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Experiments on Influence of Construal Level During Process Modeling

Bachelor Thesis at Ulm University

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Abstract

Process Models have become an important element for the specification of individual procedures in an organization. An incorrect or incomplete model leads to risks or even losses. Therefore, it is essential to ensure that process models represent corresponding procedures as well as possible. It is well known that granularity of process models depends on various factors that must be considered. In this regard, an often overlooked and not considered factor is the psychological distance.

The purpose of this thesis is to introduce the *Construal Level Theory* and their influence on the process of process modeling. In this context, an important factor that apparently affects the granularity of process models is the psychological distance, which is part of the Construal Level Theory. To confirm this assumption, an experiment is carried out.

The results indicate that psychological distance affects process modeling as well as resulting process models. In general, lower psychological distance leads to more detailed process models. However, further research is required to investigate the influence of psychological distance in more detail.

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Contents

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Introduction

Increasing globalization and rise of competitive pressure forces organization to optimize their organization structures and procedures. More and more organization move from function-oriented to process-oriented organization structure. For this reason, the elementary component of a process-oriented structure, the *process models*, are indispensable in today's world.

Documented process models are important to understand individual business processes within an organization. The more precise they are, the better is the placement of functions, roles and interfaces and thus serves to increase the transparency of business processes of an organization. Likewise, *process modeling* establish a basis for further actions such as vulnerability assessment and optimization of existing process models. Therefore, it is important for organization to put an emphasis on the *quality* of process models.

A yet not investigated influence factor that affects the process of process modeling and resulting process models is the *psychological distance*. Studies have shown, our behavior and thinking is strongly influenced by psychological distance [23]. But what are the effects of psychological distance on the process of process modeling and the process models?

Therefore, this thesis introduces the *Construal Level Theory* as well as psychological distance (i.e. social, spatial, temporal and hypothetical distance). Furthermore, an experiment with students and research assistants is established at Ulm University. Based on the *Business Process Model and Notation (BPMN)*, participants of the experiment model various process models for each psychological distance. The results of the experiment indicate a difference in granularity of process models.

The further structure of this thesis is as follows: Section 2 introduces the Construal Level Theory and the psychological distance in detail. Section 3 presents the experiments idea, planning and definition. Experiment operation, which includes preparation, execution and data validation is described in Section 4. The analysis of obtained results are present in Section 5. Finally, Section 6 discusses results and summarizes the main points of this thesis.

The general process of the experiment is illustrated in Figure 1.1.

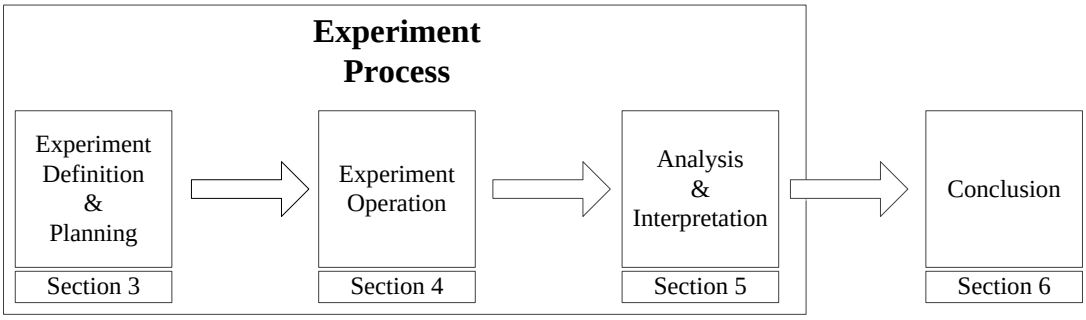

Figure 1.1.: Experiment Process

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Fundamentals of Construal Level Theory

As basis for this thesis *Construal Level Theory* and its properties is presented in Section 2. Section 2.1 describes the *level of construal*. Section 2.2 introduces the *psychological distance*. Based on this, their related distances (i.e., social, spatial, temporal and hypothetical distance) are described in Section 2.3-2.6.

Construal Level Theory (CLT) is a social-cognitive theory in *social psychology* introduced by [23] that describes the effects of psychological distance on objects or events. The fundamental idea is, which is already proved empirically [21], increasing psychological distance affects the mental representation of objects or events. This influence on the perception has a strong impact on actions and thinkings of an individual.

For example, moving house to a distant location in a distant future evokes general thoughts and actions (e.g. starting a new life, searching new friends). The same event happening in a near location and near future evokes more detailed thoughts and actions (e.g. moving box packs, register the residence) [26].

2.1. Level of Construal

Strangers, distant locations, past events - everything that is distant from us creates a more abstract reflection. The reason behind this effect is the *level of construal*. The level of construal describes how individuals interpret and perceive objects in surrounding [23]. Increasing psychological distance affects cognitive abilities of an individual and thus leads to a change in perception of objects or events.
Therefore, CLT describes two different kinds of thinking: *high-level construal* and *low-level construal*. High-level construals are abstract, coherent and superordinate representations, compared to low-level construals. The further away an object or event is the more we think in high-level construals, and on the other side, the smaller the distance the more we think in low-level construals.
For example, from a distance we see the forest (i.e., high-level construal) and as we get closer, we see the trees (i.e., low-level construal) [23].
These two aspects are influenced by *psychological distance* which is introduced in the next section.

2.2. Psychological Distance

A basic aspect of CLT is the *psychological distance*. While, for example, *objective distance* describes the quantitative and in real-world existing spatial distance of an object or event to someone, the psychological distance describes feelings, thinkings and emotions in relation to the object or event. If an individual shall estimate the distance between two distant locations then one location is perceived as further away.

For example, individuals shall estimate the distance between a city and four other cities. Two of them are in the same federal state and the other two cities are in different federal states. Distance of the four cities to the marked city is always the same.
The results show that cities in foreign federal states are perceived more distant and are consequently estimated as further away [4].
An object or event is defined as *psychological distant*, when it is not experienced physically. Objects or events which are not experienced in the *here and now* must be constructed mentally. Therefore, psychological distance is separated into several subdistances. The *social, spatial, temporal and hypothetical distance* being considered as the most important and are explained in the following [11].

2.2.1. Social Distance

Experiences and decisions which are not self-experienced as well as the relation to other individuals are *social distant*. For example, choosing a more distant seat from another individual is taken to reflect social distance [15]. The way how an individual decides for himself or for others is also affected by social distance. An example are results of [17]: An individual expects more negative activities from others than from himself. The results are in accordance with CLT. With increasing social distance evaluation for distant individuals takes place at a more abstract information level [24].

2.2.2. Spatial Distance

Spatial distance refers to objects and events happening at another physical location. Events that take place at, for example, another country are described more abstract by individuals as if they happened in the same country. Studies showed that participants describe interactions between two individuals more detailed if it takes place at a nearby location. On the other hand, descriptions are more abstract if interactions are spatial distant. [6].

2.2.3. Temporal Distance

Temporal distance deals with events happening in the past or future. When an individual thinks about temporal distant objects or events they are perceived more abstract. Studies have shown, how individuals deal with temporal distance [5]. In this context, participants have to categorize several items for an event happening in the near or further future. If the event takes place in the near future, there are more categories and they are more detailed. A more distant event results in fewer course-grained categories [10]. We retain the possibility of better planning to react against unexpected events in a distant future. For this reason, our actions are specified more abstract. On the other hand, our actions must be prepared more detailed for events happening in the near future.

2.2.4. Hypothetical Distance

Hypothetical distance accrues when an individual thinks about unreal or unlikely events but also worthwhile or elaborate situations. A study dealing with hypothetical distance is the following. As part of a contest, several prices are offered to participants. These prices are either highly attractive but hard to win or less attractive but easy to win. It was shown that for highly attractive prices participants are willing to take more effort to win. The other way around for less attractive prices is the effort correspondingly low [22].

For a better understanding Figure 2.1 summarizes the concept of CLT and the different distances (i.e., social, spatial, temporal and hypothetical distance) up.

With increasing psychological distance perceived objects and events are more abstract. Although this leads to the fact that our actions and thoughts are more general but it lacks on accuracy. On the contrary, lower psychological distance wages to a sophisticated but limited scope.

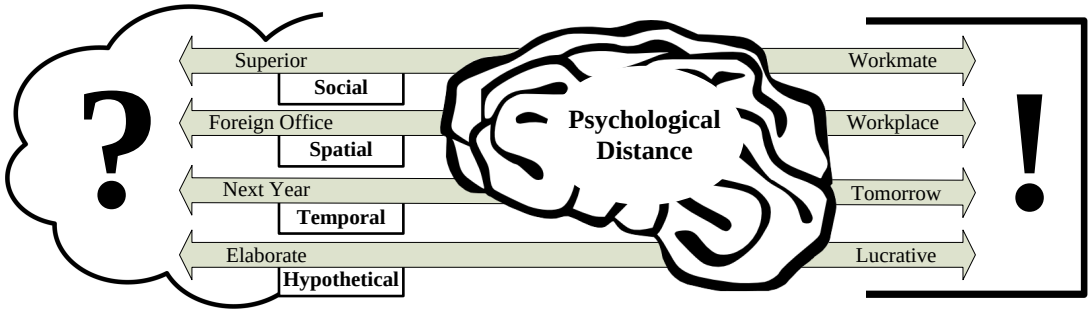

Figure 2.1.: Psychological Distance

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Experiment Planning and Definition

An experiment is conducted to investigate the effects of psychological distance on process modeling.

Section 3 deals with planning and definition of the conducted experiment.
Section 3.1 presents the goal definition. Section 3.2 introduces the context selection. Experiment setup is described in Section 3.3. Section 3.4 represents hypothesis formulation. The experiment design is described in Section 3.5. Finally, Section 3.6 deals with validity evaluation.

The implementation of an experiment is not trivial and requires a proper arrangement in order to guarantee that data obtained is valid and risks are minimized. Therefore, the experiment design strongly considers recommendations given in [27] to guarantee the validity of the results.

3. Experiment Planning and Definition

First, the definition of *why* the experiment is carried out is given and thereupon follows the instruction of *how* the experiment is performed.

For a better overview Figure 3.2 represents the structure of this section.

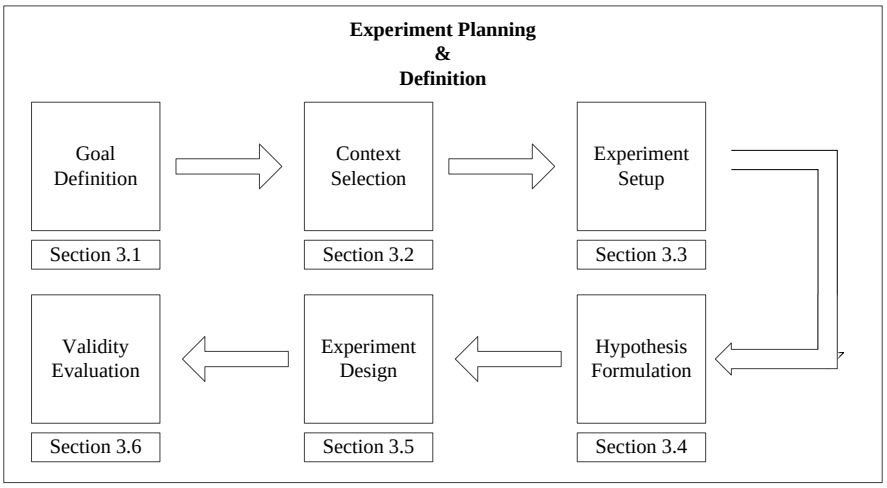


Figure 3.1.: Experiment Planning and Definition

3.1. Goal Definition

Due to the importance of process models for an organization high demands are placed on quality of process models. Notwithstanding analysis there is still a lack of which factors lead to a low process quality. What has been not analyzed so far is the personal subliminal influence of the process designer on resulting process models. This raises the following question:

Is the process of process modeling and resulting process models affected by the psychological distance?

Motivated by this question we conduct an experiment to investigate the influence of psychological distance (i.e., social, spatial, temporal and hypothetical distance) on the process of process modeling and on resulting process models.

A proper experiment definition in software engineering ensures a safe implementation and minimizes or even eliminates potential risks. As a starting point, for goal definition of the experiment we use the *Goal Quality Metric (GQM)* proposed in [3], which is defined as follows:

Object of Study: The *objects of study* are individual process models created by participants of the experiment.

Purpose: The *purpose* of the experiment is to evaluate the individual process models with respect to the influence of the psychological distance on the process of process modeling.

Quality Focus: The main effect studied in the experiment is the level of constural (cf. Section 2.1). To measure the level of constural the focus is set on the quality of each created process model.

Perspective: The *perspective* is set from the point of view of researchers. We would like to know if there are any differences on the process models when dealing with psychological distance.

Context: The experiment is conducted at the Institute of Databases and Information Systems of Ulm University. Students and reasearch assistants of computer science with basic knowledge in process modeling are used. The study is conducted as a *single object study* and can be judged as being a *randomized controlled experiment* [27].

The focus is on the measurement of the level of construal of each process and is defined in Table 3.1 as goal definition template:

Analyze	*psychological influences on process modeling*
for the purpose of	*evaluating*
with respect to their	*process model quality*
from the point of view of	*the researchers*
in the context of	*students and research assistants.*

Table 3.1.: Goal Definition Template

3.2. Context Selection

Obviously, the most significant results of an experiment are achieved in a practical environment with trained and professional staff. However, since an experiment attempts to gain information about a new method and if it is more effective than another one it is not reasonable to perform an experiment in a practical environment. A practical environment involves unsuspected risks and therefore it is advisable to perform an experiment in a controlled environment which is comparable to a practical environment. On the one hand, this option reduces the risks of an experiment, and on the other hand, it reduces also the emerging costs of an experiment [27].
Our experiment is carried out by students and research assistants in a controlled environment. However, this is possible since the results can be transfered to a practical environment. The experiment also provides an insight to the research question (cf. Section 3.1) and thus serves as a foundation for further experiments. In addition, the experimental context provides other researchers with excellent opportunities to replicate the experiment.

3.3. Experiment Setup

Based on Goal Definition Template in Table 3.1 Section 3.3 describes the experiment setup. The selection of subjects and objects is delineated in Section 3.3.1 and 3.3.2. Section 3.3.3 deals with the selection of response variables. Section 3.3.4 presents the used intrumentation and Section 3.3.5 explaines data analysis procedure.

3.3.1. Selection of Subjects

Since it is not possible to test the entire population it is important to select a sample group that is representative for the entire population. This enables us to reason for the whole population. A sample group is also known as a defined collection of *subjects* with similar properties [2]. Therefore, the selected subjects are students and research assistants. Any student and research assistant with basic knowledge of process modeling in general

and about BPMN is able to participate. Wherever possible, it is attempted to achieve a balance between students and research assistants.

3.3.2. Selection of Objects

After selecting subjects, the objects of the study have to be selected. The objects are the entites that are studied in the experiment. As described in Section 3.1 the object of study are the resulting process models of each subject. In order to investigate all distances (i.e. social, spatial, temporal, hypothetical distance) and corresponding ranges (i.e. low and high) there are a total of eight different tasks. More precise, there are two tasks for each distance: one for low and one for high psychological distance. As process modeling language the *Business Process Model and Notation 2.0 (BPMN 2.0)* is used [1].

The following paragraphs introduce individual tasks (cf. Appendix A) in more detail. The corresponding distance is accordingly highlighted.

Task 1: Social - Going for Lunch

Task 1.1 Low Social Distance: *A good friend of you starts to study at your university*. Since it is essential for a student to know, model for him a typical visit of the canteen. Start at the point he enters the canteen.

Task 1.2 High Social Distance: *A student visits your university*. Since it is essential for a student to know, model for him a typical visit of the canteen. Start at the point he enters the canteen.

Task 2: Spatial - Progess of a Lecture

Task 2.1 Low Spatial Distance: You are attending a typical lecture in *O28/H22*. Model the progress of the lecture from the point of view of a docent. Start at the point the docent enters the room and finish when he leaves the room.

Task 2.2 High Spatial Distance: You are attending a typical lecture in the *hospital auditorium (Klinikhörsaal)*. Model the progress of the lecture from the point of view of a docent. Start at the point the docent enters the room and finish when he leaves the room.

Task 3: Temporal - Exam Preparation

Task 3.1 Low Temporal Distance: You are writing an important exam in *two weeks*. Model the process of exam preparation from your point of view.

Task 3.2 High Temporal Distance: You are writing an important exam in *six months*. Model the process of exam preparation from your point of view.

Task 4: Hypothetical - University Choice

Task 4.1 Low Hypothetical Distance: You are looking for a suitable university to study. Consider you have a favorite university in mind *where a place is assured*. Model the process of university selection and application from your point of view.

Task 4.2 High Hypothetical Distance: You are looking for a suitable university to study. Consider you have a favorite university, *but there is a low probability to get a place*. Model the process of university selection and application from your point of view.

3.3.3. Response Variables Selection

The variables of an experiment are an important consideration since they measure, manipulate and control effects in the experiment. Therefore, it is important to choose proper variables to guarantee a correct statistical test of the results. Two types of variables have to be taken into account: *independent* and *dependent response variables*.

Independent Response Variables can be manipulated and controlled in the experiment. These variables have an influence on the dependent response variables.

Dependent Response Variables can only be measured or observed and must depend on independent response variables. A change in the independent leads to a change in the dependent ones. These variables are used for evaluation.

In the experiment, the psychological distances (i.e., social, spatial, temporal and hypothetical distance) are the independent variables and can be manipulated by varying the distance (i.e., low and high). The measured dependent variable is the quality of each process model.

3.3.4. Instrumentation

For measuring of response variables it is essential to apply an adequate instrumentation to guarantee that collected and analyzed data is valid. Obviously, instrumentations shall not influence the outcome of the experiment.
In our experiment, the *Cheetah Experimental Plattform (CEP)* is used [16]. CEP is developed to foster experimental research on business process modeling. CEP allows creating process models as well as integrating survey sheets. In addition, CEP is also able to record every modeling step (i.e., timestamp, type of modeling action, duration).
Before modeling the task, a *questionnaire* (cf. Table 3.2, Table 3.3) must be filled out by subjects to characterize them and the individual skill levels.
The subjects use the modeling environment of CEP (cf. Figure 3.2) to resolve the tasks. All actions (e.g., insert, delete) plus modeling duration and needed modeling steps are logged and stored separately in a database.

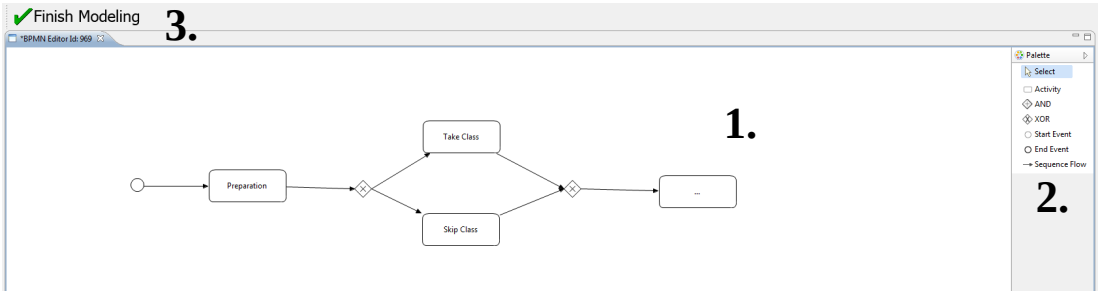


Figure 3.2.: CEP Modeling Environment

1. Work space
2. Available elements
3. Button to finish the task

For evaluation of the experimental results we use the admin environment of CEP (cf. Figure 3.3) with assistance of a self-developed evaluation sheet (cf. Figure 3.4). The individual evaluation points are described in Section 3.3.5.

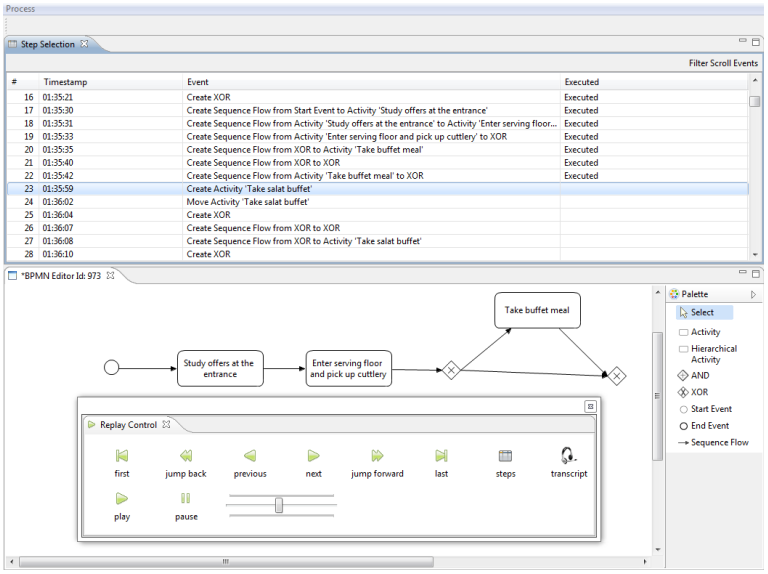


Figure 3.3.: CEP Admin Environment

Question	Possible Answers
Which description matches best your current work status?	Student Professional Academic
Overall, I am very familiar with the BPMN.	Strongly Agree Agree Somewhat Agree Neutral Somewhat Disagree Disagree Strongly Disagree
I feel very confident in understanding process models created with the BPMN.	Strongly Agree Agree Somewhat Agree Neutral Somewhat Disagree Disagree Strongly Disagree
I feel very competent in using the BPMN for process modeling.	Strongly Agree Agree Somewhat Agree Neutral Somewhat Disagree Disagree Strongly Disagree

Table 3.2.: Demographic Survey - Part 1

Question
How many years ago did you start process modeling?
How many process models have you analyzed or read within the last 12 months?
How many process models have you created or edited within the last 12 months?
How many activites did all these models have on average?
How many work days of formal training on process modeling have you received within the last 12 months?
How many work days of self education have you made within the last 12 months?
How many months ago did you start using BPMN?

Table 3.3.: Demographic Survey - Part 2

Evaluation Sheet

Number of Activities: __ Number of Edges: __

Number of Gateways: __ Overall: __

Number of branches: __

Steps: __ Duration: __

Syntactic

Number of Rule Violations: __

Semantic (7-Point Scale: -3 to 3)

Indicator	Definition	Rating
Correctness	All statements in the representation are correct.	
Relevance	All statements in the representation are relevant to the problem	
Completeness	The representation contains all statements about the domain that are correct and relevant	
Authenticity	The representation gives a true account of the domain	

Pragmatic (7-Point Scale: -3 to 3)

Understandable: __

Perceived Model Quality (5-Point Scale: -2 to 2)

	T1	T2	T3	T4
1.	__	__	__	__
2.	__	__	__	__
3.	__	__	__	__
4.	__	__	__	__
5.	__	__	__	__

Naming (3-Point Scale: 1 to 3)

Points: __

Figure 3.4.: Evaluation Sheet

3.3.5. Data Analysis Procedure

For data analysis statistical methods as well as the specific analysis framework *Lindland et al* by [9] to measure the quality of process models are applied. To indicate the level of construal the quality of each process model is measured. We assume that process models influenced by low psychological distance reflect a higher quality than those influenced by high psychological distance. An adapted framework based on *semiotic theory* is used, which considers the *syntactic, semantic, pragmatic and perceived quality* (cf. Figure 3.5) [12].

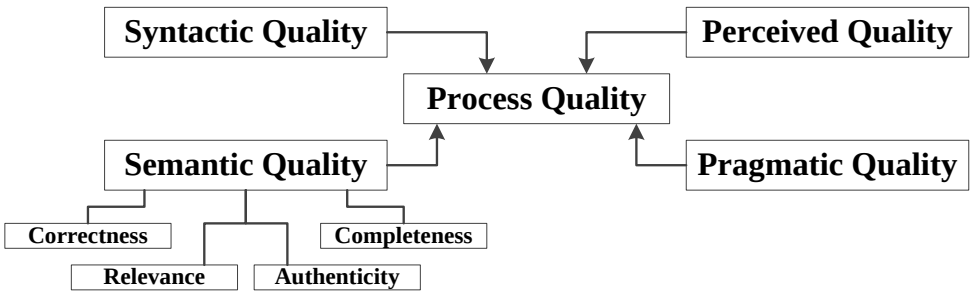


Figure 3.5.: Semiotic Theory

The *syntactic quality* is measured by counting the number of rule violations of the modeling language.

The *semantic quality* covers the aspects *correctness, completeness, relevance and authenticity*. *Correctness* means that all elements in the process model are correct and relevant to the problem. *Completeness* implies that no correct elements are missing in the final process model. *Relevance* signifies that all elements in the process model are relevant to the problem. In contrast to completeness, unnecessary elements are also considered. *Authenticity* means that representation gives a true account of the domain. Therefore, the semantic quality is determined on a 7-point Likert scale ranging from strongly disagree (-3) to strongly agree (3).

The *pragmatic quality* describes the process model comprehension and is measured by the level of understanding. Therefore, the same 7-point Likert scale is used as for semantic quality.

Perceived quality depends on the degree to which a subject agrees with his process model. Therefore, the following questions are used as proposed in [18]:

1. Does the final process model agree with your view of business process?
2. Are there significant aspects that are missing in the final process model?
3. Does the final process model describe the business process accurately?
4. Are there any serious mistakes in the final process model?
5. Would you have done the final process model in a different way?

The statements are put after each task (Task 1-Task 4) to score each question on a 7-point Likert scale ranging from strongly disagree (-3) to strongly agree (3).
Further, number of nodes, edges, gateways and branches in the process models are counted as well as number of modeling steps and modeling duration. In addition, we are considering naming of each process model and it is rated on a 3-point Likert scale ranging from normal detailed (1) to complex detailed (3). Therefore, we consider each label of an activity of process models and evaluate the level of detail.

Summarizing all the above said, each process model of the subjects is reviewed for their quality level. Therefore, the different quality dimensions (i.e., syntactc, semantic, pragmatic and perceived quality) and the additional criteria (e.g., naming, duration) are used to determine the process model quality.

3.4. Hypothesis Formulation

The *hypotheses* describe in concrete terms what are the intentions of an experiment. Therefore, a hypothesis has to be clearly and unambiguously stated. In this context, two types of hypotheses have to be formulated: *null hypothesis* and *alternative hypothesis*.

Null Hypothesis $\mathbf{H_0}$ describes the assumption that no effects or differences exist in the experimental setting. Initially, the null hypothesis is assumed to be true and the experiment tries to reject or disprove it.

Alternative Hypothesis $\mathbf{H_1}$ is exactly the opposite of the null hypothesis and describes the existence of an association between research question and obtained experimental results. It is typically what the researcher wants to show.

Based on the Construal Level Theory, we have derived one main hypothesis (cf. Table 3.4) for the psychological distance in general. These is further divided into four hypotheses (cf. Table 3.5 and 3.6), one for each distance (i.e., social, spatial, temporal and hypothetical distance).

*Does **psychological distance** have an influence on the level of construal while modeling processes?*
$H_{0,1}$: The construal level is higher or equal while modeling processes with low psychological distance.
$H_{0,1}$: $\mu_1 \geq \mu_2$
$H_{1,1}$: The construal level is lower while modeling processes with low psychological distance.
$H_{1,1}$: $\mu_1 < \mu_2$
μ_1: Expected value of the sample with lower distance μ_2: Expected value of the sample with higher psycholigical distance

Table 3.4.: Hypothesis for Psychological Distance

*Does **social distance** have an influence on the level of construal while modeling processes?* $H_{0,2}$: The construal level is higher or equal while modeling processes with low social distance. $H_{0,2}$: $\mu_1 \geq \mu_2$ $H_{1,2}$: The construal level is lower while modeling processes with low social distance. $H_{1,2}$: $\mu_1 < \mu_2$
*Does **spatial distance** have an influence on the level of construal while modeling processes?* $H_{0,3}$: The construal level is higher or equal while modeling processes with low spatial distance. $H_{0,3}$: $\mu_1 \geq \mu_2$ $H_{1,3}$: The construal level is lower while modeling processes with low spatial distance. $H_{1,3}$: $\mu_1 < \mu_2$ μ_1: Expected value of the sample with lower distance μ_2: Expected value of the sample with higher distance

Table 3.5.: Hypotheses for Social and Spatial Distace

*Does **temporal distance** have an influence on the level of construal while modeling processes?* $H_{0,4}$: The construal level is higher or equal while modeling processes with low temporal distance. $H_{0,4}$: $\mu_1 \geq \mu_2$ $H_{1,4}$: The construal level is lower while modeling processes with low temporal distance. $H_{1,4}$: $\mu_1 < \mu_2$
*Does **hypothetical distance** have an influence on the level of construal while modeling processes?* $H_{0,5}$: The construal level is higher or equal while modeling processes with low hypothetical distance. $H_{0,5}$: $\mu_1 \geq \mu_2$ $H_{1,5}$: The construal level is lower while modeling processes with low psychological distance. $H_{1,5}$: $\mu_1 < \mu_2$ μ_1: Expected value of the sample with lower distance μ_2: Expected value of the sample with higher distance

Table 3.6.: Hypotheses for Temporal and Hypothetical Distace

3.5. Experiment Design

After selection of response variables and formulation of hypotheses an appropriate experiment design has to be determined. An experiment design describes the structure and progress of an experiment. The selection of an unsuitable experiment design could cause erroneous data or lead to a failure of the experiment. There are three general principles that must be guaranteed for a correct experiment design.

Randomization: *Randomization* is a principle based on chance by which subjects are assigned. By randomization an uniform distribution between the subjects can be achieved. In our experiment, we assign each subject into one of two groups. For allocation of subjects into groups we are using randomization.

Blocking: In each experiment, unwanted effects may occur that probably have an effect on subjects. However, we have no interests in these effects and therefore we use a principle called *blocking*. Undesired effects are systematically eliminated with blocking. After careful discussion blocking is not used in our experiment. Experience of subjects could differ but it should have no influence on observed response variables.

Balancing: When investigating differences between two groups of subjects, it is desired that each group has an equal number of subjects. Therefore, *balancing* may be used to achieve it. Thus, we avoid imbalance between groups for each psychological distance in our experiment.

Summarizing all the above said, we have an independent response variable, a dependent response variable and two treatments. The independent response variable is the psychological distance. The dependent response variable is the level of construal and the treatments are low and high range. According to [27] we use a *single object study*. As mentioned above, a randomized experiment design is applied to strengthen balancing. All subjects work on their own and model for each psychological distance one process model whereas psychological distance changes alternately between the subject groups (cf. Figure 3.6).

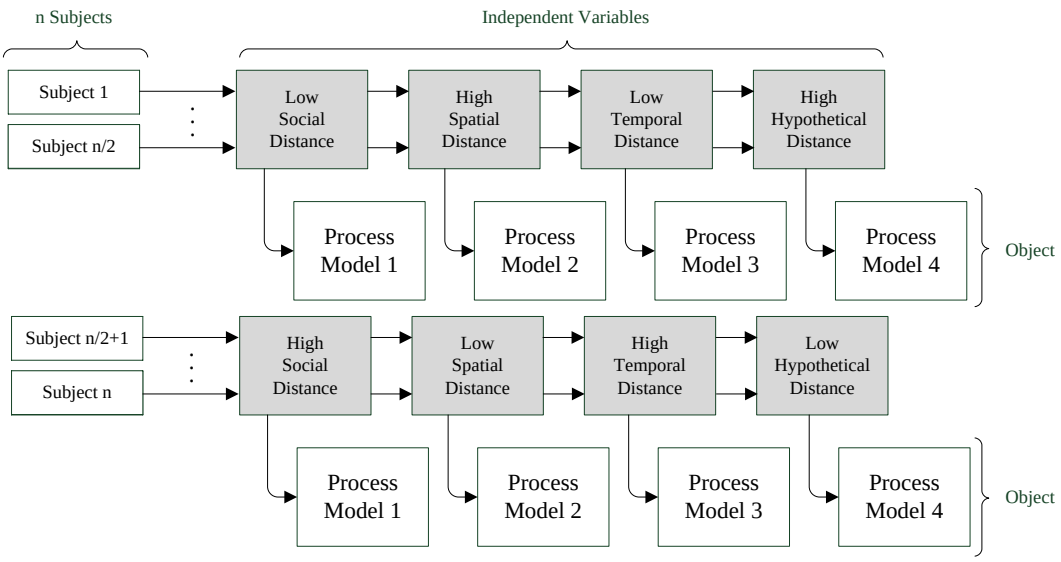


Figure 3.6.: Experiment Design

3.6. Risk Analysis and Mitigations

In every experiment, there are certain adverse factors that have to be taken into account. These factors may affect the results of the experiment. Therefore, it is important to pose the question, how valid are the obtained results?
In the experiment, we have two levels of validity on psychological distance to consider: *internal validity* (Are the effects caused by the treatment?) and *external validity* (Can the results be generalized?).

Threats to *internal validity* are:

The major threat regarding the internal validity are the chosen distances. If the distances are too small, it might be that they do not affect subjects when modeling processes. Therefore, we tried and ensured to maximize the "gap" between the two psychological distances (i.e., low and high).
Another threat concerning the internal validity is the experience in process modeling. However, participating a sufficiently large group of subjects, we can achieve that the scope of experience varied.

Further, to ensure subjects are not affected negatively (e.g., by tiredness, boredom or hunger) we conduct the experiment at a time of day where we can exclude the mentioned frames of mind. Furthermore, estimated time for modeling each task is about 15 minutes to prevent faulty models, because of lack of motivation.
Finally, all subjects are recruited on a voluntary basis.

Threats to *external validity* are:

A high threat to the external validity is involving students and research assistants instead of professionals. However, experiments has shown that such kind of results are transferable to professional [7].
Another threat is the resulting quality of process models. The quality of resulting process models always depends on quality of applied instrumentation. To mitigate this threat we use a up-to-date tool and modeling language (i.e., CEP and BPMN 2.0).
Finally, chosen tasks are a threat to external validity. In each task a subject has to model a process model to a certain setting. To mitigate the threat of using special situations which may not be experienced by a subject we pick well-known situations every participant should be aware of (e.g., exam preparation, progress of a lecture).

4

Experiment Operation

Section 4 deals with the experiment operation in general. Section 4.1 describes all necessary arrangements of experiment preparation. Section 4.2 discusses the progress of experiment execution. Finally, examination of collected data is explained in Section 4.3. Figure 4.1 summarizes Section 4.

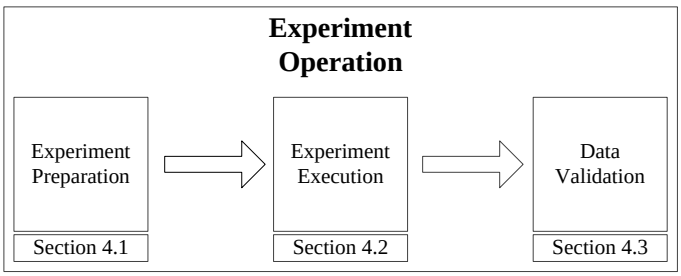


Figure 4.1.: Experiment Operation

4.1. Experiment Preparation

As subjects for the experiment students and research assistants with basic knowledge in process modeling are invited. None of the subjects are aware of the intend of the experiment. They only know they take part in an experiment in the context of a bachelor thesis. All subjects are guaranteed anonymity.
Before performing the actual experiment a prior test run with two students is conducted. The results are used to eliminate ambiguities and misunderstandings as well as to improve each task description. Further, an evaluation sheet is created to measure the level of construal by measuring the quality of each process model (cf. Section 3.3.4). In order to perform the experiment CEP (cf. Section 3.3.4) is configured for all emerging data.
The entire process of the experiment is planned within CEP (cf. Figure 4.2). In CEP it is defined when and in which sequence surveys and tasks appear. Changes can be made quickly and easily by editing the correlate activity. In addition, a database is established in which all data is stored.

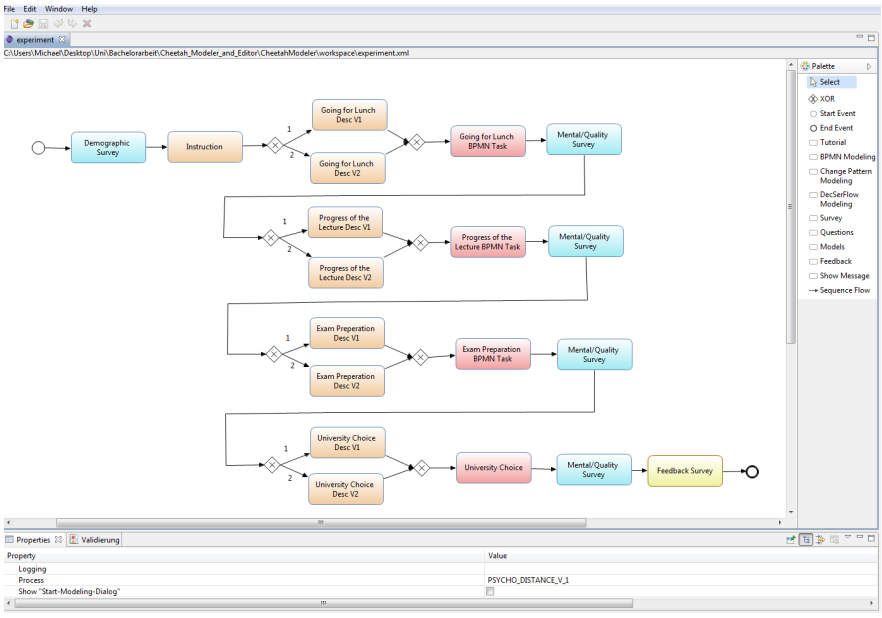


Figure 4.2.: Experiment Process in CEP

4.2. Experiment Execution

The experiment takes place in the computer lab of the Institute of Databases and Information Systems at Ulm University. Due to the spatial limitation of this computer lab only 12 subjects can participate the experiment at the same time. Therefore, several appointments within a period of four weeks are offered to the subjects. Each experiment run lasts about 60 minutes and is based on the following procedure:

At the beginning, an introduction about the experiment is offered to the subjects. Afterwards, they are requested to fill out the aforementioned questionnaire (c.f. Section 3.3.4). Then, subjects start to model the individual tasks. After each task, subjects fill out additional questions concerning perceived quality (c.f. Section 3.3.5). After finishing this, subjects are able to leave feedback. All results are stored in the established database of CEP..

4.3. Data Validation

After performing the experiment data is collected from 44 subjects in a total of five appointments. Data from two subjects are removed due to the following reasons:

- The resulting process models differ substantially from the tasks.
- The resulting process models consist only of a start activity.

After removing, data of 42 subjects is considered in data analysis (cf. Section 5). The subjects consists of 32 students and 10 research assistants: 5 of them are female and 37 are male. Course of studies are not recorded but mainly they are active in the field of computer science. All have stated that they have already experiences in BPMN (cf. Appendix B).

5

Experiment Analysis and Interpretation

Section 5 describes the last part of the experiment: *statistical analysis* and *interpretation*. Section 5.1 charaterizes obtained data with assistance of visualization. Section 5.2 deals with data set reduction and in Section 5.3 the hypotheses are tested for validity (cf. Figure 5.1).

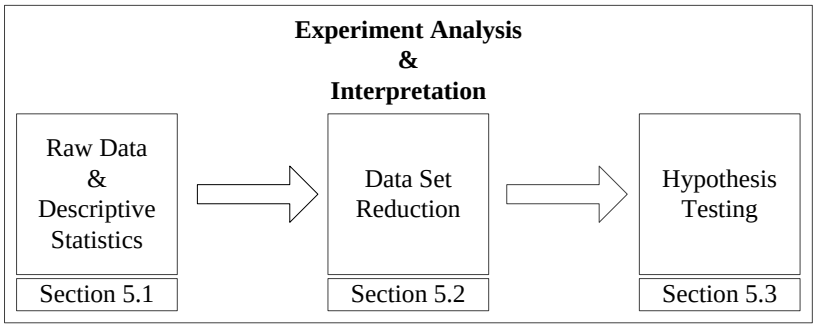


Figure 5.1.: Experiment Analysis and Interpretation

5.1. Raw Data Analysis and Descriptive Statistics

Descriptive statistics visualizes collected data as tables or graphics to provide a better comprehension. Descriptive statistics gives no decisions about the validity of the results.

The following tables show mean values from collected data (cf. Appendix C). They represent both tasks as well as individual distances low and high. Table 5.1 presents number of elements (i.e., number of activities, edges and gateways) and number of branches (i.e., number of possible branches through a process model) as well as number of modeling steps (e.g., add activity, delete edge) and needed modeling time (measured in seconds).

Task	#Activities	#Edges	#Gateways	#Overall	#Branches	#Steps	Duration
T1 low	12,73	26,14	7,59	47,23	56,68	178,59	501,23
T1 high	8,50	15,65	3,60	29,95	7,70	87,40	353,55
T1 both	10,71	21,14	5,69	39,00	33,36	135,17	430,90
T2 low	9,59	15,86	3,95	30,59	3,64	85,77	322,55
T2 high	8,95	14,70	3,20	28,80	3,55	69,95	311,55
T2 both	9,29	15,31	3,60	29,74	3,60	78,24	317,31
T3 low	8,95	16,95	4,23	32,18	4,41	95,95	382,05
T3 high	7,40	13,55	3,05	26,55	3,50	75,20	266,30
T3 both	8,21	15,33	3,67	29,50	3,98	86,07	326,93
T4 low	9,14	16,41	4,05	31,86	3,55	100,64	418,73
T4 high	6,85	12,45	3,00	24,95	2,00	63,50	293,95
T4 both	8,05	14,52	3,55	28,57	2,81	82,95	359,31

Table 5.1.: Number of Elements, Branches, Steps and Duration

Table 5.2 contains the results of syntactic (i.e., number of rule violations), semantic (i.e., correctness, relevance, completeness and authenticity) and pragmatic quality (i.e., process model comprehension) and additionally values of naming quality. Based on Likert scale, higher values (i.e., 3) are better than smaller (i.e., -3) ones.

	Syntactic	Semantic Quality				Pragmatic	
Task	**#Errors**	**Correct**	**Relevance**	**Complete**	**Authentic**	**Coherent**	**Naming**
T1 low	3,50	2,41	2,50	1,41	2,05	1,36	1,59
T1 high	2,20	1,35	1,35	-0,95	0,15	1,85	1,25
T1 both	2,88	1,90	1,95	0,29	1,14	1,60	1,43
T2 low	2,23	2,14	1,77	0,86	1,05	1,45	1,73
T2 high	1,35	1,95	1,70	0,35	1,05	2,15	1,65
T2 both	1,81	2,05	1,74	0,62	1,05	1,79	1,69
T3 low	1,45	2,05	1,77	1,00	1,36	1,55	2,18
T3 high	1,10	1,90	1,35	-0,40	0,15	1,90	1,50
T3 both	1,29	1,98	1,57	0,33	0,79	1,71	1,86
T4 low	1,33	2,23	2,05	1,32	1,32	1,36	2,43
T4 high	0,75	2,05	1,95	0,05	0,55	2,15	2,10
T4 both	1,05	2,14	2,00	0,71	0,95	1,74	2,27

Table 5.2.: Syntactic, Semantic, Pragmatic and Naming Quality

The obtained results for perceived quality (i.e., process model agreement) are shown in Table 5.3. Higher values (cf. Section 3.3.5) indicate process models which are more likely to be accepted by subjects.

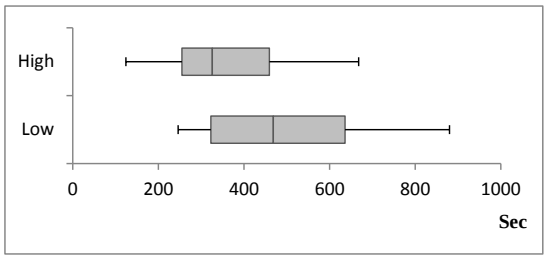
	Perceived Quality				
Task	**Agreement**	**Missing Aspects**	**Description**	**Mistakes**	**Satisfaction**
T1 low	0,86	-0,18	0,77	-1,00	-0,45
T1 high	0,35	0,10	0,25	-0,45	0,10
T1 both	0,62	-0,05	0,52	-0,74	-0,19
T2 low	0,73	-0,14	0,64	-0,82	-0,32
T2 high	0,60	-0,20	0,40	-0,65	0,05
T2 both	0,67	-0,17	0,52	-0,74	-0,14
T3 low	0,82	-0,05	0,41	-0,82	-0,14
T3 high	0,75	-0,60	0,65	-0,55	-0,05
T3 both	0,79	-0,31	0,52	-0,69	-0,10
T4 low	0,45	-0,09	0,23	-0,50	0,32
T4 high	0,35	0,20	0,05	-0,50	0,10
T4 both	0,40	0,05	0,14	-0,50	0,21

Table 5.3.: Perceived Quality

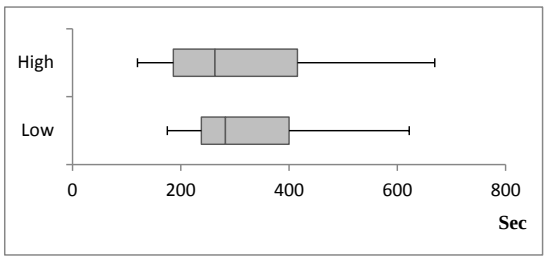
It can be seen that nearly each task shows a difference for all values between low and high psychological distance. Especially, values of social distance (i.e., Task 1) indicate clear differences. For example, we observe that number of branches has a mean of 56,68 at low social distance while high social distance has only a mean of 7,70. It can also be seen that number of steps and modeling duration are higher at low psychological distance. According to table 5.2, process models at low psychological distance tend to be more complete and give a better account of the domain. Table 5.3 supports the observations of Table 5.2.

Although differences are not always clear but it seems that process models at low psychological distance reflect a higher process model quality.

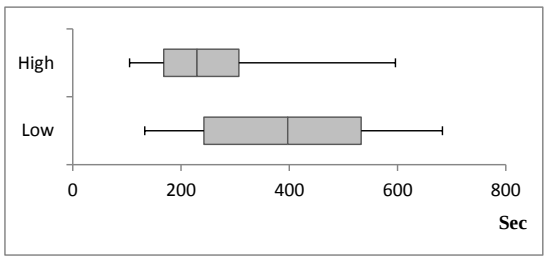
To gain an even better understanding of the data, selected results are vizualized as graphs. The modeling duration and number of modeling steps for process models are visualized as *box plots* in Figure 5.2 and 5.3 [14]. Box plots are well-suited for visualizing dispersion and show potential outliers. Box plots span a distance between the 25% percentile and the 75 % percentile. The line in the box plot represents the median. Straigt lines outside a box plot are so-called whiskers. Data points outside the whiskers can be considered as outliers. The end of the whisker represents possible alternative values.



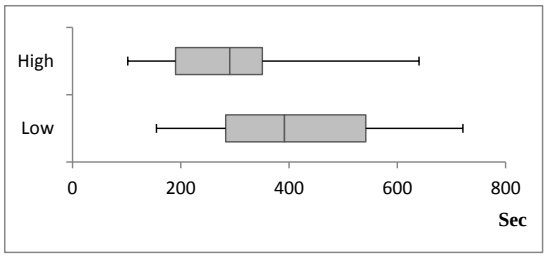
(a) T1 - Social Distance



(b) T2 - Spatial Distance

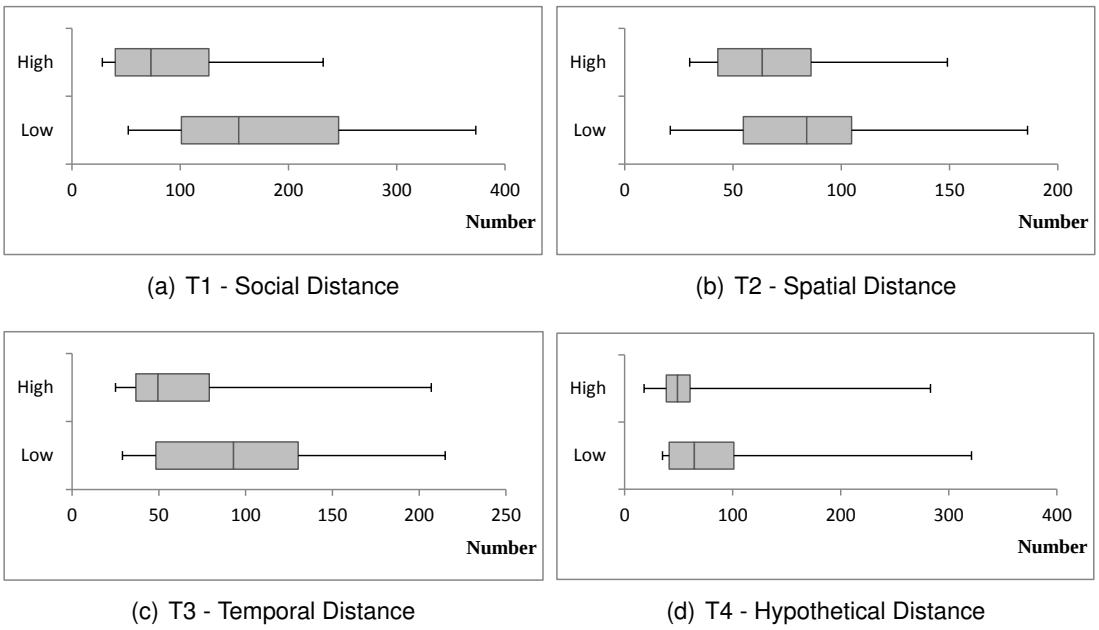


(c) T3 - Temporal Distance



(d) T4 - Hypothetical Distance

Figure 5.2.: Modeling Duration (cf. Table 5.1)



(a) T1 - Social Distance

(b) T2 - Spatial Distance

(c) T3 - Temporal Distance

(d) T4 - Hypothetical Distance

Figure 5.3.: Number of Modeling Steps (cf. Table 5.1)

One can easily recognize, as already mentioned in Table 5.1, the sharp distinction between the two psychological distances. Modeling duration and number of modeling steps are higher with low psychological distance.

Figure 5.4, 5.5 and 5.6 visualize a subset of the data from Table 5.1, 5.2 and 5.3 as *bar charts* [8]. Each bar chart consists of four classes (i.e. Task 1-Task 4) and each class represents mean values of both tasks as well as individual distances low and high.

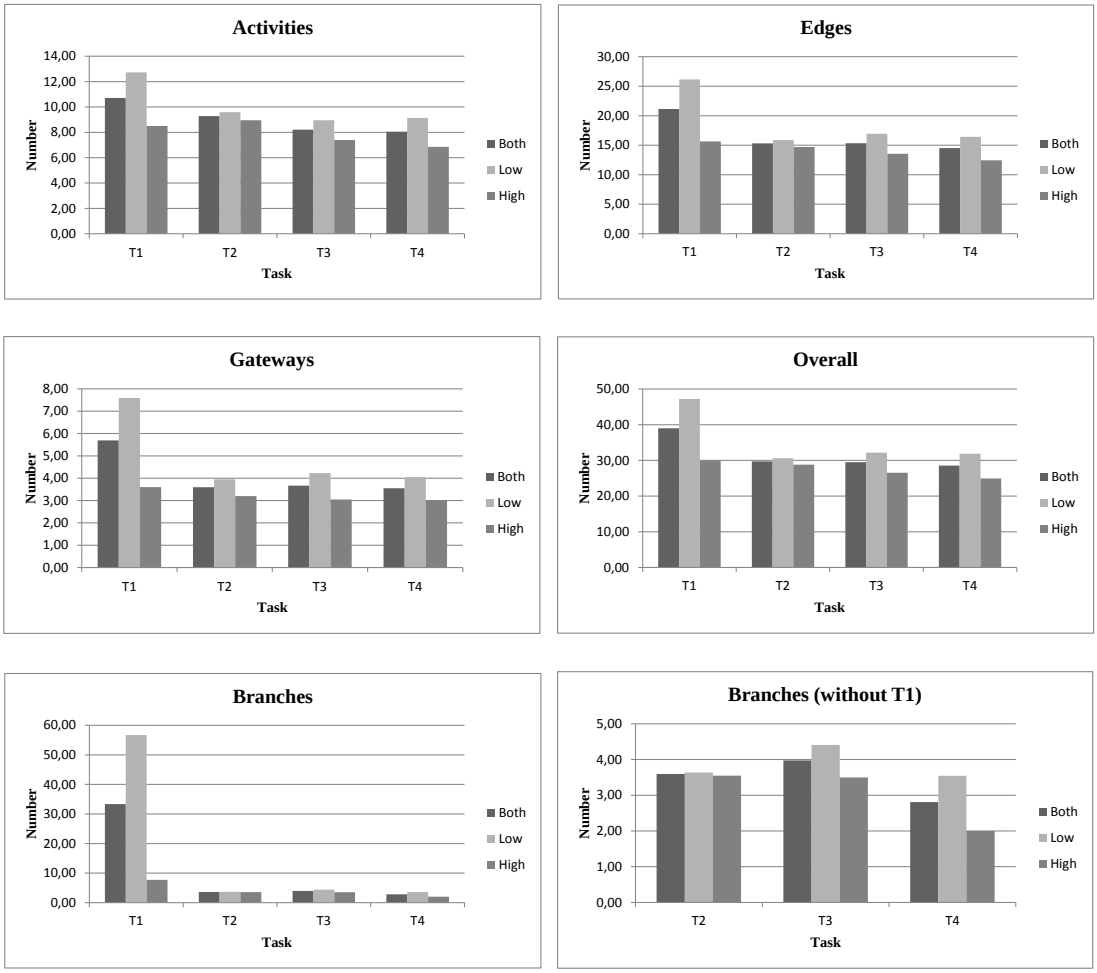


Figure 5.4.: Bar Charts - Part 1

In the category of number of elements and branches it can be seen that social distance shows clear differences. Especially, number of branches at low social distance shows a difference of about 85% compared to high social distance. The other psychological distances (i.e., spatial, temporal and hypothetical distance) show an increasement in case of low psychological distance, but not that clear.

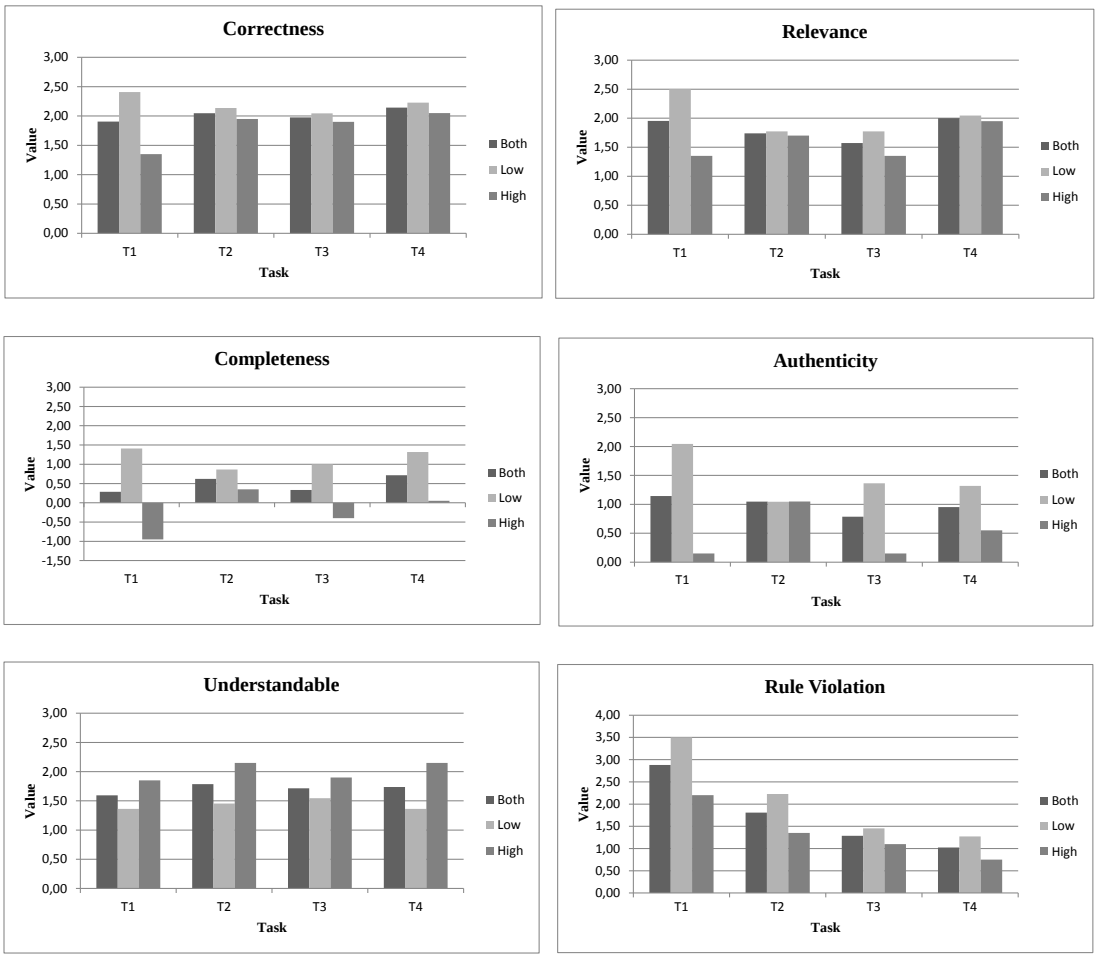


Figure 5.5.: Bar Charts - Part 2

Figure 5.5 show results of the semantic quality in detail. Again, low social distance shows significant differences compared to the other psychological distances (i.e., spatial, temporal and hypothetical distance). But temporal and hypothetical distances (i.e., Task 3 and 4) indicate also differences. In general, resulting process models with low psychological distance are more precise in repect to the domain.

The pragmatic and syntactic quality are also consistent with these observations. The larger a process model is, the more confusing it is and the more mistakes are made by subjects.

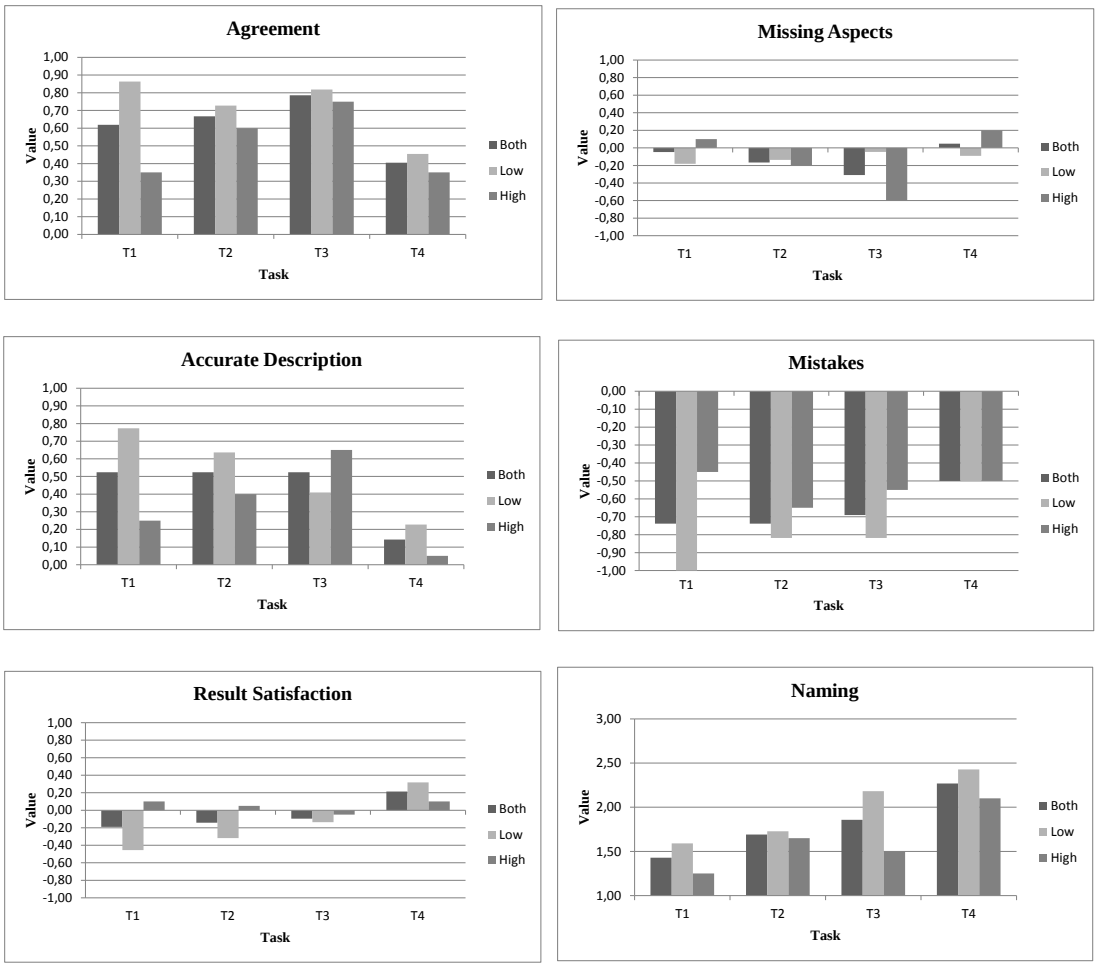


Figure 5.6.: Bar Charts - Part 3

Based on the perceived quality it can be derived that subjects dealing with low psychological distance believe their model are more complete, but in a second run they would model it differently.

For additional interpretation we visualized collected data from the questionnaire as *scatter plot* [25]. Scatter plots reveal the distribution between two values of the data set. Figure 5.7 (cf. Appendix D) presents the distributions of the individual values in dependence of the skill levels.

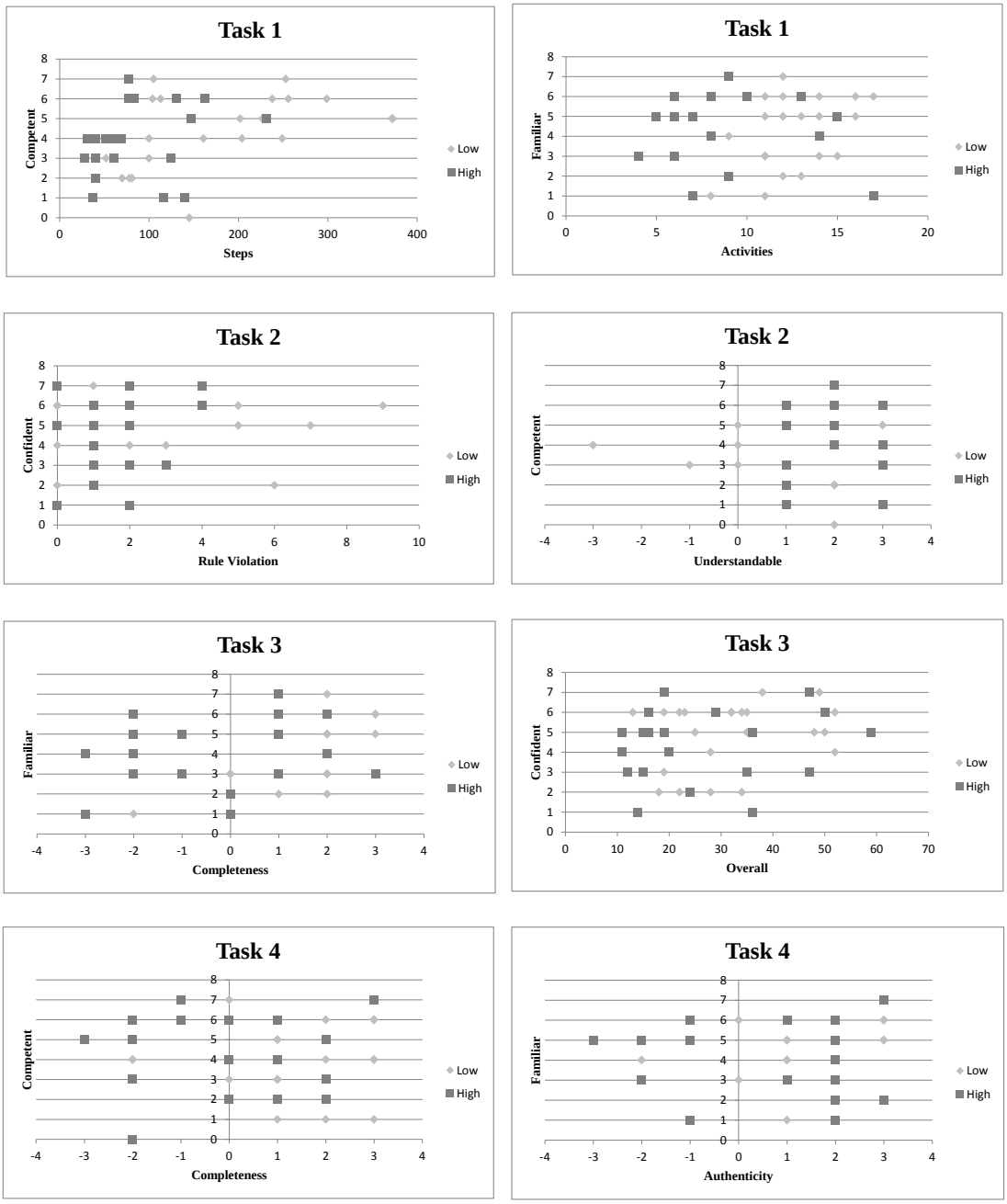


Figure 5.7.: Scatter Plots

The x-axis of scatter plots indicate the competencies in BPMN and the y-axis of scatter plots show individual results of subjects.
A similar result can be recognized between scatter plots (cf. Figure 5.7) and box plots (cf. Figure 5.2 and 5.3) as well as bar charts (cf. Figure 5.4, 5.5 and 5.6). Despite the same skill levels subjects at lower psychological distance tend to be more complex.

5.2. Data Set Reduction

Results of statistical analysis depends on quality of input data. Faulty data may lead to an incorrect conclusion. Therefore, it is important to identify outliers and decide how to deal with them. For this reason, data set reduction has to be considered. Data set reduction is critical when analyzing data because removed data could modificate the results and that may lead to a loss of information.

In the experiment, we identified several outliers. For example:

- A subject modeled a process model with 512 branches.
- A subject needed for process modeling 880 seconds.
- A subject made at process modeling 316 steps.

We decided not to remove any outliers since the outliers seem to be correct values and not a result of wrong modeling. Removing them would falsify obtained results.

5.3. Hypothesis Testing

Even if descriptive statistics shows differences, hypothesis have to be tested to proof this assumptions. With support of selected test procedures null hypotheses are tried to reject.
Initially, it is important to choose an adequate test procedure. [27] offers a good selection of common methods. Thereby, each method has a critical threshold that must be observed in order to reject the null hypothesis. When testing hypotheses, it has to be

observed whether results exceed the critical threshold or not. There are basically two outcomes:

Result is significant: If the critical threshold is exceeded, result of the experiment is significant. The null hypothesis H_0 is refuted and the alternative hypothesis H_1 is accepted.

Result is not significant: If the threshold is not exceeded, result of the experiment is not significant. The null hypothesis H_0 cannot be refuted and needs to be accepted. This does not indicate a failure of the alternative hypothesis H_1, but no difference could be found between the experimental results.

To test our hypotheses, we use the *independent two-sample t-test* [13, 20]. The t-test is the most often used test to compare means between two samples. To meet preconditions of the t-test it has to be checked if variances of experimental data are homogeneous. For this, the *f-test* is used [19]. If calculated value f exceeds critical threshold f_0 then variances are not homogeneous (i.e., if $f < f_0 \Rightarrow$ variances are homogenous). If variances are heterogeneous, the independent two-sample t-test for heterogeneous variances has to be applied. Otherwise, t-test for homogeneous variances must be used. A successful t-test (i.e., if $|t| > t_0$) rejects the null hypothesis. The calculated values of hypothesis testing can be found in Appendix E. Table 5.4 and 5.5 present a summary of the results of hypothesis testing. In addition, we checked the values for tendencies if the t-test failed [20].
Unfortunately, several presumptions are not confirmed although descriptive statistics (cf. Section 5.1) shows differences. However, some categories show significant differences and thus we are able to reject the null hypothesis.
Based on the tables (cf. Table 5.4 and 5.5) we get the following results:

- **Social Distance:** 15 out of 20 results show significant differences and 18 out of 20 results show tendencies.
- **Spatial Distance:** 0 out of 20 results show significant differences and 4 out of 20 results show tendencies.

- **Temporal Distance:** 3 out of 20 results show significant differences and 8 out of 20 results show tendencies.
- **Hypothetical Distance:** 3 out of 20 results show significant differences and 11 out of 20 results show tendencies.

On the basis of the results, for social distance we are able to reject corresponding null hypothesis and are able to accept alternative hypothesis. (cf. Table 3.5). Null hypotheses for other distances (i.e., spatial, temporal and hypothetical distance) cannot be rejected due to insufficient number of significant differences. For this reason, it is not possible to reject the null hypothesis of our main hypothesis (cf. Table 3.4). However, for social distance we can confirm that pyschological distance affects the process of process modeling.

	Social Distance		Spatial Distance	
	Tendency?	**Significant?**	**Tendency?**	**Significant?**
Activities	✓	✓	•	•
Edges	✓	✓	•	•
Gateways	✓	✓	•	•
Overall	✓	✓	•	•
Branches	✓	✓	•	•
Steps	✓	✓	✓	•
Duration	✓	✓	•	•
Syntax Rule Violation	✓	✓	✓	•
Correctness	✓	✓	•	•
Relevance	✓	✓	•	•
Completeness	✓	✓	✓	•
Authenticity	✓	✓	•	•
Understandable	✓	•	✓	•
Naming	✓	•	•	•
Mental Effort	•	•	•	•
Agreement	✓	✓	•	•
Missing Aspects	•	•	•	•
Accurate Description	✓	✓	•	•
Mistakes	✓	✓	•	•
Result Satisfaction	✓	•	•	•

Table 5.4.: Results - Social and Spatial Distance

	Temporal Distance		Hypothetical Distance	
	Tendency?	**Significant?**	**Tendency?**	**Significant?**
Activities	✓	●	✓	✓
Edges	✓	●	✓	●
Gateways	●	●	●	●
Overall	✓	●	✓	●
Branches	●	●	✓	●
Steps	●	●	✓	●
Duration	✓	✓	✓	✓
Syntax Rule Violation	✓	●	✓	●
Correctness	●	●	●	●
Relevance	●	●	●	●
Completeness	✓	✓	✓	✓
Authenticity	✓	✓	✓	●
Understandable	●	●	✓	●
Naming	●	●	✓	●
Mental Effort	●	●	●	●
Agreement	✓	●	●	●
Missing Aspects	●	●	●	●
Accurate Description	●	●	●	●
Mistakes	●	●	●	●
Result Satisfaction	●	●	●	●

Table 5.5.: Results - Temporal and Hypothetical Distance

6

Conclusion

This thesis introduces the influence of psychological distance (i.e., social, spatial, temporal and hypothetical distance) on the process of process modeling. An experiment with 42 subjects investigates differences of resulting process models influenced by psychological distance. It could be observed that an increase in process model quality exists at lower psychological distance. In several cases (cf. Section 5.3) it is possible to observe significant differences. Especially, social distance shows significant differences. The spatial, temporal and hypothetical distances show differences and tendencies, but they are not significant. Most of all, spatial distance shows the least significant results.

This may be for one of the following reasons:

- The "gap" between the two distances is too small.
- Due to the fact that selected tasks are based on scenarios that happen in every university and our subjects are students or research assistants it could be that only a low psychological distance is perceived.
- Motivation decreased with each task and that leads to scruffy work.

In general, it is reasonable to believe that lower psychological distance leads to more precise and complete process models. To get more accurate results further studies are needed and may consider the following possibilities:

- The choice of a larger test population.
- To enlarge the range between the two distances or scenarios.
- To focus on each distance separately.

A

Task Sheets

ulm university universität ulm

Code: 1111

Case Study

Please model the processes described in Task 1-4 using BPMN 2.0. Model each process based on your own experience and that way you think it is performed.
Please consider therefore all eventualities for each process. After finishing a task, press "Finish Modeling".

Task 1: Going for Lunch

A good friend of you starts to study at your university. Since it is essential for a student to know, model for him a typical visit of the canteen. Start at the point he enters the canteen.

Task 2: Progress of the Lecture

You are attending a typical lecture in the hospital auditorium (Klinikhörsaal). Model the progress of the lecture from the point of view of a docent. Start at the point the docent enters the room and finish when he leaves the room.

Task 3: Exam Preparation

You are writing an important exam in two weeks. Model the process of exam preparation from your point of view.

Task 4: University Choice

You are looking for a suitable university to study. Consider you have a favorite university, but there is a low probability to get a place.
Model the process of university selection and application from your point of view.

Thank you for participation!

Figure A.1.: Task Sheet 1

ulm university universität
uulm

Code: 2222

Case Study

Please model the processes described in Task 1-4 using BPMN 2.0. Model each process based on your own experience and that way you think it is performed.
Please consider therefore all eventualities for each process. After finishing a task, press "Finish Modeling".

Task 1: Going for Lunch

A student visits your university. Since it is essential for a student to know, model for him a typical visit of the canteen. Start at the point he enters the canteen.

Task 2: Progress of the Lecture

You are attending a typical lecture in O28/H22. Model the progress of the lecture from the point of view of a docent. Start at the point the docent enters the room and finish when he leaves the room.

Task 3: Exam Preparation

You are writing an important exam in six months. Model the process of exam preparation from your point of view.

Task 4: University Choice

You are looking for a suitable university to study. Consider you have a favorite university in mind where a place is assured.
Model the process of university selection and application from your point of view.

Thank you for participation!

Figure A.2.: Task Sheet 2

B

Demographic Survey

Based on aforementioned questionnaire (cf. Table 3.2 and 3.3) Figure B.1 and B.2 present the results of our demographic survey. All questions refer to a period within the past 12 months. We only count work days within a year and therefore we assume that a year has about 250 work days. Familiar, competent and confident are determined on a 7-point Likert scale ranging from strongly disagree (1) to strongly agree (7). The last question relates to the release date of BPMN. The first version of BPMN stems from May 2004.

B. Demographic Survey

Subject	No. Process Analyzed/Read	No. Process Created/Edited	No. Estimated Activities	No. Training Days	No. Self Education (Days)	Familiar	Competent	Confident	Start BPMN (Months)
1	20	3	10	3	20	6	7	6	12
2	35	16	12	1	2	5	6	4	28
3	10	4	8	1	3	4	4	3	1
4	50	20	10	2	2	6	6	6	12
5	1	0	10	0	0	3	4	3	40
6	10	0	15	0	0	3	4	4	1
7	5	2	6	1	1	3	5	5	12
8	10	2	10	0	2	3	6	4	27
9	2	0	0	0	1	5	5	5	36
10	75	20	20	5	10	7	7	7	51
11	50	50	20	10	10	5	5	5	25
12	30	5	10	3	10	6	6	6	24
13	100	100	15	0	3	5	5	4	30
14	50	10	20	2	5	5	6	5	24
15	50	20	20	25	20	5	6	6	8
16	5	5	9	12	7	2	2	2	18
17	100	50	10	10	3	2	2	2	12
18	50	20	10	3	2	1	2	0	9
19	200	50	30	3	15	1	2	2	7
20	30	10	10	10	10	6	6	6	12
21	45	20	10	4	2	6	6	7	10
22	15	7	9	3	1	6	6	5	10

Figure B.1.: Demographic Survey - Part 1

Subject	No. Process Analyzed/Read	No. Process Created/Edited	No. Estimated Activities	No. Training Days	No. Self Education (Days)	Familiar	Competent	Confident	Start BPMN (Months)
21	3	3	5	5	0	3	3	3	1
22	50	50	20	10	10	5	5	5	25
23	10	2	5	0	10	6	7	7	30
24	0	0	0	0	100	1	1	1	0
25	100	20	15	5	20	5	5	4	1
26	30	25	15	5	5	6	7	6	40
27	50	50	7	10	10	6	6	6	24
28	30	10	8	2	10	7	6	6	60
29	10	2	30	2	10	5	5	5	5
30	100	20	20	3	50	1	1	1	24
31	40	50	20	50	60	2	2	1	12
32	100	40	15	20	15	3	3	2	9
33	0	0	0	0	0	3	4	4	0
34	20	2	10	3	0	4	3	3	30
35	10	2	10	10	10	3	3	3	10
36	5	5	5	3	3	5	5	4	1
37	5	8	10	0	3	4	5	4	30
38	3	1	5	14	14	3	3	3	6
39	60	30	9	3	1	6	6	6	10
40	30	20	10	3	1	4	5	4	7

Figure B.2.: Demographic Survey - Part 2

C

Raw Data

ID	No. Activities	No. Edges	No. Gateways	Overall	No. Branches	No. Steps	No. Duration
548	13	27	8	50	13	104	450
543	13	26	6	27	24	204	390
503	9	11	2	22	2	52	246
558	12	26	8	48	24	256	808
553	11	20	3	36	16	100	315
928	11	18	3	34	4	249	710
923	15	25	6	48	8	372	567
918	14	22	4	42	16	161	269
933	14	30	10	56	112	227	304
790	12	43	20	77	513	253	565
765	12	23	10	42	17	147	472
770	11	24	8	45	16	113	542
795	11	32	12	57	18	100	519
800	16	37	13	68	96	373	880
810	15	26	6	49	48	238	659
297	12	27	8	49	40	78	304
302	13	18	2	35	6	70	345
317	8	19	7	36	10	145	757
358	11	24	6	43	40	81	465
665	17	36	10	65	80	299	299
660	14	29	7	52	96	105	745
675	16	32	8	58	48	202	416

Figure C.1.: Task 1 - Low Social Distance - Part 1

	Semantic				Pragmatic
ID	Correctness	Relevance	Completeness	Authenticity	Understandable
548	3	2	2	2	1
543	1	2	2	2	2
503	1	1	-1	1	0
558	3	3	2	2	1
553	1	2	2	2	-1
928	3	2	0	0	1
923	2	2	2	2	2
918	2	2	2	2	2
933	3	3	3	3	-2
790	3	3	2	2	2
765	3	3	-1	1	1
770	3	3	0	2	2
795	2	2	0	2	1
800	3	3	2	3	1
810	3	3	2	3	2
297	3	2	3	3	2
302	2	3	1	2	3
317	3	3	-2	1	3
358	2	2	2	2	2
665	3	3	3	3	2
660	2	3	3	3	1
675	2	3	2	2	2

Figure C.2.: Task 1 - Low Social Distance - Part 2

	Perceived						
ID	Agreement	Missing Aspects	Accurate Description	Mistakes	Satisfaction	Naming	No. Syntax Rule Violation
548	1	0	0	-1	0	4	2
543	0	1	0	-1	1	3	1
503	1	1	1	-1	-1	3	1
558	1	-1	1	-1	-1	0	2
553	2	-2	1	-2	-2	3	1
928	0	1	1	-1	1	2	2
923	1	0	1	-1	-1	3	3
918	1	0	0	-1	-1	2	2
933	1	1	1	-1	2	7	1
790	0	2	0	-1	0	10	2
765	1	-2	2	-1	-1	1	1
770	1	0	1	-1	-1	4	1
795	1	-1	1	-1	-1	5	2
800	1	-1	1	0	-1	6	1
810	1	-1	1	-1	-2	0	1
297	0	0	-1	0	0	4	2
302	2	-2	2	-2	-2	1	2
317	1	0	1	-1	-1	0	2
358	1	-1	1	-1	0	3	2
665	1	0	1	-1	-1	5	1
660	0	1	1	-1	1	6	2
675	1	0	0	-1	1	5	1

Figure C.3.: Task 1 - Low Social Distance - Part 3

ID	No. Activities	No. Edges	No. Gateways	Overall	No. Branches	No. Steps	No. Duration
508	6	4	0	9	1	28	125
742	5	17	4	28	4	147	472
903	6	14	4	26	8	77	259
908	7	9	1	18	1	37	243
913	7	10	2	21	1	69	305
775	10	30	10	52	13	83	336
785	13	26	8	59	64	131	455
780	9	14	2	27	1	163	510
805	15	31	10	58	8	232	641
307	17	30	8	57	8	140	668
312	9	18	4	33	10	116	405
363	6	11	2	21	3	40	290
513	6	8	1	17	2	40	162
518	14	20	3	39	3	125	364
538	6	13	3	24	6	61	316
533	6	7	0	15	1	31	173
528	8	12	2	22	4	59	289
523	4	5	0	11	1	40	124
655	8	21	6	37	12	77	453
670	8	13	2	25	3	52	481

Figure C.4.: Task 1 - High Social Distance - Part 1

	Semantic				Pragmatic
ID	Correctness	Relevance	Completeness	Authenticity	Understandable
508	1	1	-3	-2	3
742	3	3	-1	1	1
903	2	2	-2	-1	2
908	-3	-3	-3	-3	0
913	2	2	-1	0	3
775	3	2	1	2	1
785	-2	2	1	2	2
780	1	1	-1	1	0
805	3	2	1	2	2
307	2	1	0	2	2
312	1	0	-1	0	1
363	1	1	-2	-1	2
513	1	1	-2	1	2
518	2	2	1	1	2
538	1	1	-2	0	1
533	2	1	-2	-1	3
528	2	2	-1	-1	3
523	1	2	-3	-2	3
655	2	2	0	1	2
670	2	2	1	1	2

Figure C.5.: Task 1 - High Social Distance - Part 2

	Perceived						
ID	Agreement	Missing Aspects	Accurate Description	Mistakes	Satisfaction	Naming	No. Syntax Rule Violation
508	0	0	0	-1	0	0	1
742	1	-2	2	-1	-1	1	1
903	-1	1	-1	0	1	3	1
908	0	1	-1	0	1	5	1
913	0	1	0	-2	0	0	1
775	1	0	1	1	-2	4	1
785	0	-2	1	0	1	5	1
780	1	0	0	-1	1	2	2
805	0	-1	0	-1	-1	4	2
307	-1	1	0	1	1	1	3
312	0	1	0	-1	-1	2	1
363	0	0	1	-1	0	1	1
513	1	-1	0	0	0	2	1
518	0	0	-1	0	2	4	2
538	1	1	0	0	0	3	1
533	1	1	1	-2	0	0	1
528	0	0	0	1	1	3	1
523	1	0	1	-1	0	0	1
655	1	1	0	-1	0	3	1
670	1	0	1	0	-1	1	1

Figure C.6.: Task 1 - High Social Distance - Part 3

ID	No. Activities	No. Edges	No. Gateways	Overall	No. Branches	No. Steps	No. Duration
929	13	15	1	30	1	88	365
924	9	14	2	27	2	60	282
919	9	7	0	15	1	29	248
934	12	14	4	32	4	146	301
791	9	16	4	31	5	63	405
766	8	21	8	39	17	96	513
771	10	20	6	38	2	80	283
796	12	38	18	65	8	106	331
801	10	14	2	28	2	101	446
811	6	6	0	13	4	63	244
298	7	12	2	23	8	186	225
303	14	33	12	56	7	118	622
318	9	19	6	36	3	97	511
359	8	12	2	24	1	38	193
544	9	21	5	37	2	72	447
504	7	4	0	9	1	21	188
559	11	14	2	39	2	53	385
554	6	12	3	23	2	41	268
509	13	12	4	22	1	97	175
666	11	18	4	35	4	133	182
661	8	12	2	24	2	42	236
676	10	15	0	27	1	157	246

Figure C.7.: Task 2 - Low Spatial Distance - Part 1

	Semantic				Pragmatic
ID	Correctness	Relevance	Completeness	Authenticity	Understandable
929	2	2	-1	0	2
924	2	2	2	2	2
919	1	1	-1	0	3
934	2	2	1	1	0
791	3	2	2	2	2
766	3	3	2	3	1
771	2	2	2	2	2
796	2	2	3	3	0
801	2	2	1	2	3
811	2	1	1	-2	3
298	2	2	-1	1	2
303	3	2	2	3	1
318	3	3	0	2	2
359	2	3	0	1	2
544	1	1	0	1	-3
504	2	2	0	-2	3
559	3	3	1	2	1
554	1	1	1	-1	-1
509	2	-3	-1	-3	0
666	3	2	2	2	3
661	2	2	1	2	2
676	2	2	2	2	2

Figure C.8.: Task 2 - Low Spatial Distance - Part 2

	Perceived						
ID	Agreement	Missing Aspects	Accurate Description	Mistakes	Satisfaction	Naming	No. Syntax Rule Violation
929	0	0	2	0	1	3	2
924	1	0	1	-1	-1	1	3
919	1	-1	1	-2	-2	0	2
934	1	-1	1	-2	0	5	1
791	1	1	0	-1	0	1	3
766	1	-1	1	-1	-1	0	1
771	1	-1	1	-1	-1	1	1
796	0	0	0	-1	0	7	1
801	0	0	1	-1	0	1	3
811	-1	1	0	-1	1	2	1
298	1	0	1	-1	0	1	3
303	1	1	1	1	1	6	3
318	1	0	1	-1	-1	0	2
359	1	1	-1	1	1	1	1
544	1	-1	1	-1	-1	9	2
504	1	-1	1	-1	-1	0	1
559	0	0	0	-1	-1	1	2
554	1	-1	0	-1	1	2	1
509	0	0	0	-1	0	2	1
666	1	0	1	-1	-1	5	1
661	2	1	0	-1	-1	1	2
676	1	-1	1	0	-1	0	1

Figure C.9.: Task 2 - Low Spatial Distance - Part 3

ID	No. Activities	No. Edges	No. Gateways	Overall	No. Branches	No. Steps	No. Duration
904	12	16	4	30	6	62	152
909	6	7	1	14	2	130	164
914	8	9	0	19	1	47	120
776	9	16	4	31	3	62	205
786	11	15	2	30	2	78	241
781	14	21	4	41	6	86	510
806	12	20	4	38	3	94	411
308	9	24	8	50	4	86	380
313	11	18	2	38	2	55	669
364	7	11	2	22	2	42	429
514	7	10	1	20	1	43	184
519	9	13	2	26	2	78	129
539	8	14	4	28	4	65	268
534	7	8	0	17	1	30	187
529	6	8	0	14	1	42	200
524	6	10	1	19	3	38	258
656	9	21	7	39	9	149	596
671	10	9	2	18	1	43	325
743	8	21	8	39	10	96	513
549	10	23	8	43	8	73	290

Figure C.10.: Task 2 - High Spatial Distance - Part 1

	Semantic				Pragmatic
ID	Correctness	Relevance	Completeness	Authenticity	Understandable
904	2	2	1	1	2
909	1	1	-1	0	1
914	2	2	0	0	3
776	2	2	2	3	2
786	3	2	1	1	3
781	2	1	0	1	1
806	2	2	1	2	2
308	2	2	2	1	3
313	2	1	1	2	3
364	1	2	1	2	1
514	0	2	0	1	2
519	2	2	1	1	3
539	2	2	1	2	1
534	3	1	-1	0	3
529	2	2	-2	0	3
524	1	-1	-2	-3	3
656	2	2	2	2	1
671	2	2	-1	0	3
743	3	3	1	3	1
549	3	2	0	2	2

Figure C.11.: Task 2 - High Spatial Distance - Part 2

	Perceived						
ID	Agreement	Missing Aspects	Accurate Description	Mistakes	Satisfaction	Naming	No. Syntax Rule Violation
904	1	-1	1	-1	-1	2	1
909	0	0	0	0	1	2	1
914	0	0	0	-2	1	0	1
776	1	-1	1	1	-1	0	3
786	1	0	1	0	1	1	1
781	1	-1	1	-1	-1	2	2
806	1	-1	0	-1	-1	1	3
308	0	-1	0	0	1	0	3
313	0	0	1	-1	-1	1	2
364	0	0	1	-1	0	1	1
514	1	-1	1	-1	0	1	1
519	0	1	-1	-1	2	1	1
539	1	0	0	-1	-1	3	1
534	1	1	0	-1	1	0	1
529	1	0	1	0	0	2	2
524	0	1	0	0	1	2	1
656	1	0	0	-1	1	4	2
671	0	0	0	0	-1	0	3
743	1	-1	1	-1	-1	0	1
549	1	0	0	-1	0	4	2

Figure C.12.: Task 2 - High Spatial Distance - Part 3

ID	No. Activities	No. Edges	No. Gateways	Overall	No. Branches	No. Steps	No. Duration
930	9	14	2	28	4	122	625
925	11	18	4	35	8	134	239
920	8	9	0	19	1	33	133
935	16	26	6	50	12	213	683
792	13	20	3	38	2	163	554
767	5	12	6	25	6	46	179
772	10	18	2	32	1	49	397
797	9	26	11	48	26	100	435
802	9	18	5	34	4	133	252
812	7	11	2	22	2	215	517
299	8	14	4	28	2	52	196
304	8	18	6	34	5	105	571
319	5	11	4	22	3	75	538
360	4	8	2	18	1	29	276
550	13	26	8	49	8	155	405
545	9	17	4	32	2	48	182
560	5	6	0	13	1	35	139
555	15	29	6	52	2	99	370
510	5	12	2	19	1	38	256
667	11	18	4	35	1	115	508
662	11	30	9	52	3	87	553
677	6	12	3	23	2	65	397

Figure C.13.: Task 3 - Low Temporal Distance - Part 1

	Semantic				Pragmatic
ID	Correctness	Relevance	Completeness	Authenticity	Understandable
930	2	2	2	2	2
925	2	2	2	2	2
920	1	1	0	1	3
935	2	2	3	3	-1
792	3	3	2	3	1
767	2	2	-2	-2	2
772	2	2	2	2	2
797	3	3	2	2	1
802	2	2	1	2	2
812	2	2	2	2	2
299	2	2	1	2	2
304	2	2	2	3	1
319	3	2	0	1	1
360	1	1	-2	-1	3
550	3	3	2	3	2
545	1	2	2	2	2
560	2	1	-2	-1	3
555	2	-2	-2	-2	1
510	2	2	0	0	0
667	3	2	3	3	2
662	2	2	3	3	0
677	1	1	1	0	1

Figure C.14.: Task 3 - Low Temporal Distance - Part 2

	Perceived						
ID	Agreement	Missing Aspects	Accurate Description	Mistakes	Satisfaction	Naming	No. Syntax Rule Violation
930	0	2	0	0	2	2	3
925	1	1	0	-1	0	2	3
920	2	-2	2	-2	-2	0	1
935	1	0	1	0	1	9	2
792	1	1	0	-1	0	1	3
767	1	-1	1	-1	-1	0	1
772	1	0	0	-1	1	0	3
797	0	-1	-1	0	1	4	2
802	1	-1	0	-1	-1	2	3
812	1	-1	0	-1	-1	0	3
299	1	-1	1	-1	-1	2	2
304	0	1	0	0	-1	0	3
319	1	0	1	-1	-1	0	3
360	1	-1	1	-1	1	1	2
550	1	1	0	-1	1	3	3
545	0	2	1	-1	1	1	1
560	-1	1	-1	0	1	0	1
555	2	-1	1	-1	-2	1	1
510	0	0	0	-1	0	1	2
667	1	-1	1	-1	-1	1	2
662	2	-1	2	-2	-2	2	3
677	1	1	-1	0	1	0	1

Figure C.15.: Task 3 - Low Temporal Distance - Part 3

ID	No. Activities	No. Edges	No. Gateways	Overall	No. Branches	No. Steps	No. Duration
744	3	10	4	19	6	46	179
505	4	5	0	11	1	37	135
905	4	10	3	19	3	59	131
910	5	7	0	14	1	52	193
915	6	7	0	15	1	29	124
777	11	25	9	47	6	128	596
787	12	28	8	50	18	205	412
782	9	15	3	29	4	76	330
807	11	32	11	59	10	207	595
309	14	18	2	36	2	88	289
314	8	12	2	24	2	65	415
365	6	7	0	15	1	47	273
515	7	10	1	20	1	36	232
520	15	25	5	47	7	188	299
540	8	19	6	35	2	67	234
535	8	14	2	36	1	40	222
530	6	8	2	16	1	35	105
525	3	6	1	12	1	43	227
657	4	8	2	16	1	31	209
672	4	5	0	11	1	25	126

Figure C.16.: Task 3 - High Temporal Distance - Part 1

	Semantic				Pragmatic
ID	Correctness	Relevance	Completeness	Authenticity	Understandable
744	2	2	-2	-2	2
505	2	2	-3	-2	3
905	2	2	-2	-1	1
910	1	1	0	0	3
915	1	1	-1	0	3
777	3	2	2	2	1
787	2	2	1	2	1
782	2	2	1	2	1
807	0	0	1	2	-1
309	2	-3	-3	-3	0
314	3	1	0	1	3
365	2	2	-1	0	2
515	2	2	1	1	2
520	3	2	2	2	1
540	2	2	3	3	3
535	2	1	1	1	2
530	2	1	-2	0	3
525	1	1	-2	-2	2
657	2	2	-2	-1	3
672	2	2	-2	-2	3

Figure C.17.: Task 3 - High Temporal Distance - Part 2

	Perceived						
ID	Agreement	Missing Aspects	Accurate Description	Mistakes	Satisfaction	Naming	No. Syntax Rule Violation
744	1	-1	1	-1	-1	0	1
505	1	-1	1	-1	-1	0	1
905	1	0	0	-1	-1	3	1
910	1	-1	1	-1	1	0	1
915	1	0	0	-2	0	0	1
777	1	-1	1	-1	-1	0	3
787	1	1	1	0	1	3	1
782	1	-1	0	-1	-1	2	2
807	0	-1	1	1	1	5	2
309	1	-1	1	0	1	0	2
314	1	-1	1	-1	-1	0	1
365	1	-1	1	-1	0	0	1
515	0	-1	0	0	1	1	1
520	0	-1	0	-1	1	4	3
540	1	-1	1	0	0	1	2
535	0	0	1	0	1	0	2
530	0	1	0	1	0	2	2
525	1	-1	1	-1	-1	1	1
657	1	-1	0	-1	-1	0	1
672	1	0	1	0	0	0	1

Figure C.18.: Task 3 - High Temporal Distance - Part 3

ID	No. Activities	No. Edges	No. Gateways	Overall	No. Branches	No. Steps	No. Duration
906	7	8	0	17	1	64	301
911	10	11	0	23	1	39	395
916	8	12	4	26	4	83	277
778	17	35	9	64	3	192	687
788	10	35	16	63	18	316	669
783	11	22	7	42	5	239	721
808	10	13	0	25	2	74	478
310	20	27	5	55	6	161	552
315	12	18	3	36	3	321	511
366	8	13	2	25	3	56	458
516	7	10	2	21	1	41	155
521	6	12	3	23	3	41	242
541	6	17	5	30	1	72	353
536	11	23	6	42	2	65	501
531	8	14	3	27	1	58	375
526	6	9	1	18	1	41	378
658	7	11	2	22	2	64	572
673	6	7	0	15	1	36	186
773	12	18	6	41	6	67	388
798	8	28	12	50	8	107	604
931	4	7	1	14	2	35	157
926	7	11	2	22	4	42	252

Figure C.19.: Task 4 - Low Hypothetical Distance - Part 1

	Semantic				Pragmatic
ID	Correctness	Relevance	Completeness	Authenticity	Understandable
906	3	2	0	0	3
911	2	2	1	1	3
916	2	2	1	1	2
778	3	3	3	3	1
788	3	3	3	3	0
783	3	3	3	3	0
808	1	2	1	1	1
310	3	2	2	2	2
315	3	3	3	3	3
366	2	2	1	1	1
516	2	2	2	2	2
521	3	2	1	1	0
541	1	2	0	1	-2
536	3	3	3	3	2
531	0	0	-2	-2	-3
526	2	1	1	0	2
658	2	1	1	1	3
673	2	2	1	1	3
773	2	2	2	2	2
798	3	2	3	3	0
931	2	2	-2	-2	3
926	2	2	1	1	2

Figure C.20.: Task 4 - Low Hypothetical Distance - Part 2

	Perceived						
ID	Agreement	Missing Aspects	Accurate Description	Mistakes	Satisfaction	Naming	No. Syntax Rule Violation
906	1	-1	0	0	-1	0	2
911	1	-1	1	-1	1	0	2
916	0	0	-1	-2	1	0	2
778	1	-1	1	-1	-1	0	3
788	1	1	1	0	1	3	2
783	1	0	1	-1	-1	0	3
808	-1	1	-1	-1	1	1	2
310	-1	1	-2	2	2	0	3
315	1	0	1	-1	-1	0	3
366	0	0	1	-1	1	1	2
516	0	1	-2	1	1	1	2
521	0	-1	0	-1	2	2	3
541	0	1	0	-1	0	4	1
536	1	-1	0	0	1	1	3
531	0	0	0	0	-1	4	2
526	-1	1	0	1	1	2	
658	1	0	1	-1	-1	1	2
673	1	0	1	0	1	0	3
773	1	0	0	-1	0	2	3
798	1	-1	1	-1	0	4	2
931	1	-1	1	-1	1	2	3
926	1	-1	1	-1	-1	0	3

Figure C.21.: Task 4 - Low Hypothetical Distance - Part 3

ID	No. Activities	No. Edges	No. Gateways	Overall	No. Branches	No. Steps	No. Duration
921	7	14	4	27	4	60	295
936	2	3	0	7	1	18	102
793	11	15	2	30	1	92	508
745	4	10	3	19	3	41	217
768	4	10	3	19	3	41	217
803	11	19	4	37	4	121	640
813	5	9	2	19	1	44	333
300	11	18	4	35	2	58	298
305	5	9	2	18	2	34	152
320	3	10	4	19	3	55	457
361	8	15	4	39	2	52	339
551	7	14	4	27	3	40	195
546	8	15	4	29	2	46	173
506	10	14	2	28	2	54	286
561	6	6	0	14	1	30	193
556	8	20	6	37	1	78	456
511	7	16	5	30	1	62	364
668	7	10	1	20	2	30	126
663	5	6	0	13	1	31	182
678	8	16	6	32	1	283	346

Figure C.22.: Task 4 - High Hypothetical Distance - Part 1

	Semantic				Pragmatic
ID	Correctness	Relevance	Completeness	Authenticity	Understandable
921	2	2	0	1	2
936	2	0	-3	-3	3
793	2	3	3	3	3
745	2	3	-2	-2	2
768	2	3	-2	-2	2
803	2	1	2	2	2
813	2	2	-1	-1	3
300	2	2	2	3	3
305	2	2	0	2	3
320	3	2	-2	-1	3
361	2	2	1	2	2
551	1	2	0	1	2
546	2	2	1	2	3
506	2	2	2	2	2
561	2	2	-2	-1	3
556	2	1	-2	-2	-2
511	2	2	2	2	0
668	3	2	1	2	2
663	2	2	-1	-1	3
678	2	2	2	2	2

Figure C.23.: Task 4 - High Hypothetical Distance - Part 2

	Perceived						
ID	Agreement	Missing Aspects	Accurate Description	Mistakes	Satisfaction	Naming	No. Syntax Rule Violation
921	1	-1	1	-1	-1	0	2
936	1	0	0	0	-1	0	1
793	0	1	0	-1	0	0	3
745	1	-1	1	-1	0	0	2
768	1	-1	1	-1	0	0	2
803	0	1	-1	1	-1	2	3
813	1	2	0	0	1	0	2
300	-1	1	-1	-1	1	2	3
305	1	-1	2	-2	-2	0	2
320	1	-1	0	0	0	0	2
361	1	0	0	0	-1	2	3
551	0	1	-1	0	1	3	3
546	-1	2	1	0	2	1	2
506	1	-1	1	-1	-1	1	2
561	-1	2	-1	0	1	0	1
556	0	-1	-1	-1	2	2	2
511	0	0	0	0	0	1	3
668	0	1	-1	0	1	1	1
663	0	-1	0	-2	-2	0	2
678	1	1	0	0	2	0	1

Figure C.24.: Task 4 - High Hypothetical Distance - Part 3

D

Experimental Results

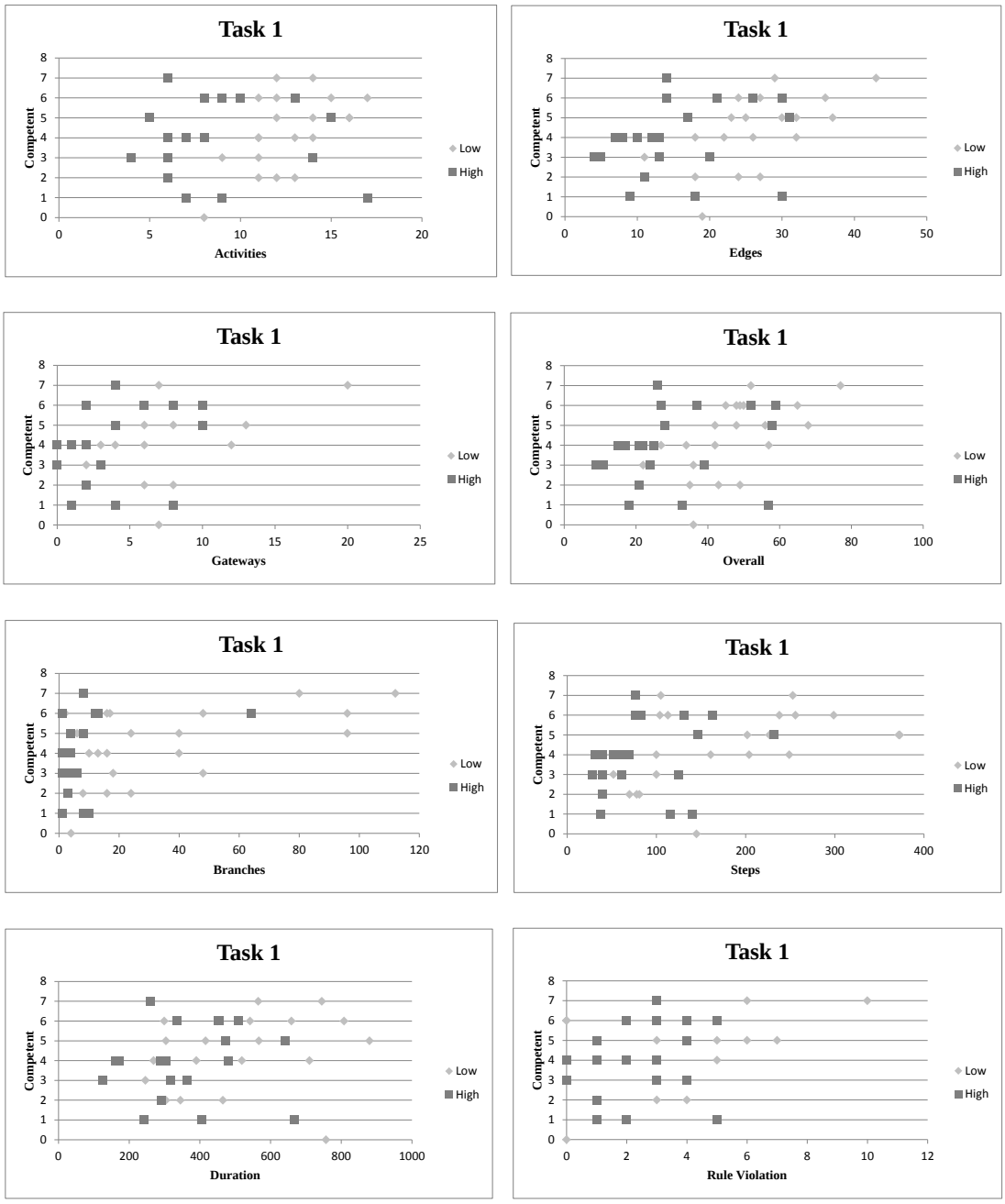


Figure D.1.: Scatter Plots - Part 1

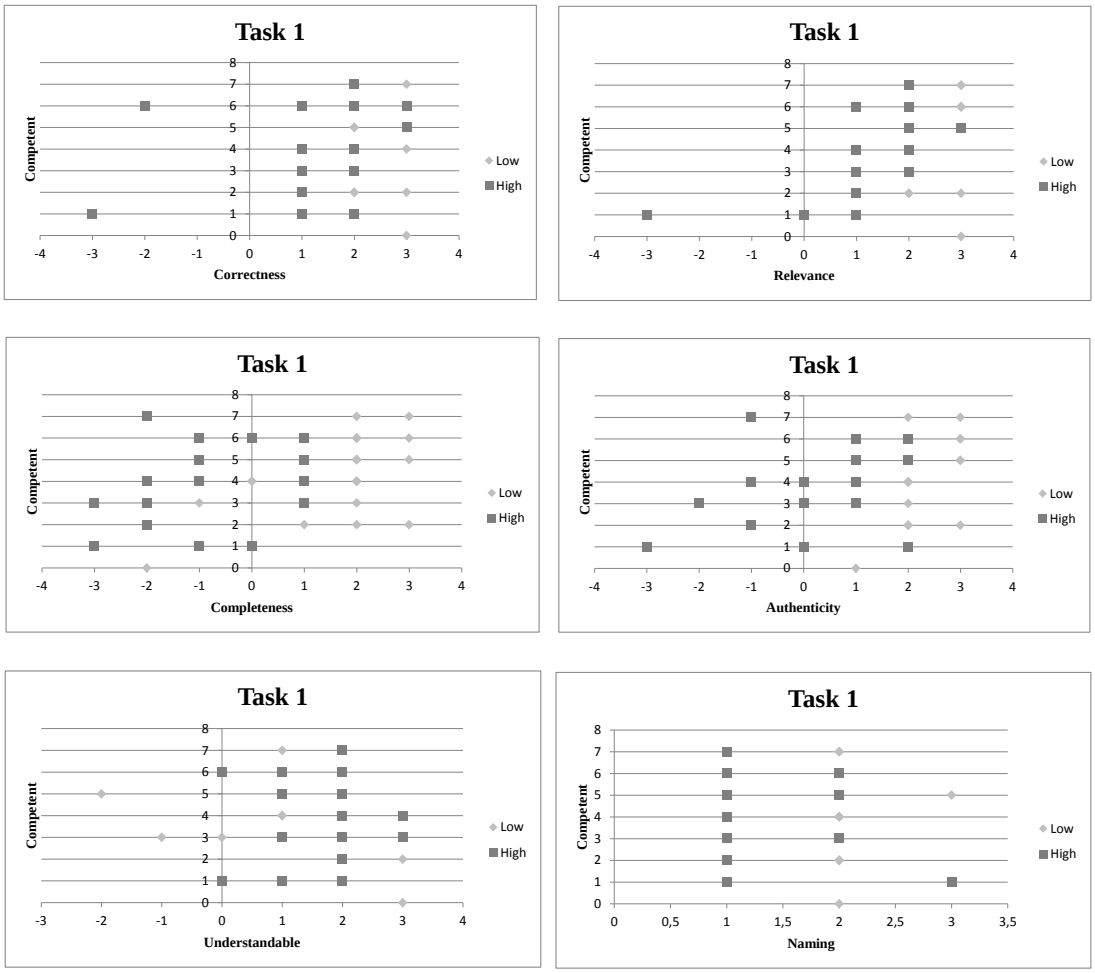


Figure D.2.: Scatter Plots - Part 2

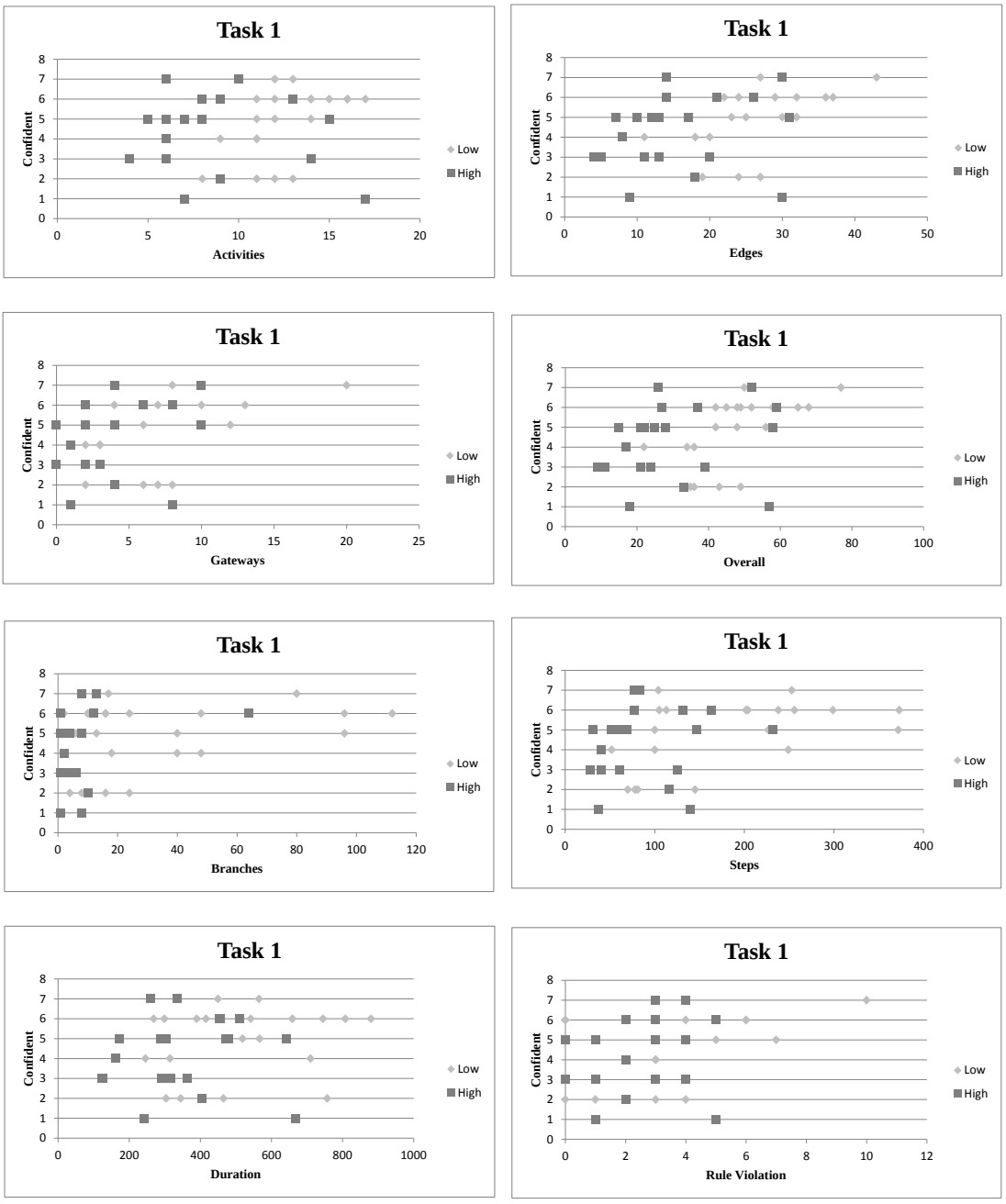


Figure D.3.: Scatter Plots - Part 3

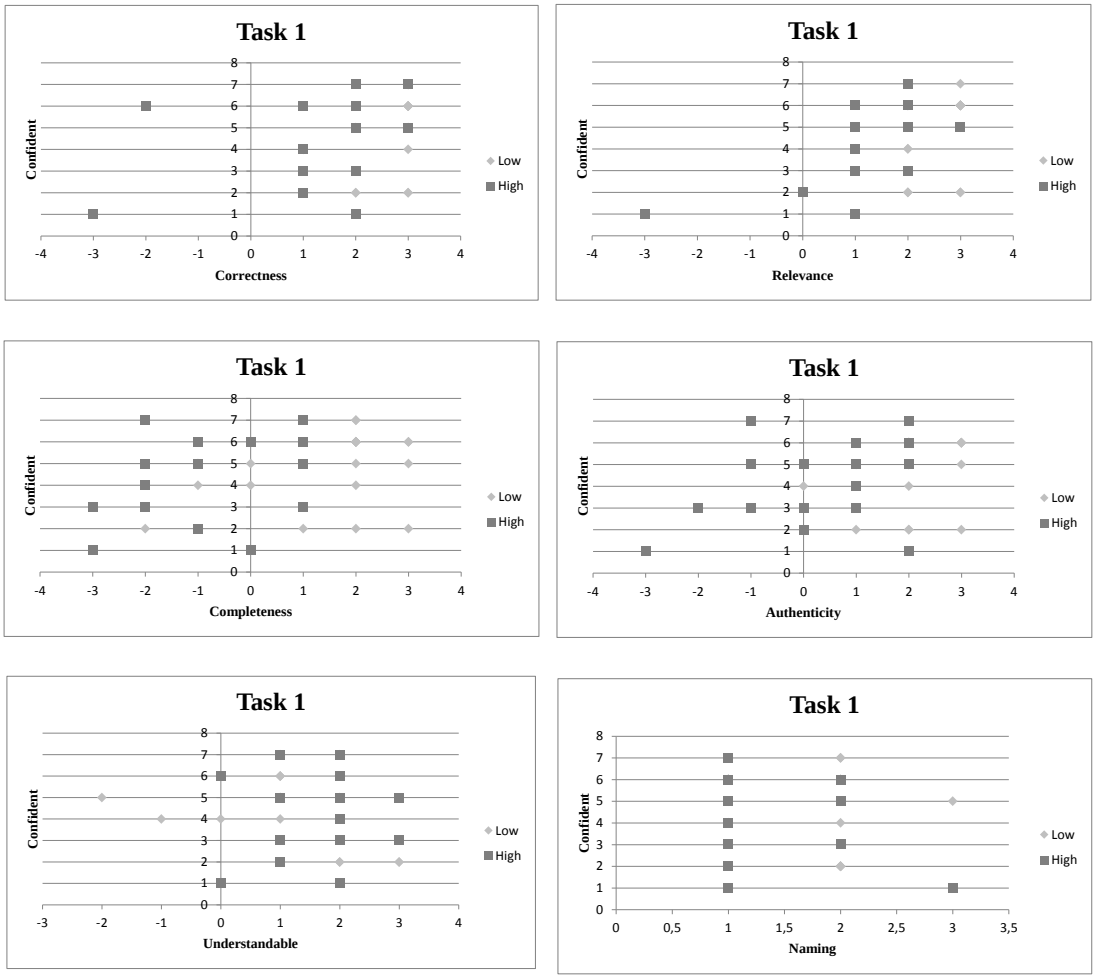


Figure D.4.: Scatter Plots - Part 4

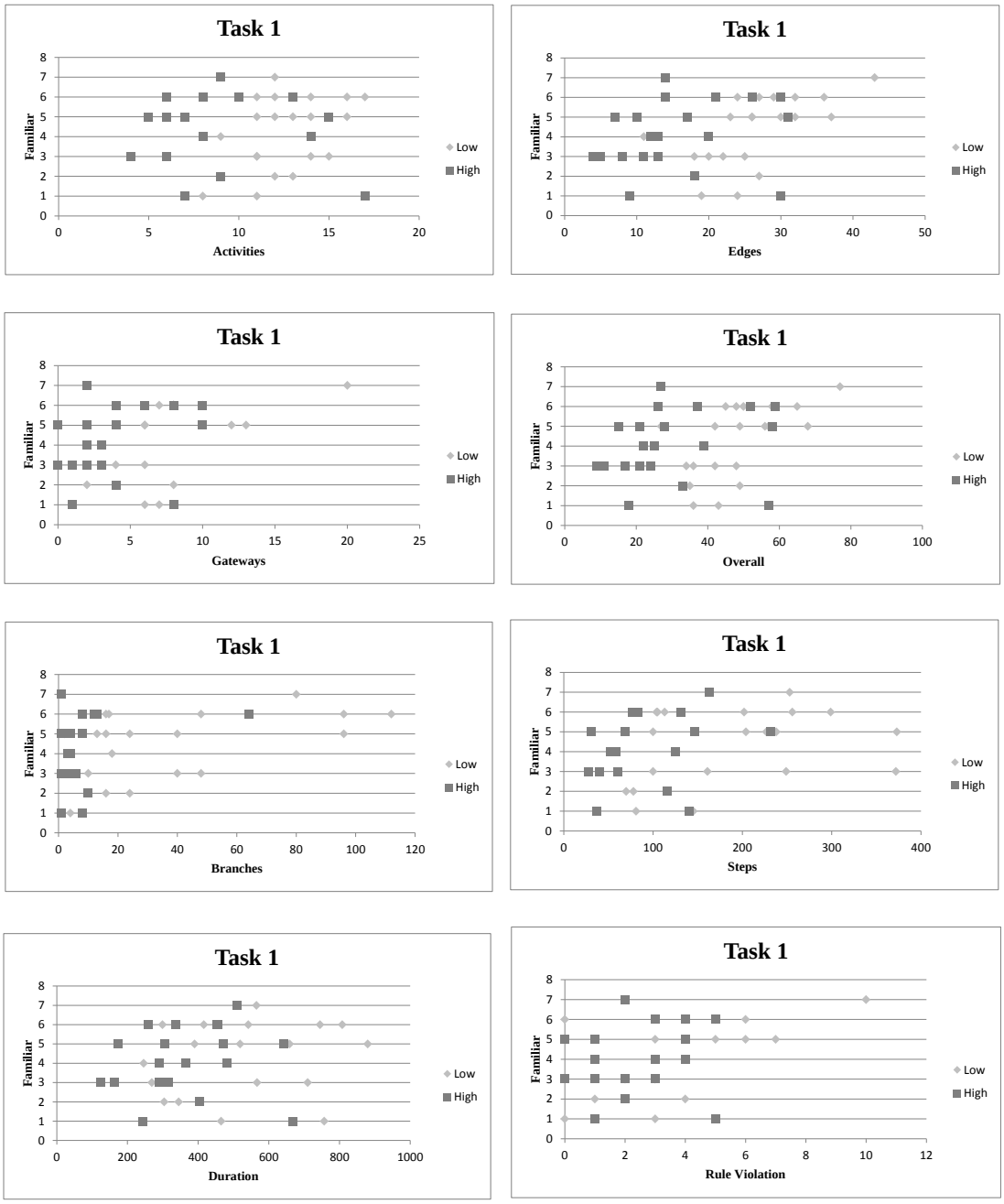


Figure D.5.: Scatter Plots - Part 5

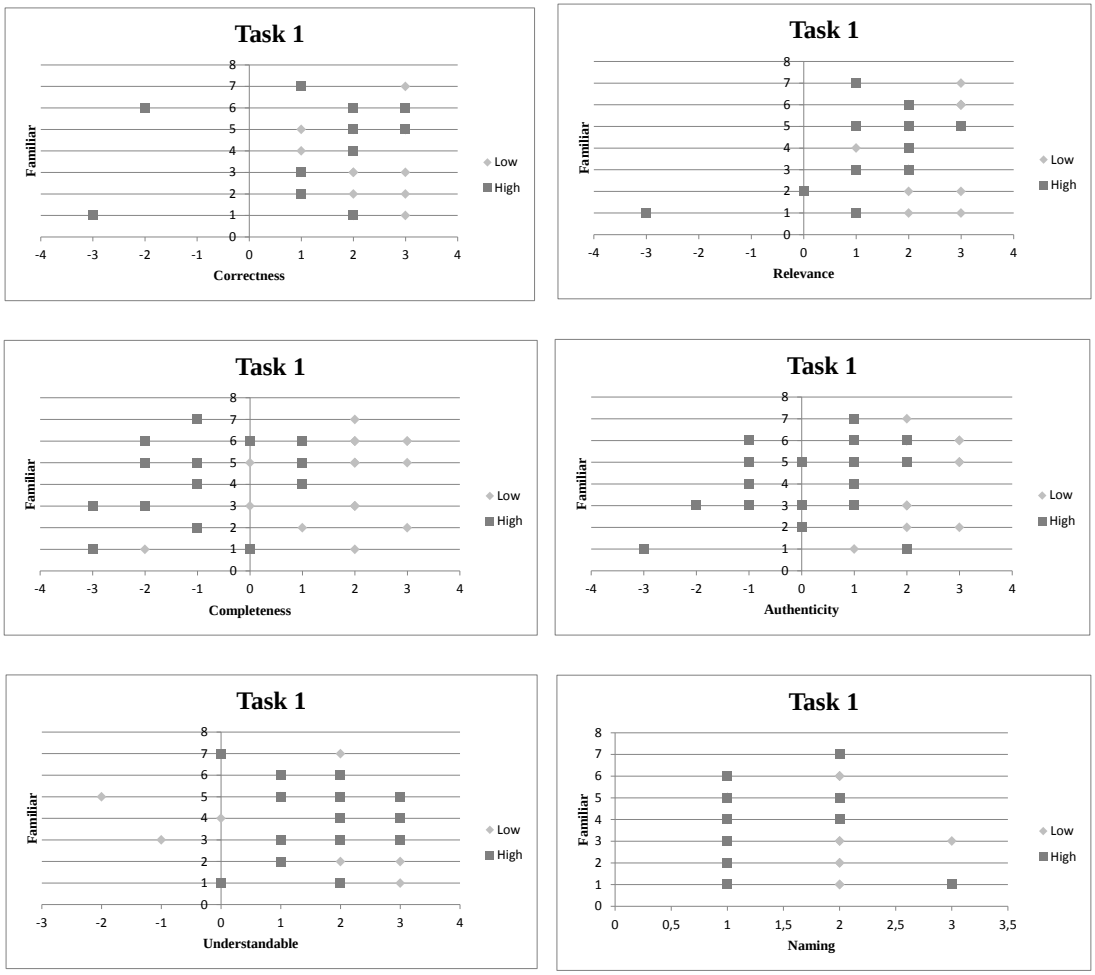


Figure D.6.: Scatter Plots - Part 6

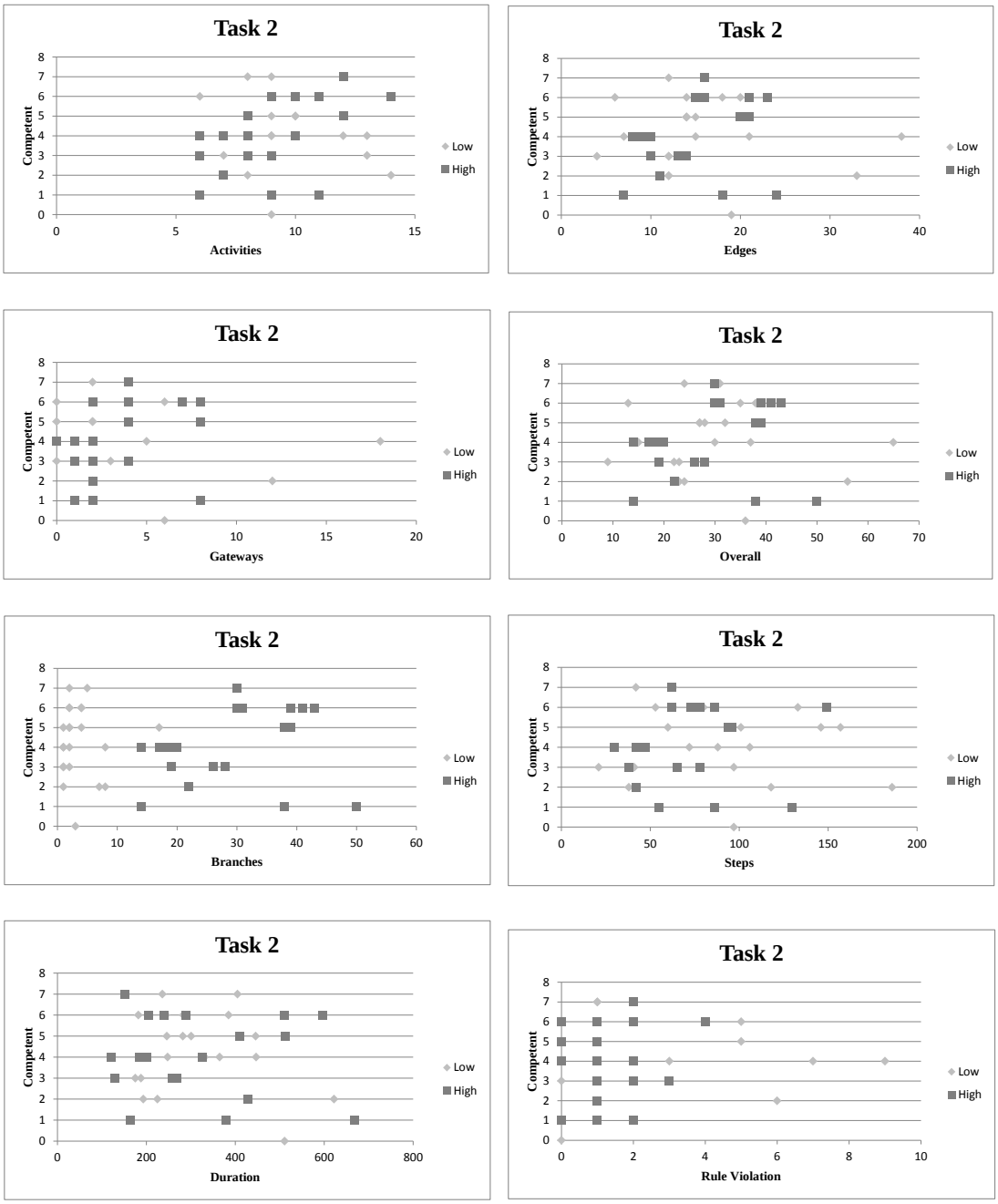


Figure D.7.: Scatter Plots - Part 7

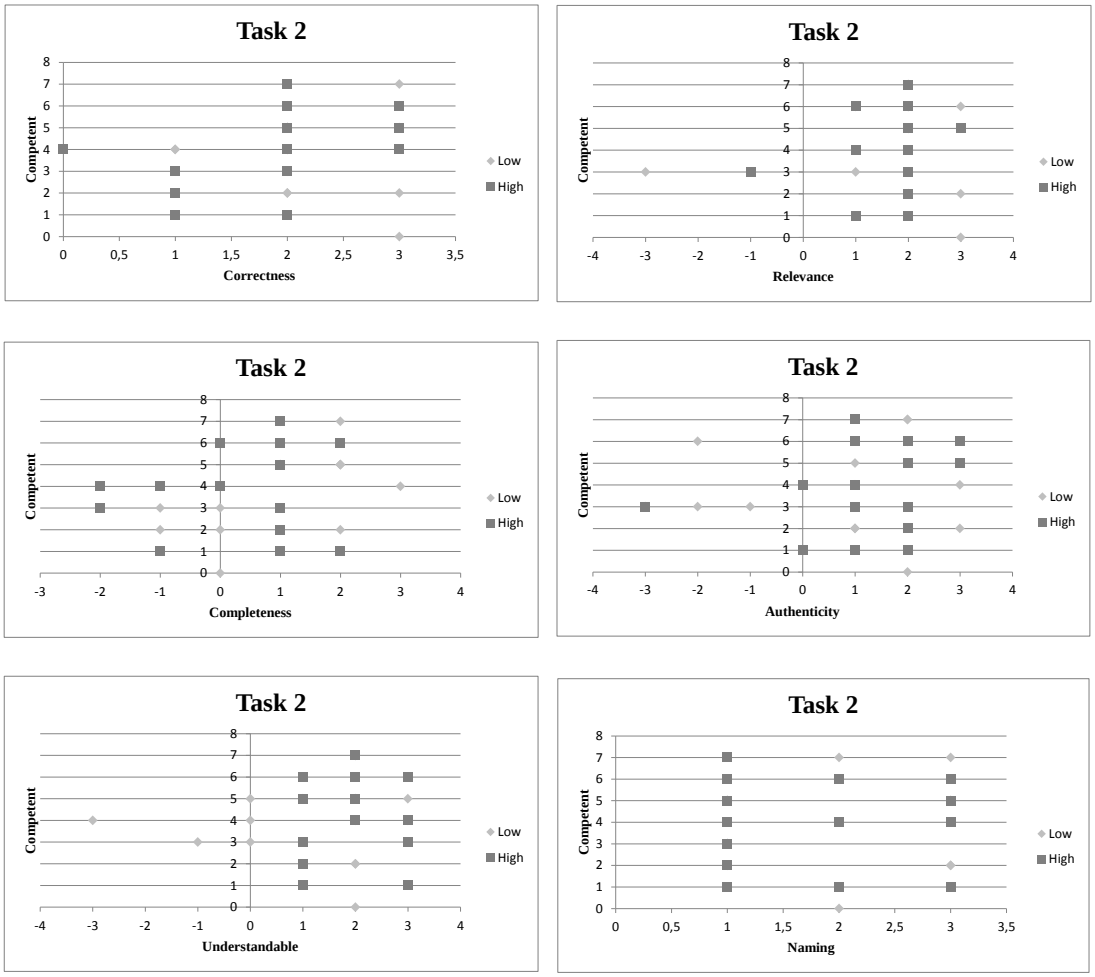


Figure D.8.: Scatter Plots - Part 8

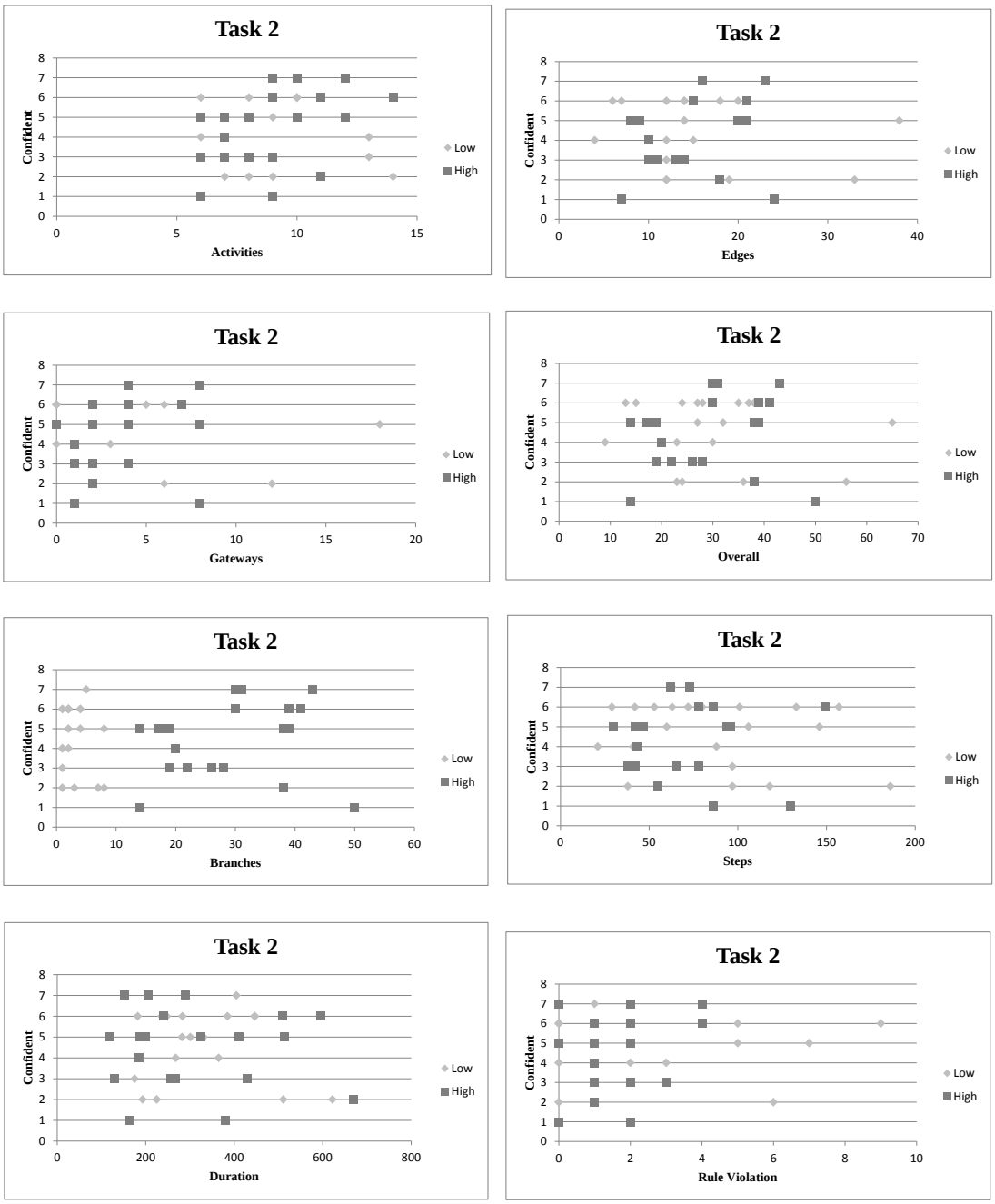


Figure D.9.: Scatter Plots - Part 9

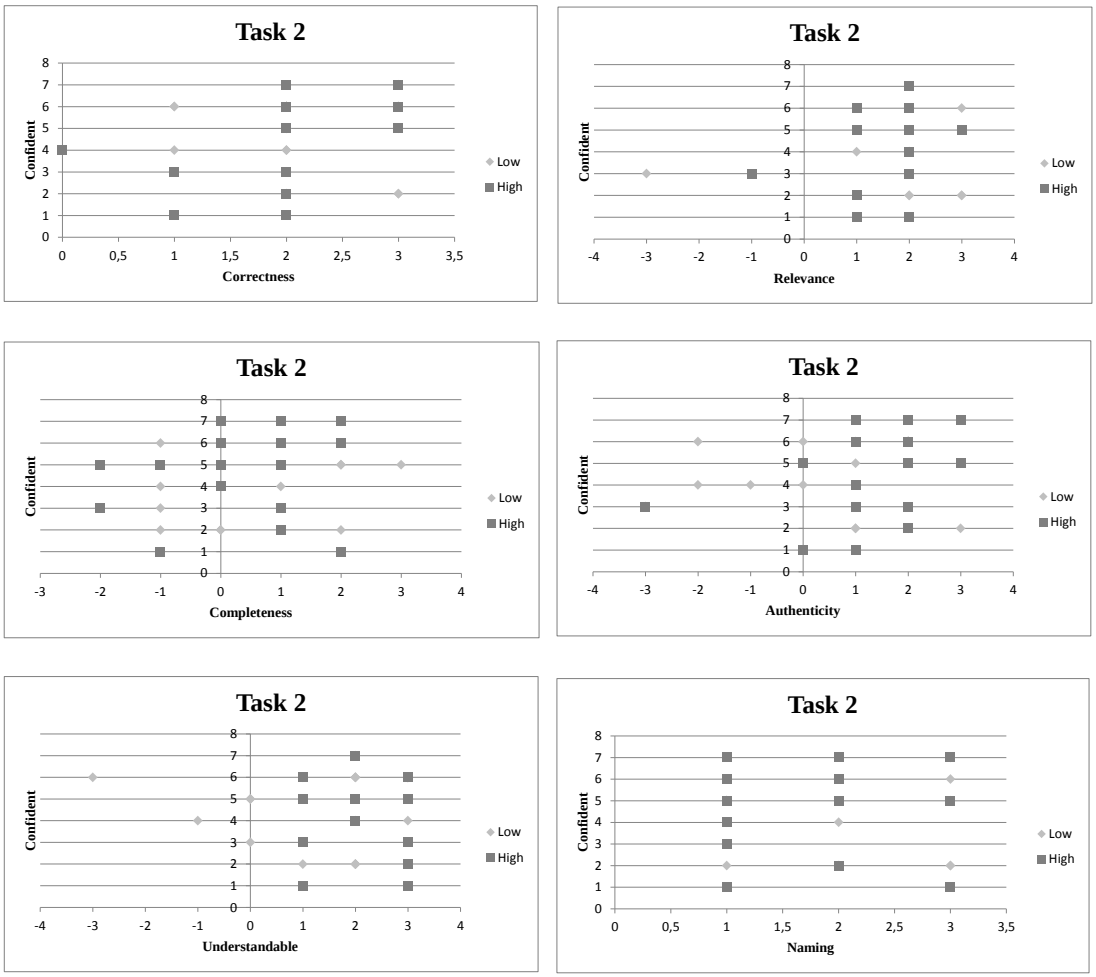


Figure D.10.: Scatter Plots - Part 10

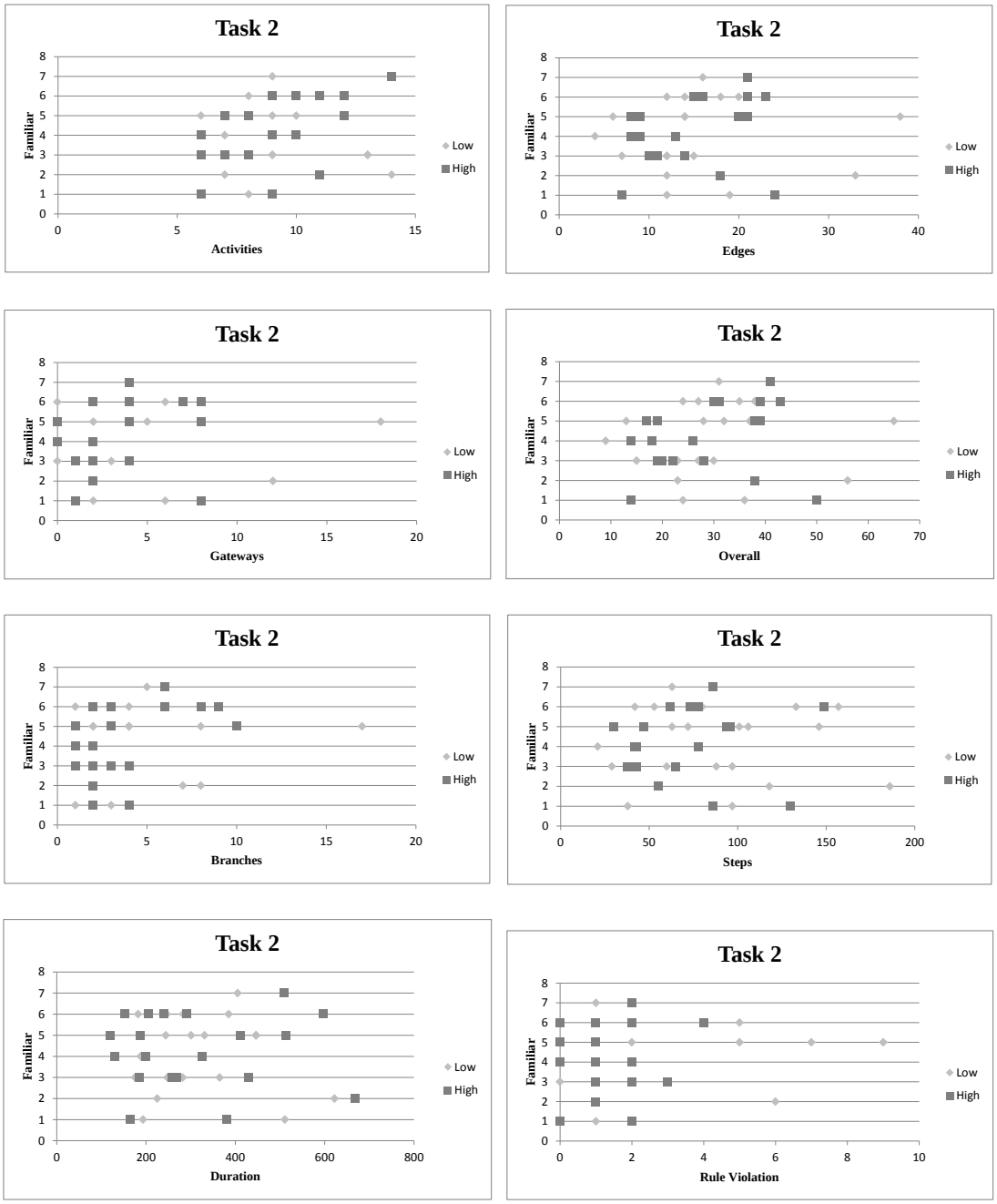


Figure D.11.: Scatter Plots - Part 11

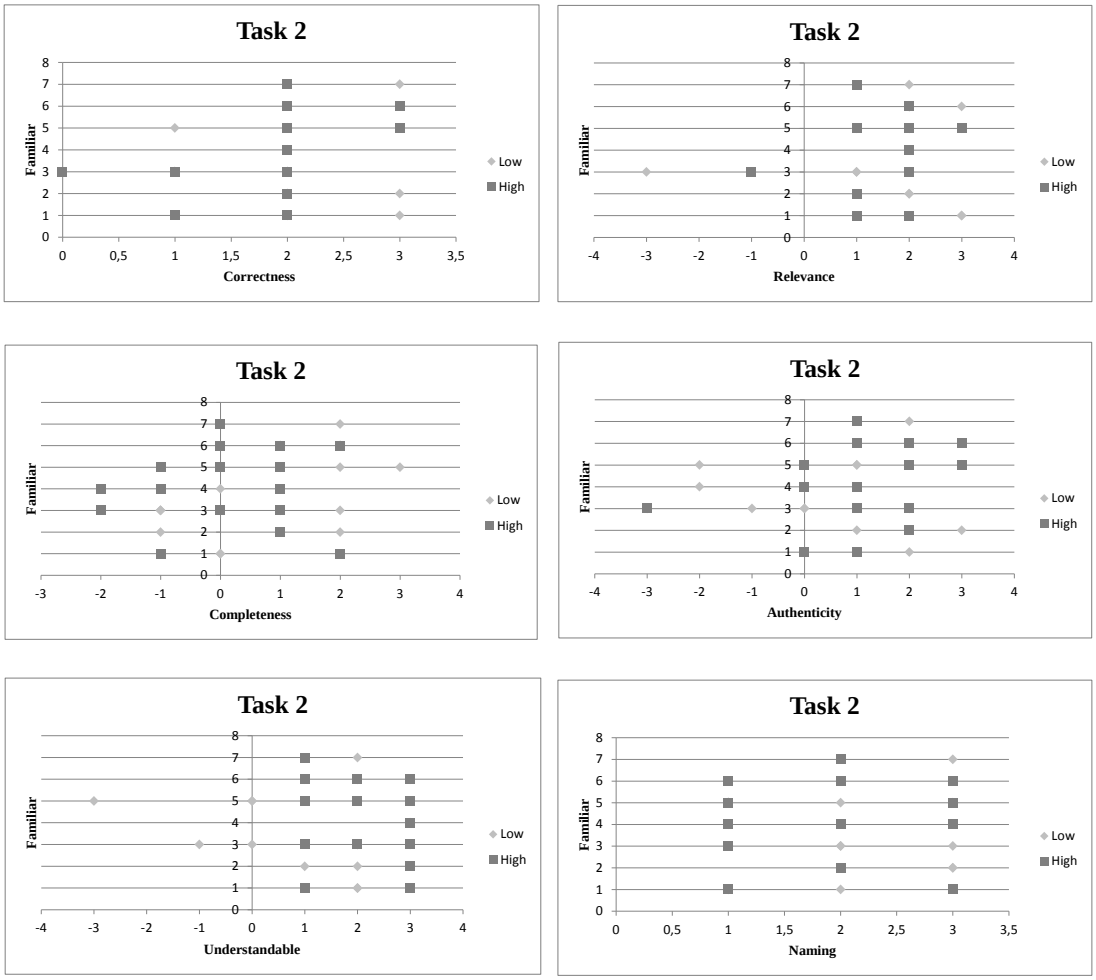


Figure D.12.: Scatter Plots - Part 12

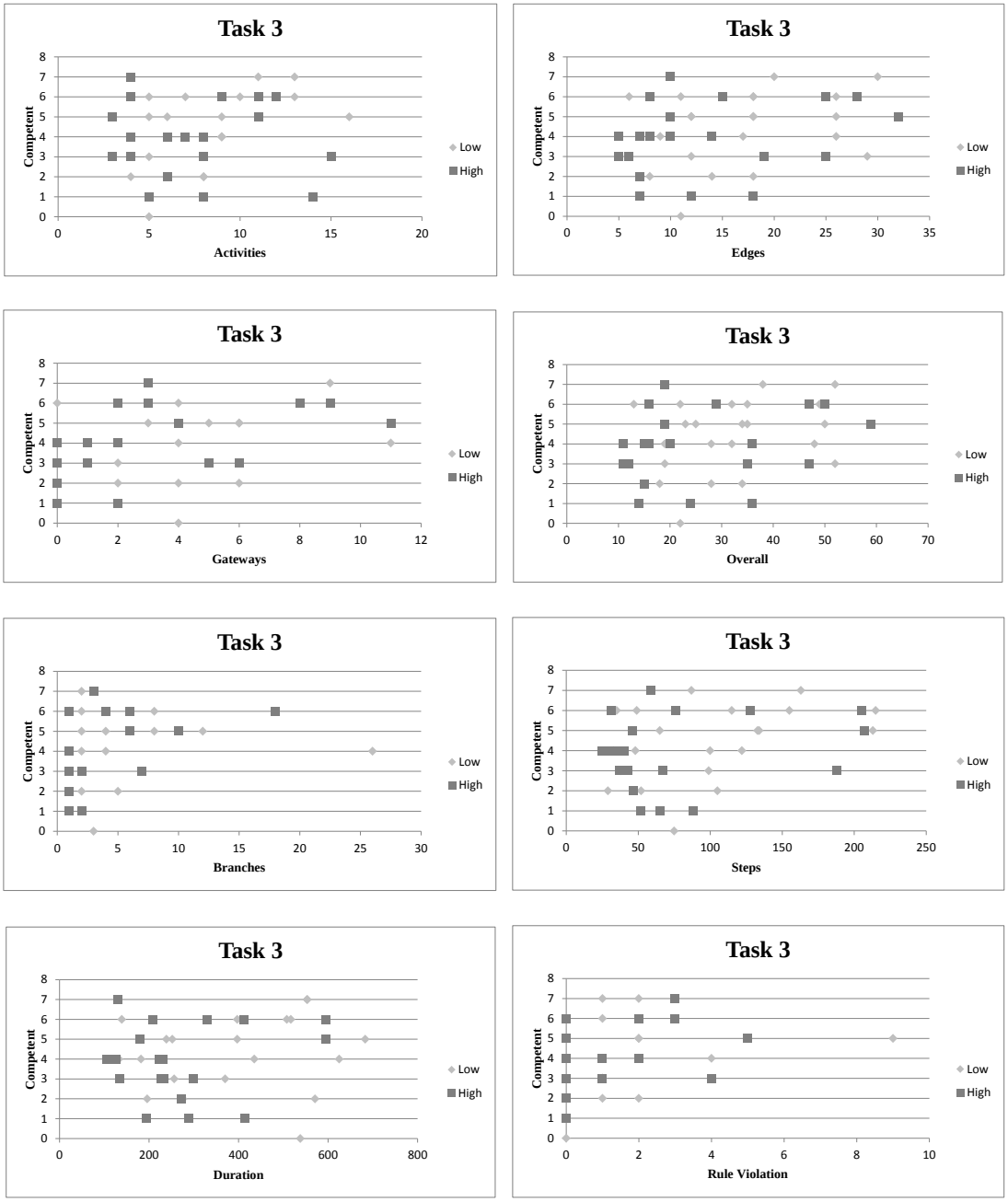


Figure D.13.: Scatter Plots - Part 13

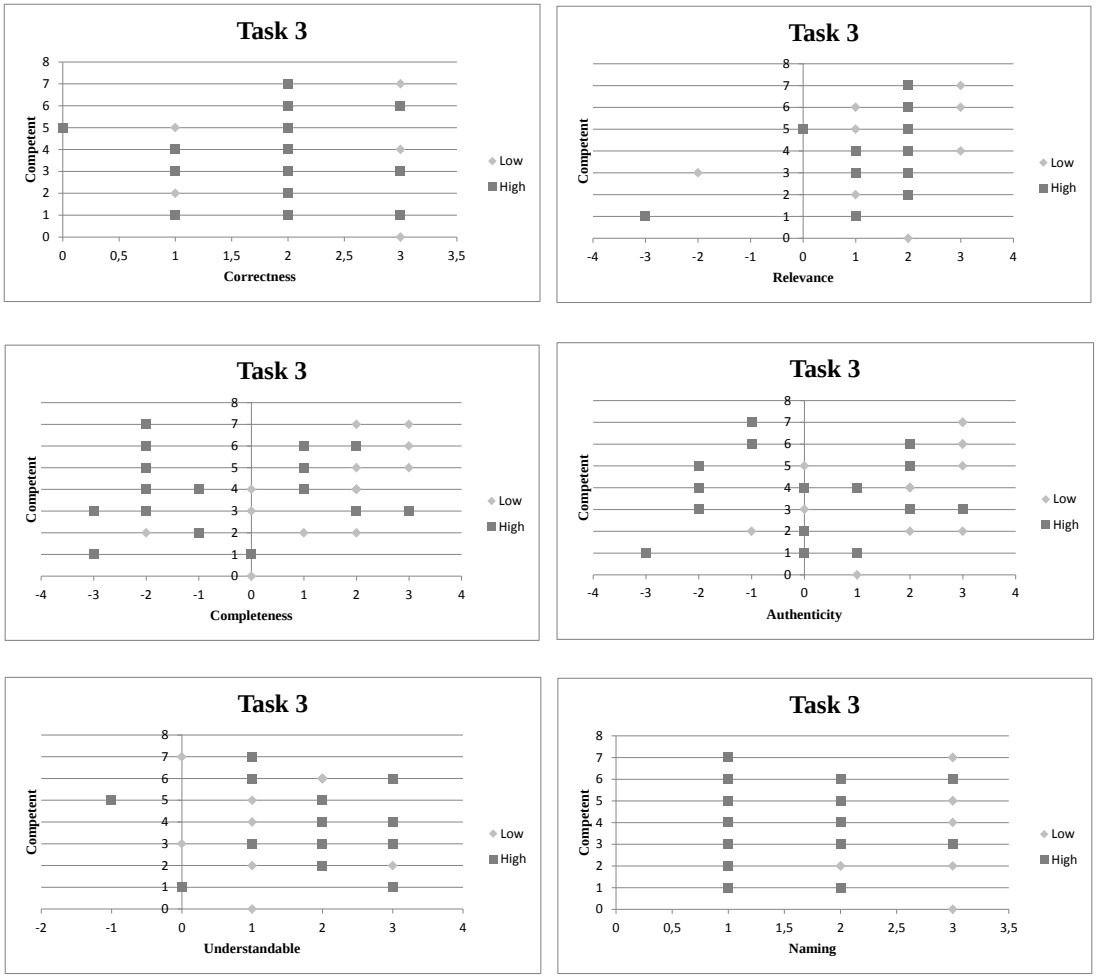


Figure D.14.: Scatter Plots - Part 14

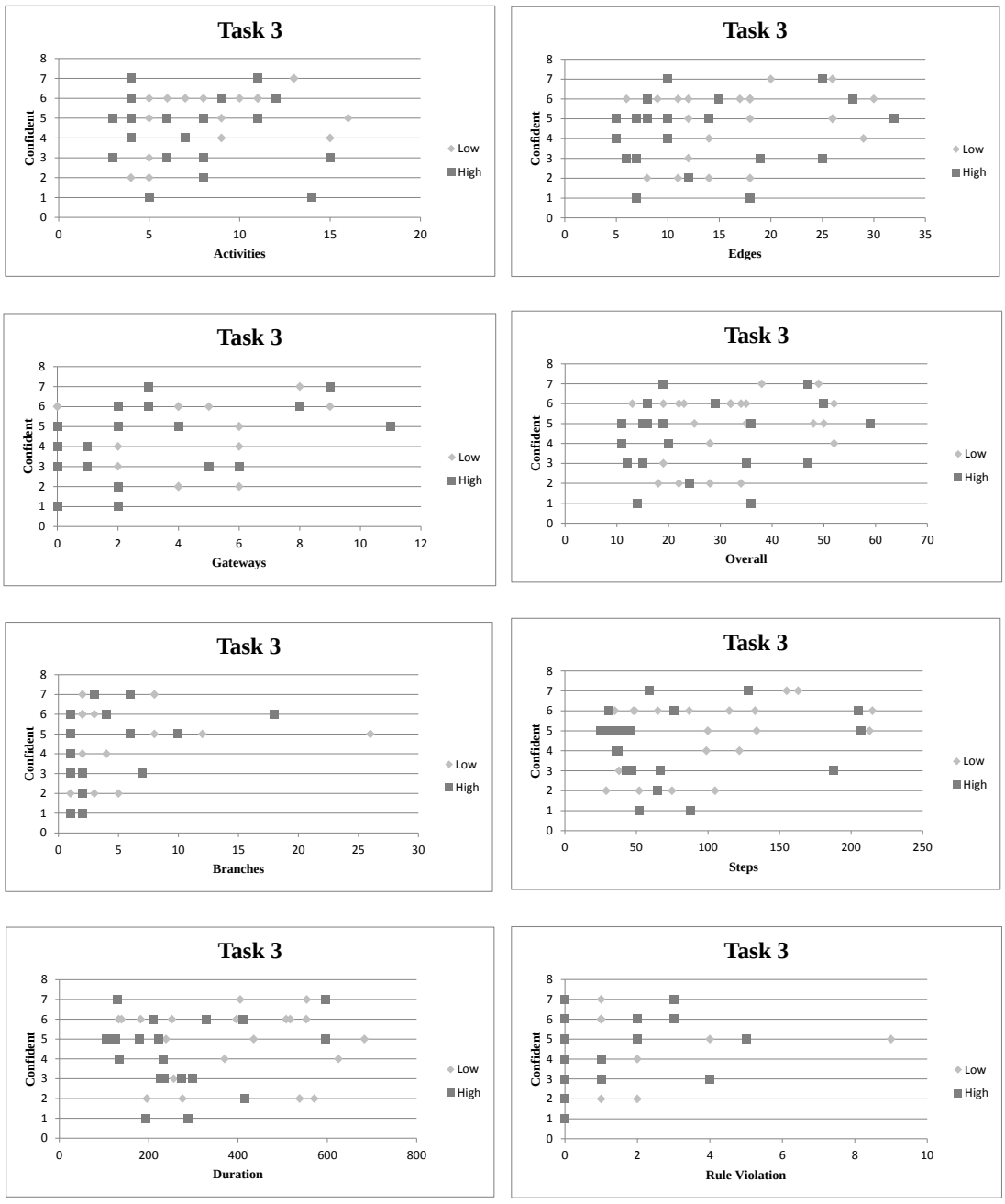


Figure D.15.: Scatter Plots - Part 15

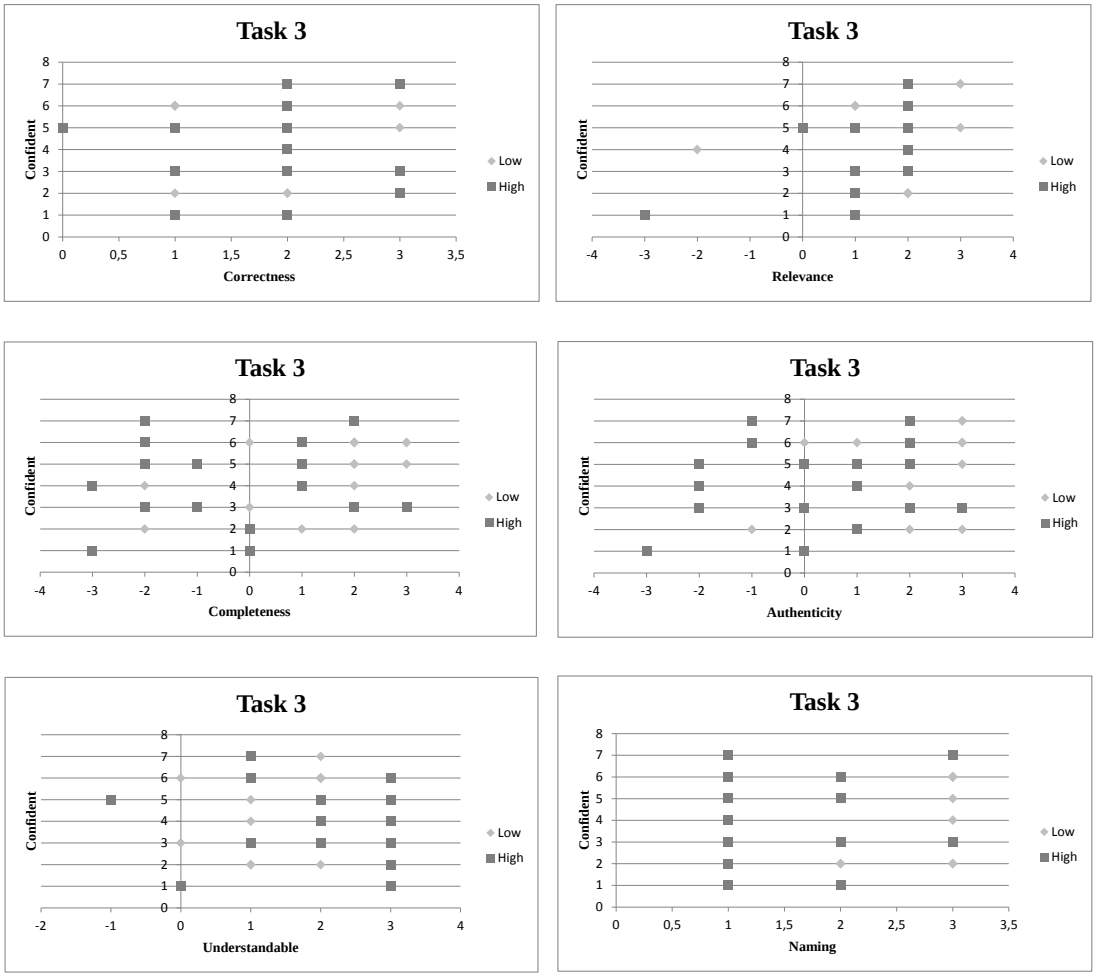


Figure D.16.: Scatter Plots - Part 16

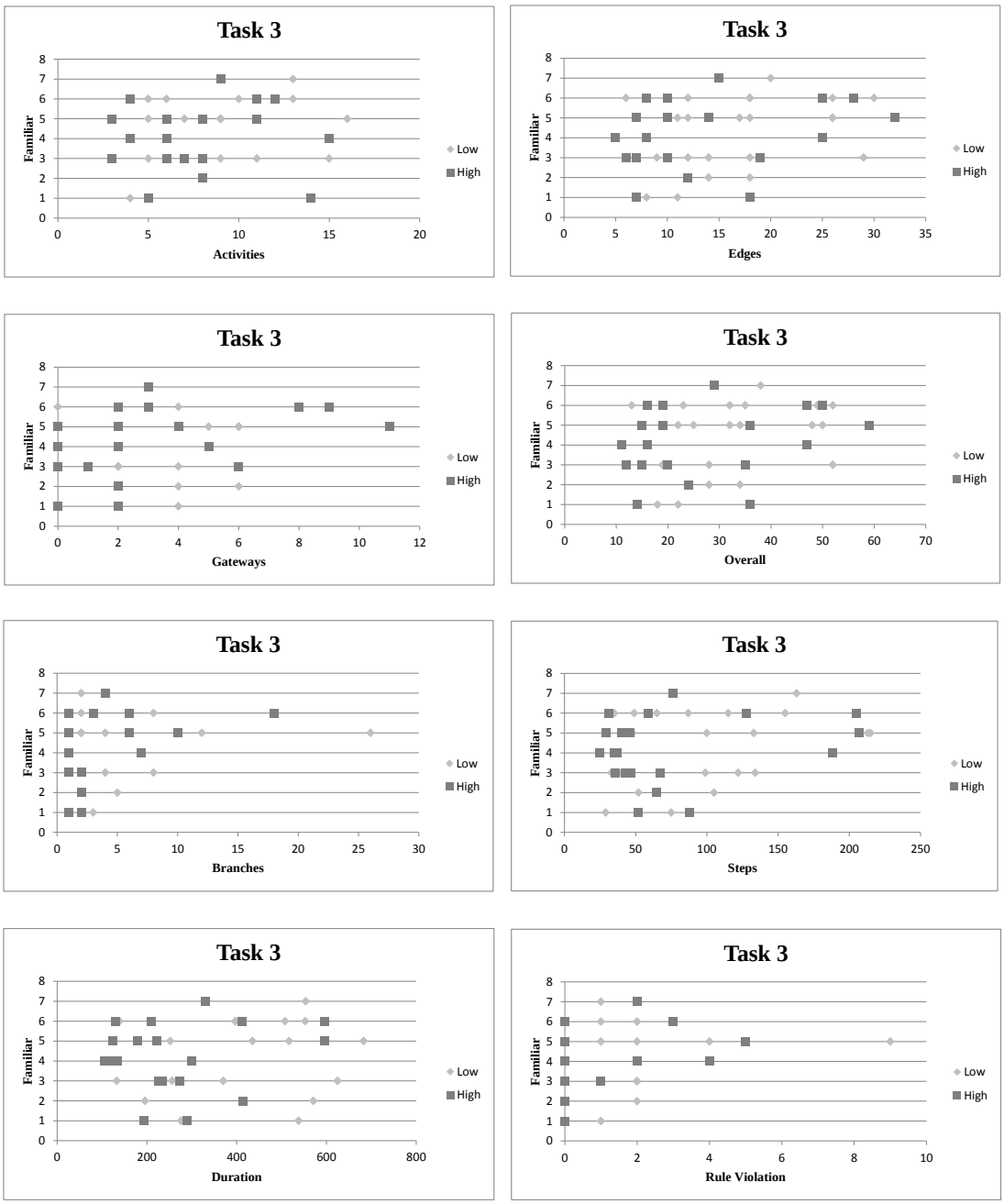


Figure D.17.: Scatter Plots - Part 17

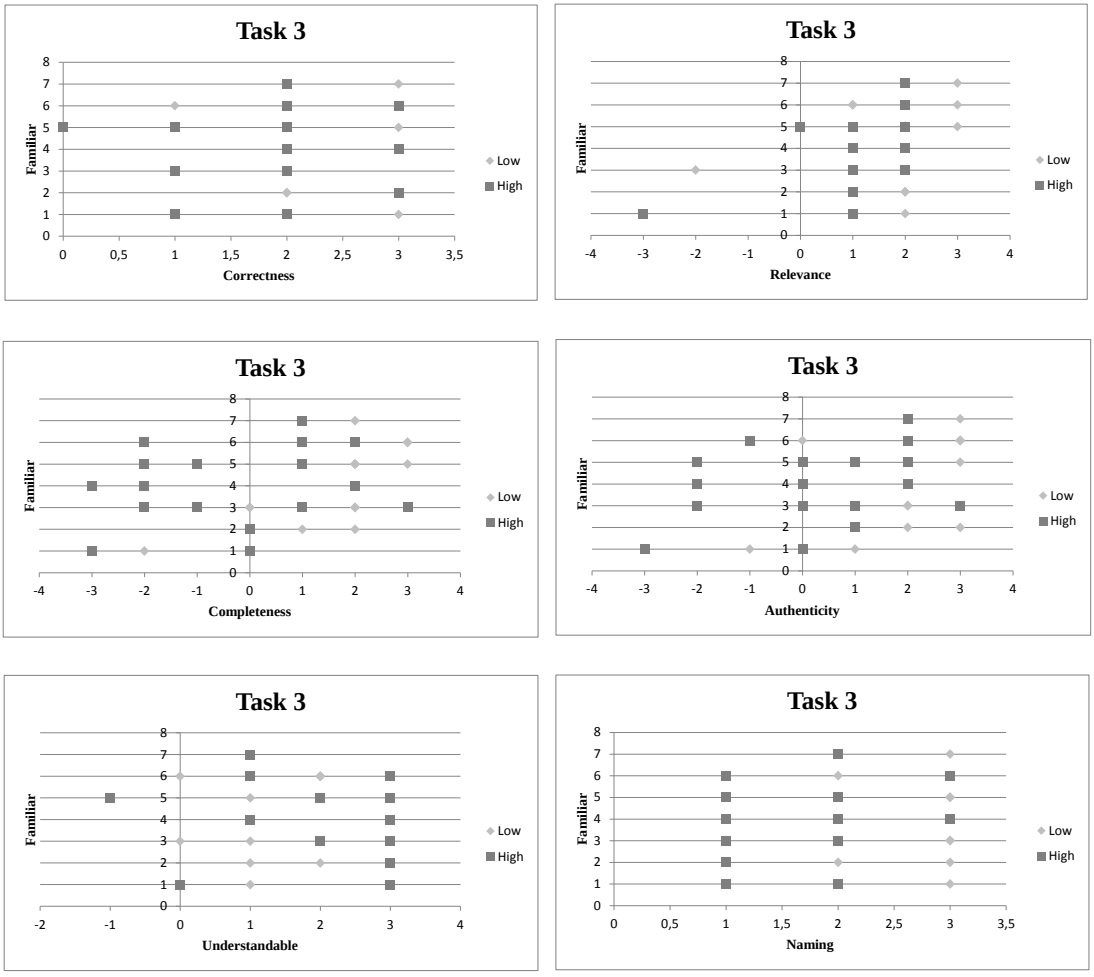


Figure D.18.: Scatter Plots - Part 18

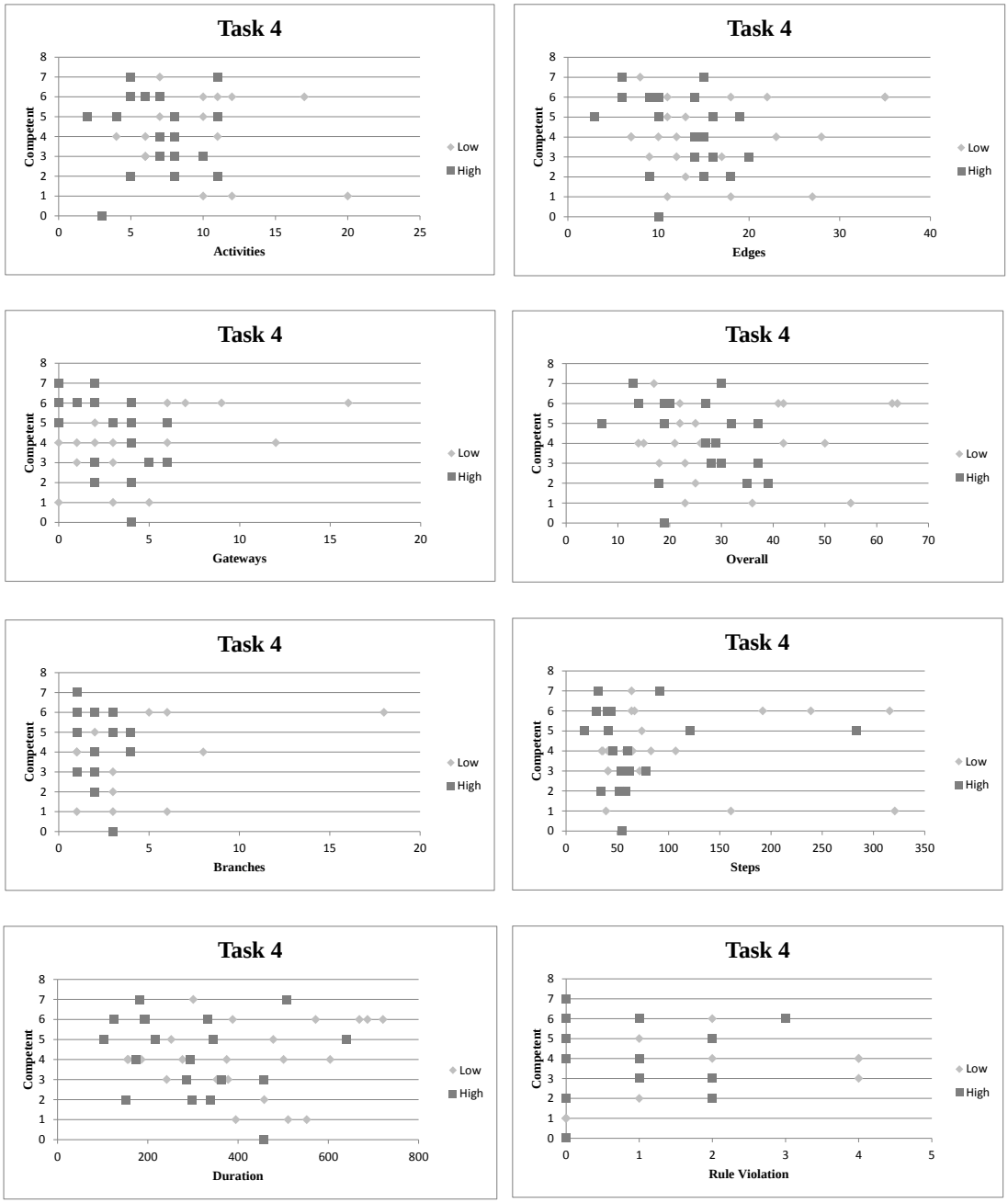


Figure D.19.: Scatter Plots - Part 19

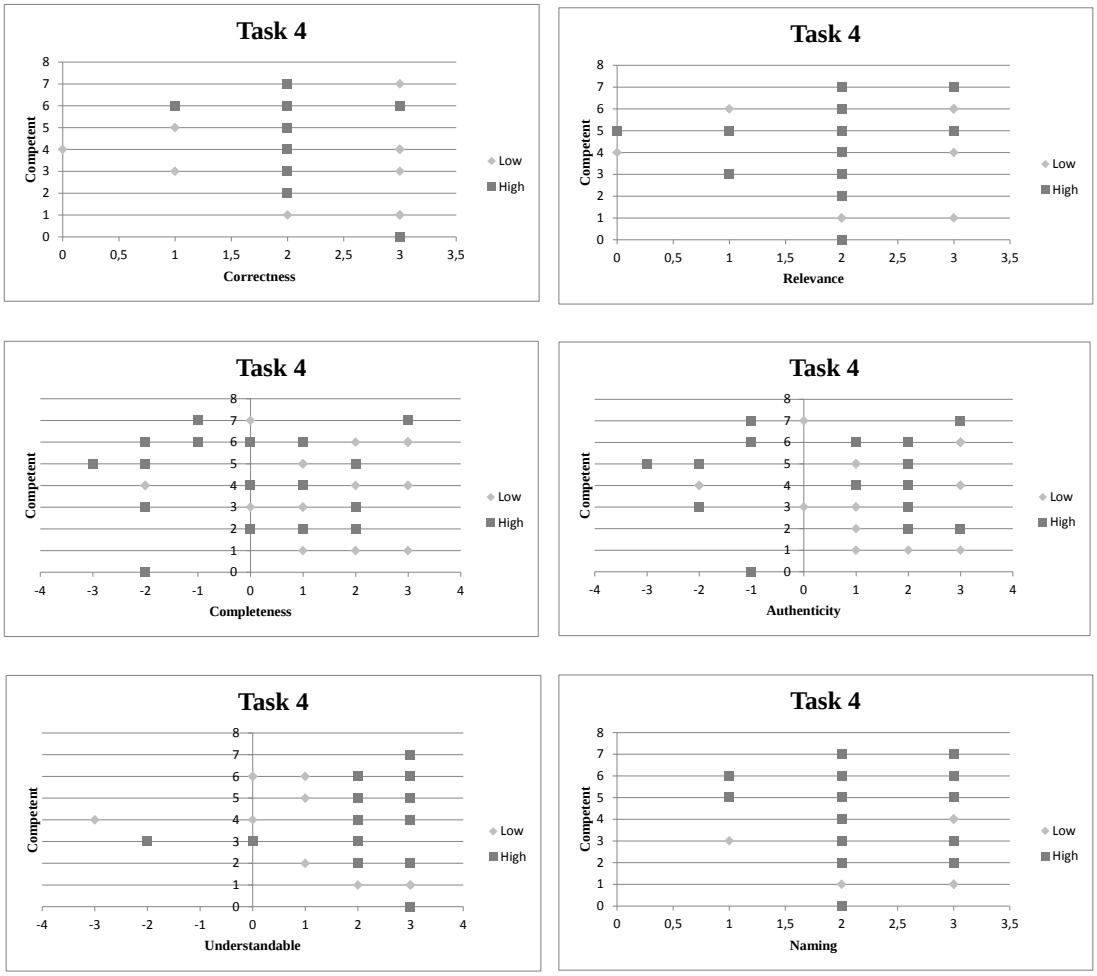


Figure D.20.: Scatter Plots - Part 20

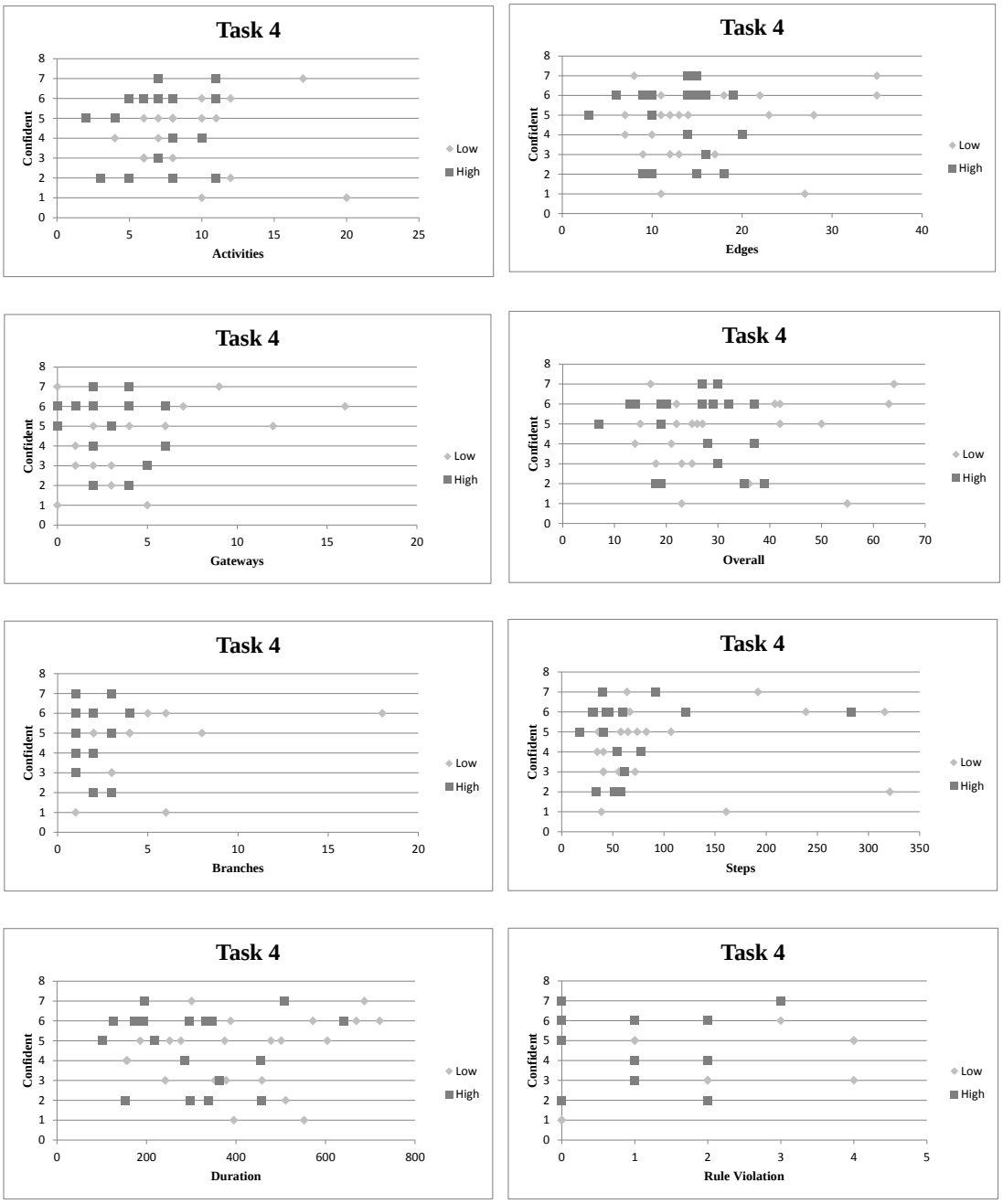


Figure D.21.: Scatter Plots - Part 21

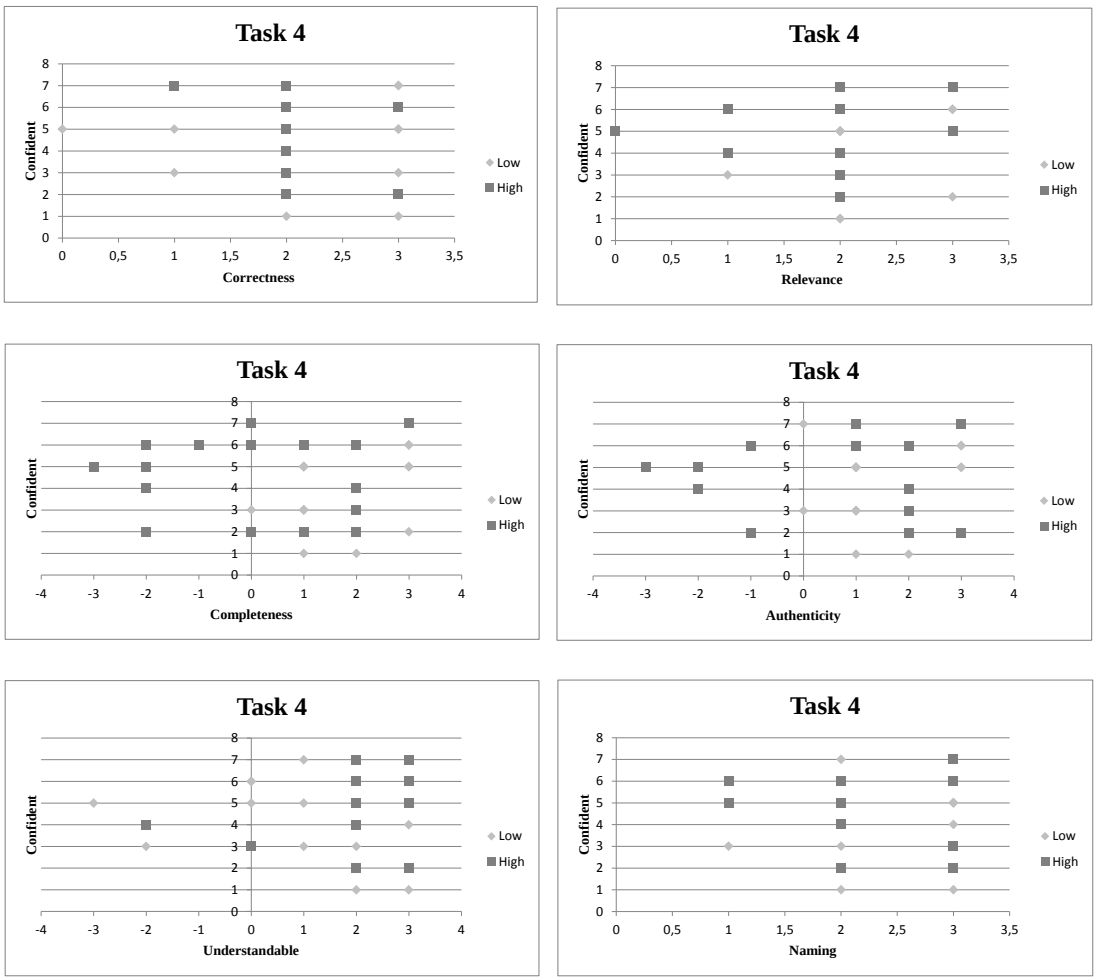


Figure D.22.: Scatter Plots - Part 22

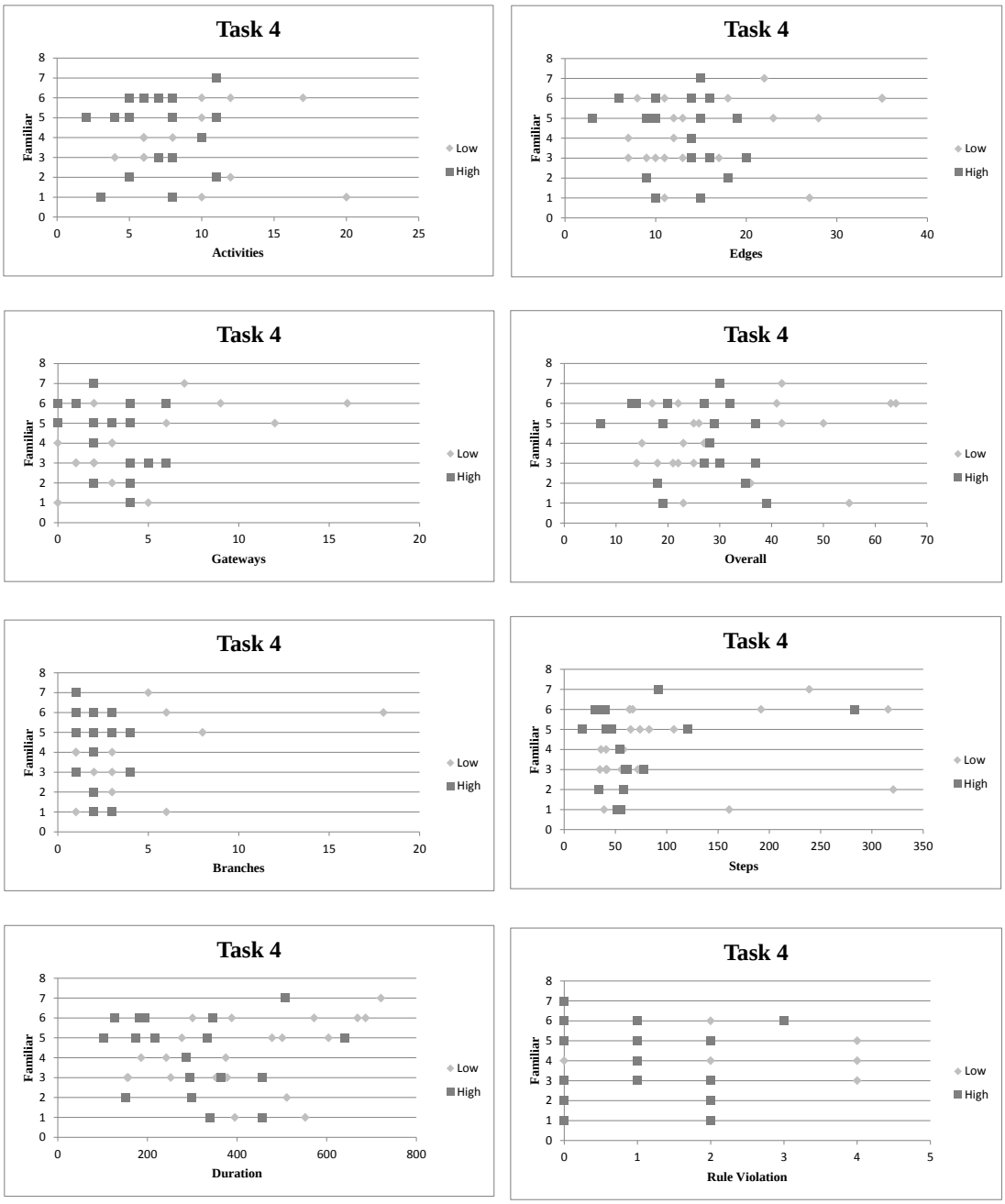


Figure D.23.: Scatter Plots - Part 23

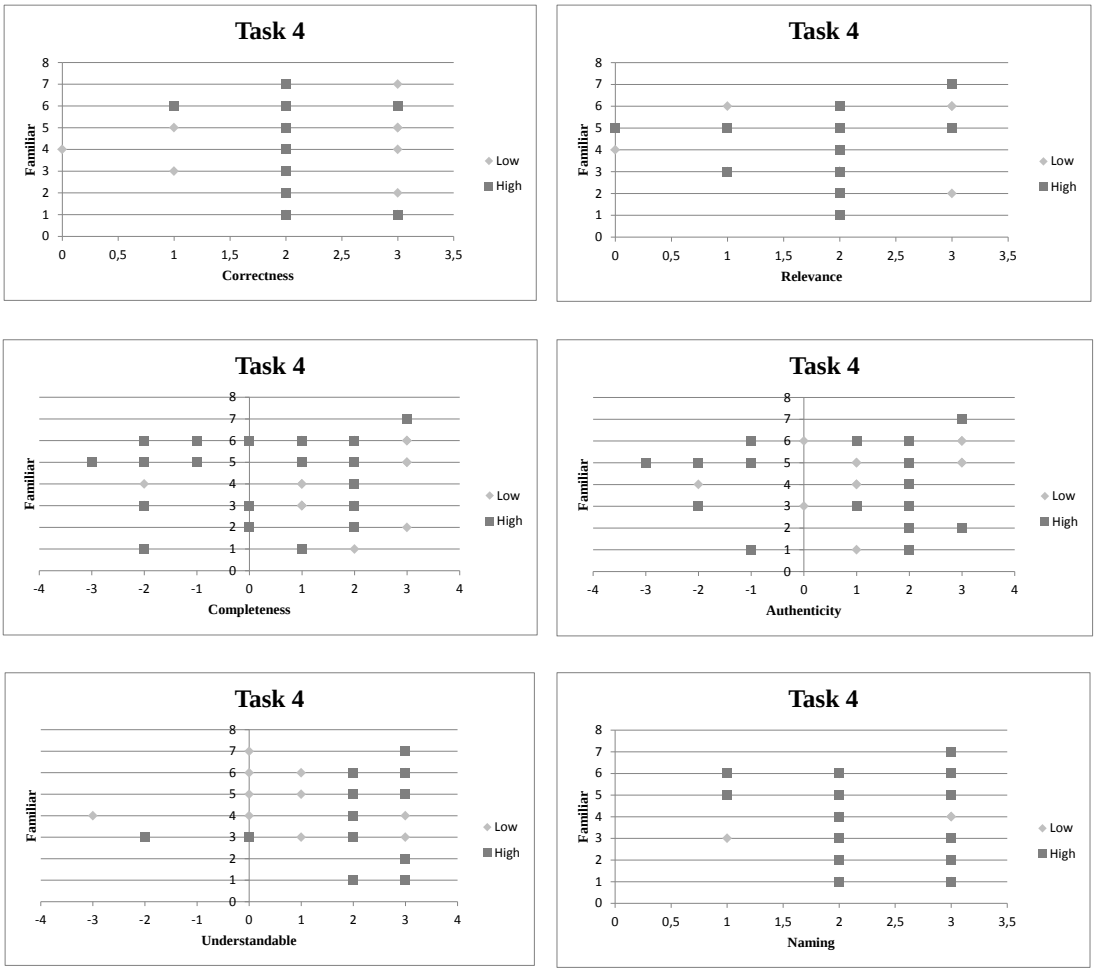


Figure D.24.: Scatter Plots - Part 24

E

Detailed Results of Hypothesis Testing

Table E.1-E.20 summarize the required and calculated values, which are defined as followed:

- f-value: Result of the homogeneous test
- Mean (x | y): Mean values for distances low x and high y
- Variance: Variances for distances low S_x^2 and high S_y^2
- Standard Deviation: Pooled standard deviation between two distances
- Correction Value: If variances are heterogeneous a special correction value must be calculate instead of pooled standard deviation
- Degrees of Freedom: Number of values that are free to vary
- t-value: Final result of the t-test

Social		
f-value	2,478 ($f_0 = 2, 15$)	
Mean (x | y)	12,727	8,500
Variance ($S_x^2 \mid S_y^2$)	5,160	12,789
Correction Value (C)	0,268	
Degrees of Freedom (df)	32	
t-value	4,521 ($t_0 = 2, 036$)	
Spatial		
f-value	1,023 ($f_0 = 2, 15$)	
Mean (x | y)	9,591	8,950
Variance ($S_x^2 \mid S_y^2$)	5,110	4,997
Standard Deviation (S_p)	2,249	
Degrees of Freedom (df)	40	
t-value	0,922 ($t_0 = 2, 021$)	
Temporal		
f-value	1,170 ($f_0 = 2, 15$)	
Mean (x | y)	8,955	7,400
Variance ($S_x^2 \mid S_y^2$)	11,188	13,095
Standard Deviation (S_p)	3,478	
Degrees of Freedom (df)	40	
t-value	1,447 ($t_0 = 2, 021$)	
Hypothetical		
f-value	2,011 ($f_0 = 2, 15$)	
Mean (x | y)	9,136	6,850
Variance ($S_x^2 \mid S_y^2$)	14,028	6,976
Standard Deviation (S_p)	3,268	
Degrees of Freedom (df)	40	
t-value	2,265 ($t_0 = 2, 021$)	

Table E.1.: Activities

Social		
f-value	1,353 ($f_0 = 2, 15$)	
Mean (x | y)	26,136	15,650
Variance ($S_x^2 \mid S_y^2$)	51,457	69,608
Standard Deviation (S_p)	7,751	
Degrees of Freedom (df)	40	
t-value	4,379 ($t_0 = 2, 021$)	
Spatial		
f-value	1,947($f_0 = 2, 15$)	
Mean (x | y)	15,864	14,700
Variance ($S_x^2 \mid S_y^2$)	60,695	31,168
Standard Deviation (S_p)	6,832	
Degrees of Freedom (df)	40	
t-value	0,551 ($t_0 = 2, 021$)	
Temporal		
f-value	1,432 ($f_0 = 2, 15$)	
Mean (x | y)	16,955	13,550
Variance ($S_x^2 \mid S_y^2$)	47,665	68,261
Standard Deviation (S_p)	7,579	
Degrees of Freedom (df)	40	
t-value	1,454 ($t_0 = 2, 021$)	
Hypothetical		
f-value	3,407 ($f_0 = 2, 15$)	
Mean (x | y)	16,409	12,450
Variance ($S_x^2 \mid S_y^2$)	72,253	21,208
Correction Value (C)	0,756	
Degrees of Freedom (df)	33	
t-value	1,899 ($t_0 = 2, 034$)	

Table E.2.: Edges

Social		
f-value	1,639 ($f_0 = 2,15$)	
Mean (x | y)	7,591	3,600
Variance (S_x^2 | S_y^2)	16,634	10,147
Standard Deviation (S_p)	3,681	
Degrees of Freedom (df)	40	
t-value	3,509 ($t_0 = 2,021$)	
Spatial		
f-value	2,489 ($f_0 = 2,15$)	
Mean (x | y)	3,955	3,200
Variance (S_x^2 | S_y^2)	18,236	7,326
Correction Value (C)	0,694	
Degrees of Freedom (df)	36	
t-value	0,690 ($t_0 = 2,028$)	
Temporal		
f-value	1,362 ($f_0 = 2,15$)	
Mean (x | y)	4,227	3,050
Variance (S_x^2 | S_y^2)	7,613	10,366
Standard Deviation (S_p)	2,987	
Degrees of Freedom (df)	40	
t-value	1,276 ($t_0 = 2,021$)	
Hypothetical		
f-value	4,990 ($f_0 = 2,15$)	
Mean (x | y)	4,045	3,000
Variance (S_x^2 | S_y^2)	16,807	3,368
Correction Value (C)	0,819	
Degrees of Freedom (df)	30	
t-value	1,083 ($t_0 = 2,042$)	

Table E.3.: Gateways

Social		
f-value	1,399 ($f_0 = 2, 15$)	
Mean (x | y)	47,227	29,950
Variance ($S_x^2 \mid S_y^2$)	147,279	243,839
Standard Deviation (S_p)	14,399	
Degrees of Freedom (df)	40	
t-value	3,884 ($t_0 = 2, 021$)	
Spatial		
f-value	1,415 ($f_0 = 2, 15$)	
Mean (x | y)	30,591	28,800
Variance ($S_x^2 \mid S_y^2$)	164,063	115,958
Standard Deviation (S_p)	11,883	
Degrees of Freedom (df)	40	
t-value	0,488 ($t_0 = 2, 021$)	
Temporal		
f-value	1,554 ($f_0 = 2, 15$)	
Mean (x | y)	32,182	26,550
Variance ($S_x^2 \mid S_y^2$)	142,251	221,109
Standard Deviation (S_p)	13,405	
Degrees of Freedom (df)	40	
t-value	1,360 ($t_0 = 2, 021$)	
Hypothetical		
f-value	2,860 ($f_0 = 2, 15$)	
Mean (x | y)	31,864	24,950
Variance ($S_x^2 \mid S_y^2$)	229,266	80,155
Correction Value (C)	0,722	
Degrees of Freedom (df)	35	
t-value	1,820 ($t_0 = 2, 030$)	

Table E.4.: Overall

Social		
f-value	60,129 ($f_0 = 2,15$)	
Mean (x | y)	56,682	7,700
Variance (S_x^2 | S_y^2)	11456,799	190,537
Correction Value (C)	0,982	
Degrees of Freedom (df)	22	
t-value	2,127 ($t_0 = 2,073$)	
Spatial		
f-value	1,768 ($f_0 = 2,15$)	
Mean (x | y)	3,636	3,550
Variance (S_x^2 | S_y^2)	13,861	7,839
Standard Deviation (S_p)	3,317	
Degrees of Freedom (df)	40	
t-value	0,084 ($t_0 = 2,021$)	
Temporal		
f-value	1,724 ($f_0 = 2,15$)	
Mean (x | y)	4,409	3,500
Variance (S_x^2 | S_y^2)	31,491	18,263
Standard Deviation (S_p)	5,021	
Degrees of Freedom (df)	40	
t-value	0,586 ($t_0 = 2,021$)	
Hypothetical		
f-value	3,547 ($f_0 = 2,15$)	
Mean (x | y)	3,545	2,000
Variance (S_x^2 | S_y^2)	14,260	1,053
Correction Value (C)	0,925	
Degrees of Freedom (df)	24	
t-value	1,846 ($t_0 = 2,063$)	

Table E.5.: Branches

Social		
f-value	3,061 ($f_0 = 2,15$)	
Mean (x | y)	178,591	87,400
Variance ($S_x^2 \mid S_y^2$)	9084,920	2968,253
Correction Value (C)	0,736	
Degrees of Freedom (df)	34	
t-value	3,849 ($t_0 = 2,032$)	
Spatial		
f-value	1,960 ($f_0 = 2,15$)	
Mean (x | y)	85,773	69,950
Variance ($S_x^2 \mid S_y^2$)	1887,517	963,103
Standard Deviation (S_p)	38,058	
Degrees of Freedom (df)	40	
t-value	1,346 ($t_0 = 2,021$)	
Temporal		
f-value	1,110 ($f_0 = 2,15$)	
Mean (x | y)	95,955	75,200
Variance ($S_x^2 \mid S_y^2$)	3130,998	3474,274
Standard Deviation (S_p)	57,394	
Degrees of Freedom (df)	40	
t-value	1,170 ($t_0 = 2,021$)	
Hypothetical		
f-value	2,408 ($f_0 = 2,15$)	
Mean (x | y)	100,636	63,500
Variance ($S_x^2 \mid S_y^2$)	7773,671	3228,474
Correction Value (C)	0,686	
Degrees of Freedom (df)	36	
t-value	1,637 ($t_0 = 2,028$)	

Table E.6.: Steps

Social		
f-value	1,478 ($f_0 = 2, 15$)	
Mean (x | y)	501,227	353,550
Variance ($S_x^2 \mid S_y^2$)	36311,898	24571,313
Standard Deviation (S_p)	175,314	
Degrees of Freedom (df)	40	
t-value	2,726 ($t_0 = 2, 021$)	
Spatial		
f-value	1,715 ($f_0 = 2, 15$)	
Mean (x | y)	322,545	311,550
Variance ($S_x^2 \mid S_y^2$)	15352,831	26327,629
Standard Deviation (S_p)	143,408	
Degrees of Freedom (df)	40	
t-value	0,248 ($t_0 = 2, 021$)	
Temporal		
f-value	1,413 ($f_0 = 2, 15$)	
Mean (x | y)	382,045	266,300
Variance ($S_x^2 \mid S_y^2$)	28946,712	20488,116
Standard Deviation (S_p)	157,889	
Degrees of Freedom (df)	40	
t-value	2,373 ($t_0 = 2, 021$)	
Hypothetical		
f-value	1,492 ($f_0 = 2, 15$)	
Mean (x | y)	418,727	293,950
Variance ($S_x^2 \mid S_y^2$)	29356,398	19676,471
Standard Deviation (S_p)	157,348	
Degrees of Freedom (df)	40	
t-value	2,567 ($t_0 = 2, 021$)	

Table E.7.: Duration

Social		
f-value	2,202 ($f_0 = 2, 15$)	
Mean (x | y)	3,500	2,200
Variance ($S_x^2 \mid S_y^2$)	6,167	2,800
Correction Value (C)	0,667	
Degrees of Freedom (df)	37	
t-value	2,005 ($t_0 = 2, 026$)	
Spatial		
f-value	4,024 ($f_0 = 2, 15$)	
Mean (x | y)	2,227	1,350
Variance ($S_x^2 \mid S_y^2$)	6,470	1,608
Correction Value (C)	0,785	
Degrees of Freedom (df)	31	
t-value	1,434 ($t_0 = 2, 039$)	
Temporal		
f-value	1,688 ($f_0 = 2, 15$)	
Mean (x | y)	1455	1,100
Variance ($S_x^2 \mid S_y^2$)	4,069	2,411
Standard Deviation (S_p)	1,811	
Degrees of Freedom (df)	40	
t-value	0,633 ($t_0 = 2, 021$)	
Hypothetical		
f-value	2,159 ($f_0 = 2, 15$)	
Mean (x | y)	1,273	0,750
Variance ($S_x^2 \mid S_y^2$)	2,017	0,934
Correction Value (C)	0,663	
Degrees of Freedom (df)	37	
t-value	1,405 ($t_0 = 2, 026$)	

Table E.8.: Syntax Rule Violation

Social		
f-value	4,155 ($f_0 = 2, 15$)	
Mean (x | y)	2,409	1,350
Variance (S_x^2 | S_y^2)	0,539	2,239
Correction Value (C)	0,180	
Degrees of Freedom (df)	27	
t-value	2,867 ($t_0 = 2, 051$)	
Spatial		
f-value	1,409 ($f_0 = 2, 15$)	
Mean (x | y)	2,136	1,950
Variance (S_x^2 | S_y^2)	0,409	0,576
Standard Deviation (S_p)	0,699	
Degrees of Freedom (df)	40	
t-value	0,863 ($t_0 = 2, 021$)	
Temporal		
f-value	1,210 ($f_0 = 2, 15$)	
Mean (x | y)	2,045	1,900
Variance (S_x^2 | S_y^2)	0,426	0,516
Standard Deviation (S_p)	0,685	
Degrees of Freedom (df)	40	
t-value	0,688 ($t_0 = 2, 021$)	
Hypothetical		
f-value	4,252 ($f_0 = 2, 15$)	
Mean (x | y)	2,227	2,050
Variance (S_x^2 | S_y^2)	0,660	0,155
Correction Value (C)	0,794	
Degrees of Freedom (df)	31	
t-value	0,912 ($t_0 = 2, 039$)	

Table E.9.: Correctness

Social		
f-value	4,207 ($f_0 = 2, 15$)	
Mean (x | y)	2,500	1,350
Variance ($S_x^2 \mid S_y^2$)	0,357	1,503
Correction Value (C)	0,178	
Degrees of Freedom (df)	27	
t-value	3,805 ($t_0 = 2, 051$)	
Spatial		
f-value	2,363 ($f_0 = 2, 15$)	
Mean (x | y)	1,773	1,700
Variance ($S_x^2 \mid S_y^2$)	1,517	0,642
Correction Value (C)	0,682	
Degrees of Freedom (df)	36	
t-value	0,229 ($t_0 = 2, 028$)	
Temporal		
f-value	1,342 ($f_0 = 2, 15$)	
Mean (x | y)	1,773	1,350
Variance ($S_x^2 \mid S_y^2$)	1,041	1,397
Standard Deviation (S_p)	1,100	
Degrees of Freedom (df)	40	
t-value	1,244 ($t_0 = 2, 021$)	
Hypothetical		
f-value	1,107 ($f_0 = 2, 15$)	
Mean (x | y)	2,045	1,950
Variance ($S_x^2 \mid S_y^2$)	0,522	0,417
Standard Deviation (S_p)	0,705	
Degrees of Freedom (df)	40	
t-value	0,438 ($t_0 = 2, 021$)	

Table E.10.: Relevance

Social		
f-value	1,006 ($f_0 = 2, 15$)	
Mean (x | y)	1,409	-0,950
Variance ($S_x^2 \mid S_y^2$)	2,063	2,050
Standard Deviation (S_p)	1,434	
Degrees of Freedom (df)	40	
t-value	5,324 ($t_0 = 2, 021$)	
Spatial		
f-value	1,032 ($f_0 = 2, 15$)	
Mean (x | y)	0,864	0,350
Variance ($S_x^2 \mid S_y^2$)	1,457	1,503
Standard Deviation (S_p)	1,216	
Degrees of Freedom (df)	40	
t-value	1,367 ($t_0 = 2, 021$)	
Temporal		
f-value	1,157 ($f_0 = 2, 15$)	
Mean (x | y)	1,000	-0,400
Variance ($S_x^2 \mid S_y^2$)	2,857	3,305
Standard Deviation (S_p)	1,752	
Degrees of Freedom (df)	40	
t-value	2,586 ($t_0 = 2, 021$)	
Hypothetical		
f-value	1,554 ($f_0 = 2, 15$)	
Mean (x | y)	1,318	0,050
Variance ($S_x^2 \mid S_y^2$)	2,132	3,313
Standard Deviation (S_p)	1,641	
Degrees of Freedom (df)	40	
t-value	2,501 ($t_0 = 2, 021$)	

Table E.11.: Completeness

Social		
f-value	3,360 ($f_0 = 2,15$)	
Mean (x | y)	2,045	0,150
Variance ($S_x^2 \mid S_y^2$)	0,617	2,239
Correction Value (C)	0,200	
Degrees of Freedom (df)	28	
t-value	5,066 ($t_0 = 2,048$)	
Spatial		
f-value	1,578 ($f_0 = 2,15$)	
Mean (x | y)	1,045	1,050
Variance ($S_x^2 \mid S_y^2$)	2,903	1,839
Standard Deviation (S_p)	1,548	
Degrees of Freedom (df)	40	
t-value	0,010 ($t_0 = 2,021$)	
Temporal		
f-value	1,134 ($f_0 = 2,15$)	
Mean (x | y)	1,364	0,150
Variance ($S_x^2 \mid S_y^2$)	2,719	3,082
Standard Deviation (S_p)	1,700	
Degrees of Freedom (df)	40	
t-value	2,310 ($t_0 = 2,021$)	
Hypothetical		
f-value	1,751 ($f_0 = 2,15$)	
Mean (x | y)	1,318	0,550
Variance ($S_x^2 \mid S_y^2$)	2,719	3,082
Standard Deviation (S_p)	1,701	
Degrees of Freedom (df)	40	
t-value	1,462 ($t_0 = 2,021$)	

Table E.12.: Authenticity

Social		
f-value	1,590 ($f_0 = 2,15$)	
Mean (x | y)	1,364	1,850
Variance (S_x^2 | S_y^2)	1,385	0,871
Standard Deviation (S_p)	1,068	
Degrees of Freedom (df)	40	
t-value	1,474 ($t_0 = 2,021$)	
Spatial		
f-value	2,951 ($f_0 = 2,15$)	
Mean (x | y)	1,455	2,150
Variance (S_x^2 | S_y^2)	2,260	0,766
Correction Value (C)	0,728	
Degrees of Freedom (df)	34	
t-value	1,852 ($t_0 = 2,032$)	
Temporal		
f-value	1,329 ($f_0 = 2,15$)	
Mean (x | y)	1,545	1,900
Variance (S_x^2 | S_y^2)	1,022	1,358
Standard Deviation (S_p)	1,087	
Degrees of Freedom (df)	40	
t-value	1,056 ($t_0 = 2,021$)	
Hypothetical		
f-value	1,809 ($f_0 = 2,15$)	
Mean (x | y)	1,364	2,150
Variance (S_x^2 | S_y^2)	2,719	1,503
Standard Deviation (S_p)	1,463	
Degrees of Freedom (df)	40	
t-value	1,739 ($t_0 = 2,021$)	

Table E.13.: Understandable

Social		
f-value	1,152 ($f_0 = 2, 15$)	
Mean (x | y)	1,591	1,250
Variance ($S_x^2 \mid S_y^2$)	0,348	0,303
Standard Deviation (S_p)	0,572	
Degrees of Freedom (df)	40	
t-value	1,930 ($t_0 = 2, 021$)	
Spatial		
f-value	1,036 ($f_0 = 2, 15$)	
Mean (x | y)	1,727	1,650
Variance ($S_x^2 \mid S_y^2$)	0,684	0,661
Standard Deviation (S_p)	0,820	
Degrees of Freedom (df)	40	
t-value	0,305 ($t_0 = 2, 021$)	
Temporal		
f-value	1,535 ($f_0 = 2, 15$)	
Mean (x | y)	2,182	1,500
Variance ($S_x^2 \mid S_y^2$)	0,727	0,474
Standard Deviation (S_p)	0,779	
Degrees of Freedom (df)	40	
t-value	2,833 ($t_0 = 2, 021$)	
Hypothetical		
f-value	1,444 ($f_0 = 2, 15$)	
Mean (x | y)	2,429	2,100
Variance ($S_x^2 \mid S_y^2$)	0,357	0,516
Standard Deviation (S_p)	0,659	
Degrees of Freedom (df)	40	
t-value	1,596 ($t_0 = 2, 021$)	

Table E.14.: Naming

Social		
f-value	1,368 ($f_0 = 2, 15$)	
Mean (x | y)	-1,000	-1,100
Variance (S_x^2 | S_y^2)	0,762	1,042
Standard Deviation (S_p)	0,946	
Degrees of Freedom (df)	40	
t-value	0,342 ($t_0 = 2, 021$)	
Spatial		
f-value	2,478 ($f_0 = 2, 15$)	
Mean (x | y)	-0,591	-0,700
Variance (S_x^2 | S_y^2)	2,634	1,063
Correction Value (C)	0,693	
Degrees of Freedom (df)	36	
t-value	0,262 ($t_0 = 2, 028$)	
Temporal		
f-value	1,212 ($f_0 = 2, 15$)	
Mean (x | y)	-0,591	-0,650
Variance (S_x^2 | S_y^2)	1,587	1,924
Standard Deviation (S_p)	1,322	
Degrees of Freedom (df)	40	
t-value	0,145 ($t_0 = 2, 021$)	
Hypothetical		
f-value	2,480 ($f_0 = 2, 15$)	
Mean (x | y)	-0,182	-0,200
Variance (S_x^2 | S_y^2)	1,299	3,221
Correction Value (C)	0,268	
Degrees of Freedom (df)	32	
t-value	0,039 ($t_0 = 2, 036$)	

Table E.15.: Mental Effort

Social		
f-value	1,434 ($f_0 = 2, 15$)	
Mean (x | y)	0,864	0,350
Variance ($S_x^2 \mid S_y^2$)	0,314	0,450
Standard Deviation (S_p)	0,615	
Degrees of Freedom (df)	40	
t-value	2,702 ($t_0 = 2, 021$)	
Spatial		
f-value	1,576 ($f_0 = 2, 15$)	
Mean (x | y)	0,727	0,600
Variance ($S_x^2 \mid S_y^2$)	0,398	0,253
Standard Deviation (S_p)	0,574	
Degrees of Freedom (df)	40	
t-value	0,718 ($t_0 = 2, 021$)	
Temporal		
f-value	2,720 ($f_0 = 2, 15$)	
Mean (x | y)	0,818	0,750
Variance ($S_x^2 \mid S_y^2$)	0,537	0,197
Correction Value (C)	0,712	
Degrees of Freedom (df)	35	
t-value	0,368 ($t_0 = 2, 030$)	
Hypothetical		
f-value	1,018 ($f_0 = 2, 15$)	
Mean (x | y)	0,455	0,350
Variance ($S_x^2 \mid S_y^2$)	0,545	0,555
Standard Deviation (S_p)	0,742	
Degrees of Freedom (df)	40	
t-value	0,456 ($t_0 = 2, 021$)	

Table E.16.: Agreement

Social		
f-value	1,285 ($f_0 = 2,15$)	
Mean (x | y)	-0,182	0,100
Variance (S_x^2 | S_y^2)	1,203	0,937
Standard Deviation (S_p)	1,038	
Degrees of Freedom (df)	40	
t-value	0,879 ($t_0 = 2,021$)	
Spatial		
f-value	1,238 ($f_0 = 2,15$)	
Mean (x | y)	-0,136	-0,200
Variance (S_x^2 | S_y^2)	0,600	0,484
Standard Deviation (S_p)	0,738	
Degrees of Freedom (df)	40	
t-value	0,279 ($t_0 = 2,021$)	
Temporal		
f-value	2,771 ($f_0 = 2,15$)	
Mean (x | y)	-0,045	-0,600
Variance (S_x^2 | S_y^2)	1,284	0,463
Correction Value (C)	0,716	
Degrees of Freedom (df)	35	
t-value	1,942 ($t_0 = 2,030$)	
Hypothetical		
f-value	2,016 ($f_0 = 2,15$)	
Mean (x | y)	-0,091	0,200
Variance (S_x^2 | S_y^2)	0,658	1,326
Standard Deviation (S_p)	0,988	
Degrees of Freedom (df)	40	
t-value	0,953 ($t_0 = 2,021$)	

Table E.17.: Missing Aspects

Social		
f-value	1,317 ($f_0 = 2, 15$)	
Mean (x | y)	0,773	0,250
Variance ($S_x^2 \mid S_y^2$)	0,470	0,618
Standard Deviation (S_p)	0,735	
Degrees of Freedom (df)	40	
t-value	2,302 ($t_0 = 2, 021$)	
Spatial		
f-value	1,210 ($f_0 = 2, 15$)	
Mean (x | y)	0,636	0,400
Variance ($S_x^2 \mid S_y^2$)	0,433	0,358
Standard Deviation (S_p)	0,630	
Degrees of Freedom (df)	40	
t-value	1,214 ($t_0 = 2, 021$)	
Temporal		
f-value	3,046 ($f_0 = 2, 15$)	
Mean (x | y)	0,409	0,650
Variance ($S_x^2 \mid S_y^2$)	0,729	0,239
Correction Value (C)	0,735	
Degrees of Freedom (df)	34	
t-value	1,134 ($t_0 = 2, 032$)	
Hypothetical		
f-value	1,202 ($f_0 = 2, 15$)	
Mean (x | y)	0,227	0,050
Variance ($S_x^2 \mid S_y^2$)	0,946	0,787
Standard Deviation (S_p)	0,933	
Degrees of Freedom (df)	40	
t-value	0,615 ($t_0 = 2, 021$)	

Table E.18.: Accurate Description

Social		
f-value	4,131 ($f_0 = 2, 15$)	
Mean (x | y)	-1,000	-0,450
Variance ($S_x^2 \mid S_y^2$)	0,190	0,787
Correction Value (C)	0,180	
Degrees of Freedom (df)	27	
t-value	2,510 ($t_0 = 2, 051$)	
Spatial		
f-value	1,193 ($f_0 = 2, 15$)	
Mean (x | y)	-0,818	-0,650
Variance ($S_x^2 \mid S_y^2$)	0,537	0,450
Standard Deviation (S_p)	0,704	
Degrees of Freedom (df)	40	
t-value	0,733 ($t_0 = 2, 021$)	
Temporal		
f-value	1,664 ($f_0 = 2, 15$)	
Mean (x | y)	-0,818	-0,550
Variance ($S_x^2 \mid S_y^2$)	0,346	0,576
Standard Deviation (S_p)	0,675	
Degrees of Freedom (df)	40	
t-value	1,286 ($t_0 = 2, 021$)	
Hypothetical		
f-value	1,439 ($f_0 = 2, 15$)	
Mean (x | y)	-0,500	-0,500
Variance ($S_x^2 \mid S_y^2$)	0,833	0,579
Standard Deviation (S_p)	0,844	
Degrees of Freedom (df)	40	
t-value	0,000 ($t_0 = 2, 021$)	

Table E.19.: Mistakes

Social		
f-value	1,294 ($f_0 = 2, 15$)	
Mean (x | y)	-0,455	0,100
Variance ($S_x^2 \mid S_y^2$)	1,212	0,937
Standard Deviation (S_p)	1,040	
Degrees of Freedom (df)	40	
t-value	1,726 ($t_0 = 2, 021$)	
Spatial		
f-value	1,249 ($f_0 = 2, 15$)	
Mean (x | y)	-0,318	0,050
Variance ($S_x^2 \mid S_y^2$)	0,799	0,997
Standard Deviation (S_p)	0,945	
Degrees of Freedom (df)	40	
t-value	1,261 ($t_0 = 2, 021$)	
Temporal		
f-value	1,851 ($f_0 = 2, 15$)	
Mean (x | y)	-0,136	-0,050
Variance ($S_x^2 \mid S_y^2$)	1,457	0,757
Standard Deviation (S_p)	1,067	
Degrees of Freedom (df)	40	
t-value	0,262 ($t_0 = 2, 021$)	
Hypothetical		
f-value	1,446 ($f_0 = 2, 15$)	
Mean (x | y)	0,318	0,100
Variance ($S_x^2 \mid S_y^2$)	1,084	1,568
Standard Deviation (S_p)	1,146	
Degrees of Freedom (df)	40	
t-value	0,616 ($t_0 = 2, 021$)	

Table E.20.: Result Satisfaction

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Bibliography

[1] *Business Process Model and Notation*. http://www.bpmn.org/. – 20.10.2012

[2] *A Guide to Basic Steps of Science*. http://explorable.com/. – 20.10.2012

[3] BASILI, Victor ; CALDIERA, Gianluigi ; ROMBACH, Dieter: The Goal Question Metric Approach. In: *Encyclopedia of Software Engineering* (1994), S. 528–532

[4] BURRIS, Christopher ; BRANSCOMBE, Nyla: Distorted Distance Estimation Induced by a Self-Relevant National Boundary. In: *Journal of Experimental Social Psychology* 41 (2005), S. 305–312

[5] DAY, Samuel ; BARTELS, Daniel: Representation Over Time: The Effects of Temporal Distance on Similarity. In: *Cognition* 106 (2008), S. 1504–1513

[6] FUJITA, Kentaro ; HENDERSON, Marlone ; ENG, Juliana ; TROPE, Yaacov ; LIBERMAN, Nira: Spatial Distance and Mental Construal of Social Events. In: *Psychological Science* 17 (2006), S. 278–282

[7] HÖST, Martin ; REGNELL, Björn ; WOHLIN, Claes: Using Students as Subjects — A Comparative Study of Students and Professionals in Lead-Time Impact Assessment. In: *Empirical Software Engineering* 5 (2000), S. 201–214

[8] KELLEY, Michael ; DONNELLY, Robert: *The Humongous Book of Statistics Problems*. Bd. 2. ALPHA, 2009

[9] KROGSTIE, John ; LINDLAND, Odd ; SINDRE, Guttorm: Towards a Deeper Understanding of Quality in Requirements Engineering. In: *Lecture Notes in Computer Science* 932, S. 82–95

[10] LIBERMAN, Nira ; SAGRISTANO, Michael ; TROPE, Yaacov: The Effect of Temporal Distance on Level of Mental Construal. In: *Journal of Experimental Social Psychology* 38 (2002), S. 523–534

[11] LIBERMAN, Nira ; TROPE, Yaacov ; STEPHAN, Elena: Psychological Distance. In: *Social Psychology: Handbook of Basic Principles* 2 (2007), S. 353–381

[12] LINDLAND, Odd ; SINDRE, Guttorm ; SOLVBERG, Arne: Understanding Quality in Conceptual Modeling. In: *IEEE Software* 11 (1994), S. 42–49

[13] MARASCUILO, Leonard ; SERLIN, Ronald: Statistical Methods for the Social and Behavioral Sciences. In: *Journal of Educational Statistics* 15 (1990), S. 72–77

[14] MCGILL, Robert ; TUKEY, John ; LARSEN, Wayne: Variations of Box Plots. In: *The American Statisitician* 32 (1978), S. 12–16

[15] NEIL, Macrae ; BODENHAUSEN, Galen ; MILNE, Alan ; JETTEN, Jolanda: Out of Mind but Back in Sight: Stereotypes on the Rebound. In: *Journal of Personality and Social Psychology* 67 (1994), S. 808–817

[16] PINGERRA, Jakob ; ZUGAL, Stefan ; WEBER, Barbara: Investigating the Process of Process Modeling with Cheeath Experimental Platform. In: *Proc. ER-POIS 10* (2010), S. 13–18

[17] PRONIN, Emily ; OLIVIOLA, Christopher ; KENNEDY, Kathleen: Doing unto Future Selves as you would do unto Others: Psychological Distance and Decision Making. In: *Personality and Social Psychology Bulletin* 34 (2008), S. 224–236

[18] RITTGEN, Peter: Collaborative Modeling of Business Processes - A Comparative Case Study. In: *Proc. ACM SAC 2009* (2009), S. 225–230

[19] SAWILOWSKY, Shlomo: Nonparametric Tests of Interaction in Experimental Design. In: *Review of Educational Research* 60 (1990), S. 91–125

[20] SIRKIN, Mark: *Statistics for the Social Sciences*. Bd. 7. Sage Publications, 2005

[21] TODOROV, Alexander ; GOREN, Amir ; TROPE, Yaacov: Probability as a Psychological Distance: Construal and Preferences. In: *Journal of Experimental Social Psychology* 43 (2007), S. 473–482

[22] TODOROV, Alexander ; GOREN, Amir ; TROPE, Yaacov: Probability as a Psychological Distance: Construal and Preferences. In: *Journal of Experimental Social Psychology* 43 (2007), S. 473–482

[23] TROPE, Yaacov ; LIBERMAN, Nira: Construal-Level Theory of Psychological Distance. In: *Psychological Review* 117 (2010), S. 440–463

[24] TROPE, Yaacov ; LIBERMAN, Nira ; WAKSLAK, Cheryl: Construal Levels and Psychological Distance: Effects on Representation, Prediction, Evaluation, and Behavior. In: *Journal of Consumer Psychology* 17 (2007), S. 83–95

[25] UTTS, Jessica: *Seeing Through Statistics*. Bd. 2. Duxbury Press, 1999

[26] WELPE, Isabell ; ANDRANIK, Tumasjan ; STROBEL, Maria: Construal Level Theory - A Theory for the Boundaryless Organization? In: *Zeitschrift für betriebswirtschaftliche Forschung* 5 (2010), S. 84–105

[27] WOHLIN, Claes ; RUNESON, Per ; HÖST, M. ; OHLSSON, Magnus C. ; REGNELL, Björn ; WESSLEN, Anders: *Experimentation in Software Engineering - An Introduction*. Kluwer Academic Publishers, 2000

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Erklärung

Ich erkläre, dass ich die Arbeit selbstständig verfasst und keine anderen als die angegebenen Quellen und Hilfsmittel verwendet habe.

Ulm, den .....

Michael Zimoch