

Design, Implementation and Evaluation of Group Decision-Making Procedures in Morphological Analysis

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1. Introduction

- What is Morphological Analysis?
- What Support Systems for Morphological Analysis do exist?

2. Research and Implementation: Collaborative Morphological Analysis

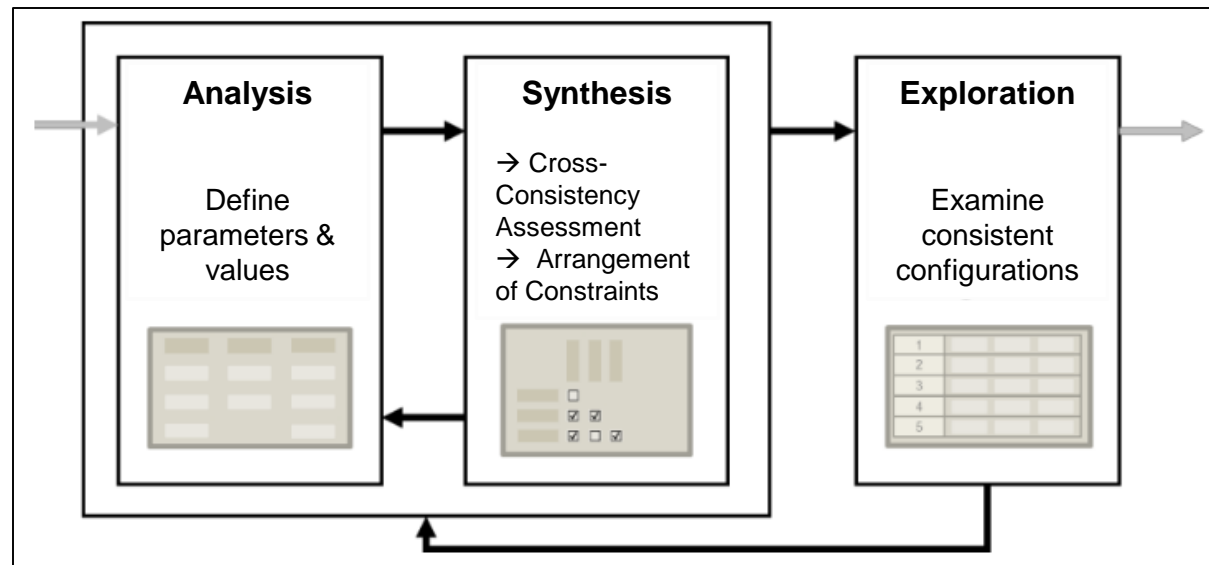
- Social Psychology Considerations
- Computer-Supported Collaborative Morphological Analysis

3. Schedule

- Creativity technique for groups
- “Method for structuring and investigating the total set of relationships contained in multi-dimensional, usually non-quantifiable, problem complexes” (Ritchey, 2006)
- Iterative process

Three main phases

1. Analysis
2. Synthesis
3. Exploration



The general iterative process model

cf. Zec et al. 2015

Decomposition of system

- Identification of parameters
- Definition of alternatives/ values for each parameter

Three main phases

1. Analysis

2. Synthesis

3. Exploration



Morphological Box/Field

Table				
Material	Number of table-legs	Form	Height	...
Wood	0	Round	50 cm	...
Glas	1	Square	80 cm	...
Plastic	4	Rhombus	120 cm	...
...

Number of simple configurations :

- $T_C = v_1 * v_2 * v_3 * \dots * v_n = \prod_{i=1}^n v_i$
- „Table“ example (4 parameters, 3 values p. p.)
→ 81 possible configurations
- 8 parameters, 6 values p. p.
→ $6^8=1.679.616$ possible configurations

Assessment of configuration consistencies

- Configurations with incompatible parameter values can be excluded from further consideration
- “negative” selection of configurations

Three main phases

1. Analysis

2. Synthesis

3. Exploration



Cross-Consistency Matrix

		Material			Form			Number of tabl...		
		Wood	Glas	Plastic	Round	Square	Rhombus	0	1	4
Form	Round	✓	✓	✗						
	Square	✓	✗	✗						
	Rhombus	✓	✗	✓						
Number of tabl...	0	✓	✗	✗	✗	✓	✗			
	1	✗	✗	✗	✓	✗	✗			
	4	✓	✓	✓	✗	✓	✓			
Height	50 cm	✓	✓	✓	✓	✓	✓	✗	✗	✓
	80 cm	✓	✗	✗	✓	✓	✓	✗	✗	✓
	120 cm	✓	✗	✗	✓	✓	✓	✓	✓	✓

After Cross-Consistency Assessment:

→ solution space is usually reduced to **1-10 %** of the simple configurations of T_C for most morphological fields (cf. Ritchey 2015)

Three main phases

1. Analysis

2. Synthesis

3. Exploration

Arrangement of constraints

- All configurations that fit with a constraint are inside the solution space
- “positive” selection of configurations



Material: Glas

Form: Round

NOT Height: 120 cm

Three main phases

1. Analysis

2. Synthesis

3. Exploration

- Exploration of the remaining set of consistent configurations



(no selection)	Round	(no selection)	(no selection)
Material	Form	Number of table-l...	Height
Wood	Round	0	50 cm
Glas	Square	1	80 cm
Plastic	Rhombus	4	120 cm

- Existing Support Systems (e.g. MA/Carma, Parmenides Eidos):
 - [Analysis] Help to collect parameters and corresponding values
 - [Synthesis] Offer tools for Cross-Consistency Assessment
 - Calculate the solution space
 - [Exploration] Help to explore the solution space of consistent configurations
 - E.g.: Fixed Input → displaying remaining consistent parameter values

- **BUT:** existing Support Systems are not collaborative!
 - Group members have to use these applications at
 - the same place and
 - the same time
 - Face-to-face meetings
 - They have to discuss and they have to agree on inputs to the application

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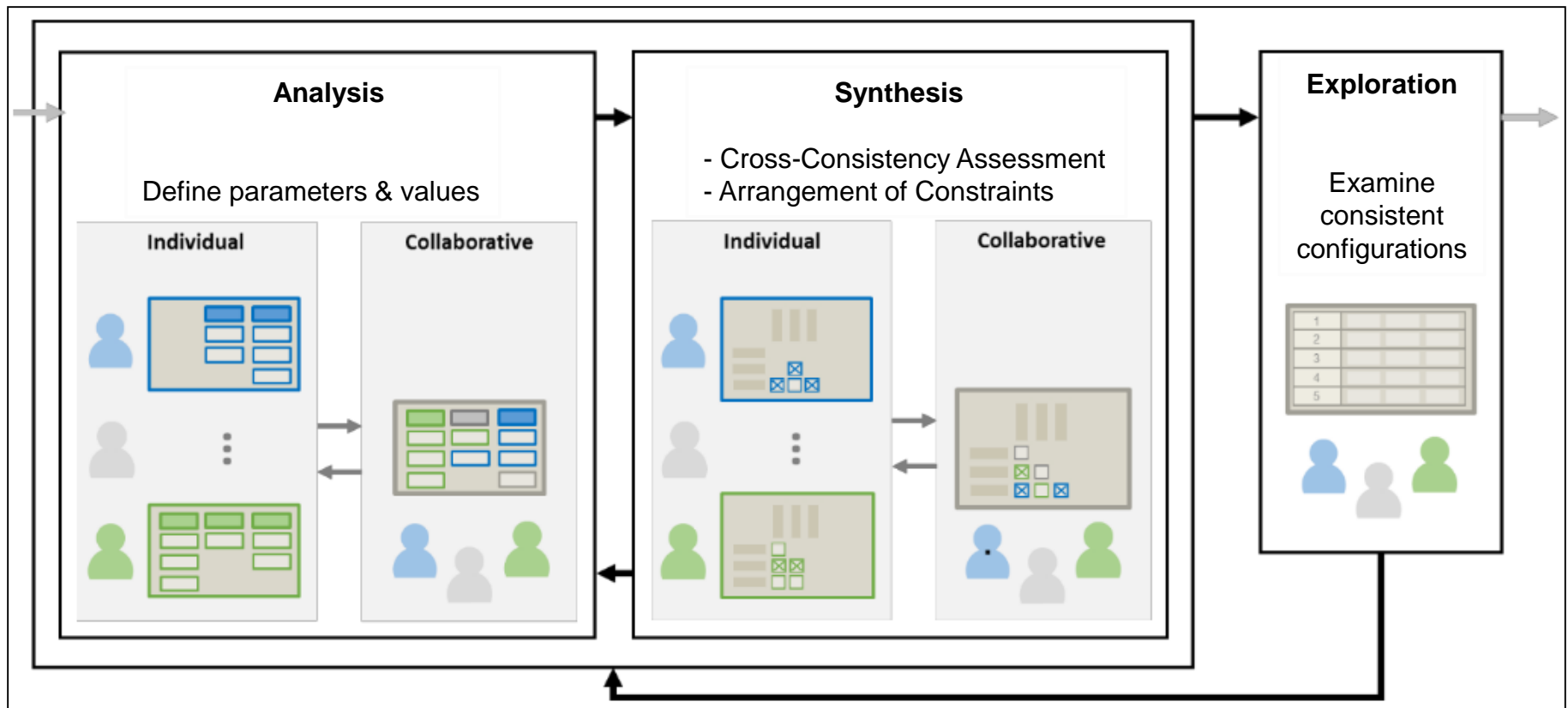
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Social Psychology Considerations

- Which **Group Decision-Making Procedures** exist?
- Which **Group Decision-Making Procedures** are suitable for the Synthesis Phase of Morphological Analysis?

- How to support **process gains** with an application?
 - Social competition, social compensation, Köhler effect, cognitive stimulation
- How to avoid **process losses** with an application?
 - Coordination losses, production blocking, social loafing, dispensability effect, sucker effect, cognitive restriction, hidden profiles



Process model for CMA derived from Delphi technique

cf. Zec et al. 2015

General Delphi Technique

→ Round based

1. Individual judgements and justifications
2. Anonymous summary by a facilitator



- Technique to conduct group assessments
- Round-less
- For **each element** that shall be assessed there are **two phases** for **each participant**:

1. Each participant makes an **assessment without knowledge** of other assessments in the group



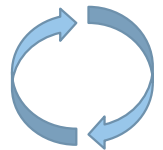
2. After the first own assessment participants get further information:

- The **average** of all of the responses of the group so far
- The **number of responses** made so far
- **Reasons** that others have given for their responses

Responses that stay in **conflict** to the group answer should be **marked**.


Participants should **observe marked responses**

- Reassess own response
- Provide a comprehensible justification for the own response



- Process can be synchronous or asynchronous
- Participants remain anonymous

cf. Gordon and Pease 2006
cf. Gordon 2009

- **Arrangement of Constraints**
 - “positive” selection of configurations
 - Each participant can compose its own constraints
 - Automatic evaluation of constraints
 - Real-time Delphi
 - Individual assessments of constraints
 - Live stats of other participants after first own assessment
 - Justifications of other participants after first own assessment
- **Cross-Consistency Assessment**
 - “negative” selection of configurations
 - Real-time Delphi
 - Individual Cross-Consistency Assessments
 - Live stats of other participants after first own CCA
 - Justifications of other participants after first own CCA
- **Framework**
 - METE 

Arrangement of Constraints

Existing Constraints

[+ New Constraint](#)

Material: Glas Form: Round	100 % 3 ✓
NOT Number of table-legs: 0	
Material: Plastic	33 % 3 ✓
NOT Height: 120 cm NOT Number of table-legs: 0	
Form: Rhombus Number of table-legs: 1	67 % 3 ✓
NOT Material: Glas	✗

My Assessment

Reasonable
 Not Reasonable

Justification

Lorem ipsum dolor sit amet, consetetur sadipscing elitr, sed diam nonumy eirmod tempor invidunt ut labore et dolore magna aliquyam erat, sed diam voluptua.

[Save](#)

Group Assessments

Positive Assessments	33 %
Number of Assessments	3

Justifications

- ✗ [Sat Jul 09 2016 00:32:22 GMT+0200 \(CEST\)](#):
Lorem ipsum dolor sit amet, consetetur sadipscing elitr, sed diam nonumy eirmod tempor invidunt ut labore et dolore magna aliquyam erat, sed diam voluptua. At vero eos et accusam et justo duo dolores et ea rebum. Stet clita kasd gubergren, no sea takimata sanctus est Lorem ipsum dolor sit amet.
- ✓ [Fri Jul 08 2016 22:45:53 GMT+0200 \(CEST\)](#):
Lorem ipsum dolor sit amet, consetetur sadipscing elitr, sed diam nonumy eirmod tempor invidunt ut labore et dolore magna aliquyam erat, sed diam voluptua.
- ✗ [Fri Jul 08 2016 22:56:22 GMT+0200 \(CEST\)](#):
Lorem ipsum dolor sit amet, consetetur sadipscing elitr, sed diam nonumy eirmod tempor invidunt ut labore et dolore magna aliquyam erat, sed diam voluptua. At vero eos et accusam et justo duo dolores et ea rebum.

Cross-Consistency Assessment

		Material			Form			Number of tabl...		
		Wood	Glas	Plastic	Round	Square	Rhombus	0	1	4
Form	Round	✓	✓	⚡						
	Square	✓	⚡	⚡						
	Rhombus	✓	✗	✓						
Number of tabl...	0	✓	⚡	✗	✗	✓	✗			
	1	⚡	⚡	✗	✓	⚡	✗			
	4	✓	✓	⚡	⚡	✓	✓			
Height	50 cm	✓	✓	✓	✓	✓	✓	✗	⚡	✓
	80 cm	✓	⚡	✗	⚡	✓	✓	⚡	⚡	✓
	120 cm	✓	✗	✗	✓	✓	✓	✓	✓	✓

Cross Consistency Assessment ✕

Number of table-legs
0

Material
Glas

Group Arguments (Assessments: 3)

✕ 67%

- Lorem ipsum dolor sit amet, consetetur sadipscing elitr, sed diam nonumy eirmod tempor invidunt ut labore et dolore magna aliquyam erat, sed diam voluptua. (Certain)
- Lorem ipsum dolor sit amet,

✓ 33%

- Lorem ipsum dolor sit amet, consetetur sadipscing elitr, sed diam nonumy eirmod tempor invidunt ut labore et dolore magna aliquyam erat, sed diam voluptua. (Somewhat certain)

Your Assessment

Consistency: Can you image a situation in which both values co-exist?

?
✕
⚡
✓

Confidence: How certain are you about your consistency rating?

Uncertain
Somewhat certain
Certain

Lorem ipsum dolor sit amet, consetetur sadipscing elitr, sed diam nonumy eirmod tempor invidunt ut labore et dolore magna aliquyam erat, sed diam voluptua.

Cancel
Save



Which Group-Decision Procedures are most suitable for the use in both specific parts of Synthesis phase of Morphological Analysis?



How can these procedures be varied to achieve particular sub goals?
→ e.g. time restrictions, quality of result



How should the chosen procedures should be implemented as web application and what are the requirements for the implementation?

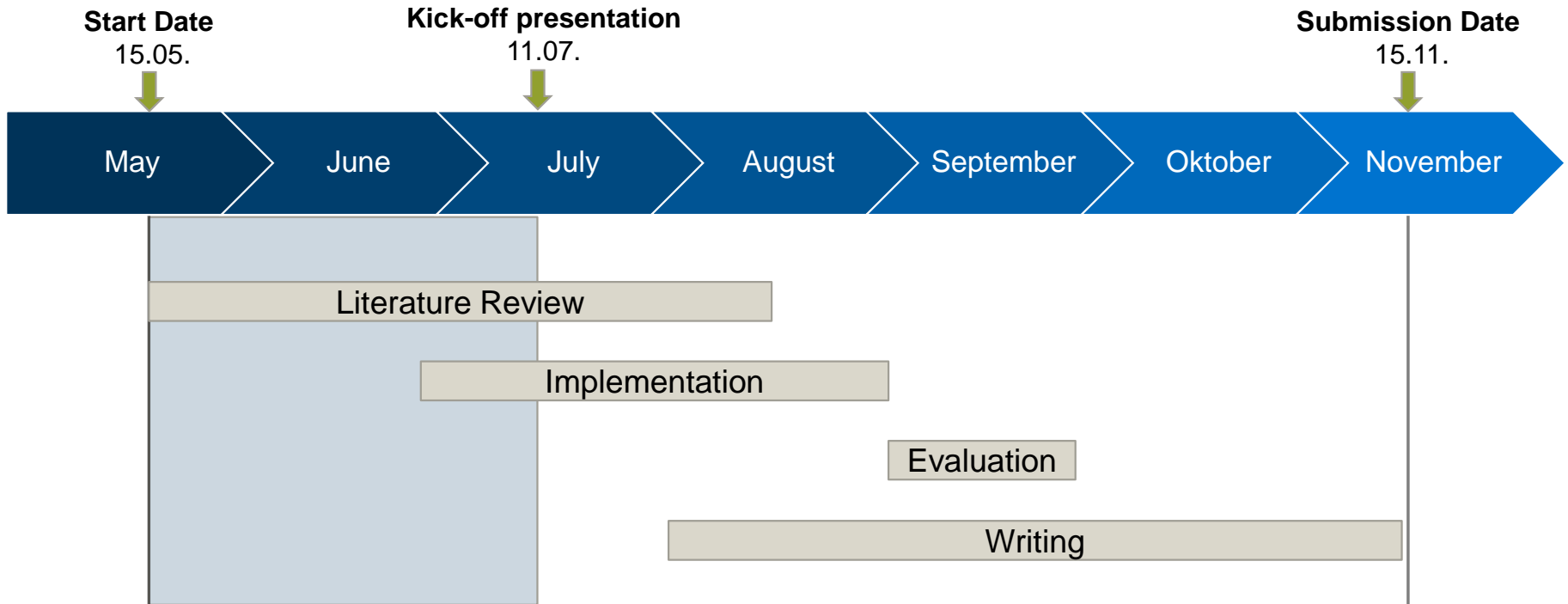
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Thank you for your attention! Any questions?



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