Augmented Knowledge Communication Spaces

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Pour your opinion to make it grow (text on the watering can)

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starting from the problem that individual argumentation is biased with regard to preference-consistent information (myside bias)

Tools *in augmented knowledge communication spaces* can support people to overcome a myside bias (and much more!)

Pour your opinion to make it grow!

or

„how to overcome your myside bias”
Knowledge creation and use

Shared digital artefact

Interpersonal exchange of knowledge
Knowledge 2.0 | user generated
Knowledge 2.0 | aggregated

newspapers
- FAZ / SZ
- Stern
- Spiegel

Content | Agenda
- User
- User
- User

virtual networks
- S. Niggemeier
- netzpolitik
- basicthinking
- bilderblog
- FAZ / SZ

blogs
- FAZ / SZ
- Bild

watchblogs
- spon.de
- heise.de
- youtube
- twitter
- facebook

online
Knowledge 2.0 | aggregated but with new filtering demands
Shared digital artefact

Knowledge creation and use

Interpersonal exchange of knowledge
Shared digital artefact

knowledge communication

Interpersonal exchange of knowledge
Facebook

My Profile
- Who I am
- Who are my friends

Status update to Friends
- What I am doing
- What I am interested in
- Pictures, Videos, Links

My Groups
- Joint interests
- Coordination
- Showing ones colors
- Group profil

General Functions
- Information management
- Social relation management
- Identity management
• **One of the 21\textsuperscript{st} Century Challenges:**
  
  exchange of relevant information to solve problems, to take decisions and to be well informed to judge about something by means of the 21\textsuperscript{st} century
Demands coming from problems of knowledge communication with intransparency

- Which knowledge, attitudes or opinions do other have
- How are these e.g. opinions distributed?
- My opinion compared to others?
- What do people think about a certain argument or subject?

⇒ achieve transparency
Demands coming from problems of knowledge communication with biased information processing

- Preference of consistent information (confirmation bias)
- Low tendency to integrate inconsistent information (myside bias)
- Preference of shared over unshared information (hidden profile bias)
- Strong influence of majorities (majority bias)

=> Support evaluation and integration of controversial information
Besides identity management and the management of social relations, Facebook could be used for information management.

*But:* Facebook is not primarily designed to support information management.

*But:* Facebook cannot easily be used for controlled and systematic empirical research.
• *However:* Facebook is in an evolutionary process of development and can also be mashed up a lot

• *Nevertheless our Conclusion is:* For the sake of controlled experimentation we are mainly using dedicated software tools to investigate and support knowledge communication
• **Assumption**: Knowledge Communication Spaces (Wikipedia, Facebook, Forums) can benefit from additional support mechanisms, which would lead to

**Augmented Knowledge Communication Spaces**
Augmented Knowledge Communication Spaces

• The Scenario

• Communication partners are often not aware of the concrete expertise and dispositions of the partners and sometimes enter an scenario not knowing the history of it

• To be successfull one has to overcome these deficits and can probably expect even more
Augmented Knowledge Communication Spaces

• Two Principles of Support

  • Mirroring: providing information about the concrete expertise and dispositions of the partners (→ group awareness)
  • Guiding: directing knowledge communication activities through transformation and salience (→ social navigation)
Augmented Knowledge Communication Spaces

• Dedicated **arrangements and tools** have been tried out in our research along two principal lines:

  • *Line A*: to deliver direct information to establish a common ground between the participating members (disclosure function)

  • *Line B*: to mine, aggregate, and transform information in order to facilitate reflection and change courses of action (intervention function)
Augmented Knowledge Communication Spaces

Tools and Studies
Lines and Tools (Studies)

Line A = disclosure function: overcoming intransparency

1 making self rated knowledge assessment visible
2 making in concept maps externalized knowledge visible
3 making knowledge differences and conflicts visible

Line B = intervention function: overcoming limitations

1 overcoming confirmation bias
2 overcoming myside bias
3 overcoming consensual information bias
4 overcoming majority bias
Tools and Studies of Line A

disclosure function: overcoming intransparency

1 making self rated knowledge assessment visible
2 making in concept maps externalized knowledge visible
3 making knowledge differences and conflicts visible
Tools and Studies of Line A

disclosure function: overcoming intransparency

1 making self rated knowledge assessment visible
2 making in concept maps externalized knowledge visible
3 making knowledge differences and conflicts visible
- **Problem:** Communicators do not know how much their interaction partners know
- **Solution:** Partner Knowledge Awareness Tool provides self-rated degrees of understanding about content elements (Dehler Zufferey, Bodemer, Buder, & Hesse, 2011)
• Learners read hypertext and rated their degree of understanding with regard to text nodes
• Tool provided knowledge awareness either about oneself or about oneself and partner
# Antikörper

**B-Lymphozyten-Aktivierung**

**Antikörper-Produktion**

**B-Gedächtniszellen**

**Antikörper-Wirkung**
Die produzierten Antikörper (im Bild blau) besetzen das Antigene (im Bild rot) am Erreger, wobei Antikörper aufgrund ihrer Form ausgerichtet sind. Dadurch wird der Abbau des Antigens durch Komplement beziehungsweise durch Phagozytose unterstützt.

## Antikörper

<table>
<thead>
<tr>
<th>C</th>
<th>B</th>
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<tbody>
<tr>
<td>B-Lymphozyten-Aktivierung</td>
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<tr>
<td>Antikörper-Produktion</td>
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<tr>
<td>B-Gedächtniszellen</td>
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<tr>
<td>Antikörper-Wirkung</td>
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## Phagozytose

<table>
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<td>Phagozyten</td>
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<td>Erkennung</td>
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<td>Prozess</td>
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<tr>
<td>Antigenpräsentation</td>
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</table>

### Schreibe bitte Deine Erklärung zum angegebenen Thema für Lempartner B in das Textfeld!

1. Bitte erkläre das Thema T-Lymphozyten

   *Erklärung*

   [Abschicken]
- Knowing about partner knowledge leads to adaptation towards partner deficits; $t(20) = 2.62$, $p < .05$
- (average number of elaborations per explainer)
Knowing about partner knowledge increases knowledge of the explainer; $F(2,40) = 4.92, p < .05$

(average percentage of correct answers in individual inferential knowledge test)
Knowing about partner knowledge increases knowledge transformation of the explainer (more deviations of explanations from original order); $F(1,40) = 4.72, p < .05$

(average number of deviations from original presentation order)
Tools and Studies of Line A

disclosure function: overcoming intransparency

1 making self rated knowledge assessment visible
2 making in concept maps externalized knowledge visible
3 making knowledge differences and conflicts visible
• Problem: Communicators conceptualize their knowledge differently

• Solution: Knowledge and Information Awareness Tools display different conceptualizations (Engelmann & Hesse, 2010)
• Learners externalized their knowledge as individual concept maps
• Tool displayed individual concept maps and prompted learners to construct a joint concept map
Quality of problemsolving:

<table>
<thead>
<tr>
<th>Variable</th>
<th>Result</th>
<th>Mean</th>
<th>$p$</th>
<th>$\eta^2$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Correct solution (1)</td>
<td>EG = CG</td>
<td></td>
<td>n.s.</td>
<td></td>
</tr>
<tr>
<td>Correct arguments for solution (1)</td>
<td>(EG &gt; CG)</td>
<td>$M_C = 1.4$&lt;br&gt;$M_E = 2.1$</td>
<td>&lt;.10</td>
<td>.08</td>
</tr>
<tr>
<td>Correct solution (2)</td>
<td>EG &gt; CG</td>
<td>$M_C = 0.55$&lt;br&gt;$M_E = 0.95$</td>
<td>&lt;.01</td>
<td>.21</td>
</tr>
<tr>
<td>Correct arguments for solution (2)</td>
<td>EG &gt; CG</td>
<td>$M_C = 0.85$&lt;br&gt;$M_E = 2.1$</td>
<td>&lt;.01</td>
<td>.37</td>
</tr>
</tbody>
</table>

- EG with better solution, especially with complex problem
Experimental group

- start map1
- start ps1*
- end map1*
- correct solution1
- end ps1
- start map2
- start ps2*
- end map2*
- correct solution2*
- end ps2

Control group

- start map1
- start ps1
- end map1
- correct solution
- end ps1
- start map2
- start ps2
- end map2
- correct solution 2
- end ps2

* significant differences between the two conditions
Tools and Studies of Line A

disclosure function: overcoming intransparency

1 making self rated knowledge assessment visible
2 making in concept maps externalized knowledge visible
3 making knowledge differences and conflicts visible
• Problem: Communicators do not see possible differences and conflicts easily

• Solution: Awareness Tools display critical values (Bodemer, 2011)
Collaborative Integration: guiding by presenting knowledge constellations
Constellations affect collaborative elaboration: results for contribution type „broaden & deepen“

(relative number of contributions)
Group awareness and discussing controversies lead to better learning

(relative frequencies of knowledge test score differences)
Tools and Studies of Line B

intervention function: overcoming limitations

1 overcoming confirmation bias
2 overcoming myside bias
3 overcoming consensual information bias
4 overcoming majority bias
Tools and Studies of Line B

intervention function: overcoming limitations

1 overcoming confirmation bias
2 overcoming myside bias
3 overcoming consensual information bias
4 overcoming majority bias
• Problem: **Information search** is biased with regard to preference-consistent information (confirmation bias)

• Solution: Preference-inconsistent recommender system (Schwind, Buder, & Hesse, 2011)
Users were confronted with arguments on a controversial issue, and were requested to select one argument for further inspection.

Tool provided no recommendation vs. preference-consistent recommendation vs. preference-inconsistent recommendation.

Results: reduced confirmation bias and better elaboration through preference-inconsistent recommendations.
The following information resource is recommended to you:

Maximizing existing potentials: Neuro-enhancers improve our ability to concentrate by stimulating neurotransmitters in the brain. They do not improve intelligence; they only make perfect use of existing powers.

Pervasiveness of natural stimulants: Caffeine, alcohol, and chocolate also affect the mind, and contribute to self-improvement. These stimulants are accepted in modern society.

No fairness: Performance enhancement in sports is generally regarded as unfair. Neuro-enhancers introduce the same inequalities for cognitive capacities.

Enhancement of creative powers: If well-known artists had not taken neuro-stimulating drugs like alcohol, absinth or marijuana, many great works of art and music would have been missing.

Minimizing risks at the workplace: Neuro-enhancement should be embraced particularly for professional fields where human failure is likely to lead to detrimental outcomes (e.g. air traffic controllers, surgeons, or military personnel).

Leveling out of advantages: Neuro-enhancement only gives a competitive edge as long as the substances aren’t available to everybody. With easy access for everybody, the benefits will level out.

Persistence of effects: The experiences that people make under the influence of neuro-enhancers can forever change their personality, even if the enhancers themselves have no immediate side effects.

Striving for undesirable perfectionism: The era of lovable little quirks might be over quite soon. Research is looking for ways to make us perfect. We don't need that.
Results Essay | How many arguments were generated?

- IV Condition *(CC vs. EC_{con} vs. EC_{inc})*

- DV # arguments essay

**ME Condition:** $F(2,86) = 2.98; p = .056$

(Generation of novel arguments: percentage of novel arguments mentioned in essays)
Results Essay | How many arguments were new?

- IV Condition (CC vs. EC_{con} vs. EC_{inc})
- DV % new arguments essay

ME Condition: $F(2,86) = 3.37; p < .05$
Tools and Studies of Line B

intervention function: overcoming limitations

1 overcoming confirmation bias
2 overcoming myside bias
3 overcoming consensual information bias
4 overcoming majority bias
• Problem: **Individual argumentation** is biased with regard to preference-consistent information (myside bias)

• Solution: support reflective judgement
Reflective Judgment

Informal Reasoning
“Reasoning about causes and consequences and about advantages and disadvantages, or pros and cons, of particular propositions or decision alternatives” (Zohar & Nemet, 2002)

Critical Thinking
“Ability to properly construct and evaluate arguments” (Facione, 1986)

Reflective Thinking
“Ability to evaluate knowledge claims and to explain and defend their points of view on controversial issues” (King & Kitchener, 1994)
Critical thinking and well informed decision making

to question assumptions
to evaluate arguments
to integrate controversial information
to take alternative interpretations into consideration
to draw founded conclusions
to evaluate again after getting new information
Der blaue Punkt markiert Ihre eingegebene Meinung zum Thema Nanotechnologie - der rote Balken die durchschnittliche Meinung der anderen Besucher, die vor Ihnen ihre Meinung eingegeben haben.

Unten werden die eingegebenen Statements der drei letzten Besucher der Ausstellung angezeigt.

Ich bin absolut gegen Nanotechnologie

Ich bin absolut für Nanotechnologie

Dies hier sind die drei zuletzt eingegebenen Statements anderer Besucher der Ausstellung Nanodialog:

"Ich bin erschrocken, dass so viele Möglichkeiten des Missbrauchs bestehen. Der Einsatz zu militärischen Zwecken macht mir Angst, es erscheint mir wahrhaftig, mit Nanotechnologie „bessere“ Tötungsmittel herzustellen. Und auch unter Gesichtspunkten des Datenschutzes ist Nanotechnologie in den falschen Händen ein großes Risiko."

"Nanotechnologie - nein danke... Für besonders problematisch halte ich Klonen, „Roboter“, sogenannte Monster, da sie den Menschen entmenschlichen und entwürdigen d.h. der Mensch ist nicht mehr das höchste Wesen, sondern eine lächerliche Gestalt, die nach Belieben veränderbar ist. Die Natur wird außer Kraft gesetzt und mittels molekularer Veränderung kann z.B. die DNA von Embryonen verändert werden, werden Behinderungen im Voraus festgestellt, kann man abtreiben, man kann also über das Leben von anderen entscheiden über natürliche Voraussetzungen hinweg."

Adjustment after feedback

after congruent feedback:

\[ t(19) = -5.32, \quad p < .001 \]

after conflicting feedback:

\[ t(17) = -2.15, \quad p < .05 \]
Reflective Judgement Score

<table>
<thead>
<tr>
<th>Feedback Type</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>No Feedback</td>
<td>3</td>
</tr>
<tr>
<td>Congruent Feedback</td>
<td>4</td>
</tr>
<tr>
<td>Conflicting Feedback</td>
<td>5</td>
</tr>
</tbody>
</table>

$t(53) = -2.33$

$p < .05$

(Arguments/rationale: 1 no, 2 weak, 3 good, 4 integrated counterposition, 5 full pro/con integration)
Counterargument / Rebuttal Construction Score

\[ t(58) = -3.76 \]
\[ p < .001 \]

(Counterarguments over 3 tasks (max. 3x5=15))
Disagreement ...

... reduced the myside bias in argumentation,

... fostered formation of opinions that take counterpositions into account,

... enhanced the ability to construct counterarguments and successful rebuttals of the personal opinion.
Tools and Studies of Line B

intervention function: overcoming limitations

1 overcoming confirmation bias
2 overcoming myside bias
3 overcoming consensual information bias
4 overcoming majority bias
- Problem: **Communicators prefer consensual information**, but conflicts foster learning

- Solution: Making controversy visible – leading to more discussion about controversial content - Study: Multi-touch table tool makes conflicting issues salient (Bodemer, in preparation)
Sollen staatliche Unternehmen privatisiert werden?

Was es ein Problem, dass staatliche Unternehmen auszuschalten werden?

Welches sind die Bedingungen des Marktes für eine Verschöpfung von privatem Handeln?

Soll der Staat in den Markt eindringen, um Bedingungen, die der private Wirtschaftssubjekt nicht, abzudecken?

Soll der Staat in den Markt eindringen, um Bedingungen, die der private Wirtschaftssubjekt nicht, abzudecken?

Soll der Staat in den Markt eindringen, um Bedingungen, die der private Wirtschaftssubjekt nicht, abzudecken?

Haben Unternehmen immer Freiheit, ihre Ware an fremde Kunden zu verkaufen?

Monetarismus

Keystanismus
Conflict Cards support perceived salience of controversial opinions

![Bar graph showing awareness score comparison between with group awareness support and without group awareness support.](image-url)
Tools and Studies of Line B

intervention function: overcoming limitations

1 overcoming confirmation bias
2 overcoming myside bias
3 overcoming consensual information bias
4 overcoming majority bias
• Problem: **Majority factions dominate minority factions even when majorities are incorrect**

• Solution: Augmented Group Awareness Tools make minority contributions salient (Buder & Bodemer, 2008)
Small groups discussed a controversial issue in an online forum.
Groups consisted of a majority that advocated an incorrect viewpoint vs. a minority advocating a correct viewpoint.
Learners rated discussion contributions on agreement and novelty (salience of minority).
Results: better post-discussion decision quality of groups.
Topic: Computer with AI (Artificial Intelligence) as a replacement of humans someday??

Intelligence. One solution would be to have the PCs networked, where each pc act as a neuron and each network connection a pathway.

Your ratings ...  Relevance: 1 2 3 4 5  Agreement: 1 2 3 4 5

Contribution # 6

I agree that human intelligence is even more ingenious than what we usually think - you can try to start and think about it if you imagine what it takes just to - for example - make a cup of coffee. All the eye-hand coordination, knowing where the sugar is, knowing that the boiling water shouldn"t go on your hands etc. However, I don"t see how networking all the computers achieve a breakthrough in machine intelligence. It would bring together great computational power and resources, but can that be equated with intelligence?

Your ratings ...  Relevance: 1 2 3 4 5  Agreement: 1 2 3 4 5

Contribution # 7

We should distinguish here between two separate questions, which tend to get mixed up. The first question is: When will we succeed in creating a computer program that will be able to fool people into believing they are talking to another person? This is a question of mimicking human behavior. The second question is: When will we create a computer that can actually think like a human? This is a question of creating true artificial intelligence.
Topic: Computer with AI (Artificial Intelligence) as a replacement of humans someday??

Intelligence. One solution would be to have the PCs networked, where each PC acts as a neuron and each network connection a pathway.

Your ratings ... Relevance: 1 2 3 4 5  Agreement: 1 2 3 4 5
Results

With augmented group awareness tool, a larger number of groups arrived at the correct (minority) decision; $\chi^2_{0.95 (2)} = 6.57 \ p < .05$

(percentage of groups per condition that arrived at the correct minority viewpoint)
Results

With augmented group awareness tool, a larger number of groups exhibited an evidence-driven deliberation style (opposed to a verdict-driven style);

\[ \chi^2_{0.95}(2) = 8.22 \text{ p } < .05 \]

(percentage of groups per condition that exhibited an evidence-driven deliberation style opposed to a verdict-driven style)

stimmte ich nicht zu  

stimmte ich sehr zu

ist für mich nicht relevant  

ist für mich sehr relevant

Wenn das bestehende Modell der Nanotechnologie-Entwicklung weiterverfolgt wird, wird sich die Klüt zwischen den Armen und Reichen der Welt vergrößern, da die Investitionen in die Nanotechnologie vornehmlich von und zum Wohle der reicheren Länder durchgeführt werden.

stimmte ich nicht zu  

stimmte ich sehr zu

ist für mich nicht relevant  

ist für mich sehr relevant
Not everything that is observable might be interesting; and not everything that is interesting might be observable.

Focusing on observable interaction is desirable, however, it can never explain the whole story. Just as the inextricable context for individual thought, individual thought is an inextricable context of collective action.

Transferable learning

Individuals are parts of numerous small groups, and it would not be helpful to think that learning gained in one group does not transfer to interaction with group B. To bridge this...

“Naive” assumptions about mental representations

The observation that individuals do not know for certain about internal mental states of others does not undermine assumptions about such states. For this reason an hermeneutic approach focusing on...

Tools for group cognition

Support for group cognition requires more than just media for exchange of messages. That might suffice. Group cognition requires support for group interaction phenomena like referencing, sequentiality, indexation...

Agreement:  | Relevance:  | Degree of Conflict:  
Transferable learning:  |  |  
“Naive” assumptions about mental representations:  |  |  
Tools for group cognition:  |  |  

Conclusions from seven (shown) and more (done) studies
• **Conclusion 1/4 (disclosure function – group awareness)**

• Compared to f-t-f scenarios internet based communication is missing some information, e.g. some contextual information and certain direct feedback components

• However: **Tools with a disclosure function** allow to achieve an awareness to **compensate** for it or even to be **superior** as relevant critical features are selected and thus become more salient than in f-t-f situations and get so higher attention
Conclusion 2/4 *(intervention function – social navigation)*

- Internet based communication compared to f-t-f communication can take advantage from computational power und means of making relevant feature graphically visible and partly easy to manipulate.

- **Tools with an intervention function** allow to achieve an augmented knowledge communication space and thus can become superior in comparison with f-t-f situations.
Augmented Knowledge Communication Spaces

• Conclusion 3/4

• *What mechanism make the “knowledge communication space” “augmented”?*

• The disclosure function takes advantage from the fact, that our capacity limited cognitive system will pay attention to salient information

• The intervention function even delivers information which cannot easily be derived without the computational power of a computer
Augmented Knowledge Communication Spaces

• Conclusion 4/4

• *Why are these mechanism so helpful”?*

• The disclosure function concentrates on crucial features of knowledge exchange

• The intervention function tries to overcome critical deficits in knowledge exchange
Augmented Knowledge Communication Spaces

- Application to a wide range of scenarios:
  - e.g. to seminar and small group interactions
  - e.g. to collaborative interactions in work live beyond study time
  - (also to OECD call for measuring collaborative problem solving in PISA 2015 – making this a highly valued skill)
References

Thank you for your attention