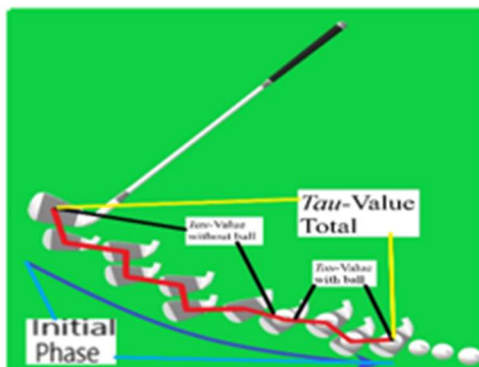
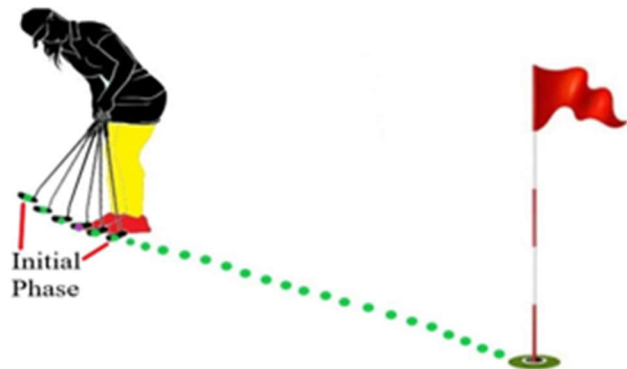


Golf - Gaze is not Static and the Visible Consequence of a Dynamic Adjustment Process by the Cortical Streams during a Golf Putt

The complete explanation of *The Quiet Eye (TQE)* within golf



Caught In A Line

The explanatory model of all motoric movement actions

N.J. Mol
October 2024 ©

Contact: kwilling@gmail.com
<https://www.researchgate.net/profile/Nj-Mol/research>
<https://www.explanatorymodel.nl/>

Abstract

This article clarifies the fundamental difference between visual perception and gaze during all strokes within golf, with a specific focus on putting. The explanatory model of all goal-directed motoric movement actions reveals that every hitting action begins with the construction of a latent perceptual image of a complete (successful) outgoing ball trajectory shape¹, from the golf ball to the hole², prior to any physical performance. In this preparatory action, visual perception is crucial.

However, this perception must quickly shift to translating the entire outgoing ball trajectory shape into a perceptual image of the initial phase, because solely during haptic contact between the clubface and the ball the beginning of an outgoing ball trajectory shape can be created. With only its end possibly leading to a successful result. So when the actual action begins, only the perceptual image of the initial phase is executed and which also immediately implies the completion of the action.

Since only the secondary focus autonomously controls the internal movements that can ensure the clubface/golf ball^(pad) will move externally (within the primary focus), the issue arises that the (inanimate) clubface/golf ball^(pad) will endlessly deviate from the (latent) perceptual image of the initial phase of the outgoing ball trajectory shape. This creates a continuous need to bring the clubface/golf ball^(pad) back to the original perceptual image of the initial phase.

Gaze specifically targets this process of constant adjustment, where the cortical streams must actively correct the actual action trajectory shape of the clubface/golf ball^(pad) whenever it deviates from the planned path. Gaze is thus not a static focus on a single point but a dynamic and continuous adjustment process, aimed at the refined control of the clubface/golf ball^(pad) in the initial phase. This continuous correction of deviations by the cortical streams ensures that the clubface and/or the ball will stay aligned with the original perceptual image, eventually enabling the ball to reach the hole.

¹ <https://www.explanatorymodel.nl/sports-actions-1/golf/golf-within-golf-we-always-first-construct-a-perceptual-image-of-a-latent-action-trajectory-shape-out-of-the-perspective-of-the-golf-ball-the-scientific-evidence>, or https://www.researchgate.net/publication/380825968_GOLF_Within_golf_we_always_first_construct_a_perceptual_image_of_a_latent_action_trajectory_shape_out_of_the_perspective_of_the_golf_ball_-_The_scientific_evidence.

² Or to the precise position before the final stroke is made, as part of a game plan that has been formed in advance, consisting of a continuous chain of ball trajectory shapes, where the final trajectory must ultimately lead the ball into the hole.

Introduction

The *Explanatory Model of the Motoric Movement Action* provides a universal explanation for all functional perceptual processes involved in all conceivable goal-directed actions. This model asserts that the execution of any motor action always requires the simultaneous observation of three autonomous foci. This aligns with J.J. Gibson's theory of perception, which identified both the movement of the organism and that of the environment as autonomous phenomena. In the case of golf, one of these foci is directed toward perceiving the movement of the hole³, which can universally be considered a catching action. The other two foci are concerned with the perception of the egocentric action, where the movement of the clubface/golf ball^(pad) inducing an outgoing ball trajectory shape (toward the hole) drives the main goal, which can universally be considered a throwing action⁴.

This article specifically focuses on the two foci involved in all egocentric throwing actions in golf primarily directed at the hole. The explanatory model demonstrates that each throwing action relies on a close collaboration between an autonomous internal focus and an autonomous external focus. From this, two conclusions can be drawn: 1. as a *novum*, a perception-action coupling can occur within the egocentric action itself, and 2. all previously identified phenomena within the movement sciences are provided with a definitive explanation, including the precise and conclusive roles of visual perception and gaze.

The model builds on two essential premises:

1. Only the external autonomous movement of the golf ball, as part of an outgoing ball trajectory shape, will fulfill the essence of the task. In relationship to which it is factually impossible to hit the ball directly into the hole; one can solely create an initial phase (the beginning) of an outgoing ball trajectory shape, with the final outcome possibly leading to the ball reaching the hole.
2. The golf ball is a lifeless object and can only be moved by (the perception of) internal autonomous movements.

These premises show that the (perception of movement within the) two foci belong to two strictly separate autonomous worlds, outside and inside the body. They can never overlap, leading to the conclusion that the initial phase can only be executed by the stacking of two autonomous perceptual images of the internal (secondary) and the external (primary) focus.

However, this leads to a crucial problem that the body has solved evolutionarily in a brilliant way. Although one can create a very smooth straight line as the initial phase, this remains only a latent perceptual image. Since this external line segment shape can only be physically executed through entirely different autonomous internal movements, the clubface/golf ball^(pad) will inevitably deviate at every point P within the initial phase of the (latent) perceptual image, and the cortical streams must, at every moment, return the clubface/golf ball^(pad) to the original perceptual image. This explains precisely why every throwing action is merely an optimization process, and why no one will ever be able to perform an identical putting action. Furthermore, the model shows that gaze is only the consequence of this stacking process and that gaze focuses exactly on this part of the throwing action.

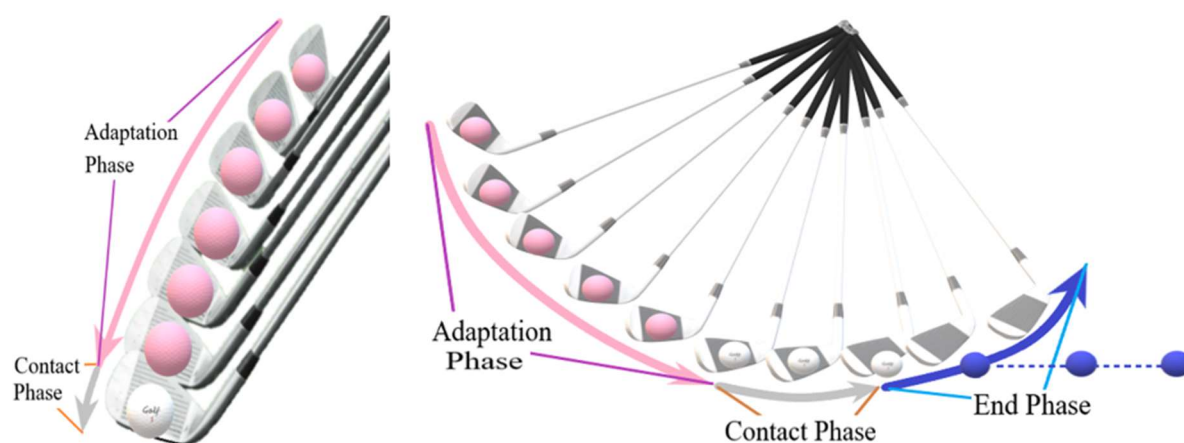
³ Or the precise position as mentioned within the previous footnote.

⁴ The complete description of all functional perception processes within golf are already published: <https://www.explanatorymodel.nl/sports-actions-1/basketball/the-complete-clarification-of-all-functional-perception-processes-within-the-free-throw-in-basketball> or https://www.researchgate.net/publication/382250091_The_complete_clarification_of_all_functional_perception_processes_within_the_free_throw_in_basketball.

Within the explanatory model of the motoric movement action, the phenomenon of **perceptual adaptation** is introduced as a novel concept. By assuming, for example, in golf that the ball remains continuously on the clubface—similar to how a basketball is consistently held during a basketball shot—the explanation of the functional perceptual processes within golf gains substantial clarity and becomes more coherent across sports. The explanatory model textually designates the phenomenon of perceptual adaptation in golf with the term golf ball^(pad).

Perceptual Adaptation in Golf – Golf ball^(pad)

Within the explanatory model of the motoric movement action, perceptual adaptation in golf refers to the process in which the player forms a mental image in which the golf ball appears to rest on the clubface from the start of the swing's main phase. This mentally constructed image ensures that, in the player's mind, the ball remains continuously in a fixed position on the clubhead, precisely where the real ball will ultimately be struck. This mental representation serves as a stable reference point, allowing the transition from the imagined ball to the actual ball to occur without any significant discrepancy, thereby ensuring a seamless execution of the swing.



Images: Perceptual adaptation in golf encompasses the mental representation that the golf ball remains on the clubface throughout the main phase⁵ of the swing. The pink balls in the image represent the imagined positions of the ball on the clubface, aligning precisely with the spot where the (actual) ball will be struck. When this mental image is transferred to the actual ball (white), the imagined and real ball positions merge. This ensures that the ball is struck exactly as intended within the tactical sports action (TSA). The white balls depict the contact phase, from the first to the last haptic contact between the clubhead and the ball. The blue balls represent the phase in which contact has ceased, marking the beginning of the final phase of the swing.

The Tactical Sports Action (TSA) and the Factual Sports Action (FSA)

The fact that we can only create the beginning of an outgoing ball trajectory shape, while the successful end can only be imagined perceptually, forms the core of the scientific evidence that a tactical preparation phase must take place prior to the actual execution. The premises within the explanatory model clearly show that, before the execution of the action, a tactical — preparatory — action must be completed. Within the explanatory model of the motoric movement action, these two successive

⁵ Based on insights from movement sciences and motor learning psychology, such as the work of Bernstein, Schmidt, and others, sports actions can be divided into three phases: 1. Preparation, 2. Main phase, and 3. Final phase. This structuring provides a systematic model for analyzing and optimizing sports movements.

actions are defined as the Tactical Sports Action (TSA) and the Factual Sports Action (FSA). The definitions can be adjusted specifically to fit the context of a particular sport.

1. The Tactical Sports Action (TSA) or the Tactical Golf Putting Action

Phase 1

The explanatory model provides scientific evidence that, also within a golf putt, we first create a perceptual image of the entire latent ball trajectory shape c.q. the outgoing ball trajectory shape (OBT). The tactical golf putting action consists of two distinct phases. These phases mark the boundary between visual perception and gaze.



Images: In phase 1 of the tactical golf putting action, a perceptual image of the entire outgoing ball trajectory shape between the current position of the ball and the hole is created through visual perception processes⁶.

In the first phase of the tactical sports action (TSA), prior to each actual golf putt, a perceptual image of a latent action trajectory shape must be created through visual input⁷. The explanatory model demonstrates conclusively that we always look for a ball trajectory shape between the current position of the golf ball⁸ and the position of the hole, where every point P along that trajectory must allow the ball to pass through⁹. In the tactical sports action (TSA) the sole concern compels how the ball (in the very near future!) needs to move in order to successfully reach the hole in its entirety (!).

The explanatory model thus provides three important novelties:

⁶ The scientific evidence that we always first construct a perceptual image of a latent action trajectory shape within golf: <https://www.explanatorymodel.nl/sports-actions-1/golf/golf-within-golf-we-always-first-construct-a-perceptual-image-of-a-latent-action-trajectory-shape-out-of-the-perspective-of-the-golf-ball-the-scientific-evidence>, or https://www.researchgate.net/publication/380825968_GOLF_Within_golf_we_always_first_construct_a_perceptual_image_of_a_latent_action_trajectory_shape_out_of_the_perspective_of_the_golf_ball_-_The_scientific_evidence.

⁷ This assertion is essentially incorrect. Prior to any conceivable motor action, you implicitly create a perceptual image of a latent action trajectory shape. The explanatory model shows that this is an unavoidable fact. You would not be able to perform any action without that perceptual image. However, it is presented here as a process of awareness that you are doing this, and that you likely need to optimize it.

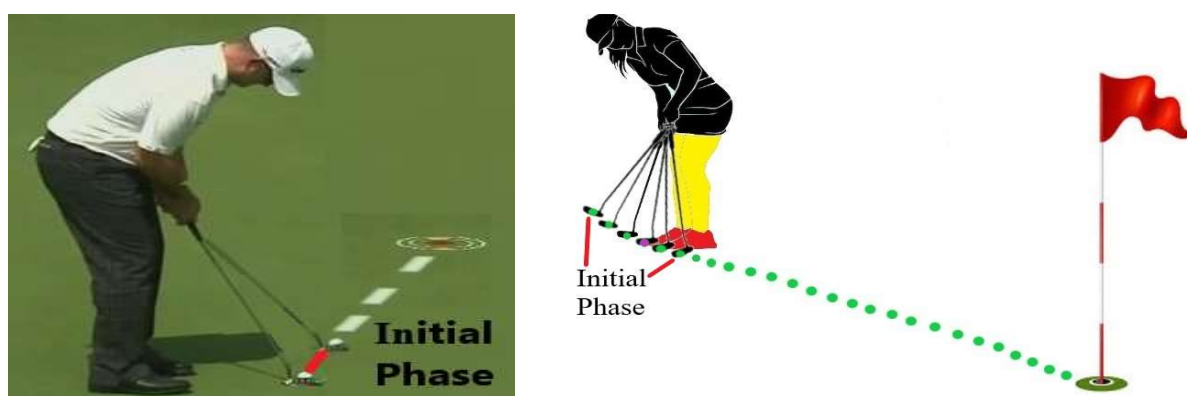
⁸ In principle, this concerns the exact physical dimensions of the ball. In practice, however, we account for a "slightly larger" width of the ball. Based on our basic cognitive knowledge, we know that a ball will deviate within any ball trajectory shape. The same applies when driving a car through a narrow street with parked cars on both sides. If the available space is greater than 30 centimeters, we often drive through without slowing down. If the distance between the cars is less than 10 centimeters, we tend to significantly reduce speed because the chance of deviation increases substantially.

⁹ This explains that in miniature golf, we construct perceptual images of latent outgoing ball trajectory shapes around the metal casings or borders of the course. Like in regular golf we look for all those interconnected places which will guarantee an uninterrupted voyage of all the dimensions of the golf ball to the hole.

- It shows that only the golf ball c.q. the movement of the golf ball, can fulfill the task within the egocentrically formulated intention.
- It clearly demonstrates that perceiving not only the hole but also all the "empty" spaces between the ball and the hole is equally important¹⁰.
- It pinpoints exactly where visual perception transitions into gaze and establishes a clear boundary: gaze begins where visual perception stops.

Phase 2

Within the second phase of the tactical golf putting action (TSA), the entire latent outgoing ball trajectory shape must be reduced to the exclusive beginning of the ball trajectory shape, where there is actual contact between the clubface and the ball. Only then is it possible to exert real influence on the ball¹¹. Forming a perceptual image of the initial phase leads to the first emergence of gaze.



Images: In phase 2 of the tactical golf putting action (TSA), the perceptual image of the entire outgoing golf ball trajectory shape must be reduced to the initial phase of that action trajectory shape. Because this is factually the sole period, through haptic contact between the clubhead and the golf ball, where we can exert actual influence on the ball. The transition from visual perception to gaze occurs within this phase.

With these two autonomous phases within the TSA of the golf putt, the explanatory model shows that after the visual perception of the hole in phase 1, there is a very rapid shift to exclusively perceiving the initial phase. The perception of the entire ball trajectory shape with direct visual sight is exclusive to phase one, and gaze only arises when an initial phase of that trajectory shape is constructed in phase two. This leads to the revolutionary conclusion that gaze solely focuses on the beginning of the outgoing ball trajectory shape and not at all on the hole.

2. The Factual Sports Action (FSA) or the Factual Golf Putting Action

¹⁰ Also see: <https://www.researchgate.net/publication/343537713> Do the perception processes within the putt in mini-golf differ from the perception processes within the putt in golf Really - Within both we actively look for those kind of free acting spaces which w

¹¹ The explanatory model provides the unique insight that, within the Tactical Sports Action (TSA), we consider the entire task, but within the Factual Sports Action (FSA), we execute only the initial phase. This reveals the unique *novum* that our perceptual processes are solely focused on the initial phase during the execution of a golf putt, and that solely gazing at the hole is actually detrimental to the action. - The pro player Jordan Spieth is considered unique because he seems to focus on the hole with direct vision during the actual execution of some *short* (!) putts (Target Focussed Aiming (TFA) versus Ball Focussed Aiming (BFA)). The explanatory model offers the rebuttal that when the putt is short enough you are capable to maintain direct vision on the hole but that simultaneously you will definitely have to focus on the initial phase with peripheral vision.

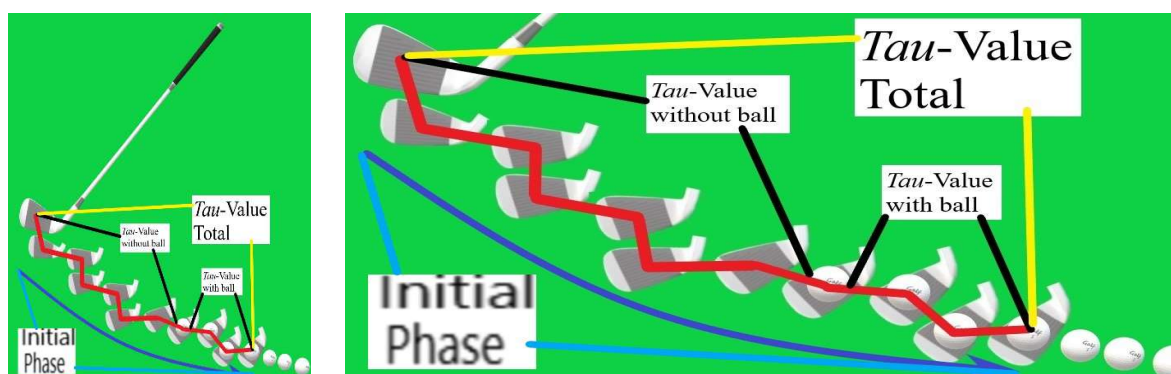
It is essential to understand, through the distinction between the TSA and the FSA, that when we actually are going to putt the golf ball, the focus must be entirely pointed at the perceptual image of the initial phase of the outgoing ball trajectory shape (OBT). The FSA is therefore exclusively concerned with the line segment of the initial phase, and the motor action ends once this initial phase is completed¹².



Images: **The factual golf putting action** – 1. It is essential to understand that the Factual Sports Action (FSA) focuses exclusively on executing and perceiving the initial phase of the outgoing golf ball trajectory shape. Once the initial phase is completed c.q. when there is no longer haptic contact with the ball, this marks the definitive end of the respective throwing action. At that point, the player no longer has direct influence over the ball, as the ball is now entirely outside the body and beyond the player's control. 2. Furthermore, it is crucial to realize that the initial phase can only be formed by autonomously perceiving the movement of the golf ball^(pad) outside the body. The clubface and the golf ball are lifeless objects and can only be moved through a combination of autonomous internal movements (within the body), which are controlled by the player. The two foci — the internal and external focus — are strictly separated by the inside and outside of the body, making them belong to two incompatible worlds.

The Precise Role and Content of Gaze

If we now could simply execute the initial phase, the action would be completed at this point. However, this is not the case, as significant issues arise due to the fact that the clubface and the golf ball are and will remain lifeless objects and will never be capable to move on their own. Yet, the ball is the sole object that will fulfil the external task. It will only move outside the body through entirely different autonomous movements within the body, which extend from the hands holding the golfclub at the handle solely to the outside of the clubface. As a result, the golf ball^(pad) is definitely going to deviate at every position P within the initial phase, and therefore the perceptual processing by the cortical streams will need to guide it intensively, moment by moment.



¹² Just like a marble in a marble run, one can say that the action is over as soon as the marble is released, even though the marble/ball is still on its way to the target.

Images: Due to the fact that we autonomously perceive the external movement of the clubface and the golf ball within the initial phase (within the primary focus) and can only achieve this external movement through the autonomous perception of internal body movements (within the secondary focus), the clubface and the golf ball are definitely going to deviate at every point P within the perceptual image of the initial phase. The cortical streams, which process all perceptions, are thus heavily tasked with continually correcting these deviations to match the perceptual image of the (latent) initial phase, which in turn results in the formation of gaze. When magnified, this always results in a zigzag pattern of the golf ball^(pad) within the initial phase. However, in practice, this is so effectively mediated by the cortical streams that the executed action trajectory appears deceptively straight.

So, during the execution of the initial phase, a highly complex process is observed, involving the stacking of two autonomous perceptual images that can only lead to success through cooperation. This process gives rise to the characteristic "gaze look" which we can witness within many athletes. Which in other words can also be depicted as a supreme display of "concentration" and can definitely be regarded as the consequence of the stacking process and absolutely not the cause.



Images: The characteristic “look of gaze”. The consequence of stacking the perceptual image of the internal focus towards the perceptual image of the external focus.

Conclusion

This article has clarified the fundamental difference between visual perception and gaze during golf hitting actions, with a specific focus on the golf putt. The explanatory model of all goal-directed motor actions shows that every throw begins with the construction of a latent perceptual image of a complete, successful outgoing golf ball trajectory shape, from the ball to the hole, before the actual action is performed. In this initial preparatory phase, visual perception plays a crucial role.

After this phase, perception must quickly reduce the complete outgoing golf ball trajectory shape to a perceptual image of the initial phase, where there is haptic contact between the clubface and the ball. Only during this initial phase can a ball trajectory be physically created, with a possibly successful outcome. Once the actual action begins, only the perceptual image of the initial phase is executed, which implies the completion of the action.

Because only the secondary focus autonomously controls the internal movements that externally move the golf clubhead (within the primary focus), the problem arises that the clubface (holding the ball), as an inanimate object, is constantly going to deviate from the latent perceptual image of the initial phase. Which demands a continuous correction to bring the movement of the golf ball^(pad) back to the original perceptual image.

This highly intensive and constant adjustment, where the cortical streams continuously correct the golf ball^(pad) when it deviates from the planned trajectory, is exactly what causes gaze. Gaze is therefore not a static focus on a single point, but a dynamic and continuous adjustment process aimed at the refined control of the golf ball^(pad) in the initial phase. Through these continuous corrections, resulting from the stacking/layering of two autonomous perceptual images, the cortical streams ensure that the ball stays aligned with the original perceptual image, ultimately enabling the ball to reach the target, the hole.