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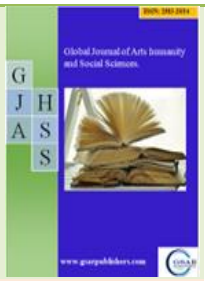

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Analysis of the Effectiveness of an Ergonomic Mouse Pen as a Replacement for Traditional Mice

By

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Abstract

Traditional mice, due to the frequent use of the index finger and limited wrist support, can easily lead to issues such as "mouse arm syndrome" (RSI), causing harm to users over prolonged periods. In contrast, the mouse pen, designed with ergonomic principles, provides a larger support platform for the arm, reduces muscle tension, distributes force more evenly across the fingers, and retains all the advantages of a pen-like shape. This paper conducts a comparative analysis of the ergonomic advantages and disadvantages of traditional mice and mouse pens, concluding that the mouse pen offers greater convenience in use while minimizing harm to the user.

Keywords: mouse arm syndrome (RSI); ergonomics; mouse pen

0. Introduction

With the advancement of technology and the widespread adoption of computers, the mouse, as a crucial tool for human-computer interaction, is being used more frequently than ever. However, prolonged use of traditional mice has revealed significant health concerns. Frequent clicking and dragging actions force the user's index finger and wrist to remain in a tense state for extended periods. Additionally, the limited wrist support area in traditional mouse designs has led many users to develop occupational ailments such as "mouse arm syndrome" (RSI) [1]. Symptoms of RSI include wrist pain, finger numbness, and arm muscle fatigue, which not only reduce work efficiency but also negatively impact users' quality of life.

Given these issues, designing a more ergonomic mouse has become an urgent challenge [2]. The mouse pen, as a novel human-computer interaction device, has garnered increasing attention from researchers due to its natural pen-holding posture. During use, the mouse pen provides a larger support platform for the arm, distributes force evenly across the fingers, and reduces muscle tension, effectively mitigating the health risks associated with traditional mouse usage.

This paper aims to conduct a detailed ergonomic comparison between traditional mice and mouse pens, analyzing their respective strengths and weaknesses to explore how improved mouse designs can minimize harm to users. Through theoretical analysis and experimental data, this study will demonstrate the potential advantages of mouse pens in reducing user fatigue and enhancing comfort, providing valuable insights for the future design of human-computer interaction devices. It is hoped that this research will contribute to the development of more user-friendly and health-conscious computer peripherals, ultimately improving both work efficiency and quality of life for users.

1. Literature Review

In modern computer work environments,the increasing frequency of mouse usage has led to growing health concerns.Research indicates that prolonged use of traditional mice can cause musculoskeletal and nerve damage in the hands,wrists,and shoulders,with symptoms commonly referred to as"mouse arm syndrome"(RSI).In response,scholars worldwide have conducted extensive research on mitigating these health risks through improved mouse design.

Jiang Haiyang et al.(2012),in a study published in Office Automation, noted that traditional mice,due to their limited wrist support and repetitive finger clicking,often lead to wrist and finger fatigue and pain[3].Similarly, Hou Jianjun(2014) highlighted in the Journal of Mechanical Design that long-term use of conventional mice can cause muscle strain in the wrist and fingers,negatively impacting work efficiency[4].

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Cao Wei et al.(2017),in a study published in Internet of Things Technologies, demonstrated that using an ergonomically designed mouse pen significantly reduces hand and wrist fatigue while improving user comfort and productivity[5].Liu Guangzheng (2018),in Internal Combustion Engine&Parts,further supported this finding,stating that the mouse pen's design aligns more naturally with the hand's gripping posture,effectively distributing pressure across fingers and wrists[6].

Additionally,Xia Jinlong (2018), in Fujian Computer,conducted an experimental comparison between traditional mice and mouse pens,revealing that the latter causes less hand strain during prolonged use[7].Tudor,C.Nicholas,and T.Aditya(2023),in JADA Foundational Science,corroborated these results,emphasizing that mouse pens significantly reduce muscle tension and enhance comfort[8].

Finally, Meng Yuxing and Zhou Xiaoru,in the journal Design, further validated the practical benefits of mouse pens in real-world work environments,underscoring their potential to improve workplace ergonomics and protect user health[9].

2. Problems and Causes of Traditional Mouse Usage

2.1 Formation of Mouse Arm Syndrome

Frequent use of traditional mice,particularly repetitive motions with the index finger,can damage wrist ligaments and lead to"mouse arm syndrome"—a condition distinct from conventional hand injuries.Among regular mouse users,wrist swelling and redness are common symptoms.When operating a keyboard and mouse with arms suspended,the spine bears full body weight,causing static shoulder fatigue,lower back pain,or even postural slumping due to weakened core muscles.Additionally,resting wrists on the desk impedes blood circulation,inducing hand fatigue and contributing to mouse arm syndrome.

The author conducted surveys on two groups with prolonged daily computer use:
(1)50 university sophomores (aged 20–22,4–10 hours/day) 68% (34/50) reported muscle tension:Palm:12| Forearm:20| Upper arm:6| Back:12|78%preferred switching to a"pen-style mouse."

(2)16 design institute engineers(aged 37–55,5–7 hours/day) 100%(16/16) reported muscle tension: Palm:16| Forearm:11|Upper arm:7 |Back:10|100% preferred a"pen-style mouse."

2.2 Ergonomic Analysis of Traditional Mice

1) The palm's grip relies on two muscle groups(thumb flexors/abductors and little finger flexors/abductors) separated by a deep groove.Compression of this groove restricts blood vessels and nerves,causing hand hypoxia over time.
2) Optimal finger posture involves:All five fingers resting naturally(no suspension).Two fingers controlling buttons; three providing support.Hand at~150°extension,with fingertip pulps aligned on micro-switches for precise clicks.
3) Wrist rotation(via forearm ulna/radius)enables cursor control.Neutral wrist position(0°tilt)is most comfortable,but traditional mice force~30°upward tilt (Figure 1a),stretching forearm muscles and impairing blood flow.

3. Replacing Traditional Mice with Mouse Pens

3.1 Force Application:Traditional Mouse vs.Mouse Pen

Ergonomically,body movements should prioritize lower-effort actions(hierarchy:legs→waist→shoulders→elbows→wrists→fingers).Traditional mice rely on wrist force,whereas mouse pens utilize finer finger motions.The pen's design aligns with the hand's natural posture,merging digital efficiency with traditional tool ergonomics.

3.2 Posture Comparison

(1) Support Platform

Traditional Mouse:Tiny support area(~4 mm²)on wrist bones,compressing nerves/vessels."Floating"posture increases static load(325 g/mm²pressure).

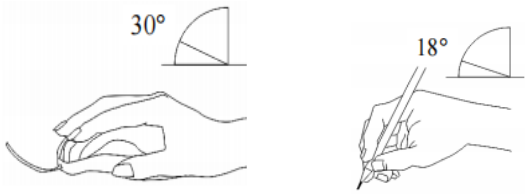
Mouse Pen:Larger support(~15 mm²)under hypothenar muscles,protecting tissues.Enables full forearm support (pressure:~100 g/mm²).
Conclusion:Mice's small support area causes excessive pressure,leading to wrist inflammation.

(2) Hand Posture

Traditional Mouse: Wrist tilted~30°upward (Figure 1a),straining muscles/circulation.

Mouse Pen: Neutral~18°tilt(Figure 1b),mimicking relaxed writing posture.

Conclusion: Mouse use induces measurable muscle tension.



（a）Use mouse gestures （bThe gesture of writing with a pen

Figure 1 uses mouse and pen gestures

(3) Force Dynamics

Traditional Mouse:
Movement relies solely on desktop friction without lever support,requiring the arm muscles to suspend and move the entire arm weight (~1,500–3,000 g).

Functions as an equal-arm lever (no mechanical advantage), resulting in inefficient force expenditure and limited cursor displacement.

Mouse Pen:
Allows multidirectional strokes (~4 cm range) with finger-based lever support (fulcrum effect), reducing effort.
Conclusion: The pen design offers greater force efficiency and

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movement range.

(4) Finger Utilization

Traditional Mouse:

Overworks the index finger(solely responsible for clicking/double-clicking),while the middle finger and thumb remain underutilized.

Mouse Pen:

Engages thumb,index,and middle fingers synergistically.

Conclusion:Traditional mice impose excessive strain on the index finger.

2.3. Ergonomic Injury Analysis of Mouse Usage

Human joint movement depends on coordinated actions of agonist (contracting) and antagonist (relaxing)muscle pairs.Optimal performance occurs when: Joints operate within a neutral range where both muscle groups remain relaxed.

This state maximizes comfort,fatigue resistance,and control precision(peak work efficiency).

Table 1 Quantitative classification of dangerous work for ergonomics injury

project			Number of days or hours per working day		
			Low risk	Highly dangerous	high risk
Finger pinch force greater than 55 N			＜25	25～120	>120
The downward pressure of the finger is greater than 90 N			＜25	25～120	>120
Force application The grip strength of the hand is greater than 230 N			＜25	25～120	>120
The force is concentrated on a small area of the skin			＜25	25～120	>120
Single-handed push or pull force exceeding 200 N			＜10	10～60	>60
Pose status The wrist is bent completely to one side			＜1800	1800～3600	>3600
Repetitive joint movements	finger	More than 8,000 times per day(excessive use)	＜12 000	12 000～16 000	>16 000
	Hands Elbow/fore arm	More than 4,000 times per day(excessive use)More than 2,000 times per day(excessive use)	＜6 000＜3 000	6 000～8 000 3000 ～4 000	>8 000>4 000
	shoulder	More than 600 times/day(excessive use)	＜900	900～1 200	>1 200

Table 1 quantifies the ergonomic injuries caused by mouse usage.The data shows that finger joints perform excessive repetitive motions up to 8,000 times/day,while wrist joints repeat movements 4,000 times/day.This indicates that wrist force drives mouse movement no more than 4,000 times daily,whereas finger force can propel the mouse up to 8,000 times daily.

The conclusion demonstrates that utilizing finger control for mouse operation can double the arm's energy efficiency.By properly employing finger strength and reducing wrist force usage,workers can decrease energy expenditure while maximizing arm productivity.The mouse pen effectively achieves this objective.As illustrated in Figure 2,its design incorporates superior ergonomic principles that embody all the advantages of pen-shaped devices.

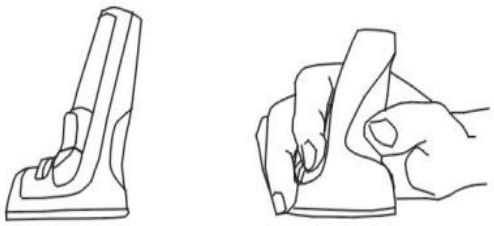

Figure 2 Mouse pen design

4. Conclusion

Through this comprehensive ergonomic comparison between traditional mice and mouse pens,we have identified that conventional mouse designs frequently lead to excessive wrist and finger fatigue,resulting in health issues such as mouse arm syndrome(RSI).In contrast,the mouse pen's ergonomic superiority—featuring an enlarged support platform and balanced force distribution—significantly reduces musculoskeletal strain and fatigue.

Our findings demonstrate that mouse pens not only enhance

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comfort and productivity but also effectively minimize the long-term health risks associated with prolonged mouse use.We recommend widespread adoption of mouse pen design principles in future computer peripherals to optimize human-computer interaction.

This study provides scientific evidence for selecting ergonomic input devices and advances the development of healthier,more efficient interaction paradigms.Through continued design innovation, we aim to create safer and more comfortable computing environments for users worldwide.

Reference documentation

1. Sun Hua, Yao Shengchang. Shape analysis and innovative design of e-sports mouse [J]. Science and Technology Innovation and Application, 2017, (16):90.
2. Hou Guiyuan. Vertical mouse design based on ergonomics [J]. China Packaging Industry, 2015, (18):25-6.
3. Jiang Haiyang, Li Liang, Zhai Laipeng, and Zhao Lijing. Design of a Pen-shaped Wireless Mouse [J]. Office Automation, 2012, (12):27-9.
4. Hou Jianjun, Shen Liming, and Liu Qingpeng. A Study on the Design of Multi-functional Mouse Pen Based on Ergonomics [J]. Mechanical Design, 2014,31(05):111-4.
5. Cao Wei, Jia Yueyuan, Wang Lingli, et al. Multi-functional wireless electronic mouse (pen) [J]. Internet of Things Technology, 2017,7(05):11.
6. Liu Guangzheng, Feng Li, Ma Xiaoyan et al. Development of Ergonomic Keyboard and Mouse Pen [J]. Internal Combustion Engine and Accessories, 2018, (04):209-10.
7. Xia Jinlong, Jia Shufei, and Yuan Kaifeng. Design and Implementation of a Multi-functional Wireless Mouse Pen Based on Axial Gyroscope [J]. Fujian Computer, 2017,33(08):31+47.
8. Tudor,Nicholas,Aditya.Ease of use in accessing electronic dental records with a touchless interface compared with a conventional mouse[J].JADA Foundational Science,2023,2.
9. Meng Yuxing and Zhou Xiaoru. A Study on Human-Machine Ergonomics Mouse User Experience Based on Online Review Text Analysis [J]. Design, 2024,37(05):144-7.

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