From Traditional Sport to Esports: Leveraging Perceptual Research to Accelerate Skill Development

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As in traditional sport, proficient decision making is fundamental to successful esports performance (Pluss et al., 2019). Specifically, the assessment and targeting of mechanisms underlying the decision making process are of central importance to skill acquisition and the design and implementation of training interventions for performance enhancement. Importantly, the development of expertise in traditional sports requires moving beyond a focus on the physical domains (e.g., strength, power and endurance) toward perceptual and cognitive behaviors. This marks a convergent point between traditional sport and esports, and provides a foundation of existing knowledge of perceptual and cognitive behavior for the development of new tools to accelerate the acquisition of specific esports skills and enhance overall esports athlete performance. However, unlike the physical domains, which are relatively easy to measure and apply to objective training interventions, perceptual and cognitive behaviors are not as easily understood or as readily translatable to training applications. Thus, there is a need for the identification of new behavioral markers that index modifiable perceptual and cognitive processes that can inform the design and implementation of training interventions (Pedraza-Ramirez, Musculus, Raab, & Laborde, 2020).

In traditional sport, the real-time uptake and processing of visual information is a primary contributor to the decision making and control of an athlete's actions, which includes both the perception of one's action capabilities and subsequent action execution (Fajen, Riley, & Turvey, 2009). Similarly, esports require athletes to locate objects in scene and to make decisions so they can execute the right action at the right time with extreme proficiency, while taking into account their own (and in certain games, their character's) capabilities. Eye gaze (i.e., oculomotor) behavior provides a window into the perceptual and cognitive processes that underlie such performance (Panchuk, Vine, & Vickers, 2019). Importantly, eye tracking has previously demonstrated efficacy for skill acquisition and development in traditional sport (Harle & Vickers, 2001; Panchuk, Farrow, & Meyer, 2014), emergency medicine (Harvey et al., 2014), and military/law enforcement (Nieuwenhuys & Oudejans, 2011; Vickers & Lewinski, 2012). That is because skilled performance is not only a product of a performer's physical capabilities, but also underpinned by the development and application of highly specialized and specific perceptual-cognitive abilities. The purpose of this abstract is to explore how an understanding of perceptual-cognitive expertise in traditional sports could be used to guide the development of a new technology platform for esports that augments the focus of eye movement training. Such a technology could push the assessment (and eventual training) of esports performance into alignment with contemporary research on skill development. We will do so by taking an approach that situates eye movements within the actions of the athlete and their performance environment.

In traditional sport performance, there is evidence of less variability in physical capabilities (e.g., agility, speed) and more refined sport-specific perceptual-cognitive skills (e.g., anticipation) as expertise increases (Reilly et al., 2000). In their influential meta-analysis, Mann et al. (2007) noted that elite performers were faster and more accurate to perceive perceptual cues and that they used visual behaviors that were systematically different from lesser-skilled performers (i.e., fewer fixations, longer duration fixations, longer quiet period). From their analysis, Quiet Eye (Vickers, 1996; 2007) was the only specific variable that distinguished between levels of expertise. Quiet

Eye is specified by the final visual fixation or tracking gaze on a specific location or object in the performance space that lasts for a minimum of 100 ms prior to the onset of the movement action (Vickers, 1996; 2007). Quiet Eye has been associated with higher levels of skill and performance in a myriad of performance activities—e.g., golf putting, stopping a hockey puck, or shooting a basketball in sport (Panchuk et al., 2014; Panchuk & Vickers, 2006; Klostermann et al., 2017), locomotion and balance (Panchuk & Vickers, 2011), precise surgical dissection in medicine (Harvey et al., 2014), rehabilitation of children with developmental coordination disorder (Miles et al., 2015), and decision making and subsequent inhibition or targeted firing of a firearm in law enforcement (Vickers & Lewinski, 2012). Quiet Eye is also sensitive to psychological factors such as anxiety and arousal in these task contexts (Vickers & Williams, 2007; Vine & Wilson, 2011). Using the weight of evidence, Quiet Eye is a useful tool for identifying perceptual-cognitive inefficiencies and for providing insights to inform enhanced skill acquisition and training. Quiet Eye assessments are one of the most prominent methods for characterizing these types of visual behaviors and provide an evidence-based foundation for training.

Based on the number of studies that link Quiet Eye and skill expertise, it is clear that eye tracking data has great potential value for esports athletes as they consider their own performance improvement. However, using Quiet Eye as a vehicle for skill development requires insights into the relationship between eye movements and performance and, more specifically, a way to contextualize an athlete's performance within the game environment (Vickers, 1996). This is even more challenging when considering the large amount of data associated with a given match. In order to leverage Quiet Eye as a performance improvement metric, the in-game performance data must be recorded, cleaned, sorted, synchronized at each time point and then reduced into performance phases. This, in turn, requires the categorization of task phases via semantic tagging for annotation and the mapping of gaze behavior onto on-screen stimuli relative to associated task phases. While this can be done manually, it is extremely time consuming and involves a degree of subjectivity. Thus, automation is required for effective implementation. Specifically, video summarization and categorization are necessary to enable the system to quickly and accurately identify the Quiet Eye period of attention—i.e., onset, duration and offset. In addition, the accurate indexing of a specific task performance outcome relative to each Quiet Eye period (e.g., successfully hitting an opponent with a fired weapon in a first-person shooter, or the successful skill shot toward an opponent in a multiplayer online battle arena) is needed to contextualize Quiet Eye within the performance environment. This requires feature extraction via pattern recognition algorithms to align the gaze fixation with the performance phase and the mapping of the performance outcome to each performance phase. In addition to the automation of the computational process of Quiet Eye, efficient data interpretation is necessary to extract insights that can be acted upon to inform targeted training interventions. Finally, while precision feedback alone can be sufficient to improve performance (Moran, Murphy, & Marshall, 2012), technology that harnesses and embeds the principles of skill acquisition (i.e., feedback) is essential. To provide esports athletes with insight into their performance that can be exploited to maximize learning, the output of the Quiet Eye assessment must ultimately provide benchmarks of performance, comparisons across multiple attempts and sessions with longitudinal tracking over time. These measures can provide esports athletes with a report of their current performance, identify metrics that underpin success, benchmark performance over time, and identify opportunities for improvement.

Conclusion

Competitive esports athletes are no different than competitive athletes in traditional sports—they want to compete at the highest level for as long as possible. While perceptual and cognitive performance is essential in both domains, developing highly attuned perceptual and cognitive

skills has the potential to provide significant competitive advantages in esports athletes (Pedraza-Ramirez et al., 2020). Athletes who are able to maximize and maintain their perceptual and cognitive abilities could realistically perform at a higher level, for longer. While there is ample evidence that coupling eye movement recording, and specifically Quiet Eye, with contextualized performance data provides an opportunity to give athletes new insight into their performance, there are a multitude of streams to explore. Regardless, providing esports athletes with personalized performance feedback and leveraging existing evidence of perception and learning from traditional sports training is a logical step toward helping esports athletes improve their skills and stay at the top of their game for longer than current training allows.

REFERENCES

- Fajen, B. R., Riley, M. A., & Turvey, M. T. (2009). Information, affordances, and the control of action in sport. *International Journal of Sport Psychology*, 40(1), 79–107.
- Harle, S. K., & Vickers, J. N. (2001). Training quiet eye improves accuracy in the basketball free throw. *The Sport Psychologist*, 15(3), 289-305.
- Harvey, A., Vickers, J. N., Snelgrove, R., Scott, M. F., & Morrison, S. (2014). Expert surgeon's quiet eye and slowing down: expertise differences in performance and quiet eye duration during identification and dissection of the recurrent laryngeal nerve. *The American Journal of Surgery*, 207(2), 187-193.
- Klostermann, A. W., Panchuk, D., & Farrow, D. (2018). Perception-action coupling in complex game play: exploring the Quiet Eye in contested basketball jump shots. *Journal of Sports Sciences*, 36(9), 1054-1060.
- Mann, D. T. Y., Williams, A. M., Ward, P., & Janelle, C. M. (2007). Perceptual-cognitive expertise in sport: a meta-analysis. *Journal of Sport & Exercise Psychology*, 29, 457-478.
- Miles, C. A. L., Wood, G., Vine, S. J., Vickers, J. N., & Wilson, M. R. (2015). Quiet eye training facilitates visuomotor coordination in children with developmental coordination disorder. *Research in Developmental Disabilities*, 40, 31-41.
- Moran, K. A., Murphy, C., & Marshall, B. (2012). The need and benefit of augmented feedback on service speed in tennis. *Medicine and Science in Sports and Exercise*, 44(4), 754–760. <https://doi.org/10.1249/MSS.0b013e3182376a13>
- Nieuwenhuys, A., & Oudejans, R. R. (2011). Training with anxiety: short-and long-term effects on police officers' shooting behavior under pressure. *Cognitive processing*, 12(3), 277-288.
- Panchuk, D., Farrow, D., & Meyer, T. (2014). How can novel training aids be used to induce acute changes in gaze behaviour? *Journal of Sports Sciences* 32(12), 1196-1201.
- Panchuk, D., & Vickers, J. N. (2006). Gaze behaviours of goaltenders under spatial-temporal constraints. *Human Movement Science*, 25, 733-752.
- Panchuk, D., & Vickers, J. N. (2011). Effect of narrowing the base of support on the gait, gaze and quiet eye of elite ballet dancers and controls. *Cognitive Processing*, 12, 267-276
- Panchuk, D., Vine, S., & Vickers, J. N. (2019). Eye Tracking Methods in Sport Expertise. In

Routledge Handbook of Sport Expertise (pp. 176–187).
<https://doi.org/10.4324/9781315776675-16>

Pedraza-Ramirez, I., Musculus, L., Raab, M., & Laborde, S. (2020). Setting the scientific stage for esports psychology: a systematic review. *International Review of Sport and Exercise Psychology*, 13(1), 319-352.

Pluss, M. A., Bennett, K. J. M., Novak, A. R., Panchuk, D., Coutts, A. J., & Fransen, J. (2019). Esports: The chess of the 21st century. *Frontiers in Psychology*, 10(JAN).
<https://doi.org/10.3389/fpsyg.2019.00156>

Reilly, T., Williams, A. M., Nevill, A. & Franks, A. (2000). A multidisciplinary approach to talent identification in soccer, *Journal of Sports Sciences*, 18(9), 695 – 702.

Vickers, J. N. (1996). Visual control when aiming at a far target. *Journal of Experimental Psychology: Human Perception and Performance*, 22(2), 342–54.

Vickers, J. N. (2007). *Perception, Cognition, and Decision Training: The Quiet Eye in Action*. Champaign, IL: Human Kinetics.

Vickers, J. N., & Lewinski, W. (2012). Performing under pressure: Gaze control, decision making and shooting performance of elite and rookie police officers. *Human Movement Science*, 31(1), 101–117.

Vickers, J. N., & Williams, A. M. (2007). Performing under pressure: The effects of physiological arousal, cognitive anxiety, and gaze control in biathlon. *Journal of Motor Behavior*, 39(5), 381–394. <https://doi.org/10.3200/JMBR.39.5.381-394>

Vine, S. J., & Wilson, M. R. (2011). The influence of quiet eye training and pressure on attention and visuo-motor control. *Acta Psychologica*, 136(3), 340–346.
<https://doi.org/10.1016/j.actpsy.2010.12.008>