trajectory shape within a primary focus.

In abstract terms the egocentrically formulated will while car driving encompasses the movement from A to B⁹. In relationship to this egocentric formulated objective the explanatory model demonstrates that solely the car, or rather the movements of the car, will execute the essence of this task, thus constituting the primary focus within this action. In addition the explanatory model provides scientific evidence that any motoric movement action comprises two subsequent autonomous phases. In the first, a tactical consideration aims to establish a perceptual image of a latent action trajectory shape in which, in this case, the car or the movements of the car will most likely succeed in the intended action. Only then does one proceed to the factual execution of the action. So when we subsequently are going to

⁷ https://www.researchgate.net/publication/372941732_Bicycling_versus_a_hometrainer_-_Bicycling_encompasses_the_obligatory_linking_of_a_secondary_internal_focus_to_a_primary_external_focus_A_hometrainer_solely_requires_a_secondary_internal_focus?_sg%5B0%5D=1cZ83Nb97Cyy3ERNuh-wMcxHKMj8aTXzogT7YwT7keZ1vz_Wl6B7Mkg6A3S5D7N70DAN1oZxF2hBBMora5u7fViQy7LC66ppv1UVavBh.qO6avdVwJfKaRh5s5iw3ZGb7OG-Qsa1XBjt-SPUR1M71YjzVsTrjvTfDwy81Xb4Io749jHtZ8WE1xFz26YKYBEQ

⁸ Upcoming publications will precisely explain how the cortical streams mediate those two autonomous phenomena separately.

⁹ The explanatory model defines all actions in which the primary egocentric objective involves a distinct movement from A to B as motoric movement action *moving A-B*. This encompasses activities such as walking, cycling, sailing, swimming, boating, skiing etc. etc..

carry out the action, we fill in that perceptual image of the latent action trajectory shape with the car. Therefore, within the primary focus, this is the essential process our perception processes must guide, a process that science has entirely overlooked thus far. Subsequent articles will reveal that filling in the action trajectory shape by the car yields the crucial *tau*-value to which the secondary focus is compellingly linked and will be explained how the cortical streams mediate this process.



Images: The explanatory model demonstrates that within every conceivable motoric movement action, an autonomous internal focus must be pointed at an autonomous external focus. It thereby provides insight into the scientific evidence that we just aren't capable to produce an identical action trajectory shape, as it involves a stacking of two perceptual images of autonomous movements that belong to two incompatible worlds. For example, you have never taken hold of a coffee cup in an identical manner, or performed a free throw in basketball in an identical way. In the same vein, you will also never be able to produce identical forms of action while driving a car c.q. you will never be able to drive one meter in an identical manner.

Maybe we do construct perfect straight action trajectories when we create (latent) perceptual images of the future positions of the car within a driving action. However, due to the fact that you can only execute the movement of the car with the perception of an entirely different autonomous movement, the car will inevitably deviate from that "*perfect*" original pre-perceptual image at every position P within the action trajectory shape. 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 time¹⁰. As a result we can never perform one motor action identically (conform Bernstein) and the car will always follow a different zigzag pattern while driving.

The secondary focus within car driving encompasses the perception of movement inside the body

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

¹⁰ 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

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.

When driving a car, as is the case with cycling, one must translate this into two autonomous processes. The width of the action trajectory shape (zigzag process) can only be mediated by the steering wheel, and the length of the action trajectory shape (accordion process) can only be mediated by the (foot) pedals. In the case of the steering action, we can only haptically perceive (the outer surface of) the steering wheel with (the outer surface of) our hands. In the case of the pedal action, we can only haptically perceive (the outer surface of) the pedal with (the outer surface of) the soles of our shoes. Then, we can only proprioceptively¹¹ perceive how movements within our body influence the haptic contact between the hand/steering wheel and sole/pedal, respectively.

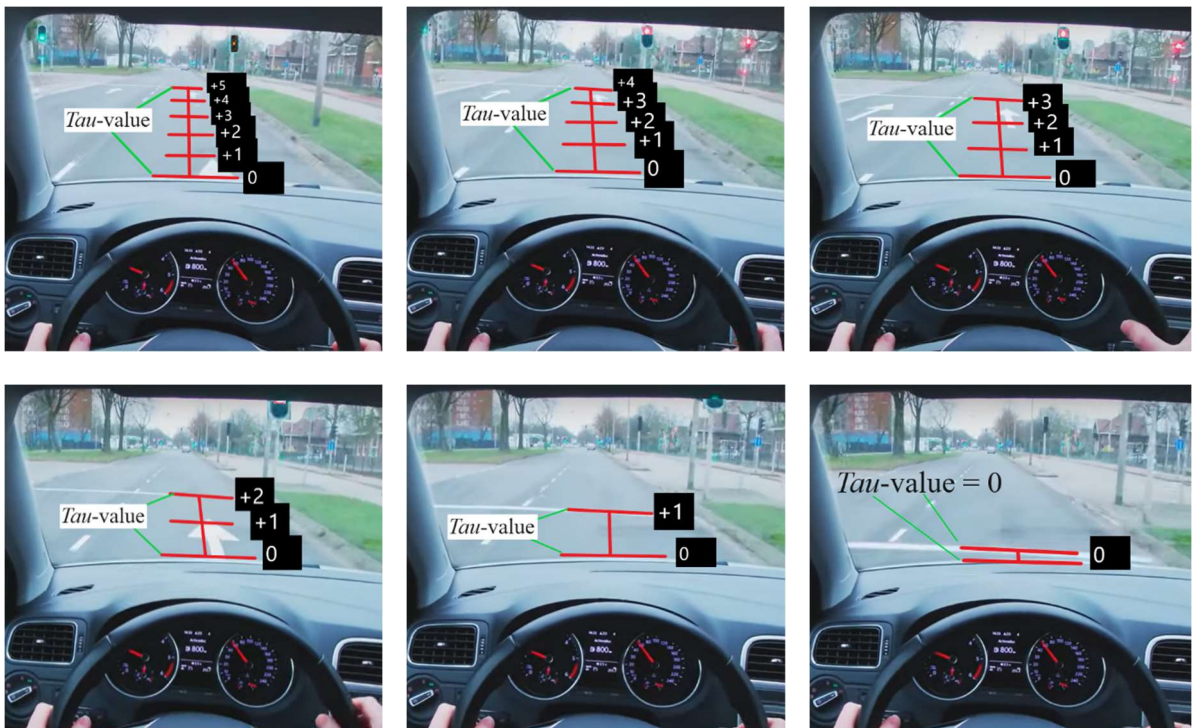


Images: Within this article, it must, of course, become entirely clear that driving and cycling demand exactly the same functional perceptual processes. The steering wheel can only adjust the action line form in width, and the pedals can only adjust the action line form in length.

Also within car driving, the essence of the task is implicitly linked to the observation of the primary focus. This often results in us being unaware of the secondary focus during many motor actions, particularly because these are frequently simple observations. However, in highly complex motor actions such as a tennis serve, attention is exclusively directed towards the secondary focus (the serving technique), completely disregarding the fact that the primary focus involves creating an outgoing ball trajectory (OBT). With some practice, you can consciously perceive the two foci simultaneously within many motor actions as well as within car driving. If you frequently change cars you will have to reset the secondary (internal) focus towards the primary (external) focus constantly.

¹¹ Scientific research has demonstrated that proprioceptive perception encompasses two autonomous phenomena, namely: 1. *Limb Position* (LP) and 2. *Movement* (M). The explanatory model clearly illustrates this within the context of car driving as well. LP is linked to the overall car driving technique, while M pertains to the specific point where this overall perception needs to be transferred to the steering wheel and to the pedals.

Part 4 - The external primary focus within car driving solely encompasses the movements of the car - Within any imaginable motor action the essence of the task is solely executed by the action object



Caught In A Line

The explanatory model of all motoric movement actions

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September 2023 ©

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Introduction

Traditionally, science has assumed that one motor action corresponds to one focus. This assumption was likely so intuitive that it was never challenged. However, this has led to the situation where, even after more than 100 years of movement sciences, a plausible explanation for the underlying functional perception processes guiding the execution of all motor actions had never been found.

In contrast, in 2016, an explanatory model emerged that has the capability to identify all functional perception processes within any imaginable motor action. It demonstrates, beyond any reasonable doubt, that each motor action can only be executed through a mandatory coupling of two foci: an internal (secondary) focus that must always be directed towards an external (primary) focus. In which it should be explicitly noted that these two foci represent entities that fundamentally differ from current scientific terminology.

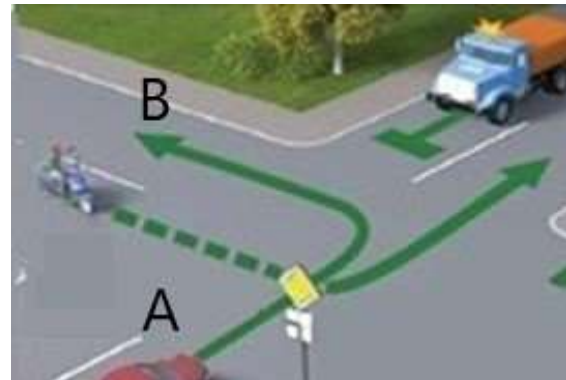
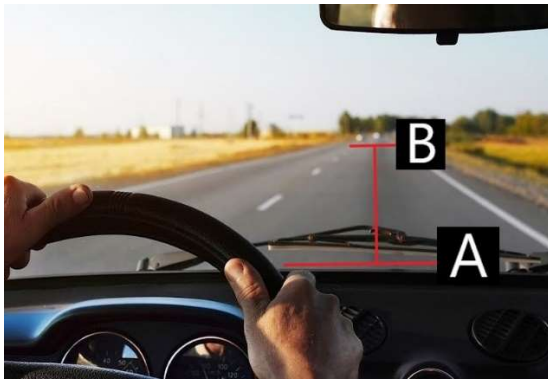
With regard to the external (primary) focus, it can be noted that science has, until now, truly missed everything. Therefore, it is being explained within a wide spectrum of motor actions, and this publication now reveals all facets of the primary focus within the motoric movement action *car driving*. It's a unique type of motor action and, like bicycling, walking, rowing, skiing, skating, swimming, etc., falls under those actions where the entire body will move from a random position A to a random position B. So within car driving, the car and the driver together will form the action object as a whole, and this results in a significant and fundamental change in perception. When reaching for a coffee cup, moving a pointer to an icon on a desktop, or writing, you see the action object (respectively the fingertips, the pointer and the tip of the pen) moving outside of yourself. In which it must become crystal clear that you perceive the action trajectory shape from the outside in these cases. In contrast, when driving a car, you yourself, along with the car, become the action object as a whole, and as a result, you perceive the action trajectory shape from the inside of the action. Just as you can observe a bobsled within a bobsled track as a spectator, you now become the bobsledder yourself. Which is exactly the same when you observe a marble within a marble run.

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

The category of motor actions discussed by the explanatory model pertains the conscious actions where it is assumed that there is always an initial formulation of an egocentric intent (an egocentric formulated will). Before picking up a coffee cup, for instance, there is always the desire to do so. The explanatory model of all motoric movement actions recognizes this as an undisputed factual aspect but adds a caveat. The egocentrically formulated intent does not, for example, concern picking up the coffee cup itself. The explanatory model reveals that this is factually incorrect and that we can only move our fingertips toward the coffee cup. Therefore, the movement of the fingertips toward the coffee cup constitutes the essence of that action.

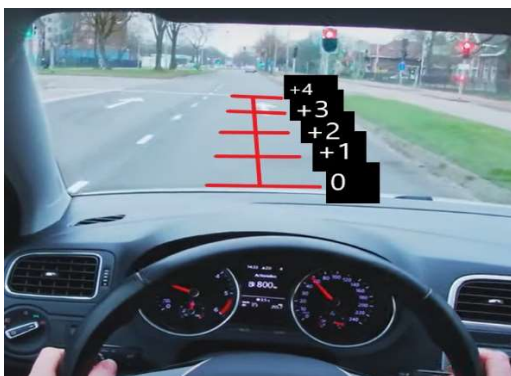
In the context of car driving, we may indeed have a strong desire to go home, but the egocentrically formulated goal pertains solely to moving the car along an action trajectory shape towards home. Only that aspect determines the essence of the task assignment, and therefore, only that aspect should be considered as the external (primary) focus.

The tactical movement action (TMA) within car driving



Images: Firstly, an egocentric intention must be formulated, indicating that we want to move our car from position A to position B. Then, starting from the current position of the car, we first establish a perceptual image of a latent action trajectory shape between position A and position B (left). This occurs as part of a tactical action where two important goals are considered. Firstly, it should lead to a successful action, and secondly, ecologically evolved organisms aim to execute actions as parsimonious as possible. The traffic situation (right) further underscores this tactical consideration. Although it might appear, due to the mere presence of other road users, that we wouldn't create a perceptual image of a latent action trajectory shape without them because then there are seemingly no obstacles present, this is categorically incorrect. The tactical consideration is not focused on other road users but solely on the "empty" positions P within the traffic situation where the car can move without obstruction. Therefore, our visual perception always focuses on positions P where there is nothing to see, as all such positions can guarantee unobstructed passage for the car.

The explanatory model of the motoric movement action demonstrates that after formulating an egocentric goal, we always engage in a tactical consideration¹², prior to any execution, to determine how we can bring the action object to the goal location within successive positions P. Within the current action, we always first create a perceptual image of a latent action trajectory shape over which the car can be successfully moved from position A to position B.



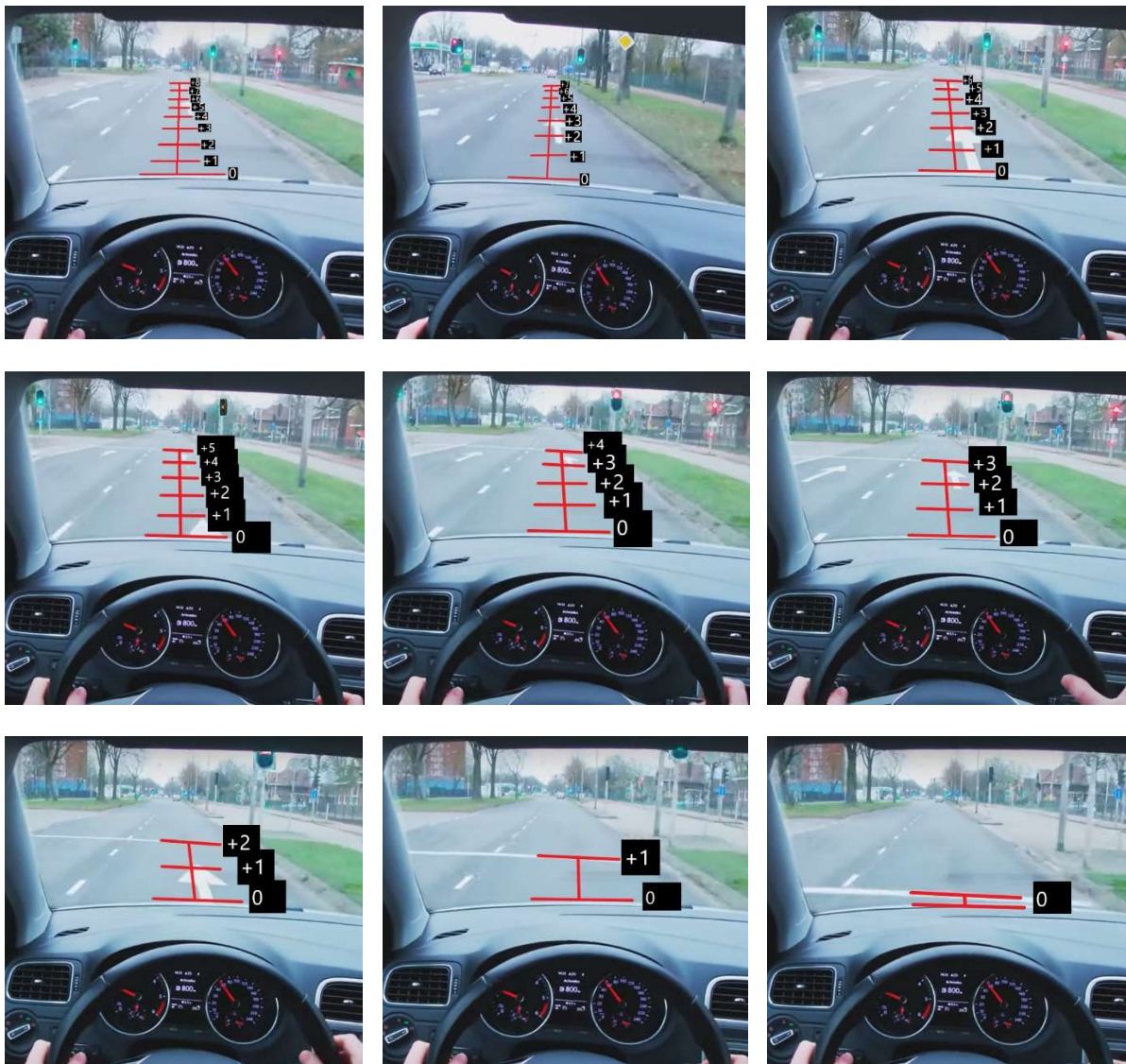
Images: It's not straightforward to display an animation that precisely represents the perceptual image of the latent action trajectory shape that is being constructed. The image on the left illustrates the

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.*

shape of the line, clearly showing all contiguous positions P being considered. However, it doesn't demonstrate that within the construction of the action trajectory shape, all dimensions of the car are also taken into account, as shown in the image on the right. It's possible that the perceptual image we construct in advance of the action trajectory consists of a hybrid mix of these two animations.

The factual movement action (FMA) when stopping a car at a traffic light

After establishing a perceptual image of a latent action trajectory shape, we proceed to execute the action, starting with bridging the actual position $P(0)$ of the car to the next position $P(+1)$ within the action trajectory shape. Although our ultimate goal is to come to a stop neatly in front of the traffic light, the explanatory model clearly illustrates that during this phase, our perception processes are primarily focused on bridging the empty space between the car and the stop line c.q. between the animal and the environment (Gibson¹³). So essentially, on a micro-level, only the positions $P(-1)$, $P(0)$, and $P(+1)$ are relevant to us during this bridging phase.



¹³ With this observation, the explanatory model of the motoric movement action finalizes J.J. Gibson's *The Affordances Theory*. In addition to the organism, Gibson introduced the second essential entity of the environment. However, he was missing the finalizing third entity of the action space between the organism and the environment.

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 car driving

With the preceding argumentation, the explanatory model of the motoric movement action now provides a comprehensive and universal explanation of how perception is linked to the action within any conceivable task. The animations in the previous section illustrate that the action object maintains a fixed relationship with the perceptual image of the action trajectory shape. This becomes easier to comprehend when envisioning a marble in a marble run. In this analogy, you will become much more aware that the perception-action coupling is one unified c.q. one complete phenomenon where only a single change occurs every ongoing time span. Within the marble run it becomes quite visible that during the actual execution, each position $P(0)$ serves as the precise separation between all already manifested positions $P(-x)$ and the latent positions $P(+x)$ yet to be traversed.

Through this explanation of the perception-action coupling, the explanatory model can precisely demonstrate how organisms must have evolved within an ecological framework. However, delving into this subject exceeds the scope of this publication. Instead, several crucial points will be highlighted concerning the functional perception processes within this motor action.

It's imperative to recognize that while the ultimate goal is to finally arrive at that random position B, 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 of the car between position A and position B are equally significant.

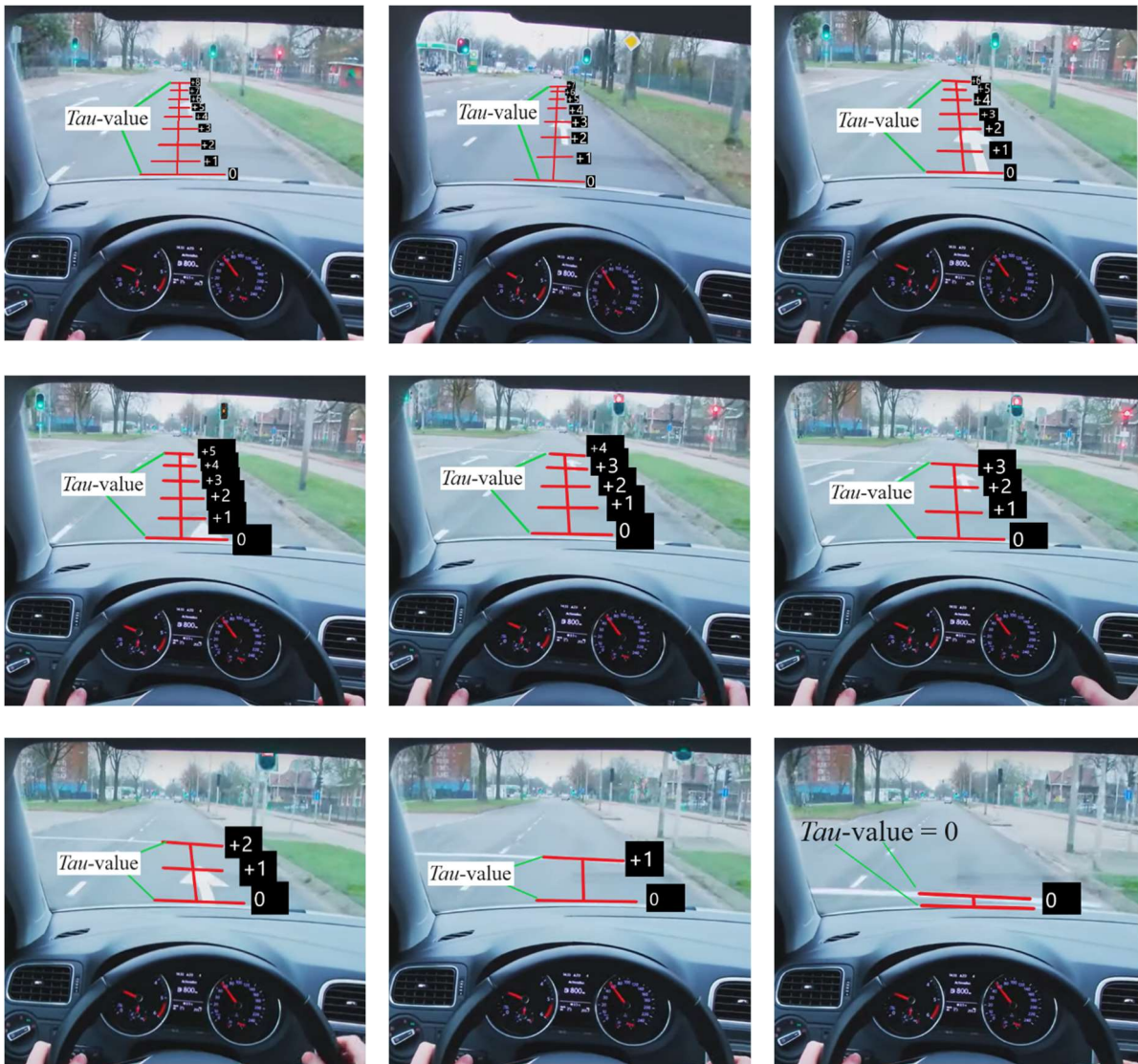
Additionally, it must be remarked that the action of the car at $P(0)$ can be perceived distinctly, yet no fixed unit of time can be attributed to it. Each unit of time can be divided into a thousand smaller units, and these units can be further subdivided, leading the explanatory model to argue that 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 actual car position solely gains meaning through the adjacent future "*actual*" positions $P(+x)$ and the adjacent manifest "*actual*" positions $P(-x)$ of the car. 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 (perception-action) 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. Without each other, they, therefore, have no meaning, and we would never, under any circumstances, be able to execute any motoric movement action.

The τ -value in relationship to stopping a car at a traffic light

The explanatory model of the motoric movement action demonstrates with the aforementioned perception-action coupling that the perception of each position of the car c.q. the action object within the action trajectory shape is equally important. However, as the car approaches the end of the action trajectory shape, the task c.q. the egocentrically formulated goal starts to become finalized. Within any imaginable motor action, the action object will universally traverse the action trajectory shape until there are no latent positions P left. Within his τ -coupling theory, D.N. Lee referred to this phenomenon as the closing of the gap c.q. as the τ -value approaching to zero.



Images: Within the perception-action coupling, the car 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 car, the *tau*-value will decrease, until it eventually approaches zero c.q. becomes zero.

The perception of the *tau*-value when stopping a car at a traffic light

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 car is approaching the traffic light, the perception within the internal focus, or more precisely, the perception of the movements of the brake pedal, must take responsibility for slowing down and adjusting the car's movement in such a way that it ends up neatly behind the stop line.

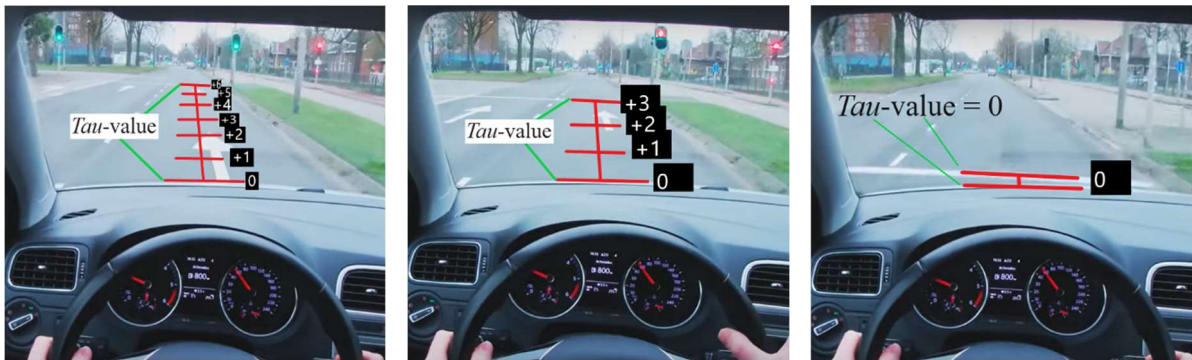
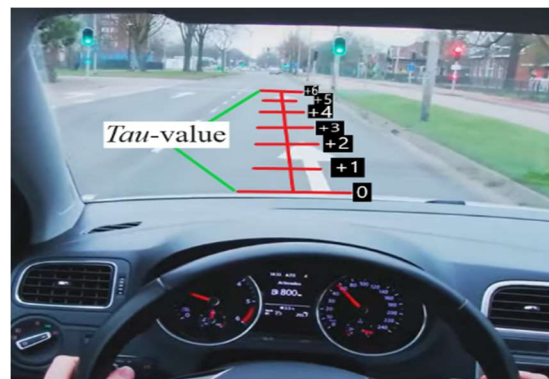


Image: The *tau*-value can be perceived in two autonomous ways. You either can observe how the manifest action trajectory shape takes over the latent trajectory shape, or you can observe at an even more fundamental level at what speed the latent (red) part of the action trajectory shape disappears. In which you essentially only perceive how the latent "gap" closes.

The perception of the *tau*-value approaching zero can be observed in two autonomous ways. The first method involves filling in the perceptual image of the entire latent action trajectory shape with the manifest positions P of the car. The other method is even more basic in its perception of the *tau*-value. Unlike the first method, it is solely based on the disappearance of the latent positions P from the perceptual image of the entire latent action trajectory shape. In this case, imagine that in the animations, you are only perceiving the speed at which the gap c.q. the red line between the car and the traffic light is closing.

Part 5 - The execution of an external action trajectory shape along which the car moves dictates all internal sensorimotor perception processes; The *tau*-coupling process when car driving demonstrates that we absolutely do not need a motor plan



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Introduction

When we want to drive with a car from point A to point B, the explanatory model of the motoric movement action has demonstrated that solely the progressive movement of the car embodies the core of the task and of our egocentric intention. Within there scientific evidence has been provided that, prior to the actual execution of any conceivable action, we first create a perceptual image of an entire latent action trajectory shape over which we can successfully move (all the dimensions of) the action object¹⁴, in this case, the car, to point B¹⁵.

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 zero¹⁶.

So, although the explanatory model demonstrates that the perception of the movement of the action object within the perceptual image of a latent action trajectory shape encompasses an autonomous phenomenon and thus exclusively is going to perform the essence of the task, the explanatory model also clearly shows that the action object itself absolutely isn't capable to move. Even when grasping with the fingertips, the explanatory model shows that the movement of the fingertips along an external

¹⁴ 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.

¹⁵ 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

¹⁶ https://www.researchgate.net/publication/374145230_The_external_primary_focus_within_car_driving_solely_encompasses_the_movements_of_the_car_-_Within_any_imaginable_motor_action_the_essence_of_the_task_is_solely_executed_by_the_action_object

action trajectory shape on the outside of the body can't be moved by the outside of the fingertips themselves. So even within grasping, the movement within the external (primary) focus can only be executed with movements that must always be perceived within the body, within the internal (secondary) focus. In the current action, where a car moves well outside the body, this insight will be easily recognized, and it will also be straightforward to determine that the car can only be moved along an external action trajectory shape using movements within the body that extend only up to the pedals and the steering wheel^{17,18}.



Images: The explanatory model of the motoric movement action shows, beyond any reasonable doubt, that there is no need for a motor plan to initiate an action. It demonstrates that all sensorimotor perception processes within the internal (secondary) focus simply need to follow the lead of the external (primary) focus. This clarification, which does not require any hierarchy, underscores our freedom from being tied to specific sensorimotor movements and this perspective is in perfect alignment with an ecological approach to motor actions. The distinction between driving oneself and accompanying as a driving instructor provides scientific evidence that perceiving the *tau*-value, within the external (primary) focus, constitutes an autonomous phenomenon.

In summary, this leads to the conclusion that the phenomenon of the perception-action coupling is solely related to the perception of movement within the external (primary) focus. Only within this focus, a perceptual image, consisting of the future positions P of the action object, is filled by the upcoming actual positions of that exact same action object. Also, only within this focus, the *tau*-value can be perceived. This publication now explains how the perception of the *tau*-value should be linked 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 action object and the end goal¹⁹ gradually approached zero and eventually completely disappeared. While Lee's discovery

¹⁷ https://www.researchgate.net/publication/373050218_Car_driving_requires_a_compelling_coupling_of_a_secondary_internal_focus_to_a_primary_external_focus_-_Driving_and_bicycling_encompass_identical_perception_processes

¹⁸ 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.

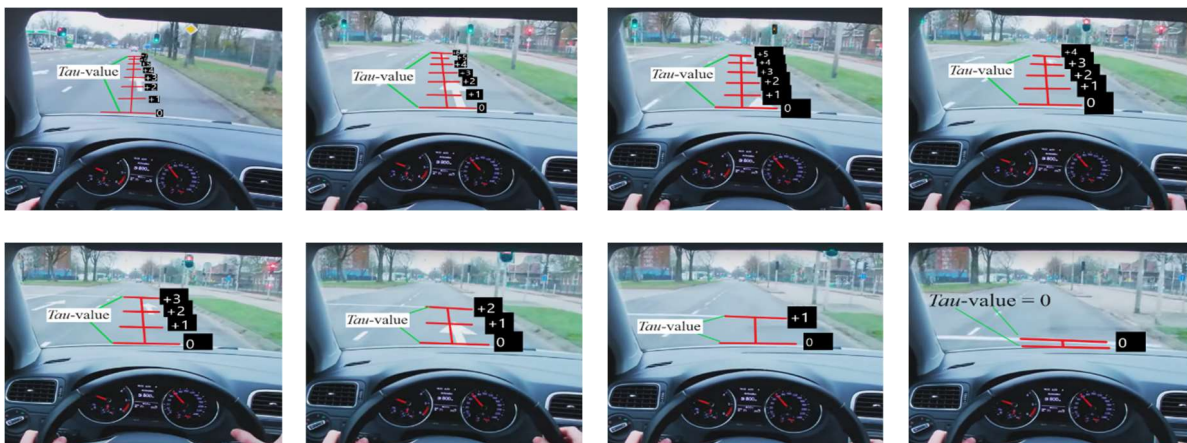
¹⁹ In the original work, examples include a long jumper leaping towards the take-off bar, a Northern Gannet diving toward the water surface, and a bee heading towards a flower.

generated significant interest in the scientific community, a major breakthrough remained elusive. Lee connected this crucial *tau*-value to various irrelevant other possible *tau*-values without realizing that multiple foci could be distinguished and linked within one single motoric action.

However, this insight proved to be highly relevant for the explanatory model of the motoric movement action. By understanding that the movement of an action object along an action trajectory shape outside the body is a completely autonomously observable phenomenon, and can only be executed by a completely different autonomously observable phenomenon within the body, it is now possible to explain precisely which phenomena should be connected and how the *tau*-coupling is established. The perception of the *tau*-value approaching zero within the external (primary) focus should ultimately guide the observations within the internal (secondary) focus.

The *tau*-coupling when driving a car from A to B

When we create an egocentrically formulated intention to move from A to B in a car, point B is often at such a distant location that after a short, probably slightly slower initial phase, the car must first cover a relatively long distance in which apparently nothing happens. Although the explanatory model of the motoric movement action conversely shows that bridging this apparent "nothing" by the car indeed requires many of our perception processes, with the cortical streams playing a crucial role, the egocentrically formulated intent will only be finalized at the end of the action trajectory shape.



Images: Before we actually move a car from point A to point B, a perceptual image is always created of a latent action trajectory shape along which all dimensions of the car will be able to reach point B successfully. Within these images, it is evident that only the movement of the car fills in this action trajectory shape, and consequently, only the car accomplishes the essence of the task. When, within the perceptual image of the action trajectory shape, there are almost no latent positions P left c.q. when the *tau*-value approaches zero, the action will be finalized, and the internal sensorimotoric movements towards the (pedals and the steering wheel of the) car must be adjusted in such a way that it neatly ends before the stop line of the traffic light.

So, while it may appear that only the end of the action trajectory is crucial, the explanatory model is clear: the perception of every position between A and B 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 as well.

However, the successful completion of the end phase is also crucial for a task to succeed. This success hinges on perceiving that the *tau*-value, within the external (primary) focus, is approaching zero. Then, within the internal (secondary) focus, adjustments to the car's brake system need to be made so that the car comes to a smooth and uniform stop before the traffic light's stop line. Ergo, in many motor

actions, it can be concluded that, after a phase of relative acceleration during the bridging phase, a relative deceleration of the action object occurs as the end of the action approaches²⁰.

The perception of the sensorimotoric movements when operating the pedals and the steering wheel within the internal (secondary) focus in relationship to the *tau*-coupling process

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 out of each other c.q. that all those positions P will always be interconnected²¹. 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 other²².

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 seeing what external results they would have, the explanatory model asserts that these roles have now been entirely reversed. When driving a car, we mainly perceive, within the external (primary) focus, the forward movement of the car and guide its progression with motor movements within the internal (secondary) focus, which extend only to the outer surface of the pedals and the steering wheel.

Thanks to this new paradigm, the explanatory model of the motoric movement action is now capable of identifying all functional perception processes within any conceivable motoric action, thus enabling it to describe all sensorimotor perception processes within any conceivable motoric action. In this section, a list of the most crucial insights will be outlined, with a focus on challenging many prevailing assumptions within the scientific community.

a. Visuomotoric perception processes

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. All action 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.

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^{23,24}. 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 proprioceptively²⁵.

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 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

²³ 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.

²⁴ 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.

²⁵ 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

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 brevity²⁶. 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 a car from point A to B²⁷. To perceive the *tau*-value, all you need to do is register the speed at which the latent part of the perceptual image of the entire action trajectory shape disappears. Essentially, this amounts to a straightforward observation of the disappearance of a two-dimensional line segment.

Subsequently the explanatory model reveals that the internal (secondary) focus can align itself with the external (primary) focus as a whole, without any rigid hierarchy. This simplifies the observation of the *tau*-coupling process to such an extent that, within an ecological framework, it's hard to surpass and which concept can also be applied to the earliest organisms.

²⁶ 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.

²⁷ https://www.researchgate.net/publication/373876147_When_driving_a_car_the_essence_of_the_task_is_executed_solely_by_the_external_movements_of_the_car_within_an_action_trajectory_shape_The_perception-action_coupling_within_the_primary_focus_produces_th

f. Sensorimotoric movements toward the outer surface of the pedals and the steering wheel are proprioceptively perceived

The explanatory model clearly demonstrates that the internal (secondary) focus is exclusively perceived within the body and therefore excludes any visual perception. The internal (secondary) focus can only be perceived proprioceptively. Driving a car is a particularly unique action because it unveils the two autonomous functions within the internal (secondary) focus so vividly. Within car driving solely the pedals can mediate deviations along the x-axis of the action trajectory shape, while the steering wheel, vice versa, can do so only for deviations along the y-axis of the action trajectory shape. So the proprioceptive perception regarding the x-axis encompasses all internal sensorimotor activity which in the end will ensure that the soles of our shoes will cause the outer edges of the pedals to move. In contrast, proprioceptive perception concerning the y-axis encompasses all internal sensorimotor activity which in the end will ensure that the palms of our hands will cause the outer surfaces of the steering wheel to move.

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. In broad daylight visual perception processes may dominate, but proprioceptive perception processes will never disappear and so will always be present in some hybrid form. So actions we perform during the day with relatively many visual perception processes are always executed proprioceptively as well. Within the internal (secondary) focus, it is no different. You can quickly realize that you can make the pedals or the steering wheel in a car move with various types of body actions. In which, in short, you may have developed your own preferred motor skills, 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 and will never strive to do so.

h. Optimization process

The explanatory model of the motoric movement action demonstrates that a motor action can only be executed by the stacking of two autonomous foci and shows within the previous paragraph that the perception of movement within the internal (secondary) focus is inherently of such a high complex nature that it will definitely prevent the occurrence of an identical internal configuration to occur.

Consequently this will cause that the action object is capable to and definitely shall deviate from the perceptual image of the latent action trajectory shape at each progressing point P and even though the cortical streams ingeniously mediate this process, it is empirically evident that an identical execution of any action trajectory shape is unattainable. This unequivocally portrays that performing any conceivable action can only be viewed as an optimization process. Hence, you will never be able to make

a car 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 explain these phenomena in a way that is understandable to everyone, these aspects are primarily discussed within the context of the present motoric movement action. This is because driving a car essentially embodies 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.

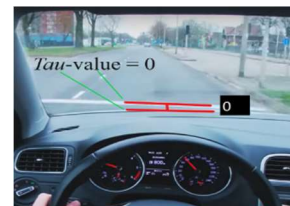
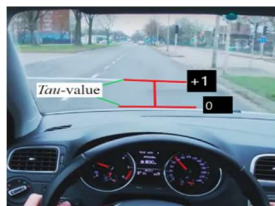
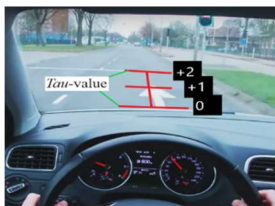
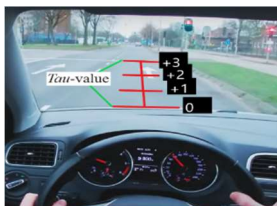
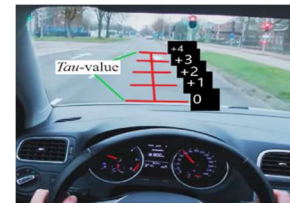
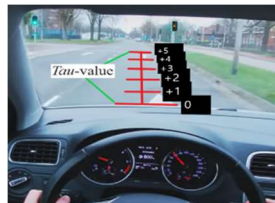
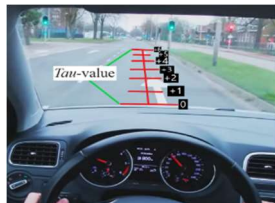
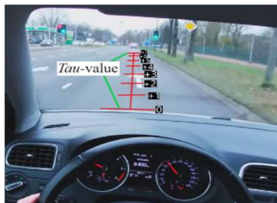
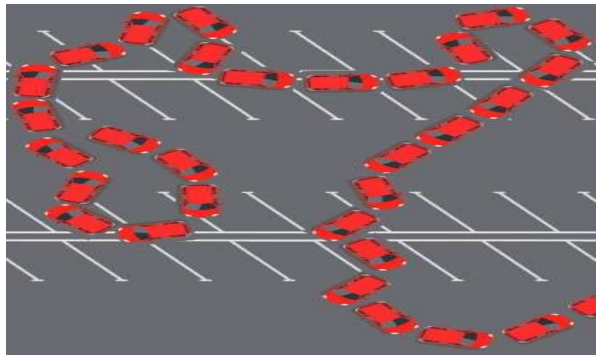
When driving a car, it becomes immediately evident that one can exclusively influence the movement within the shape (!) of the action trajectory with the steering wheel. This defines the explanatory model as mediating the deviations in the y-axis. Additionally, it should also become immediately clear 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-axis²⁸. So, when driving a car, it becomes crystal clear that perceiving (and controlling) the shape has absolutely nothing to do with perceiving (and controlling) the line. In which it is essential to mention that perceiving the filling of the latent line (within the x-axis) by the manifest places P of the action object within the external (primary) focus solely involves the *tau*-value which within car driving is solely executed by the pedals. Solely the speed with which the line is filled determines the duration of the action c.q. determines the finalization of the action.

The explanatory model of the motoric movement action demonstrates that the perception of movement within the internal (secondary) focus contains the same x- and y-axis components in any conceivable action. 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

²⁸ The same explanation naturally applies when considering a bicycle with coaster brakes.

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.

Part 6 - Within car driving the transitioning from random motor activity to the execution of deliberate actions demands shifting the internal and external focus; Scientific evidence of the origin of two autonomous foci and how their roles have evolutionarily reversed



Caught In A Line

The explanatory model of all motoric movement actions

N.J. Mol
December 2023

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 common task of car driving where, by the means of a car, one must move from position A to position B²⁹. 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, car driving is fully explained in relation to general motor activity. In contrast to the first part, the second part addresses deliberate c.q. specific actions where an egocentrically formulated intention is created to move a car from A to B. Two action strategies are highlighted in this part, logically stemming from the general motor activity mentioned in the first part. The concluding part emphasizes the relationship between the discussed motor activities and the explanatory model of the motoric movement action.

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

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

a. Basic exercise (passive arm without a spoon)

²⁹ Within the explanatory model, all motoric actions aiming to move the complete body from a position A to a position B (cycling, sailing, horseback riding, walking, rowing, etc.) are defined as motoric movement actions *moving A-B*. They all follow the same universal explanation.

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



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

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

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

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

- 1) While there is nothing predictable about where the passive arm will move, as random internal motor activity will always result in random or chance movements of the passive arm, there is, on the other hand, a very essential fact to note. All individual points/positions P of the arm will always have to be connected or 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 elbow³⁰, 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 shape³¹. 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 run³². 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 part of³³.

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, in fact, simply no escaping it.

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.

b. Basic exercise (passive arm with a spoon)

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



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

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

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

- 1) While there is nothing predictable about where the passive arm with the spoon will move, as random internal motor activity will always result in random or chance movements of the passive arm with the spoon, there is, on the other hand, a very essential fact to note. All separate points/positions P of the arm and all separate points/positions P of the spoon will always have to be connected c.q. will always have to emerge from each other. Once again, the three previously mentioned arm positions (the fingertips, the knuckles of the fist, and the elbow) will create a line segment shape, but also all the separate positions of the spoon also form separate lines. If you focus, for example, on the handle or the bowl of the spoon, you cannot escape the factual conclusion that all those points always move in a linear form, and that, too, always involves exact one (!) entire line segment shape³⁴. 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,

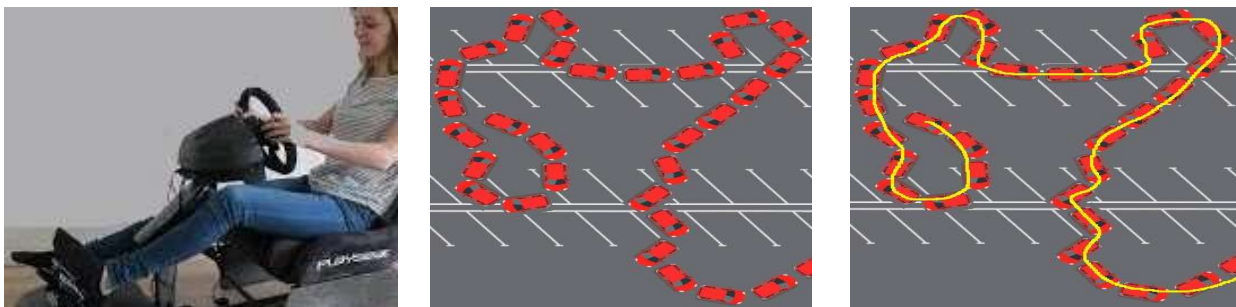
³⁴ Hence, you must also realize that when eating soup, where we typically focus on the movement of the spoon-bowl, all other mentioned body and spoon parts also move in line segment shapes. This demonstrates that the related perception processes are entirely subjective and depend on the chosen focus.

torso, head, foot action, etc.) has absolutely nothing to do with the observation of the line segment shape that all parts of the arm and now the spoon become a part of. However, the new aspect introduced by the spoon concerns the fact that a spoon is an inanimate object. What leads to the astonishing factual conclusion that, for instance, we can observe the movement of the spoon's bowl over a line, but we can only generate motor activity up to the 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. The basic exercise in relation to motor activity towards the pedals and the steering wheel leading to movement of a car across a parking area

If we define an action as a conscious motor activity in which a specific goal is pursued from an ego-centrally formulated will, the explanation in this paragraph falls outside the scope of actions. Within the basic exercise the focus is solely pointed at motor activity and it is now translated into a car driving environment where, due to the pedals and the steering wheel, a car is moved at a parking area.



Images: The basic exercise can be translated to a car driving task. Your primary attention should mainly be pointed at manipulating the exterior of the pedals and the steering wheel c.q. your attention must be directed towards proprioceptively perceiving the pedals and the steering wheel of the car and only incidentally (secondarily) notice how the car moves across the parking lot.

The basic exercise can easily be transferred to a displacement task A-B³⁵, such as driving a car. If you focus solely on internal motor activity, you will effectively observe that the car moves randomly over a surface. Once again, you can only factually determine that the actual position P (0) of the car must always stem from the preceding positions c.q. all positions P of a car are always connected in one linear form. However, two essential omissions should be noted in the animations: 1. Only a limited number of car positions are represented. If you engage in a few minutes of random motor activity, the entire parking lot would be filled with car positions. 2. The connection of successive positions P of the car cannot be captured in an animation. The perception of the car's movement involves a continuous (smooth) line of cars. The yellow line represents this continuous connection but does not show cars. Therefore, you need to create a hybrid representation, which you can only perceive by actually driving on a parking lot.

Conclusion basic exercise in relation to motor activity towards the pedals and the steering wheel leading to movement of a car across a parking area

³⁵ Within the explanatory model, all motoric actions aiming to move the complete body from a position A to a position B (cycling, sailing, horseback riding, walking, rowing, etc.) are defined as motoric movement actions *moving A-B*. They all follow the same universal explanation.

In tasks of this nature, where motor activity occurs far from the outer surface of the car, it becomes evident that you can (secondarily) move a car by solely focusing on an entirely different (primary) motor activity. This observation carries the following factual conclusions:

- 1) Although there is nothing predictable about where the car will move, as random internal motor activity will always result in random or chance movements of the car, there is, on the other hand, a very essential fact to note. All separate points/positions P of the car 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 car 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 car will always serve as the precise separation between all manifest positions $P(-x)$ and all future positions $P(+x)$.
- 2) Once again, the second highly essential conclusion follows the explanation as in the case of the other basic exercises. The perception of the movement of internal motor activity has absolutely nothing to do with the perception of the movement of the car within the line segment shape that all positions of the car become a part of.

The perplexing aspect of this realization may be the fact that the movement of the car over a line segment shape is entirely dependent on a completely different internal motoric movement solely reaching the outer surface of the pedals and the steering wheel. Without this source of action, the car will never move. Additionally, the confirming aspect of this realization may concern the conviction that the perception of the movement of the car over a linear form has absolutely no connection with the perception of internal motor movement activity.

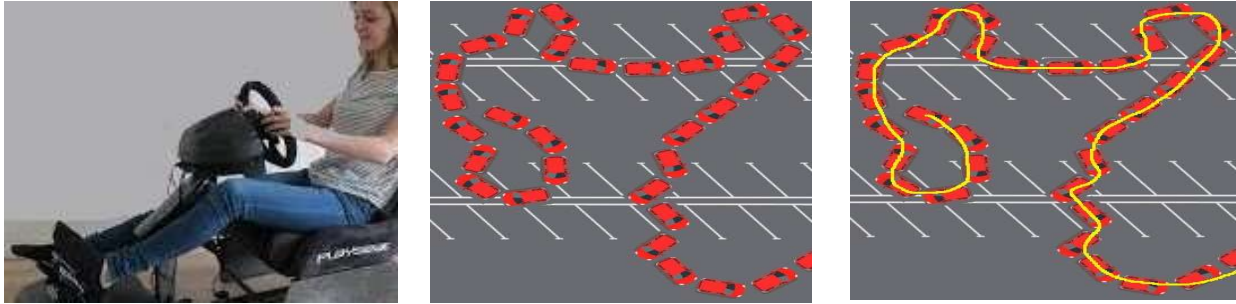
Part 2 - Internal motor (movement) activity when a deliberate goal-directed action is involved

The explanatory model of the motoric movement action encompasses the clarification of all functional perception processes within any conceivable action, assuming that these are conscious actions driven by an egocentrically formulated will, with a clearly defined specific goal. So, the motor movements in the first part specifically did not involve actions aimed at placing motor activity in a larger context. Conversely within the second part, general motor activity will now be translated towards specific motoric actions. Although the explanatory model of the motoric movement action is emphasized more in this part, the explanation within this section still aims to clarify the entire spectrum of motor (movement) activity.

So, within the second part we do assume deliberate actions where an egocentric will is formulated to achieve a specific goal and in this chapter the movement of a car from position A to position B encompasses the key issue. The basic exercise clearly shows that two possible action strategies c.q. execution perspectives can be pursued in this regard.

a. Execution perspective 1 – Primary focus on pedal and steering wheel movement and secondary focus on the movement of the car

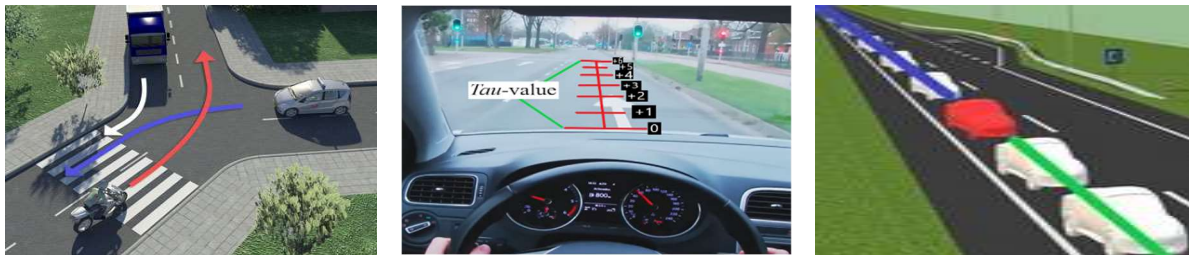
The basic exercise within the first part clearly demonstrates that with primary attention on internal motor activity, pointed at the pedals and the steering wheel of the car, we can randomly move a car (external) across a parking area. However, this random movement becomes a challenge when formulating the egocentrically expressed intention to move a car from a specific position A to a specific position B. With primary attention on internal motor activity, we might be able to make the car occupy lots of positions at a parking area in a few minutes, but it is far from parsimonious (efficient and effective). And that is even without considering whether, with the intense motor activity, causing the car to move relatively quickly, if you would be able to precisely bring the car to a standstill at that specific position B.



Images: Even when, within a deliberate action, one aims to move a car, it always compels a strategy to primarily focus on pedal and steering wheel activity and secondarily observe whether the car ever reaches an aspired goal. Although this approach might require a fair amount of luck and/or patience, it remains a possible action strategy. However, it is not particularly parsimonious within this car driving task.

b. Execution perspective 2 – Primary focus on the movement of the car and secondary focus on pedal and steering wheel movement

Contrary to the description of random motor activity within the basic exercises within the first part of this article and also in contrast to the previous action strategy, when it comes to the emergence of a conscious action, one can adopt a completely different execution perspective. It would be by far the most economical solution to conceptualize and construct an action trajectory shape between starting position A and end position B.



Images: It is most parsimonious to first construct a perceptual image of an (efficient and effective) latent action trajectory shape, along which the car can be successfully moved to position B, and then to actually execute it.

In the second execution strategy, the roles of attention are reversed. The primary focus now has the goal to track the progress of the car within the action trajectory shape, and this must be followed secondarily by motor activity. In which you now have to observe, similar to the basic exercise in the first part, that motor activity passively follows the primary focus.

It would, of course, be by far the most parsimonious execution strategy, but the reversal of roles requires significantly more cognitive capacity. While the first execution perspective allows for a straightforward initiation of the action, the second one demands the following essential cognitive skills:

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

Part 3 – General conclusion

The explanatory model of the motoric movement action is capable of appointing all functional perception processes within any conceivable action. However, its implementation in the scientific world encounters several challenges. It represents an entirely new paradigm and involves an explanation within a complex dynamic system where multiple new conceptual steps must be combined simultaneously. Therefore 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 car can be successfully moved from position A to position B prior to any actual execution. 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 computer³⁶, grasping³⁷ and throwing³⁸ 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 car within that perceptual image of a latent action trajectory. The mere quintessence of this article encompasses namely that motor activity is a completely autonomous phenomenon and although it has a direct causal relationship with the movement of the car within an action trajectory shape, the car will never be able to move by itself. So, we might be intensely motivated to reverse the roles of the primary and secondary focus and willing to construct and execute an optimal straight, ultimate parsimonious, action trajectory shape between position A and position B, but we will absolutely never be able to execute the action trajectory shape like that perceptual image due to the autonomy of the perception of both movements. The autonomous (mainly visual) perception of the movement of the car will certainly want to follow the perceptual image of the latent action trajectory shape, but the autonomous proprioceptive perception of the movement of the pedals and the steering wheel will actually ensure that the car will deviate at every point 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 car 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 on current

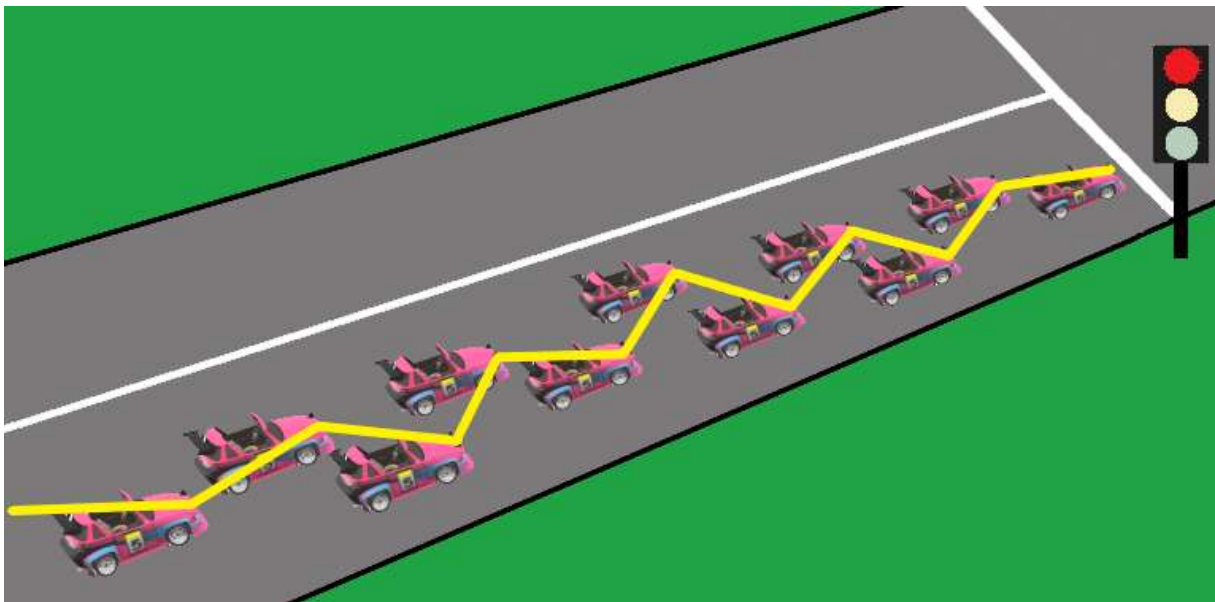
³⁶ <https://www.researchgate.net/publication/372719694> When moving a pointer on a computer screen you are mainly attentive to where 'nothing' is - The scientific evidence regarding visual perception within each motor action

³⁷ <https://www.researchgate.net/publication/372290282> Grasping encompasses two consecutive autonomous phases - The scientific proof that we tactically construct an action trajectory shape prior to the factual execution of that exact same action trajectory? sg%5B0%5D=cjBGD1Dj5IxR2T4se38lo9o1z_M-KwSU49eb_oQsTOUjibSgy5M67E9dyDJ2vYL6jmizvVBbPYrgk9NU6pmmALDQpNZJERFlrXLCWSXY.BBjj_0oQKGMN_JQZfSCEjGE1eN9IjRkkPyAjEjWlaxLJGM1U2MeX-LYMQPb3Fz_XmE18jNVnKKf8WfOSPcG4l1w&_tp=eyJjb250ZXh0Ijp7ImZpcnN0UGFnZSI6ImhvbWUiLCJwYWdlIjoicHJvZmlsZSI6InBvc2l0aW9uIjoicGFnZUNvb3RlbnQifX0

³⁸ <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

scientific literature, it asserts that there is a double and mutual relationship between the dorsal and ventral stream. In the present car driving task, the dorsal stream is mainly related to the processing of perceptions concerning the specific position of the car, 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 car relative to the action trajectory shape and vice versa. So, the dorsal stream mainly processes the position of the car, but this is always related to the action trajectory shape, and conversely, the ventral stream mainly processes the progression of the action trajectory, but this is always related to the specific position of the car.

Part 7 - The explanation of the emergence of the cortical streams - We can only guide a car towards a traffic light 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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May 2024

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Introduction

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

1. The scientific evidence showing that, as part of a tactical (ecological) consideration, we always first create a perceptual image of a latent action trajectory shape before we actually move a car from A to B.
2. The understanding of the necessity of a compelling collaboration between an internal and an external focus in every motor action. During car driving the movement of the car within the action trajectory shape can only be perceived outside the body and is solely caused by perception of movements within the body extending only to the outer surface of the pedals and the steering wheel. Due to their exclusive domains these perceptions are incompatible.
3. The assumption of the crucial role of the movement of the car over the action trajectory shape as the essence of the task within car driving, wherein the external focus must be hierarchically considered primary. This assigns a secondary status to the internal focus and demonstrates that no motor plan is ever conducted.
4. The explanation of how the primary focus generates the *tau*-value and how the secondary focus needs to obediently follow the development of that *tau*-value within a strict *tau*-coupling process, providing the first ecological explanation for anticipating all unexpected events during an action.
5. The insight that when we move the car towards a traffic light, it is mostly a subjective choice from the perspective of the car's front bumper³⁹. With the same motor action, all parts of our body and all other components of the car also move in a unique action trajectory shape. This demonstrates that in car driving, there is a causal relationship between the perception of internal and external movements, but an explicit relationship only emerges when we have “chosen” the front bumper while car driving.

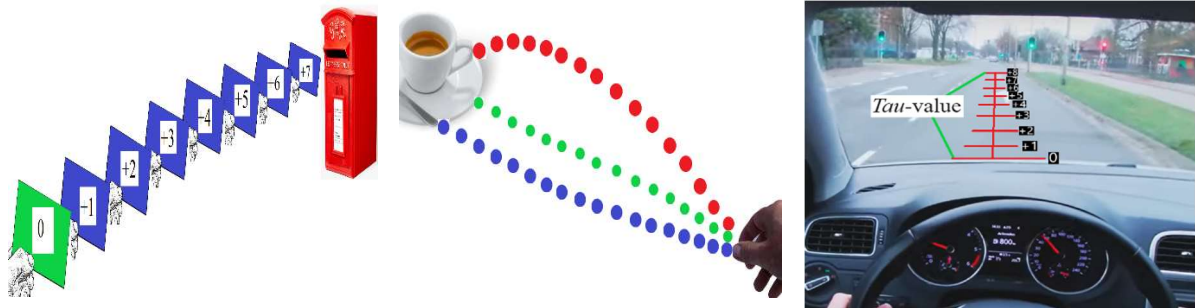
As a concluding step, this chapter delves into the functioning of the cortical streams when we aim to bring a car to a halt when approaching a traffic light. It provides a comprehensive understanding of why they must play such a pivotal role c.q. why they are ecologically/evolutionarily developed.

³⁹ When we want to parallel park a car in reverse, the subjective choice is made for the action trajectory shape from the rear bumper.

Additionally, it is precisely explained how they mediate two autonomous processes within every motor action, namely the zigzag process and the accordion process⁴⁰.

1. The main goal of the tactical movement action (TMA) encompasses the construction of a perceptual image of a latent action trajectory shape between the current position of the car and the traffic light

Supported by scientific evidence⁴¹ the explanatory model delineates that the execution of any motor action involves two distinct sequential phases: the tactical movement action (TMA) and the actual movement action (AMA). The tactical movement action is focused solely on planning the upcoming action and must be finalized before any actual execution occurs. An essential aspect of the tactical movement action when car driving is to create a perceptual image of a latent action trajectory shape between the current position of the car (position A) and the desired destination (position B). In this case, after just turning a street corner, it involves bringing our car to a stop at a traffic light. The explanatory model demonstrates that during this phase, we are indeed largely focused on all physical dimensions of the traffic light (and/or the stop line), aligning with much scientific research. However, with the recognition that a perceptual image of a latent action trajectory shape is being created, the explanatory model also arrives at a conclusion that is not yet recognized within the scientific community. The formation of a perceptual image of a latent action trajectory shape between the current position of the car and the traffic light also indicates that we strategically determine beforehand whether the space between the car and the traffic light (in the very near future) can be filled or bridged by a continuous action trajectory shape of all dimensions of the car. The explanatory model provides unequivocal scientific evidence, and you can quickly conclude from your own empirical experiences that a completely different action trajectory shape is created when obstacles are present in front of the car, and that no action trajectory shape can be created when the car is shielded by a huge shop window.



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

In addition to unveiling this novelty, it is also revealed that when the tactical movement action has been finalized, we are primarily going to focus on the movement of the car towards the traffic light. This contrasts with the traditional perspective of science, which remains constantly focused on the

⁴⁰ In previous publications, this has been referred to as the harmonica process.

⁴¹ https://www.researchgate.net/publication/372290282_Grasping_encompasses_two_consecutive_autonomous_phases_-_The_scientific_proof_that_we_tactically_construct_an_action_trajectory_shape_prior_to_the_factual_execution_of_that_exact_same_action_trajectory

traffic light itself. During the actual movement action (AMA), our main concern is the egocentric bridging process of the car, guiding it over the perceptual image of the latent action trajectory shape which is exclusively determined during the tactical movement action. So when the factual execution starts the traffic light itself is not any longer the focal point, but rather the movement of the car towards it c.q. the bridging of the void (!) between the current location of the car and the stop line forms the essence of the action.

Another revolutionary novelty aligns with the previous thought. Although reaching the end of the action trajectory shape will eventually lead us to the completion of this task, the explanatory model, supported by scientific evidence, demonstrates that we also tactically determine beforehand whether the entire (!) space between the car and the traffic light can be filled by a continuous line of all dimensions of the car. This means that all positions P between the current location of the car and the traffic light (and/or the stop line) are observed as actively and as crucially as the endpoint of the action trajectory shape. This realization provides a solid foundation for the fact that during the actual movement action (AMA), we are solely focused on traversing the latent positions P associated with the action trajectory shape. This implies that upon reaching position P(x), for example, somewhere midway along the action trajectory, we are mainly focused on the perception of three positions: position P(x-1), where we just came from, position P(x), where the car is now, and position P(x+1), the perception of the next position where we need to move the car. In this phase, we are primarily engaged in the aforementioned bridging process and only monitor whether the gap between the car and the traffic light (and/or the stop line) is closing. This also reveals another essential ecological novelty, showing that during the actual movement action, we are indeed not concerned with the traffic light itself, but only with reducing the number of latent positions P between the car and the traffic light.

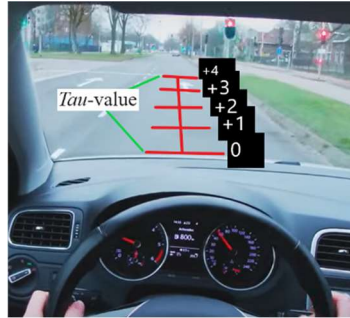
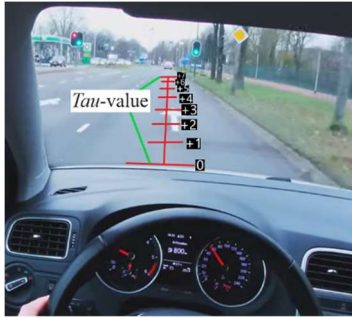
2. The reciprocal dependency between the internal and external focus results in absolute deviations of the car within the perceptual image of the latent action trajectory shape

The explanatory model of the motoric movement action illustrates within the context of car driving that two foci always arise. We can only guide the car along an external action trajectory (from A to B) with a focus on internal movements. These foci are autonomous because the (perception of) movements occur strictly separated inside and outside the body, rendering them incompatible. However, as the explanatory model now demonstrates that the movement of the car within the external action trajectory shape is going to fulfil the essence of the task, an intriguing phenomenon of reciprocal dependency emerges. Only internal motor movements can lead the car externally along an action trajectory shape, yet the progression of the car 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 car 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

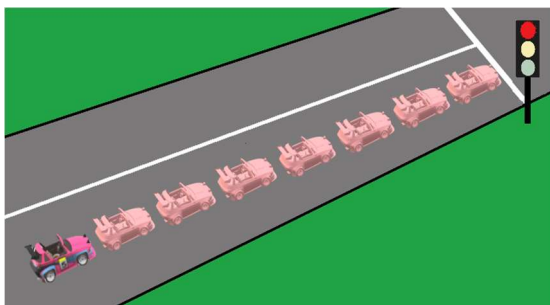
If we now combine the two preceding paragraphs and proceed to actually drive a car from a position A to a position B, our main endeavour will primarily become to initiate the bridging process of the car in which the perceptual image of the latent action trajectory shape serves as an open yet compelling guiding⁴² phenomenon. This means that we aim to *step by step* (!) reduce the distance between the current position of the car and the traffic light (and/or the stop line), starting with the first step of moving the car from position P(0) to position P(+1).

⁴² 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 car deviates, as long as the car comes closer to the endpoint. However, without a (precisely global) perceptual image of a latent action trajectory shape, motor actions cannot commence and the explanatory model introduces the term "*precise global*" in this context. The perceptual image of the latent action trajectory shape must precisely indicate the global (fluctuation borders of the) direction it should take.



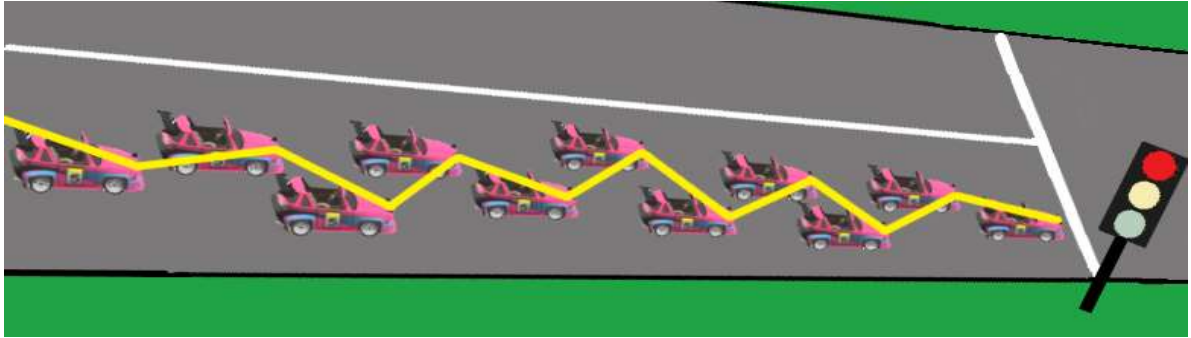
Images: The explanatory model of the motoric movement action provides a tangible example with the marble in the marble run, illustrating the continuous reciprocal perception-action coupling within any conceivable motoric action. From the perspective of the marble's current position, one can perceive 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 driving a car, 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 a car, must emerge from each other, meaning that the perception of the car's movement is always captured in one single line segment shape within car driving. In which the current position $P(0)$ of the car 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 car 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 car 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 car will inevitably deviate⁴³ from the perceptual image. It is an absolute factual given that cannot be avoided, and it would quickly lead to chaotic action trajectories⁴⁴ if there were not a system capable of mediating these deviations.



⁴³ As stated in footnote 4, this precisely illustrates an optimal parsimonious model, where nothing needs to be executed very precisely, but only gives a general (albeit compelling) direction. If you were only able to move a car in an identical manner, car driving would become an impossible task. The task, where you only need to reduce the distance, opens up countless more possibilities and shows that the bridging process is just one part of the task.

⁴⁴ On a highway, deviations lead to exponential deviations from the lane with each successive time unit. This precisely reveals, for the very first time in history, why one should not be using a phone while driving.



Images: The perceptual image of a latent action trajectory shape, constructed within the tactical movement action (TMA), depicts a smooth line segment shape from the car toward the traffic light. However, during the actual execution, the car, akin to a ring in relationship to a nerve spiral⁴⁵, 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 car 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-deviation⁴⁶. Similar to a marble in a marble run, the car 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 car towards the action trajectory shape, and vice versa the ventral stream primarily monitors the action trajectory shape towards the actual position of the car. The nerve spiral clearly demonstrates that this double reciprocal coupling inevitably leads to deviations or touches of the ring with the spiral, causing the car to follow the action trajectory shape in a zigzag movement. However, the ingenious mediation of the cortical streams ensures that the action trajectory shapes appear deceptively straight.

Within there the explanatory model of the motoric movement action illustrates that the execution of action trajectory shapes indeed encompasses the essence of motor tasks, and that success hinges on the meticulous management of deviations of the action object within the action trajectory shape⁴⁷. Therefore, it ideally presupposes a mutually reinforcing system that continuously monitors the relationship with the action trajectory shape from the current position of the car, and conversely, constantly monitors the actual position of the car from the perceptual image of the action trajectory shape.

The explanatory model thus implies a rather heavy correction system, and based upon current scientific literature, it concludes that the conceptual steps within the explanatory model precisely presuppose what is described (neuro-)scientifically regarding the processing of perceptions: namely, the functionality of the dorsal and ventral stream. At every time t or at every position P, all observations are processed by the ventral and dorsal stream in such a way that deviations simply cannot escape attention. The ventral stream primarily processes deviations from the perceptual image of the entire action trajectory shape to the actual position of the car, while the dorsal stream does so vice versa, primarily from the actual position of the car to the perceptual image of the entire action trajectory shape. The mediation of these two processing streams leads to continuous micro-adjustments of the original perceptual image of the latent action trajectory shape, happening so ingeniously and swiftly that the absolute zigzag and accordion-like deviations barely stand out, making the executed action trajectory shapes appear deceptively straight.

⁴⁵ <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

⁴⁶ You can speak of micro-adjustments or of updating c.q. renewing the perceptual image of the remaining latent action trajectory.

⁴⁷ One must be able to stop at the right distance from the traffic light, 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 shape involve two autonomous phenomena⁴⁸, which relate to the words *line* and *shape* in the compound term *line segment shape*. The explanatory model demonstrates that they are observed and processed completely separately, yet simultaneously. Car driving and cycling (without hand brakes) show, beyond any reasonable doubt, that the deviations in relationship to the line and shape are autonomously observed and processed.



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

Deviations along the length axis or y-axis of the action trajectory shape involve deviations of the movement of the action object over time. They are related to determining the *tau*-value 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 car driving

The explanatory model of the motoric movement action reveals that the zigzag process and the accordion process are inherent in every conceivable action⁴⁹. However demonstrating that they encompass

⁴⁸ 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.

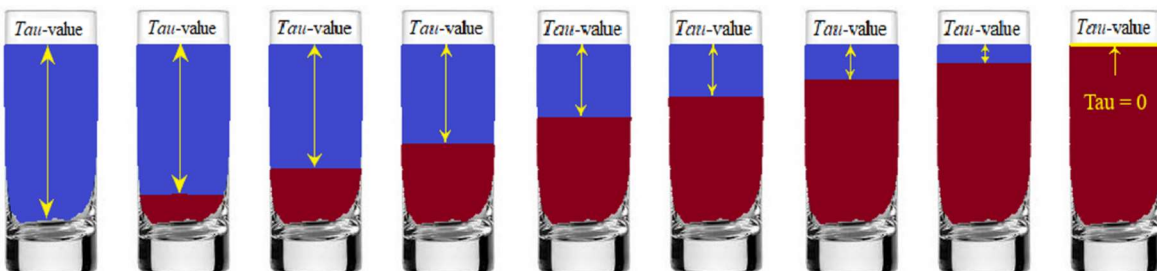
⁴⁹ While this imposes greater demands on organismal development, conversely, it allows for a compelling demonstration of its seamless integration within an ecological framework. The dichotomy that distinguishes a

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



Images: The zigzag process in any conceivable action can easily be represented in an animation. Due to the fact that the primary focus can only be executed by the autonomous secondary focus, the action object (respectively, the car, the spoon bowl, and the pointer) will definitely deviate from the perceptual image of the latent action trajectory shape in width.

Although the accordion process (the pedal process) in car driving is undoubtedly demonstrated, it is challenging to depict in an animation because it involves compressions and elongations of time⁵⁰. Nonetheless, you must recognize that you can never move the car identically in time along an action trajectory shape. Through empirical observation, you can quickly ascertain that within certain fluctuation boundaries, it will infinitely vary.



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.

⁵⁰ For the record it should be noted that the car does not move back within the action trajectory shape.