What makes a Virtual Human Alive ?

video1

1. Avatar & Autonomous Virtual Humans
2. The complexity of expressive movements
3. From artificial to real: the uncanny valley
4. Motion capture is part of the solution (offline/online)
5. Perception of real-time animation
6. Core real-time VH believability factors
7. Other R&D efforts & exercises

1. Terminology: Avatar vs Agent

- **Avatar** : [W]
  - (from sanskrit): is a term used in Hinduism for a material manisfestation of a deity
  - (computing): the graphical representation of a ***human user***. In VR the avatar movement is expected to be partially or completely driven by the user body movement (similarly to VTubers)
- **(Autonomous) Agent or (Intelligent) Virtual Human**
  - fully computer controlled
  - for the evaluation of a Virtual environment (e.g. Pedestrian from a crowd in an emergency simulation)
  - For training purpose: the VH takes an active part in a scenario, e.g. coach, instructor, assistant, or audience in a public speaking to overcome such a phobia, etc…
    - either pre-scripted or reactive to the user action or actived through a Wizard-of-Oz approach (e.g. NPC)

*note: the recent AI buzz tends to misuse the word **avatar** for purely offline productions (e.g. meteo/news/tutorial video presenters or virtual influencers)*

2. The complexity of expressive movements

- Human expression is multi-modal:
  - Gestures should be considered to be “full-body” even if they seem to involve only the hands and arms.
  - Gestures production always includes some balance control
  - The body movement is linked to the gaze & facial expression
  - Verbalization & emotions animate the mouth and eyes
  - The vocal prosody reflects intentions and emotions
  - The tongue makes complex movements when speaking
  - Cloth, accessory, hairs, sweat, tears, human tissue dynamics can be important ***secondary movements***

ANVIL [K2011-17]

- Analysis tools are necessary to understand part of these subtle interactions [K 2011]:
  - ANVIL (open source project) http://www.anvil-software.de

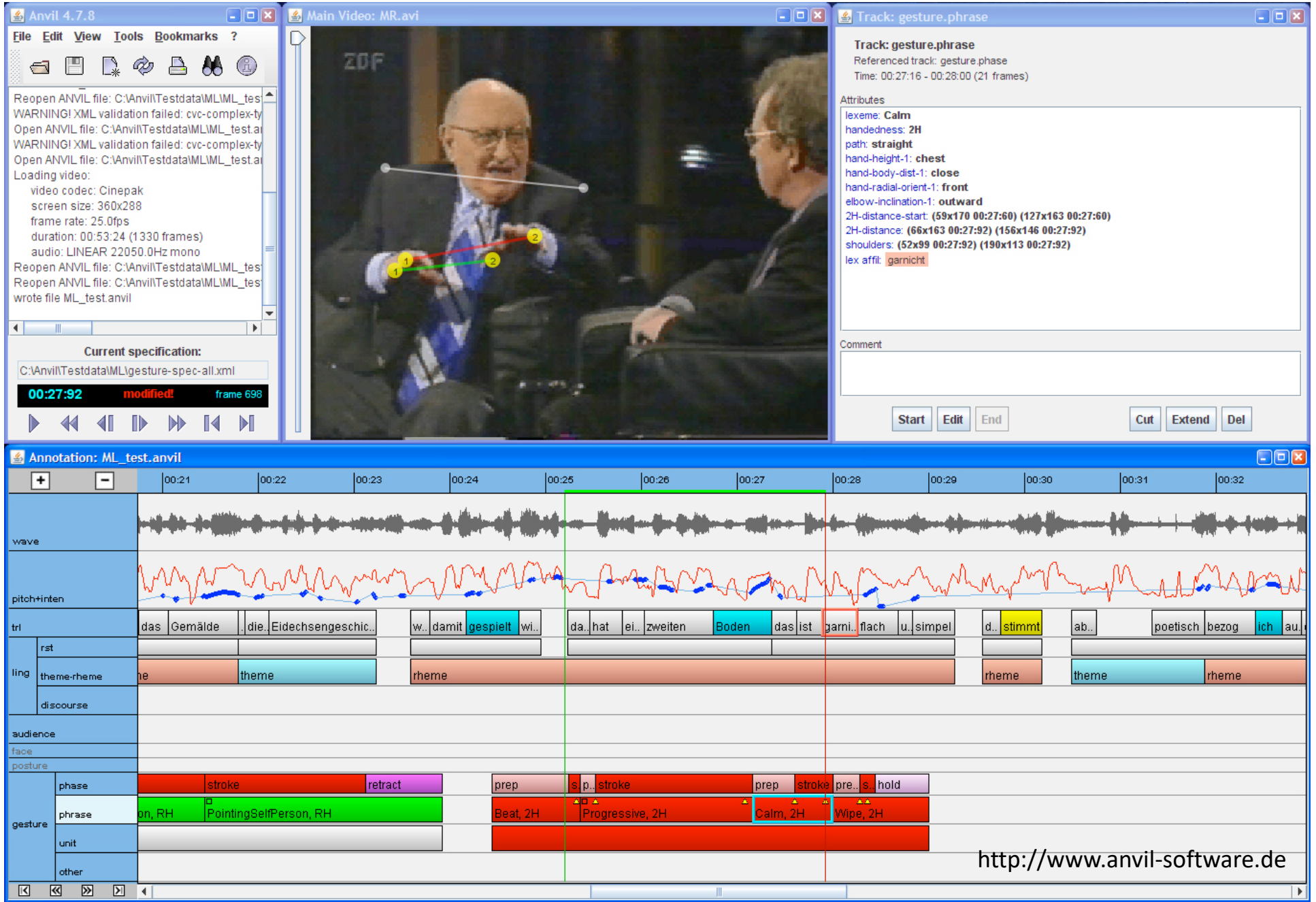
Annotating multi-modal human expression with ANVIL [K 2011]

Video image analysis

Audio track analysis

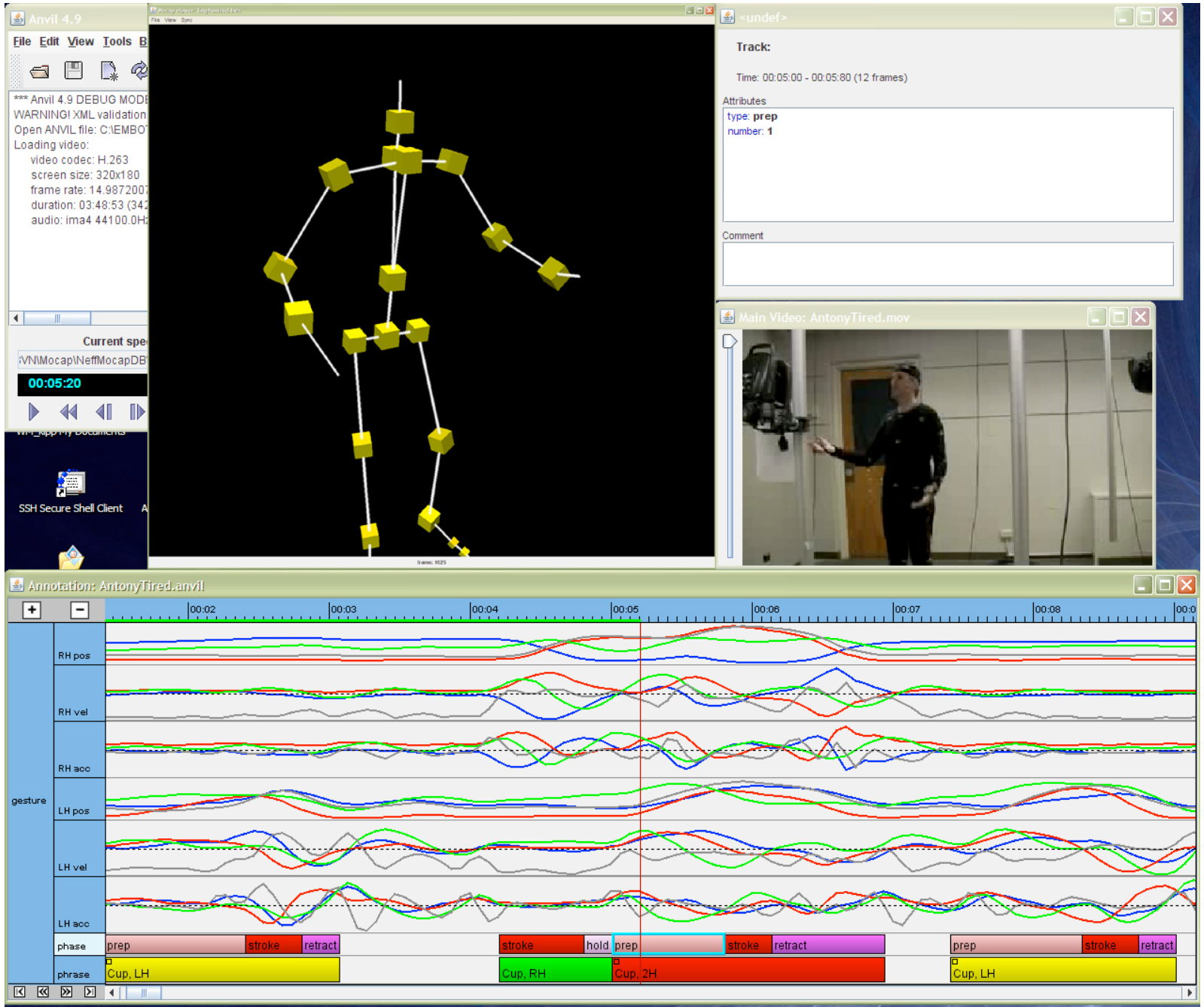
Words timing

Gestures timing



Analyzing body expression with ANVIL [K 2011]

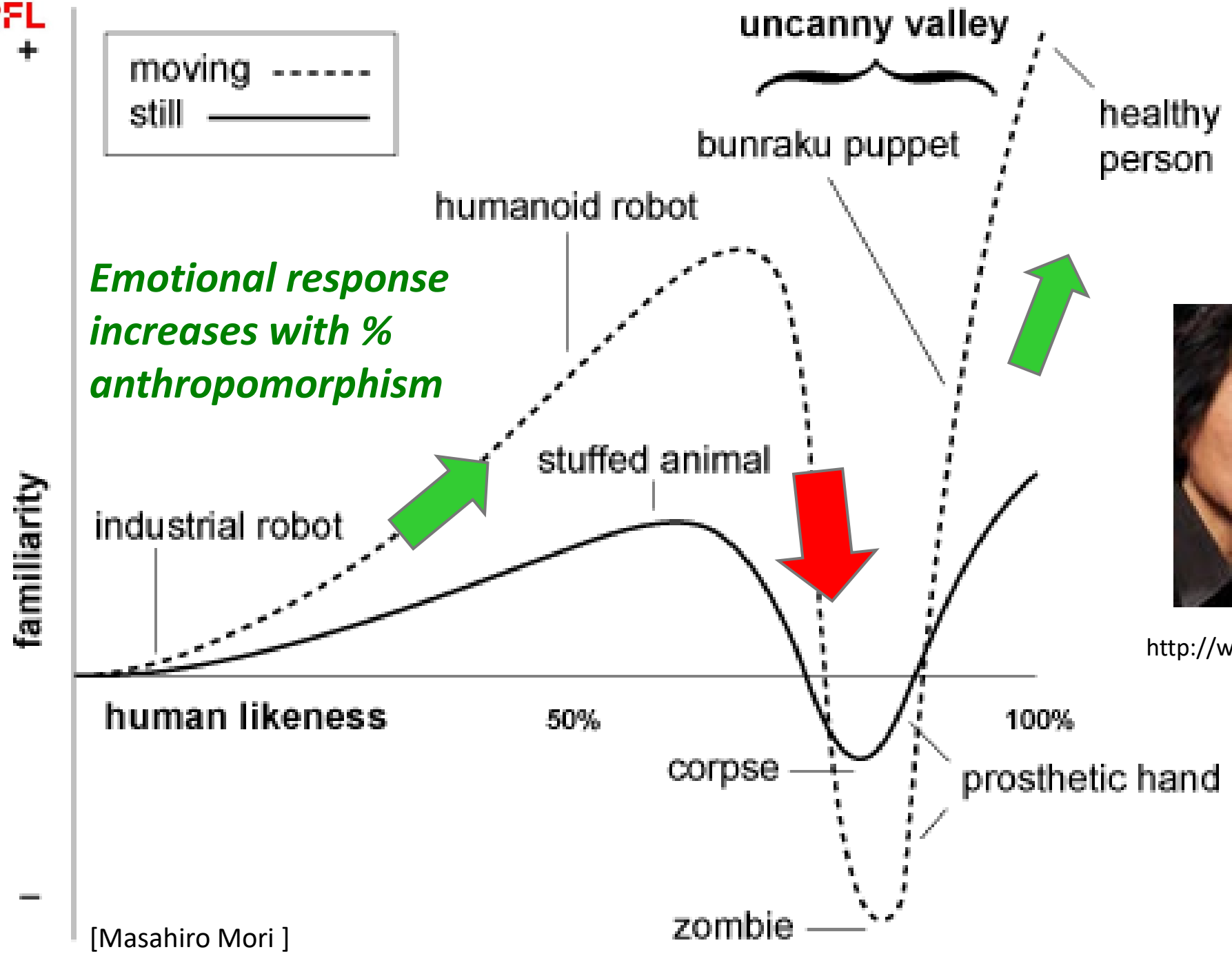
Full-body Body motion capture &analysis



3. From artificial to real : the uncanny valley

- **`uncanny`** *: (Merriam-Webster)*
  - a : seeming to have a supernatural character or origin : EERIE, MYSTERIOUS
  - b : being beyond what is normal or expected : suggesting superhuman or supernatural powers

- In the 70s Masahiro Mori studied in Robotics the emotional response effect to increasing human-like appearance of still or moving entities.
  - His key article (in Japanese) has been translated by McDorman

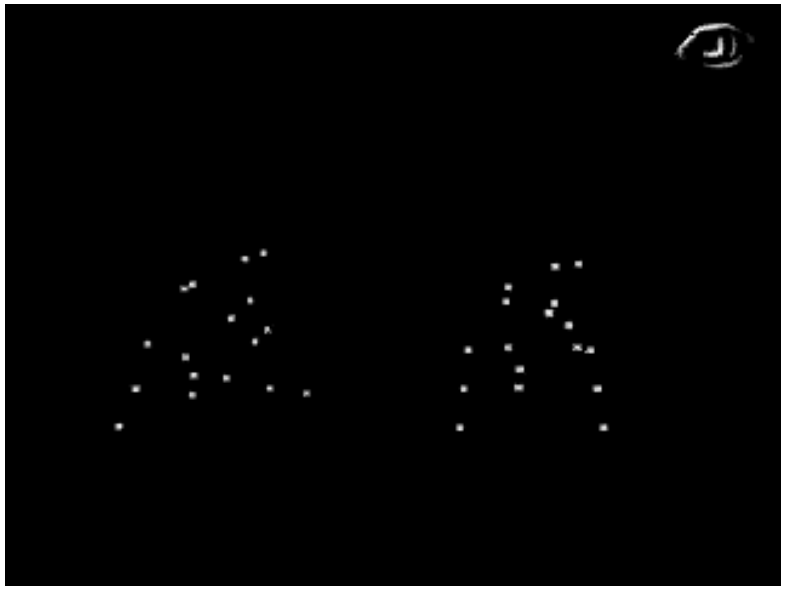


Emotional response increases with % anthropomorphism

http://www.youtube.com/watch?v=uD1CdjlrTBM

[Masahiro Mori]

3. From artificial to real : the uncanny valley (2)



High Human sensitivity to human motion perception

Turing test for computer-generated movement (Hodgins et al ~1997-98)

Question: which one is synthesized from a model vs motion captured ?

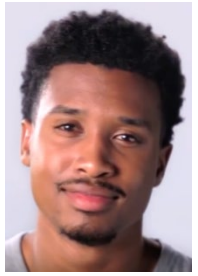
Differences between the left and right movements :

- Variety:
  - temporal, style, texture, …
- Coherence of the behavior:
  - Synergy of the whole body involved in the behavior

3. From artificial to real : the uncanny valley (3)

- The paper from Masahiro Mori is questioned regarding its scientific validity (empirical experience rather than rigorous experimental protocol)
- However the concept of uncanny valley has been adopted(and extended) in the field of Computer animation to adjust the human-likeness of a character's design to maximize public acceptance

  - *Very realistic human appearances are now feasible in terms of shape, cloth, hairs, skin texture and lighting*



(Samsung NEON real-time Virtual-Human, CES2020), no update since 2020

Unsuccessful tradeoffs (films)

2001: Final Fantasy (Square)

  - *BUT the quality of the associated animation/behavior must match the **expected** quality level for that level of verisimilar appearance*

Miquela Sousa : virtual influencer since 2016 [K2023] (among 35 others).

Successful tradeoffs (films)

2010: Avatar(J. Cameron)

[References]

[H 1998] Hodgins et al.: Perception of Human Motion With Different Geometric Models, IEEE Transactions on Visualization and Computer Graphics, 4(4), 307-316

[K 2010] Kipp, M. , Multimedia Annotation, Querying and Analysis in ANVIL. In: Multimedia Information Extraction, M. Maybury (ed.), IEEE Computer Society Press, in press

[K 2023] Kluger L. Virtual influencers in the real world, CACM march 2023, https://cacm.acm.org/news/virtual-influencers-in-the-real-world/

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http://www.anvil-software.org

http://spectrum.ieee.org/robotics/humanoids/hiroshi-ishiguro-the-man-who-made-a-copy-of-himself

[W] [http://en.wikipedia.org/wiki/Uncanny_Valley]