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# Measurability and Predictability of User Experience (UX)

# Who and Where am I?

- PhD in Psychology



- Dagstuhl Seminar on Demarcating UX 2010

**User eXperience**  
Towards a unified view

The 2nd COST294-MAUSE International Open Workshop  
October 14 2006, Oslo, Norway

**Organizers:**  
Effe Lai-Chong Law  
Ebbe Thora Hearnberg  
Marc Hazenazhi

**cost**

**MAUSE**  
<http://cost294.org/>

**norwich**

# Overview

- UX Definition **S**
- UX Models
- UX Evaluation Methods
- Measurability of UX
- Predictability of UX
- Conclusion & Outlook

# A Common Definition of UX? Not Yet!

## Why is there not *yet* a common definition of UX?

- ❑ UX is associated with a broad range of **fuzzy** and **dynamic** concepts, e.g., experience, emotion, affect, and aesthetics
- ❑ Unit of analysis for UX is too stretchable (solo vs. social)
- ❑ The landscape of UX research is complicated by diverse conceptual models with different foci

## No common understanding of what UX is!

### Reference:

Law, E., Roto, V., Hassenzahl, M., Vermeeren, A., Kote, J. (2009). Understanding, scoping and defining user experience: A survey approach. In *Proc. CHI 2009*.

# Why bother to have one?

1. Facilitate scientific discourses; otherwise communication breakdown
2. Enable practical applications of UX, operationalize it into **measures**, compare across similar products
3. Help teaching UX, its nature and scope

## Caveat:

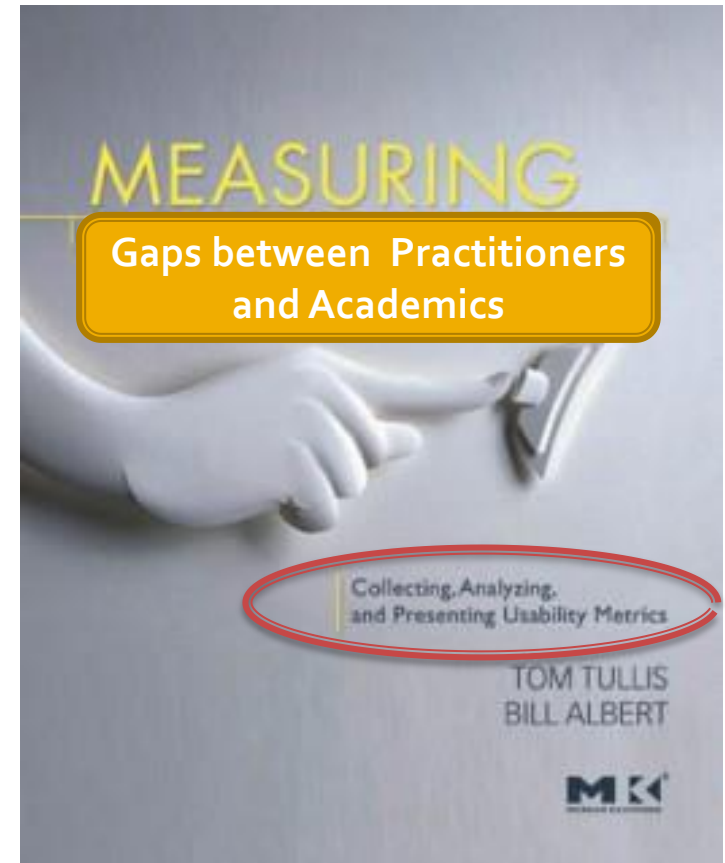
Reaching a common definition is *not* a panacea for resolving a number of problems related to UX, but it serves as crucial step towards an integrated framework of UX

# UX Definitions: Selected Examples

- **ISO 9241-210: 2010:** A person's perceptions and responses that result from the use and/or anticipated use of a product, system or service.
- **Hassenzahl & Tractinsky (2006):** A consequence of a user's **internal** state (...), the characteristics of the designed **system** (...), and the **context** within which the interaction occurs.
- **Nielson & Norman Group:** all aspects of the end-user's interaction with the company, its services, and its products. The first requirement for an exemplary user experience is to meet the exact needs of the customer, without fuss or bother. Next comes **simplicity** and elegance that produce products that are a **joy to own**, a joy to use....
- **Wikipedia:** UX highlights the **experiential, affective, meaningful and valuable** aspects of human-computer interaction and product ownership, but it also includes a person's perceptions of the practical aspects such as **utility, ease of use and efficiency** of the system.

# Example of Confusing UX Usage

- Is it a marketing strategy to entitle the book with the phrase “**the User Experience**” (NB: small font for the subtitle: “... **Usability metrics**”)
- Do the authors treat UX and Usability as synonyms? .... *Seemingly No!*
  - We take a *very broad* view of usability and examine *the entire* user experience. When we talk about “measuring usability”, we’re really looking at the entire user experience (p.4)
  - S.5.4.1 Severity ratings based on the User Experience (pp.105-106)
    - Severity rating scales of usability problem by Jakob Nielsen (1993) and Chauncey Wilson (1999)
  - S.6.7.1 Assessing Specific Attributes
    - Visual appeal ,..., Enjoyment ...
    - “Covering in detail the ways you might assess all the specific attributes you are interested in is beyond the scope of this book.” (p.158)



# Usability vs. UX

Is UX truly an extended and distinct perspective on the quality of interactive technology?\*

## USABILITY

- Practical (to find an e-book)
- Product: performance, task
- Reductionist?
- Partly objective
- Relatively persistent
- Standard usability metrics exist
  - Efficiency, Effectiveness, User satisfaction

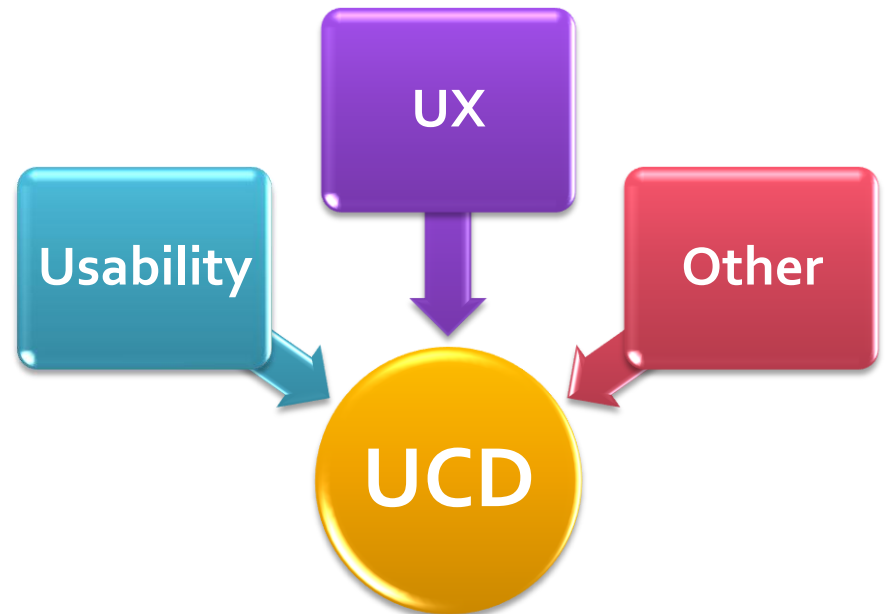
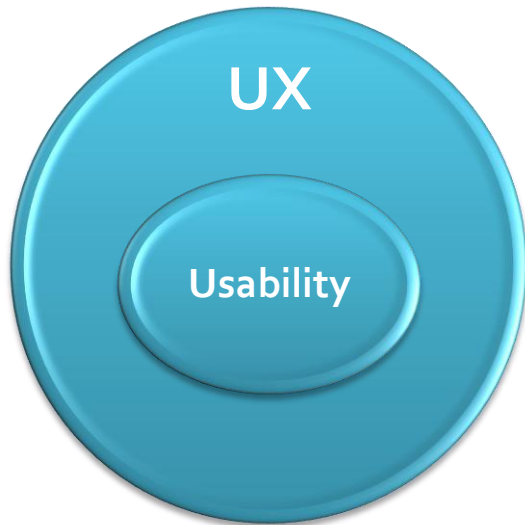
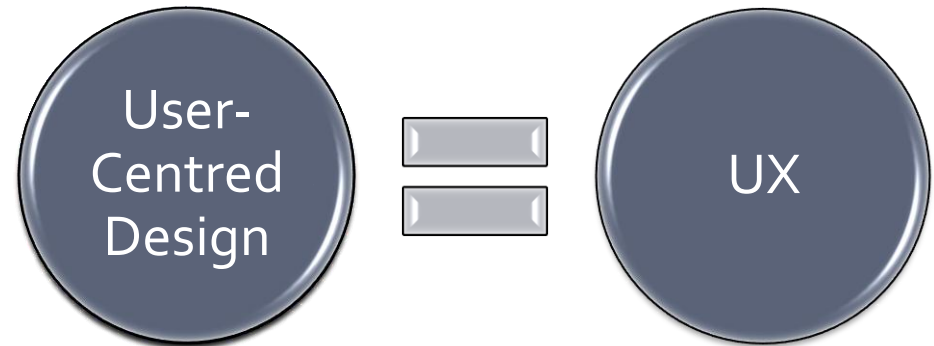
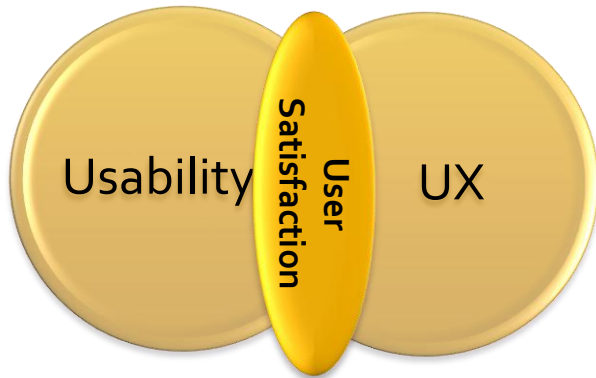
## UX

- Hedonic quality
- *be-goal\** (to feel competent)
- Experience: emotion, affect
- Holistic?
- Highly subjective
- Inherently dynamic
- Standard UX metrics yet to be created (Note 3 of ISO 9241-210: usability criteria can be used to assess aspects of user experience)

Ref: \*Hassenzahl, M. (2008). User Experience (UX): Towards the experiential perspective on product quality. In Proc. IHM.



# Relationship btw. Usability and UX



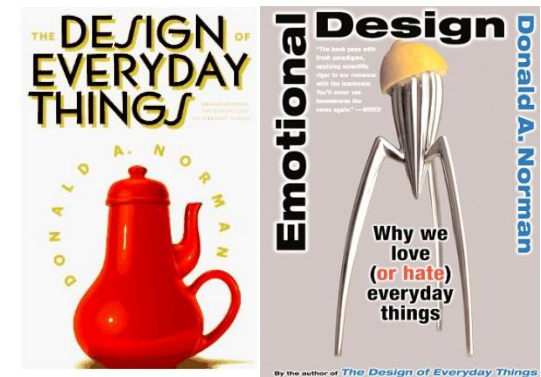
# Origin of UX

- Donald Norman, early 1990s, “User Experience Architect Group” at Apple  
(Smith et al., 1982, *Byte*;  
Roy Nierenberg et al. 1985, *InfoWorld*)



*"I invented the term because I thought Human Interface and usability was too **narrow**; I wanted to cover **all** aspects of a person's experience with a system, including industrial design, graphics, the interface, the physical interaction, and the manual. Since then, the term has spread widely, so much so that it is starting to **lose its meaning**." (1998, personal comm. Peter Merholz)*

*"... today I include much more; user experience is the **whole totality**, ... experience is actually more based upon **memory** than upon reality..." (2008, the UX Week)*



# Norman's Advocacy

- *Observe real uses in real situations*  
(basics of design and evaluation)
- *Replace 'users' with 'people'*  
(terminology confusion; "people experience")
- *Total experience that matters*  
(trajectory of experience; which momentary or episodic events carry more weights)
- *UX designers learn to speak the language of business, using **plausible numbers** (reasonable but not necessarily real) to sell our ideas and bringing **spreadsheets** to the executives; allying with marketing folks;*  
(ethical issues, formulae for ROI -> the same conundrum for usability )
- *Job title confusion → UX consultant should have a clear role in design*  
(identity crisis and concept chaos in both practice and research)

# Norman's Emotional Design

- *Visceral* (aesthetic): beauty (website visual aesthetics/attractiveness Lavie & Tractinsky, 2004)
- *Behavioural* (pragmatic): usability
- *Reflective* (hedonic):
  - Identification: self-image, other-oriented
  - Stimulation: novelty, surprise
  - Evocation: memories; temporality of UX



# UX Modelling

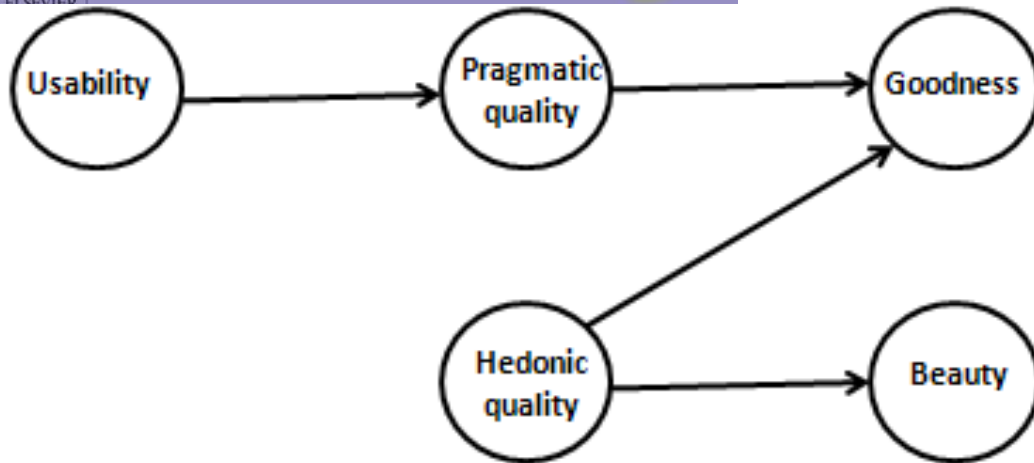
Law, E. L-C., & van Schaik, P. (2010). Modelling User Experience – An Agenda for Research and Practice . (Extended editorial of Special Issue). *Interacting with computers*, 22, 313-323



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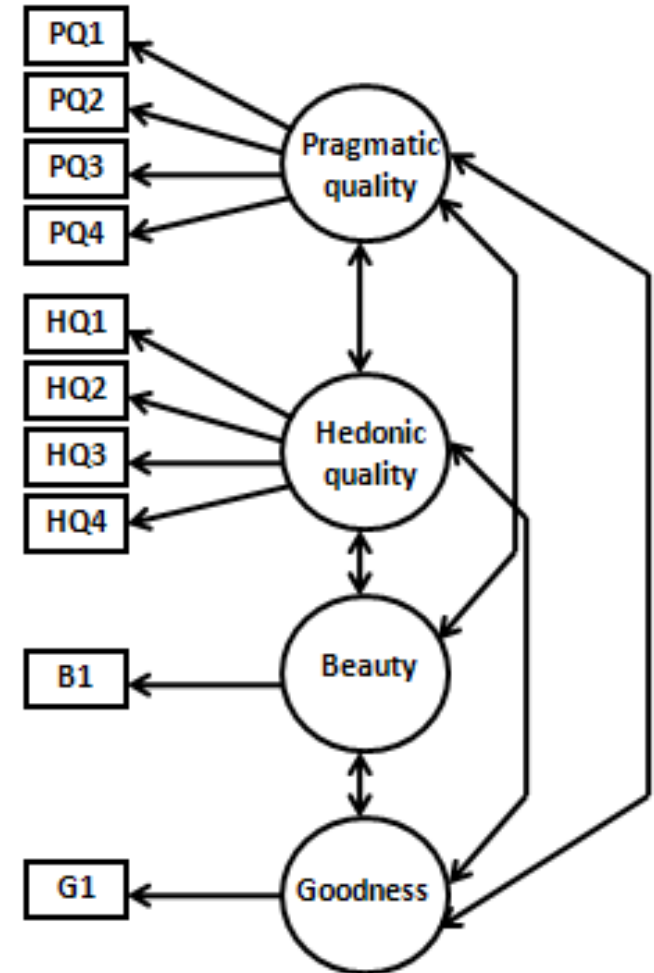


**Structural models:** To establish the (cause-and-effect) relations between constructs and inform the design of a system.

Special Issue  
Modelling user experience – An agenda for research and practice

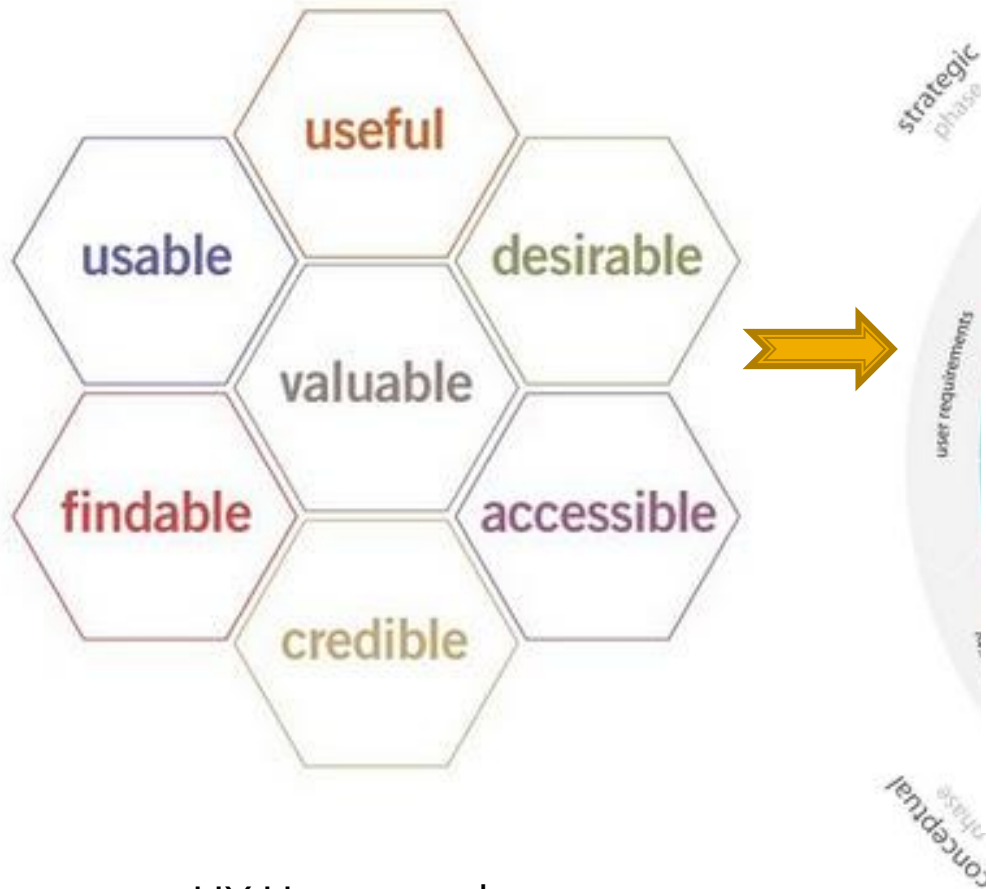
Available online at [www.sciencedirect.com](http://www.sciencedirect.com)

ScienceDirect



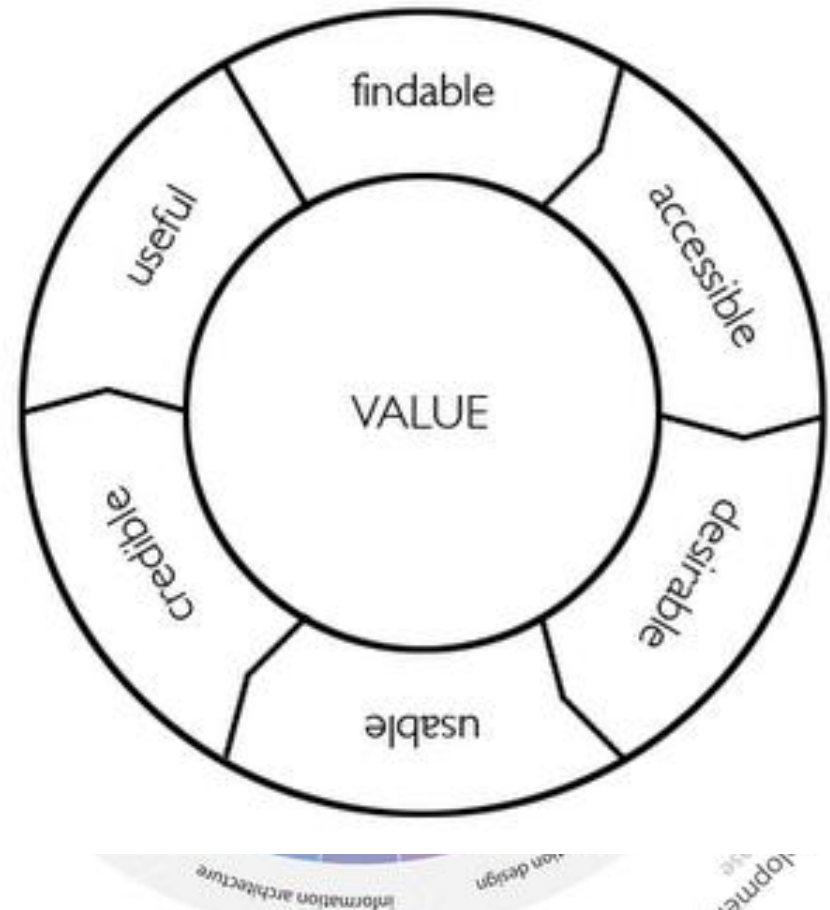
**Measurement models:** To allow constructs to be measured and inform the evaluation of a system

# Generic UX Models: Practitioner-based



UX Honeycomb, 2005

Peter Morville, Information Architect



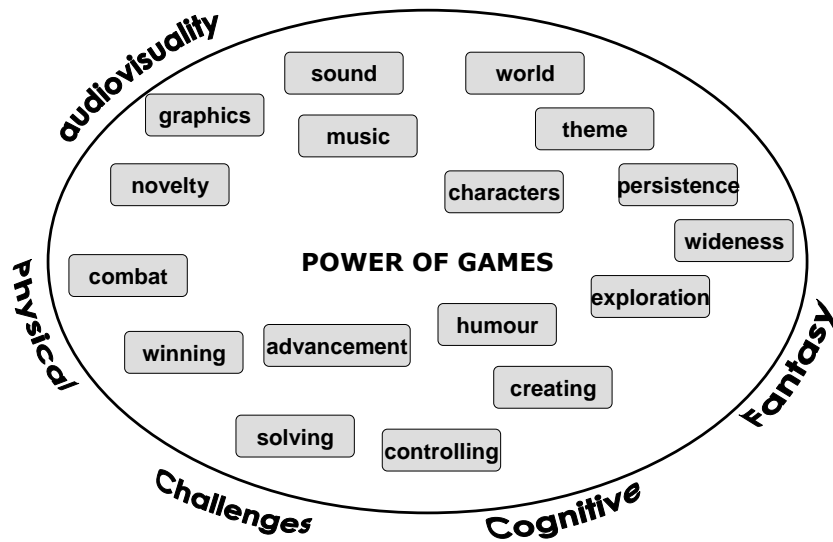
Restructured UX Honeycomb, 2007

Use Magnus Revang, UX Practitioner

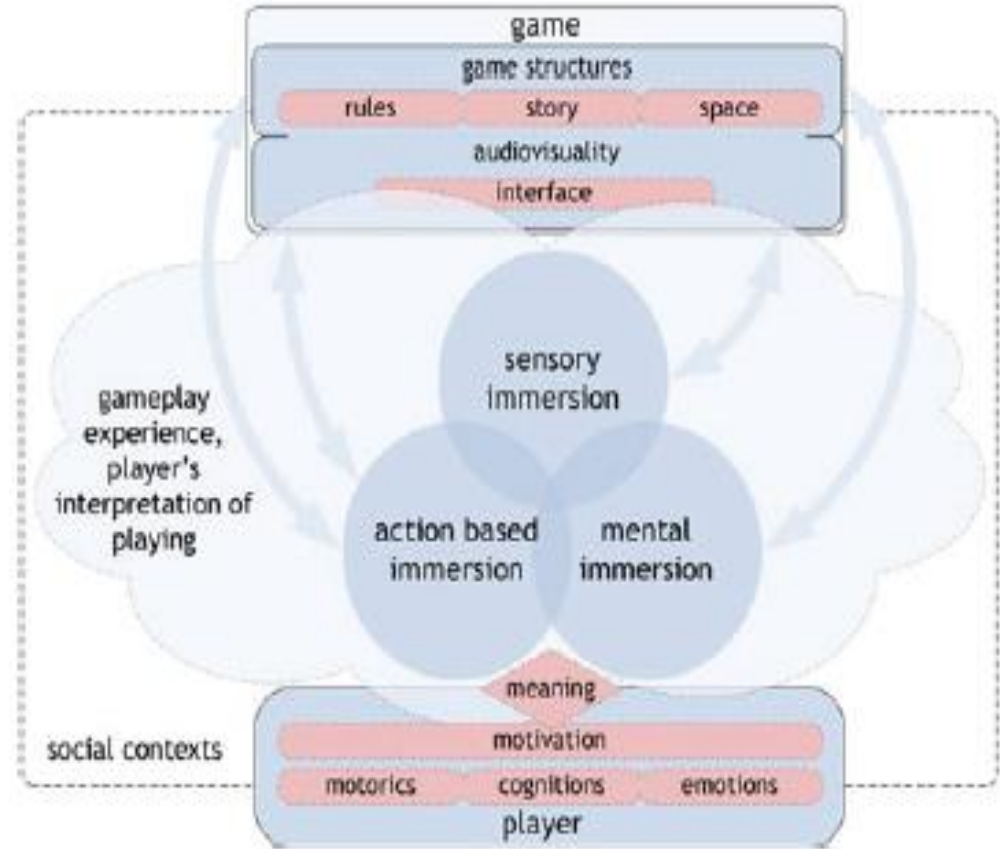
Magnus Revang



# Specific Research-based UX Model: Gameplay Experience



Elements of children's pleasurable gameplay experience, Emri & Mäyrä (2005)



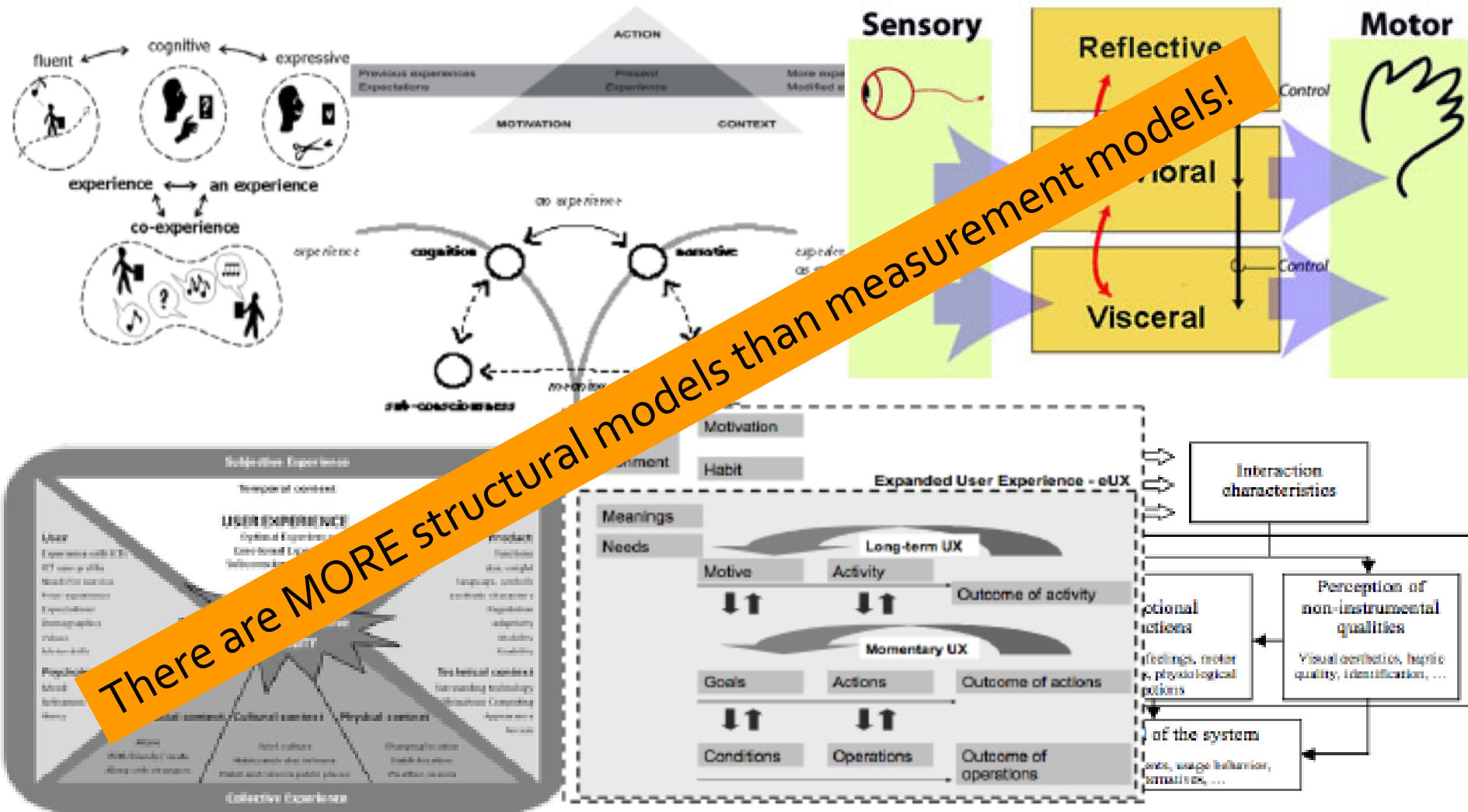
Sensory, Challenge-based Immersion (SCI) Model, Emri & Mäyrä (2005)

# Gameplay Experience: Constructs and Metrics

Construct	Metric	Description	References
Immersion	<ul style="list-style-type: none"> <li>Sensory – perceptual impacts</li> <li>Imaginative- richness of narrative</li> </ul>	<ul style="list-style-type: none"> <li>Being engrossed by audio and graphics</li> <li>Being absorbed (i.e. distorted time perception and awareness of extraneous happenings) by the storyline and game worlds;</li> <li>Identify empathetically with characters;</li> </ul>	<ul style="list-style-type: none"> <li>Brown &amp; Cairns (04)</li> <li>Emri &amp; Mäyrä (03, 05)</li> <li>Csikszentmihalyi (93)</li> </ul>
Excitement	<ul style="list-style-type: none"> <li>Bodily reactions</li> </ul>	A range of psycho-physiological measures tension, anxiety, nervousness	<ul style="list-style-type: none"> <li>Mandryk et al. (06)</li> <li>Lennart et al. (10)</li> </ul>
Enjoyment	Perceived hedonic quality	Fun and pleasure derived from gameplay	<ul style="list-style-type: none"> <li>Hassenzahl (01)</li> </ul>
Challenge	Balance between tasks and skills	Availability of difficulty levels; Meaningfulness of the game structure and gaming activities in terms of outcomes	<ul style="list-style-type: none"> <li>Klimmt et al (07)</li> <li>Sweetser &amp; Wyeth (05)</li> <li>Csikszentmihalyi (93)</li> </ul>



# A Collage of UX Models



# UX Evaluation Methods (UXEMs)

<http://www.allaboutux.org/>

Vermeeren, A., Law, E., Roto, V., et al. (2010).  
User Experience Evaluation Methods: Current State and Development Needs.  
In *Proc. NordiCHI 2011*



ALL ABOUT UX

Information for user experience professionals

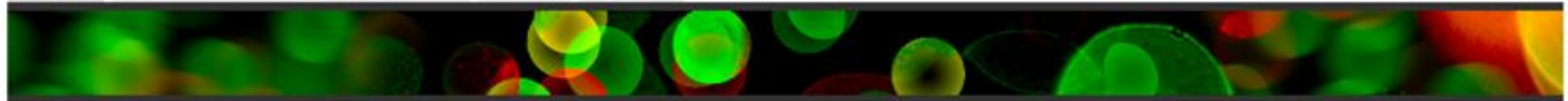
 [Blog Posts](#)

HOME

ALL UX EVALUATION METHODS

BLOG

ABOUT



## Home

Allaboutux.org provides information about user experience (UX). The information on this site is collected from the UX community and is created and maintained by volunteers.

### User experience (UX)

When using the term user experience, be careful. Different people understand it in very different ways. A group of UX experts has been working on UX White Paper, which is an important step towards a common understanding of the concept of user experience. The result is out now:

[UX White Paper](#)

### UX evaluation methods

We have been collecting evaluation methods that focus on finding out how users feel about the system that you want to evaluate. The method descriptions come from people who have reported the method, not from us at allaboutux.org.

#### RECENT BLOG POSTS

- [Tutorial on UX evaluation methods @ Lisbon](#)
- [UX White Paper published](#)
- [Welcome to Allaboutux.org!](#)

# Collection of UXEMs

Goal: Collect experiential methods from academia and industry



Literature review

3 workshops in academic conferences  
(CHI'08, Interact'09, DPPI'09)

EU project ENGAGE

Online survey

Philips' list of methods

Special interest group session in CHI'09 conference



Outcome: Descriptions of 101 UX evaluation methods

# Categorisation of UXEMs

UX evaluation methods can be categorized in various ways

we are currently trying to clarify on which theories people base their user experience work. If you are interested, check some preliminary information on the content

Lab studies (58)  
Online studies (30)  
Questionnaires / Scales (16)

Who are the participants:	Experts, Users, User groups
Time restrictions:	1 day ... Several months
Expertise required:	Special skills of researchers
Place of evaluation:	Lab, Field, Online
Data type:	Quantitative or Qualitative
Period of experience:	Moment, Episode, Overall UX
Product development phase:	Concept, Prototype, Ready product

[Advanced search](#)

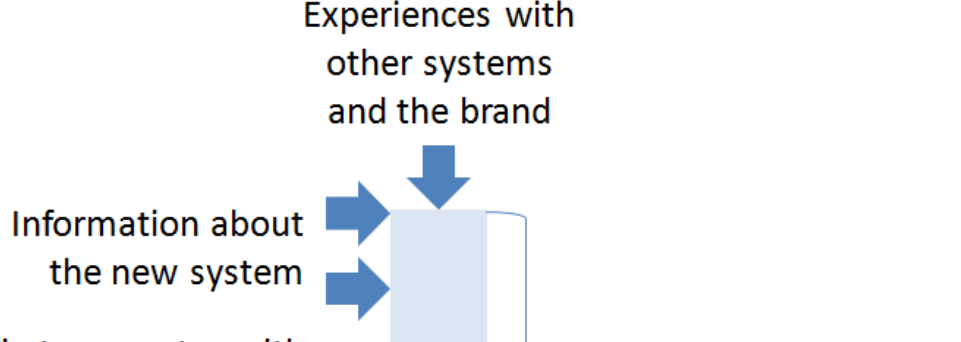
# Temporal UX Model

(UX White Paper

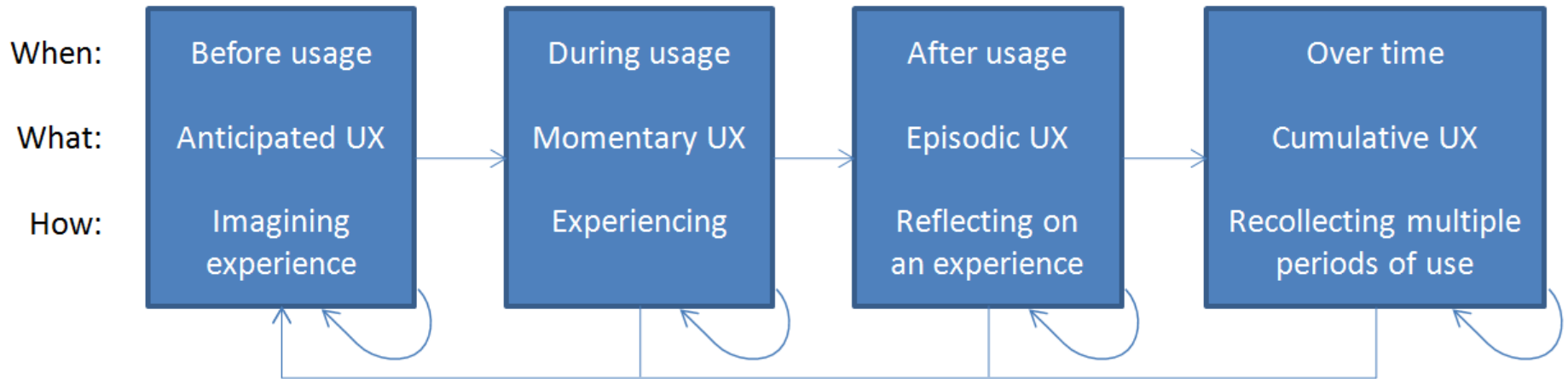
<http://www.allaboutux.org/>

Dagstuhl Seminar)

- Dagstuhl Seminar, Germany  
15-18 September 2010
- <http://www.dagstuhl.de/en/program/calendar/semhp/?semnr=10373>
- 30 researchers and practitioners from the User Experience (UX) community, including from the US and Japan
- to the period before first use, or any of the three other time spans of UX



# Period of UX Evaluation



- For longer time spans, UX can be structured in terms of a lifecycle
- Previous experiences influence a future one, for example, reflecting or recounting after one usage episode will frame anticipations of future ones.
- The phases of experiencing overlap and interleave in a variety of orders, there is no fixed sequence from anticipating to recounting

(Ref: UX White Paper)



# Evaluation Methods per Period

(adapted from UX Tutorial, Roto et al., NordiCHI 2010).

<p><b>Momentary</b> e.g. during the gameplay</p>	<p><b>Episodic</b> e.g. reflection on the 10-minute gameplay episode</p>	<p><b>Long-term</b> e.g. 3 months (the initial on and off)</p>
<p><b>Evaluating emotions</b></p>	<p><b>Evaluating an episode</b></p>	<p><b>Evaluating long-term UX</b></p>
<p><b>Observation</b></p>	<p><b>Observation</b></p>	<p><b>Self-reporting</b></p>
<p>Facial, body, vocal expressions (e.g. smile, lean back, sigh)</p>	<p>Experience thinking</p>	<p>Questionnaires, Laddering, UX Curve, Repertory Grid Technique</p>
<p><b>Psychophysiological measurements</b></p>	<p><b>Self-Reporting</b></p>	
<p>Muscle, pupil, skin reaction, and with se</p>	<p>Experience sampling, AttrakDiff, Interviews, Day Reconstruction</p>	
<p><b>Self-reporting</b></p>		
<p>Verbal: PANAS, AffectGrid Non-verbal: EmotionSlider, EmoCards, PrEmo</p>		

**Studying UX Evaluation Methods but NOT UX metrics or measures !**

# Studies on UX Measures (Rough Statistics)

	Google Scholar		ACM Digital Library	
	1991-2000	2001-2010	1991-2000	2001-2010
user experience	4950	21900	167	5665
user experience research	18	488	5	115
user experience evaluation	2	294	0	89
user experience measures	0	37	0	4
measure user experience	3	134	0	22

- What are the challenges and obstacles for advancing the research work on measuring UX qualities?
- Can they be resolved and overcome?



# What and Why of Metrics

*"To measure is to know"*

*"If you cannot measure it, you cannot improve it"*

(Lord Kelvin, n.d.)

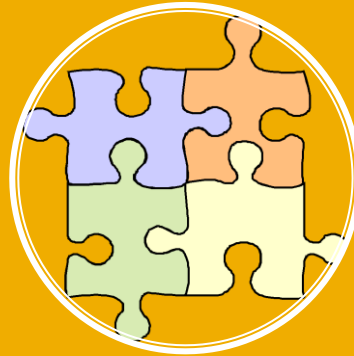
- A **metric** is a way of measuring or evaluating a phenomenon or an object quantitatively based on:
  - references to a standard definition;
  - derivation from models;
  - systematic observations;
  - reliable procedure agreed upon by a community of practice;
- A **metric** can:
  - add structure to the design and evaluation process
  - gain insights into findings
  - provide information to decision makers, especially ROI;
  - verify improvement

# Quantitative vs. Qualitative



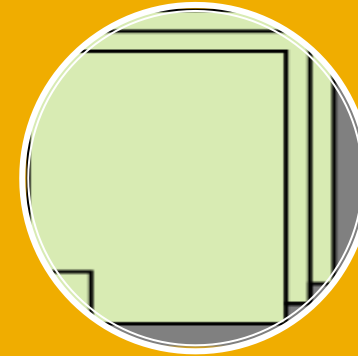
## Model-based, Quantitative

Paul van Schaik  
Marc Hassenzahl  
Alistair Sutcliffe  
Noam Tractinsky  
:



## Mixed

Andrew Monk  
Effie Law  
:  
:  
:



## Design-based, Qualitative

John McCarthy  
Peter Wright  
Mark Blythe  
Kia Höök  
Jodi Forlizzi  
:

Migration between Camps

# Comments on UX Measurability

## AGAINST

“... the reduction of experience into a number of factors or processes... such approaches may be useful for experimental analysis but they can **miss some of the insights** available in accounts that resist such reduction ... qualitative data provides a **richness and detail** that may be absent from quantitative research”

(Swallow, Blythe & Wright, 2005)

## FOR

“... rich accounts of experience might require an outstandingly reflective and attentive ‘experientor’.... I suspect experiences with technology (as many other experiences as well) to be **far less unique** and **far less variable** as implied by the proponents of the “phenomenological” approach . [McCarthy & Wright, 2004] ... **Accounts of according experiences** might differ in their quality, the experience itself does not.”

(Hassenzahl, 2008)

# My Personal stance

- Measurability is *not* an issue, or making a rather bold claim: There is nothing that cannot be measured. However, it is the design of **data collection method** (including procedure, technique, tool, and expertise as well as experience of people involved in the process) that is of critical importance to determine the **meaningfulness** of UX measures.

# Landscape of UX Studies

Bargas-Avila & Hornbaek (2011). Old wine in new bottles or novel challenge. A Critical Analysis of Empirical Studies of User experience. In Proc. CHI 2011

UX Dimension	Measurement	Data collection method
Generic UX	No	Interview, Collage
Affect/Emotion	Yes	Scales (SAM), Psychophysiology
Enjoyment/Fun	Yes	Scales, Pictures
Aesthetic, appeal	Yes	Scales (classic/expressive aesthetics)
Hedonic quality	Yes	Scales (AttrakDiff)
Engagement, flow	Yes	Scales, Interview
Motivation	No	Probes
Enchantment	No	Interview
Frustration	No	Interview, Observation
Other constructs	??	??

Adapted from Bargas-Avila & Hornbaek (2011), Table 2

**Methodologies of UX studies are largely “borrowed” from traditional HCI!**

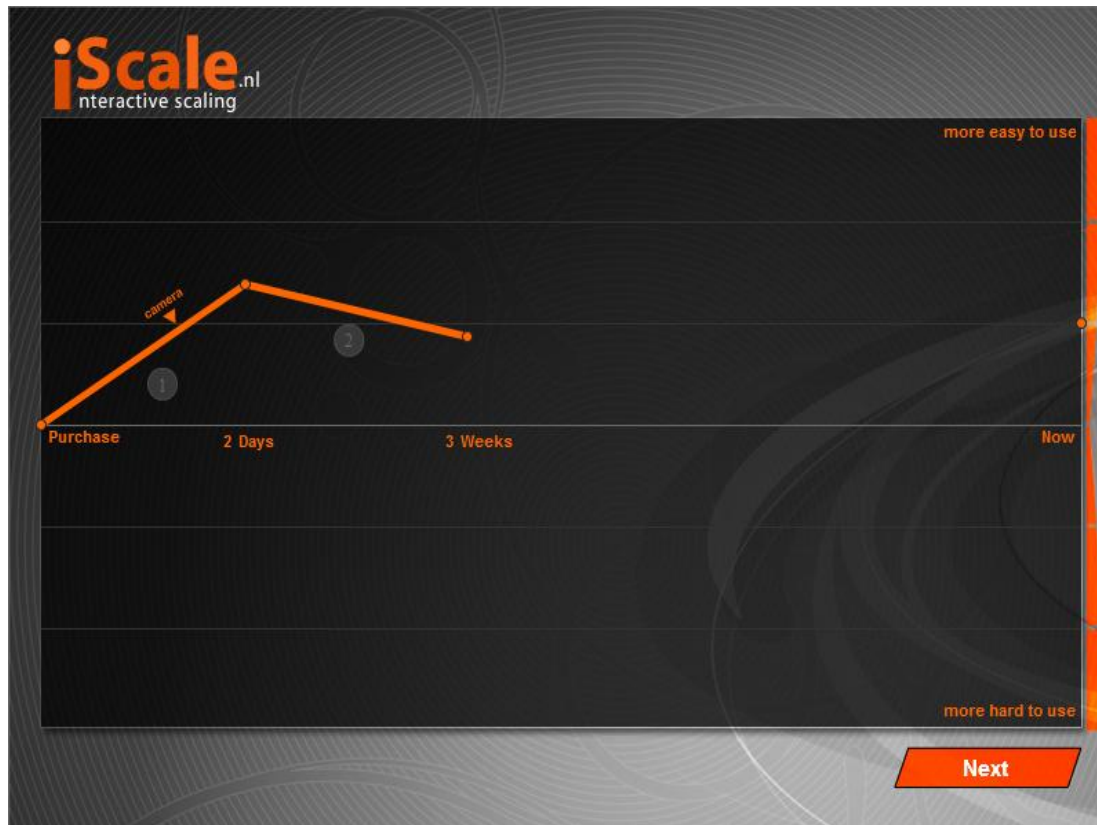
# Examples of UXEMs with Measurements

- **iScale** : *Generic UX*
- **AttrakDiff**: *Attractiveness, Visual appeal*
- **Psychophysiological measurement**: *Emotional states*
- **ProEmo**: *Emotional states*

Ref:

UX Evaluation Methods Tutorial,  
Roto, V., Vermeeren, A., Law, E. et al., NordiCHI 2010,

# iScale



# iScale tool

- A survey tool for the retrospective elicitation of longitudinal UX data
  - Concept partly based on Day Reconstruction Method (DRM, Kahneman et al. 2004)
- iScale uses sketching in the reconstruction of one's experiences with the aim to minimize retrospection bias
- iScale tool imposes a chronological order in the reconstruction of one's experiences
  - more contextual details surrounding the experienced events
  - the felt emotion is constructed on the basis of the recalled contextual details
- iScale results in an increase in the amount, the richness, and reliability of recalled information (Karapanos et al. 2010)
- The results provide support retrospective techniques as cost-effective alternatives to longitudinal studies



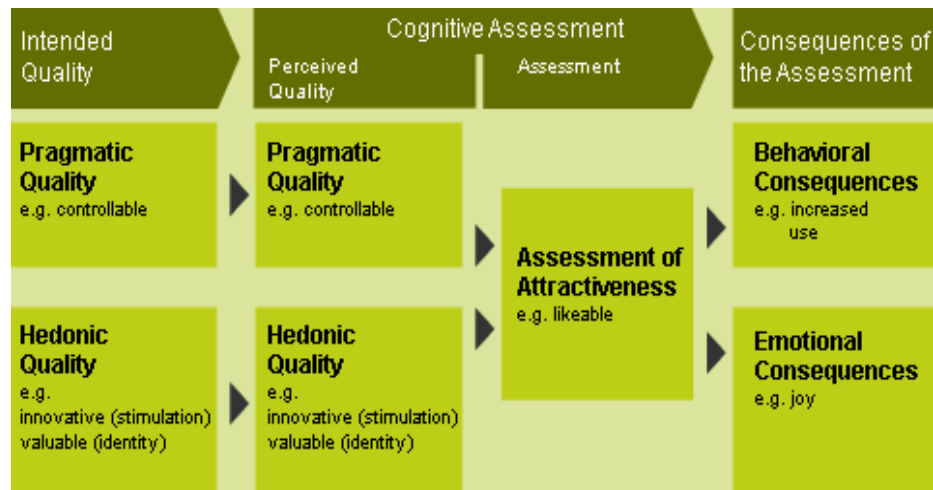
# AttrakDiff™ questionnaire

interesting ----- boring  
extravagant ----- cheap  
exciting ----- dull  
exclusive ----- standard  
impressive ----- nondescript  
original ----- ordinary  
innovative ----- conservative

AttrakDiff is owned and managed by UI Design GmbH,  
<http://www.attrakdiff.de/en/AttrakDiff/What-is-AttrakDiff/>

# AttrakDiff™ questionnaire

- Evaluates **hedonic** and **pragmatic** quality of interactive products (Hassenzahl et al. 2003)
- The data enables to evaluate how the **attractiveness** of the product is experienced, in terms of usability and appearance
- AttrakDiff™ consists of 23 word-pairs (semantic differentials) representing the extreme opposite
  - Seven-step items whose poles are opposite adjectives (e.g. "confusing - clear", "unusual - ordinary", "good - bad")
  - The middle values of an item group creates a scale value for pragmatic quality (PQ), hedonic Quality (HQ) and attractiveness (ATT)
- Supports the distinction between sub-qualities of hedonic quality, stimulation and identity



# Psycho-physiological measurements



- Brain, Body, and Bytes CHI 2010 Workshop Presentations  
<http://www.eecs.tufts.edu/~agirouo1/workshop/>

# Psycho-physiological measurements

- E.g. heart beat, skin perspiration, and facial muscles tell about the emotional state of a person.
- Physiological reactions are recorded with sensors attached to the participant. This objective data can be used in combination with self-report data to find out what the user experienced.

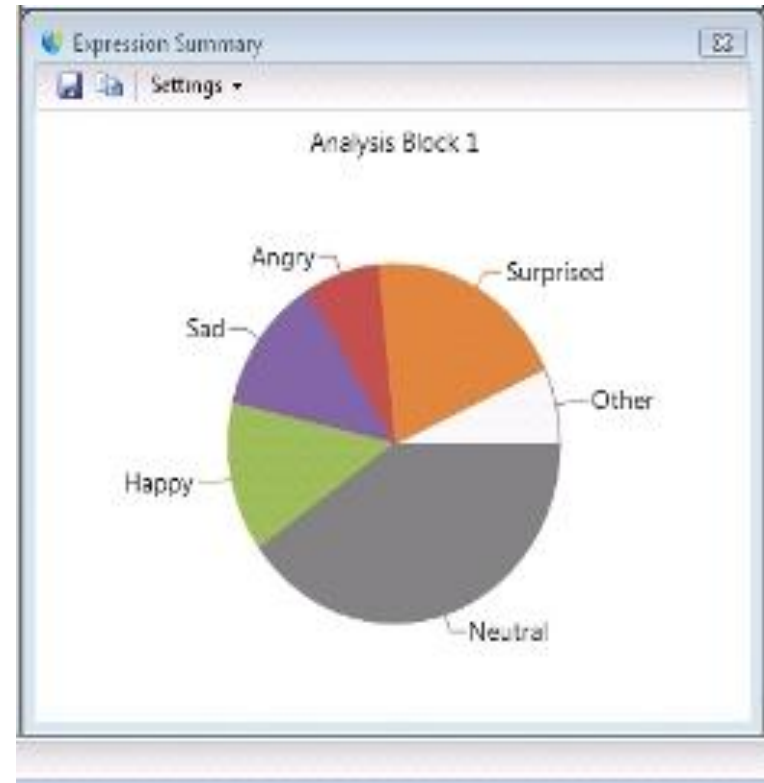
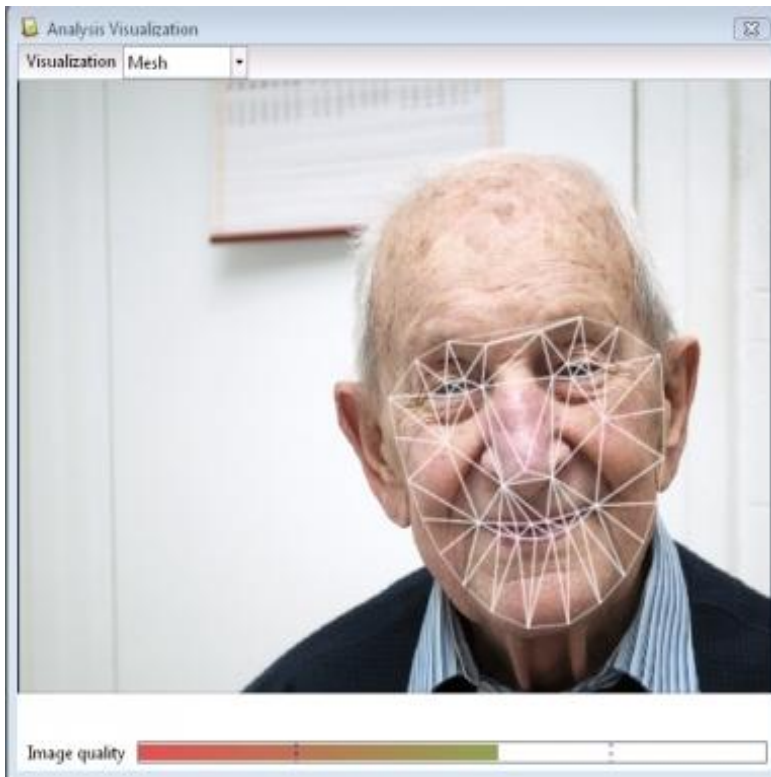
## Strengths

- Investigates momentary experiences without intervening in the interaction

## Weaknesses

- Expensive setup
- Momentary emotions are important in some domains only

# FaceReader



# FaceReader

- FaceReader is a tool to track the user affective state while using products or software without resorting to self-report.
- Real-time analysis of facial expression from a video.
- FaceReader constructs a model of the face from the video and automatically evaluate several elementary facial movements (action units).
- Based on these movements it calculates the likeliness that each of six basic emotions (joy, anger, sadness, surprise, fear and disgust) is felt at any given time.

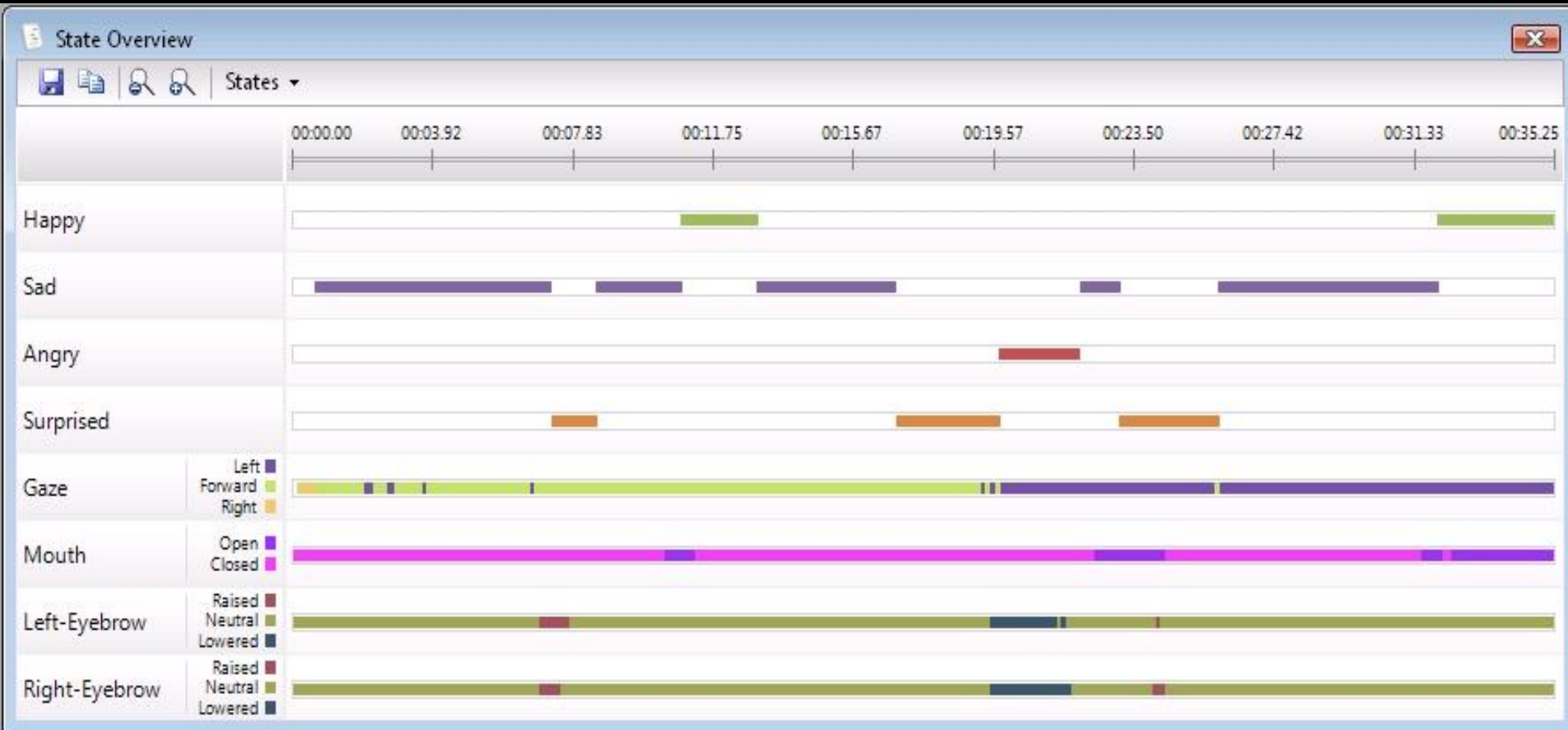
Strength:

- Objective assessment of a person's emotion

Weakness:

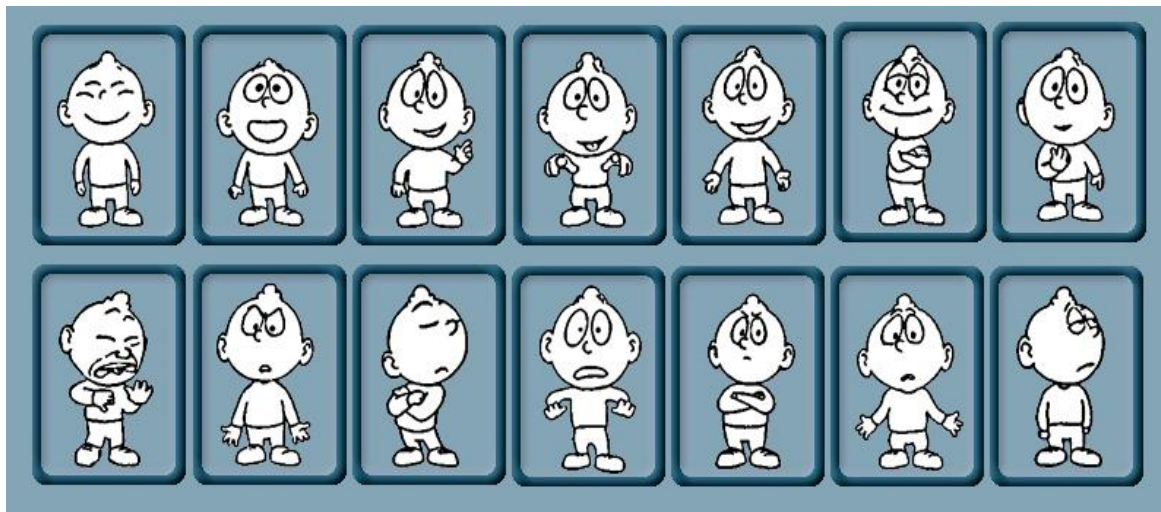
- Data limited to six basic emotions.

# FaceReader



<http://www.noldus.com/human-behavior-research/products/facereader>

# PrEmo





# PrEmo

- PrEmo is a non-verbal self-report software instrument that measures 14 emotions that are often elicited by product design.
- Emotional responses difficult to measure because
  - their nature is subtle (low intensity)
  - often mixed (i.e. more than one emotional response at the same time).
- Does not rely on words
- Each of the emotions is portrayed by an animation of dynamic facial, bodily, and vocal expressions.
- For use in internet surveys, formal interviews, and qualitative interviews, e.g.,
  - to identify the concept with the most pleasant emotional impact
  - as a discussion tool in consumer interviews.

# PrEmo (interface at work – latest version)

PrEmo v2008 - Windows Internet Explorer

http://www.bluehaired.com/premo/

File Edit View Favorites Tools Help

PrEmo v2008

Use the instrument below to reflect what you feel for the product pictured on the previous screen

Emotional Intensity Scale:

HIGH

LOW

No feeling

← BACK

NEXT →

Done Internet 100%

# PrEmo

- Procedure:
  - Show product, system, etc. to participant
  - For each of 14 emotions ask participant to indicate how intense the emotion is felt.
  
- PrEmo is a licensed commercial product

# Theories of UX?

“Where are the Ionians of User Experience Research?”  
(Kari Kuutti, NordiCHI, 2010)

**Babylonians – practical empiricists**

**Ionians – speculative theorists**

**There are not enough Babylonians either!**

# James-Lange Theory of Emotion (1880s)

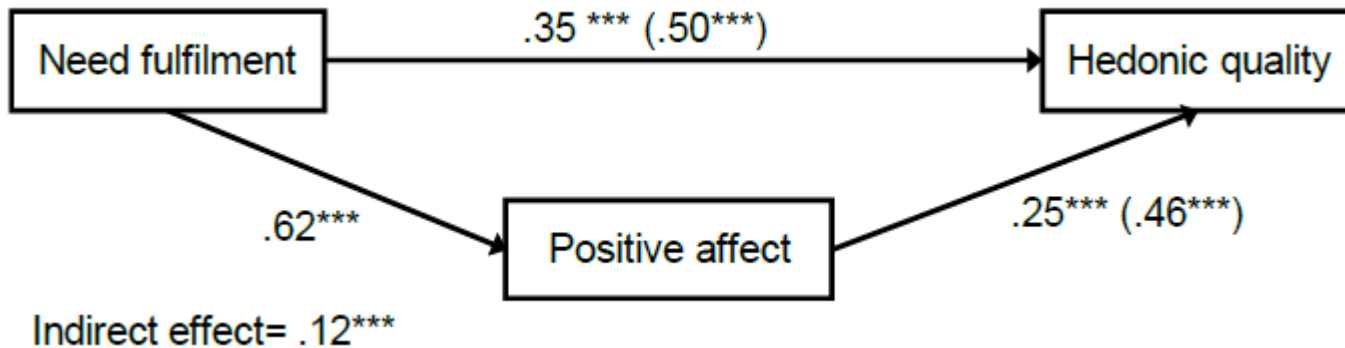
- It hypothesizes the intricate relationships between human perception, action and cognition.
- Emotion arises from our conscious cognitive interpretations of perceptual-sensory responses.
- We see and act before we feel
- *UX is a cognitive process that can be modeled and measured*

# Theory of Memory

- *Memory*: the mental faculty of retaining and recalling **past experience** based on the mental processes of learning, retention, recall, and recognition.
- Daniel Kahneman on happiness – experiencing self vs. remembering self (three cognitive traps):
  - “... *The second trap is confusion between experience and memory: basically it's between being happy in your life and being happy about your life or happy with your life. And those are two very different concepts, and they're both lumped in the notion of happiness ...*”

# Activity Theory

- It is particularly promising to shed light onto the understanding of UX, which is essentially psychological construct determined by actors' **motives** and **needs** which are in turn shaped by the **socio-cultural context** where actors are situated



Hassenzahl et al. (2010): Needs, affect, interactive products - Facets of user experience. *Interacting with Computers*, 22

# Predictability of UX

- Does the trajectory of UX follow any model, pattern, or rule of 'evolution'? (positive feelings 'survive'?)
- Is user experience predictable?
- Which *UX factors* should be included and excluded when predicting UX for a specific artifact in a specific context of use?
- How to address tradeoffs and reciprocal relationships between different UX factors, between different UX qualities and between UX factors and qualities?
  - UX factor is distinct from UX quality. The former influences how the latter will be instantiated – type, intensity, and extensity.



# Two levels of prediction

- ***UX-factor-quality-loop***: integration as well as interaction of specific UX factors (predictors) allows us to predict which UX qualities (criteria) a user is very likely to experience with an interactive entity of interest.
  - *Fidelity of prototype*: the accuracy of prediction hinges crucially on the extent to which an early prototype or a design concept resembles the fully executable version
- ***UX-behaviour-loop***: a specific set of user experiences (predictors), be they negative or positive, determines the likelihood a user (or a customer) will likely purchase or adopt a system/product/service (criterion).
  - UX accumulated over time may shape cognitive processes and behavioural tendencies

# Conclusion & Outlook

- User Experience is a research field that is still being defined!
- Measurability and predictability of UX look promising, thought still more work to be done
- Gaps between UX academics and practitioners to be bridged
- Sound theoretical frameworks for UX to inform the definition and operationalisation of UX qualities and the development of data collection methods;
- Effective algorithms to enable the combinatorial integration of a (large) set of UX factors and qualities with reasonable accuracy and efficiency.
- HCI Education

Thank you very much for your attention!

**Questions? Comments?**

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