

## Teaching Gestures

design for discovery

provide the right cues—visual signifiers that help users discover easily how they can interact

### EDUCATE IN CONTEXT OF THE ACTION

- Use just in time tips and focus on explaining a single interaction
- Hint at gestures by providing obvious, contextual clues.

WHAT MAKES A GOOD GESTURE [<https://gigaom.com/2013/08/19/heres-what-you-need-to-know-about-the-future-of-gesture-based-ui-design/>]

- **It's easy to do.** This means it's not only a simple movement, but one that we can do one-handed while on a bumpy subway or with a bag of groceries.
- **It's easy to remember.** Easy gestures are easy to remember but you also have to feel like it's important enough to want to remember.
- **It's intuitive.** This means it feels how you would behave and that the motion, on a subconscious level, corresponds with the action it does.
- **It serves a useful purpose.** This might seem obvious, but it's easy for designers to get carried away with a gesture whose worth isn't commensurate with the effort it takes to make it happen. Users aren't going to go out of their comfort zone — they're certainly not going to tap twice and twist — for a result that isn't going to make their lives easier.
- **It is a joyous experience.** Winkler says a good gesture feels “like magic.” The user experience is the X factor and it's not easy to explain. But it is part of the way we think about—and enjoy—technology. According to Brock, “We're in the era of actually living with things, and they have meaning in our lives. Like a pair of old shoes or jeans that aged well, you live with these things and they conform to you.”

### USE ANIMATION TO COMMUNICATE GESTURES

- Hint motion, or animated visual hint, shows a preview of how to interact with an element when performing the action. It aims to create associations between the gesture and the action that it triggers.
- Content teasers are subtle visual clues that indicate what's possible.
- Give some elements of your UI a high affordance to point users to features in an interface, and use bounces or pulses as an indicator of an available gesture.

TEACHING METHODS [[http://home.ieis.tue.nl/rcuijper/reports/HTIMasterthesis\\_ElineJansen\\_0580766.pdf](http://home.ieis.tue.nl/rcuijper/reports/HTIMasterthesis_ElineJansen_0580766.pdf)]

- Imitation, participants observed a human arm performing the gesture.
- pantomime, participants observed an animated interface-object that communicates the gesture by means of object affordances.
- combination method in which the participant simultaneously observed both stimuli

## GESTURE CATEGORIZATION

- intuitive or unintuitive (depending on the inherent task-association)
- Learnability, and memorability
- **Deictic** gestures are manual pointing gestures which are intended to establish joint attention (Kelly, Barr, Breckinridge Church, Lynch, 1999). The main function of deictic gestures is to locate characters in space, and to depict the spatial relationships between them
- **Iconic** 4 gestures “imagically depict[s] objects, qualities, or activities” (p.579, Kelly et al., 1999) by imitating (a part) of the action. Iconic gestures can serve two functions. They can serve to elaborate on the manner in which an action is performed, or they can serve to clarify the viewpoint from which an action is described (Cassell et al., 1998).
- **Metaphoric** gestures are intended to depict a concept without a physical form (e.g. duration) (Cassell et al., 1998).
- Beat gestures serve to support the textual aspects of a message, but are not influenced by the content of the message (e.g. when moving hands between grammatical parts of a long spoken sentence) (Cassell et al., 1998).
- **Pantomime** gestures depict actions or objects without the need for accompanying speech (McNeill, 1992). The form of the gesture is relatively unconventional, but might be affected by cultural or linguistic characteristics.
- **emblems** (also called quotable gestures) are standardized gestures (e.g. ‘thumbs-up’) which are highly influenced by cultural conventions, and therefore have a consistent form (McNeill, 1992). This is also the case for gestures used in sign language. But in sign language each linguistic structure has its own conventional sign which makes it a complete language without any links to hearing languages (McNeill, 1992).
- **Interactive** gestures, as defined by Bavelas, Chovil, Coates, and Roe (1995), are gestures which regulate dialogues (e.g. turn taking).

## GESTURE ASSOCIATION TYPES

Tasks that were perceived as being easy resulted in more ‘interface object’ gestures. More difficult tasks resulted in more ‘common gestures’ and in gestures without a clear association.

- ‘interface object’ included all gestures that participants associated with the interaction with objects or interfaces (e.g. the pantomime of rotating a rotary knob).
- ‘common gestures’ included all gestures that were standard in human language (e.g. thumbs-up).
- ‘Abstract conceptual model’ gestures were based on associations that were not related to the current task, other object, or interface, nor were common gestures (e.g. drawing a semi-circle in reference to the sun-set).
- ‘direction’, includes all pointing gestures

## HUMAN NATURE

- It is suggested that when observing an action the human mind is mainly interested in the action’s goal (‘end’) and subsequently in the means (De Lange, Spronk, Willems, Toni, & Bekkering, 2008; Bekkering, Wohlschläger, & Gattis, 2000). The goal of an action can already be known by the observer or could be inferred during action observation
- ‘learning by object observation’. An assumed advantage of this method is that the actions goal is clearly visible. In addition, the object’s action possibilities can be communicated through its affordances; “the perceived and actual properties of the thing, primarily those fundamental properties that determine just how the thing could possibly be used” (p.9, Norman, 1988).
- Point to Select

## PANTOMIME GESTURES

- Pantomimes are gestures which are formed in the working memory and involve stored information of perceptual object characteristics, action semantics and stored procedural programs (Bartolo et al., 2003).
- the transitiveness of pantomimes is debatable; pantomimes refer to an object, but the object is not physically present.
- Firstly, because pantomimes are intrinsically associated to objects, the affordances of these objects are expected to lead to automatic processing, similar to the effect of the affordances of physical objects. In addition, it is expected that these affordances will result in clear communication of the required movement (i.e. the gesture to be performed). Secondly, because it is assumed that the human mind is at first interested in the goal of a movement (De Lange et al., 2008; Bekkering et al., 2000), and the pantomime method communicates a clear goal, it is expected that the pantomime teaching-method results in better gesture memory than the imitation teaching-method.

## RESULTS

- The results showed that, as expected, there was a large main effect of intuitiveness both on the percentage of correct recall and on response time. This finding stresses the importance of intuitive gestures for the learnability and memorability of a gesture-set.
- The results showed that participants in the pantomime condition recalled, on average, fewer gestures than participants in the imitation and combination condition.
- Participants in the combination condition recalled the largest percentage of gestures, which could suggest that the imitation method and the pantomime method complement each other.
- the results for the teaching-methods were highly influenced by the intuitiveness and the type of the gestures, and the practice condition participants were in.
- Practice did not improve recall as would be expected. [goes against most other studies]

## OVERALL LEARNINGS

- First, it shows that it is important to control for the intuitiveness of the gestures, because it has a large main effect on both recall and response time.
- Second, it shows that it is important to control for gesture type. Although gesture type did not have a significant main effect it did interact with the different teaching-methods, especially for unintuitive gestures.
- Third, it shows the importance of proper stimulus design for interpretation. Although the stimuli resulted from multiple iterations and were tested in preliminary tests, there were still participants who misinterpreted the meaning
- fourth, it is important to control the expectations of the participants related to the gestures, especially because the term 'gesture' can imply different types of movements.
- all teaching methods can be used to teach gesture-sets.
- Secondly, showing only a human arm or an arm and an object potentially results in the least amount of errors caused by interpretation and potentially by expectations.
- Thirdly, intuitive emblem gestures appear to be influenced less by the way they are taught, compared to object based gestures.
- Fourthly, for unintuitive gestures participants require many more stimulus presentations before remembering a complete gesture-set.
- To facilitate a steep learning-curve for the user, a gesture-set should be used that contains a maximum of eight gestures. Preferably, only 'easy' (as defined by the users) and common interaction-tasks should be performed by means of gestures
- **For a gesture-set containing unintuitive gestures the combination method should be used.**
- when direct and flawless interpretation is required, emblems must be used instead of pantomime gestures.

## **Gesture Feedback: [<http://iihm.imag.fr/publs/2016/DelamareetalAVI2016.pdf>]**

- The results show that a concurrent feedback, which visually simplifies the 3D scene during the execution of the gesture, increases the recognition rate, but only during the first two repetitions. After the first two repetitions, users achieve the same recognition rate with a terminal feedback (after the execution of the gesture), a concurrent feedback, both or neither.
- Finally, the results also show that displaying upcoming portions of the gestures allows 8% faster completion times than displaying the complete remaining portions
- if the system knows which gesture the user wants to perform (e.g., practice phase), the guiding system should include both concurrent (better recognition rates during the first trials) and terminal feedback (users' preferences).
- if there is no practice phase enabling terminal feedback, then using only concurrent feedback is a viable solution. In addition, we showed that this concurrent feedback is beneficial only during the first two repetitions
  - This result is important since it experimentally reinforces the recommendation for early removal of concurrent feedback: indeed previous results showed that the removal of the concurrent feedback allows avoiding of negative impact on motor learning when users become experts
  - concurrent feedback does not contribute to better performances after the first two repetitions. Our design recommendation is then to provide concurrent feedback for novice users only, as well as terminal feedback if possible.

## **Gesture Feedback Types**

### **2 repetitions, equally accurate no matter which feedback type provided**

- **Terminal** provides a terminal feedback after training a gesture
  - (i.e. "nice job" or "not quite right").
  - visual comparison of the executed gesture and the intended one. (only works if system knows what gesture user is attempting, i.e. training scenarios)
- **Concurrent**
  - Can cause issues if user rely on it too much, should adapt to user experience level.
  - allows a better recognition rate during the familiarization with the guiding system.
  - Helps reduce the visual complexity during the execution of the gesture
- **Guidance System**
  - displaying the upcoming portions of gestures led to a 8% faster completion time than displaying the complete remaining portions

## **Gesture Challenges**

- it is still difficult for novices to discover (1) which commands are available,
- (2) what is the gesture corresponding to a command
- (3), how to perform the gesture.

## **Gesture Difficulty**

- A gesture can be (1) perceived difficult by users [24],
- (2) difficult to execute because of its geometrical factors such as its shape, and/or
- (3), difficult to recognize because of similar gestures in the gesture set.
- sources of difficulty will likely be related to the way gestures are presented to users. For instance, a horizontal line will be more difficult to execute if it is seen from a horizontal viewpoint than with a vertical viewpoint from the top
- In principle, gesture-based input has the disadvantage that the gestures need to be remembered, whereas menu entries only need to be recognized. This requires greater cognitive effort and increases the risk of false input commands. This disadvantage is minimized, however, if the gestures that need to be remembered are intuitive.  
[<http://www6.in.tum.de/Main/Publications/Staub2011b.pdf>]

Gesture Guiding Systems [[http://iihm.imag.fr/pubs/2015/taxoguide\\_finalDOI.pdf](http://iihm.imag.fr/pubs/2015/taxoguide_finalDOI.pdf)]

- Feedback: the feedback mechanism should provide information about the performed gesture and how well this gesture is executed or recognized
- FeedForward: the feedforward mechanism should show two types of information: (a) available commands to the user as well as (b), how to trigger the commands.

Feed Forward:

- The guide can provide a minimal hint regarding the direction only, a portion of the gesture or the whole gesture.

Gesture Guide Systems

For mid-air gestures, however, there are no comprehensive solutions that increase the visibility of the available gestures, provide guidance on how to execute those gestures and are tailored for usage without prior training.

[[http://krisluyten.net/research/publications/interact2015/Gestu-Wan-Rovelo\\_et\\_al-Interact2015.pdf](http://krisluyten.net/research/publications/interact2015/Gestu-Wan-Rovelo_et_al-Interact2015.pdf)]

Gesture Guiding Systems – search key