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THE IMPACT OF PERSONALITY TYPES ON THE EFFICIENCY OUTCOMES OF BUSINESS MANAGEMENT DECISION MAKING

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ANNOTATION

Numerous research and practical publications in business administration, economics, sociology, psychology, information sciences, etc. have been dealing with the topic of decision making, decision making behavior, decision making outcomes, or emphasizing various aspects of this research area, i.e. efficiency criteria, individual and collective decision making approaches, human characteristics, degrees of decision making rationality and measuring decision making success. But there still seems to be no clear picture if intuitive or rational decision making leads to a higher efficiency in business management decision making esp. when problem tasks with different structures (e.g. well-, mid- and ill-structured) are involved in the decision making process.

Based on an intensive literature review and on extended theoretical analysis as well as on preliminary empirical evidence the author developed a theoretical framework, proposing specific cause and effect relationships between personality types as the independent variable and the decision making efficiency as the dependent variable, intervened by differently structured decision making problems and tasks.

The present study shows that there are significant results between various degrees of the intuition/rationality indicators and the decision making efficiency degrees in well-structured, mid-structured and ill-structured decision making tasks. However, there are no overall significant correlations, indicating that overall the hypotheses cannot be substantiated, although rational types seem to achieve higher decision making efficiency outcomes within well-structured problem tasks than intuitive types. In particular, former research findings seem to be corroborated in that the highest degrees of decision making efficiency can be achieved by a “pertinent blend” of intuitive and rational personality types in general, and especially when it comes to complex strategic decision making issues.

Finally, more research needs to be conducted in the interdependencies of structural elements in decision making processes (goals, procedures, sanctions, risks, etc.) and in the individual/personal “design” of the decision makers (personality types, motivation, psychological predetermination, group dynamics, etc.).

Keywords: decision making, intuition, rational, personality types, efficiency

CONTENT

LIST OF ABBREVIATIONS

AIM	Agor Intuitive Management Test
BIB	Bachelor students in International Business
CEST	Cognitive-Experiential Self Theory
CSI	Cognitive Style Index
EDE	Estimate-discuss-estimate procedure
E-I	Extraversion-Introversion
J-P	Judging-Perceiving
MBTI	Myers-Briggs Type Indicator
MIM	Master students in International Management
MSP	Mid-structured problem
NEO-PI	NEO Personality Inventory
NFC	Need for cognition scale
ISP	Ill-structured problem
IT	Information Technology
REI	Rational-Experiential Inventory
RPD	Recognition primed decision model
R&D	Research & Development
SCR	Skin conductance responses
S-N	Sensing-Intuition
SPSS	Statistical Package for the Social Sciences
T-F	Thinking-Feeling
VMPC	Ventromedial region of the prefrontal cortex
WSP	Well-structured problem

LIST OF FIGURES

INTRODUCTION

Actuality of topic and novelty

Faced with today's ill-structured business environment with fast-paced change and rising uncertainty, organizations are searching for application oriented approaches in management decision making which will perform satisfactorily under such ambiguous conditions.[1] Managerial decision making behavior has been in focus both from a scientific and a professional position whether rational or intuitive decision making leads to better outcomes. By now, scholars have agreed that effective organizations do not have the luxury of choosing between the "applications" of intuitive or rational decision making.[2] Instead, they try to understand how different factors like personality types and problem characteristics influence the decision-making process.[3] Reviewing the literature reveals that personality pre-determination and the structure of problems (e.g. well-structured problems versus ill-structured problems) seem to have a significant impact on decision-making efficiency. Further, the review also shows that there is a lack of application-oriented empirical studies in this area of research. Therefore, the aim of this research is to propose application oriented approaches for organizations, on how to use personality type categories in combination with different structured problems in the decision-making process. First, hypotheses are derived from the literature on how personality pre-determination and behavioral patterns in the decision-making process lead to higher socioeconomic efficiency within certain problem categories. Second, a causal model and a setup for a laboratory experiment are proposed to allow testing the hypotheses. Finally, the conclusion provides an outlook on how this research could support organizations in their decision-making processes.

The following points mark the novelty of this research:

- A new model was developed to address, from an empirical point of view, with the personality types and the ambiguity of the problem more than one behavioral oriented decision making factor.
- Besides the well- and ill-structured problem the present research defines and includes with a mid-structured problem for the first time a further scenario to evaluate what is "in between" a well- and ill-structured problem.

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1 Sinclair, M.; Ashkanasy, N. M. (2005). Intuition: Myth or a Decision-making Tool? In: Management Learning 36 (3), p. 353.

2 Simon, H. A. (1997). Administrative behavior. A study of decision-making processes in administrative organizations. 4. Aufl. New York, USA: Free Press, p. 139.

3 Sinclair, M.; Ashkanasy, N. M. (2002). Intuitive decision-making amongst leaders: More than just shooting from the hip. In: Pre Print Version. Later published in Mt. Eliza Business Review, pp. 7-10.

- The author has shown on an empirical base that the highest degrees of decision making efficiency can be achieved by individuals with a “pertinent blend” of intuitive and rational personality types in general, and especially when it comes to complex strategic decision making issues.
- Based on empirical findings of the present work, a new approach has been developed which can be given to organizations to compose and train teams for different structure problem solving processes.

Purpose

Empirical findings allow for building an application orientated approach for organizations. It shows on how to use personality type categories in combination with different structured problems, to advice when to use intuitive, rational or complementary approaches in management decision making processes.

Research object

Business organizations

Research subject

Impact of personality on decision making efficiency

Aim and tasks of the promotional work

The author’s aim for this research is to empirically examine the impact of personality on the decision making efficiency of different structured problem situations. Therefore the following tasks were conducted:

- Based on an intensive literature review and on extended theoretical analysis as well as on preliminary empirical evidence, the author develops a theoretical framework proposing specific cause and effect relations between personality types as the independent variable and decision making efficiency as the dependent variable, intervened by differently structured decision making problems and tasks.
- The findings from the literature review are used to formulate the hypotheses about the impact of intuitive behavior in the decision making process on the outcomes of the socioeconomic efficiency within certain problem categories.
- The hypotheses are the basic foundation for building the causal analytical model showing the cause-effect relationship between the dependent variable with the

personality predetermination and the independent variable with the socioeconomic efficiency of the decision making process.

- Laboratory experiments are conducted to collect empirical data for correlation analyses between personality type measures of the experimentees and the decision making efficiency measures in the various decision making task structures. Furthermore computation of means, means distribution and relative frequencies of the overall efficiency measures in the various decision task structures (well-, mid- and ill-structured tasks) are conducted.
- Findings from the correlation analyses and mean values are used to falsify or tentatively substantiate the hypotheses and draw conclusions on the results.

Hypotheses

The basic hypothesis is formulated as:

H_B: Personality predetermination has an impact on decision making efficiency, varying along different decision making structures

Further sub hypotheses are defined as:

H_{01}: Intuitive behavior in decision making process leads to higher efficiency within ill-structured problems than rational behavior

H_{02}: Complimentary intuitive and rational behavior in the decision making process leads to a higher efficiency in mid structured problems than sole intuitive or rational behavior

H_{03}: Rational behavior in decision making processes leads to higher efficiency in well-structured problems than intuitive behavior

H_{04}: Rational behavior in decision making processes leads to lower efficiency within ill-structured problems than intuitive behavior

H_{05}: Intuitive behavior in decision making processes leads to lower efficiency in well-structured problems than rational behavior

Theses for defense as results of the research outcomes

1. Rational behavior in decision making processes leads to higher efficiency in well-structured problems than intuitive behavior and vice versa intuitive behavior in decision making processes leads to lower efficiency in well-structured problems than rational behavior.

2. Personality types with a mix of intuition (N) and rationality (T), by the measurement of the MBTI, show the highest efficiency outcomes in management decision making within well-, mid- and ill-structured problem situations.
3. The highest degrees of decision making efficiency can be achieved by individuals with a "pertinent blend" of intuitive and rational personality types in general, and especially when it comes to complex strategic decision making issues.
4. Management decisions in groups can be best performed by composing decision making teams with adequate personality types of rational and intuitive types.

Used methods

A laboratory experiment is used to test the hypotheses, as no other method is more appropriate for producing data/answers in such a controlled manner. Popper has already highlighted the fact that one of the main issues within an experiment is to eliminate all disturbing factors.[4] This is especially valid for laboratory experiments. The laboratory experiment, as already explained, seems to provide, in the author's case, a good possibility for the observer to gain insight into the arrangement and the execution of the experiment. The intersubjective checkability and traceability of the laboratory experiment can be rated higher than that of a field experiment which may include all kinds of disturbing side effects. A further methodical basic requirement for empirical testing, which allows repeating the experiment again under reproducible circumstances, is also fulfilled to a greater degree with a laboratory experiment than with any other purpose like method because of the controlled environment in which the experiment takes place.[5] The laboratory experiment is therefore characterized by a high degree of reliability. A further aspect of the laboratory experiment is that experimental situations can be constructed in a variable way so that cause-effect relationships can be clearly isolated and tested. This allows for attributing or denying an effect clearly to a cause.[6] In the author's case he can determine if a different kind of personality has an impact on the decision making efficiency within different structured tasks. This way it can be determined if the decision making efficiency outcomes within different structured problem situations change when personality/cognitive styles change.

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4 Popper, K. R. (2005). Logik der Forschung. 11. Aufl. Hg. v. Herbert Keuth. Tübingen: Mohr Siebeck, p. 84.
5 Neuert, J. O. (1987). Planungsgrade. Eine experimentelle Untersuchung zum Zusammenhang zwischen Planungsverhalten und Planungserfolg. Spardorf, Germany: Rene F. Wilfer, pp. 157-160.
6 Bortz, J.; Döring, N. (2006). Forschungsmethoden und Evaluation. Für Human- und Sozialwissenschaftler. 4. Aufl. Heidelberg, Germany: Springer-Medizin-Verl., pp. 57-58.

Approbation of results of research

Several steps during the development of the dissertation were presented and discussed within the following international business conferences and publications:

a) Conferences

1. Hoeckel, Christopher, PERSONALITY TRAITS, BEHAVIORAL APPROACHES AND EFFICIENCY MEASURES IN BUSINESS MANAGEMENT DECISION MAKING – A LITERATURE REVIEW, Global Business Management Research Conference, University of Applied Science Fulda, Dec. 02-04, 2011, Fulda, Germany.
2. Hoeckel, Christopher, THE IMPACT OF PERSONALITY TRAITS AND BEHAVIORAL APPROACHES ON THE OUTCOMES OF MANAGEMENT DECISION MAKING – A FRAMEWORK FOR AN EMPIRICAL STUDY, New Challenges of Economic and Business Development Conference, University of Latvia, May 10-12, 2012, Riga, Latvia.
3. Hoeckel, Christopher, THE IMPACT OF PERSONALITY TRAITS AND PROBLEM CHARACTERISITCS ON EFFICIENCY OUTCOMES IN MANAGEMENT DECISION MAKING – A FRAMEWORK FOR AN EMPIRICAL STUDY, International Business and Economics Conference, University of Applied Science Kufstein, August 03-05, 2012, Kufstein, Austria.
4. Hoeckel, Christopher, THE IMPACT OF PERSONALITY TRAITS AND PROBLEM CHARACTERISITCS ON EFFICIENCY OUTCOMES IN MANAGEMENT DECISION MAKING, 71th UL scientific conference session “Economic and Business Impact of Globalization” Conference, University of Latvia, January 30, 2013, Riga, Latvia.
5. Neuert, Josef, Hoeckel, Christopher, THE IMPACT OF PERSONALITY TRAITS AND PROBLEM CHARACTERISITCS ON MANAGEMENT DECISION MAKING OUTCOMES: SOME EXPRIMENTAL FINDINGS AND EMPIRICAL CONCLUSIONS, 42 Annual Meeting, Western Decision Sciences Institute, March 26-29, 2013, Long Beach CA, USA.
6. Neuert, Josef, Hoeckel, Christopher, THE IMPACT OF PERSONALITY TRAITS AND PROBLEM CHARACTERISITCS ON MANAGEMENT DECISION MAKING OUTCOMES: PRELIMENARY FINDINGS AND CONCLUSIONS, New Challenges of Economic and Business Development Conference, University of Latvia, May 09-11, 2013, Riga, Latvia

7. Neuert, Josef, Hoeckel, Christopher, MEASURING EFFICIENCY, IN MANAGEMENT DECISION MAKNIG – THEORETICAL ANALYSIS AND STATE OF RESEARCH, International Business and Economics Conference, University of Applied Science Kufstein, Nov. 29-30, 2013, Kufstein, Austria.

b) Publications

1. Hoeckel, Christopher (2012). The Impact of Personality Traits and Behavioral Patterns on the Outcomes of Business Management Decision Making – A Framework for an Empirical Study. In: *New Challenges of Economic and Business Development Conference Proceedings*, Riga, Latvia, pp. 259-269. http://www.evf.lu.lv/fileadmin/user_upload/lu_portal/projekti/evf/konferences/maijs_2012/session8/Hoeckel.pdf
2. Neuert, Josef, Hoeckel, Christopher A. (2013). The Impact of Personality Traits and Problem Structures on Management Decision-Making Outcomes. In: *Journal of Modern Accounting and Auditing 9 (3)*, pp. 282-293. http://www.davidpublishing.com/DownLoad/?id=12195
3. Hoeckel, Christopher (2013). Personality Traits, Behavioral Approaches and Efficiency Measures in Business Management Decision Making - A Literature Review. In: *Business Management Strategies and Research Development - Discussion Paper No. 8*, Fulda, Germany, pp. 6-16. http://fuldok.hs-fulda.de/volltexte/2013/271/
4. Neuert, Josef, Hoeckel, Christopher A. (2013). Measuring Efficiency in Management Decision Making - Theoretical Analysis and State of Research. In: *Business Management Strategies and Research Development – Discussion Paper No. 8*, Fulda, Germany, pp. 17-29. http://fuldok.hs-fulda.de/volltexte/2013/271/
5. Neuert, Josef, Hoeckel, Christopher A. (2014). The Impact of Personality Traits and Problem Characteristics on Management Decision Making Outcomes - Some Experimental Findings and Empirical Conclusions. In: *Journal of Business and Management, Vol. 19, No. 3,* pp. 77-94. http://www.chapman.edu/business/faculty-research/journals-and-essays/jbm-online.aspx

6. Neuert Josef, Hoeckel, Christopher A., Woschank, Manuel (2015). Measuring Rational Behaviour and Efficiency in Management Decision Making Processes: Theoretical Framework, Model Development and Preliminary Experimental Foundations. In: *British Journal of Economics, Management & Trade, Vol. 5, No. 3,* pp. 299-318.
   http://www.sciencedomain.org/abstract.php?iid=701&id=20&aid=6565

Content of dissertation

In the first chapter, the literature review on normative and descriptive decision making theories and personal disposition and problem characteristics in decision making reveals that individuals, as intuitive or rational types, share distinct personality characteristics and therefore behave according to their personality in certain problem situations in predictable ways. As rational types rely more on their conscious, analytical, effortful and affect free "system" they seem to perform well when solving well-structured problem tasks. Well-structured problem tasks therefore seem to call for rational decision making approaches. In turn, intuitive types rely more on their unconscious, automatic, rapid, effort less and holistic "system" and therefore seem to perform well when solving ill-structured problems. Ill-structured problems, therefore, seem to call for intuitive decision making approaches. In the second chapter the causal analytical model shows the cause-effect relationship between the dependent variable with personality predetermination and the independent variable with socioeconomic efficiency of the decision making process intervened by the problem structure. The setup of the empirical experiment explains how the data are collected within a laboratory experiment allowing to conduct statistical analyses and to measure the impact of personality type measures of experimentees and the decisions making efficiency measures in various decision making task structures. In the third chapter statistical analyses of the personality predeterminations and the overall efficiency measures in the various decision task structures (well-, mid- and ill-structured tasks) are conducted to tentatively support or refute the hypotheses. Finally the conclusions and suggestions wrap up the dissertation.

Discussion of research results

According to the literature review, the personality predetermination and the ambiguity of problem structures seem to be two of the larger contributors to the outcomes of decision making efficiency. Therefore this empirical study focused on the impact of personality types and the ambiguity of problem structures on decision making efficiency by no means denies that other factors mentioned in the literature have an impact on decision making efficiency.

Narrowing this down to two factors, could result in the fact that remaining factors, which might provide significant impact, show lower correlations.

The problem tasks for the empirical study were selected from typical business management tasks. But there is a risk that factors like experience, knowledge, etc. could "play" a more significant role beside the personality types or the ambiguity of the problem structure. Meaning that independently from the individual personality of the experimentees, the experience within specific domains of the problem task has a greater impact on the empirical efficiency outcomes.

Main results of the research

The outcome of the research can be resumed by the following general experimental findings:

Contradictive to theory, there seems to be evidence that rational oriented types achieve higher efficiency when solving ill-structured problem tasks than intuitive orientated types. As for the significant relationship between personal efficiency and rational orientated Sensing types the hypotheses H_{01} and H_{04} cannot be substantiated.

The empirical data provide significant differences in efficiency measurement between Sensing and Intuition types but no difference between Thinking and Feeling types. As the hypothesis states that "complimentary" intuitive and rational behavior in the decision making process leads to a higher efficiency in mid structured problems than sole intuitive or rational behavior, the data do not provide enough substantive results to support the hypothesis H_{02}.

According to the literature, the empirical data support the fact the rational orientated personality types (Thinking types) are overall more efficient when solving well-structured problem tasks than intuitive orientated types. In this case the empirical data provide substantive results to tentatively support the hypotheses H_{03} and H_{05}.

Main conclusions and suggestions

In particular, former research findings seem to be corroborated in that the highest degrees of decision making efficiency can be achieved by a "pertinent blend" of intuitive and rational personality types in general, and especially when it comes to complex strategic decision making issues.[7]

[7] Neuert, J. O. (1987). Planungsgrade. Eine experimentelle Untersuchung zum Zusammenhang zwischen Planungsverhalten und Planungserfolg. Spardorf, Germany: Rene F. Wilfer.

Finally, more research needs to be conducted into the interdependencies of structural elements in the decision making processes (goals, procedures, sanctions, risks, etc.) and into the individual/personal "design" of the decision makers (personality types, motivation, psychological predetermination, group dynamics, etc.).

Used sources

The model of Sinclair & Ashkanasy provides a vital basic foundation for research in the behavior oriented management decision making processes, as the model contains more than one influencing factor unlike other theories and models.[8] This enables one to better understand dependencies between these factors and most likely reflects the reality to a greater degree than the one factor models.

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Last but not least many thanks to my girlfriend and partner Stephanie Baumann for supporting me during this research journey and to my parents Robert T. and Christa Hoeckel.

[8] Sinclair, M.; Ashkanasy, N. M. (2002). Intuitive decision-making amongst leaders: More than just shooting from the hip. In: Mt Eliza Business Review - Pre Print Version, 5 (2), pp. 7-10.

1. THEORETICAL FOUNDATIONS OF MANAGEMENT DECISION MAKING THEORY AND PERSONALITY TYPES[9]

In the past business leaders and top executives used to be in the position to rely predominantly on their analytical techniques to chart the future course of their businesses. Today's business environment is more and more characterized by a climate of rapid changes.[10] To keep track of these dynamic changes organizations face today, the challenge is to move more quickly. Top executives today and increasingly in the future will therefore need to make major decisions without having the time to gather "all" (enough) information to apply only analytical methods.[11] Researchers like Schoemaker & Russo argue that the use of rational decision making approaches yield the best outcome.[12] But especially in complex situations it seems that effective managers do not have the "luxury" of choosing between a rather analytic or intuitive approach to problems.[13] Therefore it seems that for effective organizations it is necessary to couple analytical with intuitive judgment.[14] Hodgkinson et al. go even a step further as they claim that intuitive judgment is an indispensable component of strategic competence and is essential for decision makers.[15] The exclusivity for the long time dominating rational choice model seems to be outdated for two reasons. First, in complex decision making situations it is difficult for the human mind to understand the complexity, the conditions and the predictability. Second, people differ in real life significantly in their decision making process from the so called "rational choice" model because of the lack of

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9 Parts of this chapter have been published in: Hoeckel, C. (2012). The Impact of Personality Traits and Behavioral Patterns on the Outcomes of Business Management Decision Making – A Framework for an Empirical Study. In: New Challenges of Economic and Business Development Conference Proceedings, Riga, Latvia, pp. 259–269; Neuert, J.; Hoeckel, C. (2013). The Impact of Personality Traits and Problem Structures on Management Decision-Making Outcomes. In: Journal of Modern Accounting and Auditing 9 (3), pp. 382-393.

10 Cf. Agor, W. H. (1986). How Top Executives Use Their Intuition to Make Important Decisions. In: Business Horizons 29, p. 49; Hodgkinson, G. P.; Sadler-Smith, E.; Burke, L. A.; Claxton, G.; Sparrow, P. R. (2009). Intuition in Organizations: Implications for Strategic Management. In: Long Range Planning 42 (3), p. 278.

11 Cf. Agor, W. H. (1986). How Top Executives Use Their Intuition to Make Important Decisions. In: Business Horizons 29, p. 49; Patton, J. R. (2003). Intuition in decisions. In: Management Decision 41 (10), p. 989.

12 Schoemaker, P. J.; Russo, E. J. (1993). A Pyramid of Decision Approaches. In: California Management Review 36, p. 29.

13 Simon, H. A. (1997). Administrative behavior. A study of decision-making processes in administrative organizations. 4. Aufl. New York, USA: Free Press, p. 139.

14 Cf. Ju, B.; Junwen, F.; Chenglin, M. (2007). Intuitive decision theory analysis and the evaluation model. In: Management Science and Engineering 1 (2), p. 67; Kutschera, I.; Ryan, M. H. (2009). Implications of Intuition for Strategic Thinking: Practical Recommendations for Gut Thinkers. In: SAM Advanced Management Journal, p. 18; Mintzberg, H.; Westley, F. (2001). Decision Making: It's Not What You Think. In: MIT Sloan Management Review, p. 89.

15 Hodgkinson, G. P.; Sadler-Smith, E.; Burke, L. A.; Claxton, G.; Sparrow, P. R. (2009). Intuition in Organizations: Implications for Strategic Management. In: Long Range Planning 42 (3), p. 278.

time and resources.[16] There are also three reasons why people tend to place less trust in analytic methods when situations get complicated: first, analytical methods imply simplification but in complex situations they can't overlook the richness of the problem context and may miss details that are important. Second, analytical methods need assumptions most of the time which may be perceived as unrealistic. And third, people are aware that small mistakes can invalidate the outcome of the analysis.[17] Shapiro & Spence conclude from the latest research that incorrect specification of underlying causal relationships lead to poor decisions even with the help of analytical elements.[18] Therefore Shapiro & Spence see the intuitive approach in more complex situations as a good possibility to enhance the quality of the decision making process. For them most of the decisions have both elements of the rational and intuitive decision making process; they see an advantage to combine intuitive judgments explicitly with analytical judgments. Contrary to the common believe that consciously deliberate decisions are the ideal way to approach complex, multifaceted and expensive decisions to make the right choice, the study of Dijksterhuis et al. shows a different picture. In their study, participants in a simple decision making situation performed better with a conscious deliberate approach whereas in a complex situation participants performed better with unconscious thoughts without attention.[19]

Whereas discursive versus intuitive thinking in Greek philosophy with Socrates (470-399 BC) and Plato (427-348 BC) has a longer history, Chester Barnard was one of the first in management literature to distinguish decision making in what he called a "logical" (rational) and a "non-logical" (intuitive) process.[20] Research since then has studied intuitive decision making from various perspectives like neuroscience[21], psychology[22] and within contextual

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16 Roth, G. (2008). Persönlichkeit, Entscheidung und Verhalten. Warum es so schwierig ist, sich und andere zu ändern. 4. Aufl. Stuttgart, Germany: Klett-Cotta, pp. 180-181.

17 Hogarth, R. M. (2001). Educating intuition. Chicago, USA: Univ. of Chicago Press, pp. 11-12.

18 Shapiro, S.; Spence, M. T. (1997). Managerial intuition: A conceptual and operational framework. In: Business Horizons 40 (1), p. 65.

19 Dijksterhuis, A.; Bos, M. W.; Nordgren, L. F.; van Baaren, R. B. (2006). On Making the Right Choice: The Deliberation-Without-Attention Effect. In: Science 311, pp. 1005–1007.

20 Cf. Barnard, C. I. (1938/1968). The functions of the executive. Cambridge MA, USA: Harvard Univ. Press, p. 185; Henden, G. (2004). Intuition and its Role in Strategic Thinking. Thesis (PhD). BI Norwegian School of Management, Oslo, p. 14.

21 Cf. Bechara, A.; Damasio, H.; Tranel, D.; Damasio, A. R. (1997). Deciding advantageously before knowing the advantageous strategy. In: Science 275, pp. 1293–1295; Damasio, A. R. (2006). Descartes' error. Emotion, reason and the human brain. rev. ed. with a new preface. London, Great Britain: Vintage; Liebermann, M. D. (2000). Intuition: A Social Cognitive Neuroscience Approach. In: Psychological Bulletin 126 (1), pp. 109–137; Volz, K. G.; von Cramon, Y. D. (2006). What Neuroscience Can Tell about Intuitive Processes in the Context of Perceptual Discovery. In: Journal of Cognitive Neuroscience 18 (12), pp. 2077–2087.

22 Cf Epstein, S. (1991). Cognitvie-Experiential Self-Theory: An Integrative Theory of Personality. In: Rebecca C. Curtis (Ed.): The Relational self. Theoretical convergences in psychoanalysis and social psychology. New

background.[23] Research shows that there are several factors on how we make intuitive decisions. For Isenberg and Burke & Miller one key for the decision maker's choice between the rational and intuitive approach lies in the vagueness of the situation.[24] For others the task characteristic (problem structure or the ambiguity) is one of the main factors for the use of intuition.[25] Wossidlo supports this view but for him there is a lack in the empirical theory and empirical research that in most cases problem characteristics are not adequately considered in the setup. For him a definition like "well- versus ill-structured" does not provide enough accuracy. He therefore advocates a more accurate systematic approach in describing the problem characteristics.[26] Allinson & Hayes and Pretz & Totz see the personal predetermination as one of the main factors on how people choose a rather intuitive or rational approach in decision making.[27] Kirsch supports this view because for him personality is also a key factor in the decision making process.[28] Decisions seem to be a function of the decision maker's cognitive setup which varies with different psychological types.[29] For Appelt the decision making process is mostly affected by the decision features, situational factors and

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York: Guilford Press, pp. 111–137; Epstein, S. (2003). Cognitive-Experiential Self-Theory of Personality. In: Irving B. Weiner (Ed.): Handbook of psychology. Hoboken, NJ: Wiley, pp. 159–184.

[23] Cf. Burke, L. A.; Miller, M. K. (1999). Taking the mystery out of intuitive decision making. In: Academy of Management Review 13 (4), pp. 91–99; Dane, E.; Pratt, M. G. (2007). Exploring intuition and its role in managerial decision making. In: Academy of Management Review 32 (1), pp. 33–54; Khatri, N.; Alvin Ng, H. (2000). The role of intuition in strategic decision making. In: Human Relations 53 (1), pp. 57–86.

[24] Cf. Burke, L. A.; Miller, M. K. (1999). Taking the mystery out of intuitive decision making. In: Academy of Management Review 13 (4), p. 94; Isenberg, D. J. (1984). How senior managers think. In: Harvard Business Review, p. 87.

[25] Cf. Dane, E.; Pratt, M. G. (2007). Exploring intuition and its role in managerial decision making. In: Academy of Management Review 32 (1), p. 45; Fields, A. F. (2001). A Study of Intuition in Decision-Making using Organizational Engineering Methodology. Thesis (DBA). Nova Southeastern University, Florida, pp. 93-94.

[26] Wossidlo, P. R. (1988). Die wissenschaftliche Ausgangslage für das Projekt Columbus. In: Eberhard Witte (Hg.): Innovative Entscheidungsprozesse. Die Ergebnisse des Projektes "Columbus". Tübingen: J.C.B. Mohr (Die Einheit der Gesellschaftswissenschaften, 58), p. 17.

[27] Cf. Allinson, C. W.; Hayes, J. (1996). The Cognitive Style Index: A Measure of Intuition-Analysis for Organizational Research. In: Journal of Management Studies 33 (1), p. 119; Pretz, J. E.; Totz, K. S. (2007). Measuring individual differences in affective, heuristic, and holistic intuition. In: Personality and Individual Differences 43, p. 1248.

[28] Cf. Kirsch, W. (1971a). Entscheidungsprozesse II. Informationsverarbeitungstheorie des Entscheidungs-verhaltens. Wiesbaden, Germany: Betriebswirtschaftlicher Verlag Dr. Th. Gabler, p. 103; Kirsch, W. (1971b). Entscheidungsprozesse III. Entscheidungen in Organisationen. Wiesbaden, Germany: Betriebswirtschaftlicher Verlag Dr. Th. Gabler, p. 162.

[29] Cf. Feger, H. (1975). Zum gegenwärtigen Stand der psychologischen Entscheidungsforschung. In: Hermann Brandstätter (Hg.): Entscheidungsforschung. Tübingen: J.C.B. Mohr, p. 28; Hauschildt, J.; Gmünden, H. G.; Grotz-Martin, S.; Haidle, U. (1983). Entscheidungen der Geschäftsführung. Typologie, Informationsverhalten, Effizienz. Tübingen: J.C.B. Mohr, pp. 216-217; Henderson, J. C.; Nutt, P. C. (1980). The influence of decision style on decision making behavior. In: Management Science and Engineering 26 (4), pp. 371–386.

individual differences.[30] The empirical studies of Neuert come to the conclusion that individual personality has a significant impact on the degree of decision making efficiency.[31] The model (Figure 1) of Sinclair & Ashkanasy assumes that the behavior oriented decision making process is affected by four categories: 1. problem characteristics, 2. decision characteristics, 3. personal disposition, and 4. decision making context.[32] Those four categories again include sets of factors which characterize more closely the content of these categories.

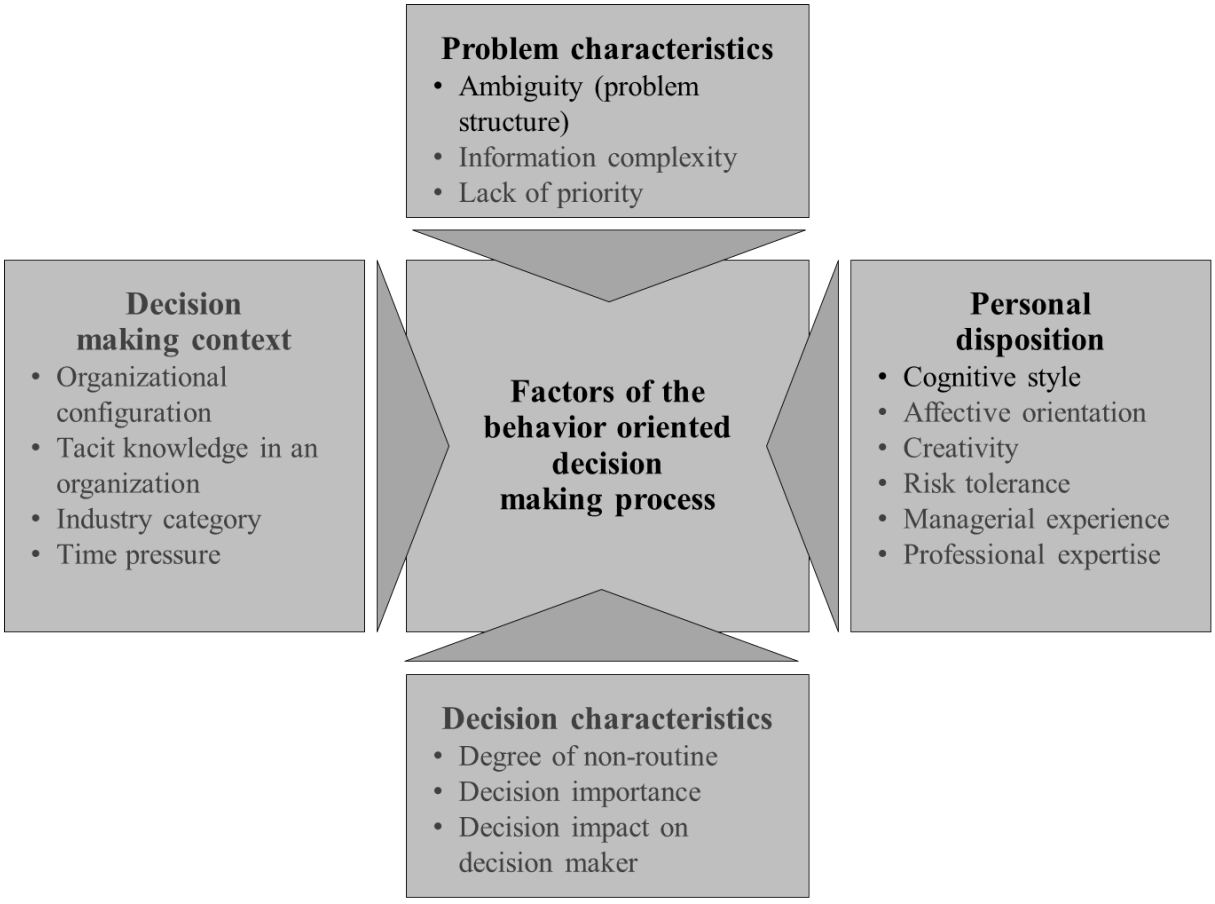

Figure 1: Categories and factors of the behavior oriented decision making process

Source: Sinclair & Ashkanasy, 2002, pp. 7-10

[30] Appelt, K. C.; Milch, K. F.; Handgraaf, M. J. J.; Weber, E. U. (2011). The Decision Making Individual Differences Inventory and guidelines for the study of individual differences in judgment and decision making research. In: Judgment and Decision Making 6 (3), p. 252.

[31] Cf. Neuert, J. O. (1987). Planungsgrade. Eine experimentelle Untersuchung zum Zusammenhang zwischen Planungsverhalten und Planungserfolg. Spardorf, Germany: Rene F. Wilfer, pp. 330-331; Neuert, J. O. (2010). The Impact of Intuitive and Discursive Behavioral Patterns on Decision Making Outcomes: Some Conjectures and Empirical Findings. In: WDSI Annual Conference Readings, Lake Tahoe, USA, p. 4491.

[32] Sinclair, M.; Ashkanasy, N. M. (2002). Intuitive decision-making amongst leaders: More than just shooting from the hip. In: Mt Eliza Business Review - Pre Print Version, 5 (2), pp. 7-10.

The model of Sinclair & Ashkanasy provides a vital basic foundation for research in the behavior oriented decision making processes as the model contains more than one influencing factor unlike other theories and models.[33] This provides a better understanding of the dependencies between these factors and most likely reflects the reality better than the one factor models.

Starting the review with the normative and descriptive decision making theories allows building the main foundation for this dissertation. In a next step the development from the rational choice theory to the bounded rationality will be laid out and therefore Simon's theory of administrative behavior in decision making in business management will be basically addressed. As intuition in decision making is more complex to understand, as it is by nature a vaguer subject, the description and definition of intuition is laid out in a more elaborate way. Within the section of personal disposition the review explains how individuals process information by two independent, interactive conceptual systems and how using these different cognitive styles impact the decision making process. The following chapter, problem characteristics, is reviewed by focusing mainly on how information complexity and the problem structure impacts the decision making process. Further, it explains how different structured problems (like ill-defined versus well-defined problems) can be conceptualized and how decision makers can approach these problem characteristics according to their cognitive structure.

1.1. Decision making in business management

A decision is, amongst others, a reaction to a conflict situation. The conflict situation in this sense can be seen as a psychological imbalance where individuals are urged by some kind of behavior to achieve again a psychological balance.[34] The literature also pictures decision making as a process which intends to reduce given complexity at the beginning of a problem. The decision making process is finished when the complexity is reduced to an acceptable point.[35] In this case decision making in business management can be characterized by a set of minimum criteria:

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[33] Sinclair, M.; Ashkanasy, N. M. (2002). Intuitive decision-making amongst leaders: More than just shooting from the hip. In: Mt Eliza Business Review - Pre Print Version, 5 (2), pp. 7-10.

[34] Thomae, H. (1975). Die Entscheidung als Problem der Interaktion von kognitiven und motivationalen Vorgängen. In: Hermann Brandstätter (Hg.): Entscheidungsforschung. Tübingen: J.C.B. Mohr, pp. 1–2.

[35] Hauschildt, J.; Gmünden, H. G.; Grotz-Martin, S.; Haidle, U. (1983). Entscheidungen der Geschäftsführung. Typologie, Informationsverhalten, Effizienz. Tübingen: J.C.B. Mohr, p. 233.

- Having at least two or more alternatives
- Having at least one existing target which can be a solution to the conflict or problem
- Disruption of previous behavior
- Weighing of the alternatives while taking into account the resulting consequences and
- The evaluation of the result[36]

Decision making is not a onetime action of a choice, rather it is a process that lasts over a certain period of time. The matter of the choice within the decision making process is an action or omission of reaching or maintaining a certain purpose.[37] But beside reaching or maintaining a certain purpose with the decision making process, a further aim is to do it with high quality. The quality within decision making can be described in the sense of how thoroughly elaborate and with how much speed it is made. More generally the decision making process can be understood as a target orientated process which at the end has an act of will to select a choice.[38] But before gaining the ultimate result of the decision the selection of a choice out of a set of alternatives is necessary and there are cognitive sub processes such as the search und evaluation of solutions. Therefore it seems clear that the decision making process consisting of various sub processes can be seen as an overall process to solve problems.[39] A decision making situation can be understood as an episode in an individual's biographical continuum which begins when at least two options of behavior are present and which (maybe not fully or definitely) ends when the individual decides to give preference to one of the options.[40] Kirsch believes from a theoretical background, that decision making and problem solution processes by definition are different processes.[41] But because they are in his sense grounded on the same base and therefore share the same kind of identity he advocates using them equally. For him the decision making- and problem solution process in business

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[36] Cf. Gzuk, R. (1975). Messung der Effizienz von Entscheidungen. Tübingen, Germany: J.C.B. Mohr (Empirische Theorie der Unternehmung, 5), pp. 17-18; Hauschildt, J.; Gmünden, H. G.; Grotz-Martin, S.; Haidle, U. (1983). Entscheidungen der Geschäftsführung. Typologie, Informationsverhalten, Effizienz. Tübingen: J.C.B. Mohr, p. 233.

[37] Gzuk, R. (1975). Messung der Effizienz von Entscheidungen. Tübingen, Germany: J.C.B. Mohr (Empirische Theorie der Unternehmung, 5), pp. 17-18.

[38] Cf. Gzuk, R. (1975). Messung der Effizienz von Entscheidungen. Tübingen, Germany: J.C.B. Mohr (Empirische Theorie der Unternehmung, 5), p. 19; Simon, H. A. (1997). Administrative behavior. A study of decision-making processes in administrative organizations. 4. Aufl. New York, USA: Free Press, pp. 3-4.

[39] Gzuk, R. (1975). Messung der Effizienz von Entscheidungen. Tübingen, Germany: J.C.B. Mohr (Empirische Theorie der Unternehmung, 5), p. 24.

[40] Feger, H. (1975). Zum gegenwärtigen Stand der psychologischen Entscheidungsforschung. In: Hermann Brandstätter (Hg.): Entscheidungsforschung. Tübingen: J.C.B. Mohr, p. 16.

[41] Kirsch, W. (1970). Entscheidungsprozesse I. Verhaltenswissenschaftliche Ansätze der Entscheidungstheorie. Wiesbaden, Germany: Betriebswirtschaftlicher Verlag Dr. Th. Gabler, pp. 70-72.

management today contains the following phases: identification of the problem, obtainment of necessary information, development of possible solutions, evaluation of those solutions, selection of a strategy for implementation of the solution and implementation of the action with a subsequent learning and revision phase.[42] Smith supports this view because for him decision making implies that there is a choice between alternatives which exists or will be identified.[43] The problem solving process in contrast is directed towards the resolution of the problem. The problem solving process is laid out to evolve from an existing situation to a desired situation but not necessarily by choosing between alternatives. For Simon decisions under an administrative or business management background are mostly purposive orientated towards goals or objectives.[44] The decision can be distinguished in the selection of final goals that he calls "value judgment" and the implementation of such goals that he calls "factual judgments". Decision making can be described as a process by which a number of alternatives are narrowed down to one alternative.[45] All decisions are a matter of compromise. Due to environmentally inevitable circumstances the final selected alternative is, in most cases, the best solution out of a limited amount of alternatives available in trying to attain the maximum level of the purpose.[46] A selection or a choice in the decision making process seems not to be a matter of a conscious or deliberate process.

For Barnard the nature of decisions within business management consists of two main parts: first, a purpose and second, the physical or social world under which circumstantial decisions will be made.[47] He refers to this part as the environment of the decision. For Barnard the purpose is essential to provide any meaning to the decision making process. But in reverse, however, the purpose without any environment itself has no meaning at all. So the purpose can only be defined in relation to the environment. As soon as a purpose is placed in a certain environment, it becomes clearer and more understandable. Barnard also believes that this is not a onetime action.[48] When placing a purpose into an environment it enables differentiating

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[42] Cf. Kirsch, W. (1970). Entscheidungsprozesse I. Verhaltenswissenschaftliche Ansätze der Entscheidungstheorie. Wiesbaden, Germany: Betriebswirtschaftlicher Verlag Dr. Th. Gabler, p. 73. Witte, E. (Hg.) (1988). Innovative Entscheidungsprozesse. Die Ergebnisse des Projektes "Columbus". Tübingen: J.C.B. Mohr (Die Einheit der Gesellschaftswissenschaften, 58), pp. 202-203.

[43] Smith, G. F. (1988). Towards a Heuristic Theory of Problem Structuring. In: Management Science and Engineering 34 (12), pp. 1489-1490.

[44] Simon, H. A. (1997). Administrative behavior. A study of decision-making processes in administrative organizations. 4. Aufl. New York, USA: Free Press, p. 3.

[45] Simon, H. A. (1997). Administrative behavior. A study of decision-making processes in administrative organizations. 4. Aufl. New York, USA: Free Press, p. 4.

[46] Ibid, p. 5.

[47] Barnard, C. I. (1938/1968). The functions of the executive. Cambridge MA, USA: Harvard Univ. Press, p. 194.

[48] Ibid., pp. 196-197.

the environment to a greater degree. In reverse a more differentiated environment allows again the change from a general purpose to a more specific purpose. This process of successive decision making allows step by step differentiation of the facts which are immaterial or irrelevant and the facts which apparently support or prevent the accomplishment of the purpose. With this differentiation the state of selection between alternatives starts.[49] The decision making process may differ due to two different perspectives. First, because of the complexity of the topic and second, because of conflicts in consequence of political imbalance which lead to different characteristics of the decision making process.[50]

1.1.1. Normative and descriptive decision making theories

a) Normative models of decision making

The normative decision making theory is mainly based on rational choice theory and aims to give advice on how ideal judgments or decisions should be made.[51] In a more general sense the normative decision making aims to support decision makers by providing models to compare possible results of various decision possibilities. A decision making model is normally composed of decision making rules and a decision making field which includes alternatives, results and the environment (Figure 2).

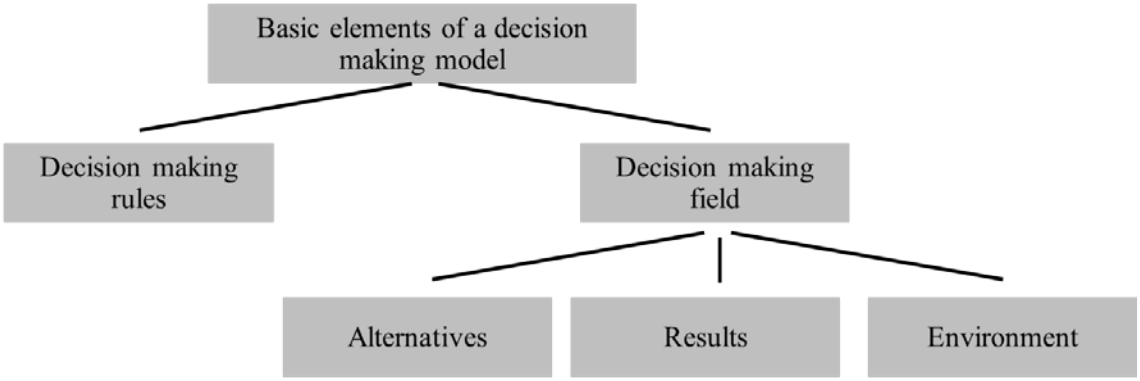

Figure 2: Basic elements of a decision making model

Source: Laux et al., 2012, p. 30

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[49] Barnard, C. I. (1938/1968). The functions of the executive. Cambridge MA, USA: Harvard Univ. Press, p. 197.

[50] Astley, W. G.; Axelsson, R.; Butler, R. J.; Hickson, D. J.; Wilson, D. C. (1982). Complexity and Cleavage: Dual Explanations of Strategic Decision-Making. In: Journal of Management Studies 19 (4), p. 360.

[51] Cf. Gintis, H. (2005). Behavioral Game Theory and Contemporary Economic Theory. In: Analyse & Kritik 27, pp. 52–54; Koehler, D. J.; Harvey, N. (2004). Blackwell handbook of judgment and decision making. 1. Aufl. Oxford, UK, Malden, MA: Blackwell Pub., pp. 3; Laux, H.; Gillenkirch, R. M.; Schenk-Mathes, H. Y. (2012). Entscheidungstheorie. 8. Aufl. Berlin, Heidelberg: Springer Gabler, p. 3.

A rational decision is only possible when there are at least two alternatives and therefore any decision making model minimum needs two alternatives. To evaluate the alternative it is necessary to also include the consequences resulting from these alternatives. The consequences are normally considered as targets within the model. These targets express which consequences the decision maker attributes to the alternatives and these targets are also a requirement for a rational decision.[52] For a rational decision the decision makers also need to have preferences about the fulfillment of the results.[53]

Some of the main requirements for preferences are:

- Future-oriented means that choices between alternatives should only be dependent on various consequences
- Transitivity means that when the decision maker prefers version A against version B and version B against version C, then version A should also be preferred against version C
- Invariance means that the preference should not be dependent on how the decision making problem is presented
- Independent of irrelevant alternatives means that preferring version A against version B should be independent if version C exists[54]

The result achieved by making a choice for a certain alternative is also dependent on the environment and therefore on things which cannot be influenced by the decision maker. Therefore the model also has to account for conditions like security, uncertainty and risk. When a decision is made under truly rational aspects the alternative, which provides the greatest need for the satisfaction of the decision maker, should be the choice.[55] A decision under security is normally considered when the decision maker knows all the relevant data about the environment for the decision making process in which the decision will be made. In turn, for decisions under uncertainty the decision maker does not have all the information about the environment and at the time of the decision he does not know the result of the decision. For decisions under uncertainty the probabilities are either known or nonexistent.[56] For decision making under risk it is not only important to determine the probability for the environmental issues but also to discuss the risk attitude of the decision maker. In general

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[52] Laux, H.; Gillenkirch, R. M.; Schenk-Mathes, H. Y. (2012). Entscheidungstheorie. 8. Aufl. Berlin, Heidelberg: Springer Gabler, pp. 30-31.
[53] Ibid., p. 41.
[54] Eisenführ, F.; Langer, T.; Weber, M. (2010). Rationales Entscheiden. 5. Aufl. Berlin, Springer, p. 7.
[55] Peterson, M. (2009). An introduction to decision theory. Cambridge: Cambridge University Press, p. 6.
[56] Ibid., p. 87.

there are three possible attitudes about risk: 1) neutral to risk, 2) risk aversion and 3) willing to take a risk. The attitude to risk has a fundamental meaning for the behavioral orientated decision making process.

One of the most popular decision making principles for decisions under risk is the Bernoulli-principle as it is in accordance with the axioms of rational behavior. As the Bernoulli-principle is orientated on the expected value of gains, decisions made in accordance with the Bernoulli-principle and therefore based on normative decision making theory under risk, are also called the "expected utility principle". The actual concept of the Bernoulli-principle is to divide complex decision making problems into smaller sub problems where there are always only three possible results to choose from. Decision making by the Bernoulli-principle is done in two steps: 1) on the foundation of a hypothetical decision problem whereby the utility function is determined and 2) the alternative whereby the maximum return on utility is chosen. If more than one alternative provides the maximum return then any one of the alternatives can be randomly chosen.[57]

A further rational decision making approach is the game theory. The game theory is a mathematical method that provides a framework to describe, analyze and predict behavior in social situations of conflict, cooperation, and coordination. One of the more well-known classical games of the game theory is the prisoner's dilemma.[58] In past research game theorists took very extreme positions from highly mathematical analyses which presumed that people at one extreme are not smart enough to satisfy everyday decisions and at the other extreme they use adaptive and evolutionary approaches. By now research tries to chart the middle course between an over-rational equilibrium analyses and under-rational adaptive analyses by using the so called behavioral game theory. It aims to describe actual behavior, mostly within designed laboratory experiments, in order to determine empirically how individuals make choices under conditions of uncertainty and strategic interaction.[59] In traditional game theory behavior in the game is entirely determined by its structure. The structure incorporates the players, the decisions, the information, the outcome of the decisions. One of the essential difficulties of the game theory is that the consequences of a

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[57] Laux, H.; Gillenkirch, R. M.; Schenk-Mathes, H. Y. (2012). Entscheidungstheorie. 8. Aufl. Berlin, Heidelberg: Springer Gabler, pp. 109-110.

[58] Cf. Güth, W.; Huck, S. (2004). Advances in understanding strategic behaviour. Game theory, experiments, and bounded rationality: Essays in honour of Werner Güth. New York: Palgrave Macmillan, p. 119; Koehler, D. J.; Harvey, N. (2004). Blackwell handbook of judgment and decision making. 1. Aufl. Oxford, UK, Malden, MA: Blackwell Pub., pp. 485-488.

[59] Gintis, H. (2005). Behavioral Game Theory and Contemporary Economic Theory. In: Analyse & Kritik 27, p. 48.

player are mostly dependent on decisions of others which the player cannot observe and must predict. Therefore most games bear uncertainty about each other's strategies.[60] Besides the normative theories, which focus on rational decision making of individuals, there is also the social choice theory. The social choice theory attempts to analyze group decisions as precisely as possible. Social choice theory therefore seeks to analyze collective decision making problems. In this case a social choice problem is any decision making problem faced by a group of individuals where every group member is willing to state at least ordinal preferences over outcomes. The challenge of such social decisions is to somehow combine the individual preference by ordering them in a way (social preference ordering) that their preference ordering reflects the preferences of all members of the group.[61]

b) Descriptive models of decision making

In turn, normative decision making theories aim to give advice on how judgments and decisions should be made. The descriptive decision making theories try to describe how, in reality, decisions are made or how people really think and explain why a person made a certain decision in a specific way. The aim of descriptive decision making theory is to find a meaningful hypotheses about individual or group behavior to predict or control behavioral orientated decisions in specific decision making situations.[62] Rational decision making approaches, like the Bernoulli-principle (maximizing the utility), are from a prescriptive view not to be criticized if given axioms are accepted from the decision maker.[63] But as human beings, for certain reasons (e.g. limited cognitive capabilities to perceive and process information in a logical/rational consistent way), do not behave and act in a totally rational way (according to the homo oeconomicus) the rational models do not match the reality of decision making of human beings.[64] Eisenführ et al. describe four main effects more in detail as to why there is a "gap" between the rational and the intuitive decision making, which can

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60 Crawford, V. P. (1997). Theory and Experiment in the Analysis of Strategic Interaction. In: Kreps, David M., Wallis, Kenneth F., eds., Advances in Economics and Econometrics: Theory and Applications, Seventh World Congress. Vol. 1, New York: Cambridge University Press, pp. 208–212.

61 Peterson, M. (2009). An introduction to decision theory. Cambridge: Cambridge University Press, p. 265.

62 Cf. Camerer, C. F. (1997). Progress in Behavioral Game Theory. In: The Journal of Economic Perspectives 11 (4), p. 167; Koehler, D. J.; Harvey, N. (2004). Blackwell handbook of judgment and decision making. 1. Aufl. Oxford, UK, Malden, MA: Blackwell Pub., p. 3; Laux, H.; Gillenkirch, R. M.; Schenk-Mathes, H. Y. (2012). Entscheidungstheorie. 8. Aufl. Berlin, Heidelberg: Springer Gabler, pp. 16-17.

63 Cf. Laux, H.; Gillenkirch, R. M.; Schenk-Mathes, H. Y. (2012). Entscheidungstheorie. 8. Aufl. Berlin, Heidelberg: Springer Gabler, pp. 105-143.

64 Cf. Eisenführ, F.; Langer, T.; Weber, M. (2010). Rationales Entscheiden. 5. Aufl. Berlin, Springer, pp. 393-39; Laux, H.; Gillenkirch, R. M.; Schenk-Mathes, H. Y. (2012). Entscheidungstheorie. 8. Aufl. Berlin, Heidelberg: Springer Gabler, pp. 146-147.

occur at different stages of the decision making process.[65] First, the bias of forecasting probability means that decision makers often have a hard time in determining the circumstances of the problem and the probability of occurrence of this problem. Second, the "Ellsberg-Paradox", means that no matter what the origin of the probability is (e.g. expert vs. non expert information), it is not valued in the same way. Third, the reference point effect, by traditional means of the utility (normative) theory just evaluates the value at the end (final state) whereas from a descriptive point of view the decision maker mostly evaluates the win or the losses from a reference point looking at the changes in wealth or welfare. And fourth, the security effect indicates a phenomenon in which decision makers tend to realize a difference between two probabilities, the transition between almost secure and secure. Besides those four effect's Eisenführ et al. see 25 more effects (e.g. sunk cost, framing, anchoring, adjustment, etc.) as to why there is a gap between the normative and the descriptive decision making models.[66]

To bridge the gap between rational models and human behavior in decision making Kahneman & Tversky have developed the "Prospect Theory".[67] The Prospect Theory is one of the most well-known descriptive decision making theories.[68] Within the Prospect Theory of Kahneman & Tversky the decision making process is divided into two phases: 1) the editing-phase and 2) the evaluation-phase.[69] The editing-phase mainly presents the prospects in a simpler form. In the second, the evaluation-phase, the edited prospects are evaluated and the prospect of the highest value is chosen. The editing-phase consists of a preliminary analysis of the offered prospects where several operations are applied. They transform the outcomes and probabilities associated with the offered prospects. Major operations can be described as follows: 1) Coding, where the reference point is defined to evaluate gains and losses. 2) Combination, where prospects can be simplified sometimes by combining the probabilities. 3) Segregation, in which riskless components are segregated from risky components. 4) Cancellation, where components that are shared by the offered prospects are discarded. 5) Simplification, which refers to the simplification of prospects by rounding probabilities or

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65 Eisenführ, F.; Langer, T.; Weber, M. (2010). Rationales Entscheiden. 5. Aufl. Berlin, Springer, pp. 395-404.

66 Ibid., pp. 405-411.

67 Cf. Kahneman, D.; Tversky, A. (1979). Prospect Theory: An Analysis of Decision under Risk. In: Econometrica 47 (2), pp. 263–291; Tversky, A.; Kahneman, D. (1992). Advances in Prospect Theory: Cumulative Representation of Uncertainty. In: Journal of Risk and Uncertainty 5, pp. 297–323.

68 Laux, H.; Gillenkirch, R. M.; Schenk-Mathes, H. Y. (2012). Entscheidungstheorie. 8. Aufl. Berlin, Heidelberg: Springer Gabler, p. 146.

69 Kahneman, D.; Tversky, A. (1979). Prospect Theory: An Analysis of Decision under Risk. In: Econometrica 47 (2), pp. 263–291.

outcomes and 6) Detection of dominance, where offered prospects are scanned to detect dominant alternatives which are rejected without further evaluation.[70] In the evaluation-phase it is assumed that the decision maker evaluates each of the prospects which were edited and chooses the prospect with the highest value. The overall value of the edited prospect is expressed in terms of two scales, π and υ. The first scale (π) associates with each probability p a decision weight π (p). The second scale (υ) assigns to each outcome x a number υ (x) which reflects the subjective value of the outcome.[71] An essential feature of the Prospect Theory is that the carriers of value are rather changes in wealth of welfare than final states. In this case for Kahneman & Tversky the value should be treated as a function in two arguments: 1) The asset position that serves as a reference point and 2) the magnitude of change from the reference point. They propose that the value function (Figure 3) is defined on deviations from the reference point, meaning generally concave for gains and convex for losses and steeper for losses than for gains.[72]

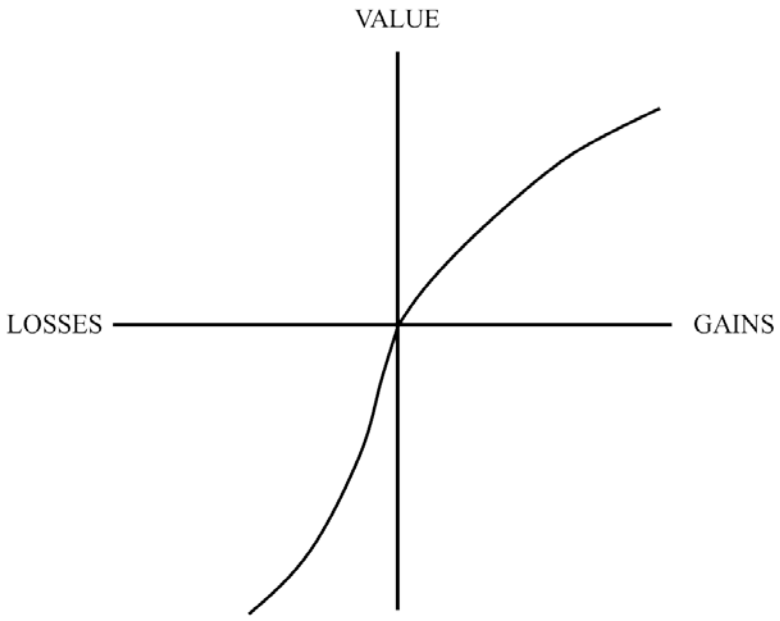

Figure 3: A hypothetical value function

Source: Kahneman & Tversky, 1979, p. 279

[70] Kahneman, D.; Tversky, A. (1979). Prospect Theory: An Analysis of Decision under Risk. In: Econometrica 47 (2), pp. 274–275.
[71] Ibid., p. 275.
[72] Ibid., pp. 277-279.

c) Utilization of decision theory elements for the present research

By now rational choice theorists admit that normative theories fail to describe actual behavior in decision making. The foundations of rational choice theories have been under attack from experimental findings of decision researchers. They have shown that the descriptive form of decision making is consistent with the principles of cognitive psychology but inconsistent with rationality as commonly construed. By now it seems obvious that for various reasons the normative decision making theory accounts only poorly for actual behavior. Therefore there is a need to better understand the actual decision making behavior.[73] This is where descriptive decision making theories and models try to explain how, in reality, decisions are made or how people really behave in certain decision making situations. Building on this foundation the present research work aims to provide inside information about the impact of personality predetermination and behavioral approaches on the efficiency outcomes of decision making in different structured problem tasks.

1.1.2. Development from rationality to bounded rationality in decision making

From a historical point of view decision making theory differentiates decision making behavior between "closed" and "open" models.[74] Closed models can be characterized as closed systems where there is no consideration on how the environment might influence the decision making process. In closed model decisions premises are taken for granted and therefore are treated as independent variables. In contradiction, the open models consider interactions between the system and the environment. Therefore decision premises in open models are treated as dependent variables.[75] The closed model which represents the classic or neoclassic view is a typical rational choice model of economic decision making where the preference of the decision maker is on the maximization of net benefits or utilities by choosing the alternative that returns the highest level of benefits.[76] Kirsch describes this rational model as the classical case of the "homo oeconomicus" where individuals with

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[73] Herrnstein, R. J. (1990). Rational Choice Theory. Necessary but Not Sufficient. In: American Psychologist 45 (3), pp. 356–358.

[74] Kirsch, W. (1970). Entscheidungsprozesse I. Verhaltenswissenschaftliche Ansätze der Entscheidungstheorie. Wiesbaden, Germany: Betriebswirtschaftlicher Verlag Dr. Th. Gabler, pp. 25-26.

[75] Ibid.

[76] Cf. Bronner, R. (1973). Entscheidung unter Zeitdruck. Tübingen, Germany: Mohr (Empirische Theorie der Unternehmung, 3), p. 12; Jones, B. D. (1999). Bounded Rationality. In: Annual Review of Political Science 2, pp. 299; Roth, G. (2008). Persönlichkeit, Entscheidung und Verhalten. Warum es so schwierig ist, sich und andere zu ändern. 4. Aufl. Stuttgart, Germany: Klett-Cotta, p. 111;

rational behavior use their given resources to maximize their returns.[77] Neuert refers to this notion as the "economic man model".[78] The economic man has a complete system of alternatives which allows him to choose among these alternatives. Also, he always has complete awareness of these alternatives and has no limits to complexity of the calculation, so that he can determine which alternative is best. Objective rationality would imply that first, all behavior alternatives prior to the decision have been viewed in a panoramic fashion, second, that all consequences that would follow the decision on each choice have been considered and third, that one alternative is picked out of a whole set of alternatives with a system of values as criterion.[79] Taking, at least, these implications into account shows that the model of rational behavior falls short.[80] For Simon decision makers are not infallible rational-analytical machines. Their behavior of objective rationality falls short in at least three ways: 1) Rationality requires a complete knowledge and anticipation of the consequences that follow on each choice. 2) Since these consequences are in the future, imagination must supply the lack of experience. 3) Rationality requires a choice among all the possible alternative forms of behavior. In actual behavior, just a very few of these possible alternatives ever come to mind.[81] This view is also supported by March. In reality, at the time of the decision making process not all alternatives are known and not all consequences are considered.[82] March even believes that relevant available information is often not used, goals are inconsistent and incomplete and decision rules used by the decision maker often differ from decision making theory. Rather than looking for the "best possible" (maximizing) action, they search for the "good enough" (satisficing). Beyond many observations of decision making behavior, for March there seems to be a theoretical reason why human beings find the satisficing behavior a more compelling notion: from a cognitive perspective a complex world gets more simplified

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77 Kirsch, W. (1970). Entscheidungsprozesse I. Verhaltenswissenschaftliche Ansätze der Entscheidungstheorie. Wiesbaden, Germany: Betriebswirtschaftlicher Verlag Dr. Th. Gabler, p. 27

78 Neuert, J. O. (2005). The Logic of Managerial Decision Making Processes – Rational Conduct in the Context of multiple Behavioral Patterns: Conjectures and Refutations tested via an Experimental Investigation. In: http://www.lab.uni-koeln.de/gew2005/public/pdf.php/program.pdf, p. 2.

79 Cf. March, J. G.; Simon, H. A.; Guetzkow, H. (1993). Organizations. 2. ed., reprinted. Cambridge MA, USA: Blackwell, p. 159; Simon, H. A. (1997). Administrative behavior. A study of decision-making processes in administrative organizations. 4. Aufl. New York, USA: Free Press, p. 87.

80 Argyris, C. (1973). Some Limits of Rational Man Organizational Theory. In: Public Administration Review 33 (3), p. 254.

81 Simon, H. A. (1997). Administrative behavior. A study of decision-making processes in administrative organizations. 4. Aufl. New York, USA: Free Press, pp. 93-94.

82 March, J. G. (2009). A primer on decision making. How decisions happen. New York, USA: Free Press, pp. 8-9.

for individuals when they are able to divide the world into two parts of "good enough" and "not good enough" instead of having to worry about an infinite number of alternatives.[83]

Recognizing this was the reason for transmuting the closed model of the "homo oeconomicus" into the open model of the "administrator" which we can recognize in everyday life of bounded reality.[84] The administrator is characterized by a satisficing rather than maximizing approach looking for the good enough solution by choosing alternatives without examining all possible solutions. Doing this, the administrator ignores interrelations and complexity that enables him to make decisions with relatively simple rules of thumb.[85] For March the development of the idea of limited rationality was also due to the fact that individuals and groups tend to simplify decision making problems because they have difficulties in anticipating or considering all alternatives and all information.[86] Here Kirsch sees similar restrictions like Simon and March as to why individuals tend to act like the administrator instead of the homo oeconomicus.[87] For Kirsch, in the first place, individuals are more comfortable with smaller changes at the time since they are less risky and they can anticipate the consequences better than with larger changes. Second, because of restricted resources of information processing individuals tend to look for a limited amount of alternatives and just consider a limited amount of consequences within these alternatives. Third, individuals tend to solve problems not finally, but rather adapt them to new possibilities. This will make them feel better, especially when they have not considered all possibilities, since they will approach the problem again anyway. Lastly, individuals mostly encounter problems as they arise rather than taking a long term approach.

Whereas in the past behavior was only considered as being rational when given targets were maximized (optimized), today the concept of rational behavior also seems to be appropriate when given targets are satisfied.[88] Originally, rationality was only considered as individual

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[83] March, J. G. (2009). A primer on decision making. How decisions happen. New York, USA: Free Press, p. 22.

[84] Cf. March, J. G. (1994). A primer on decision making. How decisions happen. New York, USA: Free Press, p. 272; March, J. G.; Simon, H. A.; Guetzkow, H. (1993). Organizations. 2. ed., reprinted. Cambridge MA, USA: Blackwell, pp. 158-160; Simon, H. A. (1978). Rational Decision Making in Business Organizations. In: American Economic Review 69 (4), p. 349; Simon, H. A. (1997). Administrative behavior. A study of decision-making processes in administrative organizations. 4. Aufl. New York, USA: Free Press, p. 118.

[85] Simon, H. A. (1997). Administrative behavior. A study of decision-making processes in administrative organizations. 4. Aufl. New York, USA: Free Press, p. 119.

[86] March, J. G. (1990). Decisions and organizations. Cambridge MA, USA: Blackwell, p. 272.

[87] Kirsch, W. (1970). Entscheidungsprozesse I. Verhaltenswissenschaftliche Ansätze der Entscheidungstheorie. Wiesbaden, Germany: Betriebswirtschaftlicher Verlag Dr. Th. Gabler, pp. 89-92.

[88] Cf. Kirsch, W. (1970). Entscheidungsprozesse I. Verhaltenswissenschaftliche Ansätze der Entscheidungstheorie. Wiesbaden, Germany: Betriebswirtschaftlicher Verlag Dr. Th. Gabler, p. 62; March, J. G.; Simon, H. A.; Guetzkow, H. (1993). Organizations. 2. ed., reprinted. Cambridge MA, USA: Blackwell, p. 162.

rationality. Decisions to satisfy role expectations or social standards were therefore, per se, not seen as rational. But decision making theory by now interprets rationality in the sense of social rationality. Therefore, when decisions are made to satisfy social standards or individual roles they are not in contradiction with rationality anymore. At the beginning of the decision making theory rationality was also interpreted as a substantial rationality. Decisions therefore were only considered as rational if targets were reached that were set by the observer. If the behavior could not be objectively evaluated and therefore was not in line with the targets given by the observing party, the decision was considered as not rational. By now rationality is interpreted as formal rationality where material content of targets or demand has no more influence if behavior is considered rational or not.[89] A further consideration if behavior was rational relied on real given information which could be observed from the outside (objective rationality). But form the experience of today it is clear that individuals reflect objective reality only partially.[90] Individuals rely only on subjective, simple models of the environment when making decisions.[91] Therefore today human beings tend to consider behavior also as rational when it relies on information which can be experienced subjectively by an individual (subjective rationality). For individuals to behave rationally in an organization does not directly imply that they try to achieve the goals of the company. They could strive for rationality to achieve their own individual targets. So when speaking of individuals as behaving irrationally it could, in general, mean that their targets are not our targets or that they are acting on incomplete information or ignoring consequences of the future. Moreover, individuals and groups in organizations tend strive for their own targets and views of what the organization should be like. Therefore our view must include the human selfishness and motivation for power.[92]

Jones believes that there is also no more doubt that the view of the classic or neoclassic model of economic decision making is empirically not sustainable anymore.[93] The view of Jones is supported by Bronner as in reality the classical model does not appear, because from a behavioral point of view, human beings never pursue maximum or minimum goals as

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89 Kirsch, W. (1970). Entscheidungsprozesse I. Verhaltenswissenschaftliche Ansätze der Entscheidungstheorie. Wiesbaden, Germany: Betriebswirtschaftlicher Verlag Dr. Th. Gabler, p. 63.

90 Ibid.

91 Ibid., p. 76.

92 Simon, H. A. (1997). Administrative behavior. A study of decision-making processes in administrative organizations. 4. Aufl. New York, USA: Free Press, p. 88.

93 Jones, B. D. (1999). Bounded Rationality. In: Annual Review of Political Science 2, p. 297.

assumed in the classical rational model.[94] Because of the lack of cognitive capabilities, limited resources for the search of information and the cost of information, human beings tend to solve problems by looking for a satisfying solution rather than maximizing the returns. For Bronner the restriction of information goes along directly with the limited development of decision alternatives.[95] Therefore the search for alternatives also concentrates on satisfying solutions. The so called simplification of reality is not an arbitrary or irrational process. Individuals try to find a search mode to be most economical by using the most promising alternative. They do this by using heuristic principles trying to separate important from less important details. These heuristic principles can be separated in at least two groups: First, into special heuristic principles which are based on certain experiences and therefore are only valid for these kinds of problems and second, into general heuristic principles which are independent from specific experience.[96] For Fredrickson boundaries of rationality on the members of an organization are often imposed by the structure of the organization (e.g. centralized versus decentralized).[97] For him the structure of the organization and the degree of complexity specifies how wide or narrow the boundaries of rationality are. For Neuert human behavior in decision making processes never shows a pattern of pure rationality, as rationality is limited to individual and/or collective constraints, like insufficient cognitive competences, psychological predispositions, feelings, emotions, etc.[98] In particular human behavior can be considered as a combination of intuitive and rational behavior. Moreover, based on his empirical findings, Neuert comes to the conclusion that a mix of rational and intuitive behavioral patterns tend to generate a higher efficiency in decision making processes.

To Eisenhardt & Zbaracki the discussion whether decision makers are rational or bounded rational is not controversial anymore.[99] They come to the conclusion that existing cognitive limits restrict the rational model and the complexity of the problem often influences the shape of the decision path. To them a heuristic perspective is emerging where in contrast to a traditional rational view as a “monolithic concept” a more multidimensional approach is

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94 Bronner, R. (1973). Entscheidung unter Zeitdruck. Tübingen, Germany: Mohr (Empirische Theorie der Unternehmung, 3), p. 13.

95 Ibid., p. 17.

96 Kirsch, W. (1970). Entscheidungsprozesse I. Verhaltenswissenschaftliche Ansätze der Entscheidungstheorie. Wiesbaden, Germany: Betriebswirtschaftlicher Verlag Dr. Th. Gabler, p. 94.

97 Fredrickson, J. W. (1986). The Strategic Decision Process and Organizational Structure. In: Academy of Management Review 11 (2), p. 288.

98 Neuert, J. O. (2010). The Impact of Intuitive and Discursive Behavioral Patterns on Decision Making Outcomes: Some Conjectures and Empirical Findings. In: WDSI Annual Conference Readings, Lake Tahoe, USA, p. 4491.

99 Eisenhardt, K. M.; Zbaracki, M. J. (1992). Strategic Decision Making. In: Strategic Management Journal 13, p. 22.

suggested. In this case decision makers are rational in some ways but not in others. One example here is the study of Isenberg where he found that managers on the one hand made contingency plans, a rational strategy, but on the other hand acted quickly on incomplete information, a bounded rational strategy.[100] For Gigerenzer & Selten bounded rationality can be described as step-by-step rules or procedures which function well in situations where there is limited research, knowledge or time available.[101] Bounded rationality can be specified into three classes of processes: into simple search rules, where pieces of information are acquired or adjustments are made and this process is repeated until it is stopped, into simple stopping rules, where the search is terminated when, for example, the first object is chosen which satisfies the aspiration level, or into simple decision rules, where the search is stopped when having acquired a limited amount of information and a simple decision rule is applied, like choosing the object that has been favored by the most important reason. For Gigerenzer & Selten bounded rationality has the following characteristics: first, it is a collection of rules and heuristics rather than a general purpose decision making algorithm, second, these heuristics are fast, frugal and computationally cheap rather than consistent, coherent and general, third, these heuristics are adapted to the particular structures of the environments, both social and physical.[102] Gigerenzer & Selten believe simple heuristics work, because they can exploit structures of information in the environment. This rationality is a form of ecological rationality rather than one of consistency and coherence. A further reason for simple heuristics to work is the robustness of their simple strategies compared with models which have large numbers of parameters. Last, real world situations often involve multiple competing goals which have no common denominator and include serious problems for optimization but can be handled by models of bounded rationality. Roth comes to the conclusion that there are rational considerations but that there are no rational decisions.[103] He argues that the limited capacity of the human brain makes it impossible to solve complex problems by calculations. Even if it is possible to calculate larger parts of problems, there are always parts which have to be estimated or assumptions which have to be made. A further fact

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[100] Isenberg, D. J. (1986). Thinking and managing: A verbal protocol analysis of managerial problem solving. In: Academy of Management Journal 29.

[101] Gigerenzer, G.; Selten, R. (2002). Rethinking Rationality. In: G. Gigerenzer & R. Selten (Eds.), Bounded rationality, The adaptive toolbox (pp. 1-12). Cambridge MA, USA: MIT Press (Dahlem workshop reports), p. 8.

[102] Gigerenzer, G.; Selten, R. (2002). Rethinking Rationality. In: G. Gigerenzer & R. Selten (Eds.), Bounded rationality, The adaptive toolbox (pp. 1-12). Cambridge MA, USA: MIT Press (Dahlem workshop reports), p. 9.

[103] Roth, G. (2008). Persönlichkeit, Entscheidung und Verhalten. Warum es so schwierig ist, sich und andere zu ändern. 4. Aufl. Stuttgart, Germany: Klett-Cotta, p. 181-197.

is how human beings make decisions in real life. Due to knowledge and time limitations human beings tend to rely on decision making heuristics like the rule of thumb, which can be very effective. They therefore accept risks and suboptimal results either because of convenience or to come to an end. The biggest flaw for Roth in rational decision making theory is the fact that rationality in decision making by human beings plays just a minor role. The studies of Dijksterhuis et al. show Roth that rationality in the case of conscious cognition only plays a role for problems with lower complexity.[104] For Roth decisions are always emotional, no matter how long rational considerations were considered. Rational arguments for him always affect decisions through emotions.

1.1.3. Intuition in decision making

The term intuition is defined as "immediate understanding, knowing something instinctively, identifying a pattern without thinking".[105] Psychology and management intuition have been associated with many terms and definitions. Such include: primary mode of perception which operates subconsciously, analyses frozen into habit, gut feelings, a problem solving process reached nearly effortless without conscious awareness involving little or no conscious deliberation, a form of reasoning with the ability to recognize patterns from experience in lightning speed, affectively charged judgments that arise through rapid, non-conscious and holistic associations.[106] For Volz & von Cramon, intuition is "knowing something without knowing how you know it".[107] Ju et al. see intuition within the decision making process as a combination of the decision maker's knowledge, experience and emotions.[108] For Sadler-Smith intuition is rapid, a judgment, affect-laden, involuntary, holistic, ubiquitous, non-conscious and both powerful and perilous.[109] Pretz & Totz view intuition as "a product of the

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[104] Dijksterhuis, A.; Bos, M. W.; Nordgren, L. F.; van Baaren, R. B. (2006). On Making the Right Choice: The Deliberation-Without-Attention Effect. In: Science 311., pp. 1005–1007.

[105] Timm, F. (1992). Das moderne Fremdwörterlexikon. Unbekannte Begriffe schnell verstehen und sicher anwenden. Köln, Germany: Naumann & Göbel, p. 249.

[106] Cf. Dane, E.; Pratt, M. G. (2007). Exploring intuition and its role in managerial decision making. In: Academy of Management Review 32 (1), p. 36; Gigerenzer, G. (2008). Gut feelings. The intelligence of the unconscious. London, Great Britain: Penguin Books, p. 18; Hayashi, A. M. (2001). When to Trust your Gut. In: Harvard Business Review 79 (2), p. 61; Hogarth, R. M. (2001). Educating intuition. Chicago, USA: Univ. of Chicago Press, p. 14; Isenberg, D. J. (1984). How senior managers think. In: Harvard Business Review, p. 85; Jung, C. G. (1921/1971). Psychological Types. London, Great Britain: Routlege, p. 366; Matzler, K.; Bailom, F.; Mooradian, T. A. (2007). Intuitive Decision Making. In: MIT Sloan Management Review 49 (1), p. 14; Simon, H. A. (1997). Administrative behavior. A study of decision-making processes in administrative organizations. 4. Aufl. New York, USA: Free Press, 139.

[107] Volz, K. G.; von Cramon, Y. D. (2006). What Neuroscience Can Tell about Intuitive Processes in the Context of Perceptual Discovery. In: Journal of Cognitive Neuroscience 18 (12), p. 2084.

[108] Ju, B.; Junwen, F.; Chenglin, M. (2007). Intuitive decision theory analysis and the evaluation model. In: Management Science and Engineering 1 (2), p. 64.

[109] Sadler-Smith, E. (2008). Inside intuition. London, Great Britain: Routledge, p. 31.

tacit system and highlight three distinct aspects of the nature of intuition: affective, heuristic, and holistic".[110] Hodgkinson et al. view intuition as a complex set of inter-related cognitive, affective and somatic processes in which there is apparently no rational thought, no deliberate process and it can be difficult to articulate.[111] To them the outcome can be experienced as a holistic hunch or gut feeling.

For Kahneman & Tversky intuition can be understood in three senses. 1) a judgment without the use of analytic methods or deliberate calculation and it can be reached by an informal and unstructured mode of reasoning, 2) a formal rule of fact of nature if it is compatible with our lay model of the world and 3) a rule or procedure seems to be part of our repertoire of intuitions when we apply it or follow the procedure in our normal conduct.[112]

For Roth there are rational considerations but there are no clear rational decisions.[113] Decisions to him are always emotional no matter how much rationality is stacked on the emotions. In this sense for him decision making always includes emotions and therefore is either affective emotional without consideration, what he calls "gut feelings", or is a combination of rationality and affective emotions. But for Roth gut feelings are not the same as intuition. For him intuition is implicit knowledge being derived from the preconscious.[114]

Intuition is mostly viewed under a philosophical or psychological perspective. Greek philosophy, especially the Platonic-Aristotelian tradition, distinguished between the ordinary inferential kind of thought, so called discursive thought, and a kind of non-inferential, non-discursive or intuitive thought. Under the philosophical approach in diverse Greek schools intuition was seen as spiritual insight whereby intuition mostly relies on the perception of the superior state of mind or divine principles.[115] From a historical point of view in psychology intuition is mostly viewed as some sort of unconscious, biased and automatic processing which is inferior to controlled analyses. Psychologists in the past had the tendency to ignore

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[110] Pretz, J. E.; Totz, K. S. (2007). Measuring individual differences in affective, heuristic, and holistic intuition. In: Personality and Individual Differences 43, p. 1248.

[111] Hodgkinson, G. P.; Langan-Fox, J.; Sadler-Smith, E. (2008). Intuition: A fundamental bridging construct in the behavioral sciences. In: British Journal of Psychology 99, p. 4.

[112] Kahneman, D.; Tversky, A. (1982). On the study of statistical intuitions. In: Cognition 11, p. 124.

[113] Roth, G. (2008). Persönlichkeit, Entscheidung und Verhalten. Warum es so schwierig ist, sich und andere zu ändern. 4. Aufl. Stuttgart, Germany: Klett-Cotta, p. 197.

[114] Ibid., p. 198.

[115] Cf. Hänsel, M. (2002). Intuition als Beratungskompetenz in Organisationen. Untersuchung der Entwicklung intuitiver Kompetenzen in Bereich systemischer Organisationsberatung. Thesis (PhD). Ruprechts-Karls-Universität, Heidelberg, pp. 7-8; Henden, G. (2004). Intuition and its Role in Strategic Thinking. Thesis (PhD). BI Norwegian School of Management, Oslo, pp. 14-15.

intuition.[116] Carl Gustav Jung was one of the first ones in psychology to address intuition in a more elaborate way.[117] For Westcott there are not many references to intuition in psychological literature. For him the only grand theory which has been presented in psychology is probably the one by Jung.[118] Jung described intuition as a kind of perception which does not exactly go through the senses but goes via the unconscious.[119] He sees intuition as a basic psychological function that mediates perceptions in an unconscious way. In intuition contents present themselves as whole and complete without being able to explain or discover how this content came into existence.

Chester Barnard was among the first in management literature to briefly distinguish the rational and intuitive process:

"By "logical processes" I mean conscious thinking which could be expressed in words, or other symbols, that is, reasoning. By "non-logical process" I mean those not capable of being expressed in words or reasoning, which are only made known by a judgment, decision or action. This may be because the processes are unconscious, or because they are so complex and so rapid, often approaching the instantaneous, that they could not be analyzed by the person within whose brain they take place. The sources of these non-logical processes lie in physiological conditions or factors or in the physical and social environment, mostly impressed upon us unconsciously or without conscious effort on our part. They also consist of a mass of facts, patterns, concepts, techniques, abstractions, and generally what we call formal knowledge or beliefs, which are impressed upon our minds more or less by conscious effort and study". [120]

Even though there are several varieties of intuition to Allport it seems they always hold knowledge in one way or the other. For him the simplest form of intuition is "direct perception" whereby less is added by experience since structures are clear and the solution and the choice seem obvious. Next is "innate knowledge and identity" which requires operative activity between the external environment and innate ideas. According to Allport there are patterns in the human mind which are confirmed by the activity of senses. A further concept of intuition is "immediate knowledge" whereas intuition rises from a sympathetic

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[116] Henden, G. (2004). Intuition and its Role in Strategic Thinking. Thesis (PhD). BI Norwegian School of Management, Oslo, p. 68.
[117] Jung, C. G. (1921/1971). Psychological Types. London, Great Britain: Routlege.
[118] Westcott, M. R. (1968). Toward a Contemporary Psychology of Intuition. A Historical, Theoretical, and Empirical Inquiry. New York, USA: Holt, Rinehart and Winston, Inc., p. 32.
[119] Jung, C. G. (1921/1971). Psychological Types. London, Great Britain: Routlege, p. 453.
[120] Barnard, C. I. (1938/1968). The functions of the executive. Cambridge MA, USA: Harvard Univ. Press, p. 303.

attitude toward outside reality; you feel it is right.[121] When interviewing 60 experienced professionals holding significant positions in major organizations Burke & Miller's findings revealed that 56 percent understood intuitive decisions to be based on previous experiences, together with emotional inputs, which are in line with the statement of Barnard.[122] For Burke & Miller intuition is a cognitive conclusion which is based on the decision maker's previous experience and emotional inputs.[123] Agor, Harper and Matzler et al. also see the ability to use intuition as a particular domain which is acquired through experience and learning and relies upon a process of pattern recognition.[124] Volz & von Cramon conceive intuition as a process where the coherence of patterns, meanings or structures are perceived in an affective valence or "gut feeling" based on previous experience.[125]

For Isenberg executives use intuition in five distinctive ways: first, for sensing intuitively when a problem exists, second, to rely on well learned behavior patterns rapidly, third, synthesize isolated bits of data and experience into an integrated picture, fourth, intuition as a check (a belt and suspenders approach) and fifth, to bypass in-depth analysis and move rapidly to come up with a plausible solution. For Isenberg intuition therefore is not the opposite of rationality, nor the random process of guessing. For him intuition is based on experience in analysis and problem solving.[126]

Khatri & Alvin Ng see intuition not as an irrational process. For them intuition is a complex phenomenon that draws from our store of knowledge in our subconscious and has it's roots in our past experience. Further it is based on the deep understanding of the situation.[127] Gigerenzer believes that intuition, or what he calls "gut feelings", has its own rationale. Rationale in this sense consists of two elements: simple rules of thumb or heuristics and these two elements taking advantage of the evolved capacities of the brain.[128] Like van Riel et al. with the active sense and common sense style, Gigerenzer understands the nature of intuition

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[121] Allport, G. W. (1937/1971). Personality. A psychology interpretation. London, England: Constable, pp. 533-538.

[122] Burke, L. A.; Miller, M. K. (1999). Taking the mystery out of intuitive decision making. In: Academy of Management Review 13 (4), p. 91.

[123] Ibid., p. 93.

[124] Cf. Agor, W. H. (1989). Intuition in organizations. Leading and managing productively. Newbury Park, USA: Sage, p. 51; Harper, S. C. (1988). Intuition: What Separates Executives from Managers. In: Business Horizons 31 (5), p. 18; Matzler, K.; Bailom, F.; Mooradian, T. A. (2007). Intuitive Decision Making. In: MIT Sloan Management Review 49 (1), p. 14.

[125] Volz, K. G.; von Cramon, Y. D. (2006). What Neuroscience Can Tell about Intuitive Processes in the Context of Perceptual Discovery. In: Journal of Cognitive Neuroscience 18 (12), p. 2082.

[126] Isenberg, D. J. (1984). How senior managers think. In: Harvard Business Review, pp. 85-86.

[127] Khatri, N.; Alvin Ng, H. (2000). The role of intuition in strategic decision making. In: Human Relations 53 (1), p. 62.

[128] Gigerenzer, G. (2008). Gut feelings. The intelligence of the unconscious. London, Great Britain: Penguin Books, pp. 17-18.

in two ways: first, one assumes that intuition solves complex problems with complex strategies and second, one assumes that simplicity relies on the evolved brain.[129] For Hammond et al. these heuristics are not foolproof. They see various kinds of "traps" when using these heuristics as shortcuts in decision making.[130] For Klein the expert's intuitive ability derives from cues which rapidly match with more commonly occurring patterns leading then to action steps in ways that lead to effective problem solving or decision making. Klein calls this routine the recognition primed decision (RPD) model which combines two processes: first, how decision maker's size up the situation to recognize which course of action makes sense and second, evaluate the course of action by imaging it. This two-part process of pattern matching and mental simulation is to Klein the explanation why human beings can make good decisions without generating and comparing a list of options. To Klein coming to a good decision means the necessity of having good mental models of how things work.[131] To Allinson & Hayes intuition is a cognitive style or trait.[132] Hogarth reviews it as a cognitive strategy.[133] For Hodgkinson et al. intuition can be conceptualized as one element of practical intelligence.[134] For Sarmany-Schuller intuition is also a cognitive style which is associated with immediate assessment and the adoption of a global perspective based on feelings.[135]

In the latest research intuition has been viewed as one part of a two part information processing system: system 1 and system 2.[136] System 1 is believed to be the evolutionary and older one and the one that involves the automatic and relatively effortless processing and learning of information without conscious attention. It is described as automatic, tacit and natural associative. The second system is called System 2 and is determined by being rule based, extensional, intentional and deliberate. System 2 enables individuals to learn

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[129] Cf. Gigerenzer, G. (2008). Gut feelings. The intelligence of the unconscious. London, Great Britain: Penguin Books, p. 18; Van Riel, A. C.; Ouwersloot, H.; Lemmink, J. (2006). Antecedents of Effective Decision Making: A Cognitive Approach. In: The IUP Journal of Managerial Economics 6 (4), pp. 10-13.

[130] Hammond, J. S.; Keeney, R. L.; Raiffa, H. (1998). The Hidden Traps in Decision Making. In: Harvard Business Review, p. 47.

[131] Klein, G. (2004). The Power of Intuition: how to use your gut feelings to make better decisions at work. New York, USA: Doubleday, p. 27.

[132] Allinson, C. W.; Hayes, J. (1996). The Cognitive Style Index: A Measure of Intuition-Analysis for Organizational Research. In: Journal of Management Studies 33 (1), p. 119.

[133] Hogarth, R. M. (2001). Educating intuition. Chicago, USA: Univ. of Chicago Press, p. 7.

[134] Hodgkinson, G. P.; Langan-Fox, J.; Sadler-Smith, E. (2008). Intuition: A fundamental bridging construct in the behavioral sciences. In: British Journal of Psychology 99, p. 6.

[135] Sarmany-Schuller, I. (2010). Decision Making under Time Pressure in regard to preferred cognitive style (analytical-intuitive) and study orientation. In: Studia Psychologica 52 (4), p. 286.

[136] Stanovich, K. E.; West, R. F. (2000). Individual differences in reasoning: Implications for the rationality debate? In: Behavioral and Brain Sciences 23, p. 658.

deliberately, to develop ideas and engage in analyses in an attentive manner.[137] According to the cognitive-experiential self-theory (CEST), a dual process model developed by Epstein and his colleagues, the rational system operates analytic, verbal and relatively affect-free at a conscious level, Epstein and his colleagues believe that these two systems are two parallel interactive modes of information processing which are served by separate cognitive systems. The experimental system is believed to be older and operates automatically, primarily non-verbal in nature and is emotionally driven at a preconscious level.[138] Recent studies by Liebermann et al. using functional magnetic resonance imaging (fMRI) have also identified two processing systems within social cognition.[139] One of the processes being intuitive (refle**x**ive) refers to 'the X-system' and the other one the analytic (refle**c**tive) refers to 'the C-system'. The older evolutionary system, the X-system, is based on parallel processing, is fast in operation, slow in learning and spontaneous. In contrast the C-system is based on serial processing, is slow in operation, fast in learning and intentional.[140] Kahnemann believes that human beings always first address System 1 because it is fast, less effortful and less work. Human beings involve themselves or switch to the slower and more effortful rational system, System 2, when the first approach to System 1 fails or does not bring the expected results.[141]

Although management writers use terms as "business instinct" and "intuitive insight" as a synonym for intuition it is important to recognize that intuition is neither the same as instinct nor is it equivalent to insight.[142] Intuition and insight are related in such a way that they both rely upon non-conscious mental processes.[143] Intuition seems to be an affect laden judgment whereas insights are clear-cut solutions. Sadler-Smith believes that insight consists of a creative problem solving process with several stages like, preparation, incubation, intimation illumination and verification where at the end the solution pops up as insight in a "Eureka"

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[137] Dane, E.; Pratt, M. G. (2007). Exploring intuition and its role in managerial decision making. In: Academy of Management Review 32 (1), p. 36.

[138] Cf. Epstein, S. (1991). Cognitvie-Experiential Self-Theory: An Integrative Theory of Personality. In: Rebecca C. Curtis (Ed.): The Relational self. Theoretical convergences in psychoanalysis and social psychology. New York: Guilford Press, pp. 111–137; Epstein, S. (2003). Cognitive-Experiential Self-Theory of Personality. In: Irving B. Weiner (Ed.): Handbook of psychology. Hoboken, NJ: Wiley, pp. 159–184; Epstein, S. (2010). Demystifying Intuition: What It Is, What It Does, and How It Does It. In: Psychological Inquiry 21 (4), pp. 295–312.

[139] Liebermann, M. D.; Jarcho, J. M.; Satpute, A. B. (2004). Evidence-Based and Intuition-Based Self-Knowledge: An fMRI Study. In: Journal of Personality and Social Psychology 87 (4), pp. 421–435.

[140] Cf. Liebermann, M. D. (2000). Intuition: A Social Cognitive Neuroscience Approach. In: Psychological Bulletin 126 (1), pp. 109–137; Liebermann, M. D.; Jarcho, J. M.; Satpute, A. B. (2004). Evidence-Based and Intuition-Based Self-Knowledge: An fMRI Study. In: Journal of Personality and Social Psychology 87 (4), pp. 421–435.

[141] Kahneman, D. (2012). Thinking, fast and slow. London: Penguin Books.

[142] Seibt, T. (2005). Intuitive and rational cognitive styles in the personnels selection. Thesis (PhD). Ludwig-Maximilians-Universität, München, pp. 10-11.

[143] Sadler-Smith, E. (2008). Inside intuition. London, Great Britain: Routledge, p. 64.

moment.[144] He sees insight as a process of "prepared mind" drawing, consciously or non-consciously, conclusions on problem relevant information. Instincts merely remain to be hardwired, autonomous reflex actions.[145]

1.2. Personal disposition in decision making

a) Personality and behavior

Personality can be derived out of two theories: First, the theory of disposition where human beings have characteristics which are stable over a certain amount of time and which enable them to show a certain behavior in certain situations. In this sense personality can be understood as the sum of characteristics which differentiate human beings from each other. But personality is not an incoherent set of characteristics, rather a hierarchy of characteristics. This hierarchy links different characteristics in a structure which then describes the structure of personality. This disposition hierarchy arises from inheritance or learning. Second, personality can be derived out of the theory about how human beings process information (e.g. cognitive, motivational and emotional). Both theories seem to be available to us and we rely intuitively on the theory which seems more appropriate to us at a given time.[146] For Kirsch personality describes values, motives, attitudes and habits which characterize human beings. He sees personality as all the information an individual has learned or stored over time, no matter if it ever was retrieved at a certain moment in time or not.[147] Roth sees personality as a combination of different characteristic types resulting from emotions, temperament, intellect and how human beings act, communicate and behave.[148] For Roth there are four factors which shape personality. The first factor is the genetic pre disposition. The second is the development of the brain and especially dysplasia in the front part of the brain or in the hippocampus. The genetic pre disposition and the development of the brain roughly shape 50 percent of the personality. The third factor is prenatal or postnatal affective-emotional experiences which roughly count for 30 percent of the personality. The fourth factor shapes the personality by socializing with friends, relatives, teachers and colleagues

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144 Sadler-Smith, E. (2008). Inside intuition. London, Great Britain: Routledge, p. 101.
145 Hodgkinson, G. P.; Sadler-Smith, E.; Burke, L. A.; Claxton, G.; Sparrow, P. R. (2009). Intuition in Organizations: Implications for Strategic Management. In: Long Range Planning 42 (3), p. 279.
146 Asendorpf, J. (2007). Psychologie der Persönlichkeit. 4. überarb. Berlin, Germany: Springer Berlin, pp. 3-5.
147 Kirsch, W. (1971a). Entscheidungsprozesse II. Informationsverarbeitungstheorie des Entscheidungsverhaltens. Wiesbaden, Germany: Betriebswirtschaftlicher Verlag Dr. Th. Gabler, p. 104.
148 Roth, G. (2008). Persönlichkeit, Entscheidung und Verhalten. Warum es so schwierig ist, sich und andere zu ändern. 4. Aufl. Stuttgart, Germany: Klett-Cotta, pp. 15-23.

during later childhood and teenage years. Roth sees personality as an outlasting pattern which is partly genetic and partly developed during the first few years in life.[149] For Roth there is no more doubt that the former dispute, about disposition and environment, concerning the development of the personality is solved. For him personality results from the interdependency of the four mentioned factors.[150] Allport understands personality as a dynamic organization within an individual's psychophysical system that determines the unique adjustments to their environment. In this sense the psychophysical system represents habits, general attitudes and dispositions. The uniqueness indicates the individuality of every adjustment of every person in time, place and quality. With the adjustment to his environment Allport refers to functional as well as to evolutionary aspects of the environment. Therefore adjustment to the environment can include behavioral, geographical as well as evolutionary aspects. For him parts of the personality are innate but he clearly stresses the fact that personality is influenced by environmental surroundings and the need to adjust to them.[151] Gigerenzer sees it as a "fundamental attribution error" to explain intuitive behavior only "internally" without analyzing the environment or the context. For him personality and attitude rarely predict behavior well. Intuition that he calls gut feelings are not fixed character traits, preferences or attitudes. Therefore to explain intuitive behavior he proposes an adaptive approach where it is necessary to have people interact with their environment to use or develop their intuitive behavior.[152]

b) Cognitive styles

Cognitive styles in the literature are described as individual preferences in perceiving and processing information or as an individual difference how people perceive, think, solve problems and relate to each other.[153] Often personality and cognitive styles are used interchangeably but cognitive style scholars have a different view about to which extent cognitive styles are related to personality. In this sense personality is seen as a combination of

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[149] Roth, G. (2008). Persönlichkeit, Entscheidung und Verhalten. Warum es so schwierig ist, sich und andere zu ändern. 4. Aufl. Stuttgart, Germany: Klett-Cotta, pp. 103-105.

[150] Ibid., p. 105.

[151] Allport, G. W. (1937/1971). Personality. A psychology interpretation. London, England: Constable, pp. 47-50.

[152] Gigerenzer, G. (2008). Gut feelings. The intelligence of the unconscious. London, Great Britain: Penguin Books, pp. 49-50:

[153] Cf. Cools, E.; van den Broeck, H. (2007). Development and Validation of the Cognitive Style Indicator. In: The Journal of Psychology 141 (4), p. 395; Cools, E. (2008). Cognitive Styles and Management Behaviour. Theory, Measurement, Application. Saarbrücken: VDM Verlag Dr. Müller, p. 30; Hough, J. R.; ogilvie, d. (2005). An Empirical Test of Cognitive Style and Strategic Decision Outcomes. In: Journal Management Studies 42 (2), pp. 421.

stable characteristics that give people their own individuality. They consider personality and cognitive styles as two independent but related constructs which together affect behavior.[154]

The work of Jung was among the first ones that differentiated people in distinctive types on how they perceive and how they process information, indicating that those types share distinct personality characteristics.[155] Jung differentiated people into four mental functions and two attitudes, allowing him to describe different types of people. Jung differentiated the four mental functions into sensing and intuitive types related to their preference on how they perceive information and into thinking and feeling types related to their preference on how they make judgments. For him intuitive types prefer to acquire information by imagining new possibilities and sensing patterns via the unconscious.[156] Intuitive types favor generalities and have a preference to focus on the big picture, see patterns in information and are future orientated.[157] Sensing types, in contrast, prefer to notice concrete factual details with their five senses. They depend on objects and only concrete, sensuously perceived objects attract their attention and are fully accepted into their consciousness.[158] Individuals with a preference for Sensing therefore focus on what is occurring at the present and what can be observed with the physical senses.[159] Thinking types come to a decision by linking up ideas through logical connections and use objective information in a logical problem solving process. They tend to rely on the principles of cause and effect and to be objective and impersonal when making a decision. Feeling types, in contrast, come to a decision by weighting relative values and merits of the issues. They tend to rely on an understanding of personal and group values and to be more subjective than thinking types.[160] Since the decision of Feeling types are generally based more on personal and group values, these decisions are frequently viewed as more subjective than decisions of Thinking types.[161] Jung described the two attitudes as introversion and extraversion. For him introverted types are orientated primarily toward the

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[154] Cools, E. (2008). Cognitive Styles and Management Behaviour. Theory, Measurement, Application. Saarbrücken: VDM Verlag Dr. Müller, pp. 38-39.

[155] Cf. Jung, C. G. (1921/1971). Psychological Types. London, Great Britain: Routlege; Westcott, M. R. (1968). Toward a Contemporary Psychology of Intuition. A Historical, Theoretical, and Empirical Inquiry. New York, USA: Holt, Rinehart and Winston, Inc.

[156] Jung, C. G. (1921/1971). Psychological Types. London, Great Britain: Routlege, p. 453.

[157] Hough, J. R.; ogilvie, d. (2005). An Empirical Test of Cognitive Style and Strategic Decision Outcomes*. In: Journal Management Studies 42 (2), p. 426.

[158] Jung, C. G. (1921/1971). Psychological Types. London, Great Britain: Routlege, pp. 362-636.

[159] Hough, J. R.; ogilvie, d. (2005). An Empirical Test of Cognitive Style and Strategic Decision Outcomes*. In: Journal Management Studies 42 (2), p. 425.

[160] Briggs Myers, I.; McCaulley, M. H.; Qenk, N. L.; Hammer, A. L. (2003). MBTI manual. A guide to the development and use of the Myers-Briggs type indicator. 3. Aufl. Palo Alto CA, USA: CPP, Inc., p. 24.

[161] Hough, J. R.; ogilvie, d. (2005). An Empirical Test of Cognitive Style and Strategic Decision Outcomes*. In: Journal Management Studies 42 (2), p. 426.

inner world and they tend to focus their energy on concepts, ideas and internal experience.[162] Introverts are more inclined to show slower reactions to events. Extraverted types in contrast are orientated mainly toward the outer world; they tend to focus their energy on people and objects.[163] Extraverts have the tendency to react quickly. For Jung there are only four ways of solving problems according to the four mental functions. Human beings can only perceive a problem by using a sensing or intuition function. When they realize that they have a problem there are only two ways to solve the problem, for instance when they choose between alternatives, which is by using the thinking or feeling function. All people prefer one of those four functions and it is called the "dominant" or "superior function. The opposite of the dominant function is the inferior function. All human beings have one function which is applied the most, the dominant function and an auxiliary function which provides a balance to the first or dominant function. When the dominant function and the auxiliary function are revealed, the decision making style for an individual is determined.[164] For Hough & ogilvie the decision style is a subset of the cognitive style, which refers primarily to how individuals gather and evaluate information for decision making.[165]

The more "romantic" view is that formal business planning processes (the sequential-logical process) rely on the left brain hemisphere, whereas the less formal intuitive and creative aspects of management are accomplished by the right hemisphere and cannot be derived from psychological research.[166] This view is also supported by neuroscience research as the activation of certain areas of the brain can be measured by using functional magnetic resonance imaging while working on intuitive tasks. But those areas are not necessarily located in the right hemisphere of the brain.[167] For Bowers et al. intuition is accessible to

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[162] Jung, C. G. (1921/1971). Psychological Types. London, Great Britain: Routlege, pp. 452-453.

[163] Ibid., p. 427.

[164] Andersen, J. A. (2000). Intuition in managers. Are intuitive managers more effective? In: Journal of Managerial Psychology 15 (1), pp. 49-50.

[165] Hough, J. R.; ogilvie, d. (2005). An Empirical Test of Cognitive Style and Strategic Decision Outcomes*. In: Journal Management Studies 42 (2), p. 425.

[166] Cf. Allinson, C. W.; Hayes, J. (1996). The Cognitive Style Index: A Measure of Intuition-Analysis for Organizational Research. In: Journal of Management Studies 33 (1), p. 122; Mintzberg, H. (1994). The Fall and Rise of Strategic Planning. In: Harvard Business Review January-February, pp. 114; Sauter, V. L. (1999). Intuitive decision-making. In: Communications of the ACM 42 (6), p. 109; Simon, H. A. (1997). Administrative behavior. A study of decision-making processes in administrative organizations. 4. Aufl. New York, USA: Free Press, p. 132.

[167] Cf. Liebermann, M. D.; Jarcho, J. M.; Satpute, A. B. (2004). Evidence-Based and Intuition-Based Self-Knowledge: An fMRI Study. In: Journal of Personality and Social Psychology 87 (4), pp. 421–435; Volz, K. G.; von Cramon, Y. D. (2006). What Neuroscience Can Tell about Intuitive Processes in the Context of Perceptual Discovery. In: Journal of Cognitive Neuroscience 18 (12), pp. 2077–2087.

everyone but it just differs in speed and accuracy.[168] Reber et al. see little or no individual differences in implicit learning and hence intuition. Therefore they suggest that it should not be related to personality theory as it was done by Jung.[169] In contrast the results of the study of Woolhouse & Bayne indicate that there are individual differences for sensing and intuitive types on how to use strategy and on the performance of implicit learning tasks. For them types with a preference for intuition are more successful in using unconscious information and types with a preference for sensing tend to prefer information in a concrete format. They clearly support the findings of Westcott and Bowers et al. that there are individual differences in the use of intuition and these differences can be related to a measure of personality.[170] Westcott found in his study that extreme groups, using his measures, had "distinguishing and coherent patterns of personality".[171] Woolhouse & Bayne see the difference in the level of use of intuition (more or less) in the nature of people exiting associations between words and concepts.[172] The main findings in the study of Shiloh et al. support the evidence that an intuitive or rational approch in decision making can be related to personality types/cognitive styles. Within their study they show that participants with a rational thinking style were more related to normative judgements and participants with intuitive thinking style were more related to heurisitc judgements.[173]

According to the Cognitive-Experiential Self Theory, human beings operate on two fundamental information processing systems. The experiential system, which operates mainly on an unconscious level relates to experiences which have been built up in the past. The experiential system can be characterized as automatic, rapid, effortless, associative and holistic.[174] Although the experiential system is a cognitive system, it derives beliefs from

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[168] Bowers, K. S.; Regehr, G.; Balthazard, C.; Parker, K. (1990). Intuition in the context of discovery. In: Cognitive Psychology 22 (1), pp. 72–110.

[169] Reber, A. S.; Walkenfeld, F. F. H. R. (1991). Implicit and explicit learning: Individual differences and IQ. Learning, Memory, and Cognition. In: Journal of Experimental Psychology 17 (5), pp. 888–896.

[170] Cf. Bowers, K. S.; Regehr, G.; Balthazard, C.; Parker, K. (1990). Intuition in the context of discovery. In: Cognitive Psychology 22 (1), pp. 72–110; Westcott, M. R. (1968). Toward a Contemporary Psychology of Intuition. A Historical, Theoretical, and Empirical Inquiry. New York, USA: Holt, Rinehart and Winston, Inc., p. 148; Woolhouse, L. S.; Bayne, R. (2000). Personality and the Use of Intuition: Individual Differences in Strategy and Performance on an Implicit Learning Task. In: European Journal of Personality 14, p. 167.

[171] Westcott, M. R. (1968). Toward a Contemporary Psychology of Intuition. A Historical, Theoretical, and Empirical Inquiry. New York, USA: Holt, Rinehart and Winston, Inc., p. 148.

[172] Woolhouse, L. S.; Bayne, R. (2000). Personality and the Use of Intuition: Individual Differences in Strategy and Performance on an Implicit Learning Task. In: European Journal of Personality 14, p. 160.

[173] Shiloh, S.; Salton, E.; Sharabi, D. (2002). Individual differences in rational and intuitive thinking styles as predictors of heuristic responses and framing effects. In: Personality and Individual Differences 32, pp. 425-426.

[174] Epstein, S. (2003). Cognitive-Experiential Self-Theory of Personality. In: Irving B. Weiner (Ed.): Handbook of psychology. Hoboken, NJ: Wiley, p. 160.

emotional experiences.[175] Epstein describes the experiential system as an automatic, preconscious experiential conceptual system. This system regulates everyday behavior which is of necessity and emotionally driven by a dynamic unconscious system".[176] In contrast the rational system operates predominantly at the conscious level in an analytical, effortful, affect-free and relatively slow manner while demanding high cognitive resources.[177] The rational system is more process oriented, logical-reason orientated and requires justification via logic and evidence. The rational system seems to be more suitable when analytic approaches are needed or considerations for long time consequences are at stake.[178] Because the rational and the experiential system are independent from each other, people believe that they can think or decide completely rational. But as the two systems can interact and influence each other every rational thought or decision is likely to be biased by the experiential system.[179] In this sense the experiential system can influence the rational system also by being a resource of creativity and bringing up ideas which would not be available in a purely logical process of the rational system. Further the experiential system can also be a useful source of information as it is a learning system. But, in turn, the rational system can also influence the experiential system.[180] It can reflect spontaneous and impulsive thoughts and override them by recognizing that they are inappropriate. The rational system can also provide understanding of the operating principles of the experiential system which in turn allows people to train, improve and develop their experiential system. In this case there is also an unintentional way in which the rational system can influence the experiential system by repetitions of thoughts and behavior. Such repetitions become habitualized and therefore shift control from the rational to the experiential system.[181] Alter et al. support the view that people make different decisions based on personality whether they adopt a rational systematic processing manner or if they rely on intuitive, heuristic processing. From their empirical study they provide evidence that when people experience difficulty or disfluency this leads them to

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[175] Epstein, S. (1991). Cognitvie-Experiential Self-Theory: An Integrative Theory of Personality. In: Rebecca C. Curtis (Ed.): The Relational self. Theoretical convergences in psychoanalysis and social psychology. New York: Guilford Press, p. 121.

[176] Epstein, S. (2003). Cognitive-Experiential Self-Theory of Personality. In: Irving B. Weiner (Ed.): Handbook of psychology. Hoboken, NJ: Wiley, p. 161.

[177] Ibid.

[178] Epstein, S. (1991). Cognitvie-Experiential Self-Theory: An Integrative Theory of Personality. In: Rebecca C. Curtis (Ed.): The Relational self. Theoretical convergences in psychoanalysis and social psychology. New York: Guilford Press, p. 123.

[179] Epstein, S. (2003). Cognitive-Experiential Self-Theory of Personality. In: Irving B. Weiner (Ed.): Handbook of psychology. Hoboken, NJ: Wiley, p. 164.

[180] Hogarth, R. M. (2001). Educating intuition. Chicago, USA: Univ. of Chicago Press, p. 192.

[181] Epstein, S. (2003). Cognitive-Experiential Self-Theory of Personality. In: Irving B. Weiner (Ed.): Handbook of psychology. Hoboken, NJ: Wiley, p. 165.

adopt a more rational approach in information processing. The participants in the study who experienced difficulty or disfluency while processing information believed that the tasks were more difficult and therefore engaged in a more analytical processing style than the participants who did not. To them people who usually tend to rely on heuristic processing turn to more systematic information processing when experiencing difficulty or disfluency. This is a clue that the problem or decision may ask for more elaborate thought and simple or intuitive response may be wrong.[182] Dijksterhuis et al. found in their studies that participants facing simple decision making situations performed well when making conscious, deliberate thoughts where as participants facing complex decision making situations performed better when making unconscious, intuitive thoughts. The study also showed that post choice satisfaction was greater in a simple decision making situation when decision makers had taken deliberate, rational approaches. For complex decisions the decision makers experienced greater post choice satisfaction when they took unconscious approaches.[183]

As different levels of cognitive activities have been observed (e.g. how managers in practice use the two information systems), this led to the conclusion that cognitive continuums on a single dimension do not allow independent variations on the intensity of use and the relative use of each system.[184] Therefore van Riel et al. proposed four basic decision styles reflecting a cognitive style mix (Figure 4).

[182] Alter, A. L.; Oppenheimer, D. M.; Epley, N.; Eyre, R. N. (2007). Overcoming intuition: Metacognitive difficulty activates analytic reasoning. In: Journal of Experimental Psychology: General 136 (4), p. 575.

[183] Dijksterhuis, A.; Bos, M. W.; Nordgren, L. F.; van Baaren, R. B. (2006). On Making the Right Choice: The Deliberation-Without-Attention Effect. In: Science 311, pp. 1005–1007.

[184] Van Riel, A. C.; Ouwersloot, H.; Lemmink, J. (2006). Antecedents of Effective Decision Making: A Cognitive Approach. In: The IUP Journal of Managerial Economics 6 (4), pp. 9-13.

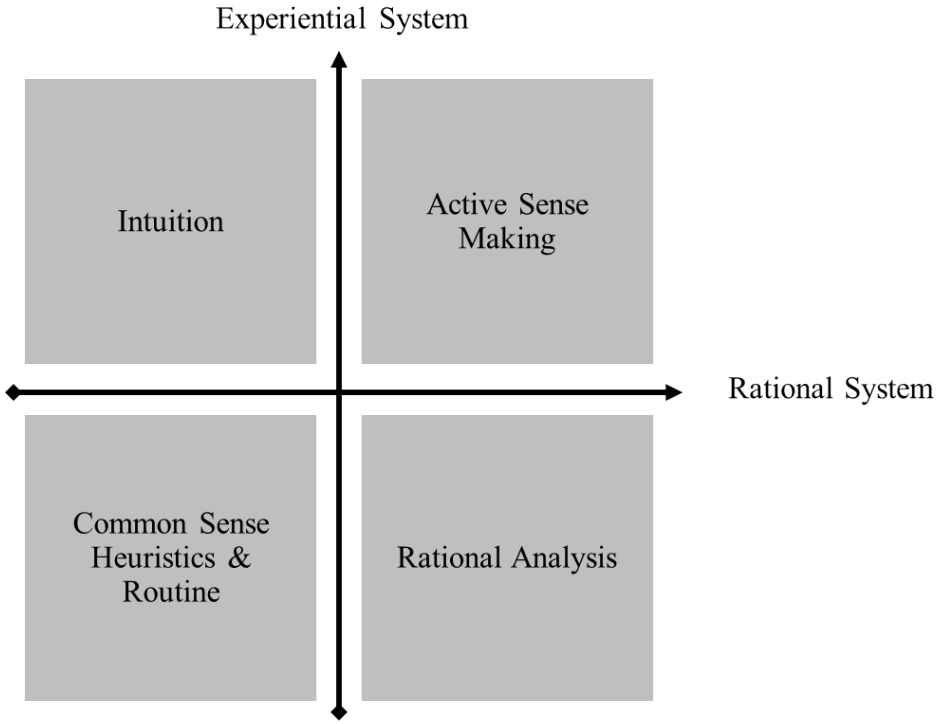

Figure 4: Cognitive style matrix

Source: Van Riel et al., 2006, p. 11

The four decision styles can be described as following: The rational style is characterized by the predominant use of the rational system. It reflects rational analysis with a deliberate and logical approach, process and evidence orientated. The common sense style is a mix of effortless analytical thinking in combination with experiential cognition. Heuristics, short cuts or routine decision making can be seen as practical examples for this style. The common sense style is often characterized by high degree of efficiency and effectiveness and is mostly used in situations with relatively limited complexity and substance where there is no in depth justification required. The intuitive style, for the most part, exclusively and intensely uses the experiential style for information processing. The fourth style is active sense making and is a combination of effortful rational thinking and intuitive insights of the experiential information processing system. As decision makers apply much effort to this style, it seems to be genuinely synthetic or creative in nature and therefore has the potential to be the source of creativity.[185] For Stanovich & West individual differences vary with the cognitive ability and thinking disposition. They claim that related to the cognitive ability there are different levels

[185] Van Riel, A. C.; Ouwersloot, H.; Lemmink, J. (2006). Antecedents of Effective Decision Making: A Cognitive Approach. In: The IUP Journal of Managerial Economics 6 (4), pp. 10-13.

of analyses and differences on how efficient individuals process at an algorithmic level.[186] The study of Kickul et al. revealed that participants showed higher self-efficacy when specific stages in a new venture creation process occurred, fitting most closely to their preferred cognitive style.[187]

1.3. Ambiguity of problem structures in decision making

In a more general sense a problem can be seen as something unknown in a situation where a person is looking to fulfill a need or to accomplish a goal. Problems are characterized by a problem domain which consists of content to define the problem elements, a problem type describing the combination of concepts and procedures on how to address the problem and how to solve it. A problem solving process which depends mostly upon the problem solver's understanding of the representation of the problem type must include the understanding of the problem and goal state (cf. experts versus novices). Finally a solution is necessary which represents the goal of the problem solver.[188]

A problem within a decision making process can be characterized by: first, what priority the problem for an individual or an organization has, meaning also what consequences may result on how the decision making process is performed; second, on how complex the information situation may be. At one extreme the information is "fully" available in a structured- and manageable form, adequate, sufficient and can be easily included in the decision making process. And at the other extreme the information is vague, maybe extremely scattered, hard to retrieve, inadequate, insufficient, overwhelming and therefore difficult to include in the decision making process; third, on how ambiguous the problem may be. Ambiguity in this sense describes to which degree a problem structure is well-defined or ill-defined or lacks clarity.[189]

For Shapiro & Spence the approach of the decision making process (intuitive versus rational) also depends on the nature of the task (e.g. structured or unstructured). For them tasks having a more structured nature like accounts receivable, order entering and inventory control are

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[186] Stanovich, K. E.; West, R. F. (1998). Individual Differences in Rational Thought. In: Journal of Experimental Psychology: General 127 (2), pp. 163.

[187] Kickul, J.; Gundry, L. K.; Barbosa, S. D.; Whitcanack, L. (2009). Intuition Versus Analysis? Testing Differential Models of Cognitive Style on Entrepreneurial Self-Efficacy and the New Venture Creation Process. In: Entrepreneurship Theory and Practice, p. 448.

[188] Jonassen, D. H. (1997). Instructional Design Models for Well-Structured and Ill-Structured Problem-Solving Learning Outcomes. In: Educational Technology Research & Development 45 (1), pp. 66.

[189] Sinclair, M.; Ashkanasy, N. M. (2002). Intuitive decision-making amongst leaders: More than just shooting from the hip. In: Mt Eliza Business Review - Pre Print Version, 5 (2), p. 10.

conducive to analytical reasoning because the they have typically well-accepted decision rules. Other tasks with less structured problems like mergers and acquisition decisions, new product planning and corporate strategy formulation are typical for the use of intuition.[190] For Fields it is also evident and observable that individuals in the R&D department have a higher level of use of "unpatterned methods" and action modes than individuals in the IT department. Fields links this to the fact that R&D works in advance of current technologies and therefore has a strong need for future orientated, creative and innovative new products and processes, i.e. intuitive behaviors. IT on the other hand works within a well-defined frame work and therefore displays rather rational behavior.[191] Van Riel et al. support the view that the decision tasks varies with the structure of the decision. They also concluded that well structured problems call for a rather rational approach as decision makers can make rational calculations. In turn for them ill-structured problems are not for rational decision making as they are characterized by a high degree of uncertainty about the actual and the desired situation and therefore don't have a base for rational calculations.[192] A further major condition for the nature of the task can be the complexity of the decision making context. Problem complexity can overstrain the physical constitution of our brain and therefore rational decision making can experience great difficulty when dealing with complex problems. Conscious thoughts, in this case, suffer from low capacity making it less suitable for very complex problems.[193]

Dane & Pratt see the problem characteristics as one of two factors influencing intuitive effectiveness. They postulate that the more increasingly unstructured the problems get the more effective intuitive judgment becomes vs. rational analysis.[194] For Dane & Pratt ill-structured problems are conducive to the intuitive decision making process due to the absence of well accepted decision making rules.[195] In a three level model of cognitive processing

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[190] Shapiro, S.; Spence, M. T. (1997). Managerial intuition: A conceptual and operational framework. In: Business Horizons 40 (1), p. 67.

[191] Fields, A. F. (2001). A Study of Intuition in Decision-Making using Organizational Engineering Methodology. Thesis (DBA). Nova Southeastern University, Florida, p. 84.

[192] Van Riel, A. C.; Ouwersloot, H.; Lemmink, J. (2006). Antecedents of Effective Decision Making: A Cognitive Approach. In: The IUP Journal of Managerial Economics 6 (4), pp. 18-19.

[193] Cf. Dijksterhuis, A.; Bos, M. W.; Nordgren, L. F.; van Baaren, R. B. (2006). On Making the Right Choice: The Deliberation-Without-Attention Effect. In: Science 311, p. 1005; Van Riel, A. C.; Ouwersloot, H.; Lemmink, J. (2006). Antecedents of Effective Decision Making: A Cognitive Approach. In: The IUP Journal of Managerial Economics 6 (4), pp. 19-20; Witte, E. (Hg.) (1988). Innovative Entscheidungsprozesse. Die Ergebnisse des Projektes "Columbus". Tübingen: J.C.B. Mohr (Die Einheit der Gesellschaftswissenschaften, 58), p. 236.

[194] Dane, E.; Pratt, M. G. (2007). Exploring intuition and its role in managerial decision making. In: Academy of Management Review 32 (1), p. 41.

[195] Ibid., p. 45.

Kitchener has proposed a possibility to identify three distinct types of problem solving skills. At the first level well-defined problems can be solved by using inferential rules and strategies. At the second level skills such as metacognition can be used to select and monitor skills from level one whereas ill-defined problems require skills which allow monitoring the epistemic nature of problems.[196] For Schraw et al. there are no epistemic assumptions needed to solve well-defined problems because they lead to certain, guaranteed solutions. For ill-defined problems this is not the case; they cannot be solved without epistemic assumptions as they have no certain, guaranteed solutions. Well-structured problems rarely show in between-domain transfer while ill-structured problems frequently do so. As epidemic assumptions differ among individuals, they reach different solutions when solving ill-defined problems as they hold different beliefes about their knowledge. Due to the fact that epistemic assumptions are needed for ill-defined problems, in contrast to well-defined problems, for both types of problems different cognitive processes are required.[197]

For Smith there are various existing conceptualizations of problem structures. At first there is the clarity of the problem's goal state. If the goal is not adequately specified this can produce a weakness in the structure and therefore can result in an ill-structured problem. Further the problem structure can be conceptualized by how well it is formulated explicitly and quantitatively and how it then can be solved with well-known techniques. In this sense the structure of the problem can be determined on the degree of clarity, which the decision maker gets from his task. Next the problem structure can also be conceptualized by the process. In this case a problem is ill-structured when there is no effective solution procedure to solve the problem.[198] In the case of a well-structured problem, the problem may still be difficult but there is a clear procedure on how to solve it. Finally the structure of the problem is linked to the knowledge of the problem solver. A problem can be well-structured if the problem solver is familiar with the knowledge needed to solve the problem or in contrast the problem can be ill-structured if the problem solver doesn't have adequate knowledge of the problem. In this case, regardless of the initial description of the structure, in the end effect it is the behavior of the problem solver making the ascriptions to the structure of the problem.[199] Within a group, problem solving environments for Chizhik et al., well-structured tasks can be seen as

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[196] Schraw, G.; Dunkle, M. E.; Bendixen, L. D. (1995). Cognitive Processes in Well-Defined and Ill-Define Problem Solving. In: Applied Cognitive Psychology 9, p. 524.
[197] Ibid.
[198] Smith, G. F. (1988). Towards a Heuristic Theory of Problem Structuring. In: Management Science and Engineering 34 (12), pp. 1492-1495.
[199] Ibid., p. 1497.

activities which have clear specified problems and that there is most likely only one possible solution to the problem. In contrast ill-structured tasks are characterized by having multiple possible solutions which can be subjectively evaluated as good or poor. Well-structured tasks make it easier for members of a group to separate correct from incorrect solutions and therefore to address the correct abilities to find that solution. If there seems to be only one correct solution in the well-structured task status, hierarchies appear to be maintained and there seems to be no need for discussions. Higher status members of the group make their suggestions in a kind of top down process restricting lower status members making additional suggestions as the task environment is not conducive. This situation has the risk of limiting opportunities in the task solving process. In contrast, ill-structured tasks seem to improve the perception of lower status group members allowing them to make suggestions even if done after the suggestions of higher status group members are made.[200] For Chizhik et al. ill-structured tasks encourage the participation of all group members to access the relevant skills, abilities and need for the task completion and therefore provide the lower status members with a greater chance to perform. In well-structured tasks the group seems to work more task orientated and maintains the hierarchical structure.[201]

Joanssen clusters problems into three kinds: puzzle problems, well-structured problems and ill-structured problems. For him puzzle problems are well-structured, have a single correct answer and all elements which are required for the solution are known. Solving these kinds of problems requires using logical, algorithmic processes where the problem solver can consistently compare the current state of the problem with the goal state. Well-structured problems for him require the use of a limited number of concepts, rules and principles, a well-defined initial state, a known goal state and a set of constrained logical operators. In contrast, ill-structured problems are typically in a specific context whereby one or more aspects are not well specified. The problem description is not clear or well enough defined and the information to solve the problem is not within the problem statement.[202] For Joanssen the main purpose in distinguishing between well- and ill-structured problems results in common assumption that skills for solving well-structured problems have limited relevance and transferability for solving ill-structured problems.[203] Hausschild et al. determine that there are

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[200] Chizhik, A. W.; Alexander, M. G.; Chizhik, E. W.; Goodman, J. A. (2003). The Rise and Fall of Power and Prestige Orders: Influence of Task Structure. In: Social Psychology Quarterly 66 (3), p. 305.
[201] Ibid., p. 315.
[202] Jonassen, D. H. (1997). Instructional Design Models for Well-Structured and Ill-Structured Problem-Solving Learning Outcomes. In: Educational Technology Research & Development 45 (1), p. 66.
[203] Ibid., p. 68.

three kinds of decisions: 1) Intra-departmental day-to-day decisions, 2) decisions of medium complexity and 3) innovative decisions. [204]

1) Well-structured problems

For Voss more generally a problem seems well-structured when it can be described by the following features:

"1) The goal is well-defined, and generally the solution is agreed upon by the members of the respective community. 2) Constraints are usually stated in the problem statement or are readily apparent. 3) Operators are frequently mathematical, logic based, or in the case of some games, objects moves. 4) The problem lends itself to computer simulation, because the number of states, the constraints and the operators are readily within computer simulation capabilities". [205]

It seems for Simon that it is impossible to set up a formal definition of a well-structured problem. He instead advocates establishing a list of characteristics whereby problems must be satisfied in order to be categorized as a well-structured problem. For him well-structured problems should comply with some or all of the following requirements: 1. criterions are defined for testing any proposed solution, 2. the initial problem state goal can be represented in at least one problem space, 3. for the transition from given to attainable states, legal moves (attainable state changes) can be represented in a problem space, 4. the problem solver can acquire knowledge about the problem represented in a problem space, 5. if the problem involves the external world, definition of state changes need to reflect with complete accuracy the laws of nature that govern the external world and 6. the basic processes postulated should only require practical amounts of search and computation of information.[206] For Simon it seems striking that parts of a process or a sub problem can be well-structured when the overall process or problem is ill-structured.[207] For Kirsch in well-defined problem situations a stimulus is recognized by the individual which triggers an execution program or at least an algorithm which can support the decision making process. If this execution program can be directly associated with a situation, this leads to a routine decision. When the execution program cannot be directly associated with a situation but with the help of an algorithm the

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[204] Hauschildt, J.; Gmünden, H. G.; Grotz-Martin, S.; Haidle, U. (1983). Entscheidungen der Geschäftsführung. Typologie, Informationsverhalten, Effizienz. Tübingen: J.C.B. Mohr, p. 266.
[205] Voss, J. F. (2005). Toulmin's Model and the Solving of Ill-Structured Problems. In: Argumentation 19 (3), pp. 322-323.
[206] Simon, H. A. (1973). The Structure of Ill-Structured Problems. In: Artificial Intelligence (4), p. 182.
[207] Ibid., p. 194.

situation can be clarified. For Kirsch this leads to an adaptive decision. When individuals face well-defined problem situations they are spared from conflict and uncertainty.[208]

For Lee & Cho in a well-structured problem the problem situation is clear and methods to solve the problem are known or present, the problem is already given in a standardized procedure and there is an appropriate algorithm which ensures the correct answer. For them within a well-structured problem there is little room for problem finding as the solutions seem obvious and easy to find.[209] Kitchener sees this in a similar way. For her well-defined problem situations are absolutely correct and knowable. Well-defined problems have two constraints, first there is only one correct situation which can be determined with total certainty and second the procedure to reach the solution is clear.[210] When reflecting on well-structured problems from an educational background, Joanssen has a similar conclusion. For him well-structured problems can by described by the following attributes: all elements of a problem are present; the problem solver understands it as a well-structured problem and has possible solutions; it involves a limited amount of concepts and rules which appear regularly and are organized in a predictive and prescriptive arrangement with constrained parameters; it includes correct, convergent answers; has knowable and comprehensible solutions and has a preferred and prescribed solution process.[211] For Joanssen the problem solving process for well-structured problems can be described by a three step process (Figure 5).

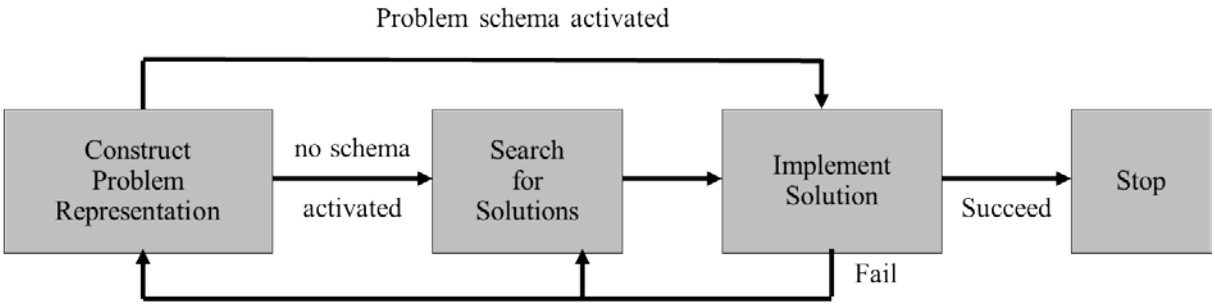

Figure 5: Problem solving process for well-structured problem

Source: Joanssen, 1997, p. 70

[208] Kirsch, W. (1971a). Entscheidungsprozesse II. Informationsverarbeitungstheorie des Entscheidungsverhaltens. Wiesbaden, Germany: Betriebswirtschaftlicher Verlag Dr. Th. Gabler, p. 143.

[209] Lee, H.; Cho, Y. (2007). Factors Affecting Problem Finding Depending on Degree of Structure of Problem Situation. In: The Journal of Educational Research 101 (2), p. 114.

[210] Kitchener, K. S. (1983). Cognition, Metacognition, and Epistemic Cognition: A three-level model of cognitive processing. In: Human Development 26 (4), p. 223.

[211] Jonassen, D. H. (1997). Instructional Design Models for Well-Structured and Ill-Structured Problem-Solving Learning Outcomes. In: Educational Technology Research & Development 45 (1), p. 68.

The first step of the problem solving process is devoted to the representation of the problem which means understanding the task of the problem including the problem statement and the goal. The problem representation is constructed by the individual and does not emerge from the context of the problem solving task. Therefore representing the problem should link it to the existing knowledge of the problem solver. The next step is the search for solutions. Most strategies to support the search for solutions require considerable skill from the problem solver.[212] For Joanssen most novices are novices because they lack heuristic strategies and problem schemas to search for the problem solution. The third and final step is trying to implement the solution. If the solution works the problem is solved, if the solution fails the problem solver should return to the problem representation or the search for solutions and adjust the process to receive another answer.[213] Shin supports this view. For her, to solve well-structured problems individuals tend to follow four solving processes: first, by finding out what exactly the problem is, second, by finding the appropriate information in the individual's memory or by applying a domain-specific or general searching strategy on how to solve the problem, third, by selecting the best solution while anticipating the logical consequences of each, and fourth, by implementing the solution and evaluating it to see if it solves the problem. Domain-specific knowledge and structural knowledge play an important role but it is not enough to solve well-structured problems. It has to be meaningfully organized or integrated to solve the problem.[214] For Shin well-structured problems can be characterized by having single correct, convergent answers which allow the decision maker to reach a satisfactory and final solution as with mathematics-related problems. For her well-structured problems can be solved with various search techniques like recall analogical problems, means-ends analysis, decomposing and simplifying the finding of sub-goals and generating or testing.[215]

2) Mid-structured problems

Mid-structured problems situation in decision making are described mostly quite vaguely within the literature. So terms which are used more frequently are mid-point or "something" in-between well- and ill-structured. Lee & Cho are one of the very few authors to describe the mid-structured (moderate) problem situation more in detail. They see the problem finding as

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[212] Jonassen, D. H. (1997). Instructional Design Models for Well-Structured and Ill-Structured Problem-Solving Learning Outcomes. In: Educational Technology Research & Development 45 (1), p. 70.
[213] Ibid., p. 71.
[214] Shin, N. (1998). The relationship between well-structured and ill-structured problem solving in multimedia simulation. Thesis (PhD). Pennsylvania State University, p. 8.
[215] Ibid., p. 11.

essential because methods and solutions are not often directly provided. In "moderate" structured problems - in the author's terms mid-structured problems - the overall goals of the decision making processes may still be evident but information, findings and data are implicitly embedded in the problem. Therefore they must be found and formulated by the individual decision maker himself.[216] For mid-structured problem situations it seems that: 1) they have a defined initial state, 2) goals are known, but information, findings and data might be implicitly embedded in the problem and must be formulated and found by the individual, 3) they require the use of a limited number of concepts, rules and principles and 4) the knowledge of skills on how to solve well-structured problems is needed and must be discovered by the decision maker himself. For mid-structured problem situations, in addition to well-structured problem situations where the problem solutions process is given by a known tool, template, method, concept, procedure, rule or algorithm which is used to solve the problem, an overall problem solution process is missing and has to be established. In this case where as for a well-structured problem situation by definition there is a clear approach and a single correct answer, for mid-structured problem situations there could be different possible problem solution processes or concepts with similar but varying approaches and answers. These varying results still can be evaluated objectively by common conventions in contrast to ill-structured problem solutions where no objective solution is possible and results respectively answers are evaluated e.g. by an expert solution.

Based on those theoretical findings from the existing literature, the author refers to mid-structured decision making problems and tasks by the following criteria and conditions:

- The problem task is part of strategic management decision making
- The goal(s) of the problem solution procedure is/are relatively clearly defined and can be measured by indicators e.g. profitability, solvency, growth, sales, costs, etc.
- However the problem environment is dealing with uncertain circumstances and can only be measured by subjective probability expectations
- The decision making alternatives are subject to those uncertain probability scenarios
- Whereas for the intended goal fulfillment, well-defined algorithms can be applied (e.g. investment appraisals, contribution margin computation, time series extrapolation methods, etc.), the uncertain environmental circumstances can only be presumed based on the problem solver's creativity and intuition

[216] Lee, H.; Cho, Y. (2007). Factors Affecting Problem Finding Depending on Degree of Structure of Problem Situation. In: The Journal of Educational Research 101 (2), p. 114.

- Thus, the measurement of the mid-structured decision making problem lies clearly in-between the precisely defined well-structured problem situation and the non-defined ill-structured problem situation.

3) Ill-structured problems

In comparison to well- and mid-structured problems ill-structured problems are less tangible. Voss describes ill-structured problems with the following features: 1) the goal is vaguely determined and to get more transparency about the whole situation more analysis and refinement is usually required, 2) the constraints of the problem are not part of the problem description, 3) in contrast to well-structured problem solutions, ill-structured problems, for the most part, cannot be claimed as right or wrong, valid or invalid, they rather can be regarded in terms of plausible or acceptable, 4) when a solution is stated it is rather verbal and when a solution is presented it is mostly rhetorical in nature, 5) often solutions for ill-structured problems are not final in the sense, that having a problem solving result, a plan is put in place to find out if the solution really works in reality, based on the implementation and evaluation, 6) when information is very complex, in the sense of size and structure, and it is therefore hard to retrieve for any kind of simulation.[217] For Simon a problem is ill-structured, when the problem structure lacks definition in some respect. A problem is considered ill-structured when it is not a well-structured problem.[218] For Bradley many ill-structured problems have no single objectively correct solution. Therefore he believes that professionals with extensive domain knowledge and task specific experiences use some kind of schema or script driven approach to solve ill-structured problems. For him these schemas or scripts are retrieved from a base of domain knowledge which has been developed through extensive domain experience. In contrast to professionals with well-developed schemas and scripts, the professionals with limited domain experience are not able to access this schema driven reasoning process to solve ill-structured problem as they have a less developed base of domain knowledge and therefore have not enough experience to fully develop these kinds of schemas.[219] For ill-structured problems Lee & Cho see the problem finding as essential because methods and solutions are often not directly provided. Problem finding in ill-structured problems is even more demanding than in mid-structured problems since there is a minimum on given

[217] Voss, J. F. (2005). Toulmin's Model and the Solving of Ill-Structured Problems. In: Argumentation 19 (3), p. 323.
[218] Simon, H. A. (1973). The Structure of Ill-Structured Problems. In: Artificial Intelligence (4), p. 181.
[219] Bradley, W. E. (2009). Ability and Performance of Ill-Structured Problems: The Substitution Effect of Inductive Reasoning Ability. In: Behavioral Research in Accounting 21 (1), p. 20.

information or basic data and therefore individuals have to use their own resources to solve the problem.[220] Lee & Cho also see a relation between knowledge (declarative and procedural) and problem finding as it is difficult to conceive a problem without being able to draw on existing knowledge.[221]

Kitchener sees ill-defined problems as problems which have conflicting assumptions, evidence and opinions which may lead to different solutions. Ill-defined problems may have different solutions or no solutions at all or there is no guarantee that a procedure is found to reach the solution.[222] For Kirsch there are generally two main reasons why a problem situation is ill-defined. First, there is no execution program or algorithm available which allows the individual to complete a routine where the selection of an evoked alternative out of a multitude of alternatives can be realized in an acceptable time frame. Second, the definition of the problem is vague or uncompleted. For Kirsch these kinds of situations call for innovative decisions.[223] By Fernandes & Simon complex and ill-structured problems are characterized by the following features: intransparency in the sense, that only a few variables are available or, in contrast, a larger number are available where relevant ones have to be picked, multiple targets interfere with each other, complex relation between patterns and variables and time delayed effects in the sense that action may not show immediate response.[224]

For Joanssen an ill-structured problem solving process can be generally described as a framed experiment where the problem solvers engage in a reflective conversation with the subjects of the problem situation. The problem solvers must frame the problem and recognize the divergent perspectives. Furthermore, they need to collect evidence to support or reject the different proposals and finally establish their own understanding of the situation.[225] Joanssen describes the ill-structured problem solving process with a seven step model. In the first step the problem solver articulates the problem space among the competing options and examines from which context the problem has emerged. Important is here for Joanssen the domain

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[220] Lee, H.; Cho, Y. (2007). Factors Affecting Problem Finding Depending on Degree of Structure of Problem Situation. In: The Journal of Educational Research 101 (2), p. 114.

[221] Ibid.

[222] Kitchener, K. S. (1983). Cognition, Metacognition, and Epistemic Cognition: A three-level model of cognitive processing. In: Human Development 26 (4), p. 223.

[223] Kirsch, W. (1971b). Entscheidungsprozesse III. Entscheidungen in Organisationen. Wiesbaden, Germany: Betriebswirtschaftlicher Verlag Dr. Th. Gabler, p. 143.

[224] Fernandes, R.; Simon, H. A. (1999). A study of how individuals solve complex and ill-structured problems. In: Policy Sciences 32, pp. 225–226.

[225] Jonassen, D. H. (1997). Instructional Design Models for Well-Structured and Ill-Structured Problem-Solving Learning Outcomes. In: Educational Technology Research & Development 45 (1), p. 79.

knowledge, as experts possess more developed problem schemas and procedures. In the next step alternatives, opinions, positions and perspectives of stakeholders need to be identified and clarified. As the ill-structured problem is not a single problem space, the problem solver needs to construct a multiple approach by identifying alternative views or perspectives on the problem. With the third step possible problem solutions are generated. Because there are multiple representations there might be multiple problem solutions. Step four assesses the viability of the alternative solutions. This is done by constructing arguments and articulating personal beliefs. For the fifth step the problem space and the solution options are monitored. Joanssen states that within an ill-structured problem, it is necessary to engage in a meta-cognitive process where the problem solvers monitor the epistemic nature of the problem. In the sixth step the problem solver implements and monitors the solution. As the ill-structured problems do not have one correct solution, the effectiveness can only be determined by its performance. Finally the last step is devoted to the adaption of the solution. As few ill-structured problems are solved in a single attempt, the problem solving process most likely becomes an iterative process.[226]

For Shin the dynamic process of solving ill-structured problems includes the following steps (Figure 6): first, the problem needs to be recognized and then it needs to be decided if there is a problem. Next, it is necessary to find out what exactly the problem is by constructing the problem space including defining the problem. The third step is the representation of the problem, which is established by searching and selecting information in order to develop an argumentation. The fourth step is the solution process which involves generating and selecting possible solutions. The next step is a decision on the best solution by the problem solver's perception of the problem and supporting the justification of problem solution by monitoring and evaluating the solution process.[227]

[226] Ibid., pp. 79-83.
[227] Shin, N. (1998). The relationship between well-structured and ill-structured problem solving in multimedia simulation. Thesis (PhD). Pennsylvania State University, pp. 17-22.

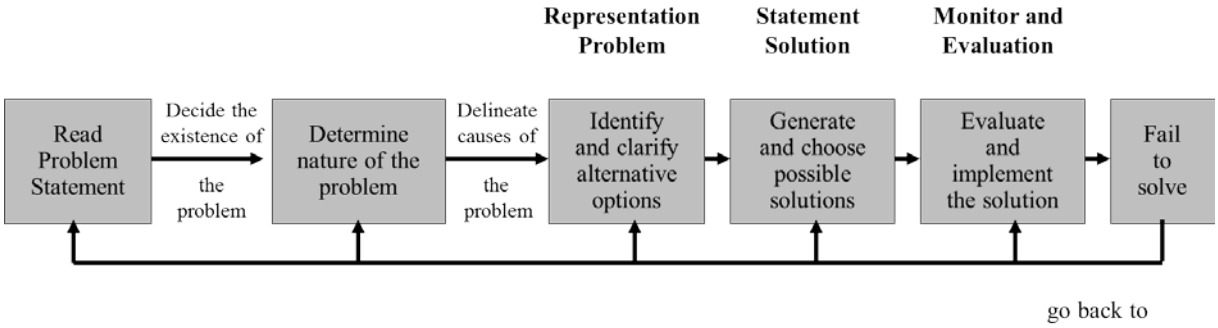

Figure 6: Problem solving process for ill-structured problems

Source: Shin, 1998, p. 22

A part of the problem solving process of ill-structured problems requires structural knowledge in order to rapidly access meaningful information and principles when domain specific knowledge is necessary for problem solving. Structural knowledge, in this case, can be described as knowledge on how concepts are interrelated with a special kind of domain. Knowledge structures can be seen as an organized network of information stored in the long term memory used for solving domain problems.[228]

In summing up, the author can point out the following: In well-structured problem situations, the relevant cause-effect relations are completely open and known. In mid-structured problem situations, there is general knowledge about the relevant cause-effect relations, but it is subject to probabilistic outcomes concerning the problem solving alternatives, partly based on subjective expectations. In ill-structured-problem situations, finally, the overall goal maybe know and given but there is hardly any knowledge about underlying cause-effect relations.

[228] Shin, N. (1998). The relationship between well-structured and ill-structured problem solving in multimedia simulation. Thesis (PhD). Pennsylvania State University, pp. 23-24.

2. RESEARCH DESIGN, METHODOLOGY AND METHODS OF RESEARCH FOR THE EVALUATION OF THE EFFICIENCY OUTCOMES IN MANAGEMENT DECISION MAKING[229]

Since decision making behavior has been in the focus of business management, both from a scientific and a professional standpoint, there seems to be a dispute on whether rational or intuitive decision making leads to better outcomes. As the literature review shows, by now scholars agree that effective organizations do not have the luxury of choosing between intuitive and rational decision making.[230] Especially within his ground breaking work in bounded rationality, Simon has shown that there are no truly rational decisions, since human beings in real life do not behave "totally" rational.[231] Decisions in reality seem to lie in a continuum where at one extreme there is true rationality and at the other extreme there is true intuition. Depending on the input of various factors like personality, problem characteristics (e.g. ambiguity), the decision making context and decision characteristics, the decision making behavior is somewhere in between these poles.[232]

Therefore it seems important to better understand how personality and the ambiguity of problems interact with each other and therefore influence the decision making process. The personality predetermination which partly shapes behavioral patterns (like intuitive versus rational decision making approaches) and the ambiguity of a problem seem to have a significant impact on the outcome of the decision making process. This is why this research work focuses on the impact of personality types and the ambiguity of problems on the efficiency of decision making.[233] This by no means denies the fact that the other factors e.g. as in the model of Sinclair & Ashkanasy have an impact on the decision making efficiency.[234]

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[229] Parts of this chapter have been published in: Hoeckel, C. (2012). The Impact of Personality Traits and Behavioral Patterns on the Outcomes of Business Management Decision Making – A Framework for an Empirical Study. In: New Challenges of Economic and Business Development Conference Proceedings, Riga, Latvia, pp. 259–269; Neuert, J.; Hoeckel, C. (2013). The Impact of Personality Traits and Problem Structures on Management Decision-Making Outcomes. In: Journal of Modern Accounting and Auditing 9 (3), pp. 382-393.

[230] Ju, B.; Junwen, F.; Chenglin, M. (2007). Intuitive decision theory analysis and the evaluation model. In: Management Science and Engineering 1 (2), p. 67; Mintzberg, H. (1994). The Fall and Rise of Strategic Planning. In: Harvard Business Review January-February, p. 329; Simon, H. A. (1997). Administrative behavior. A study of decision-making processes in administrative organizations. 4. Aufl. New York, USA: Free Press, p. 139.

[231] Simon, H. A. (1987). Making management decisions: The role of intuition and emotion. In: Academy of Management Journal, pp. 57–64.

[232] Sinclair, M.; Ashkanasy, N. M. (2002). Intuitive decision-making amongst leaders: More than just shooting from the hip. In: Mt Eliza Business Review - Pre Print Version, 5 (2), pp. 7-10.

[233] Cf. Allinson, C. W.; Hayes, J. (1996). The Cognitive Style Index: A Measure of Intuition-Analysis for Organizational Research. In: Journal of Management Studies 33 (1), p. 119; Dane, E.; Pratt, M. G. (2007). Exploring intuition and its role in managerial decision making. In: Academy of Management Review 32 (1), p. 45; Fields, A. F. (2001). A Study of Intuition in Decision-Making using Organizational Engineering

Based on the findings of the literature review in further research it should be addressed how personality predetermination (cognitive styles) or resulting behavioral patterns (intuitive versus rational) lead in the decision making process to higher socioeconomic efficiency within certain problem categories (cf. well-structured problems versus ill-structured problems). Therefore a starting point for the further research is the following setup:

Individuals with a preference for rational thinking use information in a more concrete format and are more related to normative judgment.[235] As for well-structured problems, by definition, the goal is well defined, it has a single answer, all elements for the solution are known, are logically based and problem solving requires rules like algorithmic process definition.[236] Therefore, it can be hypothesized that individuals with a preference for rational thinking should be more efficient when deciding on well-structured problems since the characteristics of well-structured problems match their "thinking routines". In contrast, individuals who have a preference for an intuitive thinking style are more successful in using unconscious information and are more related to heuristic judgments and to ill-structured problems where,

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Methodology. Thesis (DBA). Nova Southeastern University, Florida, pp. 93-94; Kirsch, W. (1971a). Entscheidungsprozesse II. Informationsverarbeitungstheorie des Entscheidungsverhaltens. Wiesbaden, Germany: Betriebswirtschaftlicher Verlag Dr. Th. Gabler, p. 103; Kirsch, W. (1971b). Entscheidungsprozesse III. Entscheidungen in Organisationen. Wiesbaden, Germany: Betriebswirtschaftlicher Verlag Dr. Th. Gabler, p. 162; Neuert, J. O. (1987). Planungsgrade. Eine experimentelle Untersuchung zum Zusammenhang zwischen Planungsverhalten und Planungserfolg. Spardorf, Germany: Rene F. Wilfer, pp. 330-331; Neuert, J. O. (2010). The Impact of Intuitive and Discursive Behavioral Patterns on Decision Making Outcomes: Some Conjectures and Empirical Findings. In: WDSI Annual Conference Readings, Lake Tahoe, USA, p. 4491; Pretz, J. E.; Totz, K. S. (2007). Measuring individual differences in affective, heuristic, and holistic intuition. In: Personality and Individual Differences 43, p. 1248, Shapiro, S.; Spence, M. T. (1997). Managerial intuition: A conceptual and operational framework. In: Business Horizons 40 (1), p. 67; Sinclair, M.; Ashkanasy, N. M. (2002). Intuitive decision-making amongst leaders: More than just shooting from the hip. In: Mt Eliza Business Review - Pre Print Version, 5 (2), p. 8; Van Riel, A. C.; Ouwersloot, H.; Lemmink, J. (2006). Antecedents of Effective Decision Making: A Cognitive Approach. In: The IUP Journal of Managerial Economics 6 (4), pp. 18-19.

234 Sinclair, M.; Ashkanasy, N. M. (2002). Intuitive decision-making amongst leaders: More than just shooting from the hip. In: Mt Eliza Business Review - Pre Print Version, 5 (2), pp. 7-10.

235 Cf. Kickul, J.; Gundry, L. K.; Barbosa, S. D.; Whitcanack, L. (2009). Intuition Versus Analysis? Testing Differential Models of Cognitive Style on Entrepreneurial Self-Efficacy and the New Venture Creation Process. In: Entrepreneurship Theory and Practice, p. 448; Shiloh, S.; Salton, E.; Sharabi, D. (2002). Individual differences in rational and intuitive thinking styles as predictors of heuristic responses and framing effects. In: Personality and Individual Differences 32, pp. 425–426; Woolhouse, L. S.; Bayne, R. (2000). Personality and the Use of Intuition: Individual Differences in Strategy and Performance on an Implicit Learning Task. In: European Journal of Personality 14, p. 167.

236 Cf. Jonassen, D. H. (1997). Instructional Design Models for Well-Structured and Ill-Structured Problem-Solving Learning Outcomes. In: Educational Technology Research & Development 45 (1), p. 70; Kirsch, W. (1971a). Entscheidungsprozesse II. Informationsverarbeitungstheorie des Entscheidungsverhaltens. Wiesbaden, Germany: Betriebswirtschaftlicher Verlag Dr. Th. Gabler, p. 143; Kitchener, K. S. (1983). Cognition, Metacognition, and Epistemic Cognition: A three-level model of cognitive processing. In: Human Development 26 (4), p. 223; Lee, H.; Cho, Y. (2007). Factors Affecting Problem Finding Depending on Degree of Structure of Problem Situation. In: The Journal of Educational Research 101 (2), p. 114; Shin, N. (1998). The relationship between well-structured and ill-structured problem solving in multimedia simulation. Thesis (PhD). Pennsylvania State University, p. 11; Voss, J. F. (2005). Toulmin's Model and the Solving of Ill-Structured Problems. In: Argumentation 19 (3), pp. 322-323.

by definition, goals are defined, vague or not at all defined, the problem description is not clear, they have no single or correct solution, problems are in a special context and there is no execution program to solve the problem in a routine.[237] Therefore it can be hypothesized that individuals with a preference for intuitive thinking should be more efficient in ill-structured rather than well-structured problems as their "thinking routine" matches the characteristics of ill-structured problems.

Following the advice of Wossidlo and the results of Neuert that well-structured problems versus ill-structured problems may not provide enough accuracy, it is apparently necessary to include at least a mid-point with a "mid-structured" problem situation. So in addition to the well-structured and ill-structured problem situation it should also be determined which individual behavior leads to the most efficient outcomes in a "mid-structured" problem situation.[238] To overcome the criticism as to whether types measured by personality tests are consistent across contexts and therefore reflect behavioral aspects, it is highly recommended to conduct an empirical experiment to observe individual behavior in "realistic" problem situations.[239] This is also recommended by Popper's "The Logic of Scientific Discovery", where scientific research is not just comprised by the formulation of cause-effect hypotheses, but also of the attempt to empirically substantiate and/or falsify the respective assumption.[240] Therefore, an empirical study should be conducted to falsify or support the hypotheses under "real conditions".

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[237] Cf. Bradley, W. E. (2009). Ability and Performance of Ill-Structured Problems: The Substitution Effect of Inductive Reasoning Ability. In: Behavioral Research in Accounting 21 (1), p. 20; Fernandes, R.; Simon, H. A. (1999). A study of how individuals solve complex and ill-structured problems. In: Policy Sciences 32, pp. 225–226; Jonassen, D. H. (1997). Instructional Design Models for Well-Structured and Ill-Structured Problem-Solving Learning Outcomes. In: Educational Technology Research & Development 45 (1), p. 79; Kirsch, W. (1971a). Entscheidungsprozesse II. Informationsverarbeitungstheorie des Entscheidungsverhaltens. Wiesbaden, Germany: Betriebswirtschaftlicher Verlag Dr. Th. Gabler, p. 143; Kitchener, K. S. (1983). Cognition, Metacognition, and Epistemic Cognition: A three-level model of cognitive processing. In: Human Development 26 (4), p. 223; Lee, H.; Cho, Y. (2007). Factors Affecting Problem Finding Depending on Degree of Structure of Problem Situation. In: The Journal of Educational Research 101 (2), p. 114; Voss, J. F. (2005). Toulmin's Model and the Solving of Ill-Structured Problems. In: Argumentation 19 (3), p. 323.

[238] Cf. Neuert, J. O. (2010). The Impact of Intuitive and Discursive Behavioral Patterns on Decision Making Outcomes: Some Conjectures and Empirical Findings. In: WDSI Annual Conference Readings, Lake Tahoe, USA, pp. 4471–4496; Wossidlo, P. R. (1988). Die wissenschaftliche Ausgangslage für das Projekt Columbus. In: Eberhard Witte (Hg.): Innovative Entscheidungsprozesse. Die Ergebnisse des Projektes "Columbus". Tübingen: J.C.B. Mohr (Die Einheit der Gesellschaftswissenschaften, 58), p. 17.

[239] Hodgkinson, G. P.; Langan-Fox, J.; Sadler-Smith, E. (2008). Intuition: A fundamental bridging construct in the behavioral sciences. In: British Journal of Psychology 99, p. 19.

[240] Popper, K. R. (2005). Logik der Forschung. 11. Aufl. Hg. v. Herbert Keuth. Tübingen: Mohr Siebeck, pp. 8-9.

2.1. Efficiency measurement in the decision making process

a) The concept of efficiency in the decision making process

Organizations are founded and operated to fulfill certain purposes and aims. The organization and respectively their members are interested in satisfying the purposes and aims of the organization so that in an indirect manner their own requirements are satisfied. In the case of decision making within the organization Gzuk believes the purpose or aim is to reach high quality within the decision making process.[241] For Gzuk, quality in this sense can be substantiated as activity to reach a purpose or aim.[242] He refers to activity in this context also as efficiency. Gzuk sees the main purpose in managerial decision making in its connected economical efficiency.[243]

For Joost efficiency is defined as a relative measurement which puts outcomes (results) and input in to relationship.[244] Barnard describes a personal or organizational action as effective if a specific desired end is attained or a certain aim is reached. This action can also be considered as efficient if it satisfies motives of that aim. In the case that a certain aim is not reached but the motives are still satisfied the action may not be effective but still efficient and vice-versa. For Barnard, efficiency most likely relates to the satisfaction of motives of individuals in an organization and effectiveness relates to the achievement of certain aims of the organization.[245] For Gzuk efficiency in general is how well a dedicated target is reached with a minimum of resources (output versus input). Gzuk understands, in this sense, the output as tangible or intangible results and the input as the deployment of mental or tangible resources. For him efficient decisions are characterized by fulfilling the aim of the target with a comparatively low amount of resources (input).[246] Simon describes efficiency more generally as the ratio between input and output. For commercial organizations, which are generally guided by profits, the criterion of efficiency is the yield of the greatest net income. The simplicity is related to the fact that money provides a common understanding for the

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[241] Gzuk, R. (1975). Messung der Effizienz von Entscheidungen. Tübingen, Germany: J.C.B. Mohr (Empirische Theorie der Unternehmung, 5), p. 5.
[242] Ibid., p. 7.
[243] Ibid., p. 11.
[244] Joost, N. (1975). Organisation in Entscheidungsprozessen. Eine empirische Untersuchung. Tübingen: Mohr, p. 11.
[245] Barnard, C. I. (1938/1968). The functions of the executive. Cambridge MA, USA: Harvard Univ. Press, pp. 19-20.
[246] Gzuk, R. (1988). Messung der Effizienz von Entscheidungen. In: Eberhard Witte (Hg.): Innovative Entscheidungsprozesse. Die Ergebnisse des Projektes "Columbus". Tübingen: J.C.B. Mohr (Die Einheit der Gesellschaftswissenschaften, 58), pp. 125–127.

measurement of efficiency in terms of output and income. But this concept needs to be expanded for specific activities in commercial organizations (e.g. personnel department) or for non-commercial organizations where factors are involved which cannot be directly measured in monetary terms.[247] For Simon, to make an efficient decision it is necessary to have empirical knowledge of the expected results that are associated with different alternative possibilities.[248] Neuert supports this view. He believes that efficiency can be characterized as an expression of performance rate, output-input relation and quality. He explicitly differentiates the term effectiveness from efficiency. For him effectiveness characterizes whether a measure is, in general, suitable to achieve a certain goal. In this case efficiency can be seen as the quality level of the results within the decision making process.[249] In the context of decisions Gzuk sees efficiency as the degree on which a purpose is reached containing two additional conditions: first, the purpose is reached with a minimum use of resources (economical input) and the result of the decision ensures a problem solution which lasts a longer period of time.[250] It seems not to be enough to measure the efficiency of a decision by itself rather than the outcome of mental or tangible activity.[251] Efficiency within the organization can also be reviewed by different approaches. Within the target approach, organizations have explicit targets and efficiency can be defined by the degree of target achievement. The systems approach considers beside the targets also the structures and processes of the system-environment relationship. Efficiency, in this case, evolves from a concrete and uni dimensional to an abstract and multidimensional construct. The organizational member approach considers the interests of the external stakeholders. An organization in this sense is efficient when the expectances of these members of the organization are satisfied or fulfilled. Closely related to the organizational member's approach is the interest approach. The interest approach assumes that evaluating the same object will lead to different efficiency evaluations due to different evaluating persons and their individual value and preference structure as well as to their different interests. The management audit approach is a more application orientated approach. Within the management audit approach

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[247] Simon, H. A. (1997). Administrative behavior. A study of decision-making processes in administrative organizations. 4. Aufl. New York, USA: Free Press, pp. 250-257.

[248] Ibid., p. 262.

[249] Neuert, J. O. (1987). Planungsgrade. Eine experimentelle Untersuchung zum Zusammenhang zwischen Planungsverhalten und Planungserfolg. Spardorf, Germany: Rene F. Wilfer, p. 109.

[250] Gzuk, R. (1975). Messung der Effizienz von Entscheidungen. Tübingen, Germany: J.C.B. Mohr (Empirische Theorie der Unternehmung, 5), p. 15.

[251] Cf. Bronner, R. (1973). Entscheidung unter Zeitdruck. Tübingen, Germany: Mohr (Empirische Theorie der Unternehmung, 3), p. 39; Gzuk, R. (1975). Messung der Effizienz von Entscheidungen. Tübingen, Germany: J.C.B. Mohr (Empirische Theorie der Unternehmung, 5), p. 16.

the organizational efficiency is determined by evaluating the organization by analyzing certain parts of the enterprise in periodical intervals with relevant questions and by variance analysis (budget-actual) of the key indicators.[252]

b) Dimensions of management decision making efficiency

Decision making outcomes in business management can be characterized by different dimensions of efficiency. Neuert describes as one dimension the material efficiency where measurement is realistic input and output in commercial activities, which can be measured with objective criteria like earnings, profitability, growth and independence.[253] Bronner refers to this part of efficiency as the economic efficiency.[254] A further dimension is personal efficiency. For Neuert in contrast to the material efficiency, the personal efficiency has rather subjective results in the decision making processes. As subjective results he understands expected team results, identification with team work, self-reflection of group behavior and the individual role within the group. In summary he characterizes personal efficiency as the subjective evaluation of the decision makers concerning the results of their decision making process as well as the self-reflection on their behavior during the decision making process.[255] Bronner supports this view. For him it is also not possible to measure the personal efficiency on an objective base. He advocates measuring it via the personal activity of the decision maker within a decision making group and the satisfaction of other group members with his activity in addition to the estimation of the overall achievement of the decision making group.[256] For Bronner, within the decision making process, time or time pressure is usually an influencing factor. He believes there is also a dimension of temporal efficiency. Temporal efficiency again is an objective criterion because it can be measured by time. For Bronner time, in this sense, can be a direct measurement (e.g when trying to reduce lead time in a process) or an indirect measurement (e.g. measuring not quantifiable deployment of persons or material in rather complex mental processes).[257]

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[252] Grabatin, G. (1981). Effizienz von Organisationen. Berlin, Germany: Walter de Gruyter (Mensch und Organisation, 8), pp. 21-39.
[253] Neuert, J. O. (1987). Planungsgrade. Eine experimentelle Untersuchung zum Zusammenhang zwischen Planungsverhalten und Planungserfolg. Spardorf, Germany: Rene F. Wilfer, p. 115.
[254] Bronner, R. (1973). Entscheidung unter Zeitdruck. Tübingen, Germany: Mohr (Empirische Theorie der Unternehmung, 3), pp. 39-40.
[255] Neuert, J. O. (1987). Planungsgrade. Eine experimentelle Untersuchung zum Zusammenhang zwischen Planungsverhalten und Planungserfolg. Spardorf, Germany: Rene F. Wilfer, p. 117.
[256] Bronner, R. (1973). Entscheidung unter Zeitdruck. Tübingen, Germany: Mohr (Empirische Theorie der Unternehmung, 3), p. 40.
[257] Ibid., pp. 42-43.

For Gzuk, to define the concept of efficiency it is necessary to have a purpose or aim, a realized output or result and an input or the use of resources.[258] For Gzuk, to achieve efficiency in the decision making process there are two conditions which need to be fulfilled: first, a decision must realize the most efficient ratio between output and input and second, a decision must bring results which ensure that the aimed objectives are achieved.[259]

To operationalize the measurement of efficiency in the decision making process Gzuk advocates establishing a multi-dimensional indicator model (Figure 7).[260] This multi-dimensional indicator model contains four efficiency dimensions: The target-output relation, the input-output relation, the target-input relation and the provision for the realization of the decision. Within those efficiency dimensions indicators need to be established to enable the operationalization of the model which then allows the measurement of the total efficiency of a decision.[261] To achieve acceptable security on the measurement of efficiency, Gzuk advocates that for each dimension there should be more than one indicator.[262]

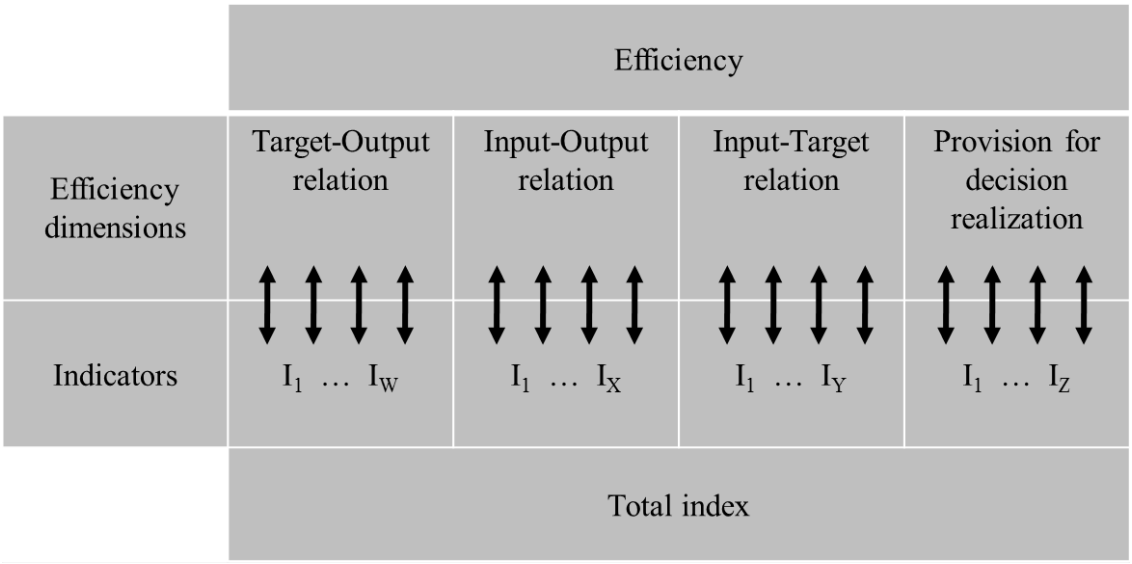

Figure 7: Multi-dimensional indicator model for the efficiency measurement

Source: Gzuk, 1975, p. 57

[258] Gzuk, R. (1975). Messung der Effizienz von Entscheidungen. Tübingen, Germany: J.C.B. Mohr (Empirische Theorie der Unternehmung, 5), p. 40.
[259] Ibid., p. 5.
[260] Ibid., pp. 54-57.
[261] Neuert, J. O. (1987). Planungsgrade. Eine experimentelle Untersuchung zum Zusammenhang zwischen Planungsverhalten und Planungserfolg. Spardorf, Germany: Rene F. Wilfer, pp. 113-114.
[262] Gzuk, R. (1988). Messung der Effizienz von Entscheidungen. In: Eberhard Witte (Hg.): Innovative Entscheidungsprozesse. Die Ergebnisse des Projektes "Columbus". Tübingen: J.C.B. Mohr (Die Einheit der Gesellschaftswissenschaften, 58), p. 130.

To measure total efficiency in terms of the formal efficiency, material efficiency and individual efficiency, Neuert has modified the multi-dimensional model of Gzuk. In Neuert's multi-dimensional model there are three dimensions for formal efficiency, material efficiency and individual efficiency. Each dimension can have from one to several efficiency criteria. A criterion for formal efficiency could, for example, be the comparison between a targeted situation and the actual situation. A criterion for material efficiency could be profit and a criterion for individual efficiency could be satisfaction. To measure those criteria in various dimensions adequate indicators have to be defined.[263]

Grabatin, reviewing the efficiency from an organizational perspective, splits total efficiency into different efficiency dimensions. For him, the dimensions are the "general" economic efficiency, the efficiency of the internal system, which includes indicators to evaluate organizational processes and the necessary constraints for the realization of the organizational efficiency. For Grabatin, typical criteria for general economic efficiency are turnover, profit, market share, etc. For the necessary constraints he picks criteria like flexibility, growth, communication, etc. Grabatin splits internal system efficiency dimension again into various dimensions, like the efficiency of the organizational structure, the efficiency of the task fulfillment and socioeconomic efficiency factors. For the socioeconomic efficiency, Grabatin introduces efficiency criteria like individual satisfaction, motivation, etc.[264]

According to Nutt, decision makers report that rapid actions are a key factor for them. In this case he sees the duration of the decision making process as a good indicator for measuring efficiency. On the other hand, efficiency also depends on the quality of the decision which also needs to be taken into account. In this sense the duration is measured by the elapsed time from the point of recognition until the time when the decision is adopted or abandoned. To Nutt objective indicators to value the quality of the decision are preferred. But as they are mostly difficult to collect and they need to be converted into common metrics and those conversions again can be argumentative and hard to describe, he advocates measures by informants who subjectively estimate the values. Therefore the quality of the decision is rated by an anchored rating scale using five anchors. A rating of 5 (outstanding) is to be given to a decisive contribution which provides an exceptional quality. A rating of 1 (poor) is to be given to a decision which had no impact or merit. The rating of 4 is termed good, the rating of

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[263] Neuert, J. O. (1987). Planungsgrade. Eine experimentelle Untersuchung zum Zusammenhang zwischen Planungsverhalten und Planungserfolg. Spardorf, Germany: Rene F. Wilfer, p. 114.

[264] Grabatin, G. (1981). Effizienz von Organisationen. Berlin, Germany: Walter de Gruyter (Mensch und Organisation, 8), p. 52.

3 is adequate and the rating 2 is disappointing.[265] To avoid the fact that decision makers can make self-serving estimates on rating the quality of the decision, Nutt advocates that only two secondary informants value the quality of the decision. These two informants value the quality of the decision independently along the rating scale and without discussion. To enhance the precision of rating the quality and to move the subjective estimates to a rather true value, Nutt introduces the estimate-discuss-estimate (EDE) procedure. He therefore computes the initial results and then has them discussed by the informants. When the individual results are far off, the informants need to explain this with compulsory arguments, which are then weighted. Taking the average out of the second rating with weighted arguments seems, for Nutt, to raise the rating toward a true value.[266]

2.2. Measuring decision making style and behavior

Individual differences continue to be one of the main explanatory variables in the field of judgment and decision making.[267] The broad term of individual difference covers areas from decision making styles to cognitive ability to personality. Therefore the measurement of individual difference can be divided into seven categories: decision making measures, risk attitude measures, personality inventories, personality construct measures, and miscellaneous measures.[268] A representative set of measures for the study of individual differences in judgment and decision making according to the seven categories have been collected and displayed by Appelt et al. in the online database "Decision Making Individual Differences Inventory" (http://www.dmidi.net).[269] Most of these measures differ in their theoretical underpinning and their psychometric properties: therefore it seems questionable if the use of such a wide range of measurements benefits the research of judgment and decision making as the results may lack comparability.[270] To allow for a better cross comparison between different studies Appelt et al. recommend using existing measures without modification,

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[265] Nutt, P. C. (2008). Investigating the Success of Decision Making Processes. In: Journal of Management Studies 45 (2), pp. 437-438.
[266] Ibid., p. 438.
[267] Appelt, K. C.; Milch, K. F.; Handgraaf, M. J. J.; Weber, E. U. (2011). The Decision Making Individual Differences Inventory and guidelines for the study of individual differences in judgment and decision making research. In: Judgment and Decision Making 6 (3), p. 252.
[268] Ibid., p. 253.
[269] Ibid., p. 252.
[270] Cf. Appelt, K. C.; Milch, K. F.; Handgraaf, M. J. J.; Weber, E. U. (2011). The Decision Making Individual Differences Inventory and guidelines for the study of individual differences in judgment and decision making research. In: Judgment and Decision Making 6 (3), p. 256; Hodgkinson, G. P.; Langan-Fox, J.; Sadler-Smith, E. (2008). Intuition: A fundamental bridging construct in the behavioral sciences. In: British Journal of Psychology 99, p. 17.

where appropriate.[271] Some of the most well-known and mostly used measures for the cognitive style or intuitive/rational behavior include the Cognitive Style Index, the Agor Intuitive Management Test, the Rational-Experiential Inventory and the Myers-Briggs Type Indicator.[272]

The Cognitive Style Index (CSI) was designed by Allinson & Hayes to assess individual preferences on information processing. It distinguishes in two different cognitive styles: an intuitive style which emphasizes feelings, open endness and global perspective and second, an analytical style which emphasizes reasoning, detail and structure. With a relatively small amount of items (38 items with 3-point ratings) the CSI is convenient when being administered within large scale organizations.[273] For Allinson & Hayes, the results of the substantial study with almost 1000 subjects indicate that the distribution of the scores support the theoretical expectations, show very good reliability in terms of internal consistency and temporal stability and clear evidence of a proper construct and concurrent validity.[274]

To test the use of intuition in management decision making, Agor started in 1981 testing executives from a wide range of organizations with the Agor Intuitive Management Test

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[271] Appelt, K. C.; Milch, K. F.; Handgraaf, M. J. J.; Weber, E. U. (2011). The Decision Making Individual Differences Inventory and guidelines for the study of individual differences in judgment and decision making research. In: Judgment and Decision Making 6 (3), p. 256.

[272] Cf. Agor, W. H. (1984). Intuitive management. Integrating left and right brain management skills. Englewood Cliffs NJ, USA: Prentice-Hall; Agor, W. H. (1986). How Top Executives Use Their Intuition to Make Important Decisions. In: Business Horizons 29, pp. 49–53; Agor, W. H. (1989). Intuition in organizations. Leading and managing productively. Newbury Park, USA: Sage, Allinson, C. W.; Hayes, J. (1996). The Cognitive Style Index: A Measure of Intuition-Analysis for Organizational Research. In: Journal of Management Studies 33 (1), pp. 119–135; Hayes, J.; Allinson, C. W.; Hudson, R. S.; Keasey, K. (2003). Further reflections on the nature of intuition-analysis and the construct validity of the Cognitive Style Index. In: Journal of Occupational and Organizational Psychology 76 (2), pp. 269–278; Briggs Myers, I.; McCaulley, M. H.; Qenk, N. L.; Hammer, A. L. (2003). MBTI manual. A guide to the development and use of the Myers-Briggs type indicator. 3. Aufl. Palo Alto CA, USA: CPP, Inc; Harper, S. C. (1988). Intuition: What Separates Executives from Managers. In: Business Horizons 31 (5), p. 15; Henden, G. (2004). Intuition and its Role in Strategic Thinking. Thesis (PhD). BI Norwegian School of Management, Oslo; Hodgkinson, G. P.; Langan-Fox, J.; Sadler-Smith, E. (2008). Intuition: A fundamental bridging construct in the behavioral sciences. In: British Journal of Psychology 99, p. 17; Langan-Fox, J.; Shirley, D. A. (2003). The nature and measurement of intuition: cognitive and behavioral interests, personality, and experiences. In: Creativity Research Journal 15, pp. 207-222; Pacini, R.; Epstein, S. (1999). The relation of rational and experiential information processing styles to personality, basic beliefs, and the ratio-bias phenomenon. In: Journal of Personality and Social Psychology 76 (6), pp. 972–987; Pretz, J. E.; Totz, K. S. (2007). Measuring individual differences in affective, heuristic, and holistic intuition. In: Personality and Individual Differences 43, pp. 1247–1257; Woolhouse, L. S.; Bayne, R. (2000). Personality and the Use of Intuition: Individual Differences in Strategy and Performance on an Implicit Learning Task. In: European Journal of Personality 14, pp. 157–169.

[273] Allinson, C. W.; Hayes, J. (1996). The Cognitive Style Index: A Measure of Intuition-Analysis for Organizational Research. In: Journal of Management Studies 33 (1), pp. 119–135.

[274] Ibid., p. 131.

(AIM).[275] The AIM is a self-report instrument including two parts. The first part reflects the ability to use intuition and consists of twelve questions which were taken from the Myers-Briggs Type Indicator (MBTI). Depending on the answer of the instrument, the first part gives an indication of the preferred cognitive style (intuitive or rational). The second part of the AIM test consists of ten questions and measures and the actual use of intuition.[276]

with the Rational-Experiential Inventory (REI) Epstein introduced a measurement to assess the preference for rational versus intuitive thinking on the basis of the Cognitive-Experiential Self Theory (CEST).[277] The REI distinguishes between two cognitive styles: a rational style which is measured by items being adapted from "Need for Cognition" (NFC) scale and an experiential style which is measured by the "Faith in Intuition" scale.[278] Theses scales are again divided into subscales of ability and favorability. The ability subscale reflects the individual's belief in his ability in using rational or experiential thinking. The favorability subscale reflects the preference of engaging in this kind of information processing.[279]

The Myers-Briggs Type Indicator (MBTI) is one of the widely used measures of intuitive types.[280] The MBTI is a self-reported personality construct which is based on the Jungian theory.[281] The MBTI identifies basic preferences on four dichotomies (Figure 8).

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[275] Agor, W. H. (1984). Intuitive management. Integrating left and right brain management skills. Englewood Cliffs NJ, USA: Prentice-Hall, p. 15; Agor, W. H. (1986). How Top Executives Use Their Intuition to Make Important Decisions. In: Business Horizons 29, p. 50.

[276] Agor, W. H. (1984). Intuitive management. Integrating left and right brain management skills. Englewood Cliffs NJ, USA: Prentice-Hall.

[277] Pacini, R.; Epstein, S. (1999). The relation of rational and experiential information processing styles to personality, basic beliefs, and the ratio-bias phenomenon. In: Journal of Personality and Social Psychology 76 (6), pp. 972–987.

[278] Cacioppo, J. T.; Petty, R. E. (1982). The Need for Cognition. In: Journal of Personality & Social Psychology 42 (1), pp. 116–131.

[279] Pretz, J. E.; Totz, K. S. (2007). Measuring individual differences in affective, heuristic, and holistic intuition. In: Personality and Individual Differences 43, p. 1250.

[280] Langan-Fox, J.; Shirley, D. A. (2003). The nature and measurement of intuition: cognitive and behavioral interests, personality, and experiences. In: Creativity Research Journal 15, p. 209.

[281] Jung, C. G. (1921/1971). Psychological Types. London, Great Britain: Routlege.

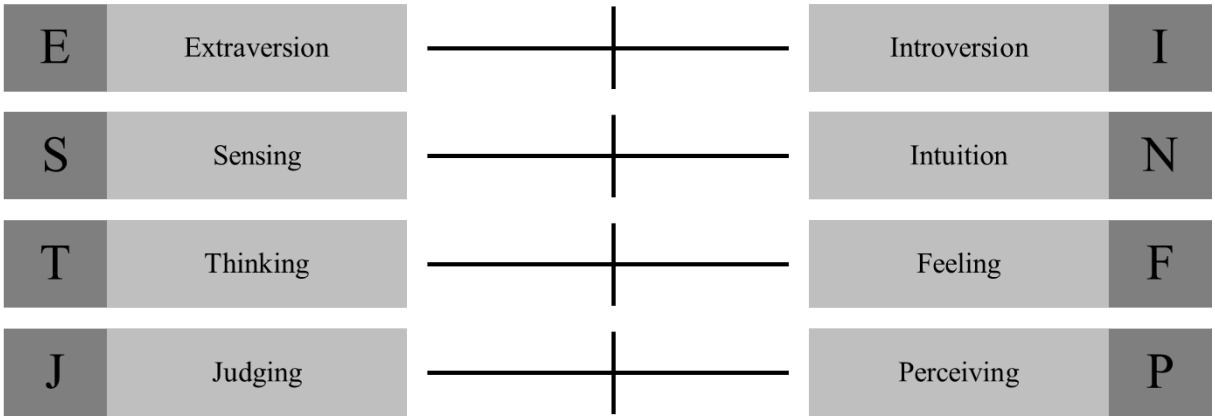

Figure 8: The four dichotomies of the MBTI

Source: Briggs Myers et al., 2003, p. 6

These basic preferences describe different ways of how people perceive information (Sensing-Intuition dichotomy) and different ways of making judgments (Thinking-Feeling dichotomy) in combination with different attitudes (the Extraversion-Introversion and Judging-Perceiving dichotomy). The Sensing/Intuition (S-N) scale taps the individual preference between the two opposite ways of perceiving information. The Thinking/Feeling (T-F) scale is designed to tap the individual preference between two contrasting ways (logic versus reliance on emotions) of making judgments.[282] In this sense the Sensing/Intuition scale may reflect the holistic nature of intuition and the Thinking/Feeling scale may reflect the affective nature of intuition.[283] The Extraversion/Introversion (E-I) scale is designed to reflect a person's preference for either the outer world focusing their energy on people and objects or the inner world focusing the energy on concepts, ideas and internal experience. The Judging/Perceiving (J-P) scale is designed to reflect a person's preference using a Judging process and therefore using either Thinking or Feeling when dealing with the outer world or using a Perceiving process and therefore using Sensing or Intuition when dealing with the outer world. The MBTI identifies 16 different personality types (Figure 9) which result from the interactions between the four dichotomies.[284] But the combination of those four letters of a "type" is more than a combination of single descriptions of attitudes and mental functions. The combination of those four letters also includes a so called "type dynamics", meaning that each four-letter type stands for a complex set of dynamic relationships among the attitudes and the functions.

[282] Briggs Myers, I.; McCaulley, M. H.; Qenk, N. L.; Hammer, A. L. (2003). MBTI manual. A guide to the development and use of the Myers-Briggs type indicator. 3. Aufl. Palo Alto CA, USA: CPP, Inc.

[283] Pretz, J. E.; Totz, K. S. (2007). Measuring individual differences in affective, heuristic, and holistic intuition. In: Personality and Individual Differences 43, p. 1250.

[284] Briggs Myers, I.; McCaulley, M. H.; Qenk, N. L.; Hammer, A. L. (2003). MBTI manual. A guide to the development and use of the Myers-Briggs type indicator. 3. Aufl. Palo Alto CA, USA: CPP, Inc., pp. 3-6.

Within the four-letter type each human being has one function which is applied the most, the dominant function. Furthermore a secondary function, an auxiliary function provides balance to the first or dominant function (Figure 9). The function that is the opposite of the dominant function is typically the least developed or inferior function and is also referred to as the fourth function. The opposite function to the auxiliary function is the tertiary function and is also referred to as the third function.[285] Determining the dominant function and the auxiliary function allows revealing the decision making style of an individual.[286]

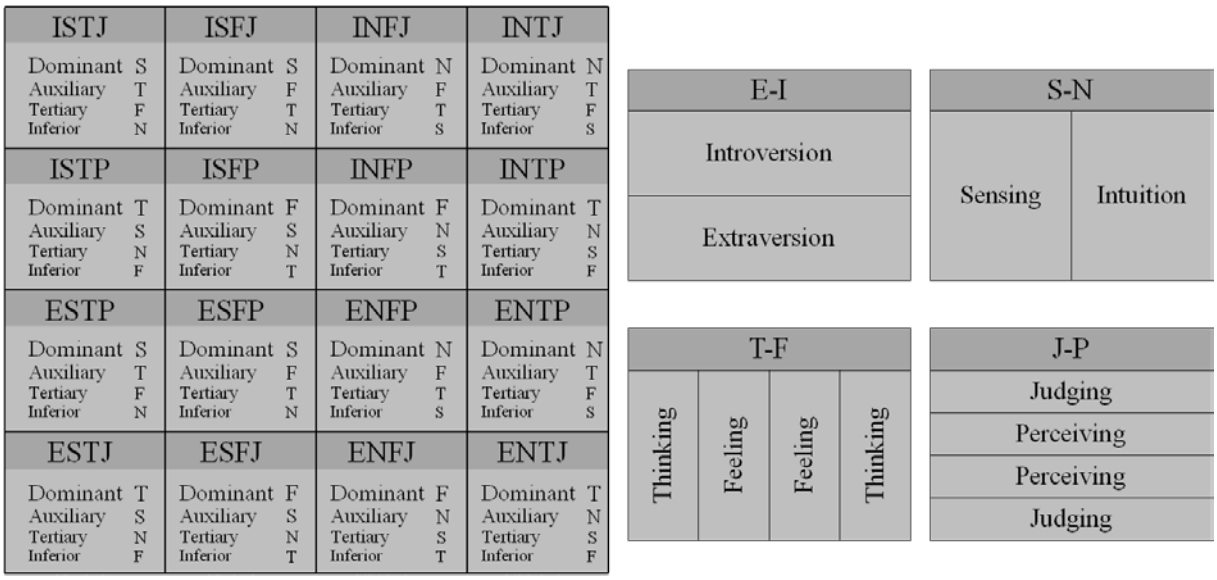

Figure 9: Priorities and directions of functions of the 16 types of the MBTI

Source: Briggs Myers et al., 2003, p. 31

Hodgkinson et al. criticize the CSI and the latest version of the REI because they show factors which are not within their underlying theory. For them the critique of the CSI has three significant respects: first, they see the empirical tests of its factor structure to be inconsistent with its declared theoretical basis. Second, it seems that it is not in line with the state-of-the-art dual-process formulation and third, a semantic analysis shows that it has little relation to intuitive domain.[287] For Hodgkinson et al. the REI appears to have item content problems with the experientially subscale as it conflates style or trait with strategy.[288] For Langan-Fox & Shirley, when taking a closer inspection of the Sensing-Intuition scale of the MBTI, none

[285] Briggs Myers, I.; McCaulley, M. H.; Qenk, N. L.; Hammer, A. L. (2003). MBTI manual. A guide to the development and use of the Myers-Briggs type indicator. 3. Aufl. Palo Alto CA, USA: CPP, Inc., pp. 29-31.

[286] Andersen, J. A. (2000). Intuition in managers. Are intuitive managers more effective? In: Journal of Managerial Psychology 15 (1), pp. 49-50.

[287] Hodgkinson, G. P.; Langan-Fox, J.; Sadler-Smith, E. (2008). Intuition: A fundamental bridging construct in the behavioral sciences. In: British Journal of Psychology 99, pp. 17-18.

[288] Ibid.

of the items assess affective or behavioral aspects of intuition.[289] When examining the nature of intuition by measuring with the MBTI and REI Pretz & Totz, findings suggest that both instruments measure affective, heuristic and holistic characteristics of intuition.[290] Woolhouse & Bayne see the MBTI as a reliable and valid instrument to measure personality as many studies have been published and especially because the MBTI shows a strong relationship with four out of five scales in the big five model of personality measured by the NEO-PI.[291]

One serious problem seems to be whether the types, as measured by personality tests, are consistent across contexts and therefore reflect behavioral aspects. Therefore and because Hodgkinson et al. see an over-reliance on psychometrically self-report instrument measures for intuitive style, they advocate more direct approaches designed to force rational and intuitive behavior.[292] For Hodgkinson et al. the use of self-report measures in conjunction with empirical experiments potentially provides a powerful setting for determining intuitive behavior.[293]

2.3. Construction of a theoretical model for the empirical testing of the impact of personality types on management decision making

2.3.1. Specification of the problem structure and construction of the hypotheses

According to the literature, intuitive or rational approches in decision making can be related to personality/cognitive styles.[294] Further findings support the evidence that participants with a rational thinking style operate predominantly at the conscious level in an analytical, effortful, affect-free and relatively slow manner while demanding high cognitive resources and are more related to normative judgements. The rational system is more process orientated,

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[289] Langan-Fox, J.; Shirley, D. A. (2003). The nature and measurement of intuition: cognitive and behavioral interests, personality, and experiences. In: Creativity Research Journal 15, p. 210.

[290] Pretz, J. E.; Totz, K. S. (2007). Measuring individual differences in affective, heuristic, and holistic intuition. In: Personality and Individual Differences 43, p. 1255.

[291] Cf. McCrae, R. R.; Costa, P. T. (1989). Reinterpreting the Myers-Briggs Type Indicator From the Perspective of the Five-Factor Model of Personality. In: Journal of Personality & Social Psychology 57, pp. 17–37; Woolhouse, L. S.; Bayne, R. (2000). Personality and the Use of Intuition: Individual Differences in Strategy and Performance on an Implicit Learning Task. In: European Journal of Personality 14, p. 160.

[292] Hodgkinson, G. P.; Langan-Fox, J.; Sadler-Smith, E. (2008). Intuition: A fundamental bridging construct in the behavioral sciences. In: British Journal of Psychology 99, p. 19.

[293] Ibid.

[294] Cf. Hough, J. R.; ogilvie, d. (2005). An Empirical Test of Cognitive Style and Strategic Decision Outcomes. In: Journal Management Studies 42 (2), pp. 426-427; Jung, C. G. (1921/1971). Psychological Types. London, Great Britain: Routlege; Westcott, M. R. (1968). Toward a Contemporary Psychology of Intuition. A Historical, Theoretical, and Empirical Inquiry. New York, USA: Holt, Rinehart and Winston, Inc., p. 148; Woolhouse, L. S.; Bayne, R. (2000). Personality and the Use of Intuition: Individual Differences in Strategy and Performance on an Implicit Learning Task. In: European Journal of Personality 14, p. 167.

logical-reason orientated and requires justification via logic and evidence. The rational system seems to be more suitable when analytic approaches are needed or considerations for long time consequences are at stake. In contrast, participants with an intuitive thinking style operate mainly on an unconscious level which relates to experiences which have been built up in the past. This intuitive system can be characterized as automatic, rapid, effortless, associative and holistic. The intuitive system is more related to heurisitc judgements.[295] When taking these implicatons into account it seems that individuals facing simple decision making situations perform well when taking rather conscious, deliberate thoughts whereas participant facing complex decision making situations perform better when taking unconscious, intuitive thoughts. There seems to be a clear link between the cognitive style and the structure of the problem. The more increasingly unstructured the problems get the more effective intuitive judgment becomes versus rational analysis. Ill-structured problems are therefore conducive to the intuitive decision making process as to the absence of well accepted decision making rules and vice versa.[296] This is also shown within an empirical study conducted by Dijksterhuis et al. This empirical study shows that conscious thinkers reported a greater post choice satisfaction when shopping for simple products and less satisfaction when shopping for more complex products. In contrast, unconscious thinkers reported a greater post choice satisfaction when shopping for more complex products and less satisfaction when shopping for simple products.[297]

To have clear specifications for the further development of this work when referring to cognitive styles, the four mental functions (Sensing/Intuition and Thinking/Feeling) defined by Jung shall be taken into account.[298] For the problem the three categories (well-structured, mid-structured and ill-structured) with the following specification will build the main foundation for this work.

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[295] Cf. Epstein, S. (1991). Cognitive-Experiential Self-Theory: An Integrative Theory of Personality. In: Rebecca C. Curtis (Ed.): The Relational self. Theoretical convergences in psychoanalysis and social psychology. New York: Guilford Press, p. 123; Epstein, S. (2003). Cognitive-Experiential Self-Theory of Personality. In: Irving B. Weiner (Ed.): Handbook of psychology. Hoboken, NJ: Wiley, p. 161; Shiloh, S.; Salton, E.; Sharabi, D. (2002). Individual differences in rational and intuitive thinking styles as predictors of heuristic responses and framing effects. In: Personality and Individual Differences 32, pp. 415–429.

[296] Dane, E.; Pratt, M. G. (2007). Exploring intuition and its role in managerial decision making. In: Academy of Management Review 32 (1), p. 45; Dijksterhuis, A.; Bos, M. W.; Nordgren, L. F.; van Baaren, R. B. (2006). On Making the Right Choice: The Deliberation-Without-Attention Effect. In: Science 311, pp. 1005–1007;

[297] Dijksterhuis, A.; Bos, M. W.; Nordgren, L. F.; van Baaren, R. B. (2006). On Making the Right Choice: The Deliberation-Without-Attention Effect. In: Science 311, pp. 1005–1006.

[298] Jung, C. G. (1921/1971). Psychological Types. London, Great Britain: Routlege, pp. 433-486.

In this sense ill-structured problems can be specified by the following elements:

- Goals are defined vaguely or not at all
- The problem description is not clear or well enough defined
- Has no single objectively correct solution
- Information to solve the problem is not within the problem statement
- The problems are in a special context whereby one or more aspects is/are not specified
- Between-domain transfer capabilities are needed
- There is no execution program or algorithm available to solve the problem in a routine
- Solutions may not be final, rather a plan is put in place to find out if the solution works in reality based on the implementation and evaluation. Problem solving in this case becomes an iterative process

For mid-structured problems the following definitions are adopted:

- The problem task is part of strategic management decision making
- The goal(s) of the problem solution procedure are relatively clearly defined and can be measured by indicators e.g. profitability, solvency, growth, sales, costs, etc.
- The problem environment is dealing with uncertain circumstances and can only be measured by subjective probability expectations
- The decision making alternatives are subject to those uncertain probability scenarios
- Whereas for the intended goals fulfillments well-defined algorithms can be applied (i. p. investment appraisals, contribution margin computation, time series extrapolation methods, etc.), the uncertain environmental circumstances can only be presumed based on the problem solver's creativity and intuition.
- The measurement of the mid-structured decision making problem lies clearly in-between the precisely defined well-structured problem situation and the non-defined ill-structured problem situation

And well-structured problems can be specified by the following elements:

- Have well defined initial state and well defined goals
- Have a single correct answer
- All elements which are required for the solution are known
- Problem solving requires using rules and strategies like logical, algorithmic processes which ensure a correct answer
- The current state of the problem can be consistently compared with the goal state

Taking the theoretical background into consideration that intuitive behavior can be characterized as automatic, rapid, effortless, associative and holistic, using heuristics to solve problems leads to the conclusion that intuitive behavior seems to be more appropriate and therefore more efficient when solving ill-structured problems as those problems by definition call for these kinds of abilities. In contrast as rational behavior can be characterized as process orientated, logical-reason orientated and requires justification via logic, using analytic approaches to solve problems leads to the conclusion that rational behavior seems to be more appropriate and therefore more efficient when solving well-structured problems.

Based on this conclusion the basic hypothesis is formulated.

H_B: Personality predetermination has an impact on decision making efficiency, varying along different decision making structures

Further sub hypotheses are stated in the introduction.

2.3.2. The causal relationship of personality types and decision making outcomes

The aim of this causal analysis is to show, how different types of personality, their resulting behavioral approaches (intuitive versus rational conduct) and different problem structures impact the outcomes of decision making in business management. At the end this should generate results, which allow in the future for provinding more clarity on how different types of personality and therefore different behavioral approaches are more efficient in solving different kinds of structured problems (e.g. well-structure, mid-structured and ill-structured problems). This could allow addressing the “right” type of personality to the “right” type of problem in order to achieve the most efficient decision making process.

A causal model in this sense demonstrates a measurement model which shows the relationship of the latent exogenous variable to the latent endogenous variable. It describes with a structural model the theoretical complex and how the independent variable (here the personality predetermination) impacts the independent variable (here the efficiency outcomes of decision making in business management). As efficiency in this sense is measured as socio-psychological and economic efficiency, the latent endogenous measurement variables are also measured by the socio-psychological efficiency (e.g. satisfaction, etc.) and the economic efficiency (e.g. duration, costs or target-actual comparison). The structure of the problem (well-structured, mid-structured and ill-structured) impacts the dependent variables so that the independent variable is characterized as an intervening variable and in this way is integrated in the structural model.

Based on the theoretical background and on the hypotheses from the previous chapter, a path analyses is used to select the relevant causal factors and to establish the relationships between the independent and dependent variables, allowing then the setup of a causal model (Figure 10). The latent exogenous measurement variables x_1, x_2, x_3 and x_4 provide information about the nature of the independent variable X (personality predetermination). The independent structural variable X influences the intervening variables $Z_w \ldots Z_i$ and the dependent $Y_w \ldots Y_i$ variables. These dependent variables ($Y_w \ldots Y_i$) again are operationalized and measured by the latent endogenous variables $y_{w1} \ldots y_{i3}$.

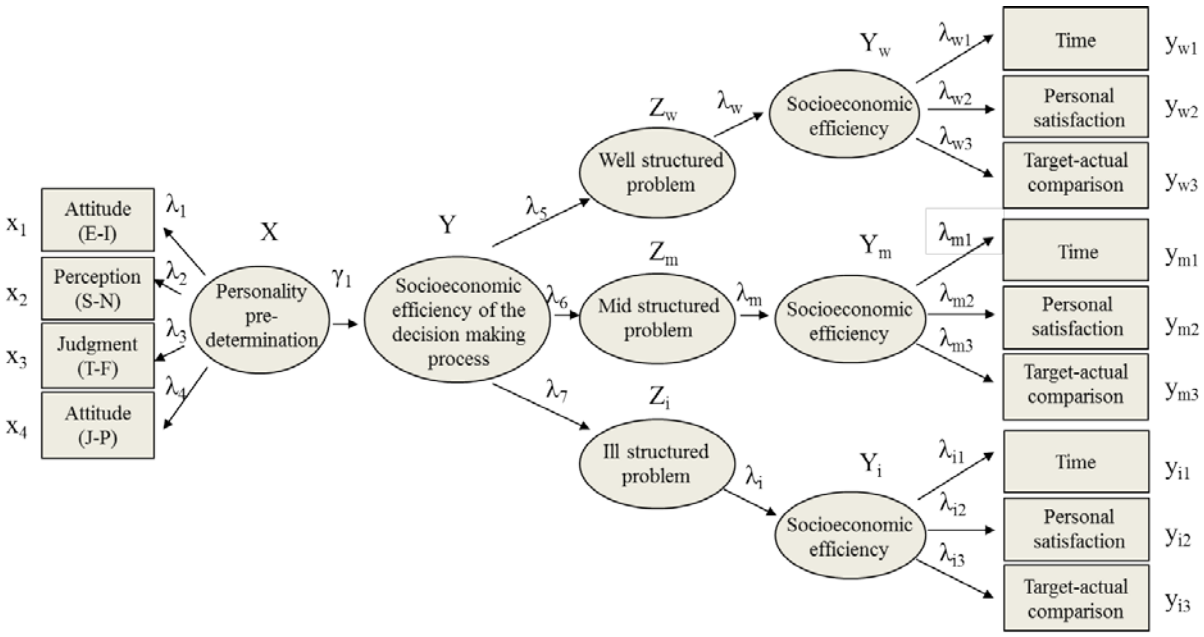

Figure 10: Causal analytical model for the relationship of personality types, behavioral approaches and socioeconomic efficiency in decision making

Source: Author

Legend of the causal model:

X	=	Independent structural variable (Personality predetermination)
Y	=	Dependent structural variable (Socioeconomic efficiency of the decision making process)
$Y_w \ldots Y_i$	=	Socioeconomic efficiency of the decision making process depending on the problem structure (well-structured, mid-structured, ill-structured)
$Z_w \ldots Z_i$	=	Intervening structural variable (structure of the problem)
$x_1 \ldots x_4$	=	Latent exogenous measurement variables (personality predetermination)
$y_{w1} \ldots y_{i3}$	=	Latent endogenous measurement variables (socioeconomic efficiency)
γ_1	=	Correlation degree between the latent exogenous and latent endogenous variable
$\lambda_1 \ldots \lambda_{u3}$	=	Correlation degree between the structural and measure variable

2.3.3. The determination variable: measurement of the independent variable

As this study aims to determine when intuitive versus rational decision making is more efficient in different structured problems, from an epistemic background it is necessary to operationalize the independent variable, the personality predetermination, in a way that intuitive and rational decision making styles can be identified. According to the literature, various instruments measure personality/cognitive style. Some of the most frequently used instruments include the Cognitive Style Index - the CSI, the Agor Intuitive Management Test - the AIM, the Rational-Experiential Inventory - the REI and the Myers-Briggs Type Indicator – the MBTI.[299] Further above, within the theoretical background, it was already laid out in a more detailed manner, that all these instruments underlay some critics. The author decided to choose the Myers-Briggs Type Indicator for the determination of personality and measurement of the cognitive style. The Myers-Briggs Type Indicator is mainly based on the theory of Jung.[300] The decision toward the Myers-Briggs Type Indicator (MBTI) was made by the author due to the following reasons:

- The psychological types which are represented by the MBTI are conceptually related to information gathering and information evaluation aspects of the decision making process[301]
- The CSI and the latest version of the REI show factors which are not within their underlying theory[302]
- The first half of the AIM instrument is based on the items of the MBTI[303]
- Langan-Fox & Shirley criticize the fact that the MBTI does not assess affective or behavioral aspects. But this is a problem Hodgkinson et al. see with most of the psychometrically self-reporting instruments. Therefore they advocate conducting, in

[299] Cf. Agor, W. H. (1986). How Top Executives Use Their Intuition to Make Important Decisions. In: Business Horizons 29, pp. 49–53; Agor, W. H. (1989). Intuition in organizations. Leading and managing productively. Newbury Park, USA: Sage; Briggs Myers, I.; McCaulley, M. H.; Qenk, N. L.; Hammer, A. L. (2003). MBTI manual. A guide to the development and use of the Myers-Briggs type indicator. 3. Aufl. Palo Alto CA, USA: CPP, Inc.; Pacini, R.; Epstein, S. (1999). The relation of rational and experiential information processing styles to personality, basic beliefs, and the ratio-bias phenomenon. In: Journal of Personality and Social Psychology 76 (6), pp. 972–987.

[300] Jung, C. G. (1921/1971). Psychological Types. London, Great Britain: Routlege.

[301] Hough, J. R.; ogilvie, d. (2005). An Empirical Test of Cognitive Style and Strategic Decision Outcomes*. In: Journal Management Studies 42 (2), p. 422.

[302] Hodgkinson, G. P.; Langan-Fox, J.; Sadler-Smith, E. (2008). Intuition: A fundamental bridging construct in the behavioral sciences. In: British Journal of Psychology 99, pp. 17-18.

[303] Agor, W. H. (1994). Intuitives Management: Die richtige Entscheidung zur richtigen Zeit. 2. Aufl. Bremen, Germany: GABAL, p. 32.

addition, a laboratory or a field experiment to assess behavioral aspects to overcome this critical point[304]

- The MBTI has proven to be a valid and reliable instrument as many studies have been published and especially because the MBTI shows a strong correlation with four out of five scales of the big five model of personality measured by the NEO-PI[305]
- The analysis of more than 32.000 respondents of the MBTI showed reliability coefficients, measured by the Cronbachs's alpha, averaging: E-I=0.79, S-N=0.84, T-F=0.74 and J-P=0.82[306]
- The MBTI is one of the most widely used and understood instruments in measuring personality types/cognitive styles within organizations and it allows direct transfer from research to practice[307]
- And to allow a better cross comparison between different studies, Appelt et al. recommend using existing and well used measures without modification, where appropriate[308]

The Myers-Briggs Type Indicator measures four dichotomies to assess the personality predetermination. To reflect a person's preference/attitude for either the outer world, focusing their energy on people and objects or the inner world, focusing the energy on concepts, ideas and internal experience, the Extraversion-Introversion (E-I) scale is used. Extraverted types are mostly interested in what happens around them, outside of their own person. Introverted types, on the other hand, are attracted to the inside of their own person. They care and focus mainly on things and details about their own person. The Sensing-Intuition (S-N) scale taps the individual preference between the two opposite ways of perceiving information (concrete factual details through the five senses versus patterns through the unconscious). Sensing types

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[304] Cf. Hodgkinson, G. P.; Langan-Fox, J.; Sadler-Smith, E. (2008). Intuition: A fundamental bridging construct in the behavioral sciences. In: British Journal of Psychology 99, p. 19; Langan-Fox, J.; Shirley, D. A. (2003). The nature and measurement of intuition: cognitive and behavioral interests, personality, and experiences. In: Creativity Research Journal 15, p. 210.

[305] Cf. Furnham, A.; Moutafi, J.; Crump, J. (2003). The relationship between the revised NEO-Personality Inventory and the Myers-Briggs Type Indicator. In: Social Behavior and Personality 31 (6), p. 582; McCrae, R. R.; Costa, P. T. (1989). Reinterpreting the Myers-Briggs Type Indicator From the Perspective of the Five-Factor Model of Personality. In: Journal of Personality & Social Psychology 57, pp. 17–37; Briggs Myers, I.; McCaulley, M. H.; Qenk, N. L.; Hammer, A. L. (2003). MBTI manual. A guide to the development and use of the Myers-Briggs type indicator. 3. Aufl. Palo Alto CA, USA: CPP, Inc., p. 178.

[306] Capraro, R. M.; Capraro, M. M. (2002). Myers-Briggs Type Indicator Score Reliability Across: Studies a Meta-Analytic Reliability Generalization Study. In: Educational and Psychological Measurement 62 (4), p. 594.

[307] Hough, J. R.; ogilvie, d. (2005). An Empirical Test of Cognitive Style and Strategic Decision Outcomes*. In: Journal Management Studies 42 (2), p. 422.

[308] Appelt, K. C.; Milch, K. F.; Handgraaf, M. J. J.; Weber, E. U. (2011). The Decision Making Individual Differences Inventory and guidelines for the study of individual differences in judgment and decision making research. In: Judgment and Decision Making 6 (3), p. 256.

solves problems with logical rules, requiring therefore, information about reality and are very thorough when developing problem solutions, which mostly takes time. The Intuitive types, in contrast, do not see things the way they are rather they see them the way they should be. The Intuitive types tend to "live" in the past or in the future. The Thinking-Feeling (T-F) scale is designed to tap the individual problem solving process by reflecting on the preference of individuals to use two contrasting means (logic versus reliance on emotions) to make judgments. For Thinking types actions rely on intellectual motives and situations are captured by logical reasoning. Problems are solved via known rules and by using classification and numbering. Thinking types tend to act impersonally. The Feeling types, in contrast, agree or disagree on appearing issues on the basis of individual value propositions, which are closely connected to their intrinsic motivation. The Judging-Perceiving (J-P) scale is designed to reflect a person's preference/attitude using the Judging process and therefore using either Thinking or Feeling when dealing with the outer world or using a Perceiving process and therefore using Sensing or Intuition when dealing with the outer world. From a theoretical point of view, within the two mental functions, the Sensing-Intuition (S-N) scale measures the holistic nature of intuition and the Thinking-Feeling (T-F) scale measures the affective nature of intuition.[309] As already reviewed within the theoretical background, the MBTI identifies 16 different personality types which result from the interactions between the four dichotomies.[310] Within the four-letter type each human being has one function which is applied the most, the dominant function and a second function, the auxiliary function, which provides balance to the first or dominant function. The function opposite the dominant function is the inferior function and is typically the least developed. It is also referred to as the fourth function. The opposite function to the auxiliary function is the tertiary function, also referred to as the third function.[311] Determining the dominant function and the auxiliary function allows revealing the decision making style of an individual.[312] In this sense dual processing research sees the Sensing/Thinking types as the most analytical and the Intuition/Feeling types as the most intuitive.[313] Further, White et al. believe that extroverts can control new situations better than introverts, due to the fact that they have the ability to handle problems in an assertive and

[309] Pretz, J. E.; Totz, K. S. (2007). Measuring individual differences in affective, heuristic, and holistic intuition. In: Personality and Individual Differences 43, p. 1250.
[310] Briggs Myers, I.; McCaulley, M. H.; Qenk, N. L.; Hammer, A. L. (2003). MBTI manual. A guide to the development and use of the Myers-Briggs type indicator. 3. Aufl. Palo Alto CA, USA: CPP, Inc., pp. 3-6.
[311] Ibid.., pp. 29-31.
[312] Andersen, J. A. (2000). Intuition in managers. Are intuitive managers more effective? In: Journal of Managerial Psychology 15 (1), pp. 49-50.
[313] Hough, J. R.; ogilvie, d. (2005). An Empirical Test of Cognitive Style and Strategic Decision Outcomes. In: Journal Management Studies 42 (2), pp. 426-427.

cooperative way.[314] It also seems that people with a more intuitive cognitive style are found to be more extraverted.[315] Therefore the four dichotomies in combination with a dominant preference for Sensing or Intuition (Figure 11) and an auxiliary preference for Thinking or Feeling provides the possibility to grade rational and intuitive behavior into the following classes:

Rational behavior 1st degree

ISTJ: Introvert with a dominant preference for Sensing and with auxiliary preference for Thinking

Rational behavior 2nd degree

ESTP: Extravert with a dominant preference for Sensing and with auxiliary preference for Thinking

Rational behavior 3rd degree

ISFJ: Introvert with a dominant preference for Sensing and with auxiliary preference for Feeling

Rational behavior 4th degree

ESFP: Extravert with a dominant preference for Sensing and with auxiliary preference for Feeling

Intuitive behavior 1st degree

ENFP: Extravert with a dominant preference for Intuition and with auxiliary preference for Feeling

Intuitive behavior 2nd degree

INFJ: Introvert with a dominant preference for Intuition and with auxiliary preference for Feeling

Intuitive behavior 3rd degree

ENTP: Extravert with a dominant preference for Intuition and with auxiliary preference for Thinking

Intuitive behavior 4th degree

INTJ Introvert with a dominant preference for Intuition and with auxiliary preference for Thinking

Figure 11: MBTI personality types with Sensing or Intuition as the dominant function and Thinking or Feeling as auxiliary function

Source: Cf. Hirsh & Hirsh, 2007, p. 5; Neuert, 1987, p. 230

[314] White, C. J.; Varadarajan, R. P.; Dacin, P. A. (2003). Market Situation Interpretation and Response: The Role of Cognitive Style, Organizational Culture, and Information Use. In: Journal of Marketing Research 67, p. 66.

[315] Cools, E. (2008). Cognitive Styles and Management Behaviour. Theory, Measurement, Application. Saarbrücken: VDM Verlag Dr. Müller, p. 37.

Following these eight types which have either Sensing or Intuition as their dominant functions are eight more, which have Thinking or Feeling as their dominant functions (Figure 12) and either Sensing or Intuition as their auxiliary function:

Rational behavior 5th degree

ISTP: Introvert with a dominant preference for Thinking and with auxiliary preference for Sensing

Rational behavior 6th degree

ESTJ: Extravert with a dominant preference for Thinking and with auxiliary preference for Sensing

Rational behavior 7th degree

INTP: Introvert with a dominant preference for Thinking and with auxiliary preference for Intuition

Rational behavior 8th degree

ENTJ: Extravert with a dominant preference for Thinking and with auxiliary preference for Intuition

Intuitive behavior 5th degree

ENFJ: Extravert with a dominant preference for Feeling and with auxiliary preference for Intuition

Intuitive behavior 6th degree

INFP: Introvert with a dominant preference for Feeling and with auxiliary preference for Intuition

Intuitive behavior 7th degree

ESFJ: Extravert with a dominant preference for Feeling and with auxiliary preference for Sensing

Intuitive behavior 8th degree

ISFP: Introvert with a dominant preference for Feeling and with auxiliary preference for Sensing

Figure 12: MBTI personality types with Thinking or Feeling as the dominant function and Sensing or Intuition as auxiliary function

Source: Cf. Hirsh & Hirsh, 2007, p. 5; Neuert, 1987, p. 230

Hirsh & Hirsh also describe this as the dominants lens (Figure 13) of the type table.

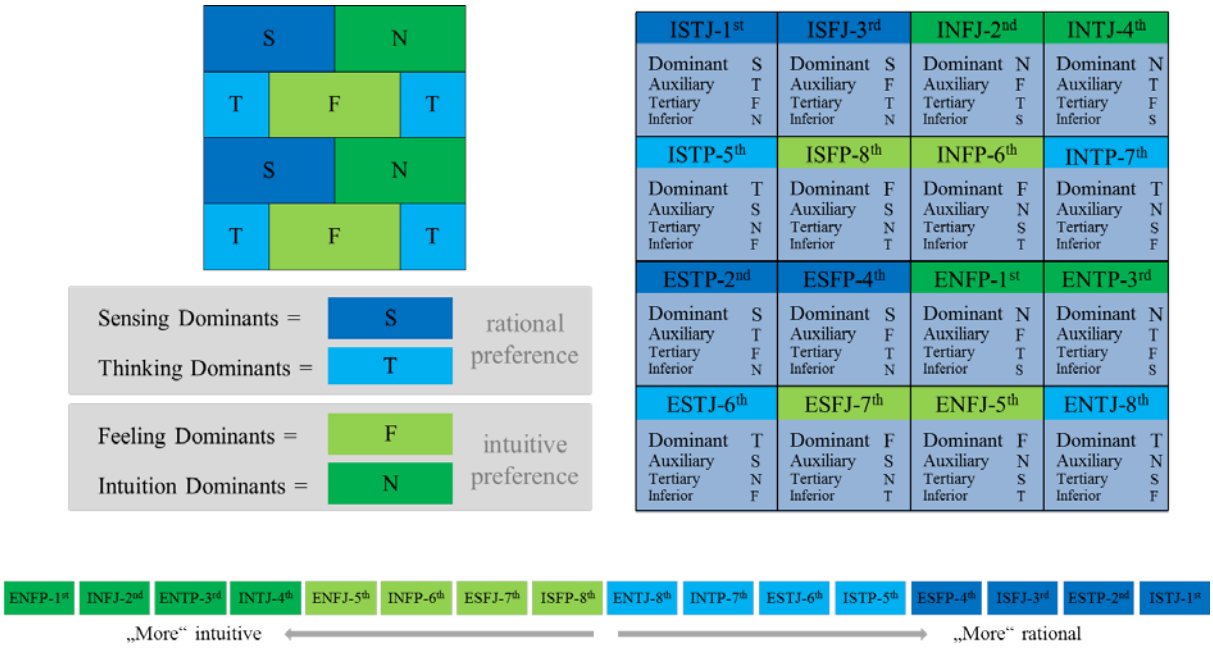

Figure 13: MBTI personality types grouped into their dominant functions

Source: Hirsh & Hirsh, 2007, p. 5

Whereas with the personality predetermination (X), the independent variable was determined and operationalized with the four dichotomies of the Myers-Briggs Type Indicator. In the next step within the model structure the intervening structural variable and dependent variable have to be operationalized.

2.3.4. The effect variables: measurement of the dependent variable and the intervening variables

The intervening variable (Z), the problem structure, is operationalized by defining three different kinds of structures within the ill-structured problem (ISP), the mid-structured problem (MSP) and the well-structured problem (WSP). The three different problem structures (ISP, MSP and WSP) are characterized according to the definitions formulated within the theoretical background (cf. chapter 2.3.1).

The determination of the socioeconomic efficiency can be done by various constructs.[316] Especially the choice of the efficiency dimensions is always related to the judgment of the

[316] Cf. Grabatin, G. (1981). Effizienz von Organisationen. Berlin, Germany: Walter de Gruyter (Mensch und Organisation, 8), pp. 39-62; Neuert, J. O. (1987). Planungsgrade. Eine experimentelle Untersuchung zum Zusammenhang zwischen Planungsverhalten und Planungserfolg. Spardorf, Germany: Rene F. Wilfer, pp. 108-124; Nutt, P. C. (2008). Investigating the Success of Decision Making Processes. In: Journal of Management Studies 45 (2), pp. 425–455.

observer. Introducing a multi-dimensional indicator model (Figure 14) allows the author to split and measure of the socioeconomic efficiency in various dimensions.[317] This allows the measurement of single efficiency dimension and then determining the total efficiency. Each dimension can have from one to several efficiency criteria.

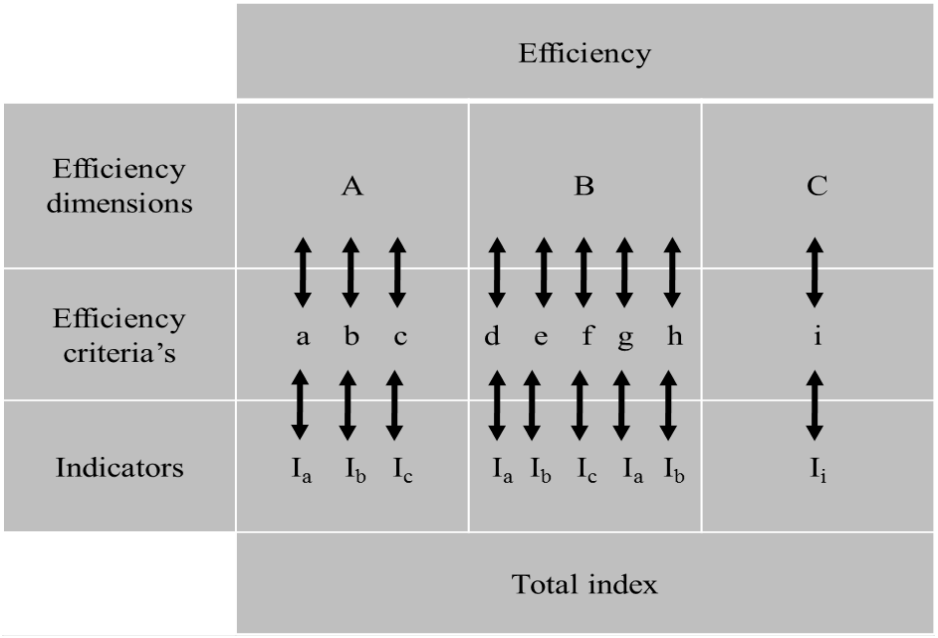

Figure 14: Multi-dimensional indicator model for the efficiency measurement

Source: Neuert, 1987, p. 114

To operationalize the dependent variables the author has decided to split the socioeconomic efficiency into a three dimensions: formal efficiency, material efficiency and individual efficiency.[318]

By definition the decision making process can be understood as a target orientated process (target-output relationship) where from a current/actual state the aim is to reach a future/target state. In this sense the decision making with its various sub processes can be seen as a formal instrument for solving problems by making choices when selecting between alternatives.[319] The comparison between those alternatives can be described as formal efficiency. The level of formal efficiency can be determined by comparing the aimed target or the desired situation with the current situation. In this sense a higher coincidence between the targeted and the

[317] Neuert, J. O. (1987). Planungsgrade. Eine experimentelle Untersuchung zum Zusammenhang zwischen Planungsverhalten und Planungserfolg. Spardorf, Germany: Rene F. Wilfer, p. 114.
[318] Ibid.
[319] Gzuk, R. (1975). Messung der Effizienz von Entscheidungen. Tübingen, Germany: J.C.B. Mohr (Empirische Theorie der Unternehmung, 5), p. 24.

current state/situation indicates a higher efficiency and in turn a lower coincidence between the targeted and the current situation indicates a lower efficiency.

Material efficiency in decision making relates to the economic results and can be understood as an input-output relationship of a corporation which are measured by criteria like profit, growth, rate of return, etc. Management science has created a series of key indicator to display material efficiency in decision making. Mostly these are measures which indicate economical activities as input-output relationships with performance indicators like profitability, cost and returns or cost and benefits. Formal and material efficiency deal rather with the "hard facts" and reflect more the economical and therefore the objective detectable and reproducible side of decision making.

Personal/individual efficiency reflects more the socio-psychological and subjective part in decision making and therefore deals with results which can be considered as "soft facts" and are related to the emotions, feelings, acceptance and satisfaction of individuals. From a more general point of view the author sees individual efficiency here as the subjective expectance of the decision maker when comparing factual results and former planned results after the decision making processes. Individual efficiency is more characterized by the decision makers hope to fulfill the expectations. Individual efficiency in this sense can also be described as the satisfaction of the decision maker concerning the achieved results.[320]

With the classification of the three efficiency dimensions (formal, material and individual efficiency) the author has tried to select relevant concepts to measure various dimensions of efficiency in the management decision making process. Efficiency dimensions are suitable to measure special aspects of the decision making process under a certain view but still need to be combined to result in a comprehensive efficiency concept, total efficiency. There are various concepts on how to combine different efficiency dimensions to satisfy the efficiency concept and to achieve total socioeconomic efficiency.[321] Grabatin advocates with an "efficiency analysis of the organization" an approach to determine the efficiency of organizations in general. In this case he defines an n-dimensional area which is limited by negotiated tolerance (target) limits. As satisfying solutions are in the focus instead of optimal

[320] Neuert, J. O. (1987). Planungsgrade. Eine experimentelle Untersuchung zum Zusammenhang zwischen Planungsverhalten und Planungserfolg. Spardorf, Germany: Rene F. Wilfer, p. 119.

[321] Cf. Grabatin, G. (1981). Effizienz von Organisationen. Berlin, Germany: Walter de Gruyter (Mensch und Organisation, 8), pp. 167-174; Gzuk, R. (1975). Messung der Effizienz von Entscheidungen. Tübingen, Germany: J.C.B. Mohr (Empirische Theorie der Unternehmung, 5), p. 57; Neuert, J. O. (1987). Planungsgrade. Eine experimentelle Untersuchung zum Zusammenhang zwischen Planungsverhalten und Planungserfolg. Spardorf, Germany: Rene F. Wilfer, p. 125.

solutions, the tolerance or target limits frame a valid solution space which then can be defined as the area of the efficient organization.[322] Neuert criticizes this approach, as tolerance (target) limits always need to be known, which does not seem to be the case in reality. Grabatin's concept also does not provide the possibility of weighting efficiency dimensions differently.[323] In his approach, Gzuk defines an algorithm for the construction of a total efficiency index, whereby the total efficiency of a decision is measured by the positive discrepancy of the worst possible efficiency profile.[324] As in this approach, the possibility to weigh different dimensions of efficiency is up to the user. This concept also does not seem to be suitable for the present work. Therefore the author has decided to rely on the "amalgamation" concept of Neuert.[325]

2.4. The research design for the empirical study measuring the impact of personality types on the efficiency outcomes of management decisions

To test the hypotheses the author has decided to introduce a laboratory experiment, as no other method seems more appropriate for producing data/answers in such a controlled manner. Popper has already highlighted the fact that one of the main issues within an experiment is to eliminate all disturbing factors.[326] This is especially valid for laboratory experiments. The laboratory experiment, as already explained, seems to provide, in the author's case, a good possibility for the observer to gain insight into the arrangement and the execution of the experiment. The intersubjective checkability and traceability of the laboratory experiment can be rated higher than that of a field experiment which may include all kinds of disturbing side effects.[327] Document analyses or a set of interviews also provide a possibility for gathering data on an empirical base but the author believes that there is a large risk of receiving subjectively biased answers from the participants. They rather report what they would like to be instead of what they are. A further methodical basic requirement for empirical testing is to allow for repeating the experiment again under reproducible

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[322] Grabatin, G. (1981). Effizienz von Organisationen. Berlin, Germany: Walter de Gruyter (Mensch und Organisation, 8), pp. 169-171.

[323] Neuert, J. O. (1987). Planungsgrade. Eine experimentelle Untersuchung zum Zusammenhang zwischen Planungsverhalten und Planungserfolg. Spardorf, Germany: Rene F. Wilfer, p. 122.

[324] Gzuk, R. (1975). Messung der Effizienz von Entscheidungen. Tübingen, Germany: J.C.B. Mohr (Empirische Theorie der Unternehmung, 5), p. 291.

[325] Neuert, J. O. (1987). Planungsgrade. Eine experimentelle Untersuchung zum Zusammenhang zwischen Planungsverhalten und Planungserfolg. Spardorf, Germany: Rene F. Wilfer, p. 125.

[326] Popper, K. R. (2005). Logik der Forschung. 11. Aufl. Hg. v. Herbert Keuth. Tübingen: Mohr Siebeck, p. 84.

[327] Aronson, E.; Wilson, T. D.; Akert, R. M. (2011). Sozialpsychologie. 6. Aufl. München, Germany: Pearson Studium (PS - Psychologie), pp. 46-47.

circumstances. This is also fulfilled to a greater degree with a laboratory experiment than with any other purpose like method, because of the controlled environment in which the experiment takes place.[328] The laboratory experiment is therefore characterized by a high degree of reliability. A further aspect of the laboratory experiment is that experimental situations can be constructed in a variable way so that cause and effect relationships can be clearly isolated and tested. This allows attributing or denying an effect clearly to a cause.[329] In this way it can be determined if decision making efficiency outcomes within different structured problem situations change when personality/cognitive styles change.

According to the causal model (cf. chapter 2.3.2) the author has developed the following structure (Figure 15) for the empirical experiment:

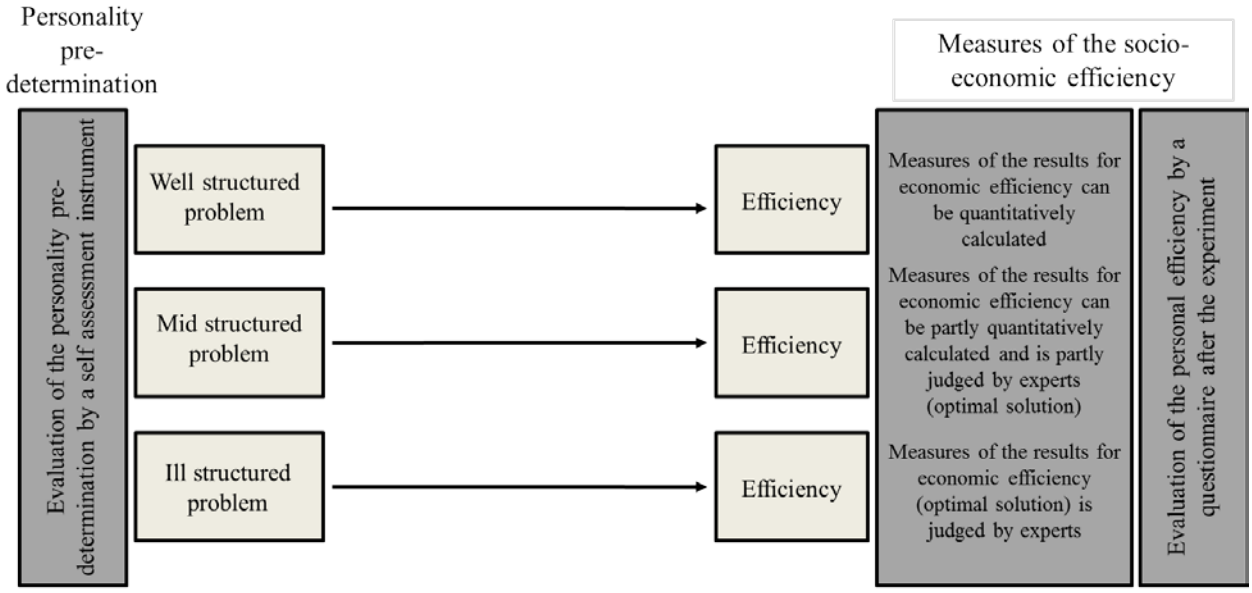

Figure 15: Structure of the empirical experiment

Source: Author

To identify the personality predetermination of each participant within the study, which also reflects the behavioral aspects of the hypotheses, in the first step of the experiment a personality self-assessment instrument is introduced. Therefore participants are asked to complete a self scorable personality assessment. In the next step, within the laboratory experiment, participants receive the first out of three tasks (cf. Appendix I) with a dedicated structure (well-, mid- and ill-structured problem) and are asked to solve the task according to

[328] Neuert, J. O. (1987). Planungsgrade. Eine experimentelle Untersuchung zum Zusammenhang zwischen Planungsverhalten und Planungserfolg. Spardorf, Germany: Rene F. Wilfer, pp. 157-160.

[329] Bortz, J.; Döring, N. (2006). Forschungsmethoden und Evaluation. Für Human- und Sozialwissenschaftler. 4. Aufl. Heidelberg, Germany: Springer-Medizin-Verl., pp. 57-58.

the description of the problem statement. This allows the author to collect data/information about economic efficiency (formal and material efficiency) in every one of the three problem structures with participants having either a rational or an intuitive decision making style. The data for individual efficiency are collected by a questionnaire (cf. Appendix II).

a) Measurement of the personality predetermination/cognitive style

As already explained above, more in detail, the author has decided to use the Myers-Briggs Type Indicator (MBTI), the German version of the form "M", to assess personality predetermination. It is a self-scoring pencil and paper test which contains 88 items to assess the four dichotomies. The results of the MBTI allow for the identification of the types for testing of the hypotheses and to verify or falsify them to determine if there is an impact of the personality predetermination (rational versus intuitive style) on the socioeconomic efficiency in management decision making.

b) Measurement of the material, the formal and the individual efficiency

As this experiment aims to provide information about the impact of personality predetermination on efficiency in management decision making it seems obvious that the problem tasks are related to business management issues. Problem tasks requiring smaller decisions from everyday life don't seem to be appropriate here.[330] Therefore specific kinds of tasks (cf. Appendix I) are selected for the three kind of problem situations (well-, mid- and ill-structured). According to the causal model (cf. chapter 2.3.2) time (also as an indirect indicator of costs) is the measurement variable to track the material efficiency dimension. So time consumption fulfills the task of providing information about material efficiency.

Formal efficiency is tracked by comparing the results of problem solutions of the participants to the "optimal results". As well-structured tasks, by definition, are tasks which can be solved quantitatively by a mathematical algorithm, the indicator for an optimal result for a well-structured problem task is a correct figure done by a calculation. For ill-structured tasks where, by definition, the problem constellation cannot be calculated by a mathematical algorithm and might not have an objective result, the optimal result is determined by the judgment of experts. For mid-structured problem tasks which are characterized by having a part within the problem structure which can be determined by a calculation and another part

[330] Witte, E.; Hauschildt, J. (1972). Das Informationsverhalten in Entscheidungsprozessen. Tübingen, Germany: Mohr (13), p. 167.

which might have no objective solution, the optimal result is a combination of both, a calculation of a figure and the judgment of experts.

The author has chosen a questionnaire as a data gathering method for individual efficiency, as in this case personal attitudes (like satisfaction, self-reflection, etc.) which are hard or almost impossible to track by observing participants in an empirical experiment. The questionnaire mainly contains questions about the personal satisfaction of the participants on solving the problem tasks, how systematic they rate their approach in solving the task and how they rate their own cognitive style. Friedrichs, in this case, advocates validity, reliability and comparability reasons, for using standardized questionnaires or existing questionnaires which can be adapted if needed.[331] Therefore the basic foundation of the questionnaire is based on a previous research project done by Neuert, whereby he evaluated the dependency of planning behavior and planning success. In this evaluation Neuert conducted a survey to collect information on individual efficiency of the planning process on the basis of a questionnaire he developed.[332] Therefore individual efficiency is tracked with a standardized and structured questionnaire (cf. Appendix II). The questionnaire makes direct reference to the impact of personality on personal decision making efficiency within different structured problem categories.

The disadvantage of a questionnaire having an uncontrolled survey can be mostly dispelled when using a standardized questionnaire and when during the answering of the questions the investigator is present.[333] Standardized questionnaires are structured and do not only fix content and sequence of the questions but also provide exact wording and a clear understandable scale for the answers. Structureness, in this sense, is represented by the fact, that single questions can be accurately used to generate answers for the hypotheses. The questionnaire, in the author's case, is fully standardized, meaning that there are only "closed" and no open questions. Closed questions are pre formulated questions with measurement scales. For this case empirical science has developed a vast amount of appropriate scales which have proven to be plausible, valid and, reliable in long term studies.[334] When developing the questionnaire the author used the "Likert-scale". The Likert scale intends to

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[331] Friedrichs, J. (1990). Methoden empirischer Sozialforschung. 14. Aufl. Opladen: Westdeutscher Verlag, p. 209.

[332] Neuert, J. O. (1987). Planungsgrade. Eine experimentelle Untersuchung zum Zusammenhang zwischen Planungsverhalten und Planungserfolg. Spardorf, Germany: Rene F. Wilfer.

[333] Bortz, J.; Döring, N. (2006). Forschungsmethoden und Evaluation. Für Human- und Sozialwissenschaftler. 4. Aufl. Heidelberg, Germany: Springer-Medizin-Verl., p. 252.

[334] Friedrichs, J. (1990). Methoden empirischer Sozialforschung. 14. Aufl. Opladen: Westdeutscher Verlag, pp. 172-187.

measure the attitude of persons concerning a specific object or situation. All items are formulated in a strict positive or negative manner. The idea of the Likert-scale is the fact that the more strongly the test subject refuses a statement, the further his attitude differs from the formulation of the statement.[335]

Exemplarily the Likert-scale in the questionnaire was formulated as following:
Question: How satisfied were you today with your problem solution process?

Answer:

very unsatisfied	1	2	3	4	5	very satisfied

2.4.1. Validity, reliability and representativity of the chosen empirical methods

a) Validity and reliability

For validity in the first step it is necessary to address appropriate indicators to the variables which allow for measuring the characteristics as they are understood. This has already been laid out more in detail in the chapters 2.3.3 and 2.3.4 on how (with which indicators) the author is going to measure the independent and dependent variable allowing an intersubjective reconsideration. The author is aware that the components of decision making behavior like, cognition, reflexion, target orientation, etc. underlay subjective norms. For the declaration of reliability in measurement, science in empirical research has developed the so called reliability coefficient. It's results, coming in general, from the quotient from error variance of the measurement and total variance of the complete data set of a research problem.[336]

The participants for the empirical experiment were selected among managers and students from business management faculties. The managers[337] were full time practitioners in the field of business administration and are also attending a part time doctoral study program in global management. The students were included as participants in the study to ensure comparability with previous empirical experiments, as many of former research have been conducted with students. The question if students behave in a management decision making situation as "real" decision makers and therefore produce valid results was already highlighted by various

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[335] Ibid., pp. 175-176.

[336] Cf. Friedrichs, J. (1990). Methoden empirischer Sozialforschung. 14. Aufl. Opladen: Westdeutscher Verlag, p. 102; Neuert, J. O. (2009). Sozio-ökonomische Analyse der "Integrierten Mediation" als Konfliktregelungskonzept. Realtheorie, Modelkonstrukt und empirische Befunde. Kufstein (Unpublished Project Study), p. 199.

[337] The managers included in the study hold among others positions like CEO, COO, Senior Manager, Managing Director, Business Unit Leader, Department Leader, Director, etc.

studies but will also again be addressed in this study.[338] These studies revealed that in laboratory experiments the decisions of students and professionals working in the business management field produced similar results.[339] Witte & Hausschildt, in this case, argue that simplifications are justified if it is assured that students do not behave differently than professionals in relationship to the variables which are under examination.[340] In the author's case, according to Witte & Hausschildt, this is assured by choosing for the well-structured problem tasks (cf. Appendix I) a task which has a business management background (e.g. an investment decision). As this kind of a task is also a part of the student's basic education in the field business management and also a typical task for professionals in the field of business management, students and managers should therefore provide similar results. There seems to be a limited risk in receiving different results between the student participants and the participating managers as for the ill-structured task, a task was chosen (cf. Appendix I) which is new to students and to professionals.

Due to the operationalization of the indicators, the measurements of the variables, from a scientific point of view, are state of the art and therefore the author believes this allows a valid measurement of the variables. The following points highlight from a validity and reliability perspective, why a laboratory experiment is preferred to other options:

- The situation and the main influencing factors can be better controlled and therefore allow for a more accurate and valid recording of the components of the independent and dependent variables.
- The comparatively low complexity of the laboratory experiment allow for a high assurance of measurement since there are a lot less disturbing effects, which arise in a field experiment due to a large amount of empirical impressions.
- A reproducibility of certain tasks or situations is, without a doubt, in a laboratory experiment easier than in a field experiment as well as in an interview situation or a document analyses.

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[338] Cf. Neuert, J. O. (1987). Planungsgrade. Eine experimentelle Untersuchung zum Zusammenhang zwischen Planungsverhalten und Planungserfolg. Spardorf, Germany: Rene F. Wilfer, pp. 165-167; Witte, E.; Hauschildt, J. (1972). Das Informationsverhalten in Entscheidungsprozessen. Tübingen, Germany: Mohr (13), p. 184.

[339] Cf. Neuert, J. O. (1987). Planungsgrade. Eine experimentelle Untersuchung zum Zusammenhang zwischen Planungsverhalten und Planungserfolg. Spardorf, Germany: Rene F. Wilfer, pp. 165-167; Witte, E.; Hauschildt, J. (1972). Das Informationsverhalten in Entscheidungsprozessen. Tübingen, Germany: Mohr (13), pp. 181-184.

[340] Witte, E.; Hauschildt, J. (1972). Das Informationsverhalten in Entscheidungsprozessen. Tübingen, Germany: Mohr (13), p. 182.

- The risk of a distorted description of elements of the independent and dependent variables is rather low, due to the presence of an observer in the laboratory experiment. In contrast, a document analyses or an interview has the risk that due to "psychological smoothing" of the participants, the reality is distorted.[341]

b) Representativity

The representativeness of empirical experiments asks for isomorphism or at least homomorphism of the research situation (here of the personal structure and the task situation) and compares this to reality. This means, that tasks which are conducted in a laboratory experiment should show high similarity to tasks in reality and people conducting the task should have the same engagement as in reality.[342] When talking about representativeness researchers in general are mainly confronted with two difficulties:

- A higher degree of abstraction enables a high controllability of all impacting factors of the empirical experiment. The chance of an accurate assessment of the cause and effect relationship is quite high. But if the degree of abstraction is too high and therefore there is a high distance to reality, this increases the risk that results cannot be applied to reality.
- At the other end, a smaller degree of abstraction, which therefore enables a relatively close distance to reality, increases the risk, that influencing factors cannot be controlled and assessed due to the high complexity of the situation. The chance of the assessment of an accurate cause and effect relationship is rather low. But in contrast the possibility of "realistic" behavior of individuals increases because of the realistic approach.[343]

As the results of experiments often have no "real" consequences for the participants, it can be questioned if the participants show the same effort within a laboratory experiment as within real life situations. The research design seems to be well constructed if it is possible to stabilize the "Ego-Involvement" during the whole time of the experiment.[344] Pre-tests for a

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[341] Neuert, J. O. (1987). Planungsgrade. Eine experimentelle Untersuchung zum Zusammenhang zwischen Planungsverhalten und Planungserfolg. Spardorf, Germany: Rene F. Wilfer, p. 165.

[342] Witte, E.; Hauschildt, J. (1972). Das Informationsverhalten in Entscheidungsprozessen. Tübingen, Germany: Mohr (13), p. 181.

[343] Neuert, J. O. (1987). Planungsgrade. Eine experimentelle Untersuchung zum Zusammenhang zwischen Planungsverhalten und Planungserfolg. Spardorf, Germany: Rene F. Wilfer, p. 155.

[344] Witte, E.; Hauschildt, J. (1972). Das Informationsverhalten in Entscheidungsprozessen. Tübingen, Germany: Mohr (13), p. 181.

similar study showed that a remark to the participants that the experiment is of pedagogical relevance, was sufficient enough to eliminate "playful behavior".[345]

When reviewing the structures of the task and the measurement of efficiency under the perspective of representativeness, the author comes to following conclusion:

- By assigning an investment decision to the laboratory experiment for the well-structured problem task, the author addressed a task which is a common task in any kind of business and therefore reflects or represents reality. The ill-structured task, which is mainly about prioritizing items, to the author's understanding, is also a task which can be found in strategic parts of business management quite often and therefore also reflects or represents reality quite well. As the mid-structured problem task is most likely a combination of a well- and ill-structured problem situation, the author believes that this task also reflects or represents the reality quite well. The selection of the mid-structured problem situation is an intermediate between the well- and ill-structured problem situations.
- For the measurement of economic efficiency the author has dedicated the measurement of time consumption to material efficiency and the target-actual comparison to formal efficiency. As time consumption is also used in the field as a measurement of material efficiency and the target-actual comparison as measurement for the formal efficiency, the author believes this demonstrates representativeness. To our understanding individual efficiency, even in a field experiment, would also have to be measured with a questionnaire, as personal attitudes (like satisfaction, self-reflection, etc.) are difficult or almost impossible to track by observing participants in an empirical experiment. Therefore, to the author's understanding individual efficiency measurement via a questionnaire provides a very accurate representativeness.

Due to the explanations above, the author believes that the setup of the empirical experiment as laboratory experiment seems to provide acceptable validity, reliability and representativeness.

[345] Witte, E.; Hauschildt, J. (1972). Das Informationsverhalten in Entscheidungsprozessen. Tübingen, Germany: Mohr (13), p. 181.

2.4.2. Planning and organization of the empirical experiment

In the previous chapter the setup of the empirical experiment was laid out and was discussed more in detail on how the experiment will be preceded and why it was preceded in the proposed construct. In next step the organization of the empirical experiment will be discussed more in detail. Prearrangements, course of action and scheduling will be reviewed.

a) Structure of the participants

The author has decided to choose the participants for the empirical experiment among managers (practitioners) and students from business management faculties to ensure comparability with previous empirical experiments as many of them were conducted with students. Several studies have already highlighted the fact that in laboratory experiment decisions of students and professionals working in the business management field produced similar results.[346] The author is aware that there is a risk that students could behave differently from practitioners, especially when tasks used in the experiment are not related to business management field. As the problem tasks for the laboratory experiment are business management related cases (cf. Appendix I) this should justify also the use of students and not only managers for the empirical experiment.[347]

b) Organization of the laboratory experiment

To be able to handle the laboratory experiment in a proper way there were several sessions with a limited amount of participants. Each session included up to a maximum of 35 participants. In the first step the participants were asked to fill with pencil and paper the personality instrument (MBTI). The participants were advised that there is no time limit on answering the questions in the instrument. After all the participants had finished the personality instrument (MBTI) they receive the first (well-structured) of three problem structured tasks (well-, mid- and ill-structured) for completion. After finishing each problem task, they were asked to fill out the questionnaire to evaluate individual efficiency for every task. To ensure, that the participants record their time on the problem task, they only received one task at a time and had to return the finished task before they could go on. In this case the supervisor/author was able to check if the time was documented. The author was aware, that

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[346] Cf. Neuert, J. O. (1987). Planungsgrade. Eine experimentelle Untersuchung zum Zusammenhang zwischen Planungsverhalten und Planungserfolg. Spardorf, Germany: Rene F. Wilfer, p. 330; Witte, E.; Hauschildt, J. (1972). Das Informationsverhalten in Entscheidungsprozessen. Tübingen, Germany: Mohr (13), p. 184.

[347] Witte, E.; Hauschildt, J. (1972). Das Informationsverhalten in Entscheidungsprozessen. Tübingen, Germany: Mohr (13), p. 184.

sessions with up to 35 participants are quite large, but to eliminate the risk that participants are biased by information of former groups, it seemed reasonable to work with groups of this size. Nevertheless, the participant were instructed not to forward any information from the experiment, therefore eliminating any risk of influencing other participants. For reasons of validity, reliability and representativeness the participants were instructed to do the following before starting the experiment:

- After the instructions, the participants received the first problem solving task (cf. Appendix I) and they were asked to complete it as required by the written problem statement.
- They could take as much time as they like: time is not a limit. But they still should document the time when they begin and when they finish the task.
- After finishing the task, they should immediately return the task to the instructor and pick up the questionnaire (cf. Appendix II) and complete it. There was also no time limit on the questionnaire.
- After they finished the questionnaire they were handed the next task and received the next questionnaire after they had turned in the completed task.
- This was the same procedure for the third and last task.
- As the experiment is of high pedagogical relevance, the participants were asked to behave as they would in a work environment.
- Until the four groups had finished the laboratory experiments, the participants were asked not communicate with other groups about the tasks they had to conducted, so that the other groups are not influenced in any way.

Each of the sessions was budgeted with about four hours in total for completing the MBTI, the three problem solving tasks and the questionnaire.

2.5. The operationalization of the variables

After the hypothetical constructs (hypotheses) were described on a theoretical basis by the construction of the theoretical causal model and the layout of the research design for the laboratory experiment was completed. The next step was to complete the scientific evaluation. It is necessary to operationalize the research variables. This was done by formulating a

measurement model for the latent exogenous and endogenous variables.[348] The quality of the results to falsify or support the hypotheses is strongly influenced by the measurement indicators. The better the empirical definitions or indictors match the theoretical definitions the more valid the results will be. This is also described as construct validity.[349]

a) The latent exogenous (independent) variables

Following the chapter 2.3.3, the independent variable, the personality predetermination, has been constructed on a theoretical analytical basis and indicators have been derived. In the next step, the empirical testing of causal theory, the exact description of the measurement of the variables will be addressed.

In the main hypotheses it is assumed that the personality predetermination has an impact on the socioeconomic efficiency of management decision making. Therefore the H_0 is formulated:

- Intuitive behavior in the decision making process leads to higher socioeconomic efficiency within certain problem categories.

In this case the personality predetermination (intuitive/rational behavior) is operationalized by a self-scoring personality profile, the Myers-Briggs Type Indicator (MBTI), which measures four dichotomies (Figure 16) to assess personality predetermination.

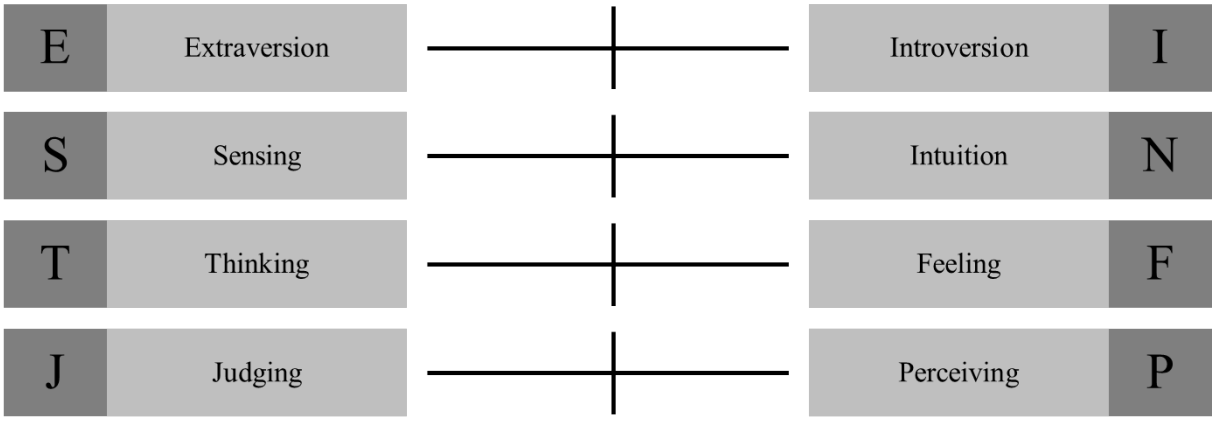

Figure 16: The four dichotomies of the MBTI

Source: Briggs Myers et al., 2003, p. 6

[348] Weiber, R.; Mühlhaus, D. (2010). Strukturgleichungsmodellierung. Eine anwendungsorientierte Einführung in die Kausalanalyse mit Hilfe von AMOS, SmartPLS und SPSS. Heidelberg, Germany: Springer (Springer-Lehrbuch), pp. 85-86.

[349] Friedrichs, J. (1990). Methoden empirischer Sozialforschung. 14. Aufl. Opladen: Westdeutscher Verlag, p. 102.

The Extraversion/Introversion (E-I) scale is used to tap a person's preference focusing their attitude/energy either on the outer world, on people and objects (E) or on concepts, ideas and internal experience (I). The Sensing/Intuition (S-N) scale taps the individual preference between two opposite ways of perceiving information, concrete factual details through the five senses using logical rules (S) versus seeing patterns through the unconscious using gut feelings (N). The Thinking/Feeling (T-F) scale taps the individual problem solving process by reflecting the preference of individuals between two contrasting ways: logic (T) versus reliance on emotions (F) when making judgments. The Judging/Perceiving (J-P) scale is designed to reflect a person's preference/attitude using a Judging process and therefore using either Thinking or Feeling (J) when dealing with the outer world or using a Perceiving process and therefore Sensing or Intuition (P) when dealing with the outer world.

These four dichotomies of the MBTI identify 16 different personality types. Within the 16 different personality types every type has one out of the four mental functions (S-N and T-F) which is preferred the most, the dominant function. The second function, the auxiliary function, provides balance to the first or dominant function. The function opposite the dominant function is the inferior function and is typically the least developed. It is also referred to as the fourth function. The opposite function to the auxiliary function is the tertiary function, also referred to as the third function.[350]

As the dual processing research sees the Sensing/Thinking types as the most analytical and the Intuition/Feeling types as the most intuitive, the four dichotomies in combination with a dominant preference for Sensing or Intuition and an auxiliary preference for Thinking or Feeling provides for the possibility to grade rational and intuitive behavior in different ranks.[351]

b) The latent endogenous (dependent and intervening) variables

In this context the socioeconomic efficiency represents the dependent variable. As already discussed in a more elaborate way in chapter (2.3.4) the determination of the socioeconomic efficiency can be done by various constructs. To operationalize the dependent variables, the socioeconomic efficiency, the economic part of efficiency, in this context, will be determined

[350] Briggs Myers, I.; McCaulley, M. H.; Qenk, N. L.; Hammer, A. L. (2003). MBTI manual. A guide to the development and use of the Myers-Briggs type indicator. 3. Aufl. Palo Alto CA, USA: CPP, Inc., pp. 29-31.

[351] Hough, J. R.; ogilvie, d. (2005). An Empirical Test of Cognitive Style and Strategic Decision Outcomes. In: Journal Management Studies 42 (2), pp. 426-427.

and measured by material and formal efficiency and the socio-psychological part of efficiency will be determined and measured by individual efficiency.

1) Operationalization and measurement of the economic efficiency

Material efficiency in decision making relates to economic results and can be understood as an input-output relationship which is measured by criteria like profit, growth, rate of return, etc. Management science has created a series of key indicators to display material efficiency in decision making. Mostly these are measures which indicate economical activities as input-output relationships with performance indicators like profitability, cost and returns or cost and benefits.[352] So in this context the time, as an indirect measure for costs, will serve as a measurement indicator for the latent endogenous variable. Within the experimental study, the participants will be instructed to record the time they have used for the completion of the different tasks. So the duration of time the participants need for each task fulfillment, will provide an indication on the material efficiency in the decision making process.

Since time as a measurement indictor does not give any indication on the quality of the decision making process, but is a main criteria of efficiency, the measurement of formal efficiency will give an indication on the quality of the decision making process.[353] In this context formal efficiency will be tracked by comparing the results of problem solutions from the participants to the "optimal results". Since well-structured tasks by definition (cf. chapter 2.3.1) are tasks which can be solved quantitatively by a mathematical algorithm, the indicator for an optimal result for a well-structured problem task will be a correct figure achieved by a calculation. For the ill-structured tasks, where by definition (cf. chapter 2.3.1), the problem constellation cannot be calculated by a mathematical algorithm and might not have an objective result, the optimal result will be determined by the judgment of experts. For the mid-structured problem tasks, which are characterized (cf. chapter 2.3.1) by having a part within the problem structure which can be determined by a calculation and another part which might have no objective solution, the optimal result will be a combination of both a calculation of a figure and a judgment of experts.

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[352] Neuert, J. O. (1987). Planungsgrade. Eine experimentelle Untersuchung zum Zusammenhang zwischen Planungsverhalten und Planungserfolg. Spardorf, Germany: Rene F. Wilfer, p. 119.

[353] Gzuk, R. (1975). Messung der Effizienz von Entscheidungen. Tübingen, Germany: J.C.B. Mohr (Empirische Theorie der Unternehmung, 5), p. 5.

2) Operationalization and measurement of the socio-psychological efficiency

The socio-psychological efficiency is represented by individual efficiency and is the more subjective part within the decision making process dealing with results which can be considered as “soft facts” and are related to emotions, feelings, acceptance and satisfaction of individuals. The individual efficiency is more characterized by the decision makers hope to fulfill the expectation and in this sense can also be described as the satisfaction of the decision maker concerning the achieved results. As in this case it is rather difficult or almost impossible to track personal attitudes (like satisfaction, self-reflection, etc.) by observing participants in an empirical experiment a questionnaire (cf. Appendix II) is used which contains mainly questions about the personal satisfaction of the participants on solving the problem tasks, how systematic they rate their approach solving the task and how they rate their own cognitive style.[354]

3) The total efficiency in the concept of the causal context

In the end economic efficiency (material and formal efficiency) and socio-psychological efficiency (individual efficiency) with the various measurement indicators need to be brought together in a construct of total efficiency within the causal analytical context. This means seeing, how different kinds of personalities (personality predetermination) impact the efficiency of management decision making.

As discussed in chapter 2.3.4 the total efficiency will be calculated by the amalgamation of material, formal and individual efficiency. For this case the author has decided to rely on the amalgamation concept of Neuert.[355] Neuert has conducted a survey, taking a representative sample from the population, to evaluate the weighting of different efficiency dimensions as they are present in reality. The evaluation indicated that material efficiency represents 70% of the weight, formal efficiency 20% of the weight and individual efficiency 10% of the weight.[356] Therefore the same level of weighting will be used for the calculation of the total efficiency within this study.

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[354] Neuert, J. O. (1987). Planungsgrade. Eine experimentelle Untersuchung zum Zusammenhang zwischen Planungsverhalten und Planungserfolg. Spardorf, Germany: Rene F. Wilfer, Appendix 3.

[355] Neuert, J. O. (1987). Planungsgrade. Eine experimentelle Untersuchung zum Zusammenhang zwischen Planungsverhalten und Planungserfolg. Spardorf, Germany: Rene F. Wilfer, Appendix 3, p. 125.

[356] Ibid., p. 268.

2.6. Evaluation of the material, the formal, the individual and the total efficiency

In the previous chapters the concept of material, formal and individual efficiency are described in a more elaborate way and it is also shown how they can be measured. In the next step it will be shown how material, formal, individual efficiency and finally total efficiency can be evaluated from the results of the laboratory experiment. For illustration purposes the efficiency figures will be standardized to a scale from 0 to 1.

a) Evaluation of the material efficiency

For material efficiency (E_M), the use of time as an indirect measure for costs, serves as indicator. In this case the time which is consumed to fulfill the different tasks is measured and evaluated. Meaning that using less time to achieve the tasks indicates a higher material efficiency. To have a common "direction" of the figures (the higher = the better), the time is inverted (1-time). To standardize material efficiency on the scale from 0 to 1, the time is divided by 60, turning the minutes into hours. To avoid negative figures for material efficiency, results which exceed 60 minutes will be excluded from the sample.

$$E_M = 1 - \left(\frac{\text{time}}{60}\right) \tag{1}$$

b) Evaluation of the formal efficiency

As described in chapter b) formal efficiency (E_F) within the laboratory experiment will be tracked by comparing the results of the problem solution process of the participants with the "optimal results". For the three kind of problem situations (well-, mid- and ill-structured) three different specific kinds of tasks (task I, task II and task III) were selected. Due to different structure (well-, mid- and ill-structured) they require different methods for the evaluation of the respective formal efficiency.

1) Evaluation of the formal efficiency of task I

Task I, the well-structured task, is about an investment decision making problem of choosing between three different production machines. As this the well-structured task can be solved quantitatively by a mathematical algorithm, the indicator for an optimal result will be a correct figure done by a calculation. Task I includes seven steps to complete the final result. Therefore the solution for task I is evaluated by seven different assessment criteria which are used to evaluate the quality of solving the problem. The distribution of the points on the different assessment criteria is shown in Figure 17.

Assessment criteria's	Pts.
A1: Calculation method of the fixed costs	2
A2: Result on the calculation method of the fixed costs	1
A3: Calculation method of the variable costs	2
A4: Results on the calculation method of the variable costs	1
A5: Evaluation and selection of the most economic production machine	1
A6: Calculation method of the critical production volume when to select which machine	2
A7: Result on the calculation method of the critical production volume	1
$E_{F\,TI}$ Total result:	10

Figure 17: Assessment criteria's for the evaluation of task I

Source: Author

The candidates can achieve within task I between 0 and 10 points concerning on how close their calculation is to the "correct" calculation. To standardize formal efficiency of the task 1 on a scale from 0 to 1 the results are divided by 10. Therefore the formal efficiency of task I ($E_{F\,TI}$) is calculated as follows:

$$E_{F\,TI} = \frac{(A_1 + A_2 + A_3 + A_4 + A_5 + A_6 + A_7)}{10} \qquad (2)$$

2) Evaluation of the formal efficiency of task II

Task II, the mid-structured task, which can be characterized by having a part within the problem structure which can be determined by a calculation and another part which might have no objective solution and is addressed by a case study about a decision making process for a marketing strategy. Within this task the candidates, **first** have to rank the plausibility of the decisions taken by different managers (sales director, technical director, finance director, marketing director and human resources director) about the marketing strategy, **second** to rank which of the manager's strategy the candidates prefer the most and **third** to setup a calculation on the financial impact of the strategy. Task II is also laid out on a 10 point scale. The first part is maximum credited with a maximum of 2.5 points, the second part with a maximum of 2.5 and the third part with a maximum of 5 points (cf. Figure 18). The **first part** of formal efficiency measures (E_{f1}), the evaluation of the quality of the ranking plausibility of the manager's decisions and is done by comparing the results of the candidates to an expert's solution. Meaning if the candidate is within the range of the expert's solution the candidate is credited with points and if not the candidate doesn't receive any points. As there are five managers and the maximum total is 2.5 points every correct answer is credited with 0.5

points. The **second part** of formal efficiency measures (E_{f2}), the evaluation of the candidate's solution on the preference of the manager's strategy and is done by subtracting the candidate's solution from the expert's solution. The maximum quality is achieving 0 points, meaning there is no difference to the expert's solution or the minimum quality is achieving 12 points, meaning the ranking was the maximum inverse to the expert's solution. To have the same "direction" as task I, the higher the points the better the quality of the solution. The results of the task II (T_{II}) of the candidates where subtracted from the minimum score (12 points). To also stay within the 10 point scale as with task I, the second part of formal efficiency is further standardized to a 2.5 scale as follows:

$$\mathrm{E}_{f2} = (12 - T_{II}) \times \frac{2{,}5}{12} \tag{3}$$

The **third part** of formal efficiency measures (E_{f3}) is about calculating which one of two options of the marketing strategy is more favorable. Therefore the option 1 and option 2 are evaluated so that the final result is calculated. In the final result each of the two options is credited with one point.

Adding up the first, the second and the third part of the measures results in the final formal efficiency ($\mathrm{E_{FTII}}$) of task II. To standardize formal efficiency again on a scale from 0 to 1 the sum of the partial formal efficiencies will be divided by ten, so that formal efficiency will also include values from 0 to 1.

$$E_{F\,TII} = \frac{E_{f1} + E_{f2} + E_{f3}}{10} \tag{4}$$

No.	Evaluation Details	Exp.	Pts.	xxx325	xxx325	xxx023	xxx023
1.	Plausibility sales director	4-5	0,5	5	0,5	2	0,0
2.	Plausibility technical director	1-2	0,5	1	0,5	1	0,5
3.	Plausibility financial director	1-2	0,5	5	0,0	1	0,5
4.	Plausibility marketing director	4-5	0,5	5	0,5	4	0,5
5.	Plausibility human res. Director	2-3	0,5	1	0,0	2	0,5
E_{f1}	Sub results:		2,5		1,5		2,0
6.	Preference sales director	4		4	0	3	1
7.	Preference technical director	1		2	1	2	1
8.	Preference financial director	2		5	3	1	1
9.	Preference marketing director	5		3	2	5	0
10.	Preference human res. Director	3		1	2	4	1
	Standardizing (the higher= better):				4		8
E_{f2}	Sub results standard. on 2.5 pt. scale:				0,8		1,7
11.	Option 1		1,66		0,0		0,8
12.	Option 2		1,66		0,0		0,8
13.	Evaluation final result		1,66		0,0		0,0
E_{f3}	Sub result:				0		1,7
E_{FTII}	Total result:				0,23		0,54

Figure 18: Example of the evaluation of task II

Source: Author

3) Evaluation of the formal efficiency of task III

The Task III, the ill-structured task, where by definition the problem constellation cannot be calculated by a mathematical algorithm and might not have an objective result and where the optimal result will be determined by the judgment of experts represents a decision making situation in an imaginative urgency (crash on the moon). The task is to rank 15 items from 1-15 (cf. Figure 19) on how “important” they are for a successful survival of the urgency. The calculation about the quality of the solution is done by calculation of the difference between the “expert’s” solution ranking of devices and the ranking of the candidate. The maximum quality is achieving 0 points, meaning there is no difference to the expert’s solution or the minimum quality of achieving 112 points, meaning the ranking was the maximum inverse to the expert’s solution. To have again a “common” direction as in the figures of task I and task II, the higher the points the better the quality of the solution. The results of the candidates are subtracted from the minimum score (112 points). Therefore the result of task III can be calculated as:

$$T_{IIIs} = 112 - T_{III} \quad (5)$$

To also have a 0 to 1 point scale as in task I and task II the results of task III are also standardized:

$$E_{F\,TIII} = \frac{(T_{IIIs} \times \frac{10}{112})}{10} \quad (6)$$

No.	Items	Exp.	xxx157	xxx157	xxx387	xxx387
1.	Box of matches	15	15	0	13	2
2.	Food concentrate	4	9	5	9	5
3.	50 feet of nylon rope	6	6	0	11	5
4.	Parachute silk	8	10	2	15	7
5.	Portable heating unit	13	2	11	7	6
6.	Two .45 caliber pistols	11	11	0	12	1
7.	One case of dehydrated milk	12	8	4	14	2
8.	Two 100 lb. tanks of oxygen	1	1	0	1	0
9.	Stellar map	3	14	11	2	1
10.	Self-inflating life raft	9	12	3	10	1
11.	Magnetic compass	14	13	1	3	11
12.	5 gallons of water	2	3	1	4	2
13.	Signal flares	10	5	5	8	2
14.	First aid kit, including injection needle	7	7	0	5	2
15.	Solar-powered FM receiver-transmitter	5	4	1	6	1
T_{III}	Min. = 112 pts.			44		48
T_{IIIs}	Standardization (higher values = better results):			68		64
E_{FTIII}	Total result standardized on a 0-1 pt. scale:			0.61		0,57

Figure 19: Example of the evaluation of task III

Source: Author

c) Evaluation of the individual efficiency

Every candidate is asked to fill out a standardized and structured questionnaire after completing the different tasks (task I, task II and task III). Different questions (cf. Appendix II) within the questionnaire are build up in a way that candidates who are more satisfied and can identify themselves more with the problem solution process will rate higher scores on a

five point Likert scale rather than those who are less satisfied and can less identify themselves with the problem solution process.[357]

Example:

How satisfied were you today with your problem solution process?

very unsatisfied	1	2	3	4	5	very satisfied

Therefore the higher the candidates score on the five point Likert scale the higher their individual efficiency can be rated. The overall individual efficiency is then calculated by adding up the different figures from the Likert scales of the first six questions from the questionnaire and then dividing them by six to get the mean value. To standardize the individual efficiency for the amalgamation of total efficiency the sum of the partially individual efficiencies will be divided by five, so that individual efficiency will again include values between 0 and 1.

$$\mathrm{E_P} = \frac{(Q_1 + Q_2 + Q_3 + Q_4 + Q_5 + Q_6)}{(6 \times 5)} \tag{7}$$

d) Evaluation of the total efficiency

Having evaluated and standardized the results of the material, the formal and the individual efficiencies, the total efficiency for every task is calculated by adding up the individual, the formal and the material efficiency. By the amalgamation concept of Neuert the material efficiency is weighted with 70%, the formal efficiency with 20% and the individual efficiency with 10%.[358] Therefore the total efficiency is calculated by:

$$E_T = \mathrm{E}_M \times 0.7 + E_F \times 0.2 + E_P \times 0.1 \tag{8}$$

The total efficiency measure is calculated for each of the different problems (well-, mid- and ill-structured) individually.

[357] Neuert, J. O. (1987). Planungsgrade. Eine experimentelle Untersuchung zum Zusammenhang zwischen Planungsverhalten und Planungserfolg. Spardorf, Germany: Rene F. Wilfer, Anhang 3.

[358] Ibid., p. 125.

3. EMPIRICAL RESULTS, AND CONCLUSIONS AND SUGGESTIONS, DERIVED FROM THE RESEARCH FINDINGS [359]

3.1. Explanation of the statistical analysis

From a scientific point of view, research is not just comprised of the formulation of cause-effect hypotheses. It also demands that these hypotheses are confronted with reality by establishing empirical tests to allow falsifying or tentatively substantiating these hypotheses.[360] So in this case to satisfy scientific standards it is necessary to confront the hypotheses with reality (in the present case the empirically retrieved data of management decisions from candidates with different personalities).

According to Prim and Tilmann the structure for generating and validating the author's theory about the impact of personality on management decisions can be described as following:

- The formulation of the hypotheses, e.g.: Intuitive behavior in decision making process leads to higher socioeconomic efficiency within ill structured problems than rational behavior
- The setup of so called basic sentences from the empirical data collection (e.g. human beings with intuitive behavior are more efficient when solving ill-structured problem situations, etc.)
- The confrontation of the hypotheses with the basic sentences (in our case the hypotheses are falsified or temporarily confirmed with the empirical data)[361]

This means that any basic sentence which is contrary to the statements or any of hypotheses can refute those hypotheses. In turn every hypothesis which is supported by a basic sentence can be taken as tentatively substantiated.[362] So for this case if statistical measures show a confirmation of the hypotheses it seems to be evident that human beings with a certain

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[359] Parts of this chapter have been published in: Hoeckel, C. (2012). The Impact of Personality Traits and Behavioral Patterns on the Outcomes of Business Management Decision Making – A Framework for an Empirical Study. In: New Challenges of Economic and Business Development Conference Proceedings, Riga, Latvia, pp. 259–269; Neuert, J.; Hoeckel, C. (2013). The Impact of Personality Traits and Problem Structures on Management Decision-Making Outcomes. In: Journal of Modern Accounting and Auditing 9 (3), pp. 382-393.

[360] Popper, K. R. (2005). Logik der Forschung. 11. Aufl. Hg. v. Herbert Keuth. Tübingen: Mohr Siebeck, pp. 16-17.

[361] Prim, R.; Tilmann, H. (1977). Grundlagen einer kritisch-rationalen Sozialwissenschaft. Studienbuch zur Wissenschaftstheorie. 3. Aufl. Heidelberg: Quelle und Meyer, p. 82 ff.

[362] Neuert, J. O. (2009). Sozio-ökonomische Analyse der "Integrierten Mediation" als Konfliktregelungskonzept. Realtheorie, Modelkonstrukt und empirische Befunde. Kufstein (Unpublished Project Study), p. 278.

behavior (e.g. intuitive) are more efficient when solving tasks with a certain kind of structure (e.g. ill-structured).

A scientific research design consists in the first step of a concept to gather empirical data in regards to the main research question and to falsify or tentatively substantiate the construct of the hypotheses. In the second step, following the collection of the data, an evaluation and interpretation of the data is carried out with statistical methods and procedures. Statistics in this sense can be understood as the scientific collection, preparation, illustration, analysis and interpretation of figures and data.[363] Statistical methods are used to quantify mass data to allow describing, judging and drawing conclusions from them.

In this context there is also a differentiation between descriptive and inferential statistics. Descriptive statistics are used when statistical analyses are mainly needed to record, summarize and present data. Descriptive statistics use e.g. tables, histograms and numerical characteristics like mean values, standard deviations and correlation coefficients to summarize and present data. Actually the interest of scientific research is not only to summarize and present data but also to draw the right conclusions from the results. And inferential statistics include in addition to the presentation of data conclusions and evaluations in a form of an interpretation of the results from the obtained data. Therefore inferential statistics mainly use two methods, first the method of estimation and second statistical tests to prove the hypotheses.[364] In addition statistical procedures also represent uni-, bi- and multi-variant methods. If just on variable is part of the research, then uni-variant statistical methods (e.g. averaging, standard deviation, etc.) are required. When two variants are part of the research then bi-variant methods (e.g. correlation analysis) are of use. Having three and more variables require multi-variant statistical methods like multiple regression analyses or covariance based causal analyses.[365] As most of the above mentioned statistical methods and procedures are complex and time consuming to calculate modern information and media technology has developed a vast amount of software products which are adequate to process large amounts of data and support a manifold of statistical analyses. One of the most popular software products for statistical analysis is the program SPSS (Statistical Package for Social the Sciences).[366] For the completion of the statistical analyzes of the present work the author has used the

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[363] Lorenz, R. J. (1996). Grundbegriffe der Biometrie. 4. Aufl. Stuttgart, Jena, Lübeck, Ulm: G. Fischer, pp. 16-19.
[364] Ibid.
[365] Ibid.,pp. 51 ff.
[366] Backhaus, K.; Erichson, B.; Plinke, W.; Weiber, R. (2011). Multivariate Analysemethoden. Eine anwendungsorientierte Einführung. 13. Aufl. Berlin, Germany: Springer.

current version of the SPSS. With the support of the SPSS package the author has managed to realize the descriptive and inferential statistics of this work.

Based on the laboratory experiment treatments and the resulting data sets the following statistical procedures were conducted:

- Computation of means and means distribution and relative frequencies of the overall efficiencies measures (incl. Chi-Square-Tests) in the various decision task structures (well-, mid- and ill-structured tasks)
- Statistical correlation analyses on the basis of a structural equation model for the examination of complex correlations between various personality trait measures of the experimentees and the decision making efficiency measures in the various decision making task structures

The functions and procedures of the statistical analyses will be described later in a more elaborate way when analyzing the empirical data of the laboratory experiment.

3.2. Demographic data from the participants of the empirical study

The overall sample size of the laboratory experiments included 111 participants (Figure 20).

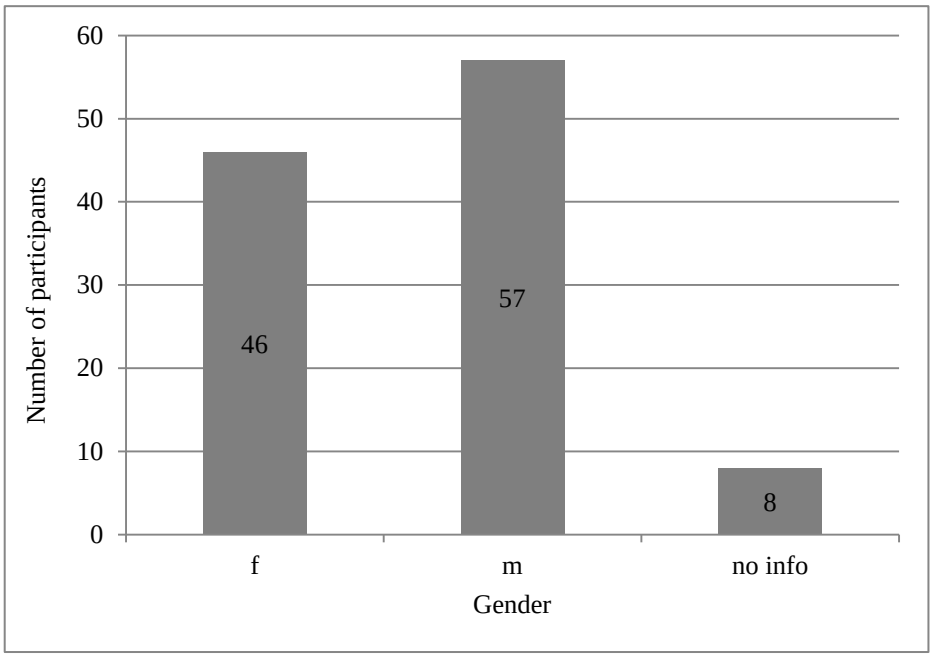

Figure 20: Distribution of gender within the laboratory experiments

Source: Author

From these 111 participants 109 completed task 1, task 2 was completed by 98 participants and task 3 was completed by 106 participants. These completed data sets were included in the

statistical analyses. The experiments were carried out in four groups, whereby two groups were managers in the field of business administration, one group was comprised of master students (MIM) in the field of international management and one group was comprised of bachelor students (BIB) in the field of international business (Figure 21).

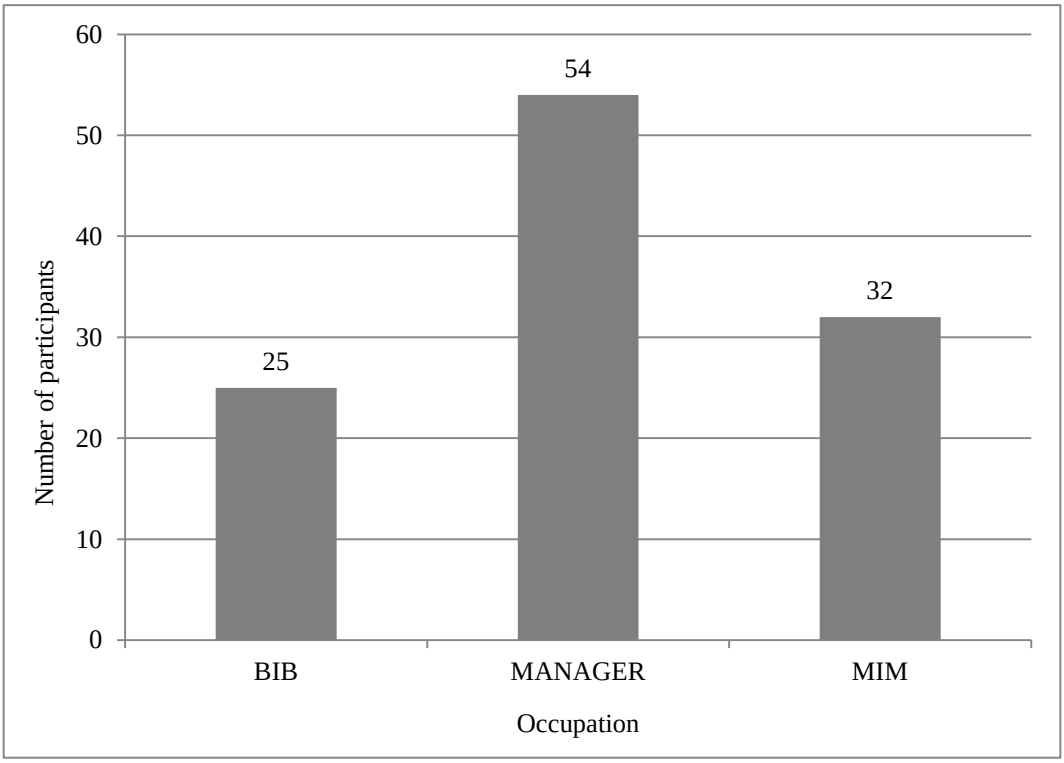

Figure 21: Occupation of the participants of the laboratory experiments

Source: Author

From the 111 participants 46 (41 %) were females and 57 (57 %) were males. For 8 (7 %) participants there was no information on the gender available. Seventy two of the participants had birth dates between 1962 and 1991. The rest of the participants (39) did not provide any information on their year of birth during the experiment (Figure 22). The mean of the year of birth for the managers, the master and the bachelor students was 1982.

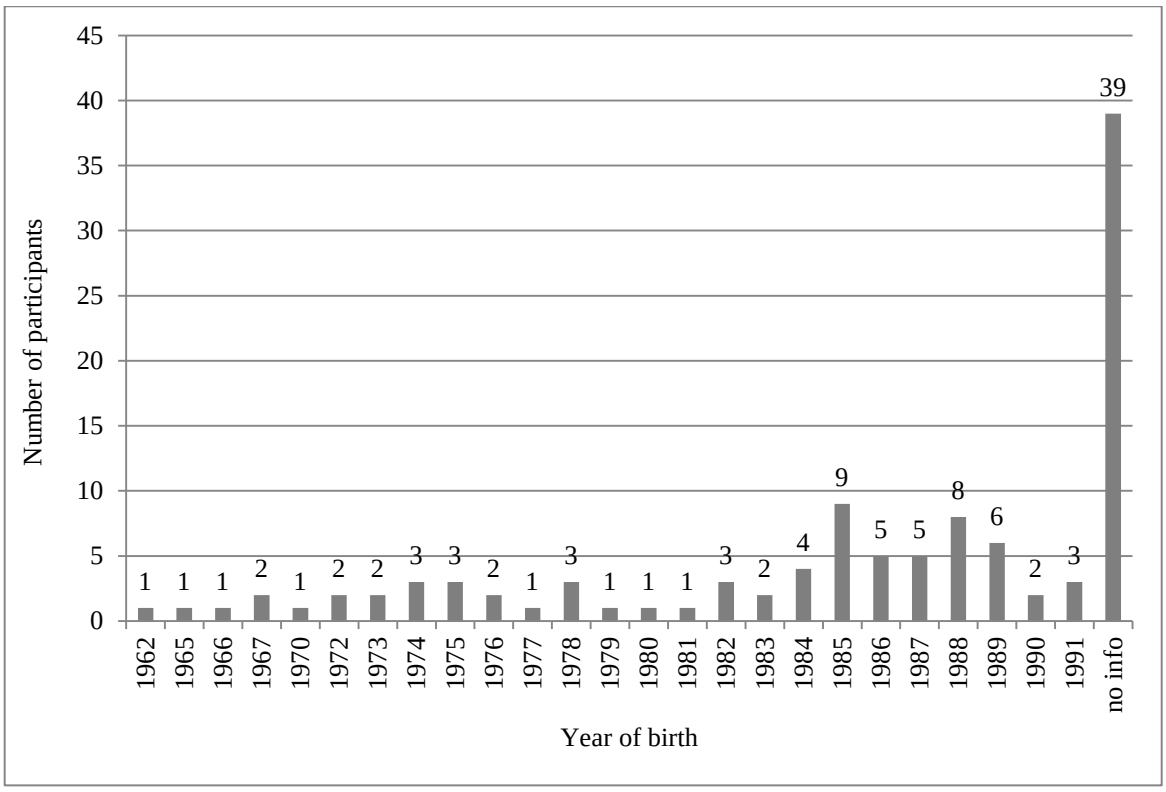

Figure 22: Distribution of age among the participants of the laboratory experiments

Source: Author

Figure 23 shows, not surprisingly, that the managers are on the average “older” than the master students (MIM) and they are again “older” than the bachelor students (BIB). The mean of the manager’s year of birth was 1977, the master student’s mean of the year of birth was 1985 and the bachelor student’s mean of the year of birth was 1987.

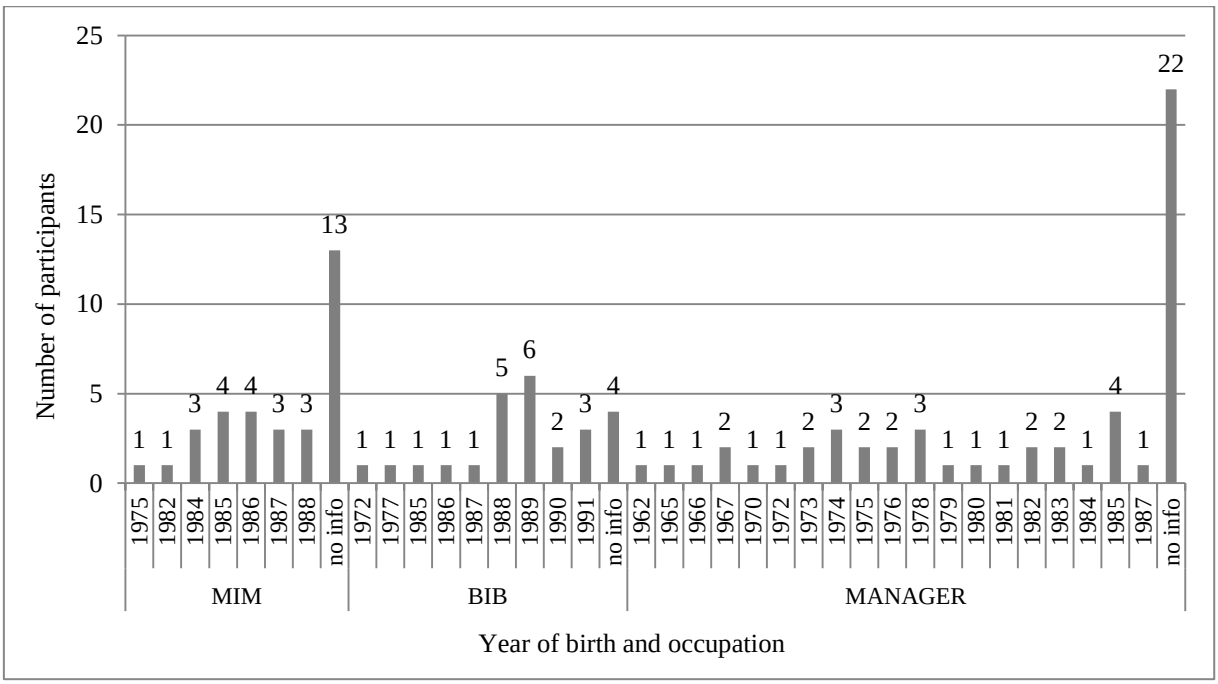

Figure 23: Distribution of age and per occupation among the participants

Source: Author

The measurement of the personality predetermination by the MBTI revealed that 78 (70 %) participants are Extraverted and 33 (30 %) are Introverted on the Extraverted-Introverted (E-I) scale. On the Thinking-Feeling (T-F) scale, 87 (78 %) of the participants are Thinking types and 24 (22 %) are Feeling types. Sensing types are represented by 57 (51 %) participants and Intuition types are represented by 54 (49 %) participants on the Sensing-Intuition (S-N) scale. On the Judging-Perceiving (J-P) scale the Judging types are represented by 69 (62 %) and Perceiving types are represented by 42 (38 %) participants. The results show, that among the participants of the experiment the Judging, Extraverted and especially the Thinking types are more highly represented than the other types (Figure 24).

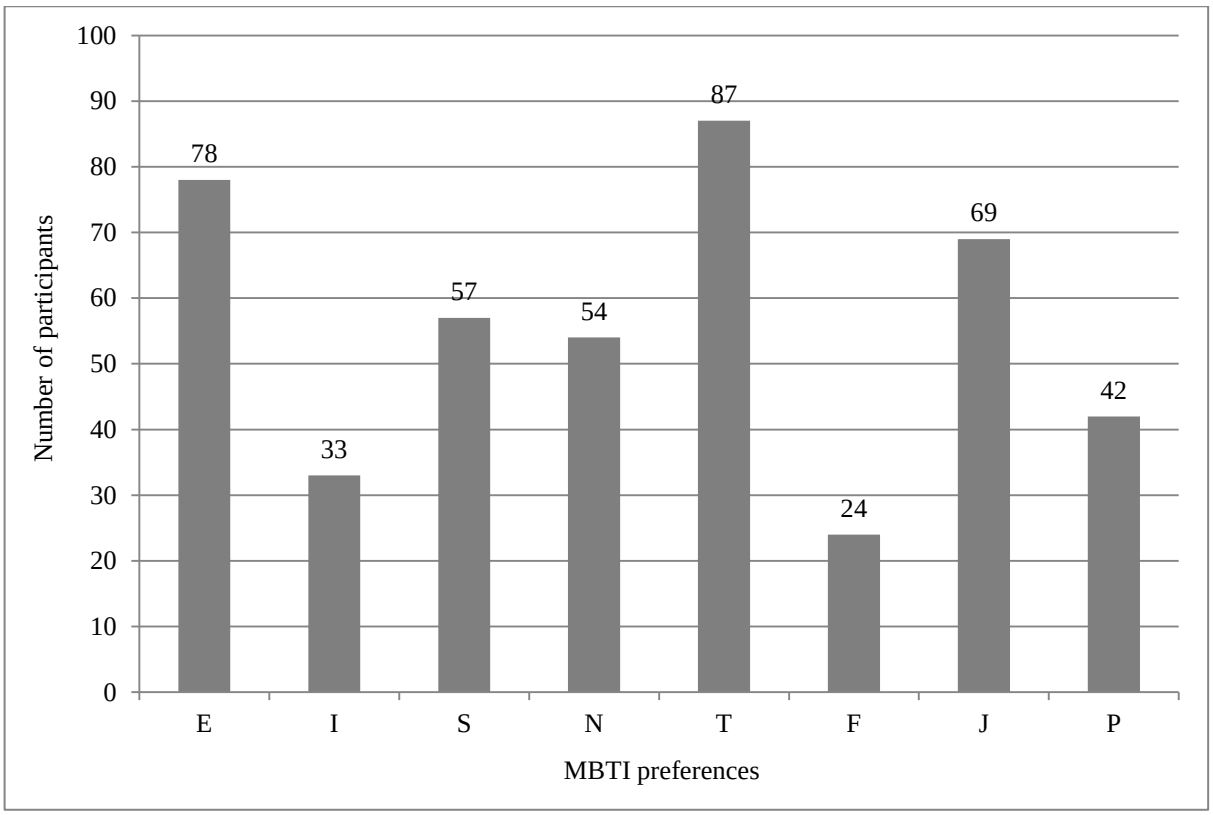

Figure 24: The MBTI preferences among the participants

Source: Author

Figure 25 shows the distribution of the personality types among the participants of the experiment. Besides the personality types, Figure 25 also shows how the different MBTI types are related to different behavioral styles according to their dominant function (cf. Figure 13).[367] From the 16 personality types of the MBTI the ENTJ, ESTJ and the ENTP represent 48% of the participant's types.

[367] Hirsh, K; Hirsh, E. (2007). Introduction to Type and Decision Making. Mountain View, CA: CPP, Inc., p. 5.

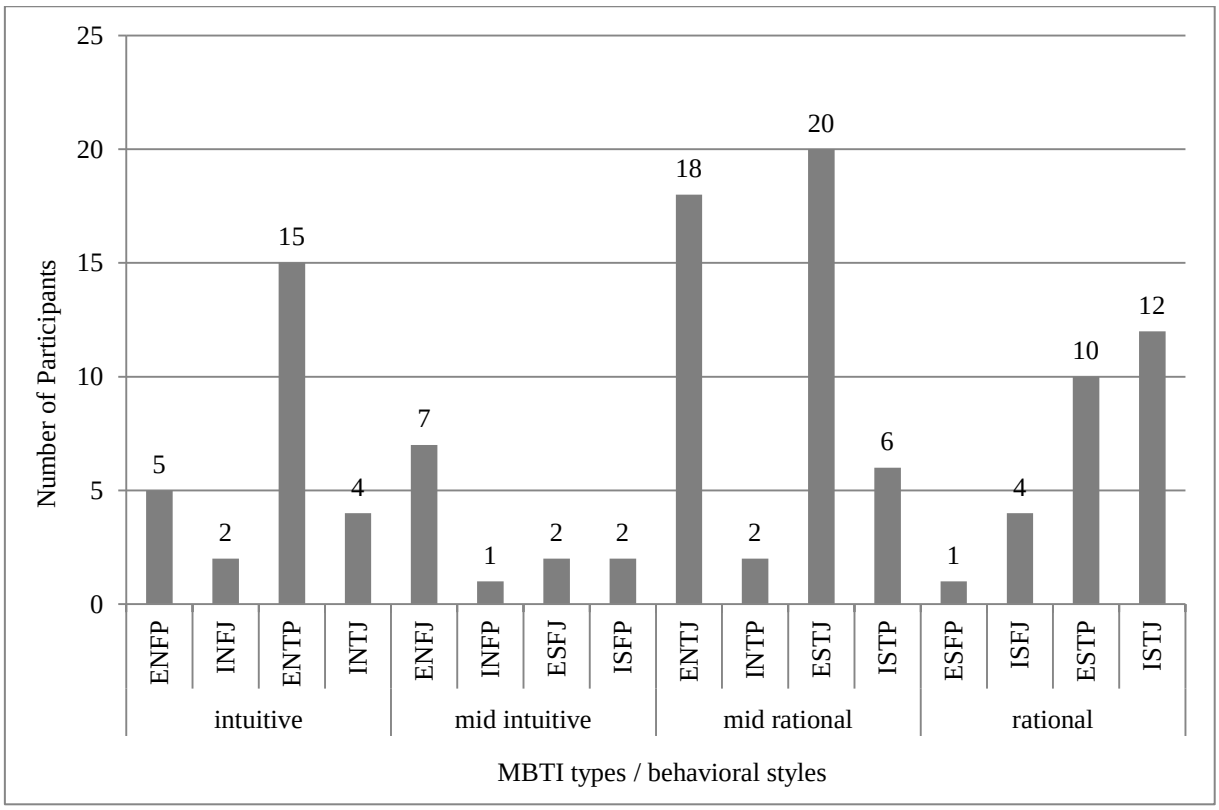

Figure 25: Distribution of the MBTI personality type and the behavioral style among the participants

Source: Author

According to their dominant function (cf. Figure 13) the participants of the laboratory experiment where grouped into four kinds of behavioral styles (intuitive, mid intuitive, mid rational and rational). Figure 26 shows that 46 (41%) participants have a mid-rational style. The clear rational 27 (24 %) and intuitive 26 (23 %) participants of the study are about on the same level. The mid intuitive 12 (11 %) participants are somewhat “underrepresented”.

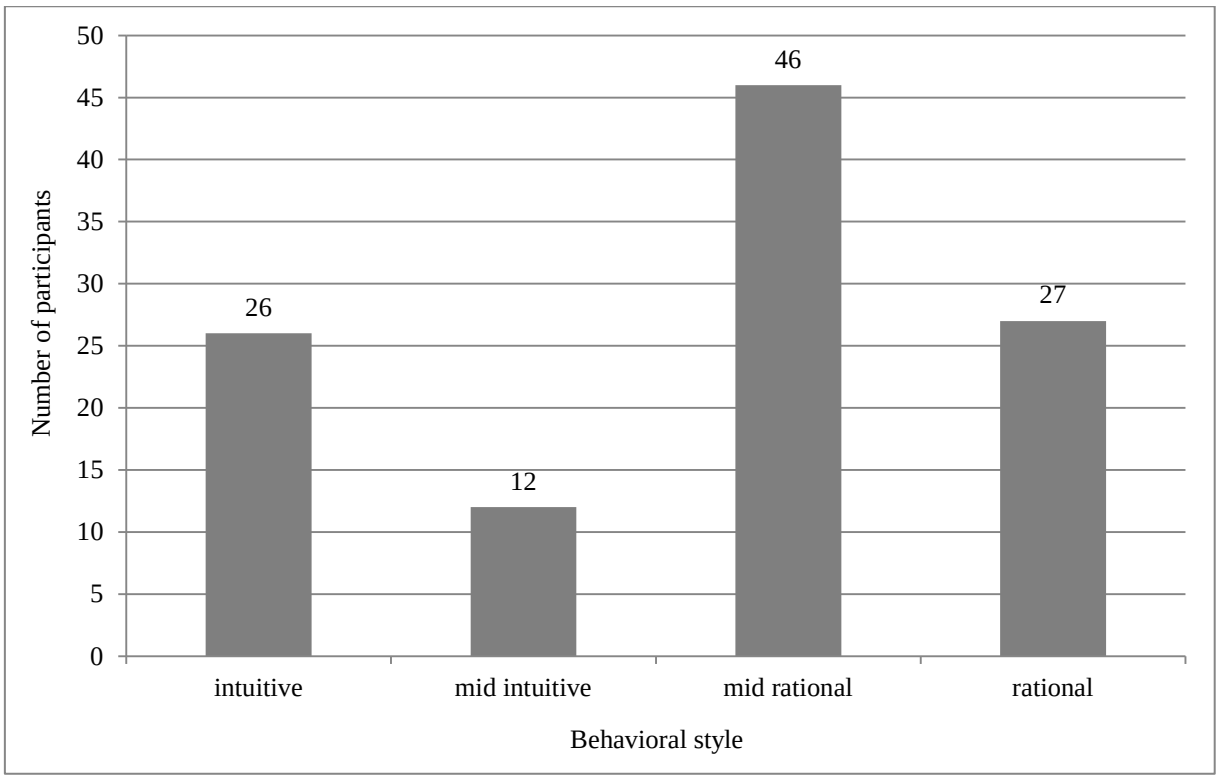

Figure 26: Participants of the laboratory experiment grouped by their behavioral style
Source: Author

The distribution of the personality types (predetermination) among the participants of the empirical experiment could lead to the insight that the data may not represent the general population as some personality types (Figure 25) or grouped personality types (Figure 26) are more highly represented than others. But according to the findings of Briggs Myers et al. certain personality types are more likely to select a certain kind of job or jobs with certain kinds of tasks.[368] For ESTJ and ENTJ types it is quite common to be working in management jobs. The ESTJ and the ENTJ are both types which are overrepresented by working MBA students as compared with the national sample.[369] In this case it seems quite "normal" and acceptable that personality types of the mid rational types are "overrepresented" in the test sample compared to the other personality types.

[368] Briggs Myers, I.; McCaulley, M. H.; Qenk, N. L.; Hammer, A. L. (2003). MBTI manual. A guide to the development and use of the Myers-Briggs type indicator. 3. Aufl. Palo Alto CA, USA: CPP, Inc., pp. 293-295.
[369] Ibid., pp. 89-95.

3.3. Testing of the hypotheses concerning the impact of personality types on the efficiency outcomes of management decisions

Based on the theoretical complex, the author assumes that intuitive behavior in the decision making process leads to higher socioeconomic efficiency within certain problem categories. This assumption is tested by taking the personality predetermination as the independent variable and evaluating the impact on the socioeconomic efficiency of the decision making process where as the dependent variable which is influenced by the structure of the problem as a intervening variable.

3.3.1. Statement and findings within ill-structured problem situations

In the proposed theory the author states that there is a cause and effect relationship between the intuitive and rational personality predetermination, an ill-structured problem situation and socioeconomic efficiency of the decision making process. Therefore the hypotheses H_{01} and H_{04} are addressed by the following statements:

H_{01} Intuitive behavior in decision making process leads to higher efficiency within ill-structured problems than rational behavior.

H_{04} Rational behavior in decision making processes leads to lower efficiency within ill-structured problems than intuitive behavior

The results from the empirical data of the participants solving ill-structured problem tasks can be interpreted according to the empirical data as follows:

The mean value shows a slight difference between Extraverted (E) and Introverted (I) types and total efficiency outcomes when solving ill-structured problem tasks (Figure 27).

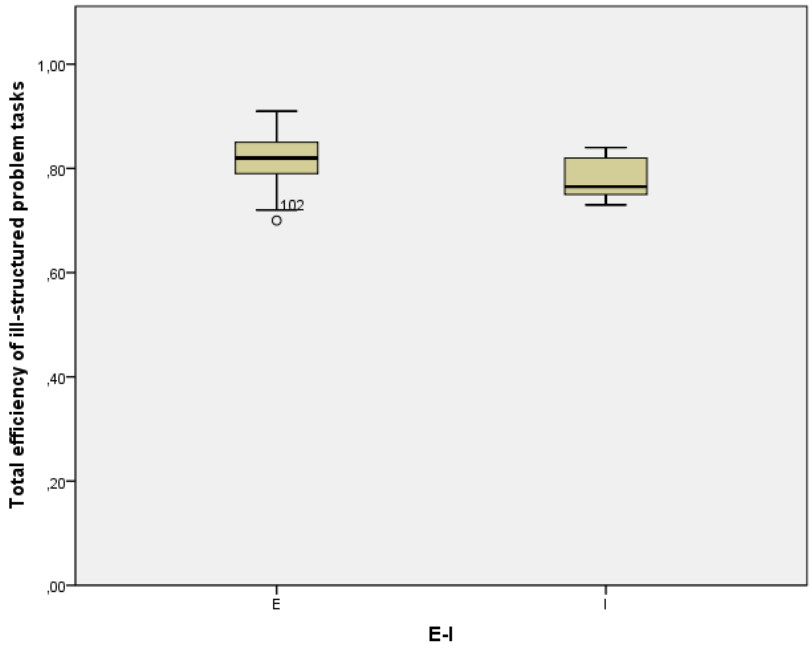

Figure 27: Mean values of Extraverted-Introverted (E-I) types and decision making efficiency when solving ill-structured problem tasks

Source: Author

But when comparing Extraverted (E) and Introverted (I) types on material efficiency it can be seen that the Extraverted (E) types use generally less time to complete the tasks and therefore are more efficient than Introverted (I) types.

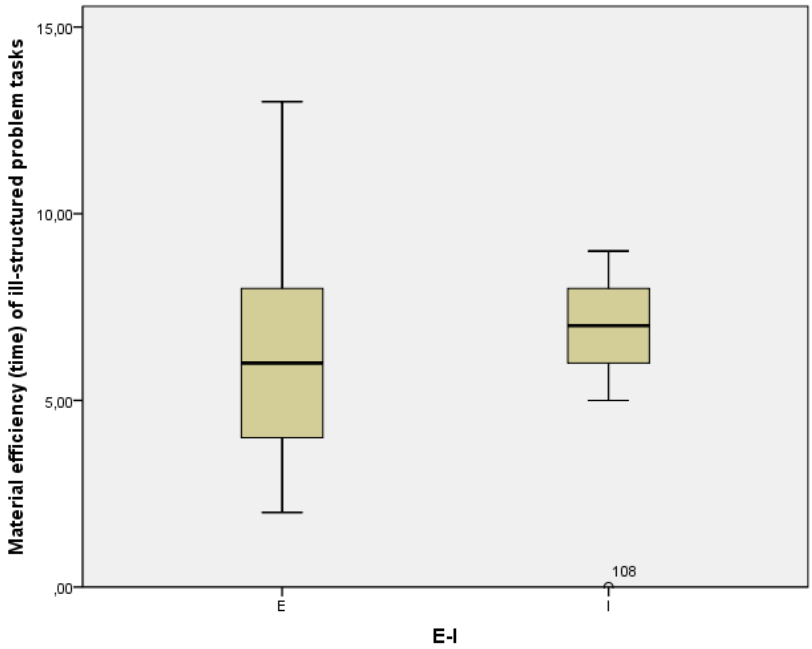

Figure 28: Mean values of Extraverted-Introverted (E-I) types and material efficiency when solving ill-structured problem tasks

Source: Author

The Chi-Square-Test also shows a significant relationship between Extraverted (E) types and material (Figure 29) efficiency when solving ill-structured problem tasks.

E types - material effciency	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	23,554[a]	12	,023
Likelihood-Ratio	16,341	12	,176
Linear-by-Linear Association	,005	1	,946
No. of Valid Cases	107		

Figure 29: Chi-Square-Test of Extraverted (E) types and material efficiency when solving ill-structured problem tasks

Source: Author

Similar to the material efficiency, the Extraverts (E) also show on the average higher scores when completing ill-structured problem tasks and therefore are more efficient than Introverts (I).

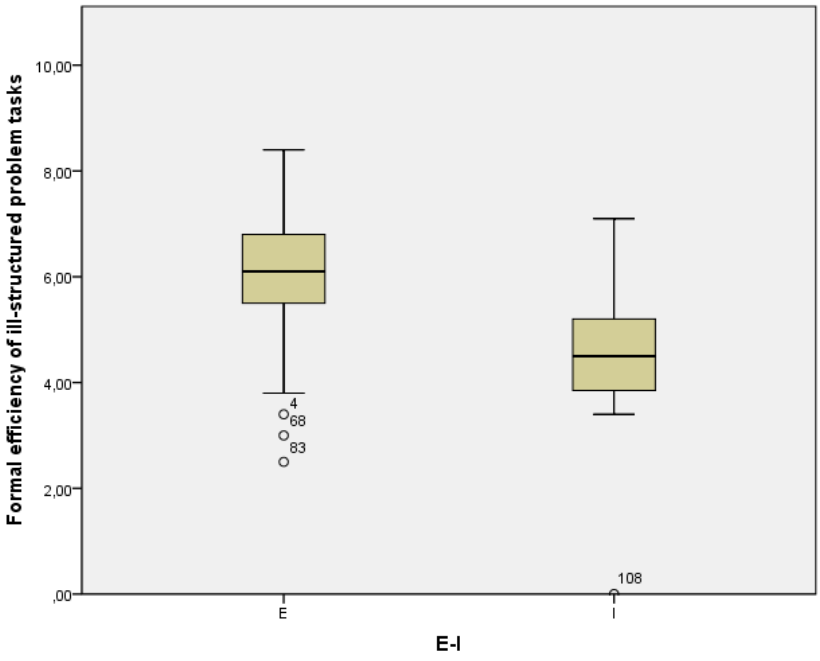

Figure 30: Mean values of Extraverted-Introverted (E-I) types and formal efficiency when solving ill-structured problem tasks

Source: Author

The Chi-Square-Test again shows again a significant relationship between Extraverted (E) types and formal efficiency (Figure 31).

E types - formal efficiency	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	40,065[a]	27	,051
Likelihood-Ratio	27,196	27	,453
Linear-by-Linear Association	11,174	1	,001
No. of Valid Cases	106		

Figure 31: Chi-Square-Test of Extraverted (E) types and formal efficiency when solving ill-structured problem tasks

Source: Author

In this case the Extraverted (E) types show a significant impact on the efficiency outcomes of material and formal efficiency when solving ill-structured problem tasks (Figure 32).

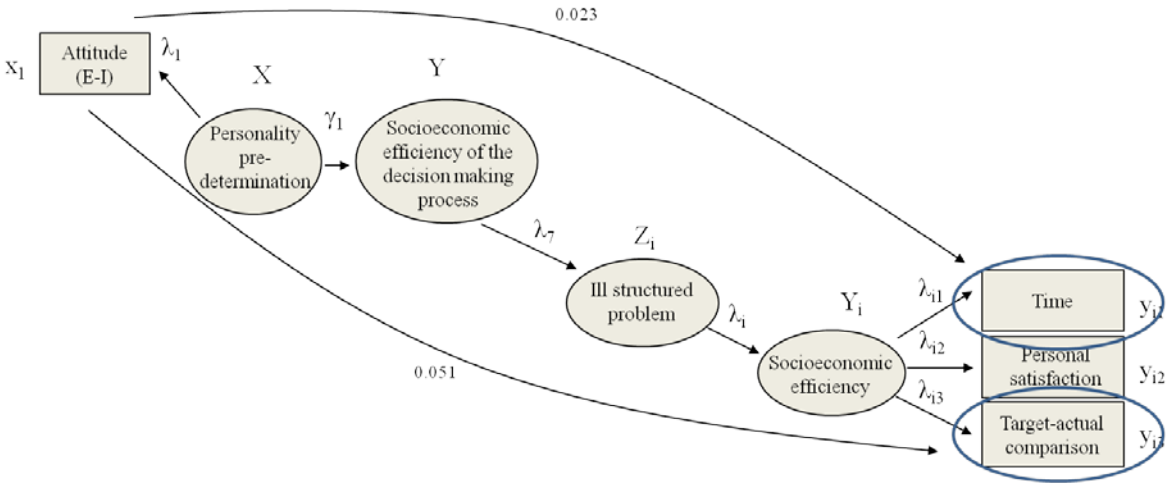

Figure 32: Significance of Extraverted (E) types on the outcomes of material and formal efficiency when solving ill-structured problem tasks

Source: Author

For the Sensing-Intuition (S-N) types the mean values for total efficiency outcomes show no great difference when solving ill-structured problem tasks (Figure 33).

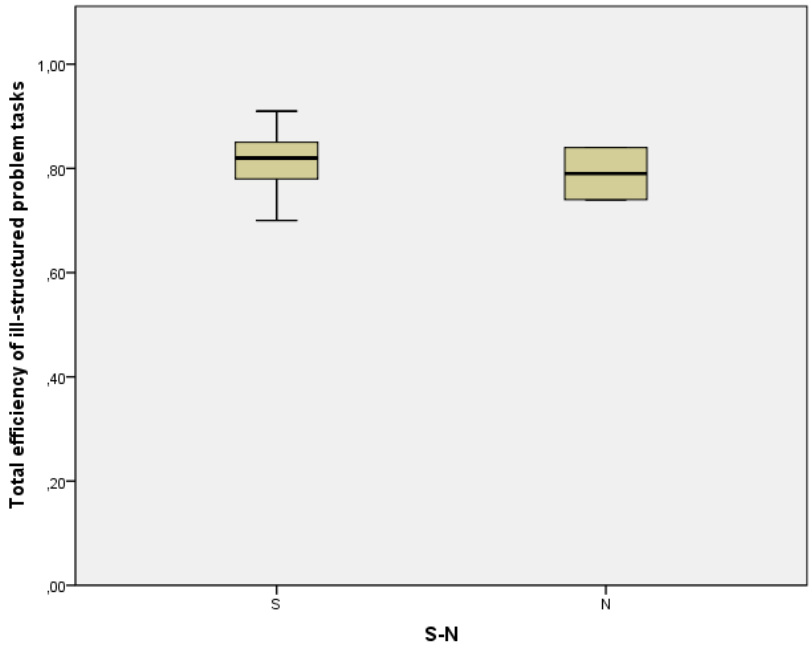

Figure 33: Mean values of Sensing-Intuition (S-N) types and decision making efficiency when solving ill-structured problem tasks

Source: Author

But when comparing more closely the outcomes of the personal efficiency when solving ill-structured problem situations (Figure 34), it seems that Sensing (S) types achieve higher efficiencies.

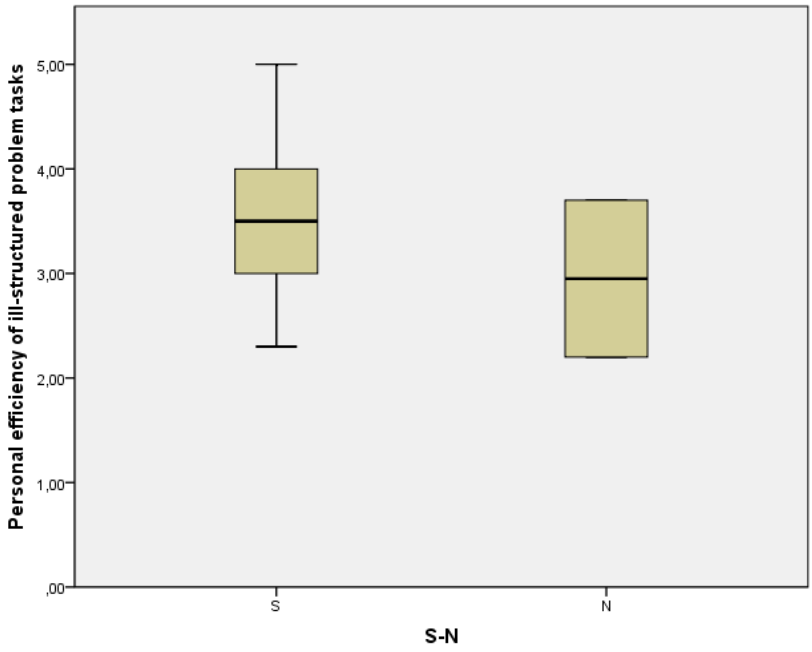

Figure 34: Mean values of Sensing-Intuition (S-N) types and personal efficiency when solving ill-structured problem tasks

Source: Author

These results are also supported by a Chi-Square-Test which shows a highly significant relationship between the rational orientated Sensing (S) types and personal efficiency (Figure 35).

S types - personal effciency	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	57,383[a]	17	,000
Likelihood-Ratio	13,342	17	,713
Linear-by-Linear Association	1,653	1	,199
No. of Valid Cases	106		

Figure 35: Chi-Square-Test of Sensing (S) types and personal efficiency when solving ill-structured problem tasks

Source: Author

In this case the Sensing (S) types, contradictive to the theory, show a significant relationship to the personal efficiency when solving ill-structured problem tasks (Figure 36).

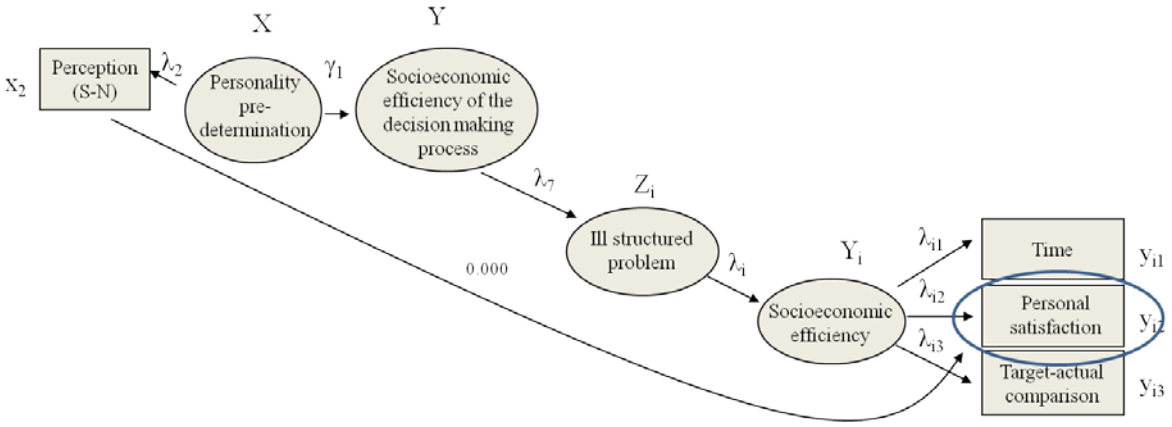

Figure 36: Significance of Sensing (S) types on the outcomes of personal efficiency when solving ill-structured problem tasks

Source: Author

For the mean values of the Thinking-Feeling (T-F) types and the outcomes of the total efficiency there is no obvious difference when solving ill-structured problem tasks. Thinking and Feeling types seem to achieve similar results (Figure 37).

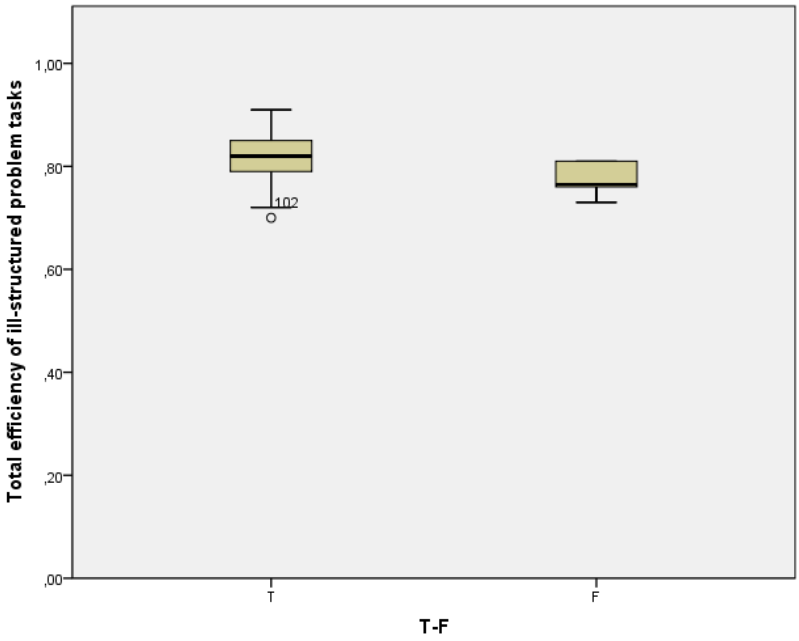

Figure 37: Mean values of Thinking-Feeling (T-F) types and decision making efficiency when solving ill-structured problem tasks

Source: Author

In the Judging-Perceiving (J-P) dichotomy there also seems to be no substantial difference in total efficiency when solving ill-structured problem tasks when comparing at the mean values (Figure 38).

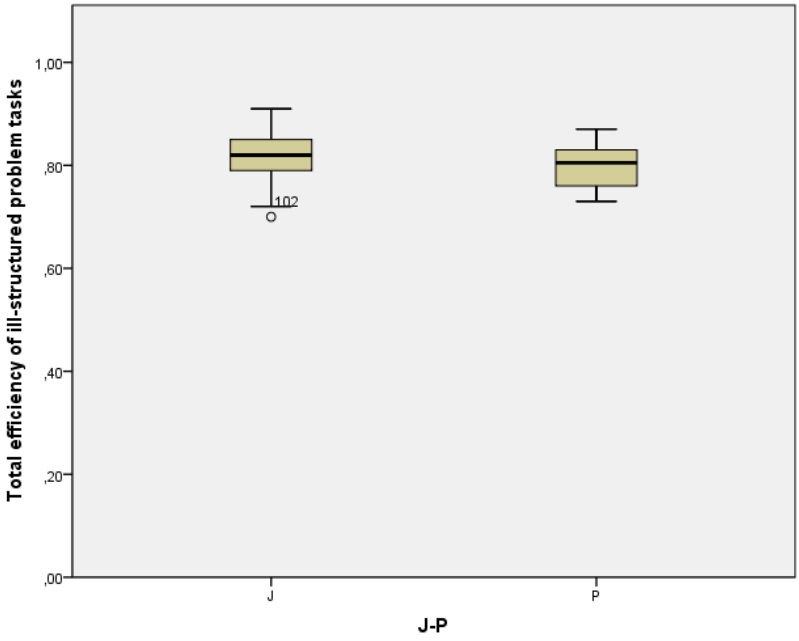

Figure 38: Mean values of Judging-Perceiving (J-P) types and decision making efficiency when solving ill-structured problem tasks

Source: Author

When comparing the mean values of decision making efficiency (Figure 39) of the four groups participating in the laboratory experiments, the results show no significant differences between the groups when solving ill-structured problem tasks.

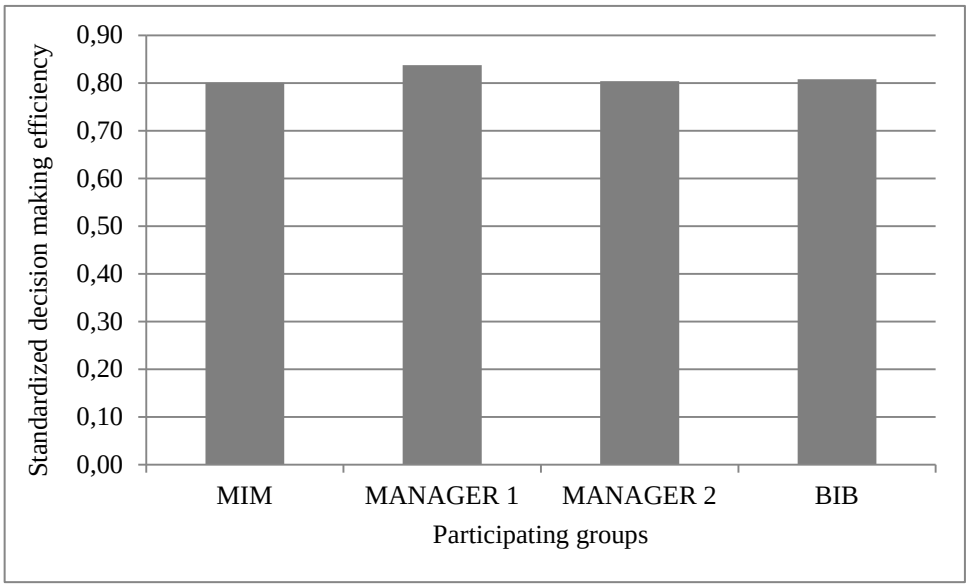

Figure 39: Mean values decision making efficiency when solving ill-structured problem tasks of the groups participating in the laboratory experiments

Source: Author

The coefficient of variation of decision making efficiency (Figure 40) of the four groups participating in the laboratory experiments show a little more variation among the MIM group and the BIB group compared to the manager groups.

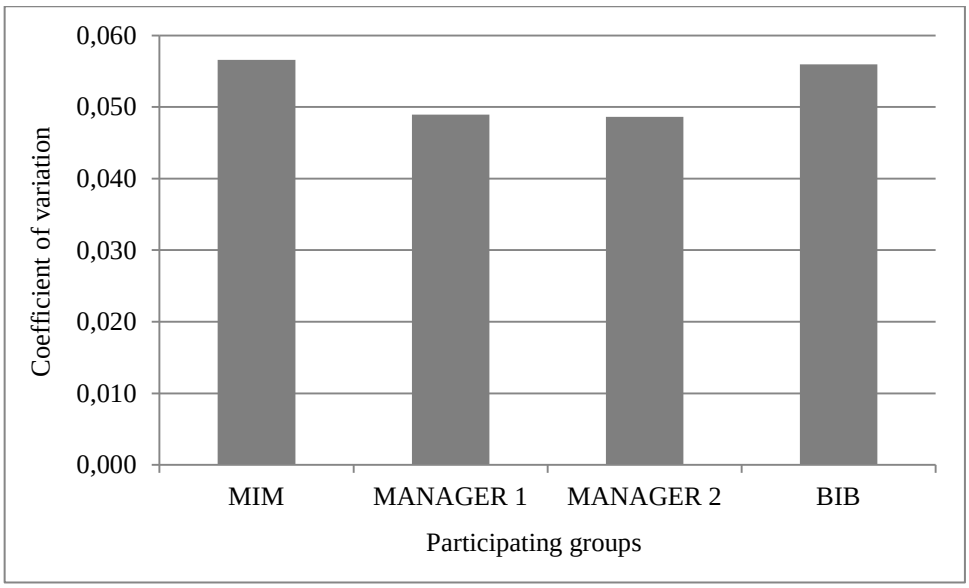

Figure 40: Coefficient of variation of the decision making efficiency when solving ill-structured problem tasks

Source: Author

When solving ill-structured problems there seems to be no substantial difference in efficiency outcomes between Thinking (T) and Feeling (F) types or for Judging (J) and Perceiving (P) types. Contradictive to the theory, Extraverted (E) and Sensing (S) types seem to achieve higher decision making efficiency outcomes when solving ill-structured problem tasks. The correlation analysis did not provide overall significant results between the personality predetermination and the efficiency outcomes when solving ill-structured problem situations. Though correlation analysis between the personality predetermination and the material efficiency shows a correlation coefficient of 0,192* with a r^2 of 0,037 (cf. Appendix III), in this case the variables "only" explain about 4% of the impact on the efficiency outcomes.

3.3.2. Statement and findings within mid-structured problem situations

In the proposed theory the author states that there is a cause and effect relationship between the complimentary personality predetermination, a mid-structured problem situation and socioeconomic efficiency of the decision making process. Therefore the hypothesis H_{02} is addressed by the following statement:

H_{02} Complimentary intuitive and rational behavior in the decision making process leads to a higher efficiency in mid structured problems than sole intuitive or rational behavior.

The results from the empirical data of the participants solving mid-structured problem tasks can be interpreted according to the empirical data as follows:

When comparing the mean values Extraverted (E) score slightly higher total efficiencies (Figure 41) in decision making outcomes than Introverts (I) types when solving mid-structured problem tasks.

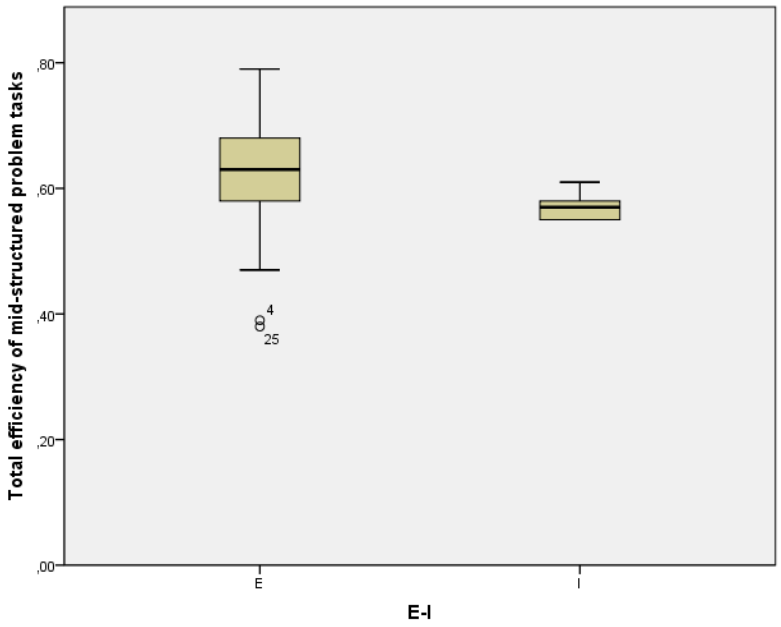

Figure 41: Mean values of Extraverted-Introverted (E-I) types and decision making efficiency when solving mid-structured problem tasks

Source: Author

The higher total efficiency outcomes in decision making of Extraverted (E) types when solving mid-structured problem tasks are also supported by outcomes of material efficiency (Figure 42) and the level of significance (Figure 43) of material efficiency when solving mid-structured problem tasks.

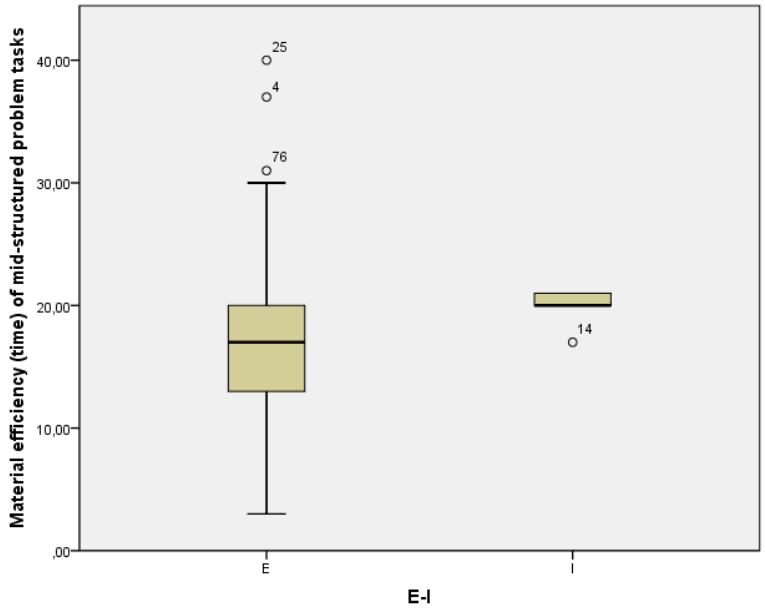

Figure 42: Mean values of Extraverted-Introverted (E-I) types and material efficiency when solving mid-structured problem tasks

Source: Author

E types - material efficiency	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	55,730[a]	26	,001
Likelihood-Ratio	26,841	26	,418
Linear-by-Linear Association	,819	1	,365
No. of Valid Cases	99		

Figure 43: Chi-Square-Test of Extraverted (E) types and material efficiency when solving mid-structured problem tasks

Source: Author

In this case the Extraverted (E) types show a significant relationship with the outcomes of material efficiency when solving mid-structured problem tasks (Figure 44).

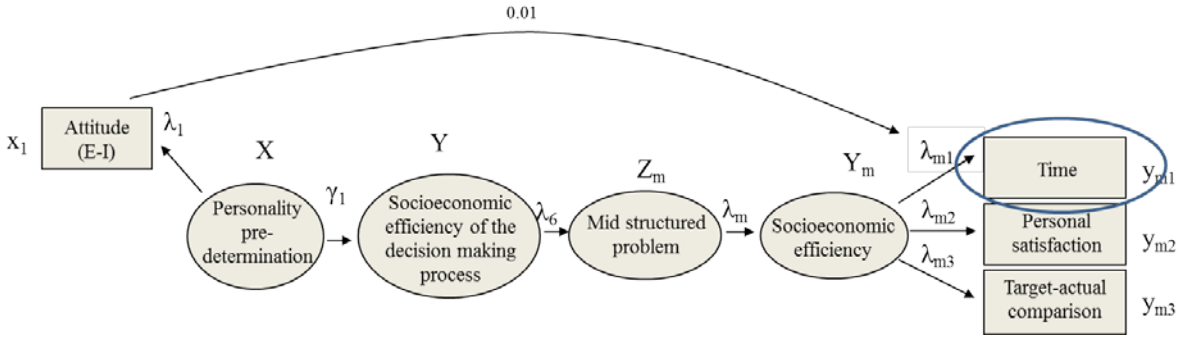

Figure 44: Significance of Extraverted (E) types on the outcomes of material efficiency when solving mid-structured problem tasks

Source: Author

Results of mean values (Figure 45) show a substantial difference between Sensing (S) and Intuitive (N) types in the outcomes of decision making efficiency when solving mid-structured problem tasks.

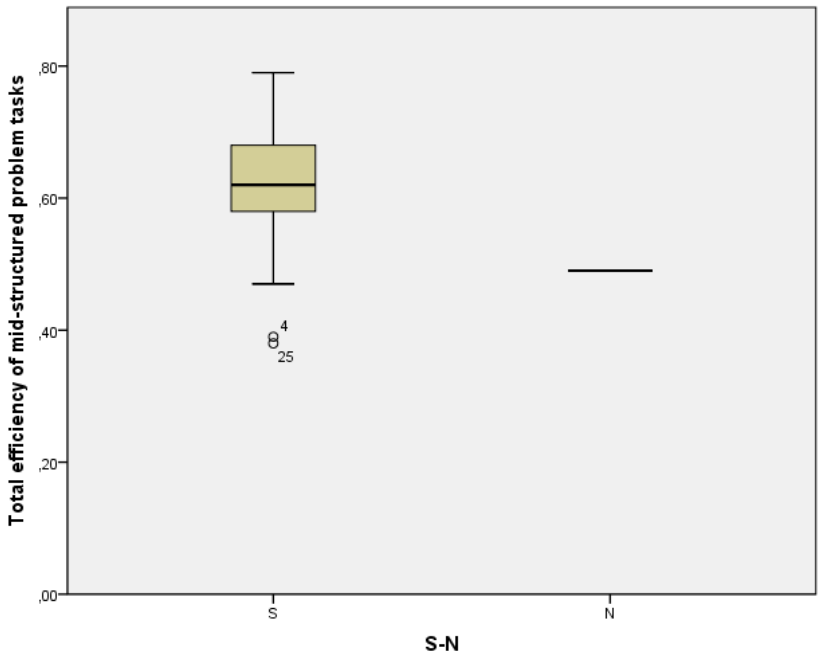

Figure 45: Mean values of Sensing-Intuition (S-N) types and decision making efficiency when solving mid-structured problem tasks

Source: Author

These results are also supported when comparing the outcomes of material efficiency when solving mid-structured problem tasks as there seems to be a significant relationship (Figure 46) to the Sensing (S) types.

S types - material efficiency	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	99,000[a]	26	,000
Likelihood-Ratio	11,180	26	,995
Linear-by-Linear Association	3,384	1	,066
No. of Valid Cases	99		

Figure 46: Chi-Square-Test of Sensing (S) types and material efficiency when solving mid-structured problem tasks

Source: Author

In this case the relationship between the Sensing (S) types and the outcomes of material efficiency when solving mid-structured problem situations seem to be significant (Figure 47).

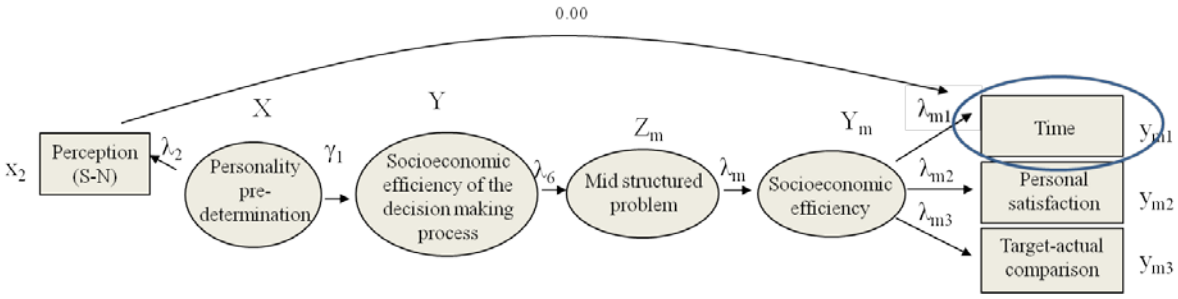

Figure 47: Significance of Sensing (S) types on the outcomes of material efficiency when solving mid-structured problem tasks

Source: Author

Between Thinking (T) and Feeling (F) types there seems to be no difference in the outcomes of decision making efficiency (Figure 48) when solving mid-structured problem situations and when looking at the mean values. These results are also supported by comparing the according correlations.

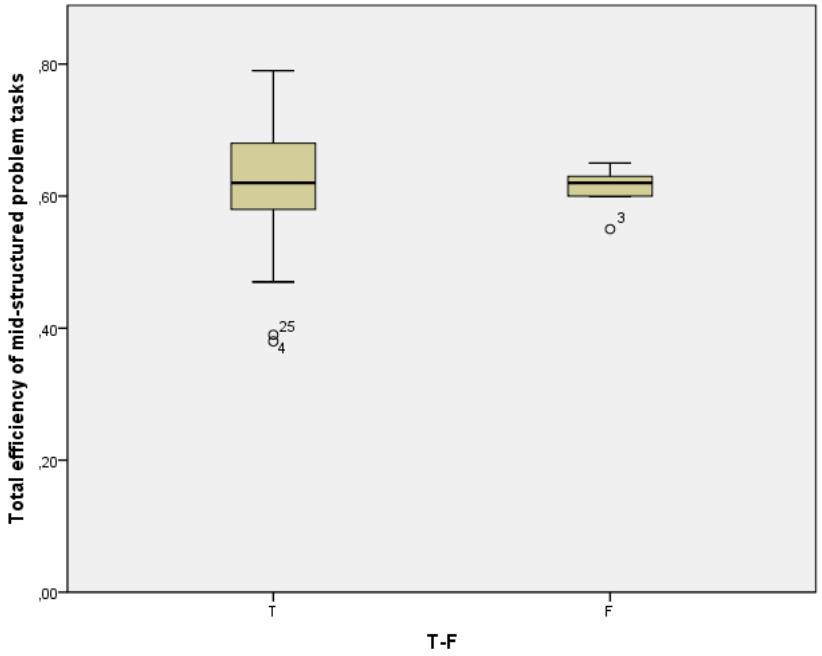

Figure 48: Mean values of Thinking-Feeling (T-F) types and decision making efficiency when solving mid-structured problem tasks

Source: Author

Judging and perceiving types in the Judging-Perceiving (J-P) dichotomy seem to be quite equal (Figure 49). They both seem to be at the same efficiency outcomes level when solving mid-structured problem situations. These results are also supported by the correlation analysis, since there are also no significant correlations between either of these types (J-P) and the efficiency outcomes of decision making tasks.

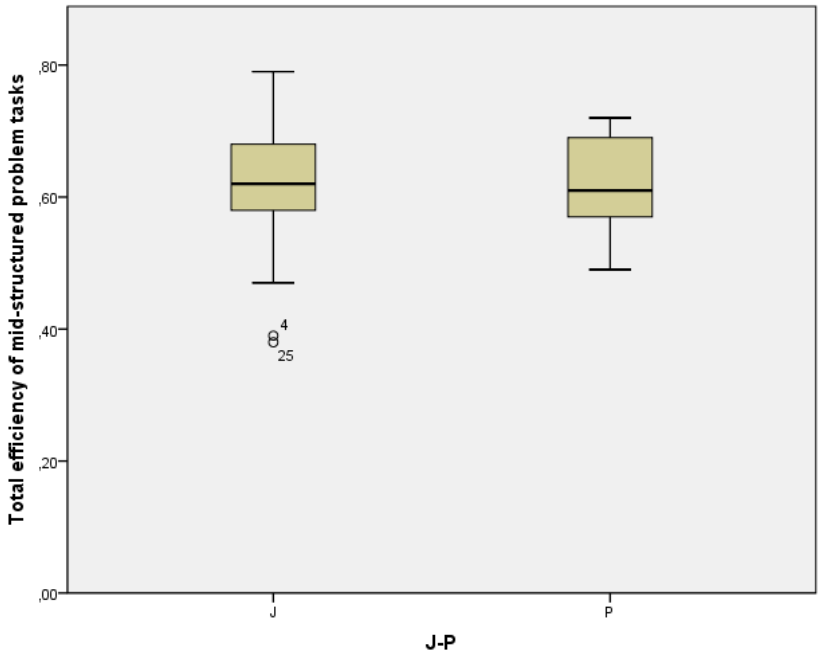

Figure 49: Mean values of Judging-Perceiving (J-P) types and decision making efficiency when solving mid-structured problem tasks

Source: Author

The mean values of the decision making efficiency (Figure 50) of the four groups participating in the laboratory experiments show no significant differences when they are solving mid-structured problem tasks.

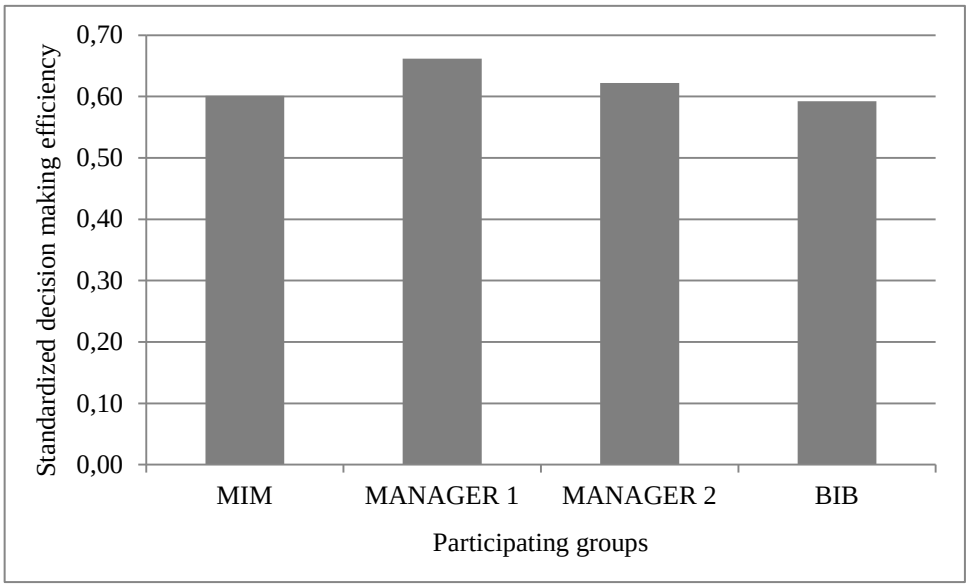

Figure 50: Mean values decision making efficiency when solving mid-structured problem tasks of the groups participating in the laboratory experiments

Source: Author

The coefficient of variation in decision making efficiency (Figure 51) shows a higher variation for the MIM participants. The BIB participants are on a similar level with the managers.

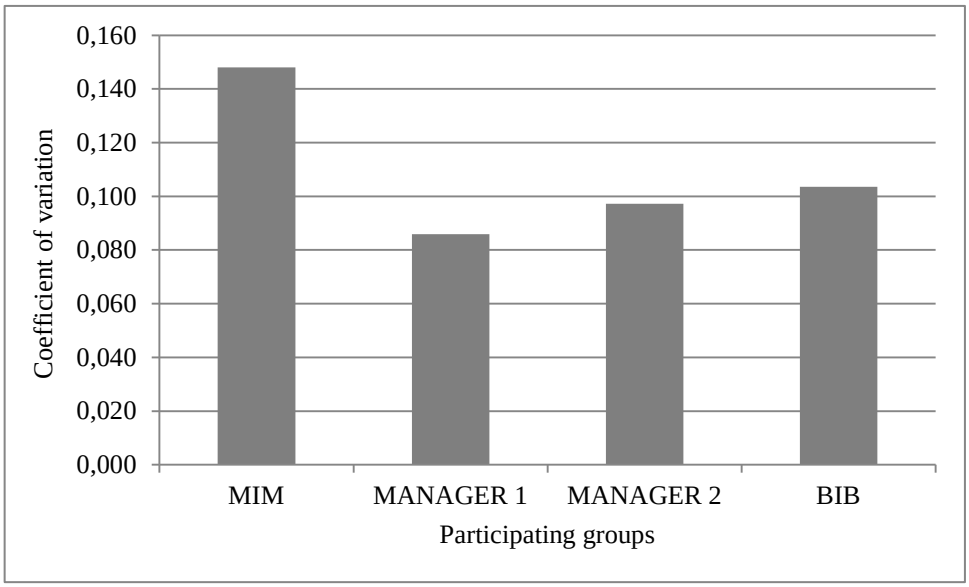

Figure 51: Coefficient of variation of the decision making efficiency when solving mid-structured problem tasks

Source: Author

When solving mid-structured problems there seems to be a difference in efficiency outcomes between Extraverts (E) and Introverts (I) and also between Sensing (S) and Intuitive (N) types. For the other types there are no significant differences in decision making efficiency outcomes when solving mid-structured problem tasks.

3.3.3. Statement and findings within well-structured problem situations

In the proposed theory the author states that there is a cause and effect relationship between the rational and intuitive personality predetermination, a well-structured problem situation and socioeconomic efficiency in the decision making process. Therefore the hypotheses H_{03} and H_{05} are addressed by the following statements:

H_{03} Rational behavior in decision making processes leads to higher efficiency in well-structured problems than intuitive behavior.

H_{05} Intuitive behavior in decision making processes leads to lower efficiency in well-structured problems than rational behavior

The results from the empirical data of the participants solving well-structured problem tasks can be interpreted according to the empirical data as follows:

Extraverted (E) types seem to score higher outcomes in task evaluations when looking at the mean values (Figure 52) of total efficiency and when solving well-structure problem situations than as Introverted (I) types.

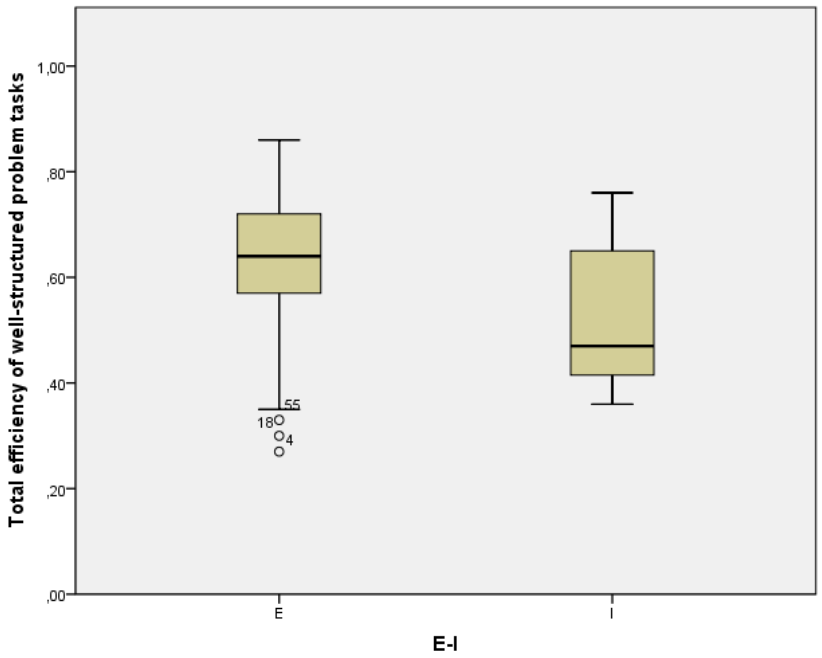

Figure 52: Mean values of Extraverted-Introverted (E-I) types and decision making efficiency when solving well-structured problem tasks

Source: Author

These facts are also supported by the significance results when conducting the Chi-Square-Test (Figure 53). Extraverted (E) types have a significant relationship to material efficiency when solving well-structured problem tasks.

E types - material efficiency	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Quadra	58,155[a]	32	,003
Likelihood-Ratio	31,542	32	,490
Linear-by-Linear Association	3,768	1	,052
No. of Valid Cases	109		

Figure 53: Chi-Square-Test of Extraverted (E) types and material efficiency when solving well-structured problem tasks

Source: Author

Taking the mean values and the Chi-Square-Test into consideration, it seems that Extraverted (E) types achieve higher outcomes when solving well-structured problem situations (Figure 54).

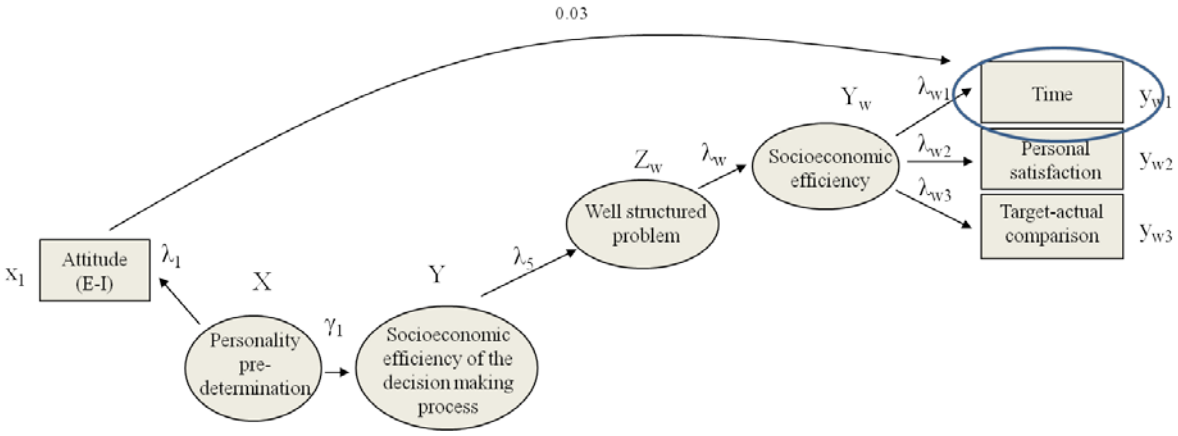

Figure 54: Significance of Extraverted (E) types on the outcomes of material efficiency when solving well-structured problem tasks

Source: Author

According to the mean values analysis the Sensing-Intuition (S-N) types show no obvious difference (Figure 55) in efficiency outcomes when solving well-structured problem tasks.

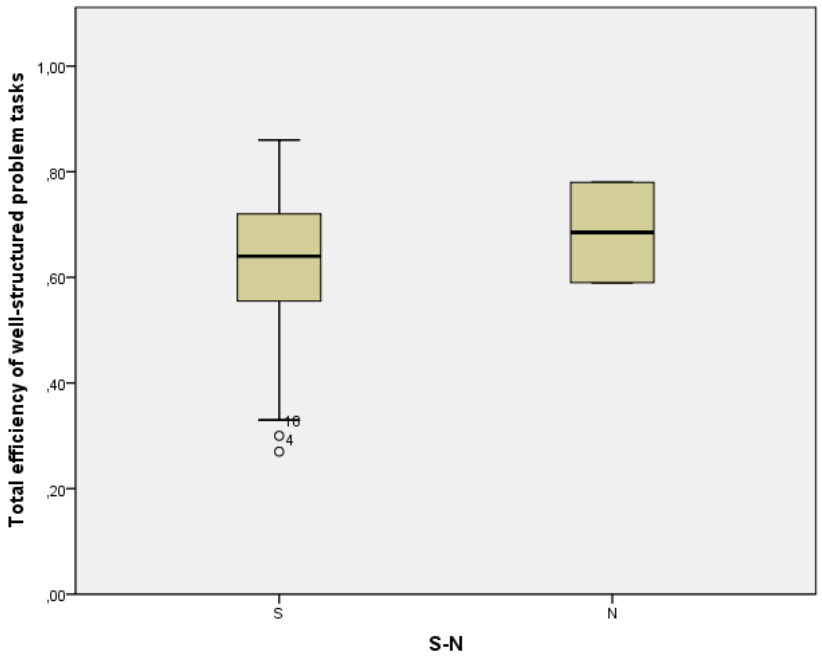

Figure 55: Mean values of Sensing-Intuition (S-N) types and decision making efficiency when solving well-structured problem tasks

Source: Author

Thinking (T) types seem to achieve higher efficiency outcomes, with their problem solution processes when solving well-structured problem situations than Feeling (F) types according to the mean values (Figure 56). From a correlation analysis point of view there are no significant results in seeing the same tendency.

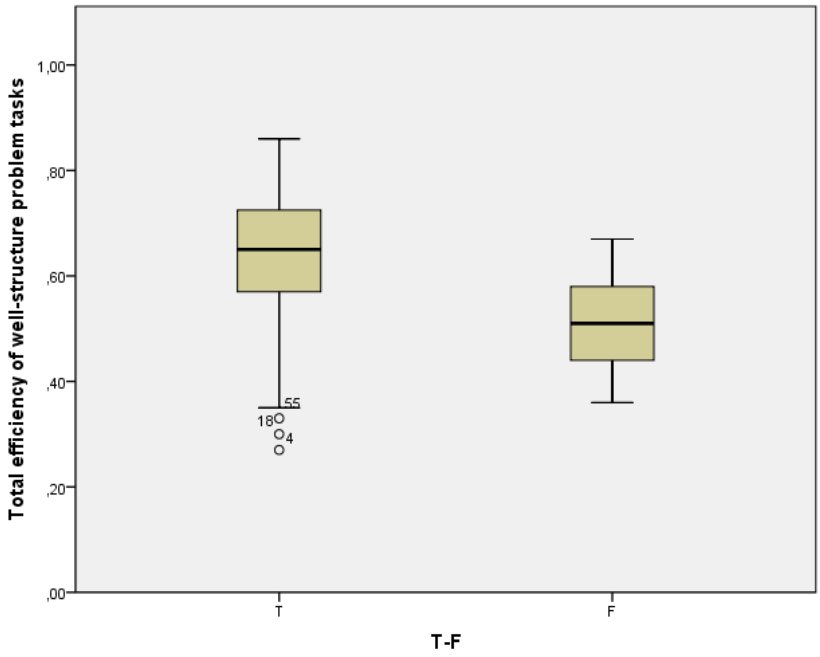

Figure 56: Mean values of Thinking-Feeling (T-F) types and decision making efficiency when solving well-structure problem tasks

Source: Author

When solving well-structured tasks, the higher efficiency outcomes of Thinking (T) types are also supported by the significance of the Chi-Square-Test (Figure 57).

T types - material effciency	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	47,199[a]	32	,041
Likelihood-Ratio	25,160	32	,800
Linear-by-Linear Association	5,009	1	,025
No. of Valid Cases	109		

Figure 57: Chi-Square-Test of Thinking (T) types and material efficiency when solving well-structured problem tasks

Source: Author

Therefore there seems to be a significant relationship between Thinking (T) types and the outcomes of material efficiency when solving well-structured problem tasks (Figure 58).

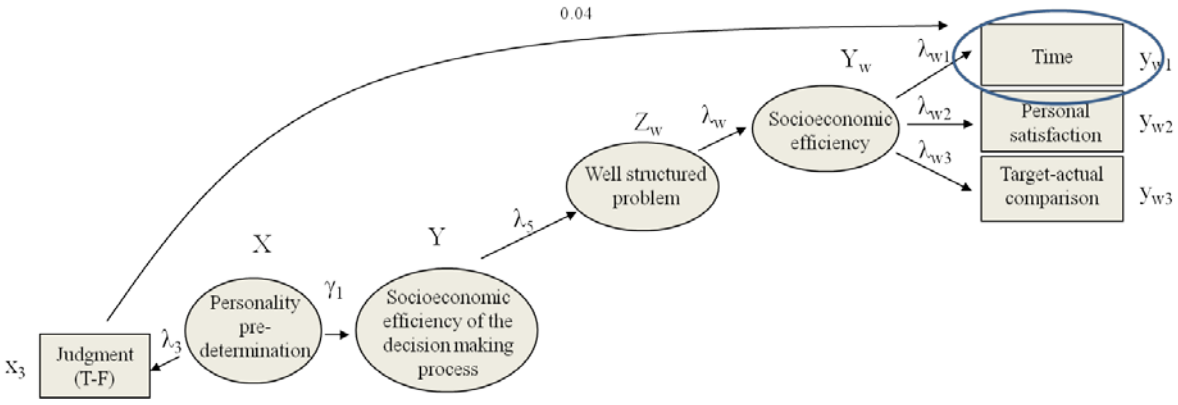

Figure 58: Significance of Thinking (T) types on the outcomes of material efficiency when solving well-structured problem tasks

Source: Author

When comparing the mean values of Judging (J) and Perceiving (P) types the Judging (J) types score slightly higher in total efficiencies (Figure 59) in decision making outcomes, than Perceiving (P) types do when solving well-structure problem tasks.

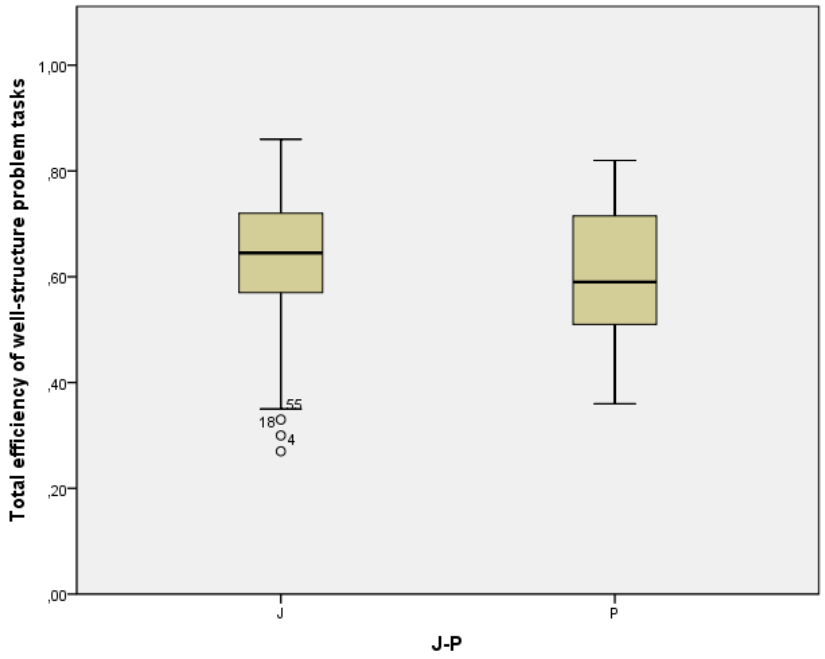

Figure 59: Mean values of Judging-Perceiving (J-P) types and decision making efficiency when solving well-structure problem tasks

Source: Author

But when comparing the outcomes of formal efficiency in solving well-structured problem situations (Figure 60) it seems that Judging (J) types are substantially more efficient.

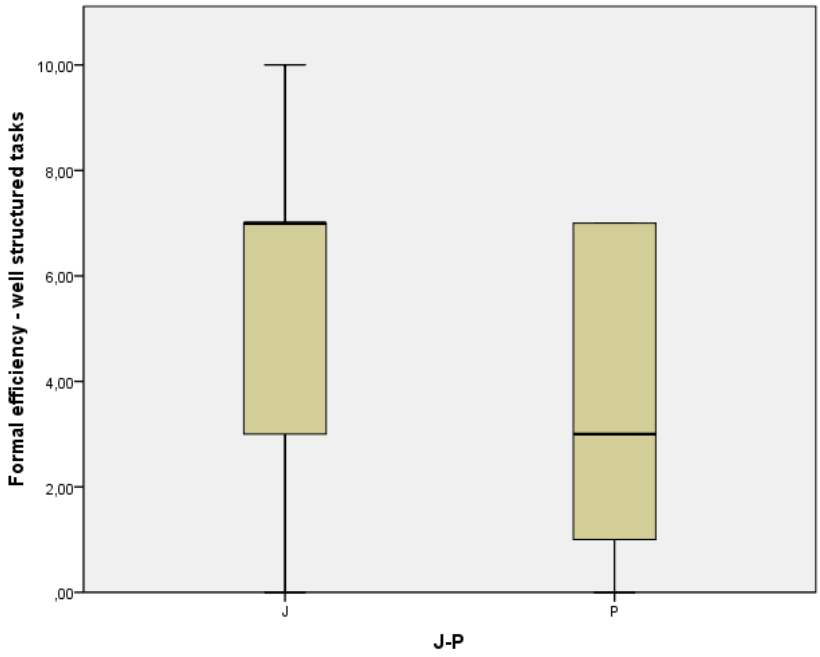

Figure 60: Mean values of Judging-Perceiving (J-P) types and formal decision making efficiency when solving well-structured problem tasks

Source: Author

This is also supported by the fact that Judging (J) types show a highly significant relationship to the outcomes of formal efficiency when solving well-structured problem tasks (Figure 62).

J types -formal effciency	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	24,627[a]	10	,006
Likelihood-Ratio	23,020	10	,011
Linear-by-Linear Association	3,374	1	,066
No. of Valid Cases	109		

Figure 61: Chi-Square-Test of Judging (J) types and formal efficiency when solving well-structured problem tasks

Source: Author

So there seems to be a significant relationship between Judging (J) types and the outcomes of formal efficiency when solving well-structured problem situations (Figure 62).

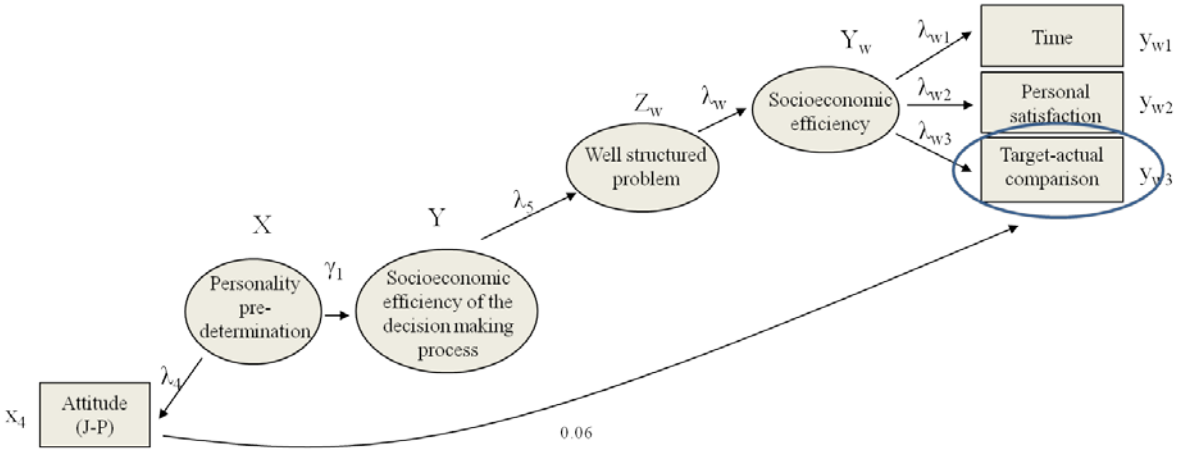

Figure 62: Significance of Judging (J) types on the outcomes of formal efficiency when solving well-structured problem tasks

Source: Author

The mean values of the decision making efficiency (Figure 63) of the four groups participating in the laboratory experiments, show that the efficiency of the manager groups is slightly higher than that of the MIM and BIM groups when solving well-structured problem tasks.

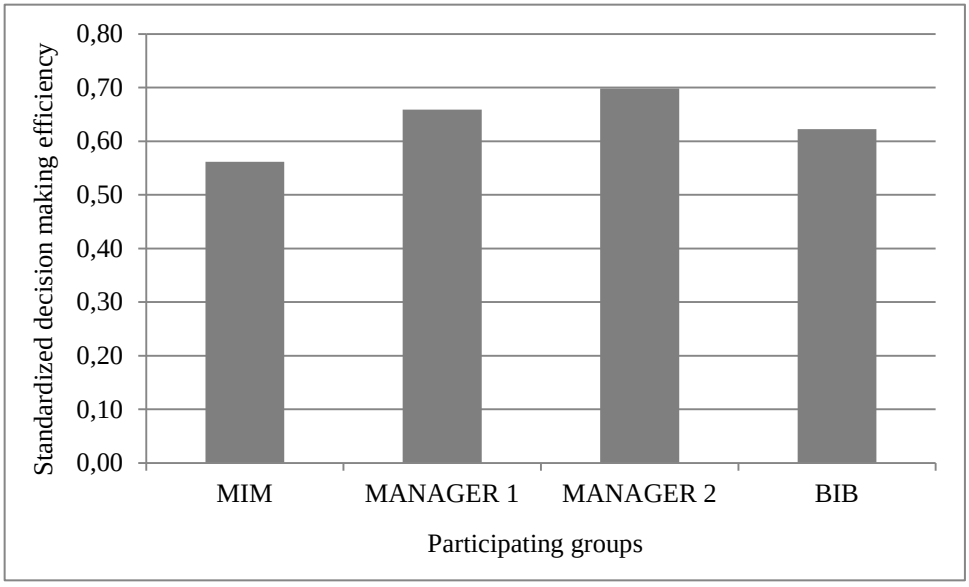

Figure 63: Mean values decision making efficiency when solving well-structured problem tasks of the groups participating in the laboratory experiments

Source: Author

The coefficient of variation in decision making efficiency for the MIM group (Figure 64) shows a higher variation than for the other groups.

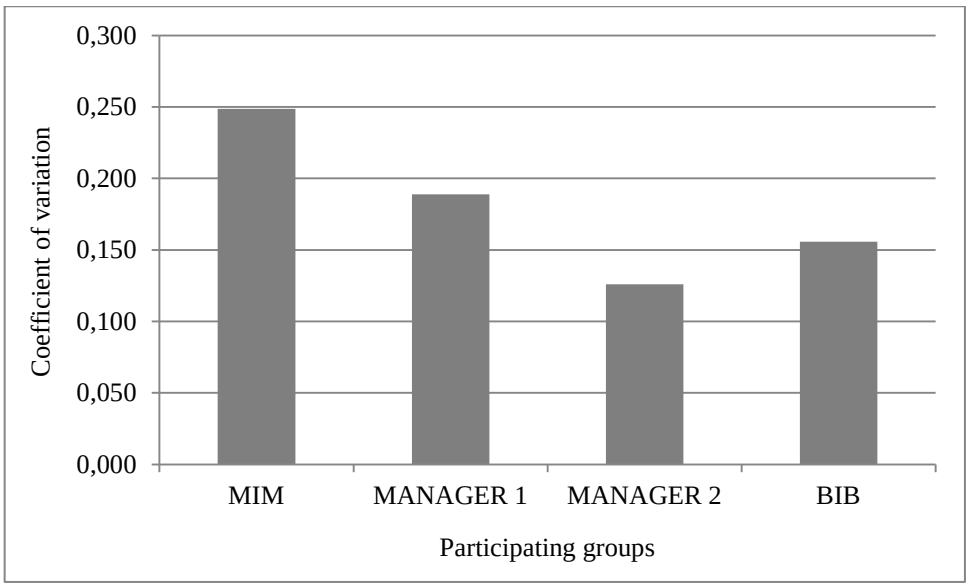

Figure 64: Coefficient of variation of decision making efficiency when solving well-structured problem tasks

Source: Author

These results reflect the fact that Extraverted (E), Thinking (T) and Judging (J) types seem to be working more effectively (systematic) and are more comfortable when solving well-structured problem situations. For the TJ (Thinking-Judging) types this would be in line with the underlying theory and also in line with Briggs Myers et al. They describe the TJ types as logical decision makers whose goal it is to impose a logical organizational structure to problems in order to solve them most efficiently.[370] For the Sensing-Intuition (S-N) dichotomy the data do not seem to fit the theory, since for this dichotomy the theory claims that the Sensing types are rationally orientated and therefore should be more efficient when solving well-structured problem situations. This position cannot be supported by the empirical data.

3.3.4. Comprehensive explanation and discussion of the experimental research findings

The four groups participating in the laboratory experiment achieved similar decision making efficiencies within the various problem tasks. In this case previous findings from laboratory experiments seem to be confirmed, in that decisions of business management students and managers in the field of business management produced similar results.[371]

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[370] Briggs Myers, I.; McCaulley, M. H.; Qenk, N. L.; Hammer, A. L. (2003). MBTI manual. A guide to the development and use of the Myers-Briggs type indicator. 3. Aufl. Palo Alto CA, USA: CPP, Inc., p. 52.

[371] Cf. Neuert, J. O. (1987). Planungsgrade. Eine experimentelle Untersuchung zum Zusammenhang zwischen Planungsverhalten und Planungserfolg. Spardorf, Germany: Rene F. Wilfer, p. 330; Witte, E.; Hauschildt, J. (1972). Das Informationsverhalten in Entscheidungsprozessen. Tübingen, Germany: Mohr (13), p. 184

When solving ill-structured problem tasks, the empirical data support the fact, that contradictive to the theory, there seems to be a significant relationship between the personal efficiency and Sensing types. So there seems to be evidence that rationally oriented types achieve higher efficiencies when solving ill-structured problem tasks than intuitive orientated types. As for the significant relation between the personal efficiency and the rationally orientated Sensing types, the hypothesis H_{01} and the hypothesis H_{04} in this case cannot be substantiated.

For solving the mid-structured problem tasks, the empirical data on the bases of Chi-Square-Tests provide a significant difference in efficiency measurement between the Sensing and the Intuition types but no difference between the Thinking and Feeling types. But as the hypothesis states that "complimentary" intuitive and rational behavior in the decision making process leads to higher efficiency in mid structured problems than sole intuitive or rational behavior, the data do not provide enough substantive results to support hypothesis H_{02}.

When solving well-structured problem tasks, the empirical data support the fact that Thinking and Judging types achieve higher efficiencies than Feeling and Perceiving types. Thinking and Judging types perceive themselves as working more systematically and are more comfortably when solving well-structured problem tasks than Feeling and Perceiving types. This is also in line with Briggs Myers et al. They describe the Thinking/Judging (TJ) types as logical decision makers whose goal it is to impose a logical organizational structure to problems in order to solve them most efficiently.[372] According to the literature, the empirical data show that rationally orientated personality types (Thinking types) are overall more efficient when solving well-structured problem tasks than intuitive orientated types. So in this case the empirical data do provide substantive results to tentatively support the hypothesis H_{03} and the hypothesis H_{05}.

The empirical results of the study of Woolhouse & Bayne support the hypothesis H_{03} and the hypothesis H_{05}, whereby rational oriented personality types are more efficient when solving well-structured problem tasks. The results of their study indicate a clear difference in strategy and performance on implicit learning tasks between rational and intuitive oriented personality types. According to their study individuals with a rationally orientated personality type are

[372] Briggs Myers, I.; McCaulley, M. H.; Qenk, N. L.; Hammer, A. L. (2003). MBTI manual. A guide to the development and use of the Myers-Briggs type indicator. 3. Aufl. Palo Alto CA, USA: CPP, Inc., p. 52.

more efficient when applying concrete rules, which is one of the main characteristics of a well-structured problem task.[373]

Overall, when comparing the mean distributions of the so called four mental functions, the NT (Intuition/Thinking) types (Figure 65) seem to achieve the highest decision making efficiencies when solving problem tasks.[374]

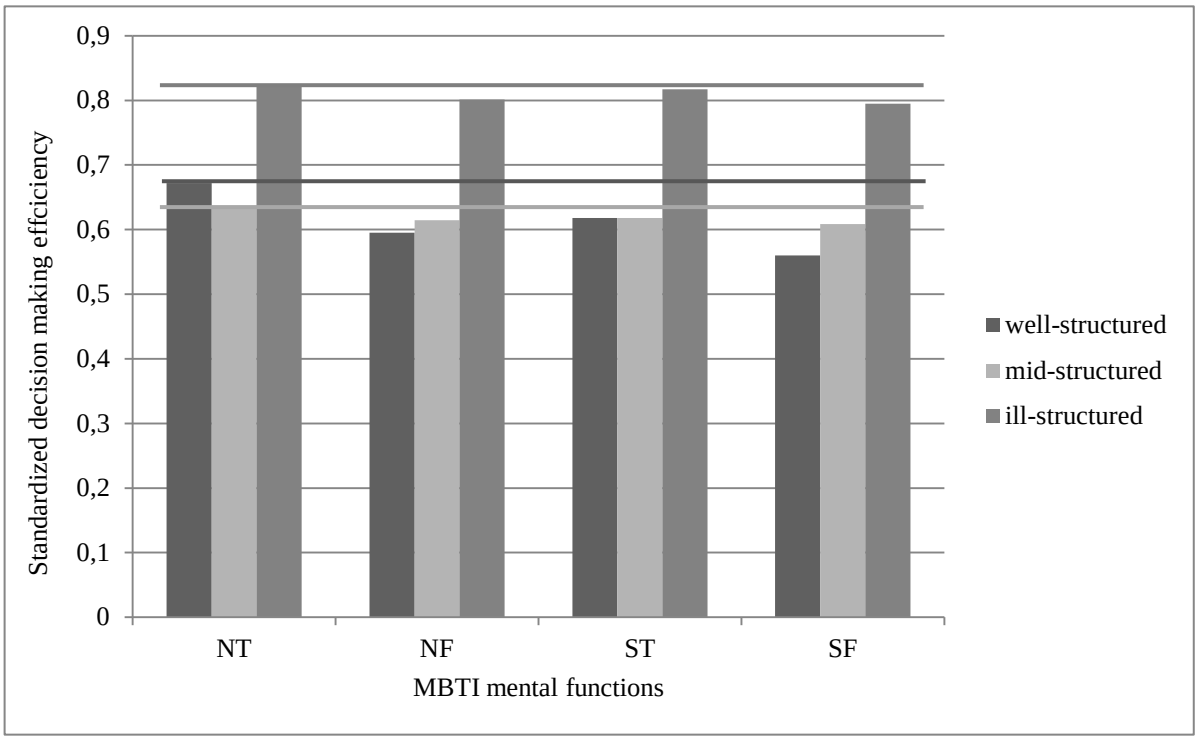

Figure 65: Mean values of decision making efficiency measures among the four mental functions

Source: Author

The coefficient of variation of the sampling of the four mental functions of the MBTI (Figure 66) also shows that the distribution of the data within the samples and the different structured tasks are quite consistent.

[373] Woolhouse, L. S.; Bayne, R. (2000). Personality and the Use of Intuition: Individual Differences in Strategy and Performance on an Implicit Learning Task. In: European Journal of Personality 14, pp. 167-168.

[374] Briggs Myers, I.; McCaulley, M. H.; Qenk, N. L.; Hammer, A. L. (2003). MBTI manual. A guide to the development and use of the Myers-Briggs type indicator. 3. Aufl. Palo Alto CA, USA: CPP, Inc., p. 40.

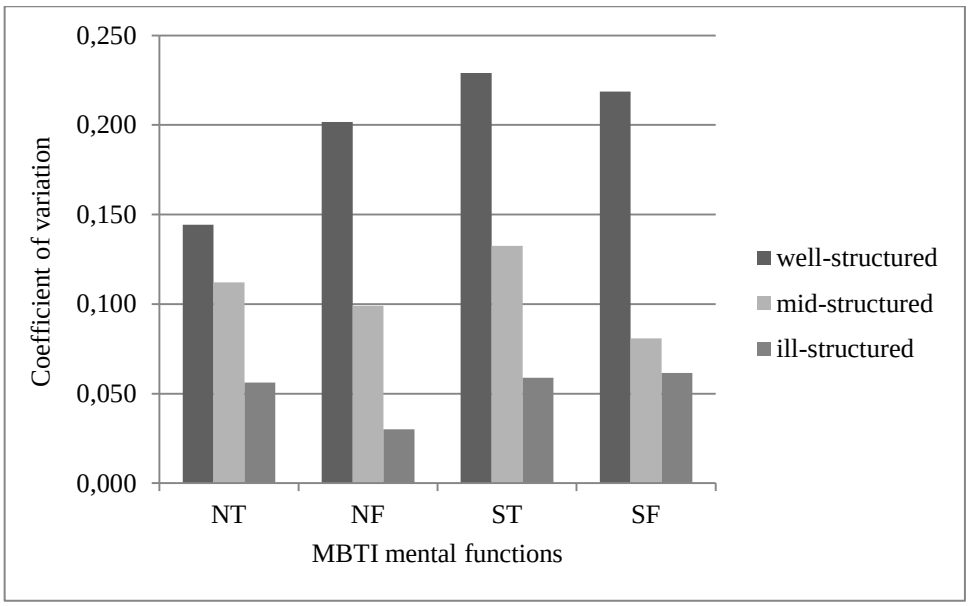

Figure 66: The coefficient of variation of the sampling among the four mental functions

Source: Author

When conducting a study with 750 managers the empirical results of Hough & ogilvie also showed that managers with a preference for Intuition/Thinking (NT) had the highest quality in strategic decision making. In particular the research showed that NT-types make higher qualitative strategic decisions than NF, SF and ST-types (Figure 67).[375]

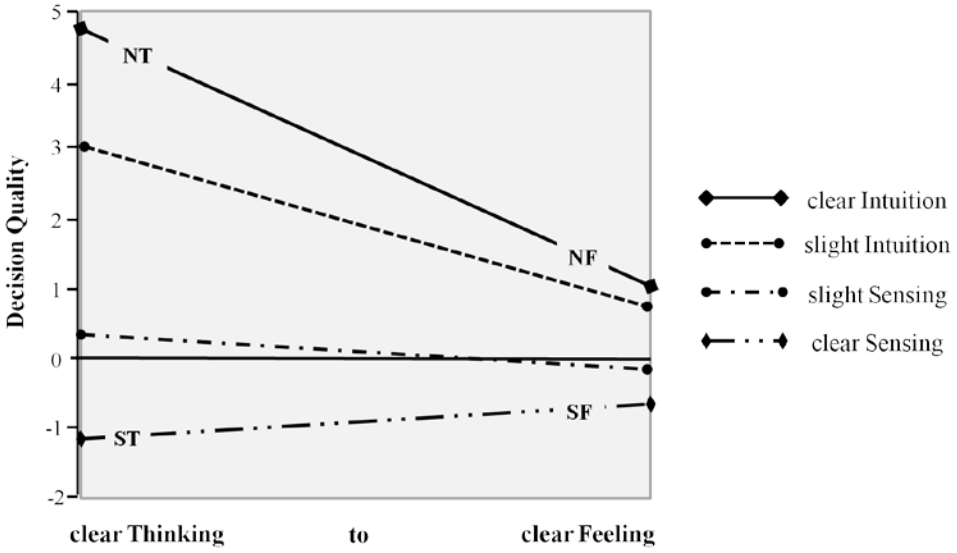

Figure 67: Interaction of Judgment (TF) and Perception (SN) Predicting Decision Quality rationality

Source: Hough & ogilvie, 2005, p. 493

[375] Hough, J. R.; ogilvie, d. (2005). An Empirical Test of Cognitive Style and Strategic Decision Outcomes. In: Journal Management Studies 42 (2), pp. 438–439.

In a further study with 200 managers in eight companies, Andersen had similar findings. His results showed when measuring the way the managers perceived problems and made their decisions, that types with a combination of Intuition (N) and Thinking (T) where 6.7 times more strongly, related to organizational effectiveness than with the other decision making styles. The covariance between effective and less effective managers being NT-types was 4, while the covariance for the "other" managers was 0.6.[376]

Experimentees from the present study, with a complimentary intuitive and rational personality like the NTJ-types (Figure 68), seem to achieve higher overall efficiency measures in decision making than clear rational (cf. STJ or STP) or clear intuitive (cf. NFP or NFJ) types.

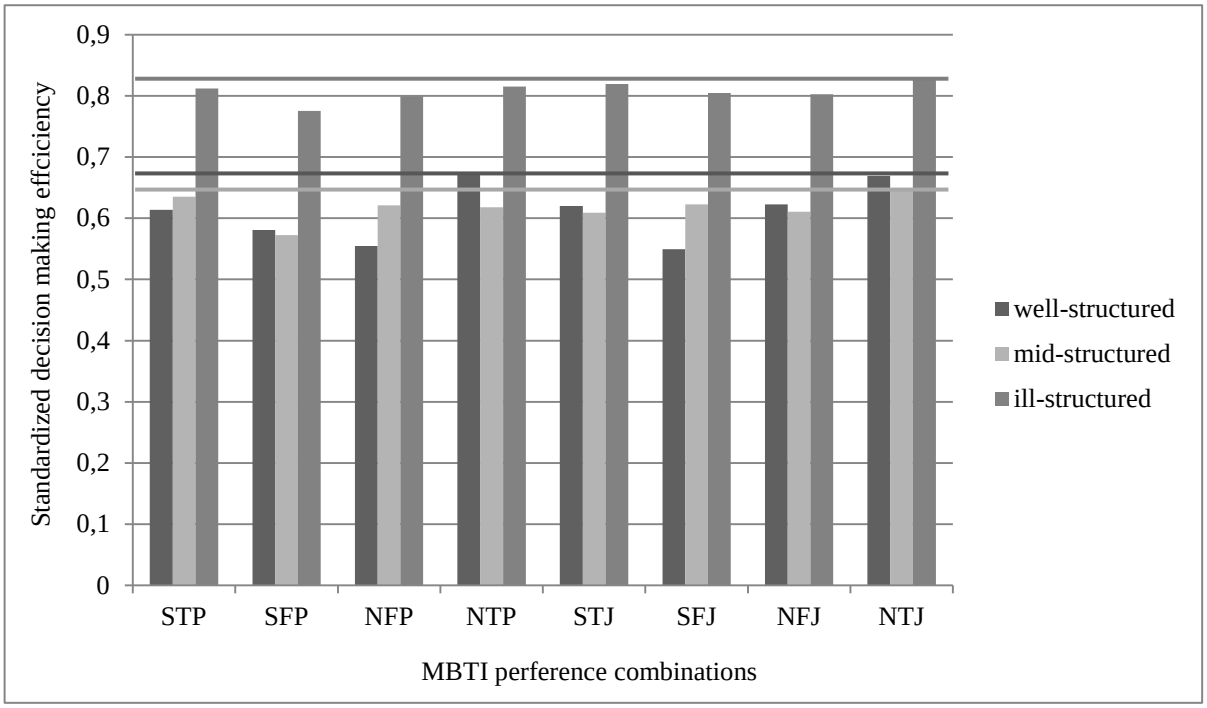

Figure 68: Mean values of decision making efficiency among MBTI preferences

Source: Author

This becomes even more evident when looking at the four letter types. The ENTJ and INTP types seem to be among the types with the overall highest efficiency measures in decision making (Figure 69). In this case it seems evident that types with a "mixture" of rational and intuitive personality achieve the highest decision making efficiency.

[376] Andersen, J. A. (2000). Intuition in managers. Are intuitive managers more effective? In: Journal of Managerial Psychology 15 (1), pp. 59–62.

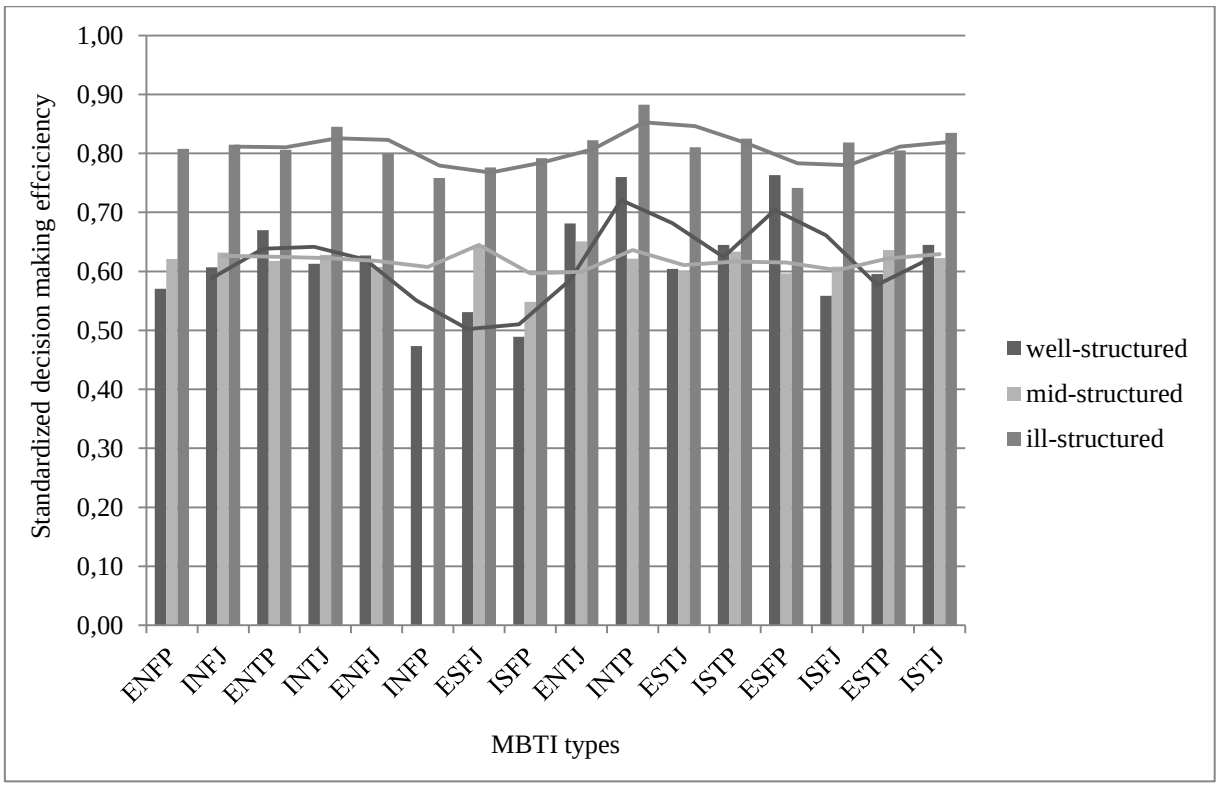

Figure 69: Mean values of decision making efficiency among the 16 MBTI types

Source: Author

Neuert had similar empirical findings within his research, when he tried to discover a potential cause-effect-relationship between intuitive versus discursive decision making behavior and decision making efficiency. In his research he conducted a laboratory experiment, where the independent variable was measured on a scale from 1 (meaning "full" degree of intuition) to 8 (meaning "full" degree of discursion). The dependent variable, which was represented by the degree of rationality gained from the data set of experimental observation on a scale between 0 (meaning no rational decision making behavior at all) and 5 (meaning "total" rational decision making behavior), revealed that as in the findings of the present work the highest decision making efficiency can be achieved by personality types which are in the middle of the spectrum between "complete intuition" and "complete discursion (Figure 70).[377]

[377] Cf. Neuert, J. O. (1987). Planungsgrade. Eine experimentelle Untersuchung zum Zusammenhang zwischen Planungsverhalten und Planungserfolg. Spardorf, Germany: Rene F. Wilfer, pp. 281-284; Neuert, J. O. (2010). The Impact of Intuitive and Discursive Behavioral Patterns on Decision Making Outcomes: Some Conjectures and Empirical Findings. In: WDSI Annual Conference Readings, Lake Tahoe, USA, pp. 4478–4491.

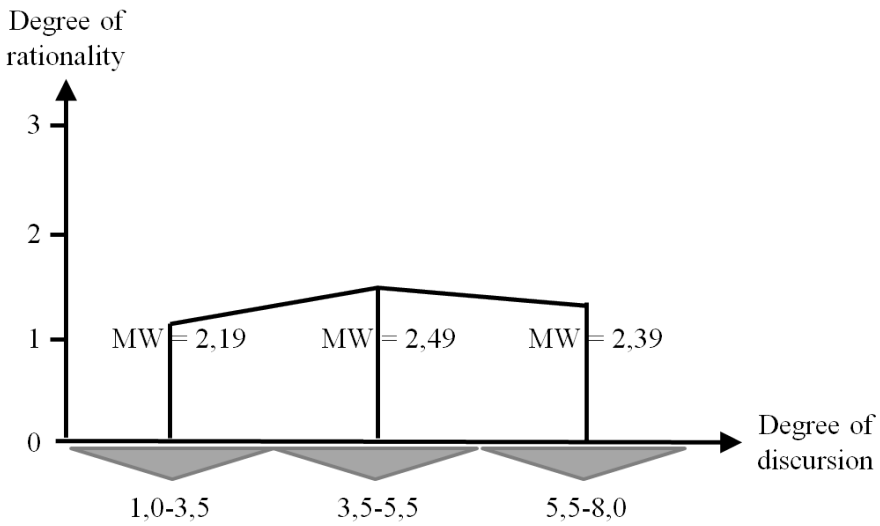

Figure 70: Relationship between personality and decision making efficiency

Source: Neuert, 1987, p. 283

These results also indicate, that the highest degrees of decision making efficiency can be achieved by a "pertinent blend" of intuitive and rational personality types in general, and especially when it comes to complex strategic decision making issues.

3.4. Impact of the research results on management decision making via an application orientated approach

The literature (cf. chapter 1) establishes a common point of view that individuals which have a tendency for an intuitive thinking style are more successful in using unconscious information as well as heuristic judgments and therefore are more efficient when solving ill-structured problems. In contrast, individuals with a tendency for rational thinking, who use information in a more concrete format and are more related to normative judgment, seem to be more efficient when solving well-structured problems. Therefore according to the literature, as already indicated within the hypotheses, intuitive behavior should lead to higher efficiency within ill-structured problem situations and rational behavior should lead to higher efficiency within well-structured problem situation in the decision making process. In this case it would be a rather "simple" approach for top managers to establish rules to assign the right "type" of people to the appropriate problem situation (rational orientated personality types for well-structured problem situations versus intuitive orientated personality types for ill-structured problems situation) or compose teams in a way that their personality structure matches the appropriate problem structure, in order to achieve overall the highest efficiency in the management decision making processes. But the results of this research, in general, did

not provide substantive results to tentatively support those hypotheses. Rather they indicated that the highest efficiency can be achieved by a “pertinent blend” of intuitive and rational personality. Therefore, managers need to better understand how to develop complimentary decision making teams comprised of a “perfect” mixture of intuitive and rational decision making types. Further it seems that managers need to recognize how to enhance their decision making efficiency within different kinds of problem situations (well-, mid- and ill-structured). To allow the development of a complimentary intuitive and rational decision making approach and the enhancement of decision making efficiency, the following three step application orientated approach was developed. This approach is ideally kicked off in a workshop with a group of managers, followed up by individual coaching and carried on by reflections of the individual managers to improve their decision making efficiency:

- Step 1: Awareness of the personality type and training/improvement of the less developed behavioral patterns

In this first step it is necessary that managers be introduced to the different styles of personality/behavior to understand how they differ and which impact different types of personality can have on management decision making. Ideally this is not only done by conducting a sole personality type assessment to deliver the type. Rather this is done by having a personality type assessment upfront and then conducting a workshop based on examples and case studies where different styles of behavior are carved out. It is crucial that managers experience and reflect the various differences among the personality types and the possible impacts on management decision making. This will enable managers to understand where they are on a continuum from totally rational to totally intuitive and also to recognize their type related communication style. This will put them into a position to understand what their dominant decision making style is and then to reflect continuously if they also activated their non-dominant decision making style in appropriate cases. Further it supports the managers when informing team members, subordinates or stakeholders about their decisions, taking into account the different type related perceiving modes of the addressed individuals.

- Step 2: Understand the decision making requirements for managers

In the second step it is crucial for managers to understand the decision making requirements of their daily job and how they can characterize them in terms of the problem situation (well-, mid-, ill-structured) to be able to solve them most efficiently. Therefore the managers should identify and list difficult situations from their daily business which require elaborate decision making processes. After that they need to understand the difference of well-, mid- and ill-

structured problem situations (cf. chapter 2.3.1.). Next the identified and listed situations should be categorized into well-, mid- and ill-structured problems according to the criteria which have been established in chapter 2.3.1. This allows in a practical manner to address daily problem situations which require elaborate decision making approaches to the appropriate problem structure.

- Step 3: Development of decision making approaches for differently structured problem situations

After the categorization of the daily job situations into well-, mid- and ill-structured problem situations, in the final step, decision making approaches for the different problem structures have to be developed. As well-structured problems, by definition, have a well-defined initial state, well defined goals, a single correct answer and all elements for the solution are known, the task for the managers is to develop and gather tools, templates, checklists, methods and procedures which support the problem solution process for solving daily well-structured problem situations. That requires the development of sound knowledge of classical decision making heuristics such as investment appraisal, optimization algorithms, cost accounting tools, etc. As for mid-structured problem situations, by definition, the goals are known but information, findings, problem solutions and data might be implicitly embedded in the problem, the gathering of tools, templates, methods and procedures can be used but in addition an overall missing problem solution process has to be established. This can be done by using a creativity technique like brainstorming, scenario writing, application of decision matrices, etc. This would allow for developing and evaluating different possible problem solution processes for solving mid-structured decision problems. For ill-structured problem situations, where by definition, goals are vaguely or hardly defined, have no single objectively correct solution and no execution program or algorithm is known, rather than creating a clear problem solution process in a first step, managers need to establish a "competency attitude" to see or recognize patterns within the problem situation which they can track back to previous experience they had in similar situations. For this case a method which is developed for solving complex problems can be used to setup an approach for solving daily ill-structured problem situations. This method (i.p. "Look, See, Imagine, Show") enables managers to visualize complex and ill-structured problems to better identify and recognize patterns within these problem situations and then work on concrete problem solutions.[378] As a final step after

[378] Roam, D. (2009). Unfolding the napkin. The hands-on method for solving complex problems with simple pictures. New York: Portfolio.

learning how to visualize complex problem situations it is crucial, that this know-how be “internalized” to build a competency attitude. Therefore it will be necessary for the managers to use and repeat this kind of method in a frequent mode in daily business so that it’s developed it into a habit.

Surely this is only one possibility to transfer the results of this research study into an application orientated approach helping manages to improve their decision making efficiency, but it will be the foundation for leadership decision making training hosted by the author.

CONCLUSIONS

Based on the intensive literature research and, in particular, on the results of the empirical investigation the scientific study leads to the following conclusions:

1. Neither intuitive decision makers nor rational decision makers per se achieve outstanding decision making performance in differing decision making situations (well-, mid- and ill-structured) but mostly a "pertinent blend" of decision making characteristics leads to the relatively best decision making results. This empirically supported finding suggests that intuition and rationality, as well, significantly contribute to high decision making efficiency. Nonetheless, there are some decision making situations, where obviously more intuition based decision making or more rational decision making can be partially superior. This can be tentatively confirmed by the empirical results of this study, as Thinking (T) types achieve higher efficiencies than Feeling (F) types when solving well-structured problem situations. This is also supported by the fact that there is a significant correlation (χ^2 = 0,041) between Thinking (T) types and material efficiency when solving well-structured problem tasks. The results also show that Judging (J) types achieve higher efficiencies than Perceiving (P) types when solving well-structured problem situations and that there is a significant correlation (χ^2 = 0,060) between Judging (J) types and the formal efficiency when solving well-structured problem tasks. These findings are also line with the underlying theory of Briggs Myers et al., as they describe the TJ types as logical decision makers whose goal it is to impose logical organizational structure to problems to solve them most efficiently.
2. Individuals who have a preference for an intuitive thinking seem to be more successful in using unconscious information and are more related to heuristic judgments as well as to ill-structured problems where, by definition, goals are defined vaguely or not at all. But contradictive to theory the rational orientated Sensing (S) types achieve higher decision making efficiencies than the Intuition (N) types when solving ill-structured problem situations. Further there is a significant correlation between the Sensing (S) types and personal efficiency when solving ill-structured problem situations. Therefore the findings from the literature review cannot be supported by the empirical results of this study.

3. For mid-structured problem situations it was assumed that individuals who have a preference for a complementary rational and intuitive thinking style are most efficient when solving mid-structured problem tasks. Here again the empirical results of the study do not provide significant evidence to support this assumption. However, the empirical results show, that personality types with a mix of intuition (N) and rationality (T) by the measurement of the MBTI show the highest efficiency outcomes in management decision making. These results are also in line with other empirical studies which have been conducted with managers.
4. Overall there are no significant statistical correlations between the various degrees of intuition/rationality indicators and the decision making efficiency degrees in well-structured, mid-structured and ill-structured decision making. This indicates that there is no "linear" function between rational/intuitive reasoning and decision making performance. Therefore it does not seems possible to "simply" establish rules for management decisions to use a more rational approach when facing well-structured problem situations and a more intuitive approach when facing ill-structured problem situations.
5. The outcomes from the empirical experiment support the notion, that the highest decision making efficiency can be achieved by a "pertinent blend" of intuitive and rational personality types, which is also consistent with previous empirical studies.
6. The empirical experiments, included managers (practitioners) and students from business management faculties as in many previous empirical experiments. Here again the findings from previous laboratory experiments seem to confirm that decisions of students and managers in the field of business management produced similar results as the four groups (two groups of managers and two groups of students) participating in the laboratory experiment. Also they achieved similar decision making efficiencies within the various problem tasks. This allows for the presumption that managers and business students alike can function as probands for experimental research studies.
7. The overall general conclusion yields the fact that different personality types are not per se a dominant independent variable for decision making success, but corroborate the notion that various decision making types can nearly equally contribute to acceptable decision making efficiency in managerial problem solving.

SUGGESTIONS

From the results of this scientific study the author suggests the following points:

1. Whereas the literature until now proposed that rational oriented types seem to be more efficient when solving well-structured problems and vice versa intuitive orientated types are more efficient when solving ill-structured problems and therefore types could be allocated accordingly to the different problem situations. The results of the present study suggest that managers should also train their non-dominant decision making style to build up a complementary approach allowing them then to increase their decision making efficiency. Being able to address a complementary approach by mixing rational and intuitive approaches will not only increase the decision making efficiency of managers but also will enable them to consider how their subordinates and stakeholders perceive these decisions according to the difference of their personality type. A complementary approach therefore will support a type related communication resulting in a better understanding and therefore provide higher efficiency during the implementation of the decision making outcomes by team member, subordinates or stakeholders.
2. Apart from the individual personality development, aiming to consider the impact of personality types on the decision making efficiency when solving problems within groups, managers can increase the decision making efficiency, by increasing the heterogeneity of their teams in terms of having individuals with different kinds of personality types. This means that team members are chosen according to the domination they have as a decision making style (intuitive vs. rational). This again would allow having a kind of complementary rational and intuitive approach to achieve higher decision making efficiency rather than an isolated rational or intuitive approach.
3. For the operationalization on how to solve differently structured problems managers should identify the various decision making situations in their job environment and try to categorize them by well-, mid- and ill-structured problem situations (cf. chapter 2.3.1). After that they should seek for adequate problem solutions, methods and procedures and practice them so that they become inherent. For well-structured problem situations this could mean using known algorithms, concepts, tools, templates and checklists which support the problem solution process. For mid-structured problem situations algorithms, concepts, tools and templates may first have to be developed in order to establish an overall, not knowing from the beginning, problem solution process. For ill-structured problem situations managers need to establish a

"competency attitude" to see and recognize patterns within problem situations which enable them to relate to previous experience they had in similar situations and to apply them then to a concrete problem solution process on a current problem.

4. The author also recommends that the results of this study should be part of a leadership training or workshops within business organizations or professional academies, especially in the context of management decision making training. In this case the application oriented approach, outlined in chapter 3.4, could be a first starting point within workshops to implement and address the results of this study to increase the awareness of leaders and managers for this kind of topic in business organizations.
5. As decision making and especially strategic decision making is one of the major management tasks, the results of this study should also be used for the education and training of future managers at Universities. Especially the impact of problem structures and individual behavior should be in the focus of this kind of education. Here also the application oriented approach, outlined in chapter 3.4, could be build up as a case study to support future managers to become better aware of the "mechanics" on how personality types impact the decision making efficiency.
6. Last but not least, more research including various factors of personal disposition (e.g. personality, managerial experience, professional expertise, etc.) and the problem characteristics would be desirable to better understand how different factors influence the efficiency of the management decision making process and how personal behavior can be adjusted to improve this process, especially in an increasingly insecure and uncertain business environment. As in this case personal behavior is also related to situational circumstances, esp. in today's dynamic business environment, there also seems to be a great need of further research in dynamic decision making structures and how they influence the efficiency of management decision making. Especially the development of more sophisticated tools on how to train people in dynamic situational decision making would be helpful.

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APPENDIX

Appendix I: Decision making tasks

a) Well-structured decision making task

Task 1 (English version)

Registration number: _____
Year of birth: _____
Gender: □ female □ male
Semester: □ 1 □ 2 □ 3 □ 4 □ 5 □ 6 □ 7 □ 8
Course of specialization: _____
Time start: _____
Time stop: _____

Description[379]:

For purchasing a new machine (option A, B or C) a decision shall be made based on a comparative cost method (investment calculation). The machine producing with the lowest cost per unit and therefore has the highest cost efficiency shall be selected.

Task:

Please determine which machine the most cost efficient option is? Please assume that the capacity of the machines will be fully utilized.

Determine also for the two most cost efficient options until which critical production volume which option is more cost efficient?

Total Costs		Machine A	Machine B	Machine C
Purchasing price	(EUR)	80.000	70.000	100.000
Machine life	(Years)	10	7	10
Capacity	(Units/Year)	10.000	7.000	12.000
Fix costs	(EUR/Year)	13.000	15.000	16.000
Variable costs	(EUR/Year)	32.000	18.760	29.760

[379] Cf. Perridon, L, Steiner, M. (1997). Finanzwirtschaft der Unternehmung, 9. Aufl. München, Vahlen Verlag, pp. 43-44.

Aufgabe 1 (German version)

Ihre Matrikelnummer: _____
Ihr Jahrgang: _____
Ihr Geschlecht: □ weiblich □ männlich
Ihr aktuelles Fachsemester: □ 1 □ 2 □ 3 □ 4 □ 5 □ 6 □ 7 □ 8
Ihr Studienschwerpunkt: _____
Uhrzeit Start: _____ Uhr
Uhrzeit Ende: _____ Uhr

Beschreibung[380]:

Für die Anschaffung einer neuen Anlage (Variante A, B oder C) soll eine Entscheidung auf Basis einer Kostenvergleichsrechnung (Investitionsrechnung) getroffen werden. Es soll die Anlage beschafft werden, welche die geringsten Kosten pro Leistungseinheit (LE) erwirtschaftet bzw. damit die höchste Kosteneffizienz besitzt.

Aufgabe:

Bitte ermitteln Sie, welche Anlage die kostengünstigste Variante ist? Nehmen Sie an, dass die Kapazitäten der Anlagen jeweils voll genutzt werden.

Beurteilen für die zwei kostengünstigsten Varianten auch, bis bzw. ab welcher kritischen Produktionsmenge welche Anlage kostengünstiger ist?

Gesamtkosten		Anlage A	Anlage B	Anlage C
Anschaffungswert	(EUR)	80.000	70.000	100.000
Nutzungsdauer	(Jahre)	10	7	10
Kapazität	(LE/Jahr)	10.000	7.000	12.000
Fixe Kosten	(EUR/Jahr))	13.000	15.000	16.000
Variable Kosten	(EUR/Jahr)	32.000	18.760	29.760

[380] Cf. Perridon, L, Steiner, M. (1997). Finanzwirtschaft der Unternehmung, 9. Aufl. München, Vahlen Verlag, pp. 43-44.

b) Mid-structured decision making task

Task 2 (English version)

Registration number: _____
Year of birth: _____
Gender: □ female □ male
Semester: □ 1 □ 2 □ 3 □ 4 □ 5 □ 6 □ 7 □ 8
Course of specialization: _____
Time start: _____
Time stop: _____

Description:

Pipers, which is a subsidiary of a large international food company, markets a range of meat products in Ruritania, one of the more backward European countries. The range contains four brand leaders, the longest-established and most profitable of which is the **Pipers Premium Pasta**. **Premium Pasties** owe their superior taste and texture to the use of Scottish beef steak and a unique cooking process devised by Sir Peter Piper, the founder of the firm. When Sir Peter sold his company to the present owners he was asked to stay on as Chairman of the Board. The day-to-day running of Pipers is now in the hands of a Canadian Managing Director in his thirties, while Sir Peter, who is twenty years his senior, devotes most of his time to an active and successful political career.

The largest retailer in Ruritania is a firm called Metro Markets, which has increased its share of the total food market from 47% to 50% over the last five years. MM's success is built on their buying power and the siting of their 700 retail outlets, one in every major town in Ruritania. MM demand that all their suppliers give them a price 2½% below their lowest list-price. They also expect manufacturers of leading brands to supply an MM own-label product of almost comparable quality at a price 10% below the lowest list-price of the manufacturer's brand. Pipers (like all their competitors), have given MM the extra 2½%, but Pipers have resolutely refused to supply a cheap own-label imitation of their **Premium Pasty**. In retaliation, MM have priced and shelved the product so that MM contribute less than 30% of its total sales volume. In addition, MM have refused to stock the last three new products Pipers have introduced until more than six months after they have proved themselves successful in other stores.

One year ago a formidable new competitor for Pipers appeared in Ruritania, a subsidiary of CC (Meat Products) Inc. They have launched a premium product, the **Rancho Steak Pie** which is rated in consumer tests almost equal with **Pipers Premium Pasty**, despite being made from frozen South American beef. **Rancho Steak Pies** cost less to produce than

Premium Pasties, partly because of their cheaper raw materials, and partly because their new factory employs advanced manufacturing technology. The greater productivity of their plant compensates for the extra processes required by their lower-grade raw material. The result is that **Rancho Steak Pies** are sold to the consumer at prices 5% below **Premium Pasties**.

This month MM approached Pipers stating that they plan to launch a new **MM Premium Pasty** in six months' time. CC have already stated their willingness to manufacture the new product. MM says they wish to give the manufacturer of the brand leader one final chance before they accept CC's offer.

The Sales Director of Pipers believes they should take this opportunity since the sales volume of **Premium Pasties** is static and Pipers plan to launch several new lines in the next year.

The Technical Director supports this view; he points out that a new automated manufacturing system for **Premium Pasties** would bring down the unit cost of production by more than the 7½% difference in the price realised from Pipers and MM own-label pasties.

The Finance Director confirms that the lower unit costs and extra profits on Premium Pasties sold to customers other than MM would enable the cost of the new automated plant to be recovered in 2½ years.

The Marketing Director opposes the manufacture of MM own-label by Pipers, since this would inevitably take volume and market share from **Pipers Premium Pasties**.

The Personnel Director points out that the installation of an automated manufacturing system in Pipers' factory would cause 400 process workers to become redundant. The unemployment level in Ruritania, the highest in Europe, has made the present government very sensitive on this issue, and redundancy payments would be considerable.

Sir Peter opposes the manufacture of MM own-label. He has been actively lobbying the government to set up a Monopolies Commission to investigate the retail trade. He is also one of a group of MPs trying to introduce Fair Trading laws like those in force in the USA and the more advanced European countries: such laws would make MM's demand illegal.

Task:

Next month the Managing Director is due to present Pipers annual and five-year plans to the Board of the international holding company. These plans must contain proposals for dealing with the present situation. Therefore please answer the following questions:

1. How plausible are the reasons of the different leaders from your point of view? Please evaluate the plausibility of the leaders in the following table:

1 = very plausible **to** 5 = not plausible at all.

	1	2	3	4	5
Sales Director					
Technical Director					
Finance Director					
Marketing Director					
Personnel Director					

2. Please bring the different reasons into order (from 1 to 5) according to your preference.

1 = preferred the strongest **to** 5 = preferred the least

Sales Director	
Technical Director	
Finance Director	
Marketing Director	
Personnel Director	

3. Please set up cost-benefit calculation for both strategic options, to show, which one of the options is to accept/decline.

Aufgabe 2 (German version)

Ihre Matrikelnummer: _____
Ihr Jahrgang: _____
Ihr Geschlecht: □ weiblich □ männlich
Ihr aktuelles Fachsemester: □ 1 □ 2 □ 3 □ 4 □ 5 □ 6 □ 7 □ 8
Ihr Studienschwerpunkt: _____
Uhrzeit Start: _____ Uhr
Uhrzeit Ende: _____ Uhr

Beschreibung:

Pipers, eine Tochterfirma eines internationalen Nahrungsmittelkonzerns, vermarktet eine Auswahl von Fleischprodukten in Ruritania, eines der rückständigeren europäischen Länder. Die Auswahl beinhaltet vier Markenführer. Die am längsten etablierte und profitabelste Marke ist die **Pipers Premium Pastatasche. Premium Pastataschen** verdanken ihren ausgezeichneten Geschmack und die Textur dem Einsatz von schottischem Rindfleisch und einer einmaligen Zubereitung, erfunden von Sir Peter Piper, dem Gründer der Firma. Als Sir Peter die Firma an den jetzigen Besitzer verkaufte, wurde er gefragt, ob er als Aufsichtsratsvorsitzender im Unternehmen verweilen möchte. Das Tagesgeschäft wird nun durch einen kanadischen Geschäftsführer geführt, der Mitte dreißig ist, während Sir Peter, welcher bereits 20 Jahre in diesem Geschäft tätig ist, die meiste seiner Zeit für eine aktive und erfolgreiche Karriere in der Politik aufwendet.

Der größte Einzelhändler in Ruritania ist eine Firma namens Metro Märkte, welche ihren Marktanteil die letzten fünf Jahre von 47% auf 50% gesteigert hat. MM's Erfolg kommt von der Einkaufsstärke und dem Sitz der 700 Filialen, eine fast in jeder größeren Stadt von Ruritania. Die MM's behaupten, dass ihnen alle Lieferanten Preise geben, welche 2,5% unterhalb der niedrigsten Preisliste liegen. Sie erwarten von den Markenherstellern auch, dass diese Produkte in vergleichbarer Qualität für die MM Eigenmarke hergestellt werden, bei denen die Preise 10% unterhalb der niedrigsten Preisliste der Markenprodukte der Hersteller liegen. Pipers hat (wie alle anderen Wettbewerber) MM die extra 2,5% gegeben, aber Pipers weigert sich vehement, ein Billigproduktimitat für ihr **Premium Pastataschen** zu liefern. Im Gegenzug hat MM das Produkt so platziert und ausgezeichnet, dass es weniger als 30% des Verkaufsvolumens beträgt. Weiter hat sich MM geweigert, drei weitere neue Produkte anzubieten, welche Pipers bereits seit mehr als sechs Monate erfolgreich in anderen Läden eingeführt hat.

Vor ca. einem Jahr ist ein neuer eindrucksvoller Wettbewerber in Ruritania aufgetaucht, eine Tochterfirma der CC (Fleischprodukte) AG. Sie haben ein Premium Produkt eingeführt, den **Rancho Steak Pie,** welcher bei Konsumententests genauso gut bewertet wurde, wie die **Pipers Premium Pastataschen**, unabhängig davon, dass der **Rancho Steak Pie** von gefrorenem südamerikanischen Rindfleisch hergestellt wird. Die **Rancho Steak Pies** kosten weniger, bedingt durch den Einsatz von günstigeren Rohmaterialien und weil die neue Fabrik modernere Herstelltechnologie einsetzt. Die höhere Produktivität der Werke kompensiert den Mehraufwand, welcher durch den Einsatz von geringer wertigem Rohmaterial entsteht. Das Ergebnis ist, dass die **Rancho Steak Pies** zu einem Preis verkauft werden, der 5% günstiger ist als bei den **Premium Pastataschen**.

Diesen Monat ist MM auf Pipers zugegangen und hat ihnen mitgeteilt, dass sie innerhalb der nächsten sechs Monate planen eine neue **MM Premium Pastatasche** einzuführen. CC hat bereits signalisiert, dass sie gewillt sind das neue Produkt herzustellen. MM sagt, dass sie dem Hersteller der Premium Marke noch eine letzte Chance geben bevor sie das Angebot von CC annehmen.

Der Verkaufsdirektor von Pipers glaubt, sie sollten die Chance wahrnehmen, da das Verkaufsvolumen der **Premium Pastataschen** stagniert und Pipers plant weitere neue Produktlinien einzuführen.

Der technische Direktor unterstützt diese Sichtweise, er weist darauf hin, dass ein neues automatisiertes Herstellungsverfahren für die **Premium Pastataschen** die Stückkosten von Pipers im Gegensatz zu dem MM Eigenprodukt Pastataschen um 7,5% senken könnte.

Der Finanzdirektor bestätigt, dass geringere Stückkosten und der dadurch entstandene Zusatzgewinn bei den **Premium Pastataschen** durch die anderen Kunden (außer MM), es ermöglicht, die Kosten der neuen automatisierten Fabrik innerhalb von 2,5 Jahren zu amortisieren.

Der Marketingdirektor spricht sich gegen die Produktion der MM Eigenmarke durch Pipers aus, da diese unwillkürlich Marktanteile und Volumen von **Pipers Premium Pastataschen** Kosten kanibalisieren würde.

Der Personaldirektor weist darauf hin, dass die Installation eines neuen automatisierten Herstellungsverfahrens in Pipers Fabrik etwa 400 Arbeitskräfte überflüssig machen würde. Die hohe Arbeitslosigkeit in Ruritania, eine der höchsten in Europa, hat die hiesige Regierung extrem sensibel für solche Situation gemacht und wodurch Freisetzungsprämien vorstellbar sind.

Sir Peter lehnt die Herstellung der MM Eigenmarke ab. Er betreibt aktive Lobbyarbeit, dass die Regierung eine Kartellbehörde einsetzt, um den Einzelhandel zu kontrollieren. Er ist auch in einer Gruppe von Parlamentsmitgliedern, die versuchen, „faire Handelsgesetze“ einzuführen wie z. B. in den USA oder in den mehr entwickelten Ländern in Europa. Diese würden die Anforderungen von MM illegal machen.

Aufgabe:

Nächsten Monat muss der Geschäftsführer den Jahres- bzw. den Fünfjahresplan dem Aufsichtsrat der internationalen Holding vorlegen. Der Plan muss Vorschläge enthalten, wie mit der derzeitigen Situation umgegangen werden soll. Beantworten Sie dazu die folgenden Fragen:

1. Wie plausibel klingen Ihrer Meinung nach die Begründungen der einzelnen Führungskräfte? Bitte bewerten Sie diese in der folgenden Tabelle von

1 = sehr plausibel bis 5 = überhaupt nicht plausibel.

	1	2	3	4	5
Verkaufsdirektor					
Technische Direktor					
Finanzdirektor					
Marketingdirektor					
Personaldirektor					

2. Bitte bringen Sie die Sichtweisen in eine Reihenfolge (von 1 bis 5) gemäß Ihrer Präferenz.

1 = am stärksten präferiert bis 5 = am wenigsten präferiert

Verkaufsdirektor	
Technische Direktor	
Finanzdirektor	
Marketingdirektor	
Personaldirektor	

3. Bitte erstellen Sie eine Kosten-Erlös Kalkulation der beiden strategischen Optionen, um aufzuzeigen, welche der beiden Optionen ggf. abzulehnen/anzunehmen sind.

c) Ill-structured decision making task

Task 2 (English version)

Registration number: _____
Year of birth: _____
Gender: □ female □ male
Semester: □ 1 □ 2 □ 3 □ 4 □ 5 □ 6 □ 7 □ 8
Course of specialization: _____
Time start: _____
Time stop: _____

Beschreibung:

You are a member of a space crew scheduled to rendezvous with a mother ship on the lighted surface of the moon. However, due to mechanical difficulties, your own ship was forced to land at a spot 200 km from the rendezvous point. During re-entry and landing, much of the equipment aboard was damaged and, since survival depends on reaching the mother ship, the most critical items available must be chosen for the 200 km trip. 15 items are listed as being intact and undamaged after landing.

Task:

Your task is to rank them in terms of their importance for your crew, to allow them to reach the rendezvous point. Place the number 1 by the most important item, the number 2 by the second most important, and so on through to number 15 for the least important.

Solution:

Your ranking:	Salvaged items:		
	Box of matches		
	Food concentrate		
	50 feet of nylon rope		
	Parachute silk		
	Portable heating unit		
	Two .45 caliber pistols		
	dehydrated milk		
	Two 100-pound tanks of oxygen		
	Stellar map		
	Self-inflating life raft		
	Magnetic compass		
	Five gallons of water		
	Signal flares		
	First aid kit containing injection needles		
	Solar powered FM receiver		

Aufgabe 3 (German version)

Ihre Matrikelnummer: _____
Ihr Jahrgang: _____
Ihr Geschlecht: □ weiblich □ männlich
Ihr aktuelles Fachsemester: □ 1 □ 2 □ 3 □ 4 □ 5 □ 6 □ 7 □ 8
Ihr Studienschwerpunkt: _____
Uhrzeit Start: _____ Uhr
Uhrzeit Ende: _____ Uhr

Beschreibung:

Sie sind Mitglied einer Raumschiff-Crew. Ursprünglich war geplant, dass Sie mit einem Mutterschiff auf der beleuchteten Oberfläche des Mondes ein Rendezvous haben. Wie auch immer, wegen mechanischer Probleme musste Ihr Raumschiff an einem Punkt ca. 200 km entfernt von dem Rendezvous Punkt landen. Während des Wiedereintritts und der Landung wurde das meiste von Ihrer Ausrüstung an Bord beschädigt und da das Überleben vom Erreichen des Mutterschiffes abhängt, müssen die kritischsten Ausrüstungsgegenstände für den 200 km langen Trip ausgewählt werden. Unten sind 15 Gegenstände aufgelistet, welche nach der Landung noch intakt und unbeschädigt sind.

Aufgabe:

Ihre Aufgabe ist es nun, diese Gegenstände nach der Wichtigkeit für Ihre Crew zu ordnen, um es Ihnen zu ermöglichen den Rendezvouspunkt zu erreichen. Positionieren Sie den wichtigsten Gegenstand mit der Nummer **1**, den zweitwichtigsten mit der Nummer **2** und so weiter bis zum am wenig wichtigsten Gegenstand mit der Nummer **15**.

Lösung:

Ihre Reihenfolge:	Gegenstände:		
	Streichhölzer		
	Lebensmittelkonzentrat		
	Fünfzig Fuß Nylonseil		
	Fallschirmseide		
	Tragbares Heizgerät		
	Zwei Pistolen Kaliber .45		
	Trockenmilch		
	Zwei 100-Pfund-Tanks mit Sauerstoff		
	Mondatlas		
	Sich selbst aufblasendes Lebensrettungsfloß		
	Magnetischer Kompass		
	Fünf Gallonen Wasser		
	Signalleuchtkugeln		
	„Erste-Hilfe“-Koffer mit Injektionsnadeln		
	Sonnenenergie-UKW-Funkgerät		

Appendix II: Questionnaire for the evaluation of the individual efficiency

Questionnaire (English version)

Registration number: _____
Year of birth: _____
Gender: □ female □ male
Semester: □ 1 □ 2 □ 3 □ 4 □ 5 □ 6 □ 7 □ 8
Course of specialization: _____
Type of task: □ 1 □ 2 □ 3

Please answer the following questions:

1. How satisfied were you today with your problem solution process?

very unsatisfied	1	2	3	4	5	very satisfied

2. How complex was the underlying problem for you?

very complex	1	2	3	4	5	very easy

3. How intense can you identify yourself with the discovered problem solution?

very little	1	2	3	4	5	very much

4. How do you evaluate your work concerning a target orientated information search?

very disorientated	1	2	3	4	5	very target oriented

5. How do you evaluate your work concerning a target orientated information search?

very weak information search	1	2	3	4	5	very strong information search

6. How do you evaluate your work concerning a systematic approach?

very unsystematic	1	2	3	4	5	very systematic

7. . How do you evaluate your problem solving style,
rational (figures and facts-decider) or intuitive (stomach-decider))?

very rational	1	2	3	4	5	very intuitive

Fragebogen (German version)

Ihre Matrikelnummer: _____
Ihr Jahrgang: _____
Ihr Geschlecht: □ weiblich □ männlich
Ihr aktuelles Fachsemester: □ 1 □ 2 □ 3 □ 4 □ 5 □ 6 □ 7 □ 8
Ihr Studienschwerpunkt: _____
Aufgabentyp: □ 1 □ 2 □ 3

Bitte beantworten Sie uns folgende Fragen:

1. Wie zufrieden sind Sie heute mit Ihrem Problemlösungsprozess?

sehr unzufrieden	1	2	3	4	5	sehr zufrieden

2. Wie schwierig war das heutige Problem für Sie?

sehr schwierig	1	2	3	4	5	sehr leicht

3. Wie stark können Sie sich mit der getroffenen Problemlösung identifizieren?

sehr gering	1	2	3	4	5	sehr stark

4. Wie beurteilen Sie Ihre Arbeit hinsichtlich einer zielorientierten Problembearbeitung?

Orientierungslos	1	2	3	4	5	sehr zielorientiert

5. Wie beurteilen Sie Ihre Arbeit hinsichtlich einer zielorientierten Informationsbeschaffung?

sehr schwache Informationssuche	1	2	3	4	5	sehr starke Informationssuche

6. Wie beurteilen Sie Ihre Arbeit hinsichtlich des systematischen Vorgehens?

sehr unsystematisch	1	2	3	4	5	sehr systematisch

7. Wie beurteilen Sie Ihren Problemlösungsstil, rational (Zahlen, Daten, Fakten-Entscheider) oder intuitive (Bauchentscheider)?

sehr rational	1	2	3	4	5	sehr intuitiv

Appendix III: Empirical data

Correlations of the MBTI preferences and the various problem tasks

Correlations				
			MBTI types 1-16	R^2
formal efficiency well-structured	Task 1 (0-10)	Korrelationskoeffizient	,093	-
		Sig. (2-seitig)	,336	
		N	109	
material efficiency well-structured	Time 1	Korrelationskoeffizient	,005	-
		Sig. (2-seitig)	,961	
		N	109	
formal efficiency mid-structured	Task 2 (0-10)	Korrelationskoeffizient	-,031	-
		Sig. (2-seitig)	,760	
		N	100	
material efficiency mid-structured	Time 2	Korrelationskoeffizient	-,053	-
		Sig. (2-seitig)	,600	
		N	99	
formal efficiency ill-structured	Task 3 (0-10)	Korrelationskoeffizient	-,044	-
		Sig. (2-seitig)	,652	
		N	106	
material efficiency ill-structured	Time 3	Korrelationskoeffizient	,192*	,037
		Sig. (2-seitig)	,047	
		N	107	
individual efficiency well-structured	PE1	Korrelationskoeffizient	-,186	,035
		Sig. (2-seitig)	,053	
		N	109	
total efficiency well-structured	Total1	Korrelationskoeffizient	,068	-
		Sig. (2-seitig)	,483	
		N	109	
individual efficiency mid-structured	PE2	Korrelationskoeffizient	,015	-
		Sig. (2-seitig)	,887	
		N	98	
total efficiency mid-structured	Total2	Korrelationskoeffizient	,006	-
		Sig. (2-seitig)	,950	
		N	98	
individual efficiency ill-structured	PE3	Korrelationskoeffizient	-,027	-
		Sig. (2-seitig)	,782	
		N	106	
total efficiency ill-structured	Total3	Korrelationskoeffizient	-,025	-
		Sig. (2-seitig)	,798	
		N	106	

* $p < 0.05$ ** $p < 0.01$

Mean values of ill-structured problem tasks

Ill-structured problem tasks

E_I	Mean value	Variance	Minimum	Maximum	Standard deviation	Coefficient of variation
E	,8171	,002	,70	,91	,0458	,05610
I	,7783	,002	,73	,84	,0426	,05476
Total	,8149	,002	,70	,91	,0464	,05689

Ill-structured problem tasks

S_N	Mean value	Variance	Minimum	Maximum	Standard deviation	Coefficient of variation
S	,8154	,002	,70	,91	,04615	,05660
N	,7900	,005	,74	,84	,07071	,08951
Total	,8149	,002	,70	,91	,04636	,05689

Ill-structured problem tasks

T_F	Mean value	Variance	Minimum	Maximum	Standard deviation	Coefficient of variation
T	,8174	,002	,70	,91	,04603	,05631
F	,7733	,001	,73	,81	,03141	,04062
Total	,8149	,002	,70	,91	,04636	,05689

Ill-structured problem tasks

J_P	Mean value	Variance	Minimum	Maximum	Standard deviation	Coefficient of variation
J	,8178	,002	,70	,91	,04626	,05657
P	,7957	,002	,73	,87	,04380	,05505
Total	,8149	,002	,70	,91	,04636	,05689

Mean values of mid-structured problem tasks

Mid-structured problem tasks

E_I	Mean value	Variance	Minimum	Maximum	Standard deviation	Coefficient of variation
E	,6254	,006	,38	,79	,07644	,12222
I	,5720	,001	,55	,61	,02490	,04353
Total	,6227	,006	,38	,79	,07554	,12132

Mid-structured problem tasks

S_N	Mean value	Variance	Minimum	Maximum	Standard deviation	Coefficient of variation
S	,6240	,006	,38	,79	,07470	,11971
N	,4900	.	,49	,49	.	
Total	,6227	,006	,38	,79	,07554	,12132

Mid-structured problem tasks

T_F	Mean value	Variance	Minimum	Maximum	Standard deviation	Coefficient of variation
T	,6233	,006	,38	,79	,07710	,12369
F	,6100	,001	,55	,65	,03808	,06242
Total	,6227	,006	,38	,79	,07554	,12132

Mid-structured problem tasks

J_P	Mean value	Variance	Minimum	Maximum	Standard deviation	Coefficient of variation
J	,6238	,006	,38	,79	,07608	,12197
P	,6154	,006	,49	,72	,07446	,12099
Total	,6227	,006	,38	,79	,07554	,12132

Mean values of well-structured problem tasks

Well-structured problem tasks

E_I	Mean value	Variance	Minimum	Maximum	Standard deviation	Coefficient of variation
E	,6359	,015	,27	,86	,12420	,19532
I	,5314	,024	,36	,76	,15636	,29422
Total	,6292	,016	,27	,86	,12824	,20383

Well-structured problem tasks

S_N	Mean value	Variance	Minimum	Maximum	Standard deviation	Coefficient of variation
S	,6281	,017	,27	,86	,12856	,20466
N	,6850	,018	,59	,78	,13435	,19613
Total	,6292	,016	,27	,86	,12824	,20383

Well-structured problem tasks

T_F	Mean value	Variance	Minimum	Maximum	Standard deviation	Coefficient of variation
T	,6360	,016	,27	,86	,12632	,19860
F	,5117	,012	,36	,67	,11053	,21602
Total	,6292	,016	,27	,86	,12824	,20383

Well-structured problem tasks

J_P	Mean value	Variance	Minimum	Maximum	Standard deviation	Coefficient of variation
J	,6332	,016	,27	,86	,12620	,19931
P	,6040	,020	,36	,82	,14242	,23579
Total	,6292	,016	,27	,86	,12824	,20383