The DXT Mouse

James Bowden MCSP MSOM
Stephen Bowden BSc Hons (Human Factors)

Development

Design Objectives

- Improve productivity
- Usability – left and right handed
- Fit as many hand sizes as possible
- Reduce risk of MSD
- Attractive design

Forms of grip

Napier* showed that all forms of grip can be grouped as either :

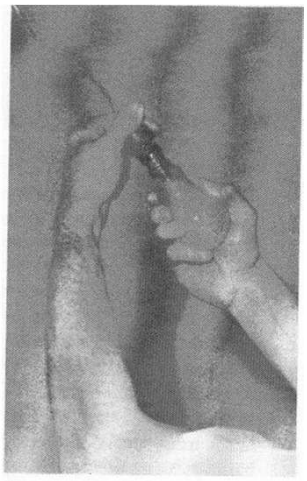
a) Power grips
   or
a) precision grips

Power grip is thought to have developed early in humans and consists of a prehensile movement in which the object is grasped by the fingers and pressed against palm. This is a powerful movement with little skill involved.

Precision grip is thought to be the most recent adaptation of the evolving human hand. It is an accurate prehensile action in which the object is held away from the palm between thumb and fingertips

*Napier JR 1956. *The prehensile movements of the human hand*. J Bone Joint Surg;38B:902-913.

Power and precision grips



Kinetics and comparative anatomy

- The human hand is not much different from that in a chimpanzee with some exceptions:
  - position at rest
  - opposability of the thumb
  - relative lengths of the fingers and thumb

Position of least tension/rest

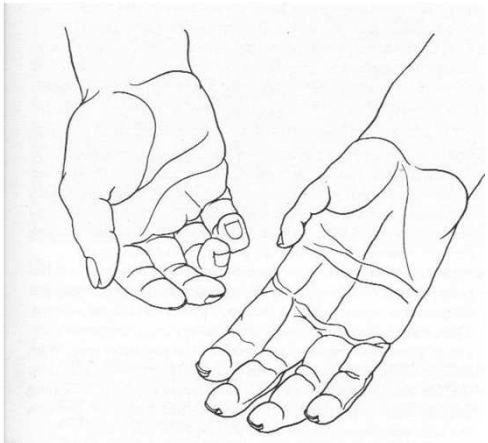
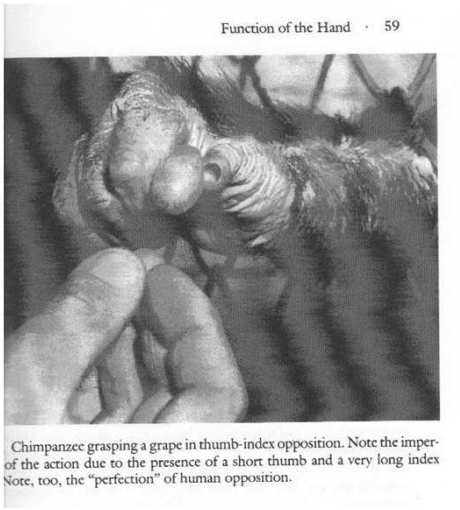


Fig. 27. Human (left) and chimpanzee (right) hands in a position of rest.

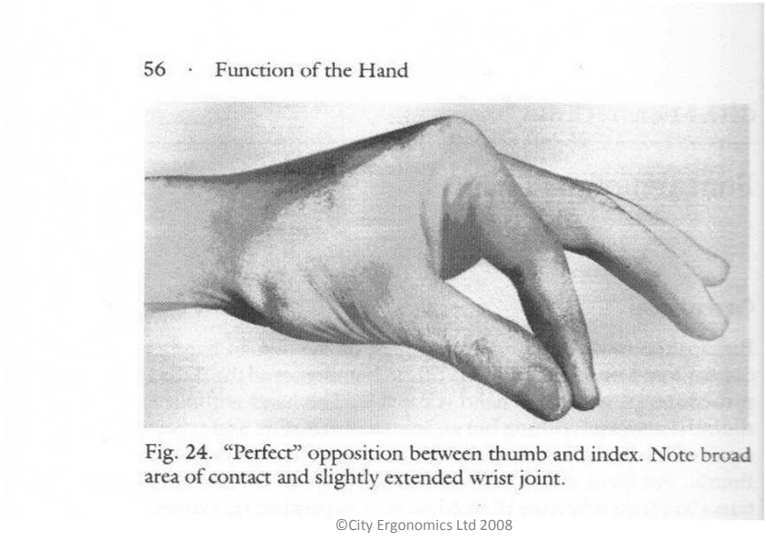
Opposability of the thumb & relative lengths of the fingers and thumb



Function of the Hand · 59

Chimpanzee grasping a grape in thumb-index opposition. Note the imper-
of the action due to the presence of a short thumb and a very long index
Note, too, the "perfection" of human opposition.

Perfect opposition and band width



56 · Function of the Hand

Fig. 24. "Perfect" opposition between thumb and index. Note broad area of contact and slightly extended wrist joint.

Cortical representation & band width

Differences between proximal and combined proximal with distal control

Proximal Control

- Reduction in precision
- Concentration of load
- Concentration of muscle activity

Proximal Control and Distal Control

- Optimal precision
- Distribution of load
- Distribution of muscle activity

The most common features of existing "ergonomic" mice	Ideal features of an ergonomic mouse
• Sloped palm	• Sloped palm
• Palm-conforming shape	• Non palm-conforming shape
• Click buttons that support the entire length of the extended fingers	• Click buttons that avoid supporting the entire length of the extended fingers and utilise sensory nerve endings in finger pads
• Proximal focus on a particular limb segment for their entire operation.	• Use of all limb segments for their operation

Development

Design Objectives	Solutions
• Improve productivity	• Utilise available band width from upper limb
• Usability – left and right handed	• Finger pad grip
• Fit as many hand sizes as possible	• Precision grip – optimise the thumb and index finger to work together
• Reduce risk of MSD	• Symmetrical design about a vertical plane with common set of finger buttons
• Attractive design	• Utilise "chuck function" of fingers and thumb and avoid filling the palm
	• Avoid horizontal palm position
	• Distribute load
	• Utilise hand position of least tension
	• Design consultancy

Features and Benefits

Feature	Advantage	Benefit
Symmetrical about a vertical plane	Allows right or left handed use	Can be used to aid recovery or potentially prevent upper limb disorders Anyone can use the mouse
One set of click buttons for use by either hand	Left and right click function does not have to be changed when using other hand.	Allows users to quickly change hands and use left and right click functions intuitively
Designed to accommodate 1st percentile Asian to 99th percentile US male	One size fits (nearly) all	Reduced procurement and stockholding costs
400, 800, 1600 DPI selection	Allows DPI to be specific for individual users	Improves mousing experience.
Positioned and moved by either the pads of the fingers or gross arm movements or a combination of the two	Spreads the postural loading throughout the upper limb and reduces static activity	Reduce incidence of upper limb disorders
Manipulated by the fingers and thumb	Enables precision grip Speed and accuracy improved	Improved productivity
Compact	Increased desk space and can be used in confined space such as on trains	Improved productivity and more likely to be used by laptop users in the field
Can be used in the mid line (in front of the keyboard)	Improved accuracy	Improved productivity
Modern look in keeping with general office designs	Does not shout that the user has a problem.	Increased acceptance

Design Conclusions

- The precision grip that does not involve the fingers being held in an extended position but in a position of mid flexion of the fingers and thumb without the object being in contact with the palm of the hand.
- In order to improve the speed and accuracy of mousing the design of a mouse should utilise the precision grip. In order to achieve this mouse design should allow for the mouse to be manipulated by the fingers and thumb tips and be compact enough to allow the body of the mouse to be drawn towards the palm of the hand.
- Such a design will utilise the rich sensory nerve endings that populate the tips of the fingers. These nerve endings are less likely to be used efficiently when a mouse design promotes full contact of the palmar surface of the fingers and thumb as is the case with a range of ergonomic mice currently on the market.
- A design which allows precision movement by the fingers will not restrict the control of movement to the hand but will enable the user to choose to spread the postural loading throughout the limb thus increasing the potential to increase both speed and accuracy whilst potentially reducing the risk of upper limb disorders.