Embodiment, Planning and Design – A SIRN approach

Juval Portugali* and Egbert Stolk**
17th Herbstakademie – Heidelberg, Germany – October 3, 2012

* ESLab (Environmental simulation lab) and Department of Geography, Tel Aviv University, Tel Aviv, Israel, juval@post.tau.ac.il; visiting professor Dept. of Urbanism TU Delft.

** Department of Urbanism, Delft University of Technology, Delft, Netherlands, e.h.stolk@tudelft.nl
The talk

• SIRN – an introduction (or reminder)
• SIRN in relation to classical and embodied cognition
• On the production of artifacts
• Design and planning as two types of Mental Time Travel
• Designing large scale artificial environments
• Example
SIRN
synergetic inter-representation nets
(Haken and Portugali 1996)

A reminder
Many cognitive processes, evolve as an interaction between internal and external representations.

Some examples:
Multiplication
The Bull by Picasso and
The Kiss by Brancusi
Serial reproduction by Bartlett

City Games by Portugali
Examining the above we can make a distinction between:

**Cognitively simple tasks** that can be performed by working memory by a single cognitive act such as the multiplication $2 \times 3 = 6$.

**Cognitively complicated tasks** cannot be performed by a single cognitive act such as the multiplication (e.g. $257 \times 389 = 99,973$)

We solve these tasks by IRN

**Cognitively complex tasks** refer to *creative* cognitive tasks (writing, painting, designing ..) Here too the process proceeds by IRN, but with one important addition – it involves *emerging properties*. It is here where *synergetics* (and complexity theories in general) comes in and the process becomes SIRN.
By emerging properties we mean:
Emotions such as... The AHA! Experience*

(S)IRN: the play between internal and external representation becomes possible due to Humans’ representation capabilities.
Using Humans’ representation capabilities we humans

(1) solve *cognitively complicated* tasks

by means of the process of IRN (Inter Representation Nets)

(2) solve *cognitively complex* tasks

by means of Humans’ creative capabilities and the process of SIRN (Synergetic IRN)
The general SIRN model

(Haken and Portugali 1996)

Looking at Haken's (1991/2004) 'synergetic computer' from the side, as indicated by the arrow.

Rotating it 90 degrees gives us the basic SIRN-model.
The three SIRN Submodels
1. Intrapersonal, 2. interpersonal, 3. simultaneous
(Haken and Portugali 1996)
The intrapersonal
The interpersonal (sequential)
The interpersonal ("duet")
The simultaneous (mediated) collective
SIRN in relation to classical and embodied cognition

An extension to the embodied cognition view

Whereas embodied cognition suggests action-perception, SIRN suggests action-perception-production. That is to say, that similarly to ‘action’, the production of artifacts is part of cognition.

1. perception
2. perception — action
3. perception — action

Classical Embodied SIRN

Q: On what basis?
A: On the basis of the claim that humans differ from animals (among other things) in the following:

Humans produce artifacts

Artifacts=Culture=Choice

Henri Bergeson (1911/1954) in *Creative Evolution*, page 139:

“... say not homo sapiens but homo faber”
The birds made this nest out of artificial materials; is it an artifact?

Dawkins: the nest is the bird’s extended phenotype and in this respect it is part of nature
The same with the beavers, termites ....
They have no choice but to build dams and castles, and ...
We humans have choices: nature tells us to build artificial shelters but not how to build them.
Nature tells us to build artificial collective shelters but we built/build cities
The homo sapience sapience (HSS) Known also as the homo faber (Bergeson) is covered by artifacts and is living in artifacts = in artificial environments such as a city.

The production of artifacts is unique to humans.
This is so with small artifacts...

... and this is so with large artifacts such as buildings and whole cities

The city as an artifact is a major means of adaptation to changing environmental conditions
On the one hand, the city is a major means of adaptation to changing environmental conditions.

The art of building dykes
Without dykes and dams the Netherlands would not exist. The first dykes were built about 1,000 years ago by monks. Now thousands of kilometers of dykes, many dams and several storm surge barriers protect the Netherlands against flooding. Building dykes and dams is an art which is constantly advancing.
On the other: the city is an environment to its many urban agents – a complex, self-organizing, artificial environment – to which urban agents have to adapt.
Q: How do people produce artifacts?

A1: By means of their representation capabilities (SIRN) and,

A2: By means of their chronesthetic, planning, and design capabilities
Chronesthesia, or mental time travel (MTT): the brain’s ability to think about the past, present, and future

Lars Nyberg; Reza Habib, Alice S. N. Kim, Brian Levine, and Endel Tulving, *Proceedings of the National Academy of Sciences*.

“.... certain regions in the left lateral parietal cortex, left frontal cortex, and cerebellum, as well as the thalamus, were activated differently when the subjects thought about the past and future compared with the present. Notably, brain activity was very similar for thinking about all of the non-present times (the imagined past, real past, and imagined future).
The production of artifacts (by planning/design) is related to the property that:

1. The human memory is *chronesthetic* and *constructive*, enabling constructive *mental time travel* (MTT) to the past as well as to the future

1. **Planning** and **design** are direct manifestations of MTT as well as **humans’ ability/need to construct artifacts** (implemented by a SIRN process)

3. Humans are, therefore, **natural planners and designers**

*Cognitive planning is an established domain in cognitive science; cognitive design is a new field of study.*
Designing and planning as two types of Mental Time Travel
The Time Machine in Our Mind

Thinking about a distant past/future triggers abstract thinking

Construal Level Theory (Trope and Liberman, 2010) describes the relation between psychological distance and the extent to which people’s thinking is abstract or concrete.

In general, the idea is that distant objects are thought of to be more abstract, and close objects as being more concrete.

The psychological distance is influenced by different types of distances, like distance in time (recent or distant past/future), distance in space, social distances, distance in familiarity, etc.

The types of distances have strong relationships; affect and are affected by the degree of abstraction; and affect predictions, preferences and actions.

Planning and design as two types of Mental Time Travel

Merging MTT, CLT and some basic notions about planning and design results in the following diagrams:

While a plan often evolves from the concrete here-and-now and becomes abstract as it “time travels” to the future, a design often starts as an abstract future and evolves/”travels” back in time to the concrete here-and-now.
Planning and design evolve as SIRN processes

Similarly to other cognitive tasks that require sequential cognitive processing, planning and design too evolves as an ongoing play between internal and external representations.

Remember the three SIRN submodels:

- Intrapersonal sequential submodel
- Interpersonal sequential submodel
- Interpersonal simultaneous submodel

An example from the domain of Urban Design shows:

*a hybrid intra-/interpersonal design model*
In general, urban design artifacts:

• are much larger than the human body;
• are experienced from the inside by moving the body;
• can never be experienced completely.

In the example, one of the challenges was to incorporate the human scale in the design process of a large scale artifact.

‘Traditional’ intrapersonal sequential design process
• The designer externalizes the design ideas by means of sketches (paper/pencil) and computer drawings, ‘reflection in action’;
• Some abstract notions are used as a starting point in the design process.
• Emotionally driven: design fixation (frustration), eureka-moment (AHA! Experience), sense of beauty and coherence as an important motivation.
‘New’ hybrid intra-/interpersonal design process

• The designer uses a simulation model to test the response of the city, introducing an interpersonal design process;

• The interplay between the simulation model, traditional sketching/drawing results in a hybrid intra-/interpersonal design process.
Traveling ‘back in time’ from abstract to concrete

- The abstract notions from the beginning of the process are transformed to concrete ‘tangible’ design proposals;
- The hybrid intra-/interpersonal design model supported the design process: the response of the city is taken into account and ‘humanized’ the spaces.
A typical urban design process

Design for Almere Hout (Almere) by Egbert Stolk

Design for Katenbroek (Amersfoort) by Kuiper Compagnons
Conclusions?
Not yet

We are currently working on developing the domain of cognitive design.

Maybe in the next Herbstakademie

What do we take home from this akademie?
A lot, but specifically the role of emotions in cognitive design
Thank you for your attention