Input Technologies and Input styles
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input modalities (p. 96)
Instead of looking at as intrinsically good or bad, we need to consider their usefulness in the context of specific use cases.

They argue with Guiard, that instead of viewing input modalities as a *competition*, it should be considered how modalities *cooperate*, and how enable a division of labor. (p. 98) They also refer to this view as a ***multi-modality perspective***.

They use the term ***breadth-depth dichotomy*** for the dilemma that designers face between one-size-fits-all and a more specific and customized, perhaps for a smaller user base. (p. 98)

The design should be tailored to the input modality instead of viewing the input modality as arbitrary. (p. 98)

Input devices sense physical properties of humans and things. (p. 99) The visual feedback from the interaction with the input devices need to be considered. Consider: physical sensor, feedback, ergonomics, industrial design, its relation to the the possible interactions and other devices in the environment.

They argue against terming input modalities ***natural*** and that the conceptual models and mappings for fx touch are not psychologically innate. There is "no inherently natural set of gestures" (p. 100)

They define the ***interaction technique*** as the total complex of input and output, hardware and software, which enables the accomplishment of tasks for a specific conceptual model. They give the gestures for zooming in on a touch screen as an example.

Input device properties (p. 101) can be classified in terms of the properties sensed, where it is possible to distinguish between absolute (fx position) and relative sensing (fx movement). Other properties: Number of dimensions of the input data, the ***device acquisition time*** could be the time it takes to move the hand from the keyboard to the mouse.
A ***direct-input*** devices has "unified input and display surface", most obvious is the touch screen. (p. 101) Considerations: Fatigue, multi-touch, force applied, angle of

pen or finger, distinguishing stylus from hand. Also relevant is hand posture and ***shape-based input*** (p. 104) which fx can give more information about how the hand touches the surface. Which finger? Also ***in-air sensing*** is possible, by using cameras.

Latency (p. 105) must not exceed 100 ms and for direct-input it needs to be far below.

Indirect-input devices avoid *occlusion*, because the device is in a different place than the display (p. 105). They argue that the mice will be used for pointing for many years to come, and that indirect-input devices are still important fx in cars.

Input device states: Buxton has a three-state model for devices (p. 107): Out of range, tracking, dragging, also referred to simply as state 0, 1, and 2. These are needed to implement the various functionality needed for effective interactive systems. The mouse and touchpads are both two-state systems but not the same, since on a touchpad no tracking is done when the finger is not on the surface. Thus a mouse moves between state 1 and 2, touch between 0 and 2. *Proximity-sensing* devices can have a state system with both 0, 1 and 2, but there are problems.

In ***phrasing*** (p. 109) extra *degrees of freedom* are added, fx the state that a user presses down while moving the mouse allows for menus, by using muscular tension.

It is non-trivial to determine the best mode of interaction for a given task, since all tasks such as “create square” (p. 110) would be a part of a system supporting other tasks, thus necessitating considerations on the ***context of surrounding operations***.

Fitts’ law (p. 110) is an empirically supported equation which describes the time of movement from the beginning point to the target point (fx a place on the screen) as a function of the distance (amplitude A) and the size of the target (the width W). There are also constants a, b which depend on the specific device. $T = a + b * log\_2(A/W + 1)$ It can be used to identify the bitrate of the user’s motions. (MacKenzie) It can be used to optimize placement of icons.

Transfer functions (p. 111) are the mathematical or algorithmic functions which translate the signals from the input devices to its correlate in the interactive system, fx the acceleration and velocity of movement of the mouse should have an appropriate correlate with the cursor.

The QWERTY keyboard layout dates to 1868 (p. 113), extremely well-suited for longer text entry. For users, the ability to type on a keyboard is ***procedural memory***.

The layout is also used for mobile phones, where they are mostly used as *two-thumb keyboards*, both mechanical and touch. Keyboard is 60 wpm, handwriting is 15 wpm.

Cadoz has ***3 categorises for hand gestures*** as semiotic (thumbs up), ergodic (press the button) and epistemic (gain information fx by touching). Non-trivial to identify when a movement starts and stops, distinguish it from accidental.
Whole-body techniques usually use computer vision. Microsoft Kinect can be used.

Sensing of muscle activation can be done with electromyography (Saponas 2009)

The form factor is the physical configuration, the size, the form of the device.

Machine learning will become important to exploit the low-level data from input devices. (p. 122) Representation of this data, so that it can be used by different software will also become important.