International Journal of Esports

Effects of mouse sensitivity: performance and injury prevention

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Abstract

Mouse sensitivity is one of the most important in-game performance factors in First Person Shooter (FPS) and Third Person Shooter (TPS) videogames. The only source of information about how to optimize sensitivity is the professional players' own experience. There is a need of more scientific investigations about mouse sensitivity in order to predict players' personal needs. However, researchers have not yet explored mouse sensitivity in esports to improve performance or to prevent player injuries. Nevertheless, studies among office workers have brought some interesting information about computer mouse use and its effects on health and performance. Computer mouse use has an impact on upper limb muscular activity and particularly on tendon overuse, proprioception, upper limb motricity, muscular fatigue, sensory motor control, and posture. Finally, these findings show that mouse ergonomics and customed physical conditioning for each player are needed to be performant and healthy.

Keywords: Mouse sensitivity; Injury Prevention; Musculoskeletal disorders; Performance; Ergonomics

Highlights:

- Mouse sensitivity is affected by equipment, ergonomics, and players' motor preferences and fitness.
- Mouse sensitivity plays a role in players' health and performance by determining the mechanical load over upper limb muscles, tendons, and joints.
- All players are different when looking at their way of controlling their mouse, so customed physical training is needed to manage mechanical strain and avoid injuries.

Introduction

Recently, esports has gained recognition from the whole community and is attracting more and more players day-by-day. A lot of players are training on their computer every day for a large amount of time using mostly computer mouse and keyboard as an interface for their gameplay. Two of the most famous type of games are First Person Shooter (FPS) or Third Person Shooter (TPS) games. They have the same performance factor: aim with the greatest possible accuracy at one or multiple in-motion enemies. To answer this aspect of gameplay, players must select their devices wisely. There are a lot of different gaming computer mouses in the market, and these differ from one another by their shape, weight, type of sensor, and wired or wireless connectivity. The effects of one of these parameters are illustrated by Chen et al. (2011), who studied the effect of mouse weight on biomechanical factors such as wrist motion and muscle activity among university staff and students (1). Participants completed a typical computer task where they were asked to rapidly (50 repetitions/minute) or slowly (25 repetitions/minute) point and click two targets with different mouse weight (70g, 100g, 130g, 160g, and 190g). During the task, the radial extensors, ulnar extensors, finger extensors and upper trapezius muscular activity were recorded with a surface electromyograph device as well as the wrist kinematics using an electrogoniometer. When the mouse was too heavy (190g), control of the mouse changed for a more exaggerated movement pattern because of an increase in the required force to move the mouse. When the mouse was too light, movement was less accurate and the cursor overreached the target, so the travelled distance increased because of trajectory adjustments. Chen et al. (2011) concluded that the mouse weight must be somewhere between 100g and 160g to minimize the neural process required to regulate the musculoskeletal system and in order to improve movement efficacy and decrease muscular cost. These findings show that the ergonomics of the mouse play a role in performance. The effects of mouse weight on performance can be balanced by adequate mouse sensitivity, which has not been yet explored in the scientific literature.

Mouse sensitivity in esports

Mouse sensitivity represents how much your cursor (crosshairs) moves in comparison with how much your mouse moves on the mousepad. In computer science and videogames, mouse sensitivity is defined by dots per inch (DPI), which represents an accuracy unit used to measure mouse optical resolution. As players can choose their hardware, they can also choose how much sensitivity they will play with. Mouse sensitivity can be high, so the player will move the mouse over a short distance to move the cursor over a long distance on the screen. Conversely, mouse sensitivity can be low, so the player will have to do a greater movement with the mouse to move it a longer distance on the screen. Mouse sensitivity can also be modified by an in-game option that differs between games, so one can decide to adjust to one sensitivity in all games or to adapt sensitivity as a function of the games played. Some games even allow players to customize mouse sensitivity between the different characters or different weapons.

One study has investigated the effect of mouse gain on mouse clicking performance and muscle activation in young and elderly experienced computer users(2). Subjects participated in a multidirectional pointing task using a computer mouse where three different targets were used: small (128 pixels), medium (256 pixels), and large (512 pixels) where 1 pixel represented 0.315mm, as well as three different sensitivity levels. When mouse sensitivity is high and targets are small, performance (accuracy on pointing) diminished, especially among the elderly compared to the young group. Decreasing the mouse sensitivity makes players more accurate against small targets

by avoiding an overshooting effect. Concerning forearm muscular activity and its interaction with mouse sensitivity, no statistical differences exist between the different mouse sensitivities but the use of an ergonomic chair with armrests probably influenced the results. According to the authors, it is possible that forearm muscular activity could be dependent on stability demand rather than on hand movements, highlighting the role of the forearm and shoulder muscles as stabilizers to maintain player accuracy and to smooth arm movements during aiming. Therefore, the shoulder and forearm muscles are constantly activated during the task, which can be detrimental for players' performance and health.

Physiological and neurophysiological impact of mouse sensitivity

Hägg (1991) pointed out that long-lasting static contraction can cause health issues because of the Cinderella Hypothesis where muscles that are constantly recruited for contraction will overload type I fibres, leading to fatigue and eventually to damaged fibres(3). Clearly, using a computer mouse can be detrimental for the musculoskeletal health(4) due to the high frequency of repetitive movements during gameplay(5), especially when players report an average of 5.28 hours of play time per day(6). This training volume puts players in a chronic mental and physical fatigue state. They have to stiffen their upper body muscles to be able to be more accurate and improve their motor control(7). By stiffening their upper body muscles, they influence their posture, which subsequently is a determining factor of their mouse sensitivity (Figure 1). The way players grip and move their mouse affects their posture and vice-versa. That is probably why some professional players measure the space between their mouse, keyboard, screen, and chair when they are on stage; they want to recreate the same performance environment they have at home. It can be explained by the muscle length-tension relationship and joint angles theory(8), which affect motor control and, therefore, mouse sensitivity. That is why posture and motor control play a part in players' health issues.

Mouse sensitivity and players' health

Recently, the health impact of intensive gaming practice has been investigated, indicating that a sedentary lifestyle and highly repetitive movements seem to be the main causes of musculoskeletal injuries(9,10). Musculoskeletal injuries are mediated by multiple factors including work schedule, psychosocial factors, stress, biomechanical and physiological factors. The biomechanical and physiological factors can be divided into four different classes: repetitive movements, excessive strength required, prolonged sustained contractions and posture, and extreme joint range of motion. Mouse sensitivity influences the extreme range of motion of some joints (e.g., the wrists when flicking to react to an enemy spotted in one's peripheral vision), repetitive movements for particular joints (e.g., the wrists to control crosshair placement and quickly react to enemies appearing in one's field of view), and the sustained and prolonged contractions of specific muscles (e.g., the upper trapezius to stabilize and stiffen the shoulder girdle during aiming). The weight of these different biomechanical interactions between the players and the mouse will differ if one player is using low mouse sensitivity when another prefers high sensitivity. It means that optimal sensitivity cannot be universal, but rather personal and is related to players' motor preferences, perception, characters and/or weapons played, and ergonomics (table and chair height, armrests or no armrests, mouse control strategy, etc.).

Currently, discussions about mouse sensitivity are based on players' beliefs and experience and it seems like individuation is the key to performance because all humans perceive and move differently. There is a lack of attention regarding how mouse sensitivity can negatively affect players' health. More information is needed to identify the required physical conditioning for every player to handle long training sessions and be performant during their whole career. A player with a low sensitivity and a fingertip grip will not have the same health issues and performance criteria that a player with high sensitivity and a palm grip will. To avoid an increase in injuries, all esports organizations must seek help of healthcare providers and performance coaches to inform their players how to adapt their daily habits and physical conditioning to their idiosyncratic mouse sensitivity and motricity. Ultimately, future studies are needed to show the impact of mouse sensitivity on upper limb muscle activity and fatigue, which will eventually guide healthcare providers and performance coaches towards more adapted and customed physical training of players.

Conclusion

A lot of features affect mouse sensitivity. These features originate from differences in perception, motor control strategy, and gameplay style of each player. There is a need for customization of physical training to avoid player performance decline, injuries, and early retirement. Esports organizations need to look for science of movement experts who can guide players towards a healthy lifestyle during their entire career.

Acknowledgements

Special thanks to Bradley J. Baker, Elisabeth Russin, and Tristan Martin who helped to write this publication in an idiomatic and understandable English. And I want to thank (again) Tristan Martin for helping me to improve the content of this article. Finally, I would like to thank the AREFE association and the Esports Research Network.

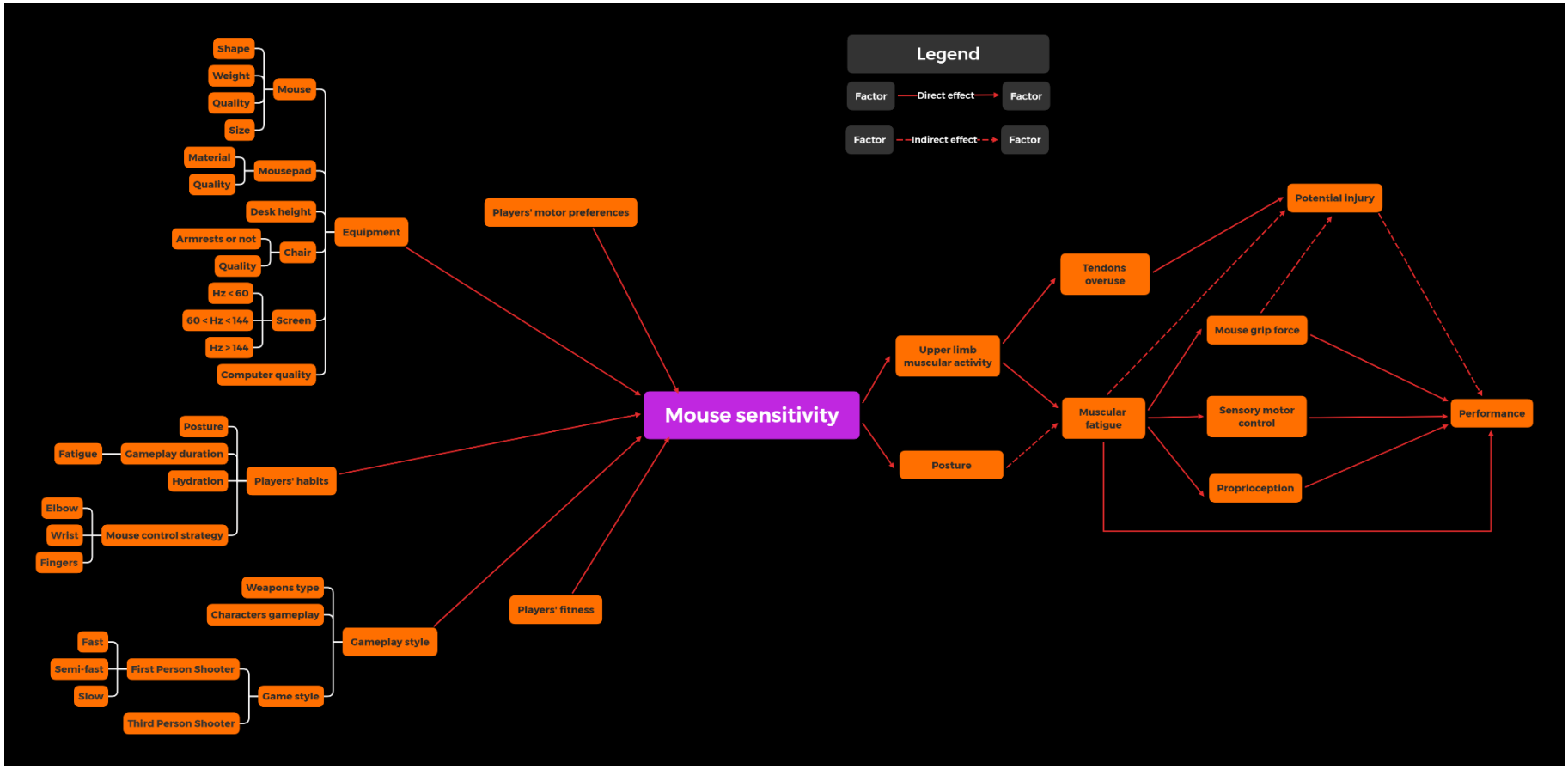

Figure 1 - Factors affecting mouse sensitivity and its impacts on esports players' health and performance.

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