Cognitive Psychology
- Creativity -
Kai Sassenberg
Rijksuniversiteit Groningen

Overview of Lectures on Cognitive Psychology

- What is creativity and how is it assessed?
- Approaches to creativity
- The mad genius
- Why is being creative so difficult?
- The creative chaos
- Mood and creativity
- Motivation and creativity
- The social context and creativity
- Putting everything in an organizational context
What is Creativity?

A Scientific Take on Creativity

- **Definition of creativity (conceptual):** Mental process involving the generation of new ideas or concepts, or new associations between existing ideas or concepts.
- **Definition of creativity (scientific):** Cognitive process leading to original and appropriate outcomes.
- **Similar concepts:** divergent vs. convergent thinking (induction vs. deduction)
Dimensions of Divergent Thinking (Guilford, 1950)

- **fluidity** (number of ideas)
  - Ideation: listing red round objects
  - Association: Fog is ... like a sponge
  - Expression: listing words ending with -ism

- **flexibility** (number of content categories / shifts)
  - Spontaneous: listing uses of a pencil
  - Adaptive: What would happen if nobody could or would like to sleep anymore?

- **originality** (ideas just mentioned by one participant)

- **elaboration** (number of ideas per content category)
  - What would you need to do, if you would plan a cycle trip across the Alps with a group of 30 people?

Creativity versus Innovation (Glynn, 1996)
Types of Creativity and how they are Assessed?

Brainstorming – The Technique

- Group creativity technique made popular by Alex Faickney Osborn in the late 1930s.
- Rules usually applied:
  - Collect as many ideas as possible from all participants with no criticisms or judgments made while ideas are being generated.
  - All ideas are welcome no matter how silly or far out they seem. The more ideas the better, because at this point you don't know what might work.
  - Absolutely no discussion during the brainstorming activity. Talking about the ideas will take place after brainstorming is complete.
  - Do not criticize or judge. Don't even groan, frown, or laugh. All ideas are equally valid at this point.
  - Do build on others’ ideas.
Brainstorming – Examples

• For which purpose can you use a red brig?
• What can you do in everyday life to contribute to the preservation of the environment?
• Dimensions:
  Fluidity: Number of ideas
  Flexibility: Number of categories (e.g., goals and means)
  Originality: How many unique ideas did somebody generate?
  Elaboration: How many ideas per category did somebody generate?

Brainstorming – The Outcomes

• Brainstorming in non-interactive groups (nominal groups) leads to better outcomes than group brainstorming.
• Production blocking rather than social loafing and evaluation apprehension is the cause of the problem.
  – Just one person can talk at a time. The delay increases forgetting and reduces cluster length. (Nijstad, Stroebe, & Lodewijks, 2003)
  – The generated ideas do not facilitate but restrict the search for ideas. (Diehl & Stroebe, 1987, 1991)
• Why is it popular anyway?
  – Teambuilding function
  – Illusion of group effectiveness (Stroebe, Diehl, & Abakoumkin, 1992)
    (members of 3 person groups claim 61% of the ideas)
Brainstorming – The Conclusions

- Group brainstorming helps to generate a common problem definition.
- Group brainstorming (already in dyads) is more satisfying.
- Nominal groups are more efficient than electronic groups and electronic groups are more efficient than real groups.
  
  (DeRosa, Smith, & Hantula, 2007; Ziegler, Diehl, & Zijlstra, 2000)
- Cognitive stimulation helps (giving information or forming heterogeneous groups).
  
  (e.g., Nijstad, Stroebe, & Lodewijkx, 2002)

(Creative) Problem Solving or Creative Insight I

- Task vs. problem
- Problems require goal directed idea generation. Mostly the ideas serve to restructure the situation.
- Examples:
  - Connect the following set of dots with 4 straight connected lines.

  ![Dots Diagram]

  - Participants receive: a small candle, a full book of matches, and a box of thumbtacks, and get the following instructions:
    
    Your task is to affix the candle to the wall so that the candle burns properly and does not drip wax on the table or floor.
(Creative) Problem Solving or Creative Insight II
Schooler, Ohlsson, & Brook (1994)

• *More examples:*
  – Show how you can make the triangle pointing downward by moving only three circles.
  – A prisoner was attempting to escape from a tower. He found in this cell a rope that was half long enough to permit him to reach the ground safely. He divided the rope in half, tied the two parts together, and escaped. How?
  – Describe how to cut a whole in a post-card that is big enough for you to but your head through.

• *A task:*
Mary won’t eat fish or spinach, Sally won’t eat fish or beans, Steve won’t eat shrimps or potatoes, Alica won’t eat beef or tomatoes, and Jim won’t eat fish or tomatoes. If you are willing to give such a bunch of fuzzy eaters a dinner party, which items from the following list can you serve: green beans, creamed codfish, roast beef, roast chicken, celery, and lettuce.

Intuition – The Basics

• Intuition entails vague and tacit knowledge, whereas insight involves sudden and clear awareness. *(Policastro, 1995)*
• Active, conscious thinking is not necessary to extract regularities from a complex set of information.
• Intuition arises from knowledge and experiences stored in memory.
• How can we demonstrate, that intuition exists?
  – Administer a difficult test
  – Ask participants to provide a solution
  – Request them to guess a solution and provide a confidence rating
  – Evidence for intuition is given, if higher confidence for guessed solution co-occurs with more correct answers.
Intuition – The Remote Association Task
(Mednick, 1962)

A: Blank, White, Lines  B: Light, Folk, Head
A: Rabbit, Cloud, House  B: Finger, Speak, Worm
A: Deck, Stool, Pocket  B: Silk, Cream, Even

Intuition – The Evidence

Bowers, Regehr, Balthazard, & Parker (1990)

Proportion of correct solutions in unsolved trials:

This ability is impaired by negative mood.
(Bolte, Goschke, & Kuhl, 2003)
Creativity

• *Forms*: intuition, generation and problem solving
• *Dimensions*: fluidity, flexibility, originality, elaboration, and functionality
• *Criteria*: efficiency, joint problem definition and satisfaction

Approaches to Creativity: From *who* is creative to *how* can someone be creative
The Genius

- A naïve perspective on creativity focuses outstandingly creative individuals: Aristotle, Descartes, Shakespeare, Michelangelo, Beethoven ...
- The scientific analyses show, that creativity is not limited to a few outstanding individuals.
- It suggests that the personality characteristics related to creativity differ, depending on the domain to which creativity is applied.
  
  (Hershman & Lieb, 1988)

Creativity and Personality

- Characteristics that are (weakly) related to creativity in several domains are:
  - openness to experiences,
  - low conventionality,
  - self-confidence,
  - self-acceptance,
  - ambition,
  - hostility, and
  - impulsiveness.
  
  (Feist, 1998)

- But why?
Creativity as Blind Variation and Selective Retention – The Evolutionary Approach
(Campbell, 1960; Simonton, 1999)

- Creativity can be modeled after Darwin’s theory of biological evolution as a two step process:
  1. *Blind variation*: a non-teleological variation without any foresight in the production of ideas
  2. *Selective retention*: a test of the applicability and progress resulting from the ideas
- **Advantages**: This approach mirrors what people consciously do while trying to be creative.
- **Problems**:
  - The approach does not provide any insight in when or how people can be more creative.
  - Creativity is undermined by conscious monitoring!

Creativity is Undermined by Conscious Monitoring
Schooler, Ohlsson, & Brooks (1994)

![Bar chart showing percentage of solved problems](chart.png)
The Creative Cognition Approach - Principles
(Finke, Ward, & Smith, 1992)

- Human cognition can go beyond stored knowledge.
  Examples:
  - flexible use of language
  - separate units from incoming stream of information
  - combining categories to generate more complex ones
- The processes underlying this ability to generate can be studied using experimental methods.
- Creative performance – in everyday life as well as in extraordinary cases – is based on mental processes that can at least theoretically be assessed.

The Creative Cognition Approach – Processes
(Finke, Ward, & Smith, 1992)

**Generative processes**
- formation of associations between structures
- **mental synthesis of new structures**
- mental transformation of existing structures
- analogic transfer from one domain to another
- category reduction to reduce structures

**Explorative processes**
- search for desired attributes in mental structures
- search for metaphorical implications of mental structures
- **search for potential functions of the structures**
- evaluation of structures from different perspectives
- search for practical or conceptual limitations of structures
The Creative Cognition Approach – Implications  
(Finke, Ward, & Smith, 1992)

- Creative performance can be analyzed, understood, and trained.
- Contextual preconditions of creativity can be identified.

Approaches to Creativity

- The *genius* is outdated and naïve.
- *Personality* variables allow for the prediction of creativity, but the effects are weak and do not explain creativity.
- The *evolutionary approach* fits the actors perspective, but is of limited predictive value.
- The *creative cognition approach* provides the most informative analyzes from the scientific perspective as well as for training purposes.
Evidence for the Madness of the Genius

- Individuals high in creativity
  - are highly intelligent
  - show low levels of latent inhibition (Carson, Peterson, & Higgins, 2003)
- Schizophrenic patients show
  - low levels of latent inhibition
  - high flexibility scores (Spitzer, Braun, Hermle, & Maier, 1993)

⇒ There is an overlap in information processing between schizophrenic patients and creative individuals.
Creativity and Latent Inhibition

- *Latent inhibition* is the ability to screen stimuli from current attention focus that were previously experienced as irrelevant.

- Interpersonal differences in creativity are associated with the ability to respond (flexible) to changing tasks demands.

- This specific ability seems to be important for creative performance.

- Other characteristics of Schizophrenic patients that could lead to creativity are further and faster spreading activation.

- Not every creative person is mad, but there are similarities in information processing.

Why is Being Creative so Difficult?
- A Closer Look at Psychological Research -
Please create up to three new names for a pasta!
Examples are Spaghetti, Lasagna, Fettucini, Rotini, Pastina, Rigatoni

The Memory Problem

- Creativity requires the generation of something new based on the stored knowledge.
- 86% of newly generated product names match existing names (number of syllables and word endings). (Rubinet al., 1991)

Sample Study (Marsh, Landau & Hicks, 1996)
- Task: Paint animals from a planet with different living conditions. These animals should be maximally different from animals on earth.
- Manipulation: 0, 1, 3, 6, or 9 examples with antennas, a tale, and four legs.
- Dependent variable: Proportion of painted animals holding the features of the examples.
This creature is very friendly and has a retractable neck which helps it to eat off of trees.

This creature walks the planet eating all sorts of things like rocks and dirt.
The Impact of Examples

A very fluffy creature that hops from one place to the next using its very strong legs.

The graph shows the proportion of animals with the same characteristics as examples versus the number of examples. As the number of examples increases, the proportion of animals with the same characteristics also increases.
The Boundaries of Idea Generation

- The generation of alternatives is restricted by activated concepts and known alternatives (i.e., inadvertent plagiarism).
- People are neither aware of copying ideas nor able to overcome these restrictions intentionally...
  ...just as they are not aware to control the impact of activated knowledge in other context.

- Is priming “creativity” a way around inadvertent plagiarism?
- Can automaticity put the brakes on automaticity?

Priming Creativity

- Priming concepts lead to behavior that is in line with these concepts.

- The domain of creativity is different, because … … the request to behave creative does not suggest a concrete behavioral strategy. … creative behavior cannot be shown intentionally.

Does priming creativity help to overcome inadvertent plagiarism (i.e., reduce the impact of activated knowledge)?
Priming Creativity in a Generation Task

- **Coverstory**: two pretests for different studies
- **Mindset priming**: “Please describe three situations in which...
  (a) you behaved creatively” or
  (b) you cared about preciseness.”
  (c) no prime
- **Generation task**: “Please generate up to three new names
  for (a) a new pasta, (b) a new nuclear element, and (c)
  a new analgesics.”
- There was an explicit instruction not to use any features of
  given examples.
- **Dependent variable**: Relative frequency of generated ideas
  with similar endings as examples.

Relative Frequency of Non-conforming Word Endings

- pasta
- nuclear element
- analgetics

- preciseness
- no prime
- creativity
Discussion

- Priming creativity reduces inadvertent plagiarism.
- The “priming” manipulation might have other effects than just activating a concept.

Is the activation of the concept “creativity” sufficient to increase creativity?

Relative Frequency of Non-conforming Word-endings

<table>
<thead>
<tr>
<th>Word</th>
<th>Activity</th>
<th>Creativity</th>
</tr>
</thead>
<tbody>
<tr>
<td>pasta</td>
<td>0.3</td>
<td>0.4</td>
</tr>
<tr>
<td>analgetics</td>
<td>0.2</td>
<td>0.5</td>
</tr>
<tr>
<td>element</td>
<td>0.4</td>
<td>0.7</td>
</tr>
</tbody>
</table>
How Does This Work?

An Explanation

- Creativity is associated with “Think different”.
Criteria for a Creative Person / Action / Product

Proportion of participant, mentioning the following concept at least once:

- new: 90%
- different: 77%
- spontaneous: 43%
- Intelligent: 37%
- interesting: 13%
- simple: 10%

An Explanation

- Creativity is associated with “Think different”.
- This association might serve as mindset and undermines the automatic activation of close association. (Sassenberg & Moskowitz, 2005)
- Remote associations might be activate instead.
**Assessment of Spreading Activation**

**Task:** Lexical decision task (sequential priming: faces)

- +
- butter
- sweet

- 750 ms
- 100 ms

Response time for lexical decision assessed.

---

**Close and Remote Associations**

- Lexical decision task (sequential priming: words)

- **Independent variables**
  - *Mindset*: creativity vs. no prime (between subjects)
  - *Prime*: close vs. remote vs. control (within subjects)

- **Example**: primes: sugar, tea; target: sweet

- **Hypothesis**
  - Less facilitation from closely associated primes but more facilitation for remotely associated primes in the creativity condition than in the no prime condition.
In all preceding studies participants formed an intention not to copy any feature of the examples.

Is this intention a precondition for the priming effect?

Replication of experiment 1:
2 (creative vs. thoughtful) x 2 ("do not copy“ vs. “be creative“)
Relative Frequency of Non-conforming Word-endings

Mindset: $F(1, 42) = 7.79, p = .008$
Intention: $F(1, 42) = 6.04, p = .018$

Relative Frequency of Non-conforming Word-endings

Mindset: $F(2, 95) = 3.44, p = .036$
• Thought suppression leads to heightened accessibility.  
⇒ The aim to generate original ideas leads to heightened accessibility of the critical word endings.

• If priming “creativity” leads around activated knowledge, no rebound effect should occur.  
⇒ Successful suppression should not lead to heightened accessibility after priming creativity.

Predictions and Method

• **Hypothesis:**  
  Without mindset priming less conforming word endings (i.e. successful suppression) lead to heightened accessibility of the respective letters. When being primed with creativity this relation disappears.

• **Procedure:**  
  – Mindset priming based on three situations (IV: creative vs. no prime)  
  – Idea generation: names for a new pasta (DV: conforming word endings)  
  – Word stem completion  (DV: letter accessibility)
Letters Filled in by Prime and Conforming Word Endings

Main effect of Prime on conforming word endings:
\[ F(1,53) = 4.31, \ p = .043 \]

Prime x Conformity interaction on word completions with critical letters: \[ t(50) = 2.14, \ p = .038 \]

The Creative Chaos
(Rothenberg, 1986; Rothenberg & Sobel, 1980)
Activating Diversity and Disconformity

- **Task**: Write down creative uses of a read brick.
- **Dependent variable**: Number and originality of ideas.
- **Manipulation**: Different posters on the wall right in front of participants table.

Results

<table>
<thead>
<tr>
<th></th>
<th>Group 1</th>
<th>Group 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of ideas</td>
<td>7.18</td>
<td>5.53</td>
</tr>
<tr>
<td>Creativity of ideas</td>
<td>5.04</td>
<td>4.62</td>
</tr>
</tbody>
</table>

(Förster, Friedman, Butterbach, & Sassenberg, 2005)
Counterfactual Thinking Fosters Creative Performance  
(Galinsky & Moskowitz, 2000)

Jane went last weekend to a concert of her favorite band. Jane switched her seat with the tall person next to her so that both of them could get a good view to the stage. It was announced that a fan would win a trip to Hawaii and that the winner would be determined by the seat number currently occupied. The person Jane just switched her seat with won the trip to Hawaii.

- **Manipulation:** Story with or without counterfactual
- **Task:** Duncker’s (1935) candle problem
- **Result:** The problem was solved faster and more frequent after reading a counterfactual story.

Mood and Creativity
Mood and Creativity

- Positive mood leads to more risky behavior (compared to neutral and negative mood).
  - It might also impact on creativity.
- Positive mood leads to the inclusion of untypical exemplars in categories (feet in vehicle), because broader categories are formed... (Isen & Daubman, 1984)

  ... and information is processed on a global level. (Gasper & Clore, 2002)

Measures of Global- vs. Detailed Information Processing
Motivation and Creativity

- Intrinsic motivation increases creative performance, because it has a positive impact on spontaneity and depth of processing. (Amabile, 1990)
- Rewards and other extrinsic motivators increase creativity, if rules for creative performance are known. (Eisenberger, Armeli & Pretz, 1998)
- If rules for creative performance are not known, extrinsic motivators can reduce creative performance. (Hennessey, 2000)
- This is only true for the domain of creativity. (Harackiewicz & Sansone, 2000)
Regulatory Focus Theory (Higgins, 1997)

<table>
<thead>
<tr>
<th></th>
<th>Promotion Focus</th>
<th>Prevention Focus</th>
</tr>
</thead>
<tbody>
<tr>
<td>regulated needs</td>
<td>eagerness</td>
<td>safety / security</td>
</tr>
<tr>
<td>goals take the form of</td>
<td>ideals</td>
<td>obligations</td>
</tr>
<tr>
<td>perception of events</td>
<td>gain vs. non-gain</td>
<td>non-loss vs. Loss</td>
</tr>
<tr>
<td>behavioral strategy</td>
<td>risky, superficial</td>
<td>rule-based, detailed</td>
</tr>
</tbody>
</table>
## Regulatory Focus and Creativity

<table>
<thead>
<tr>
<th>Promotion</th>
<th>Prevention</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inhibiting given solutions</td>
<td></td>
</tr>
<tr>
<td>Restructering of Cognitions</td>
<td></td>
</tr>
<tr>
<td>Number of analogies</td>
<td></td>
</tr>
<tr>
<td>Number of creative ideas</td>
<td></td>
</tr>
<tr>
<td>Analytic task performance</td>
<td></td>
</tr>
</tbody>
</table>

*(Friedman & Förster, 2000, 2001, 2002)*

---

## The Social Context and Creativity
Group Norms Guiding Creativity

- **Task:** Creating a leaflet.
- **Manipulations:**
  - working individually vs. in groups
  - group norm: being creative with words vs. pictures
- **Dependent variable:** percentage of words
- **Prediction:**
  Participants follow the norm, when working in groups but contrast from the norm, when working individually.

### Percentage of Words on the leaflet

<table>
<thead>
<tr>
<th></th>
<th>word norm</th>
<th>picture norm</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>group</strong></td>
<td>50</td>
<td>40</td>
</tr>
<tr>
<td><strong>individual</strong></td>
<td>30</td>
<td>50</td>
</tr>
</tbody>
</table>

Cognitive Psychology    Kai Sassenberg
Putting Everything in an Organizational Context

Work Environment for Creativity

(Amabile, Conti, Coon, Lazenby, & Herron, 1996)

- encouragement of creativity
- group and organizational norms
- autonomy and freedom
- low conformity rich environment
- resources
- intrinsic motivation
- challenging workload
- pressure
- regulatory focus
- organizational impediments
- extrinsic motivation
What Helps Individuals to be Creative?

_Mental processes and states leading to creativity_
- latent inhibition
- fast and far spreading activation
- automatic rather than intentional processes
- positive mood
- promotion focus
- internal motivation

_Contextual features fostering creativity_
- chaotic or diverse environment
- counterfactuals
- rewards
- group norms