



Reducing Physical Discomfort and Pain Among 3D Computer Users: RESEARCH RESULTS

SUMMARY

VSI Risk Management and Ergonomics, a leading independent ergonomics consulting firm, conducted a research study of 3D computer users, specifically computer-aided designers and animators.

The purpose of this study was to learn what level of discomfort or pain was experienced by these users and to assess what impact a two-handed working style using a 3D motion controller might have on reducing discomfort and pain.

Two surveys were conducted, the first a qualifying survey of 124 computer users, and the second, a more detailed survey, of 27 users who reported how their pain changed while using a 3D motion controller.

KEY FINDINGS

- **46%** of the 1st survey's 124 users reported discomfort levels which interfered with their job performance
- **97%** of the 2nd survey's 27 participants **reported decreased pain** while using a 3D motion controller
- Using a 3D motion controller **reduced pain by 61% in the first month**, and by **77% after six months**
- **89%** of the respondents reported that reducing their discomfort was "very important" or "somewhat important" to them
- **96%** of the users of a 3D motion controller anticipated that returning to a one-handed working style with a mouse alone would cause their pain to increase.

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1. INTRODUCTION

Pain arising from intense computer use can impair a person's job performance, satisfaction and well-being. This is an important topic not only to users with pain, but also to users who wish to avoid pain in the future. By extension, it is important to managers and safety professionals wanting to ensure their staff have a healthy and productive work environment.

VSI Risk Management and Ergonomics, an independent ergonomics consulting firm, conducted a research study during February and March, 2005, to better understand computer users' pain, and the potential for reducing it.

2. FOCUS OF PROJECT RESEARCH

The primary focus of this research was to understand what impact a different, two-handed working style would have on 3D computer users who were experiencing discomfort or pain from using their computer. The two primary classes of such 3D computer users are:

- Computer Aided Designers (CAD)
- Animator and Modelers

As compared to the traditional one-handed working style (using a mouse in one hand), would users employing a two-handed working style (a mouse in one hand and a 3D motion controller in the other) find that their discomfort or pain:

- Decreases?
- Stays the same?
- Increases?

and by how much?

Furthermore, the study intended to understand how this pain might change over time, namely at one month and six month intervals of working with a two-handed approach.

3. EXPERIMENTAL DESIGN

The target population for this study was intense 3D computer users who had experienced discomfort and who had worked with both the traditional one-handed approach as well as the two-handed working style with a 3D motion

controller. A 3D motion controller is a device, such as 3Dconnexion's SpaceBall or SpaceMouse, that allows the user to pan, zoom or rotate with the motion controller in one hand while simultaneously selecting or editing with the mouse in the other hand.

Participants would be recruited while registering their 3Dconnexion motion controllers, via an offer to participate in an ergonomic survey.

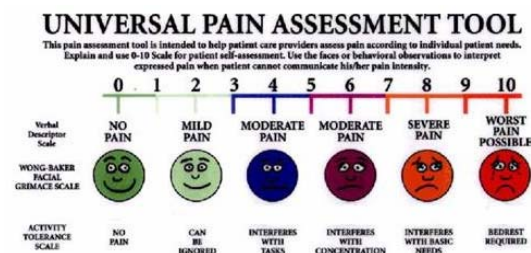
3.1 First Survey

An initial survey would be sent to qualify users by asking what primary application they used, how many hours per day they used it, and their level of discomfort or pain prior to using a motion controller in their second hand.

3.2 How to Measure Pain

One of the key elements of this experimental design was to determine the most appropriate instrument for measuring pain.

Shown below, the Visual Analog/Numerical Pain Scale (VA/NPS) uses a numerical scale (0-10) depicted on a visual horizontal line.



For further clarity, the scale is augmented by a Verbal Rating Scale (at the bottom) which includes descriptors of the pain's impact.

The VA/NPS was selected because various studies have shown it to be sensitive to change, repeatable and easy to use. Thus, this scale is widely used for experimental and clinical study. Major health institutions and hospitals such as Stanford University Medical Center use the VA/NPS as their principal pain instrument.

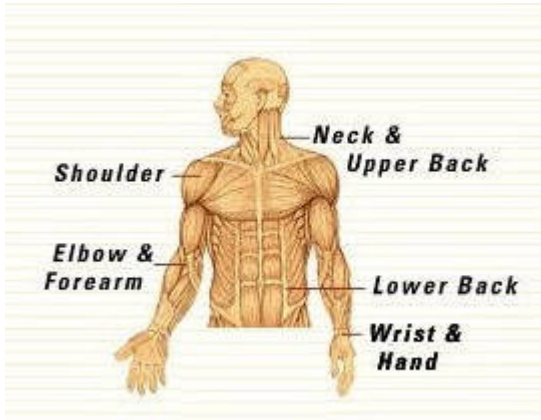
3.3 Second Survey

Then, a second survey would be offered to those respondents who had pain levels of "2" or higher.

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This 2nd survey would focus on assessing what changes in discomfort and pain occurred after using a 3D motion controller for one month and, where applicable, six months.

This survey would also elicit information about where the pain was located in their body, as depicted on the upper body diagram below.



Users would also be asked their attitudes towards reducing pain, and how important they considered it.

Finally, an anticipatory question would be asked to understand what impact stopping use of the 3D motion controller would have.

4. RESEARCH RESULTS—1ST SURVEY

One hundred twenty-four (124) individuals participated in the first survey. As expected, most of these users used their computers for 4-8 hours, primarily focused on one “professional” application.

4.1 Applications Representation

Respondents represented all the major CAD and Animation & Modeling applications, as listed in the table below.

Applications Represented	
CAD	ANSYS CATIA Inventor Pro/Engineer Solid Edge SolidWorks Unigraphics VX
Animation & Modeling	3ds max Cinema4D Maya SOFTIMAGE XSI

4.2 Company Size Representation

Participants included 3D users from small, medium and large organizations, ranging from independent contractors to employees of Fortune 50 companies.

4.3 Geographical Representation

Respondents were recruited worldwide, and came from numerous countries, including:

- U.S.
- Canada
- Finland
- France
- Germany
- Italy
- Netherlands
- Sweden
- UK
- Japan
- Australia

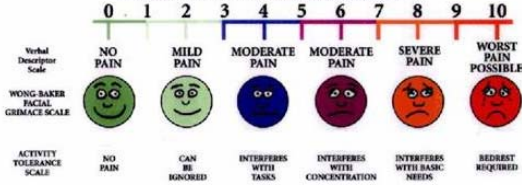
4.4 Reported Pain Levels

Pain is perceived individually, so that the same stressor can be perceived by two individuals as different levels of pain. The VA/NPS (below, again) is able to accommodate these different pain tolerances, and to also capture the changes in pain levels as perceived by each individual.

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UNIVERSAL PAIN ASSESSMENT TOOL

This pain assessment tool is intended to help patient care providers assess pain according to individual patient needs. Explain and use 0-10 Scale for patient self-assessment. Use the faces or behavioral observations to interpret expressed pain when patient cannot communicate his/her pain intensity.

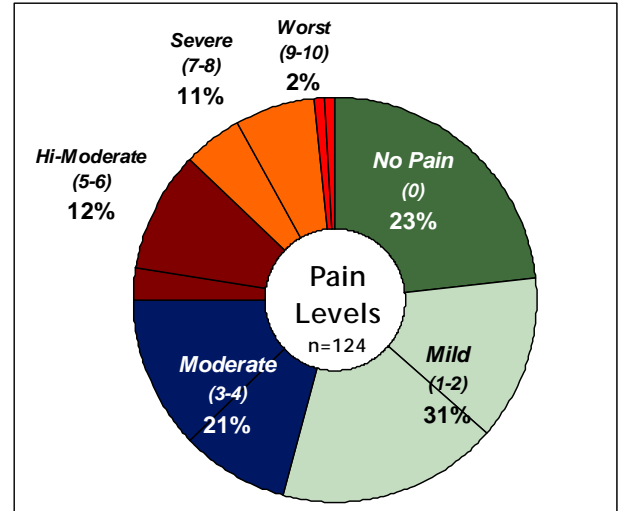


Each level of pain (none, mild, moderate, high moderate, severe, worst) is described by the impact it has on one's work, as well as the increasing impact on the organization, as shown in the table below:

Pain Level	Impact on Individual	Impact on Business
None (0)	None	
Mild (1-2)	Aware of the pain, but can be ignored	
Moderate (3-4)	Interferes with tasks	
High-Moderate (5-6)	Interferes with concentration	
Severe (7-8)	Interferes with basis tasks	
Worst (9-10)	Bed rest required	

Whereas the user is aware of mild pain and above, his work is impacted with pain levels of moderate or above, indicated by the arrow, making the pain not only an individual health issue, but also a business performance issue.

The 124 respondents to the first survey spanned the entire 0-10 pain range, as indicated in the chart below.

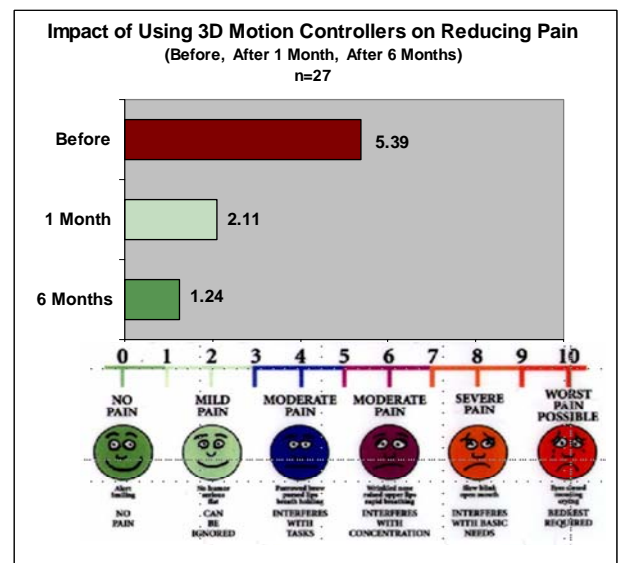


46% of the respondents reported moderate or higher pain, and a combined 77% reported mild pain or higher.

5. RESEARCH RESULTS—2ND SURVEY

5.1 Pain Changes

Using a two-handed working style with a 3D motion controller was shown to substantially reduce pain, both in the first month, and yet further after six months, as depicted in the chart below:



Respondents had an average pain level of 5.39 (high-moderate), before using a 3D motion

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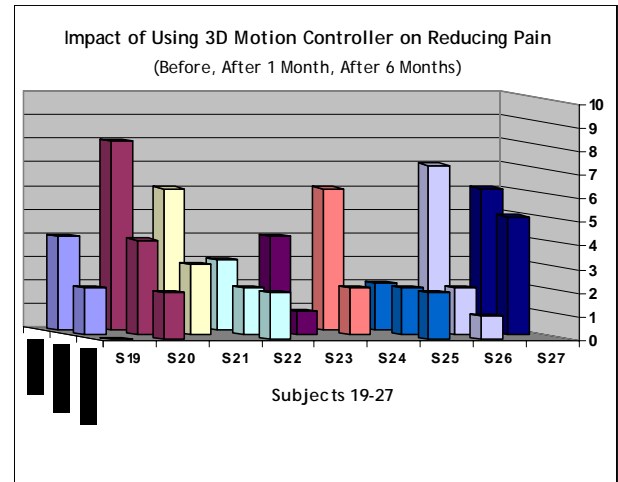
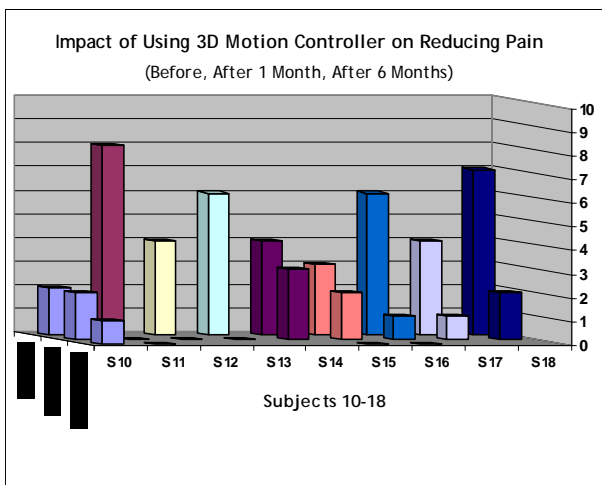
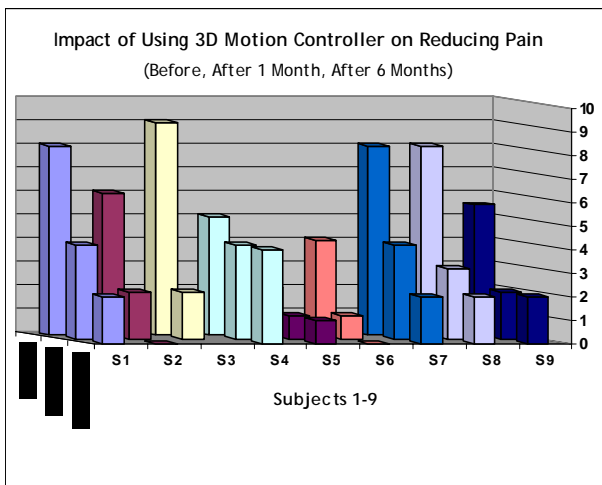
controller, where the pain would interfere not only with tasks, but also with concentration.

After one month, the average pain was reduced 61%, down to 2.11 (mild pain), where the user was aware of their discomfort, but could ignore it.

After six months, the pain was reduced even further, from 2.11 to 1.24, another 41%, down to the boundary of no pain and mild pain.

The average total pain decrease over six months was 77%.

The detailed results of all 27 participants in the second research survey are shown below, in three groups of nine for readability.

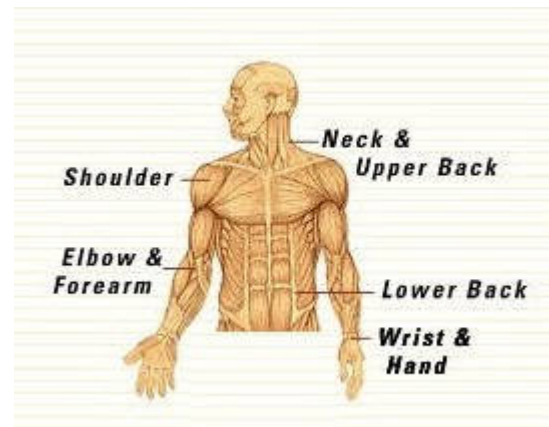


A few observations about the results:

- 97% (26 of 27) of the respondents pain decreased over their period of use (1 or 6 months)
- 93% (25 of 27) of the respondents pain decreased in the first month
- No respondents increased pain, either at one month or six months

5.2 Where the Pain Occurs

Participants were further asked to report where they experienced discomfort before and after using a 3D motion controller, using the upper body illustration below.



Quantitative results were not generated for this question. However, a number of important observations can be made from the responses:

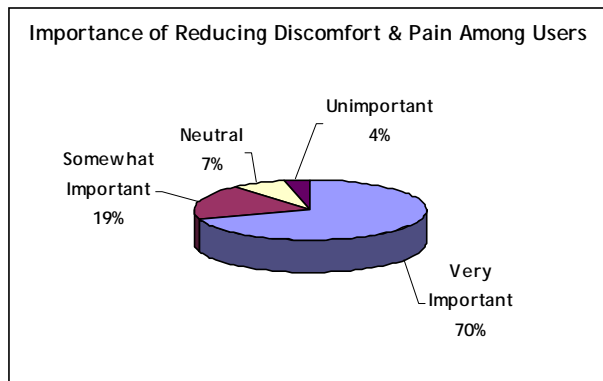
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- The discomfort and pain users reported before using a 3D motion controller was very “one-sided”—focused on the side of the body (hand, arm, shoulder, lower back, neck) which used the mouse
- Users could report specific upper body areas where their pain was reduced or went away entirely after using a 3D motion controller

5.3 Attitudinal Assessment

Given the reductions in discomfort and pain, this study was interested to assess how much this mattered to users. Was it really important or just a “nice to have”?

In order to assess user attitudes toward their pain, participants were asked how important it was to reduce their pain. A Likert-type 1-5 scale was used, with “1” representing “unimportant” and “5” representing “important”. The results are shown in the chart below.



Some observations about the results:

- 89% of users felt that reducing their discomfort and pain was “very important” or “somewhat important”
- Only one user felt it was “unimportant” and two users perceived it as “neutral”

5.4 Anticipatory Assessment

Respondents were asked what discomfort result they would anticipate if they were to return to their previous one-handed working style without a motion controller.

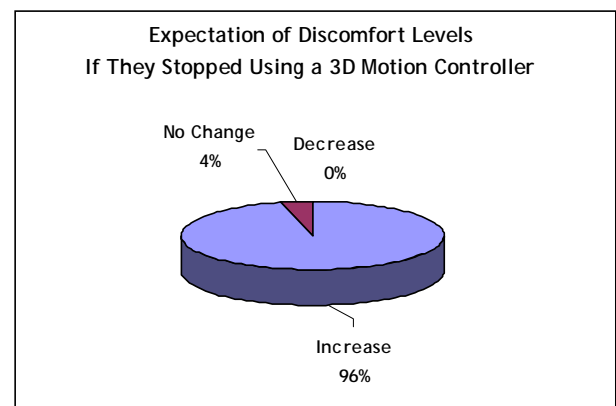
This question seeks to get at two issues:

- How strongly do participants believe that continuing use of a 3D motion controller is important to keeping discomfort at bay?
- By inference, would using a 3D motion controller likely “prevent” pain from occurring in users who might otherwise experience discomfort or pain?

Participants were asked, if they had to again work without a 3D motion controller, would they anticipate their discomfort to:

- Decrease
- Stay the same
- Increase

The results are charted below.



No respondents believed their pain would decrease. Only one user felt his pain would stay the same. The remaining 96% all believed their pain would increase if they were to stop using a 3D motion controller.

This response suggests that early use of a motion controller would be able to prevent future discomfort or pain from ever happening. One user, with a “before” pain rating of “2” remarked that it was “only 2” because he “got the SpaceBall early”. Another user cited “I suppose my pain would return to the original level of before the SpaceMouse.”

6. RESEARCH CONCLUSIONS

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Of the 124 initial respondents, 46% indicated pain levels that would interfere with their job performance, not to mention their health. And an additional 31% reported “mild pain” that they were conscious of, but had not yet impacted their work. 23% reported no pain whatsoever.

A two-handed working style, employing a 3D motion controller together with a mouse was shown to significantly reduce pain, by 61% within the first month, and by 77% after six months.

Users perceived that reducing pain was very important to them and that if they had to return to working without a motion controller, their pain would increase.

7. RESEARCH RESULTS IMPLICATIONS

This study purported to provide users and management with research results which could lead to recommendations regarding the reduction and prevention of pain among intense 3D computer users.

The primary implications from the research results are, as follows:

- Users experiencing discomfort or pain would be well advised to use a 3D motion controller to reduce their pain. They should see this as an important health issue and seek support from their management and safety departments.
- Users concerned about potentially developing discomfort or pain should consider using a 3D motion controller to avert this pain. The anticipatory response of current users suggests that 3D motion controllers could prevent or lessen pain in those who would otherwise develop it.
- Finally, managers and safety professionals should understand that both the health and the performance of 3D computer users can be measurably impacted by pain. If users report pain or seek assistance, 3D motion controllers should be considered as one important component of a healthy working environment.