



# 认知心理学： 问题解决研究的新发展

Joachim Funke

Psychologisches Institut, Universität Heidelberg



# 提纲

- 什么是“复杂问题解决Complex Problem Solving“ (CPS)?
  - Dynamic Decision Making 动态决策的定义
  - Definition of Complex Environments 复杂环境的定义
- CPS: The European Approach 复杂问题解决的欧洲发展
  - Background 背景
  - Examples 实例
  - Problems and Solutions 问题和解决方法
- Major issues for the future 对未来的主要展望
  - Theoretical steps 理论发展
  - Empirical steps 经验发展
  - Methodological steps 方法发展



# 复杂环境下的动态决策

- Dynamic decision making: 动态决策
  - interacting with a responsive setting/environment over a longer period of time to reach certain goals
  - 在相关的条件或环境的制约下经过较长的时间周期达到目的.
  - implies intentions, plans, and goals 隐含意图, 计划, 目的
- Why dynamic? 为什么是动态?
  - the decision: a series of interrelated decisions over time
  - 决策, 是一系列相关的较大时间跨度的决定
  - the situation: not static but dynamic (incl. *Eigendynamik*, i.e. momentum)  
处境, 非静止的, 动态的.
- the dynamics of decision making: 决策的动态性:
  - it is *not* „the“ decision which has to be made 并非决定必须做什么
  - it is a *course of action* which has to be *shaped* 需要决定行动的方向



# Complex environments: Examples

## 复杂环境: 实例

- complex environments are found in ...复杂环境出现在:
  - fire fighting 救火
  - aircraft piloting 飞机驾驶
  - running nuclear power plants 运行核电站
  - military activities 军事行动
  - Politics 政治活动
- but also in daily life... 但是也在日常生活中...
  - friendships, partnership, marriage & divorce 朋友, 恋爱关系, 结婚, 离婚
  - Career 事业
  - Health 健康



# Complex environments: Four Features

## 复杂环境: 四个特征

- complexity and connectivity 复杂和相关性
  - requires information reduction and anticipation of side effects  
-> model building
  - 需要简化信息和进行预测以提高效率, 建造模型
- Intransparency 不透明
  - requires systematic collection of information  
-> decision making under uncertainty
  - 需要系统筛选信息, 在不确定条件下作出决策
- Dynamics 动态
  - requires anticipation and prediction of future developments  
-> time pressure
  - 需要预见和推测未来发展, 时间压力
- Polytely *Zielkonflikte* 目标矛盾
  - requires the settlement of goal priorities and solution of goal conflicts  
-> influence of value systems
  - 需要确定目标的重要性等级和解决目标之间的矛盾, 改变价值体系



# Complex Problem Solving

## 复杂问题解决

- „Complex Problem Solving“ means interaction of a *problem solver* with a *dynamic situation* in order to control a complex situation with respect to certain *goals*

复杂问题解决对解决问题的人来说意味着, 在一个动态环境中控制复杂的环境并达到确定的目标

- Examples 实例
  - Fire fighting 救火
  - Managing a business 商业管理
  - Running a private household 家政
  - ...



# Complex Problem Solving: 复杂问题解决 European Approach 欧洲发展

- two ways of doing expertise research (Sternberg, 1995):  
学术专家研究的两个方向
  - American way: 美国
    - expert-novice-comparisons showing that experts know more than novices 专家与非专家比较显示专家比非专家知道的多
    - studying physics expertise - how many Americans become physicists, or actually even ever study physics?  
物理专业专家-有多少美国人能成为物理学家?
    - studying experts does not explain how to *become* an expert  
教育专家无法解释如何成为专家
  - European way: 欧洲
    - almost anyone can be a subject; people in general, not only a small fraction of „experts“ -> population generalizability  
每一个人都可以成为对象, 不仅仅是一小部分专家-全体人群普遍化
    - problems are about life in general -> task generalizability 问题涉及普通生活, 任务普遍化
    - much more interest in individual differences 更关注个性差异

Sternberg, R. J. (1995). Expertise in complex problem solving: A comparison of alternative conceptions. In P. A. Frensch & J. Funke (Eds.), *Complex problem solving: The European perspective* (pp. 295-321). Hillsdale, NJ: Lawrence Erlbaum.



## Complex Problem Solving: 复杂问题解决 Short History & Background 简单历史和背景

- in the mid-1970s: 70年代中期
  - disappointment with predictive power of IQ tests for predicting problem solving in real-life situations  
对智商测试能够解决现时生活环境问题的设想的失望
    - one of the reasons: academic nature of tasks from IQ tests
    - 原因之一: 智商测试中任务的学术本质
- alternative approach to IQ measurement: 其他鉴定智商的方式
  - construction of computersimulated scenarios and their presentation to naive subjects as a tool for analyzing “complex problem solving”
    - under controlled conditions in the lab
    - with a lot of more task requirements than traditional IQ testing
    - 建立计算机模拟方案作为区别于传统智商测试的新工具, 在实验室模拟条件下分析复杂解决问题和处理多项任务.





## Examples 实例

- “Lohhausen” (Dörner et al., 1983) „罗豪森“ 地名
  - simulated town consisting of more than 2000 variables
  - subject’s task: be a good mayor for the next 10 simulated years!
  - 模拟一个诚实现状, 超过2000个变量, 测试对象的任务是假想担任10年的出色市长
- “Tailorshop” (Putz-Osterloh & Lüer, 1981; Funke, 1983) 裁缝店
  - simulated factory (24 variables)
  - subject’s task: be a good manager for the next 24 months!
  - 模拟工厂, 24个变量, 测试对象的任务是假想担任24个月的出色经理

Results showed: 结果表明

- IQ scores were predictive only in transparent situations
- 智商值只在明了环境中具有预见性
- task complexity led to many “catastrophes” 任务复杂性导致多重“灾难“
- strong interplay between cognitive and emotional processes 认知过程和心理过程的强烈相互影响

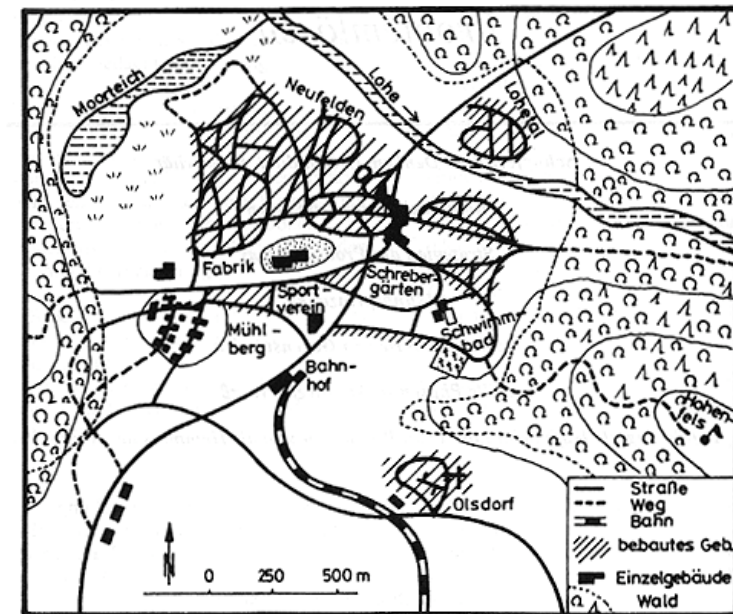


# CPS: The Lohhausen Study

## 复杂问题解决: 罗豪森研究

- Complex problem solving (CPS): 复杂问题解决
  - 创始于多纳(德国班贝格(地名))进行的开创性的研究, 论著发表于1983:
    - 48 名学生作为对象成为假想市长
    - 10小时完成担任10年的市长
    - 2000多个变量
    - 成功因素:
      - 不测智商!
      - 自信
      - 迅速切换局部和全局观点

Map of Lohhausen



Dörner, D., Kreuzig, H.W., Reither, F. & Stäudel, T. (Eds.). (1983). *Lohhausen. Vom Umgang mit Unbestimmtheit und Komplexität*. Bern: Huber.



## „Lohhausen“: Follow-ups 罗豪森延续发展

- hundreds of studies and experiments since this initial study done with computer-simulated scenarios  
自此开创性的研究之后, 有过上百次类似的计算机模拟的方案
- advantages of this methodology: 此类方法的优点:
  - error friendly (no real disasters) 容许错误(非真实灾难)
  - Replicable 可重复性
  - easy data logging 数据整理便捷
  - manipulation of time 节省时间
    - *slow motion*: reduction of time-pressure by running event-driven instead of time-driven simulations 慢动作: 减少时间压力, 通过事件驱动代替时间驱动模拟
    - *fast motion*: long periods can be abbreviated, long-term effects become visible shortly 快动作: 长时间周期可以浓缩, 长时效果可以短时可见
    - *real-time* simulation in high-fidelity simulators 高逼真模拟体现实时效果

Funke, J. (1995). Experimental research on complex problem solving. In P. A. Frensch & J. Funke (Eds.), *Complex problem solving: The European perspective* (pp. 243-268). Hillsdale, NJ: Lawrence Erlbaum.

Funke, J. (2003). *Problemlösendes Denken* [Problem solving]. Stuttgart, Germany: Kohlhammer.



# Problems of CPS Research

## 复杂问题解决研究的问题

- complexity of scenarios: a problem for researchers...  
模拟方案的复杂性成为研究者的问题
  - how to evaluate subjects's solutions? 如何评估对象的解决方案
  - how to compare different scenarios? 不通的模拟方案的可比性
- reliability and validity 可靠性和有效性
  - reliability: low for system scores, better for behavioral data
  - 可靠性: 对系统分数较低, 对行为数据较好
  - validity: many problems, mainly face-validity
  - 有效性: 问题很多, 主要是表面有效性
    - » high on "social validity" (i.e., acceptance by testees)  
社会可靠性高, 被测试者接受
- focus on action 注重行动
  - most results are concerned with action (in terms of information requests, decisions, etc.) 很多结果与行动相关(搜寻信息, 作出决策)
  - what about knowledge? 知识的作用?
  - what about strategies? 策略的作用?



## Possible Solution 可能的解决办法

- psychometric approach to CPS (Funke, 2003, 2006):
- 心理测量接近复杂问题解决CPS
  - use of more simple scenarios 采用更多的简单模拟方案
    - goal: represent most of the features of complex problems
    - 目的: 表达复杂问题的大多数特征
    - use of formalisms (reason: systematic construction, easy comparisons, straightforward derivation of measures)
    - 采用形式主义(原因: 系统建立, 可比性, 测试的直接推论)
      - » linear structural equations 线性结构方程
      - » finite state automata 有限状态自动机
  - separation of knowledge *acquisition* and knowledge *application*  
对知识的拥有和知识的运用进行分离
    - identification of system 系统的特性
    - system control 系统控制

Funke, J. (2003). *Problemlösendes Denken* [Problem solving]. Stuttgart, Germany: Kohlhammer.

Funke, J. (2006). Lösen komplexer Probleme. In J. Funke & P. A. Frensch (Eds.), *Handbuch der Allgemeinen Psychologie - Kognition* (pp. 439-445). Göttingen: Hogrefe.



# CPS „lessons learned“: Theoretical and empirical advances

## 复杂问题解决: 理论和经验的发展

- increased knowledge about *strengths and weaknesses* of human activities in complex situations  
有关复杂环境下人类活动的力量和弱点
- strong interplay between *cognition and emotion*  
认知和心理的强烈相关性
- shift of focus from decision to *strategy* 关注焦点从决定转化到策略
- many detailed results on the role of *person* variables, *task* characteristics, *situational* factors, and their interactions  
很多细节结果根据人的角色可变, 任务特性, 环境因素, 以及其相互作用.

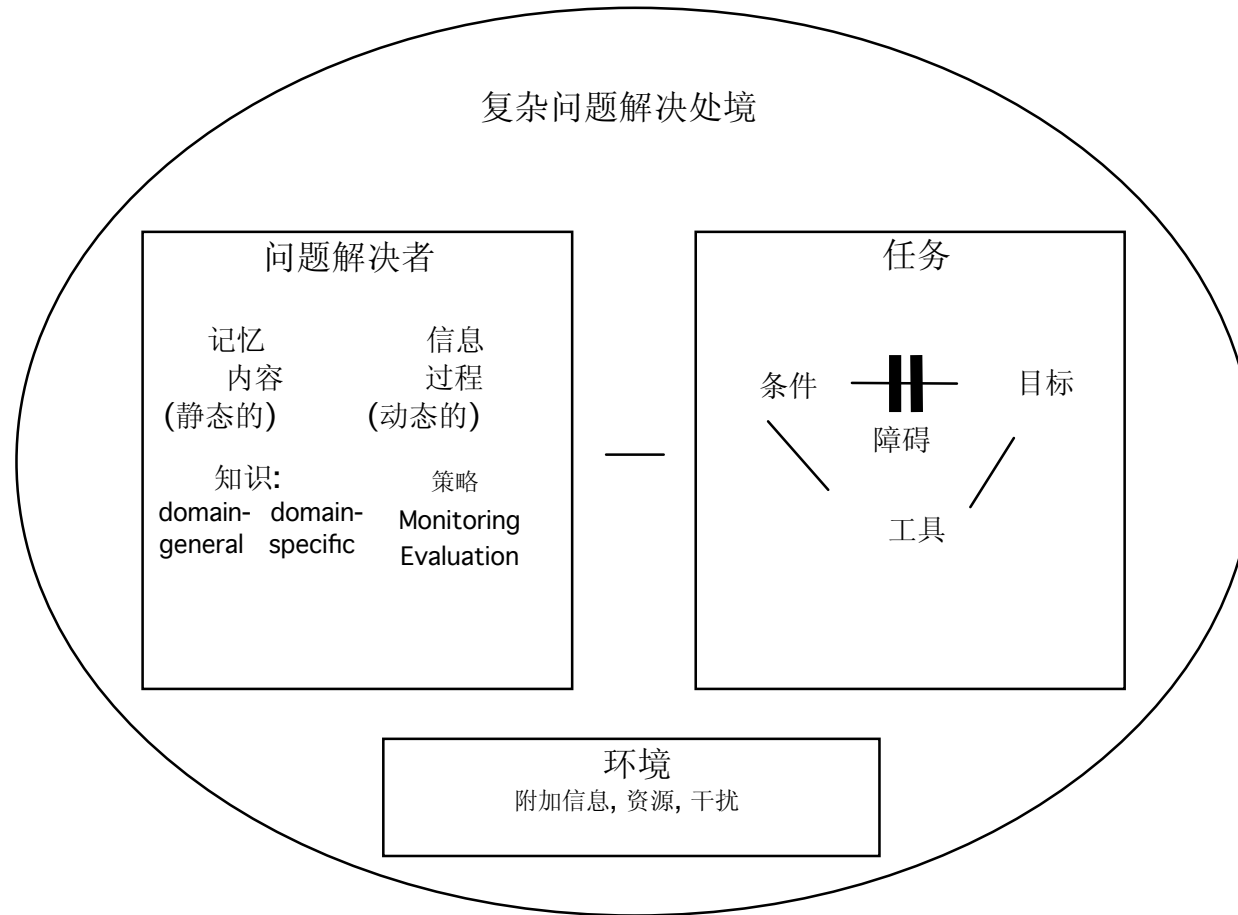
Dörner, D. (1996). *The logic of failure. Recognizing and avoiding error in complex situations*. Reading, MA: Addison-Wesley.

Funke, J. (2006). Komplexes Problemlösen [Complex problem solving]. In J. Funke (Ed.), *Denken und Problemlösen* (=Enzyklopädie der Psychologie, Themenbereich C: Theorie und Forschung, Serie II: Kognition, Band 8) (pp. 375-445). Göttingen: Hogrefe.



# CPS Taxonomy of Influential Factors

## 重要因素的复杂问题解决分类







# „Social loafing“ in complex situations

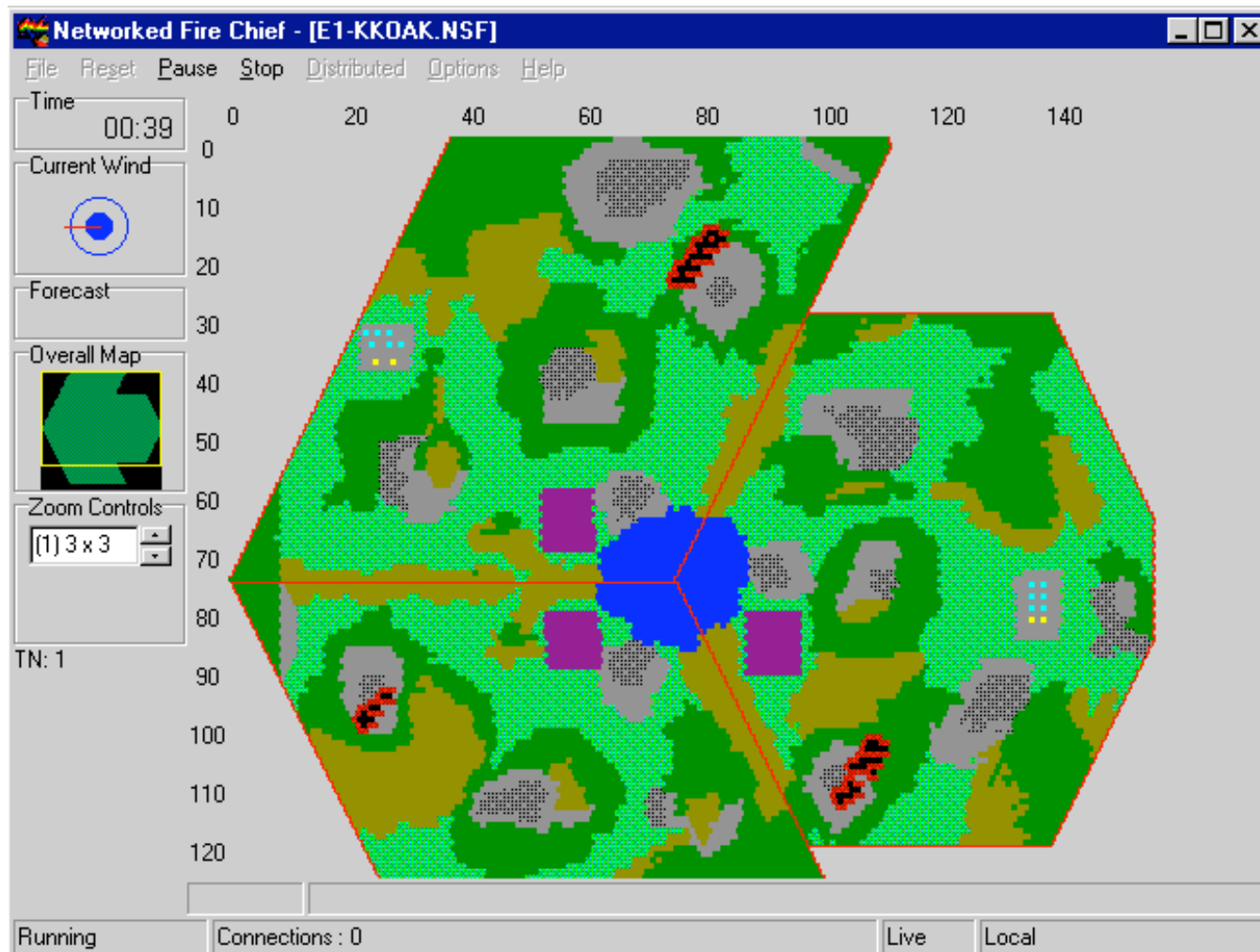
## 复杂环境中的社会惰性

- Background: 背景
  - „collective effort model“ (CEM) by Karau & Williams (1993, 1995) 集中努力模式
  - Instrumentality in collective situations lower than in coactive groups 集体努力程度低
- paradox results from Jackson & Williams (1985): 自相矛盾的结果
  - social loafing is helpful when solving more complex tasks aus 社会惰性有益解决多个复杂任务
  - groups with less effort yield better performance 努力程度低的群体产生好的成绩
- Feuchter & Funke (2004): Experiment with „Fire Fighting“-Szenario 模拟救火
  - 2x2 Design:
    - Difficulty of Task: „simple“ (appliances need only water) versus „complex“ (appliances need water and gasoline) 简单任务, 对象只需要水, 相对复杂, 对象需要水和汽油
    - Type of group: „coactive“ (=nominal group, individual performance counts) versus „collective“ (=real group, group performance counts)
    - 群体类型: 协作团体, 单个评分, 相对于集体组, 集体评分
  - Dependent Variables: 依赖变量
    - Effort (*in terminis* of interventions into the system) 努力程度
    - Performance (*in terminis* of saved ground; on individual as well as on group level) 成绩
  - Exp.: N=60 graduate students (38 female), randomly distributed in 20 groups of 3; interventions only in their own area 60名学生(38名女性), 随机分配为20个3人小组



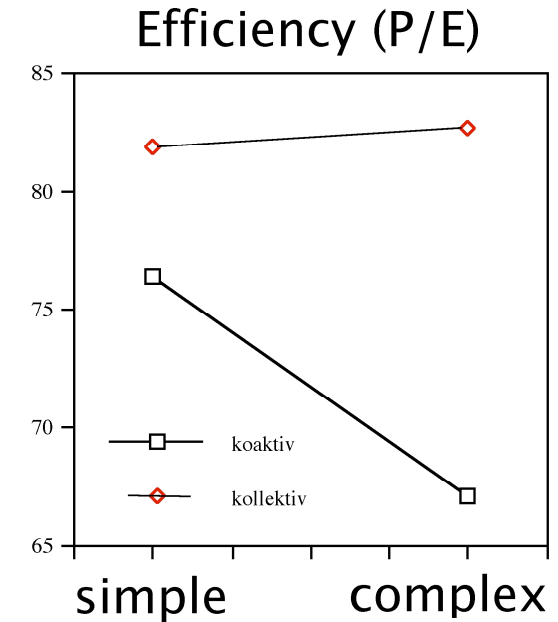
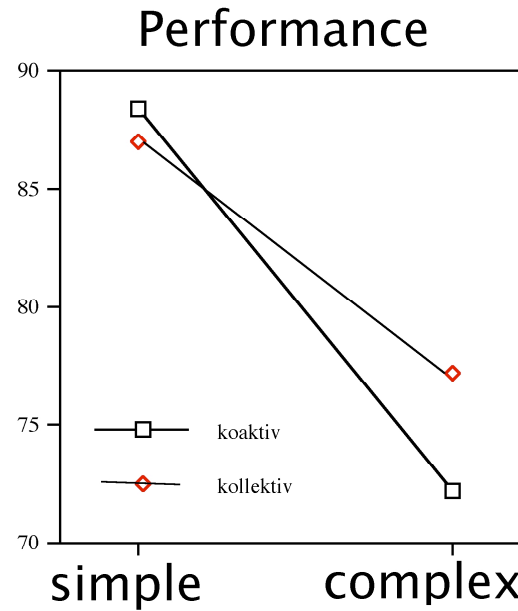
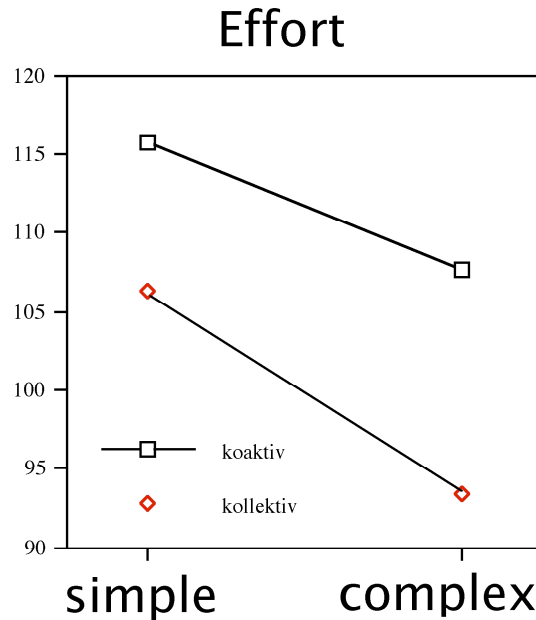


# „社会惰性Social Loafing“: 任务





# „社会惰性“：结果



- social loafing occurs: collective effort is lowered 集体努力低
- increased complexity reduces Performance 复杂程度增加导致成绩降低
- social loafers are more efficient (especially in complex situations)
- 社会惰性导致高效率(特别是在复杂环境下)

Feuchter, A., & Funke, J. (2004). Positive Effekte sozialen Faulenzens beim Lösen komplexer Probleme. *Kölner Zeitschrift für Soziologie und Sozialpsychologie*, 56, 304-325.



## Agenda for future research 未来研究的计划

- Theoretical steps 理论发展
- Empirical steps 经验发展
- Methodological steps 方法发展



# Theoretical steps 理论发展

- CPS has to deal theoretically with ...复杂问题解决在理论上必须结合
  - implicit cognition, intuitive DM: automaticity and routine behavior
  - 内隐认知, 直觉, 自动行为和惯例行为
    - see Betsch and Haberstroh (2005)
  - explicit cognition, problem-solving: thinking, *non-routine* behavior
  - 外显认知, 解决问题, 思维, 非惯例行为
    - see Frensch and Funke (2002)
- Integration of cognition and emotion 认知与情绪的结合
- Relationship between micro- and macro-processes  
微观过程与宏观过程的关系
  - „Macro cognition“ 宏观认知

Betsch, T., & Haberstroh, S. (Eds.). (2005). *The routines of decision making*. Mahwah, NJ: Lawrence Erlbaum.

Frensch, P. A., & Funke, J. (2002). Thinking and problem solving. In N. Cowan (Ed.), *Experimental psychology and its implications for human development. Encyclopedia of life support systems (EOLSS), developed under the auspices of the UNESCO*. Oxford, UK: Eolss Publishers. [<http://www.eolss.net>]

Klein, G., Ross, K. G., Moon, B. M., Klein, D. E., Hoffman, R. R., & Hollnagel, E. (2003). Macro cognition. *IEEE Intelligent Systems*, 18(3), 81-85.



## Empirical steps 经验发展

- do not focus *too* much on expertise areas! 不再过多地关注专家范畴
  - switch between domains to get fresh insights
  - 变换不同的领域以获得新的认识
- CPS is *not* restricted to experts and their expert domains!  
复杂问题解决不受专家以及专家领域的限制
  - problem solving occurs in the expert as well as in the novice
  - 问题解决存在于专家和非专家范畴
  - there do exist experts for everyday life activities like shopping etc.
  - 存在于日常生活, 例如购物
- open the focus for naturalistic daily life activities and their complexities!  
开始关注自然日常生活及其复杂性
  - frontal lobe patients suffer strongly from the complexities of daily life
  - 病人心理伤害主要来自日常生活的复杂性



## Methodological steps 方法发展

- the complimentary nature of laboratory based and field based methodologies 实验室和实际方法的正面特性
- use of simulation techniques 实用模拟技术
- the complimentary nature of qualitative and quantitative methodologies  
注重质的方法和注重量的方法的正面特性

there is no way around the development of a sound theory  
综合理论的发展不可避免

- comprising explicit and implicit processes 内隐和外显过程
- comprising cognitive and emotional processes 认知和情绪过程
- comprising micro- and macro-processes 微观和宏观过程



# Future research perspectives in our lab

## 我们实验室的未来研究展望

- Interplay of cognition and emotion in problem solving
- 解决问题中认知与情绪的相互作用
  - Emotions as additional information 情绪作为附加信息
  - Emotions as trigger to select different strategies 情绪作为选择不同策略的触发器
- Developmental aspects: When and how does planning and problem solving develop? 发展的观点: 计划和解决问题什么时间以什么形式发展?
  - What are preconditions? 先决条件是什么
  - What are the abilities? 什么是才能
- Neural base of problem solving 解决问题的神经基础
  - In addition to searching for „places“: search for synchronisations 除了在研究“地点“以外, 研究同步
- Relationship between micro- and macro-cognition
- 微观认知与宏观认知的关系

感谢您的听讲!  
还有问题吗?



Prof. Dr. Joachim Funke  
Psychologisches Institut  
Universität Heidelberg  
Hauptstr. 47-51  
D-69117 Heidelberg  
Germany



E-Mail: [joachim.funke@psychologie.uni-heidelberg.de](mailto:joachim.funke@psychologie.uni-heidelberg.de)  
<http://funke.uni-hd.de/>