

CHALMERS



Product Sound Quality and Sensory Evaluation

An Approach to Assessor Selection and a Comparative Study of Panels

Master's Thesis in the Master's programme in Sound and Vibration

JONAS WALLGREN

Department of Civil and Environmental Engineering

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Room Acoustics Group

CHALMERS UNIVERSITY OF TECHNOLOGY

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ABSTRACT

It is an increasing interest in product sound quality (PSQ) within the industry. A new product should not only have low noise in order to fulfil laws and regulations, it should also have the “right” sound in order to be more appealing to the customer.

Research has been conducted in the area of PSQ at *Chalmers University of Technology* (CTH) for a number of years. In this work a panel of selected listeners have been established, which is used to evaluate various subjective aspects of the experience of sound. The group consists mainly of students in the field of technology.

At *SIK – the Swedish Institute for Food and Biotechnology* (SIK) analytical sensory panels have been used since the middle of the 20th century in both research and commercial projects for the evaluation of sensory properties such as taste, aroma and texture. The current panel consists of selected and trained persons specialized in this area. However, it has not previously been used for listening tests.

In this study a selection method for assessor candidates to PSQ sensory panels have been created. The method focuses on the discrimination of sounds due to different psychoacoustic variables, e.g. loudness, roughness, sharpness. The method has then been applied to the analytical sensory panel at *SIK* and the *CTH* panel in order to validate it as well as to see if any differences between the two panels could be detected.

The results obtained by the selection method show only small differences between the two panels. However, there were quite large variations among the assessors’ individual discrimination skills.

Keywords: Sound Quality, Sound Character, Psychoacoustics, Sensory Evaluation, Perceptual Evaluation, Jury Testing, Assessor Selection

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1 Introduction

1.1 Background

A specific product sound is a fundamental and desirable feature of a new product and customer surveys has shown that the acoustic properties of a product are an important factor. It determines the image of a product, profiles a product against competitors, influences the customer's satisfaction with a product, and the customer's decision on selecting and buying a product. As a consequence the industry shows an increasing interest in product sound quality (PSQ) since it can be an efficient way to strengthen their market position and to achieve an advantage over competitors [1].

A new product should not only have low noise in order to fulfil the legal regulations, it should also have the "right" sound for the product in question. Sound that is unwanted is normally classified as noise and when designing products the noise should be as low as possible in order to reduce the negative effects of sound. However, sound can also be an important carrier of information. The sound from a machine for example can inform the user if there is something wrong with it, or give information on when it is time for maintenance.

To provide for the increased interest in PSQ many organizations have started research programs in order to understand how sound and its perceived qualities affect humans in their daily life. The ultimate aim for researchers in this field is to eliminate the listening tests used today and replace them with predictive models that can accurately estimate the human perception of sound. However, no such model has been successfully established and therefore listening tests are still an essential part of PSQ evaluation [2].

For instance, research has been conducted in the sound quality area for a number of years at the *Chalmers University of Technology* (CTH) where a research group is focusing on various aspects on PSQ. In this work a listening panel has been established, which is used to evaluate various subjective aspects of the experience of sound. The listening panel at *CTH* consists mainly of students in the field of technology, which means that the panel might not be representative for the population as a whole.

At *SIK the Swedish Institute for Food and Biotechnology* (SIK), a subsidiary to *SP Technical Research Institute of Sweden*, sensory panels for the evaluation of e.g. taste, aroma and texture have been used since the middle of the 20th century in both research and commercial projects. These panels consist of either trained persons specialized in the area (i.e. analytical sensory panel), or representative consumers statistically selected with respect to the product of interest (i.e. consumer sensory panel). However, none of these panels have been used for listening tests before.

1.2 Objective

The main objective of this master thesis work was to investigate whether the existing analytical sensory panel at *SIK*, which today mainly is used for the evaluation of taste, aroma and texture also could be used in the evaluation of product sounds.

2 Theory

2.1 Product Sounds

Most products emit sounds in one way or another and this is not merely a negative attribute to be reduced or eliminated. Often those sounds can either be intended to give the user information or just a consequence of the product operating/running. Either way, it is an attribute that can be used for positive product presentation [3].

Some parts of the sounds produced may be expected and is likely to be accepted as characteristics of the product unless they are too loud. They let us know what is happening in the product and may reinforce our sense of product quality. Sound may also be a product identifier. If a new product comes along that sounds very different from similar existing products there may be a problem with the acceptance since the consumers expect that products of a certain type will sound in a certain way. Furthermore, some sounds are uncharacteristic of the product and the user will not regard such a sound in the same light as the characteristic sounds. Such a sound might be the result of a problem that will lead to the failure of the product and the user will have concerns about using such a product. Even if somehow the user becomes convinced that breakdown or danger is not imminent, the sound will be attention grabbing and make the user unsatisfied with the product. This means it is not the loudness of uncharacteristic sounds that is the problem, it is their presence that is the problem and they should be eliminated or made undetectable.

The acceptability and desirability of a product are affected by attributes that generally fall into three different categories, *Resource Commitment*, *Functionality* and *Aesthetics*, as seen in Figure 2.1. Within each category there is a set of attributes or features that may or may not be of importance for the product in question. The sound generated by a product is part both of *Functionality* and *Aesthetics* [3, 4].

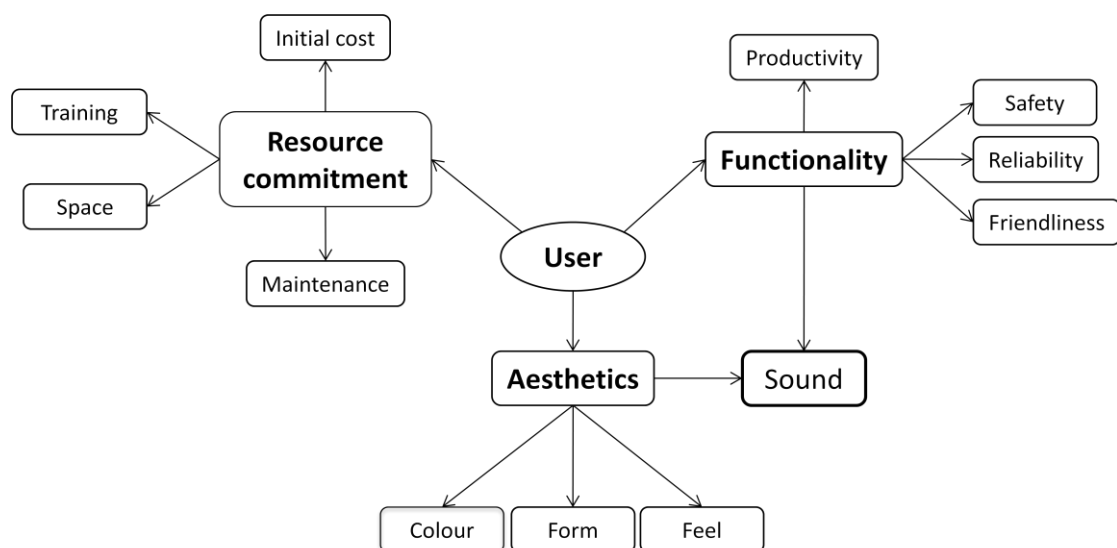


Figure 2.1 The connections between different product attributes [3].

Depending on their nature the emitted sounds can roughly be categorized into three different groups, *passive*, *running/operating* or *signal sounds*.

Passive sounds are produced when the product is touched but not operating (e.g. doors open/close, etc.). These sounds are very important because they affect the costumers purchase decision and the immediate image of the product.

Running/operating sounds are produced when the product is running or operating and are not aimed at providing the user with any specific information. However, sometimes the running/operation sounds will provide information (e.g. when a motor needs maintenance etc.). The running/operating sounds affect the comfort and the reliability of the product.

Signal sounds are produced when the product is running or operating and are aimed at providing the user with information. It can for example be the beep from the microwave oven when done etc [4].

2.1.1 Product Sound Quality and Product Sound Character

The quality of a product's emitted sounds is often defined in line with the following definition proposed by J. Blauert and U. Jekosch:

“Product-sound quality is a descriptor of the adequacy of the sound attached to a product. It results from judgements upon the totality of auditory characteristics of the said sound – the judgements being performed with reference to the set of those desired features of the product which are apparent to the users in their actual cognitive, actional and emotional situation.”[5]

This definition states that sound quality is a percept, and as a consequence has both subjective and objective parts. The percept is product specific and relates to the appropriateness and acceptance of a sound in a certain situation for a certain product, this in turn implies a scale for sound quality in which listeners can make consistent judgements, which may then be incorporated into a physical scale for the component sounds for that product [3, 6, 7].

However the general term *sound quality* is often insufficiently defined and used ambiguously. Because of this it is not always understood properly [7]. Therefore a major distinction is done in this work between the quality and character of product sounds, hence *product sound quality* (PSQ) and *product sound character* (PSC) [6].

PSQ refers to the subjective opinions, i.e. preference or good/bad judgements. Such judgements are highly dependent on individual factors such as taste differences, situational factors such as expectations, and non-auditory input such as visual influences and vibration [6].

PSC refers to the sensory properties of a sound, i.e. how loud, rough, sharp etc. it is. Those properties are invariant across individuals, cultures and situations and therefore a fairly reliable perceptual estimate [6]. Many of the psychoacoustic metrics described in *Chapter 2.1.2* are measures of PSC.

The relationship between PSQ and PSC is shown in Figure 2.2 together with their individual constituents.

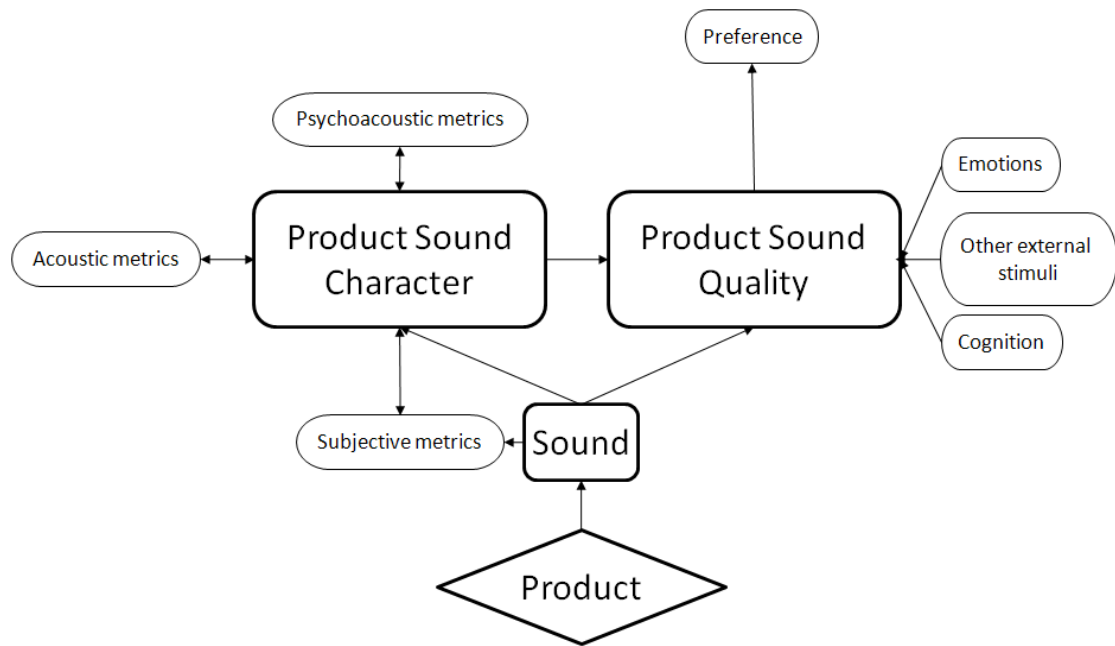


Figure 2.2 The relationship between PSQ, PSC and their constituents [6].

2.1.2 Psychoacoustics

Psychoacoustics is the science where parameters of acoustic waves are related to attributes of auditory events. It thus investigates the relation between people's reactions to sounds to the physical stimulus that causes the sound (i.e. pressure fluctuations in the air). The perceptual reaction to a sound is internal to the subject and psychoacoustics relates the perception to an objective internal scale and then to external objective physical metrics of sound [1, 3, 5].

A basic problem concerning the psychoacoustic indices is their validity. The relation between the indices and the physical sound has been derived from listening tests using specific sounds, and in general the resulting index can only be applied to the same type of sounds. Another issue present is that they are defined as monaural indices, which mean that they are calculated for each ear independently. In contrast the human auditory system combines signals from both ears, and therefore the binaural indices might differ from the monaural. As consequence psychoacoustic applications can be helpful, but only if the user has the right psychoacoustic experience and expertise [1].

In most cases the psychoacoustic metrics are poor indicators of PSQ but fairly good measures of PSC and therefore they play an important role in sound quality engineering [6, 8].

Loudness

Loudness is categorized as an intensity sensation and strongly affects the perceived PSQ [8, 9].

It is the only psychoacoustic metric that has been standardized so far and there are two major definitions commonly in use, established by Stevens and Zwicker respectively. Both definitions share the explanation of loudness as the attribute of a sound that can

be ordered on a scale extending from quiet to loud. The standardized definitions can be found in *ISO 532 A* and *ISO 532 B* [2, 3, 10].

The basic unit of perceived loudness is *sone*, which is defined as the loudness of a 40 dB 1 kHz tone. In order to compensate for the effect of frequency on the perceived loudness it is also expressed in *loudness level* measured in *phons*. Loudness level is given by the sound pressure level of a tone at 1 kHz, which is equally loud to the tone being presented. The relation between loudness level and loudness is determined at 1 kHz [3].

Loudness cannot be measured directly since it is a perceptual quantity, although it can be estimated through listening tests or through the use of models developed to predict its subjective impression. The loudness level is frequency dependent and can be estimated for any sound, but best known are the loudness levels for different frequencies of pure tones. Lines which connect points of equal loudness in the hearing area are often called equal-loudness contours, see Figure 2.3 [2, 9].

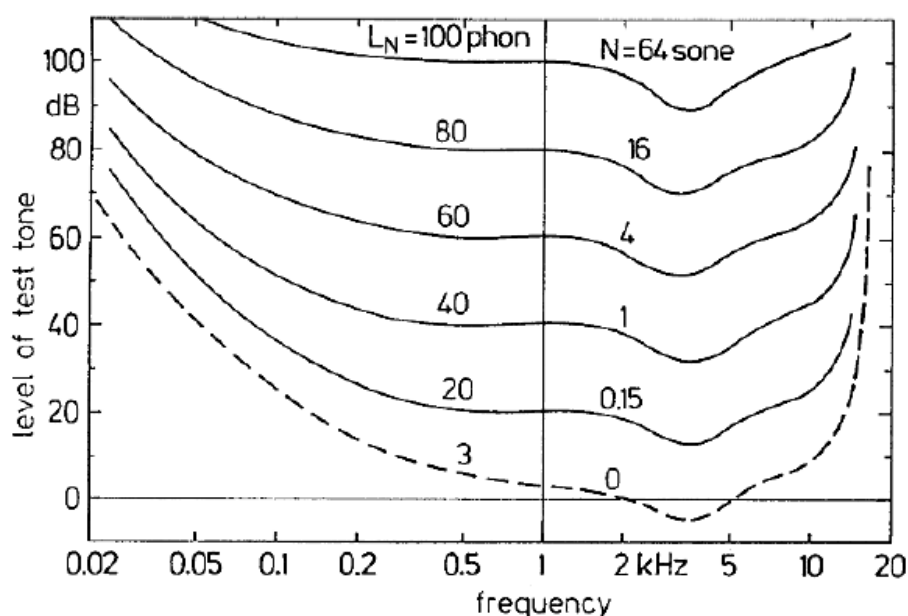


Figure 2.3 Equal-loudness contours [9].

Fluctuation Strength and Roughness

When listening to a 100% amplitude-modulated tone the listener will experience three different sensations as the modulation frequency increases, see Figure 2.4. At low modulation frequencies, from 1 to around 20 Hz, the loudness intensity changes up and down and the listener experiences a loudness fluctuation. This sensation is known as *fluctuation strength*. The maximum perceived fluctuation strength arises at approximately 4 Hz [8, 9, 11].

The unit for fluctuation strength is *vacil*. One vacil is defined as a 60 dB, 1 kHz tone that is 100% amplitude-modulated at 4 Hz [9].

When the modulation frequency reaches about 15 Hz the perceived loudness fluctuations start to disappear and instead the sound is perceived as rough, this is the

sensation of *roughness*. It reaches its perceived maximum at around 70 Hz and the upper limit is located at about 300 Hz. As the modulation frequency is increased even higher the listener starts to hear separate pure tones without any effects due to the amplitude modulation [9-11].

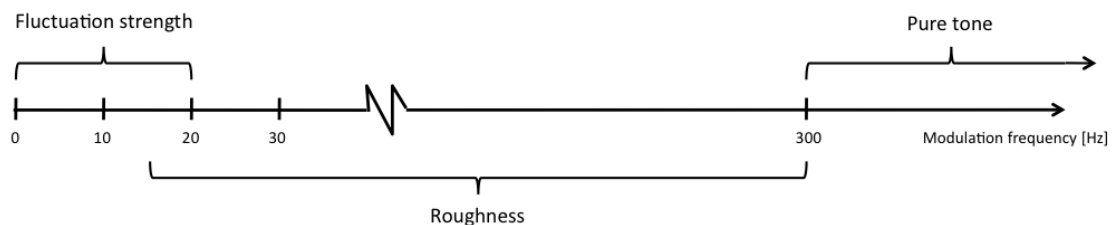


Figure 2.4 The relationship between fluctuation strength and roughness with respect to the modulation frequency.

The unit of roughness is *asper*. One asper is defined as the roughness produced by a 1 kHz tone of 60dB which is 100% amplitude modulated at 70Hz [9].

Sharpness

Sharpness describes the high frequency components of a sound and plays a prominent role for the perceived sound quality. A sound that contains mainly low frequencies will feel dull and if it contain mainly high frequencies it will feel sharp. If the right amount of sharpness is given it will give the product a character of powerfulness. However, if the sound is too sharp it will be perceived as aggressive [8, 10, 12, 13].

The unit for sharpness is acum. One acum is defined as a narrow-band noise one critical-band wide at a centre frequency of 1 kHz having a level of 60 dB [9].

Tonality

Tonality describes the tonal character, i.e. the “tone-to-noise” ratio, of a signal. There exist several models for tonality. However, the perceived tonality varies among individuals. Therefore it is suggested that tonality should be subjectively assessed [10].

Additional and Composite Metrics

In addition to the psychoacoustic metrics discussed, a number of additional quantities have been suggested in the literature. Specific sound quality indices for specific applications seem to be more reasonable than the basic metrics. Those indices might consist of a weighted combination of standard signal analysis indices, psychoacoustic indices, or even newly developed specific indices. It can be expected that some of these types of indices have been developed, but are not published and kept confidential due to have an advantage on the competitive market [1, 10].

Examples of additional and composite metrics are: Sensory pleasantness, impulsiveness, rumble noise, subjective duration and rhythm [10].

2.2 Sensory Evaluation

In the field of sensory evaluation humans are used as “measuring instruments” in order to evaluate consumer products with respect to the human senses (sight, touch, aroma, taste and hearing) [14].

There are mainly two purposes of implementing sensory evaluation. First there is product preference, i.e. which product will be more favourable or less favourable to the consumer in accordance to production quality, power, sound etc. Secondly it is to determine certain design features or degree of modification of a manufacturing process [3].

Sensory evaluation has been implemented in the food industry for quite some time, e.g. at SIK since the mid 20th century. Among others it also has been used by the automotive industry which has put a lot of emphasis into the development of product sounds and overall sound quality in cars. However, other industrial sectors still have a great potential to develop their use of sensory evaluation [1].

2.2.1 Sensory Evaluation Techniques

The purpose of the study will affect just about every aspect of the experimental design and the interpretation of the achieved response data. The testing should be carried out under a careful experimental design so that the evaluation of the results can be done in a proper and objective way.

Depending on the area of interest in the study there are a number of key standards that define certain aspects of sensory evaluation. These are quite well defined in terms of their domain and application as well as their usage. When such a standard exist, it should be consider whether the method is suitable for the task in question instead of developing a new method [2, 3].

There are a lot of variables to consider when designing/performing a sensory evaluation, the type of test to be used, the number of assessors and the duration of the test etc. Depending on the aim of the study the number of assessors and the time required can vary substantially. Hence, the test will in most cases be broken up into more than one session [3].

There is no limitation to what stimulus that can be used in a study as long as it can be well motivated and stimulates the selected response attribute. However, there is a practical limit to the number of variations that can be allowed in the stimulus set. For an experiment to be carried out in a reasonable amount of time no more than four or five components should be used [2, 3].

2.2.2 Sensory Panels

In sensory evaluation mainly two types of panels are used, the *consumer panel* and the *expert/analytical panel*. The consumer panel consist of assessors whom in most cases meet no particular criterion, i.e. naïve assessors, and it is often used if the aim of the study is product preference etc. If the aim of the study instead is towards design features etc. a panel of selected and trained assessors, i.e. *expert* or *specialized expert* assessors, are often used.

Depending on the aim of the study a consumer panel can consist of just a few assessors up to several hundred in order to get statistically valid results. This is due to the fact that assessors differ in sensory abilities, interests, ability to work as test subjects, and so on. The results obtained also tend to be highly subjective due to the assessors' lack of training in the relevant field of interest. If a trained expert panel is used the number of assessors can be substantially reduced. For listening studies the number of assessors can be reduced up to a factor 7 according to Bech. The results generated by an expert panel are also more objective in their nature since the assessors are trained to ignore their personal preferences. In the remainder of this report the main focus is on the expert panel and its assessors [2].

The ability of the individual assessor relates to his/her capability to rate the presented stimuli in a reliable and repeatable manner. This can be assessed through an evaluation of the subject's performance during some sort of selection procedure or by analysis of the subject's performance following an experiment. Also some practical topics like logistics etc. are indirectly very important since it is essential that an assessor is available, prompt and reliable for the purpose of completing an experiment. Guidance on the selection, training and monitoring of assessors can be found from several standards and in literature outside the field of this report, e.g. a well formulated structure for assessor categorisation widely employed in the sensory analysis of food products can be found in *ISO 8586-1* and *ISO 8586-2*, see *Table 2.1* for a summary. The standardised approach presented here is well structured and rigorous and is almost directly applicable when it comes to the evaluation of sound [2].

Table 2.1 Summary of assessor categories as defined in ISO standard 8586-2 [2, 15].

Assessor Category	Definition
Assessor	Any person taking part in a sensory test
Naïve assessor	A person who does not meet any particular criterion
Initiated assessor	A person who has already participated in a sensory test
Selected assessor	Assessor chosen for his/her ability to carry out a sensory test
Expert	In the general sense, a person who through knowledge or experience has competence to give an opinion in the fields about which he/she is consulted (Please note that the term <i>expert</i> does not provide any indication regarding the qualification or suitability of the individual to perform sensory tests)
Expert assessor	Selected assessor with a high degree of sensory sensitivity and experience in sensory methodology, who is able to make consistent and repeatable sensory assessments of various products
Specialized expert assessor	Expert assessor who has additional experience as a specialist in the product and/or process and/or marketing, and who is able to perform sensory analysis of the product and evaluate or predict effects of variations relating to raw materials, recipes, processing, storage, ageing, and so on.

3 Method

3.1 Assessor Selection Procedure

The recruitment process of assessors for sensory evaluation can be divided into two parts. The first part is to obtain general information about the subject. This can for instance be done by an interview or a questionnaire. Subsequently a screening procedure is performed in order to assess the subjects suitability [16].

As there is yet no standardized selection procedure for assessors with respect to listening skills a new approach to *assessor selection* was created. The selection procedure was mainly designed with the intent to be performed at the SIK premises in Gothenburg with the equipment available.

The selection procedure was partially based on the *Generalised Listener Selection procedure* by Mattila, Zacharov and Isherwood *et al.* [2], *ISO 8586-1* [16], *ISO 8586-2* [15] and *NT ACOU 111* [17].

The assessor selection procedure was divided into three separate blocks aiming at selecting the best suited assessors due to certain criteria in each block. A questionnaire was used in the first block in order to do a background check and the screening procedure was divided into an audiometric test and a listening test, see *Table 3.1* for a schematic overview of the three blocks.

Table 3.1 Schematic overview of the Assessor Selection Procedure

Assessor Selection Procedure		
1) Questionnaire	2) Audiometric Test	3) Listening Test
<ul style="list-style-type: none">• Known hearing loss• Interest• Availability	<ul style="list-style-type: none">• Normal hearing	<ul style="list-style-type: none">• Discrimination• Repeatability• Quantification

The selection of the SIK and CTH panels was performed using the same procedure. In the case of any deviations from this method it will be indicated in the text.

3.1.1 Questionnaire

A questionnaire was created based on previous work by Bech, Zacharov [2, 18], Trost and Hultåker [19]. The aim of the questionnaire was to exclude assessors with a known hearing loss, lack of interest and/or motivation. The subjects were also asked about their availability to attend the practical parts of the study.

In some questions the questionnaires sent out to the two panels differed slightly due to the nature and experience of the panels, see Appendix B and Appendix C for a complete exposition.

The questionnaires were sent out via email to all assessors in both the SIK and CTH panels.

3.1.2 Audiometric Test

An audiometric test was conducted in order to find out about the assessors hearing level. Due to the audiometric equipment and facilities used the assessors were only tested for a deviation of 20dB hearing level, i.e. normal hearing in the interval 125 to 8000 Hz [20].

Prior to the test a short oral introduction about the test was given to each assessor.

All audiometric tests were carried out in an office at SIK during 2009-2010 with the PC-based screener audiometer *Oscilla USB-300* and *AudioConsole* software from *Inmedico* (www.inmedico.com), see Figure 3.1.



Figure 3.1 PC-based screener audiometer *Oscilla USB-300*¹.

3.1.3 Listening Test

A listening test aims at testing the assessors' ability to discriminate between a number of sound stimuli as well as to and quantify them in accordance to a given scale. Also, by doing a number of replicates for each judgement the assessors' ability to repeat their judgements are tested.

The listening test was divided into three separate blocks with a short break in between each subsequent block. Each block was further divided into two or three sub tests each testing for one dependent variable at a time. A schematic overview of the listening test can be found in *Table 3.2*.

The listening test was made up of two test types, triangle and intensity tests. Triangle tests were chosen due to their simplicity and aimed to test the assessors' discrimination skills. Intensity tests were chosen in order to test the assessors' quantification skills.

¹ Courtesy of Inmedico A/S

Table 3.2 Schematic overview of the listening test.

	Block I		Block II		Block III		
Independent variable level	Part I	Part II	Part III	Part IV	Part V	Part VI	Part VII
1	Relative reproduction level=0dB	Relative reproduction level=0dB	AM-period: 0.250s	AM-period: 0.250s	AM-period: 0.018s	Tone: none	Pink Noise
2	Relative reproduction level=-2dB	Relative reproduction level=-2dB	AM-period: 0.207s	AM-period: 0.207s	AM-period: 0.014s	Tone: 200Hz (RRL -25dB)	Sound 1 + White Noise HPF4000Hz, RRL -20dB
3	Relative reproduction level=-3dB	Relative reproduction level=-3dB	AM-period: 0.185s	AM-period: 0.185s	AM-period: 0.013s	Tone: 600Hz (RRL -20dB)	Sound 2 + White Noise HPF6000Hz, RRL -20dB
4	Relative reproduction level=-7dB	Relative reproduction level=-7dB	AM-period: 0.098s	AM-period: 0.098s	AM-period: 0.011s	Tone: 1000Hz (RRL -15dB)	Sound 3 + White Noise HPF8000Hz, RRL -20dB
5		Relative reproduction level=-10dB		AM-period: 0.033s			
Dependent Variable	Loudness		Fluctuation Strength		Roughness	Tonality	Sharpness
Sample	Pink Noise		Amplitude Modulated (100%) 440Hz pure tone		Amplitude Modulated (100%) 440Hz pure tone	Left: Sine sweep 300Hz to 500Hz (RRL 0dB) Right: Sine sweep 900Hz to 700Hz (RRL 0dB) + Tone	Pink Noise + White Noise (High Pass Filtered)
Test Type	Triangle	Intensity	Triangle	Intensity	Triangle	Triangle	Triangle

In the listening test the following parameters were used: Loudness (discrimination and quantification), Fluctuation Strength (discrimination and quantification), Roughness (discrimination), Tonality (discrimination) and Sharpness (discrimination).

The presentation order for the loudness, fluctuation strength and roughness triangle tests were chosen in a way where the difficulty level of the judgements got harder and harder step by step². However this was not the case for the tonality and sharpness triangle tests where the presentation order was chosen in a more randomized way. For a full review of the presentation order see Appendix G. For the intensity tests the presentation order was randomized.

² NB due to a human error this is not the case for roughness, see Table 3.5

All listening tests were performed in the SIK sensory lab during spring 2010. The equipment used can be found in Appendix A and a picture of one of the test booths can be found in Figure 3.2.



Figure 3.2 One of the booths in the sensory lab at SIK.

Designing the Sounds

All sounds used in the listening test were primarily generated in *Test Tone Generator* by *Esser Audio* (www.esseraudio.com), see Figure 3.3. Additional components and mixing were done using the software presented in *Table 3.3*. The duration of all sound samples were two seconds.

Table 3.3 Software used for sound design.

Test Tone Generator v.4.32 by Esser Audio
Multi Tone Generator v.1.81 by Esser Audio
Filtered Noise Generator v.1.0 by Esser Audio
Audacity 1.2.6

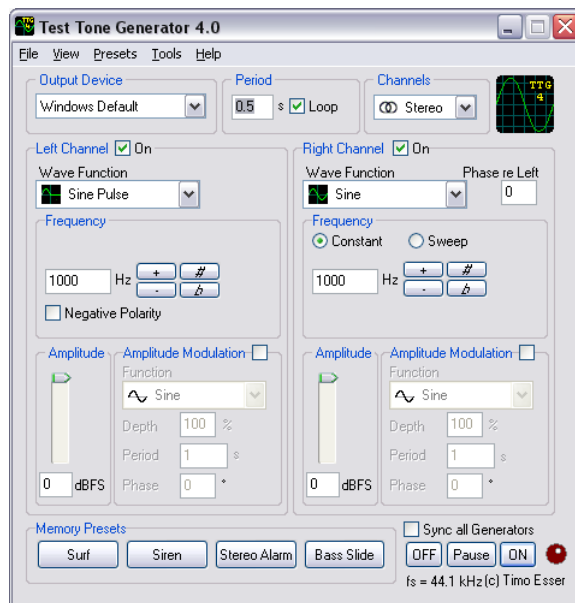


Figure 3.3 Screenshot of Test Tone Generator.

During the development process of the listening test a number of test runs were conducted with a number of individuals in order to get the sound levels right as well as the formulation of the questions.

Loudness

Pink noise was used for the loudness sound samples. The loudness levels for the four sound samples were chosen in a way so the relative differences were achieved in accordance with *Table 3.4* for Part I. As can be seen the relative differences for each pair goes from a fairly large difference of 7 dB down to a quite small difference of 1 dB.

Table 3.4 Relative differences in loudness level between sound samples.

Sounds	Relative difference in loudness level
2 - 3	1 dB
1 - 2	2 dB
1 - 3	3 dB
3 - 4	4 dB
2 - 4	5 dB
1 - 4	7 dB

In Part II an additional fifth sound was added with a relative loudness level found in *Table 3.2*.

Fluctuation Strength and Roughness

For fluctuation strength and roughness a similar approach as for loudness was used. A pure sine tone with a frequency of 440 Hz was chosen as a base for the sound samples. The tone was then 100% amplitude modulated with the modulation periods found in *Table 3.2* and the relative differences in modulation period between the samples can be found in *Table 3.5*.

Table 3.5 Relative differences in modulation period between sound samples for fluctuation strength and roughness.

Sounds	Fluctuation Strength	Roughness
2 - 3	0.022 s	0.001 s
1 - 2	0.043 s	0.004 s
1 - 3	0.065 s	0.005 s
3 - 4	0.087 s	0.002 s
2 - 4	0.109 s	0.003 s
1 - 4	0.152 s	0.007 s

Tonality

For the tonality test a sound composed of two sine sweeps was used, 300 to 500 Hz for the left ear and 900 to 700 for the right ear. Then additional tones were added in accordance with *Table 3.2*.

Sharpness

Pink noise was used as a base for the sharpness sound samples. Then high pass filtered white noise was added to the sound samples in order to get a increased level of sound energy in the higher frequencies, see *Table 3.2*.

4 Results and Analysis

From here on the assessors from the SIK panel are labelled *SIK_XX* and the assessors from the CTH panel are labelled *CTH_XX* (*XX* denote the number each assessor are allotted to be identified and followed during the selection procedure).

The results of the two panels are treated individually in order to observe if there are any differences between the two. Further the assessors are also examined individually in order to verify the selection procedure. A summary of the number of assessors during the different steps of the selection procedure can be found in *Table 4.1*.

All tests were carried out during 2009-2010 at the SIK premises in Gothenburg, Sweden. No consideration has been taken in accordance concerning the gender of the assessors. The assessors from the SIK panel were compensated with salary (approx. 180Skr/hour). The CTH assessors were compensated with 2-3 cinema tickets depending on the number of tests each assessor participated in.

Table 4.1 Summary of the number of assessors during the Selection Procedure.

Panel	Assessors contacted	Questionnaires	Audiometric tests	Screening tests
SIK	27	22	19 ³	9 ⁴
CTH	Approx. 125 ⁵	15	10 ⁶	10

4.1 Questionnaire

The questionnaires were sent out to the SIK panel during late fall 2009 and to the CTH panel during early spring 2010.

Out of 27 questionnaires sent out to the SIK panel 22 were returned with answers. None of the assessors from the SIK panel were excluded due to their answers concerning health, interest etc. Although some assessors did not have the possibility to take part in further testing. See *Table 4.1*.

Approximately 125 questionnaires were sent out to the CTH panel. The exact number was hard to obtain due to several non valid e-mail addresses. Due to few responses within time additional recruitment were conducted among the student population in Gothenburg. The final number of answered questionnaires including the additional recruitment was 15. None of the assessors were excluded due to their answers. Although some assessors did not have the possibility to take part in further testing. From here on the new recruits will be treated as members in the CTH panel.

With respect to the answers in the questionnaires the categorization of assessors, according to *ISO 8586-2*, found in *Table 4.2* could be done.

³ One of the assessors tested has not answered the questionnaire

⁴ One assessor did not take part in Block III

⁵ Additional recruitment due to few answers from the CTH assessors

⁶ Three of the assessors have performed the test earlier with satisfactory results

Table 4.2 Categorization of assessors according to ISO standard 8586-2.

Panel, Sensation	Naïve Assessor	Initiated Assessor	Selected Assessor	Expert Assessor
SIK, Taste/Aroma	0	0	0	22
SIK, Sound	20	2	0	0
CTH, Taste/Aroma	10	5	0	0
CTH, Sound	4	0	11	0

A more thorough review of the questionnaires can be found in Appendix D.

4.2 Audiometric Test

Assessors available for further testing conducted an audiometric test. The audiometric test only tested the assessors for a deviation of 20 dB hearing level, i.e. normal hearing in the interval 125-8000 Hz.

The audiometric test was conducted in an office at the SIK premises during the period 2009-2010. The test location and the simplicity of the test were assumed to influence the test results. Hence a mean deviation of <21.40 in the frequency range 125-8000 Hz were allowed in order to take part in further testing.

Due to a deprived hearing level a few of the SIK assessors but none of the CTH assessors were excluded from further testing. A more comprehensive review of the audiometric test results can be found in Appendix E.

4.3 Listening Test

During a number of sessions in the spring of 2010 nine assessors from the SIK panel and ten assessors from the CTH panel took part in the listening test. One assessor from the SIK panel only performed Block I and II and due to technical problems one SIK assessor was forced to undergo the listening test a second time.

Before the listening test was started the assessors were given a short oral introduction. They were told about the 30 second time limit for each question and how to go about when answering the questions in the test etc.

The average time⁷ used to perform the listening test for each assessor was approximately 40 minutes for the SIK panel⁸ and 28 minutes for the CTH panel, see

⁷ Excluding breaks

⁸ SIK_19 not included

Table 4.3 for individual test times.

A summary of the results obtained in the listening test can be found in Chapters 4.3.1-4.3.3, a more thorough review of the results can be found in Appendix H.

All significances for the triangle tests are calculated using the table in Appendix I. Note that the maximum significances differ between the three first columns and the three last columns in the loudness, fluctuation strength and roughness triangle tests due to the number of judgements for each pair. For additional calculations *PanelCheck* and *FIZZ Calculation* have been used.

Table 4.3 Time in seconds used for the different tests.

Code	Part I	Part II	Part III	Part IV	Part V	Part VI	Part VII	Total time
SIK_03	838	318	469	237	396	570	450	3278
SIK_04	479	194	414	168	411	340	368	2374
SIK_06	378	202	334	176	307	385	334	2116
SIK_07	424	216	322	120	346	402	367	2197
SIK_10	421	147	338	162	324	378	365	2135
SIK_11	516	167	456	122	493	516	475	2745
SIK_15	412	154	434	90	514	605	543	2752
SIK_18	590	176	344	114	287	375	386	2272
SIK_19	753	291	469	269	-	-	-	1782 ⁹
CTH_01	239	109	158	58	143	223	161	1091
CTH_03	327	138	283	109	271	260	274	1662
CTH_04	290	97	230	90	195	278	278	1458
CTH_06	371	158	294	131	253	315	272	1794
CTH_07	286	95	218	85	221	254	249	1408
CTH_10	539	175	286	126	484	276	492	2378
CTH_12	468	160	331	125	372	312	318	2086
CTH_13	404	152	338	135	292	283	294	1898
CTH_14	275	111	225	109	245	226	259	1450
CTH_15	456	212	255	143	228	260	252	1806

4.3.1 Block I – Loudness

Loudness - Triangle Test

With respect to loudness both panels show the same significance, see *Table 4.4*. If you look at each assessor at a time some differences can be found, see

Table 4.5.

As expected the majority of errors came toward the relative difference of 1dB. Errors in the first three triangles are probably due to poor concentration or negligence.

⁹ Only Part I-IV

Table 4.4 Loudness significance for the both panels.

Panel	1 & 4	2 & 4	3 & 4	1 & 3	1 & 2	2 & 3
SIK	0.001	0.001	0.001	0.001	0.001	0.001
CTH	0.001	0.001	0.001	0.001	0.001	0.001

Table 4.5 Loudness significance for each assessor.

Code	1 & 4	2 & 4	3 & 4	1 & 3	1 & 2	2 & 3
SIK_03	0.05	0.05	0.05	0.005	0.05	0.05
SIK_04	0.05	0.05	0.05	0.05	0.005	ns
SIK_06	0.05	0.05	0.05	0.005	0.005	0.005
SIK_07	0.05	0.05	0.05	0.005	0.30	0.05
SIK_10	0.05	0.05	0.05	0.005	0.005	0.005
SIK_11	0.05	0.05	0.05	0.005	0.005	ns
SIK_15	0.05	0.05	0.05	0.005	0.005	ns
SIK_18	0.05	0.05	0.05	0.005	0.005	0.005
SIK_19	0.05	0.05	0.05	0.005	0.005	0.005
CTH_01	0.05	0.05	0.05	0.05	0.005	ns
CTH_03	0.05	0.05	0.05	0.005	0.05	ns
CTH_04	0.30	0.05	0.05	0.05	0.05	ns
CTH_06	0.05	0.05	0.05	0.005	0.005	0.005
CTH_07	0.05	0.05	0.05	0.005	0.005	0.30
CTH_10	0.05	0.05	0.05	0.05	0.30	0.30
CTH_12	0.05	0.05	0.05	0.005	0.05	0.05
CTH_13	0.05	0.30	0.05	0.005	0.005	0.005
CTH_14	0.05	0.05	0.05	0.005	0.005	0.005
CTH_15	0.05	0.30	0.05	0.005	0.005	0.05

Loudness – Intensity Test

The results from the loudness intensity test are shown in *Table 4.6*. One can clearly see a big spread of the sounds in the middle while the two outer (reference) sounds got a smaller spread for the SIK panel. For the CTH panel this is not as legible.

Table 4.6 Results from loudness intensity test.

Code	Sound 1			Sound 2			Sound 3			Sound 4			Sound 5		
SIK_03	90	74	90	86	68	79	87	70	89	24	19	34	9	10	19
SIK_04	77	72	76	49	49	60	73	69	53	45	52	26	17	19	16
SIK_06	77	72	71	75	56	51	23	18	45	14	17	15	10	10	11
SIK_07	82	85	86	66	80	52	36	29	68	14	13	11	3	8	6
SIK_10	90	90	86	23	51	37	38	32	21	11	10	10	10	9	10
SIK_11	90	90	90	54	44	44	16	44	62	10	16	10	10	10	10
SIK_15	88	88	88	86	87	87	88	87	87	25	15	14	14	14	12
SIK_18	97	95	99	90	97	84	80	66	81	25	49	35	10	17	10
SIK_19	75	72	90	71	72	74	59	48	49	25	30	37	11	10	12
CTH_01	62	55	75	66	78	82	78	62	86	50	47	28	11	28	10
CTH_03	89	89	89	83	87	85	63	67	69	33	27	16	11	11	11
CTH_04	90	90	85	68	52	57	49	29	47	15	15	13	12	10	10
CTH_06	88	74	90	68	72	80	65	59	46	37	21	20	10	20	9
CTH_07	83	80	85	76	79	72	72	68	63	28	31	12	18	29	11
CTH_10	80	72	87	61	60	72	79	86	84	80	51	70	52	57	52
CTH_12	84	87	75	54	51	69	52	60	38	17	20	28	15	15	12
CTH_13	90	90	82	46	61	48	85	77	83	25	30	18	11	20	11
CTH_14	88	90	90	79	82	85	82	76	61	37	54	10	11	14	10
CTH_15	84	82	86	71	66	83	65	68	78	50	50	31	14	27	15

When the results in *Table 4.6* undergo a Tukey test the results in *Table 4.7* are obtained. The difference between levels with same letter is not significant (5%). As can be seen the assessors have problems discriminating between *Sound 2*, *Sound 3* and *Sound 4*. When the Tukey test is done for the whole panels the SIK panel can discriminate between all sounds while the CTH panel have problems discriminating between *Sound 2* and *Sound 3*.

Table 4.7 Tukey Test at 5% for Loudness.

Code	Sound 1	Sound 2	Sound 3	Sound 4	Sound 5
SIK_03	A	A	A	B	B
SIK_04	A	AB	BC	C	D
SIK_06	A	A	B	B	B
SIK_07	A	AB	B	C	C
SIK_10	A	B	B	C	C
SIK_11	A	B	BC	CD	D
SIK_15	A	A	A	B	B
SIK_18	A	AB	B	C	D
SIK_19	A	A	B	C	D
SIK Panel	A	B	C	D	E
CTH_01	A	A	AB	BC	C
CTH_03	A	A	B	C	D
CTH_04	A	B	C	D	D
CTH_06	A	AB	B	C	C
CTH_07	A	A	A	B	B
CTH_10	A	A	AB	AB	B
CTH_12	A	B	B	C	C
CTH_13	A	A	B	C	C
CTH_14	A	A	A	B	B
CTH_15	A	A	A	B	C
CTH Panel	A	B	B	C	D
SIK&CTH Panel	A	B	B	C	D

Table 4.8 Loudness statistics for the SIK Panel.

	Sound 1	Sound 2	Sound 3	Sound 4	Sound 5
Mean	84,44	65,63	56,22	22,44	11,37
Range (max-Min)	28	74	73	42	16
Std. Dev. (n-1)	8,33	18,89	23,95	12,50	3,71
Var. Coeff. (%)	9,86	28,78	42,60	55,68	32,65
Conf. Int. 5%±	3,29	7,47	9,48	4,94	1,47

Table 4.9 Loudness statistics for the CTH Panel.

	Sound 1	Sound 2	Sound 3	Sound 4	Sound 5
Mean	83,03	69,77	66,57	32,13	18,23
Range (max-Min)	35	41	57	70	48
Std. Dev. (n-1)	8,56	12,05	14,74	17,50	13,22
Var. Coeff. (%)	10,31	17,27	22,14	54,45	72,48
Conf. Int. 5%±	3,20	4,50	5,50	6,53	4,93

4.3.2 Block II - Fluctuation Strength

Fluctuation Strength - Triangle Test

With respect to Fluctuation Strength both panels show the same significance, see *Table 4.10*. If you look at each assessor differences can be found, see

Table 4.11.

Table 4.10 Fluctuation Strength significance for the both panels.

Panel	1 & 4	2 & 4	3 & 4	1 & 3	1 & 2	2 & 3
SIK	0.001	0.001	0.001	0.001	0.001	0.001
CTH	0.001	0.001	0.001	0.001	0.001	0.001

Table 4.11 Fluctuation Strength significance for each assessor.

Code	1 & 4	2 & 4	3 & 4	1 & 3	1 & 2	2 & 3
SIK_03	0.05	0.05	0.05	0.005	0.005	0.05
SIK_04	0.05	0.05	0.05	0.005	0.005	0.30
SIK_06	0.05	0.05	0.05	0.005	0.005	0.005
SIK_07	0.05	0.05	0.05	0.005	0.005	0.05
SIK_10	0.05	0.05	0.05	0.005	0.05	0.30
SIK_11	0.05	0.05	0.05	0.005	0.005	0.05
SIK_15	0.05	0.05	0.05	0.005	0.05	0.05
SIK_18	0.05	0.05	0.05	0.005	0.005	0.05
SIK_19	0.05	0.05	0.05	0.005	0.005	0.005
CTH_01	0.05	0.05	0.05	0.005	0.05	0.30
CTH_03	0.05	0.05	0.05	0.005	0.005	0.005
CTH_04	0.05	0.05	0.05	0.005	0.005	0.05
CTH_06	0.05	0.05	0.05	0.005	0.005	0.005
CTH_07	0.05	0.05	0.05	0.005	0.005	0.005
CTH_10	0.05	0.05	0.05	0.005	0.005	0.005
CTH_12	0.05	0.05	0.05	0.005	0.005	ns
CTH_13	0.05	0.05	0.05	0.005	0.005	0.005
CTH_14	0.05	0.05	0.05	0.005	0.005	0.005
CTH_15	0.05	0.05	0.05	0.005	0.005	0.005

Fluctuation Strength – Intensity Test

The results from the fluctuation strength intensity test are shown in *Table 4.12*.

Table 4.12 Results from loudness intensity test.

Code	Sound 1	Sound 2	Sound 3	Sound 4	Sound 5
SIK_03	10 10 23 17 25 29 33 26 56 77 82 90 90 90 90				
SIK_04	21 25 21 28 35 39 57 66 34 69 67 63 75 82 84				
SIK_06	11 13 12 40 48 48 47 35 47 50 44 60 90 88 90				
SIK_07	10 8 6 22 11 17 26 46 46 71 69 73 95 81 98				
SIK_10	13 13 15 12 11 15 18 10 11 72 86 86 91 90 93				
SIK_11	34 10 19 47 12 16 44 19 14 90 77 87 90 90 85				
SIK_15	14 15 15 14 15 14 13 15 14 21 15 12 85 83 81				
SIK_18	10 5 2 20 21 10 49 35 31 21 66 74 90 90 90				
SIK_19	25 26 11 22 26 20 34 26 51 90 85 80 90 91 90				
CTH_01	10 23 59 52 17 22 40 18 23 30 42 34 90 87 91				
CTH_03	11 11 10 22 31 39 36 20 28 59 54 47 88 89 88				
CTH_04	49 35 38 36 45 25 43 38 32 38 77 40 83 84 86				
CTH_06	10 10 13 42 13 25 31 35 29 60 57 80 90 90 89				
CTH_07	11 20 20 29 36 36 40 48 46 58 54 54 79 82 69				
CTH_10	19 25 24 74 79 65 73 74 66 76 88 83 80 82 89				
CTH_12	12 13 14 16 16 12 17 13 30 49 63 57 76 82 87				
CTH_13	17 11 12 21 24 16 23 37 49 79 74 57 90 89 89				
CTH_14	23 16 16 33 29 17 30 48 48 74 71 68 90 89 86				
CTH_15	13 15 24 41 33 31 37 24 28 69 64 71 90 90 89				

When the results in *Table 4.12* undergo a Tukey test the results in

Table 4.13 are obtained. The difference between levels with same letter is not significant (5%). As can be seen the assessors have problems discriminating between *Sound 2*, *Sound 3* and *Sound 4*. When the test is done for the whole panels the SIK panel can discriminate between all sounds while the CTH panel have problems with *Sound 3* and *Sound 4*.

Table 4.13 Tukey Test at 5% for Fluctuation Strength.

Code	Sound 1	Sound 2	Sound 3	Sound 4	Sound 5
SIK_03	A	A	B	BC	C
SIK_04	A	AB	BC	CD	D
SIK_06	A	B	B	B	C
SIK_07	A	B	C	D	D
SIK_10	A	A	B	B	B
SIK_11	A	A	B	B	B
SIK_15	A	B	B	B	B
SIK_18	A	AB	BC	BC	C
SIK_19	A	A	B	B	B
SIK Panel	A	B	C	D	E
CTH_01	A	B	B	B	B
CTH_03	A	B	C	C	D
CTH_04	A	B	B	B	B
CTH_06	A	B	C	C	C
CTH_07	A	B	BC	C	D
CTH_10	A	A	A	A	B
CTH_12	A	B	C	C	C
CTH_13	A	A	B	BC	C
CTH_14	A	B	C	CD	D
CTH_15	A	B	C	CD	D
CTH Panel	A	B	C	C	D
SIK&CTH Panel	A	B	C	C	D

Table 4.14 Statistics Fluctuation Strength SIK Panel.

	Sound 1	Sound 2	Sound 3	Sound 4	Sound 5
Mean	14,70	23,48	33,44	65,81	88,22
Range (max-Min)	31	38	56	78	23
Std. Dev. (n-1)	7,36	11,96	16,01	23,67	4,82
Var. Coeff. (%)	50,08	50,92	47,86	35,97	5,47
Conf. Int. 5%±	2,91	4,73	6,33	9,37	1,91

Table 4.15 Statistics Fluctuation Strength CTH Panel.

	Sound 1	Sound 2	Sound 3	Sound 4	Sound 5
Mean	19,47	32,57	36,80	60,90	86,10
Range (max-Min)	49	67	61	58	22
Std. Dev. (n-1)	11,86	17,00	15,23	15,10	5,07
Var. Coeff. (%)	60,93	52,21	41,38	24,80	5,89
Conf. Int. 5%±	4,43	6,35	5,69	5,64	1,89

4.3.3 Block III - Roughness, Tonality and Sharpness

Roughness - Triangle Test

With respect to Roughness both panels show the same significance, see *Table 4.16*. If you look at each assessor differences can be found, see

Table 4.17.

Table 4.16 Roughness significance for the both panels.

Panel	1 & 4	2 & 4	3 & 4	1 & 3	1 & 2	2 & 3
SIK	0.001	0.001	0.001	0.001	0.001	0.001
CTH	0.001	0.001	0.001	0.001	0.001	0.001

Table 4.17 Roughness significance for each assessor.

Code	1 & 4	2 & 4	3 & 4	1 & 3	1 & 2	2 & 3
SIK_03	0.05	0.05	0.05	0.005	0.005	0.005
SIK_04	0.05	0.05	0.05	0.005	0.005	0.30
SIK_06	0.05	0.05	0.05	0.005	0.005	0.005
SIK_07	0.05	0.05	0.05	0.005	0.005	0.30
SIK_10	0.05	0.05	0.05	0.005	0.005	0.30
SIK_11	0.05	0.05	0.05	0.005	0.05	0.30
SIK_15	0.05	0.05	ns	0.05	ns	0.05
SIK_18	0.05	0.05	0.05	0.005	0.005	0.005
SIK_19	N/A	N/A	N/A	N/A	N/A	N/A
CTH_01	0.05	0.05	0.05	0.005	0.005	0.05
CTH_03	0.05	0.05	0.05	0.005	0.005	0.30
CTH_04	0.05	0.05	0.05	0.005	0.05	0.005
CTH_06	0.05	0.05	0.05	0.005	0.005	ns
CTH_07	0.05	0.05	0.05	0.005	0.005	0.005
CTH_10	0.05	0.05	0.05	0.005	0.005	ns
CTH_12	0.05	0.05	0.30	0.005	0.005	0.005
CTH_13	0.05	0.05	0.05	0.005	0.005	0.005
CTH_14	0.05	0.05	0.05	0.005	0.005	0.05
CTH_15	0.05	0.05	0.05	0.005	0.005	0.005

Tonality - Triangle Test

With respect to tonality both panels show the same significance, see *Table 4.18*. If you look at each assessor differences can be found, see *Table 4.19*.

Table 4.18 Tonality significance for the both panels.

Panel	1 & 4	2 & 4	3 & 4	1 & 3	1 & 2	2 & 3
SIK	0.001	0.001	0.001	0.001	0.001	0.001
CTH	0.001	0.001	0.001	0.001	0.001	0.001

Table 4.19 Tonality significance for each assessor.

Code	1 & 4	2 & 4	3 & 4	1 & 3	1 & 2	2 & 3
SIK_03	0.05	0.05	0.05	0.05	0.05	0.20
SIK_04	0.20	0.05	0.05	0.20	0.05	0.05
SIK_06	0.05	0.05	0.05	0.05	0.05	ns
SIK_07	0.20	0.20	0.05	0.20	0.05	ns
SIK_10	0.05	0.05	0.20	0.20	0.05	0.05
SIK_11	0.20	0.05	0.20	0.20	0.05	0.05
SIK_15	0.05	0.05	0.20	0.20	0.20	0.05
SIK_18	0.05	0.05	0.05	0.05	0.05	0.05
SIK_19	N/A	N/A	N/A	N/A	N/A	N/A
CTH_01	0.05	0.05	0.05	0.20	ns	ns
CTH_03	0.05	0.05	0.05	0.05	0.05	0.05
CTH_04	0.05	0.05	0.05	ns	ns	0.05
CTH_06	0.05	0.05	0.05	ns	ns	0.05
CTH_07	0.05	0.05	0.05	0.05	0.05	0.05
CTH_10	0.05	0.05	0.05	0.05	0.05	0.05
CTH_12	0.05	0.05	0.05	0.20	ns	ns
CTH_13	0.05	0.05	0.05	0.05	0.05	0.05
CTH_14	0.05	0.05	0.05	0.05	0.05	0.05
CTH_15	0.05	0.05	0.05	0.05	0.05	0.05

Sharpness - Triangle Test

With respect to sharpness both panels show the same significance, see *Table 4.20*. If you look at each assessor differences can be found, see *Table 4.21*.

Table 4.20 Sharpness significance for the both panels.

Panel	1 & 4	2 & 4	3 & 4	1 & 3	1 & 2	2 & 3
SIK	0.001	0.001	0.001	0.001	0.001	0.001
CTH	0.001	0.001	0.001	0.001	0.001	0.001

Table 4.21 Sharpness significance for each assessor.

Code	1 & 4	2 & 4	3 & 4	1 & 3	1 & 2	2 & 3
SIK_03	0.05	0.05	0.20	0.05	0.20	0.05
SIK_04	0.05	0.05	0.20	0.05	ns	0.05
SIK_06	0.05	0.05	ns	0.05	0.05	0.05
SIK_07	0.05	0.05	ns	0.20	ns	0.05
SIK_10	0.05	0.05	0.05	0.05	0.05	0.05
SIK_11	0.05	0.05	0.20	0.05	0.05	0.05
SIK_15	0.05	0.05	ns	0.05	0.20	0.20
SIK_18	0.05	0.05	ns	0.05	0.20	0.05
SIK_19	N/A	N/A	N/A	N/A	N/A	N/A
CTH_01	0.20	0.05	0.20	0.05	ns	0.05
CTH_03	0.05	0.05	ns	0.05	0.20	0.05
CTH_04	0.05	0.05	ns	0.05	0.05	0.05
CTH_06	0.05	0.05	0.05	0.05	0.05	0.05
CTH_07	0.05	0.05	ns	0.20	0.05	0.05
CTH_10	0.05	0.05	ns	0.05	0.05	0.05
CTH_12	0.20	0.05	ns	ns	ns	ns
CTH_13	0.05	0.05	0.20	0.05	0.05	0.05
CTH_14	0.20	0.05	0.05	0.05	0.20	0.05
CTH_15	0.05	0.05	ns	0.05	0.05	0.05

5 Discussion

In order to examine if the existing analytical sensory panel for taste/aroma at SIK also could be used for listening tests with respect to PSQ a selection procedure was created and implemented. The selection procedure uses a similar structure to other existing selection processes in sensory analysis. What differ between this procedure and other existing procedures are the exact contents in each part of the selection procedure. Both the selection procedure and the assessors, both individually and as groups, will be discussed in order to evaluate the selection procedure as well as the both panels.

In this work the questionnaire was mainly used in order to find out if the assessors had a known hearing loss and if they had the possibility to take part in further testing. In doing this it worked very well. As can be seen in Chapter 4 none of the assessors were discarded due to a known hearing loss, although some assessors were discarded since they had no possibility to take part in further testing.

Out of the 27 questionnaires sent out to the SIK assessors 22 were returned with answers while only 15 out of approximately 125 questionnaires sent out were answered by the CTH assessors. This makes an answer rate of over 80% for the SIK panel and around 12%¹⁰ for the CTH panel. The big difference in the rate of answered questionnaires is probably due to interest and motivation as well as some non working e-mail addresses for assessors in the CTH panel. The SIK assessors show great interest and motivation in their work as panellists while this is not really the case with most of the CTH assessors. This might derive from the fact that the SIK assessors are employed part-time working with sensory evaluation and the CTH assessors do this more on a voluntary basis. However, the main conclusion drawn from the questionnaires is that the SIK assessors have much more experience in the field of sensory testing; all of them can be categorized as expert assessors with regard to at least one sensory sensation. This is not the case for any of the CTH assessors, see *Table 4.2*.

Due to economic matters and lack of extended expertise in the field of audiometry a simpler audiometric test was used instead of letting the assessors undergo a professional audiometric evaluation. However, the audiometric test used in general showed a worse result for the SIK assessors as regards to the CTH assessors. This can probably be originated from the average age difference between the two panels.

Among the assessors who carried out the audiometric test only a few of the SIK assessors were rejected from further testing due to poor hearing. One might argue about letting people with a deviation larger than 20 dB from normal hearing continue in the selection procedure but since the test conditions was not ideal a slightly larger deviation was accepted.

When it comes to the listening test the triangle test probably was a bit easier to understand and perform if one has little or no previous experience from sensory evaluation or similar activities. The triangle test also worked better with the software used.

¹⁰ Including additional recruitment

The results in the listening test only show small differences between the two panels and the most legible difference between the two panels is the time used for the listening test; the average time used is roughly 40 minutes for the SIK panellists and 28 minutes for the CTH panellists. This means that the SIK panel will need approximately 45% longer time into account to complete the test. This might be the effect of the greater interest shown by the SIK assessors. When it comes to the judgements there are no immense differences between the results obtained by the two panels other than slightly better results in the two intensity tests (loudness and fluctuation strength) by the SIK panel.

6 Conclusion

The aim of this thesis was to investigate whether the existing analytical sensory panel at *SIK*, which today mainly is used for the evaluation of taste, aroma and texture also could be used in the evaluation of product sounds.

Since the number of assessors is limited it is hard to make a distinct conclusion about one group being better than the other. However, the results obtained show that the *SIK* panel can be used in a similar way as the *CTH* panel, i.e. as consumer panel.

The big differences are instead between the individual assessors. This indicates that the ability in sensory evaluation with regard to hearing is individual and not connected to the abilities with regard to the other senses. And as a consequence this would imply that one should test assessors in the field of interest and not assume that great skills in one sensory area means great skills in another. This implies that additional recruitment needs be done if *SIK* would constitute an expert/analytical panel with regard to hearing.

When it comes to the selection procedure the triangle tests were much easier to understand and perform. Therefore triangle tests suits a screening test better. In order to draw any further conclusions and to validate the selection procedure additional testing needs to be done.

7 Future Work

This thesis only discusses an approach to an assessor selection procedure and additional work should be done in order to develop and validate the selection procedure even further.

Additional recruitment need to be done if SIK would constitute an expert/analytical panel with regard to hearing. Further the listening environment in the sensory lab also needs to be improved in order to suit the task better.

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Appendix A - Test Environment and Equipment

Location: Sensory lab in accordance to ISO 8589-1998

- 1: PC with Fizz sensory software version 2.45A
- 2: Sennheiser HD 202 headphones

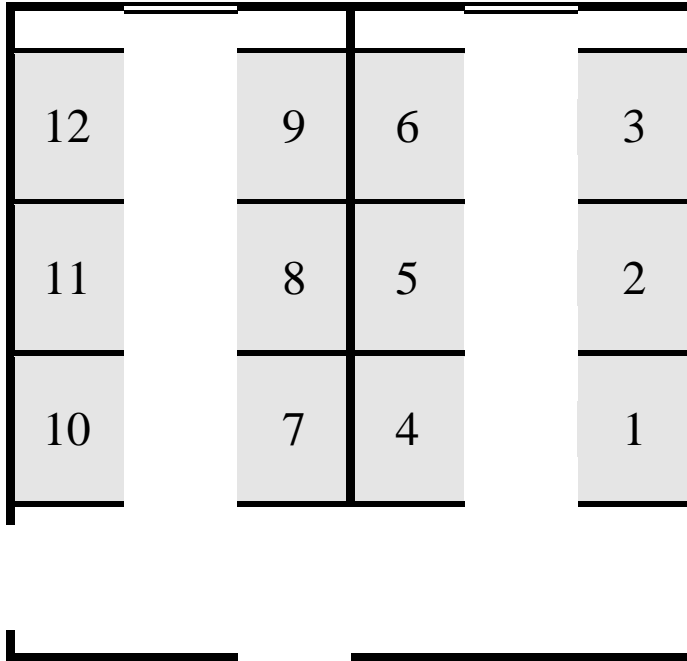


Figure. Schematic overview of the sensory lab at SIK.

Appendix B – Questionnaire SIK

Ljudkvalitet & Sensoriska paneler

Följande frågeformulär är en del av mitt examensarbete vid *Chalmers Tekniska Högskola* och *SIK – Institutet för Livsmedel och Bioteknik AB*.

Arbetet handlar om selektionsmetoder till sensoriska paneler för ljudkvalitetsbedömning samt hur dessa bedömningar kan genomföras.

Jag ser gärna att du svarar på frågorna i formuläret vilket kommer att ligga till grund för ett första urval till den panel som jag kommer att använda i mitt examensarbete.

Frågorna i formuläret besvaras med ett kryss i den ruta som du anser passar bäst. Vissa frågor och kommentarer besvaras dock genom att du skriver ditt svar på angiven plats, jag ser mer än gärna att du kommenterar dina svar i möjligaste mån.

Alla svar kommer att behandlas konfidentiellt.

Om du har några frågor så är det bara att kontakta mig på jonas.wallgren@sik.se

Tack på förhand för din medverkan.

Jonas Wallgren



Fyll i nedanstående frågeformulär och skicka tillbaka till jonas.wallgren@sik.se
Observera att du får spara formuläret först och därefter bifoga det i mailet.

Namn:	
e-postadress:	
Kön:	<input type="checkbox"/> kvinna <input type="checkbox"/> man
Födelseår:	År
Har du svenska som modersmål?	<input type="checkbox"/> Ja <input type="checkbox"/> Nej Kommentar:
Vad är din huvudsakliga sysselsättning?	<input type="checkbox"/> Arbete <input type="checkbox"/> Studier <input type="checkbox"/> Annat

Vilken hörselnivå anser du att du har?	<input type="checkbox"/> Över normal <input type="checkbox"/> Normal <input type="checkbox"/> Under normal <input type="checkbox"/> Mycket under normal Kommentar:
Har du tidigare haft problem med hörseln?	<input type="checkbox"/> Ja <input type="checkbox"/> Nej Kommentar:
Har du nu eller tidigare haft problem med synen? (observera, ej problem som korrigerats med hjälp av glasögon/kontaktlinser)	<input type="checkbox"/> Ja, nu <input type="checkbox"/> Ja, tidigare <input type="checkbox"/> Nej Kommentar:
Är du särskilt uppmärksam på ljud i din omgivning?	<input type="checkbox"/> Ja <input type="checkbox"/> Nej Kommentar:
Störs du av ljud <i>inomhus</i> i din vardag? (t.ex. dammsugare, dator, grannar, ventilation etc.)	<input type="checkbox"/> Ja, ofta <input type="checkbox"/> Ja, ibland <input type="checkbox"/> Nej, aldrig Kommentar: Om ja, vilka?
Störs du av ljud <i>utomhus</i> i din vardag? (t.ex. bilar, flygplan, fåglar och djur etc.)	<input type="checkbox"/> Ja, ofta <input type="checkbox"/> Ja, ibland <input type="checkbox"/> Nej, aldrig Kommentar: Om ja, vilka?
Störs du av ljudet från produkter som någon i din närhet använder? (t.ex. ljudet från grannens gräsklippare när han/hon klipper gräset)	<input type="checkbox"/> Ja, ofta <input type="checkbox"/> Ja, ibland <input type="checkbox"/> Nej, aldrig Kommentar:

Fortsätt på nästa sida!

Har du lätt för att koncentrera dig oavsett vad som händer runt omkring dig?	<input type="checkbox"/> Ja, alltid <input type="checkbox"/> Ja, oftast <input type="checkbox"/> Nej, aldrig Kommentar:
Har du behov av fullständig tystnad?	<input type="checkbox"/> Ja, ofta <input type="checkbox"/> Ja, ibland <input type="checkbox"/> Nej, aldrig Kommentar:
Vänjer du dig vid de flesta ljud utan större svårighet.	<input type="checkbox"/> Ja, oftast <input type="checkbox"/> Ja, ibland <input type="checkbox"/> Nej, aldrig Kommentar:
Spelar du något instrument eller sjunger?	<input type="checkbox"/> Ja <input type="checkbox"/> Nej Kommentar:
Har du tidigare deltagit i sensoriska tester med avseende på <i>hörse</i> l?	<input type="checkbox"/> Ja, fler än 2 ggr <input type="checkbox"/> Ja, 1-2 ggr <input type="checkbox"/> Nej, aldrig Kommentar:

Följande frågor behandlar den "totala ljudkvaliteten" för några olika produktsegment. Med "totala ljudkvaliteten" menas alla ljud som produkten utsänder, dvs. även från knapptryckningar etc.

Vid köp av hemelektronik , hur avgörande är den <i>totala ljudkvaliteten</i> för vilken produkt du väljer? (t.ex. ljudanläggningar av olika slag, tv-apparater, digitalkameror etc.)	<input type="checkbox"/> Mycket avgörande <input type="checkbox"/> Något avgörande <input type="checkbox"/> Ej avgörande Kommentar:
Vid köp av hushållsmaskiner/vitvaror , hur avgörande är den <i>totala ljudkvaliteten</i> för vilken produkt du väljer? (t.ex. diskmaskin, tvättmaskin, elvisp, matberedare etc.)	<input type="checkbox"/> Mycket avgörande <input type="checkbox"/> Något avgörande <input type="checkbox"/> Ej avgörande Kommentar:
Vid köp av motorfordon , hur avgörande är den <i>totala ljudkvaliteten</i> för vilken produkt du väljer? (t.ex. bil, motorcykel, moped etc.)	<input type="checkbox"/> Mycket avgörande <input type="checkbox"/> Något avgörande <input type="checkbox"/> Ej avgörande Kommentar:

Fortsätt på nästa sida!

Har du möjlighet att delta i vidare tester för mitt examensarbete som behandlar ljudkvalitet och sensoriska paneler? Testerna är beräknade att genomföras 2009/2010. Information om vidare tester för de som blir utvalda kommer att meddelas senare. Ersättning utgår enligt SIK:s gällande normer.

Ja Nej

Kommentar:

Har du ytterligare synpunkter på frågeformuläret och dess frågor så skriv dem gärna här.

.....

Nu behöver du bara spara dokumentet och bifoga det i ett mail till jonas.wallgren@sik.se

Tack för att du tog dig tid att besvara mina frågor!

/Jonas Wallgren

Appendix C- Questionnaire CTH

Ljudkvalitet & Sensoriska paneler

Följande frågeformulär är en del av mitt examensarbete vid *Chalmers Tekniska Högskola* och *SIK – Institutet för Livsmedel och Bioteknik AB*.

Arbetet handlar om selektionsmetoder till sensoriska paneler för ljudkvalitetsbedömning samt hur dessa bedömningar kan genomföras.

Jag ser gärna att du svarar på frågorna i formuläret vilket kommer att ligga till grund för ett första urval till den panel som jag kommer att använda i mitt examensarbete.

Frågorna i formuläret besvaras med ett kryss i den ruta som du anser passar bäst. Vissa frågor och kommentarer besvaras dock genom att du skriver ditt svar på angiven plats, jag ser mer än gärna att du kommenterar dina svar i möjligaste mån.

Alla svar kommer att behandlas konfidentiellt.

Om du har några frågor så är det bara att kontakta mig på jonas.wallgren@sik.se

Tack på förhand för din medverkan.

Jonas Wallgren



CHALMERS

Fyll i nedanstående frågeformulär och skicka tillbaka till jonas.wallgren@sik.se
Observera att du får spara formuläret först och därefter bifoga det i mailet.

Namn:	
e-postadress:	
Kön:	<input type="checkbox"/> kvinna <input type="checkbox"/> man
Födelseår:	År
Har du svenska som modersmål?	<input type="checkbox"/> Ja <input type="checkbox"/> Nej Kommentar:
Vad är din huvudsakliga sysselsättning?	<input type="checkbox"/> Arbete <input type="checkbox"/> Studier <input type="checkbox"/> Annat

Vilken hörselnivå anser du att du har?	<input type="checkbox"/> Över normal <input type="checkbox"/> Normal <input type="checkbox"/> Under normal <input type="checkbox"/> Mycket under normal Kommentar:
Har du tidigare haft problem med hörseln?	<input type="checkbox"/> Ja <input type="checkbox"/> Nej Kommentar:
Har du nu eller tidigare haft problem med synen? (observera, ej problem som korrigerats med hjälp av glasögon/kontaktlinser)	<input type="checkbox"/> Ja, nu <input type="checkbox"/> Ja, tidigare <input type="checkbox"/> Nej Kommentar:
Är du särskilt uppmärksam på ljud i din omgivning?	<input type="checkbox"/> Ja <input type="checkbox"/> Nej Kommentar:
Störs du av ljud <i>inomhus</i> i din vardag? (t.ex. dammsugare, dator, grannar, ventilation etc.)	<input type="checkbox"/> Ja, ofta <input type="checkbox"/> Ja, ibland <input type="checkbox"/> Nej, aldrig Kommentar: Om ja, vilka?
Störs du av ljud <i>utomhus</i> i din vardag? (t.ex. bilar, flygplan, fåglar och djur etc.)	<input type="checkbox"/> Ja, ofta <input type="checkbox"/> Ja, ibland <input type="checkbox"/> Nej, aldrig Kommentar: Om ja, vilka?
Störs du av ljudet från produkter som någon i din närhet använder? (t.ex. ljudet från grannens gräsklippare när han/hon klipper gräset)	<input type="checkbox"/> Ja, ofta <input type="checkbox"/> Ja, ibland <input type="checkbox"/> Nej, aldrig Kommentar:

Fortsätt på nästa sida!

Har du lätt för att koncentrera dig oavsett vad som händer runt omkring dig?	<input type="checkbox"/> Ja, alltid <input type="checkbox"/> Ja, oftast <input type="checkbox"/> Nej, aldrig Kommentar:
Har du behov av fullständig tystnad?	<input type="checkbox"/> Ja, ofta <input type="checkbox"/> Ja, ibland <input type="checkbox"/> Nej, aldrig Kommentar:
Vänjer du dig vid de flesta ljud utan större svårighet.	<input type="checkbox"/> Ja, oftast <input type="checkbox"/> Ja, ibland <input type="checkbox"/> Nej, aldrig Kommentar:
Spelar du något instrument eller sjunger?	<input type="checkbox"/> Ja <input type="checkbox"/> Nej Kommentar:
Hur många lyssningsförsök har du tidigare deltagit i?	<input type="checkbox"/> Fler än 5 st <input type="checkbox"/> 3-5st <input type="checkbox"/> 1-2 st <input type="checkbox"/> Inga Kommentar:
Har du tidigare deltagit i sensoriska tester med avseende på <i>smak</i> ?	<input type="checkbox"/> Ja, fler än 2 ggr <input type="checkbox"/> Ja, 1-2 ggr <input type="checkbox"/> Nej, aldrig Kommentar:
Har du tidigare deltagit i sensoriska tester med avseende på <i>lukt</i> ?	<input type="checkbox"/> Ja, fler än 2 ggr <input type="checkbox"/> Ja, 1-2 ggr <input type="checkbox"/> Nej, aldrig Kommentar:

Följande frågor behandlar den "totala ljudkvaliteten" för några olika produktsegment. Med "totala ljudkvaliteten" menas alla ljud som produkten utsänder, dvs. även från knapptryckningar etc.

Vid köp av hemelektronik , hur avgörande är den <i>totala ljudkvaliteten</i> för vilken produkt du väljer? (t.ex. ljudanläggningar av olika slag, tv-apparater, digitalkameror etc.)	<input type="checkbox"/> Mycket avgörande <input type="checkbox"/> Något avgörande <input type="checkbox"/> Ej avgörande Kommentar:
Vid köp av hushållsmaskiner/vitvaror , hur avgörande är den <i>totala ljudkvaliteten</i> för vilken produkt du väljer? (t.ex. diskmaskin, tvättmaskin, elvisp, matberedare etc.)	<input type="checkbox"/> Mycket avgörande <input type="checkbox"/> Något avgörande <input type="checkbox"/> Ej avgörande Kommentar:
Vid köp av motorfordon , hur avgörande är den <i>totala ljudkvaliteten</i> för vilken produkt du väljer? (t.ex. bil, motorcykel, moped etc.)	<input type="checkbox"/> Mycket avgörande <input type="checkbox"/> Något avgörande <input type="checkbox"/> Ej avgörande Kommentar:

Fortsätt på nästa sida!

Har du möjlighet att delta i vidare försök för mitt examensarbete som behandlar ljudkvalitet och sensoriska paneler?

Ja Nej

Kommentar:

Har du ytterligare synpunkter på frågeformuläret och dess frågor så skriv dem gärna här.

.....

Nu behöver du bara spara dokumentet och bifoga det i ett mail till jonas.wallgren@sik.se

Tack för att du tog dig tid att besvara mina frågor!

/Jonas Wallgren

Appendix D – Questionnaire Answers

Kod	Kön	Födelseår	Har du svenska som modersmål?	Vad är din huvudsakliga sysselsättning?	Vilken hörselnivå anser du att du har?	Har du tidigare haft problem med hörseln?	Har du nu eller tidigare haft problem med synen?
SIK_01	████	██	Ja	Arbete/Studier	Normal	Nej	Nej*
SIK_02	████	██	Ja	Arbete	Normal	Nej	N/A
SIK_03	████	██	Ja	Annat	Normal	Nej	Nej
SIK_04	████	██	Ja	Annat	Normal	Nej	Nej
SIK_05	██	██	Ja	Annat	Över normal	Nej	Nej
SIK_06	██	██	Ja	Arbete	Normal	Nej	Ja, nu*
SIK_07	████	██	Ja	Arbete	Normal	Ja*	Nej
SIK_08	████	██	Ja	Arbete	Normal	Nej	Nej
SIK_09	██	██	Ja	Arbete	Normal	Nej	Nej
SIK_10	████	██	Ja	Arbete	Normal	Nej*	Nej
SIK_11	████	██	Ja	Annat	Över normal	Nej	Nej
SIK_12	████	██	Ja	Annat	Under normal*	Nej	Nej
SIK_13	██	██	Ja	Arbete	Under normal	Ja*	Nej
SIK_14	████	██	Ja	Arbete	Normal	Nej	Nej
SIK_15	████	██	Nej*	Arbete	Normal	Nej	Nej
SIK_16	██	██	N/A	N/A	N/A	N/A	N/A
SIK_17	████	██	Ja	Arbete	Normal/Under normal*	Nej*	Nej
SIK_18	████	██	Ja	Arbete	Normal	Nej	Nej
SIK_19	████	██	Ja	Arbete/Annat	Normal	Nej	Nej
SIK_20	████	██	Ja	Arbete	Normal*	Nej	Nej
SIK_21	████	██	Nej*	Arbete	Över normal	Nej	Nej
SIK_22	██	██	Ja	Arbete	Över normal	Nej	N/A
SIK_23	████	██	Ja	Annat	Över normal*	Nej	Nej
CTH_01	██	██	Ja	Studier	Normal	Nej	Nej
CTH_02	████	██	Ja	Annat	Normal	Nej	Nej
CTH_03	████	██	Ja	Arbete/Studier	Normal	Nej	Nej
CTH_04	██	██	Ja	Annat	Normal	Nej	Nej
CTH_05	██	██	Ja	Studier	Normal	Nej	Nej
CTH_06	██	██	Ja/Nej*	Annat	Under normal	Nej	Nej
CTH_07	████	██	Ja	Arbete	Normal	Nej	Nej
CTH_08	████	██	Ja	Studier	Normal	Nej	Nej
CTH_09	████	██	Nej	Arbete	Normal	Ja*	Nej
CTH_10	████	██	Ja	Studier	Normal	Nej	Nej*
CTH_11	████	██	Ja	Studier	Normal	Nej	Ja, nu*
CTH_12	████	██	Ja	Studier	Normal	Nej	Nej
CTH_13	██	██	Ja	Studier	Normal	Nej	Nej
CTH_14	████	██	Ja	Arbete	Normal	Nej	Ja, nu*
CTH_15	████	██	Ja	Studier	Normal	Nej	Nej

* Answer had additional comments to it.

Kod	Är du särskilt uppmärksam på ljud i din omgivning?	Störs du av ljud inomhus i din vardag?	Störs du av ljud utomhus i din vardag?	Störs du av ljudet från produkter som någon i din närhet använder?	Har du lätt för att koncentrera dig oavsett vad som händer runt omkring dig?	Har du behov av fullständig tystnad?	Vänjer du dig vid de flesta ljud utan större svårigheter?	Spelar du något instrument eller sjunger?
SIK_01	Ja*	Ja, ibland	Ja, ibland	Ja, ibland	Ja, oftast	Ja, ofta	Ja, ibland	Nej
SIK_02	Nej	Ja, ibland*	Ja, ibland*	Nej, aldrig	Ja, alltid	Nej, aldrig	Ja, oftast	Nej
SIK_03	Nej	Nej, aldrig	Nej, aldrig	Nej, aldrig	Ja, oftast	Nej, aldrig	Ja, oftast	Nej
SIK_04	Ja	Nej, aldrig	Nej, aldrig	Ja, ibland	Ja, oftast	Ja, ibland	Ja, oftast	Nej
SIK_05	Ja*	Ja, ibland*	Ja, ibland*	Ja, ibland*	Ja, oftast	Nej, aldrig	Ja, oftast	Ja
SIK_06	Nej	Ja, ibland*	Ja, ibland*	Ja, ibland	Ja, oftast	Nej, aldrig*	Ja, ibland	Nej*
SIK_07	Ja*	Ja, ibland*	Ja, ibland*	Nej, aldrig	Ja, oftast	Ja, ibland	Ja, ibland*	Nej
SIK_08	Ja	Ja, ibland*	Ja, ibland*	Ja, ibland	Ja, alltid	Nej, aldrig	Ja, oftast	Nej
SIK_09	Ja*	Ja, ofta*	Ja, ibland*	Ja, ibland*	Nej, aldrig	Ja, ofta	Ja, ibland	Ja*
SIK_10	Ja	Ja, ofta*	Nej, aldrig	Ja, ibland*	Nej, aldrig*	Ja, ibland*	Ja, ibland	Nej
SIK_11	Ja	Ja, ibland*	Ja, ibland*	Ja, ibland*	Ja, oftast*	Nej, aldrig*	Ja, ibland	Ja
SIK_12	Ja	Ja, ibland*	Ja, ibland*	Ja, ibland	Ja, oftast	Ja, ibland	Ja, ibland	Nej*
SIK_13	Nej	Nej, aldrig	Ja, ibland*	Nej, aldrig	Ja, alltid	Nej, aldrig	Ja, oftast	Ja*
SIK_14	Nej	Ja, ibland*	Ja, ibland*	Nej, aldrig	Ja, alltid	Nej, aldrig	Ja, oftast	Nej
SIK_15	Ja	Ja, ibland*	Ja, ibland*	Ja, ibland	Ja, alltid	Ja, ibland	Ja, oftast	Nej
SIK_16	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
SIK_17	Nej*	Nej, aldrig	N/A	Ja, ibland	ja, oftast	Ja, ofta	Ja, ibland	Nej
SIK_18	Nej*	Ja, ibland*	Ja, ibland*	Ja, ibland*	Ja, oftast	Ja, ibland	Ja, oftast	Nej
SIK_19	Nej	Nej, aldrig	Nej, aldrig	Nej, aldrig	Ja, alltid/Ja, oftast	Ja, ibland	Ja, oftast	Ja*
SIK_20	Ja*	Ja, ofta*	Ja, ibland*	Ja, ibland*	Nej, aldrig*	Ja, ofta	Nej, aldrig*	Nej
SIK_21	Ja	Nej, aldrig	Nej, aldrig	Nej, aldrig	Nej, aldrig	Nej, aldrig	Ja, oftast	Nej
SIK_22	Ja	Ja, ofta*	Nej, aldrig	Ja, ibland*	Ja, oftast	Nej, aldrig	Ja, oftast	Ja
SIK_23	Ja*	Ja, ibland*	Ja, ibland*	Ja, ibland	Nej, aldrig*	Ja, ibland*	Ja, ibland*	Nej
CTH_01	Nej	Ja, ibland	Ja, ibland	Ja, ibland	Ja, oftast	Nej, aldrig	Ja, ibland	Nej*
CTH_02	Ja	Ja, ofta	Ja, ibland	Ja, ofta	Ja, oftast	Ja, ibland	Ja, ibland	Nej
CTH_03	Ja*	Ja, ibland*	Nej, aldrig	Ja, ibland	Ja, oftast	Nej, aldrig*	Ja, oftast	Ja
CTH_04	Ja	Ja, ibland	Ja, ibland	Nej, aldrig	Nej, aldrig	Ja, ibland	Ja, oftast	Nej
CTH_05	Ja	Nej, aldrig	Nej, aldrig	Ja, ibland	Ja, oftast	Nej, aldrig	Ja, oftast/Ja, ibland*	Nej
CTH_06	Ja	Ja, ibland	Ja, ibland	Nej, aldrig	Nej, aldrig	Nej, aldrig	Ja, oftast	Nej
CTH_07	Ja	N/A	Nej, aldrig	Nej, aldrig	Ja, oftast	Nej, aldrig	Ja, oftast	Ja
CTH_08	Ja	Ja, ibland	Ja, ibland	Ja, ibland	Ja, oftast	Nej, aldrig	Ja, ibland	Ja
CTH_09	Nej	Ja, ibland	Ja, ibland	Ja, ibland	Nej, aldrig	Ja, ofta	Ja, ibland	Ja*
CTH_10	Ja*	Nej, aldrig*	Nej, aldrig*	Nej, aldrig*	Ja, oftast*	Nej, aldrig	Ja, oftast	Nej*
CTH_11	Nej	Nej, aldrig	Nej, aldrig	Nej, aldrig	Ja, oftast	Nej, aldrig	Ja, oftast	Nej
CTH_12	Nej	Ja, ibland*	Ja, ibland*	Ja, ibland*	Ja, oftast*	Ja, ibland*	Ja, ibland*	Ja*
CTH_13	Ja	Ja, ibland*	Ja, ibland*	Ja, ibland*	Ja, oftast	Ja, ibland	Ja, ibland	Nej
CTH_14	Ja	Ja, ibland	Ja, ibland	Ja, ibland	Ja, oftast	Ja, ibland	Ja, oftast	Ja
CTH_15	Nej	Nej, aldrig	Ja, ibland	Ja, ibland	Ja, oftast	Ja, ibland	Ja, oftast	Ja*

* Answer had additional comments to it.

Kod	Har du tidigare deltagit i sensoriska tester med avseende på hörsel?	Hur många lyssningsförsök har du tidigare deltagit i?	Har du tidigare deltagit i sensoriska tester med avseende på smak?	Har du tidigare deltagit i sensoriska tester med avseende på lukt?
SIK_01	Nej, aldrig			
SIK_02	Nej, aldrig			
SIK_03	Nej, aldrig			
SIK_04	Nej, aldrig			
SIK_05	Ja, 1-2 ggr*			
SIK_06	Nej, aldrig			
SIK_07	Nej, aldrig			
SIK_08	Nej, aldrig			
SIK_09	Nej, aldrig			
SIK_10	Nej, aldrig			
SIK_11	Nej, aldrig			
SIK_12	Nej, aldrig			
SIK_13	Nej, aldrig			
SIK_14	Nej, aldrig			
SIK_15	Nej, aldrig			
SIK_16	N/A			
SIK_17	Nej, aldrig			
SIK_18	Nej, aldrig			
SIK_19	Nej, aldrig			
SIK_20	Nej, aldrig			
SIK_21	Nej, aldrig			
SIK_22	Ja, 1-2 ggr			
SIK_23	Nej, aldrig			
CTH_01		Fler än 5 st	Nej, aldrig	Nej, aldrig
CTH_02		3-5st	Nej, aldrig	Nej, aldrig
CTH_03		Fler än 5 st	Nej, aldrig	Nej, aldrig
CTH_04		3-5st	Ja, 1-2 ggr	Ja, 1-2 ggr
CTH_05		3-5st	Ja, 1-2 ggr	Nej, aldrig
CTH_06		3-5st	Nej, aldrig	Nej, aldrig
CTH_07		Fler än 5 st	Nej, aldrig	Ja, 1-2 ggr
CTH_08		Fler än 5 st	Nej, aldrig	Nej, aldrig
CTH_09		Fler än 5 st	Nej, aldrig	Nej, aldrig
CTH_10		3-5st	Nej, aldrig*	Nej, aldrig*
CTH_11		Inga	Nej, aldrig	Nej, aldrig
CTH_12		Inga	Nej, aldrig	Nej, aldrig
CTH_13		Inga	Ja, fler än 2 ggr	Nej, aldrig
CTH_14		Fler än 5 st	Nej, aldrig	Nej, aldrig
CTH_15		Inga	Ja, fler än 2 ggr*	Nej, aldrig

* Answer had additional comments to it.

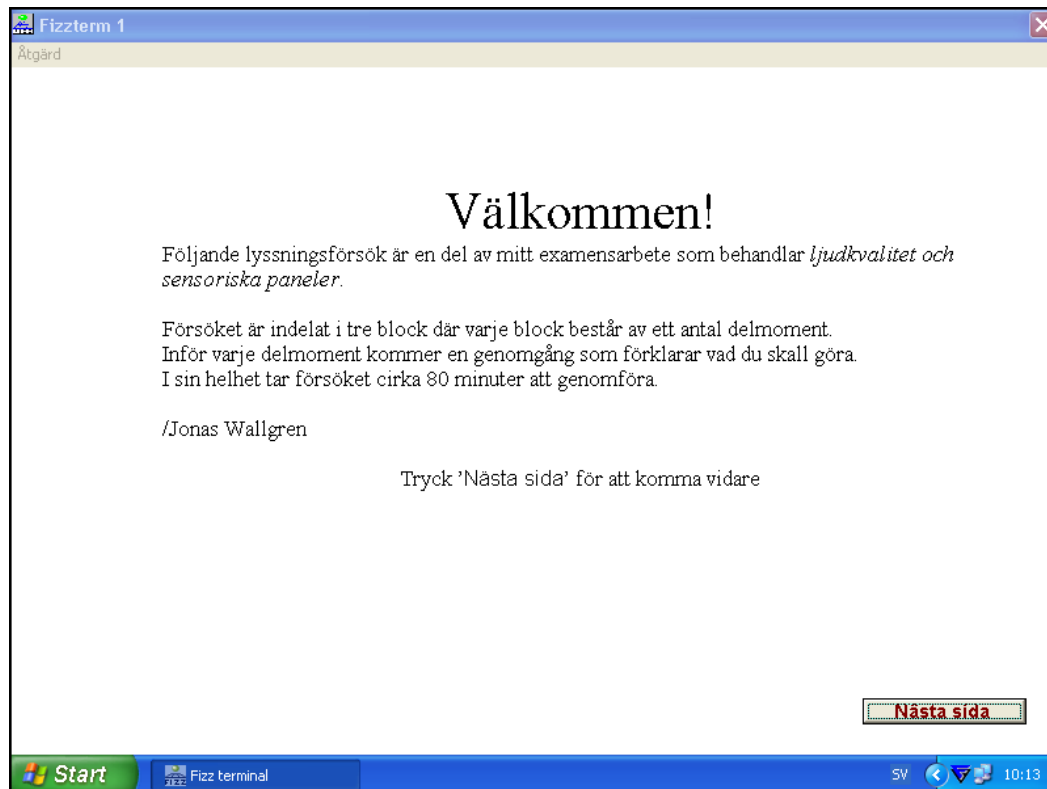
Kod	Vid köp av hemelektronik, hur avgörande är den totala ljudkvaliteten för vilken produkt du väljer?	Vid köp av hushållsmaskiner/vitvaror, hur avgörande är den totala ljudkvaliteten för vilken produkt du väljer?	Vid köp av motorfordon, hur avgörande är den totala ljudkvaliteten för vilken produkt du väljer?
SIK_01	Något avgörande	Något avgörande	Något avgörande
SIK_02	Mycket avgörande	Mycket avgörande	Något avgörande
SIK_03	Mycket avgörande	Mycket avgörande	Mycket avgörande
SIK_04	Något avgörande	Mycket avgörande	Ej avgörande
SIK_05	Något avgörande	Mycket avgörande	Mycket avgörande
SIK_06	Ej avgörande	Mycket avgörande	Ej avgörande
SIK_07	Något avgörande	Något avgörande	Något avgörande
SIK_08	Mycket avgörande	Mycket avgörande	Något avgörande
SIK_09	Något avgörande*	Något avgörande	Ej avgörande
SIK_10	Ej avgörande*	Ej avgörande	Ej avgörande
SIK_11	Mycket avgörande	Mycket avgörande	Mycket avgörande
SIK_12	Något avgörande	Mycket avgörande	Mycket avgörande
SIK_13	Ej avgörande	Något avgörande	Ej avgörande*
SIK_14	Ej avgörande	Något avgörande	Ej avgörande*
SIK_15	Något avgörande	Något avgörande	Något avgörande
SIK_16	N/A	N/A	N/A
SIK_17	Ej avgörande	Ej avgörande	Ej avgörande
SIK_18	Ej avgörande	Ej avgörande	Ej avgörande
SIK_19	Något avgörande	Mycket avgörande	N/A
SIK_20	Något avgörande	Något avgörande*	Något avgörande*
SIK_21	Mycket avgörande	Mycket avgörande	Något avgörande
SIK_22	Mycket avgörande	Ej avgörande	Mycket avgörande
SIK_23	Ej avgörande*	Något avgörande*	Ej avgörande*
CTH_01	Något avgörande	Något avgörande	Något avgörande
CTH_02	Något avgörande	Något avgörande	Mycket avgörande
CTH_03	Mycket avgörande	Något avgörande	Något avgörande
CTH_04	Mycket avgörande	Något avgörande	Ej avgörande
CTH_05	Något avgörande	Ej avgörande	Ej avgörande
CTH_06	Något avgörande	Något avgörande	Något avgörande/Ej avgörande
CTH_07	Mycket avgörande	Något avgörande	Något avgörande
CTH_08	Något avgörande	Ej avgörande	Ej avgörande
CTH_09	Ej avgörande	Något avgörande	Ej avgörande
CTH_10	Mycket avgörande*	Mycket avgörande*	Något avgörande*
CTH_11	Något avgörande	Något avgörande	Något avgörande
CTH_12	Ej avgörande*	Ej avgörande*	Ej avgörande*
CTH_13	Mycket avgörande	Mycket avgörande	Mycket avgörande
CTH_14	Något avgörande	Något avgörande	Något avgörande
CTH_15	Något avgörande	Något avgörande	Något avgörande

* Answer had additional comments to it.

Appendix E – Audiometric Test Results

Assessor	125Hz		250Hz		500Hz		750Hz		1000Hz		1500Hz		2000Hz		3000Hz		4000Hz		6000Hz		8000Hz		Mean: 125-8000Hz
	V	H	V	H	V	H	V	H	V	H	V	H	V	H	V	H	V	H	V	H	V	H	
SIK_01	20	25	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20,23
SIK_02	20	20	20	20	20	20	20	20	25	20	20	20	20	20	25	25	25	20	30	20	20	20	21,36
SIK_03	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	25	20	20	20,23
SIK_04	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20,00
SIK_05	20	20	20	20	20	20	20	20	30	20	25	25	35	20	30	25	25	20	25	20	60	35	25,23
SIK_06	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	25	20	40	20	20	20	20	21,14
SIK_07	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	25	25	25	20	20,68
SIK_08	25	20	20	20	20	20	20	20	20	20	20	25	20	20	20	20	40	20	60	60	70	30	27,73
SIK_09	20	20	20	20	20	20	20	20	20	20	20	20	20	20	25	20	30	20	25	20	35	20	21,59
SIK_10	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	25	20	20	20	20,23
SIK_11	20	20	20	20	20	25	20	20	20	20	20	20	20	20	20	20	20	20	20	25	20	35	21,14
SIK_12	35	40	25	35	25	30	20	30	25	45	25	40	20	40	35	30	25	35	20	50	25	45	31,82
SIK_13	20	20	20	20	20	20	20	25	30	20	35	20	20	20	30	25	40	25	20	25	20	30	23,86
SIK_14	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	30	20	30	20	20	20,91
SIK_15	20	20	20	25	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20,23
SIK_16	25	20	40	20	30	20	20	20	20	20	20	20	20	20	20	20	35	30	25	25	20	35	23,86
SIK_17	30	25	25	30	25	25	25	30	35	30	20	30	30	25	25	25	30	20	30	20	25	20	26,36
SIK_18	20	20	20	20	20	20	20	20	20	20	20	30	20	20	25	20	20	20	20	30	20	20	21,14
SIK_19	20	20	20	20	20	20	20	20	20	20	25	20	25	20	20	20	20	20	20	25	20	30	21,14
CTH_01	20*	20*	20*	20*	20*	20*	20*	20*	20*	20*	20*	20*	20*	20*	20*	20*	20*	20*	20*	20*	20*	20*	20,00*
CTH_03	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	25	20	20	20,23
CTH_04	20*	20*	20*	20*	20*	20*	20*	20*	20*	20*	20*	20*	20*	20*	20*	20*	20*	20*	20*	20*	20*	20*	20,00*
CTH_06	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20,00
CTH_07	20*	20*	20*	20*	20*	20*	20*	20*	20*	20*	20*	20*	20*	20*	20*	20*	20*	20*	20*	20*	20*	20*	20,00*
CTH_10	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	25	20	20	20	20,23
CTH_12	20	20	20	20	20	25	20	20	20	20	20	20	20	20	20	20	20	20	30	20	20	20	20,68
CTH_13	20	20	20	20	25	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20,23
CTH_14	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20,00
CTH_15	20	20	25	25	25	20	20	20	20	20	20	20	25	20	25	20	25	20	20	20	20	20	21,36

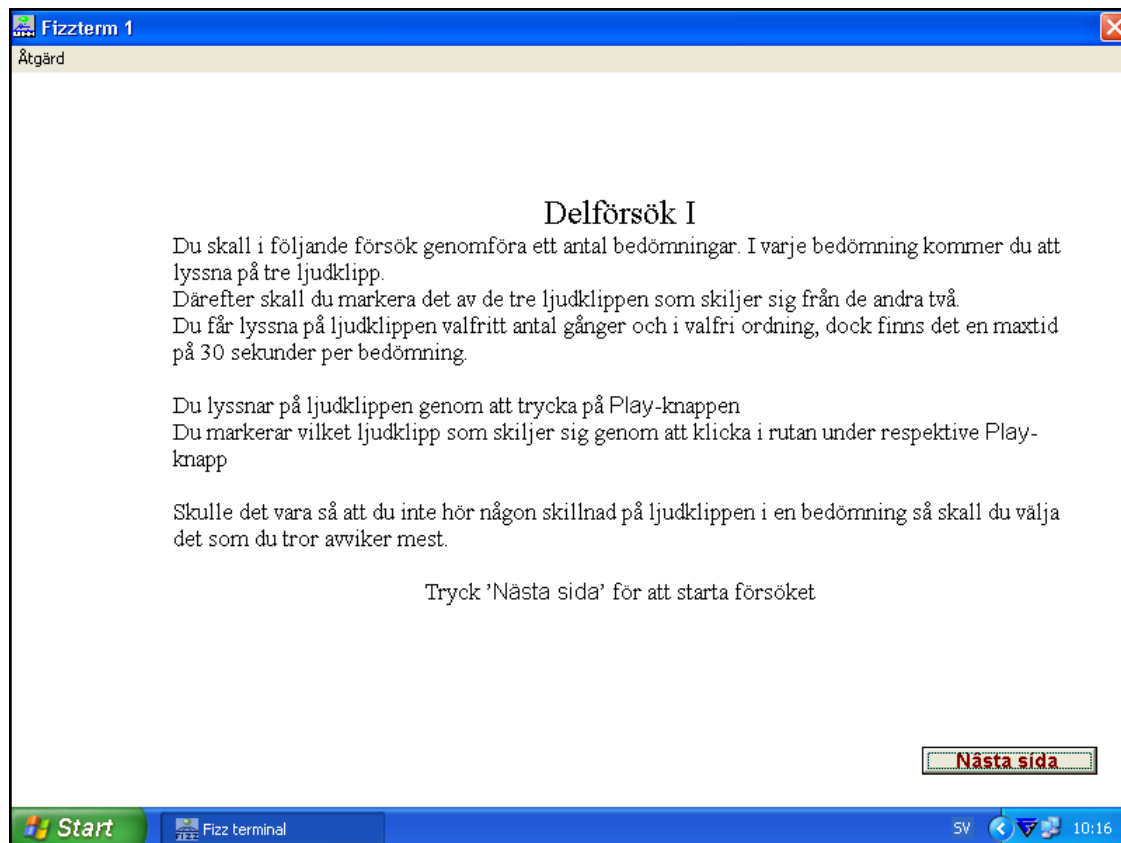
Appendix F – Listening Test



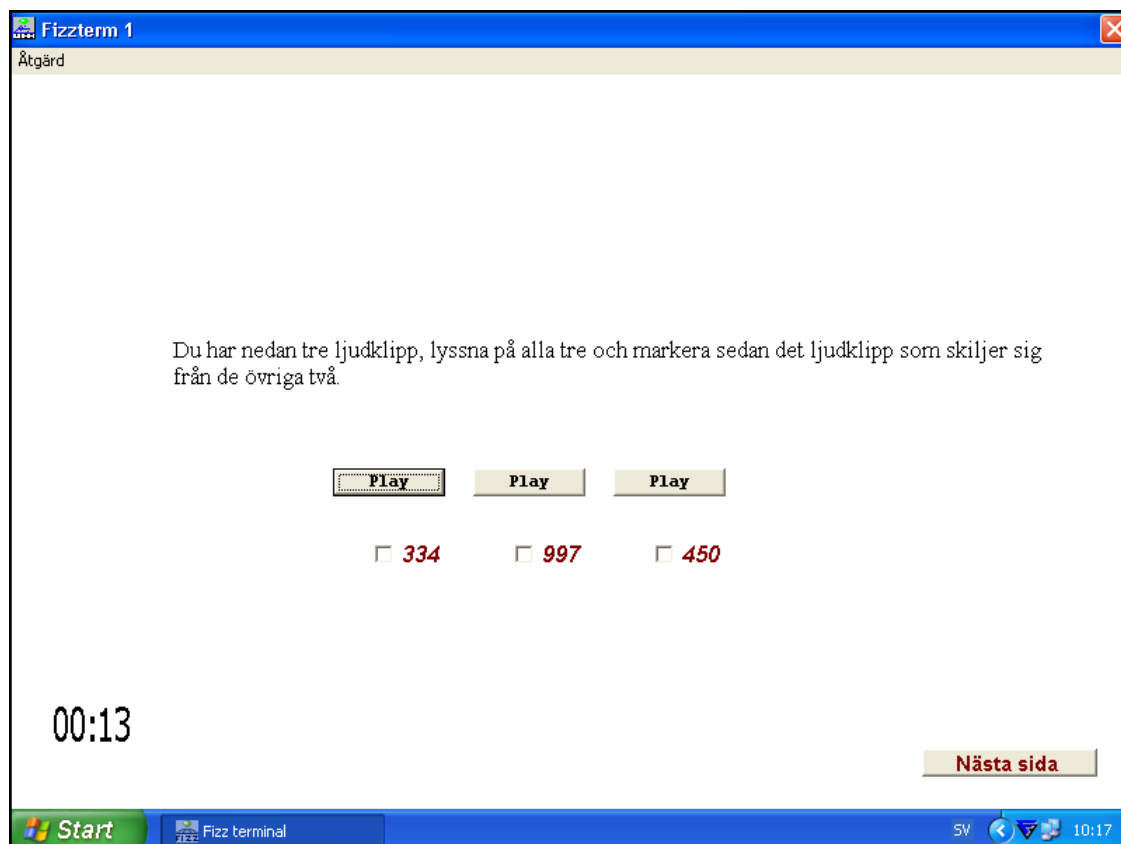
i : Welcome page



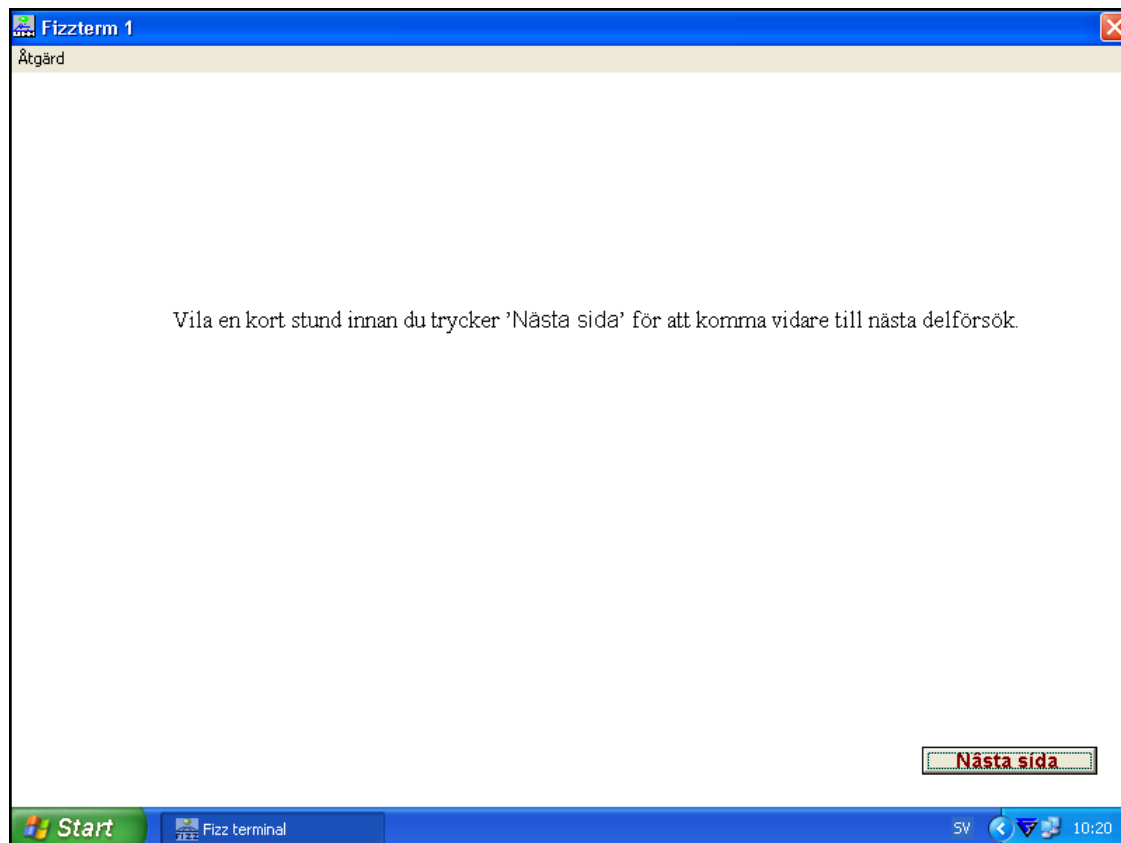
ii : Instructions



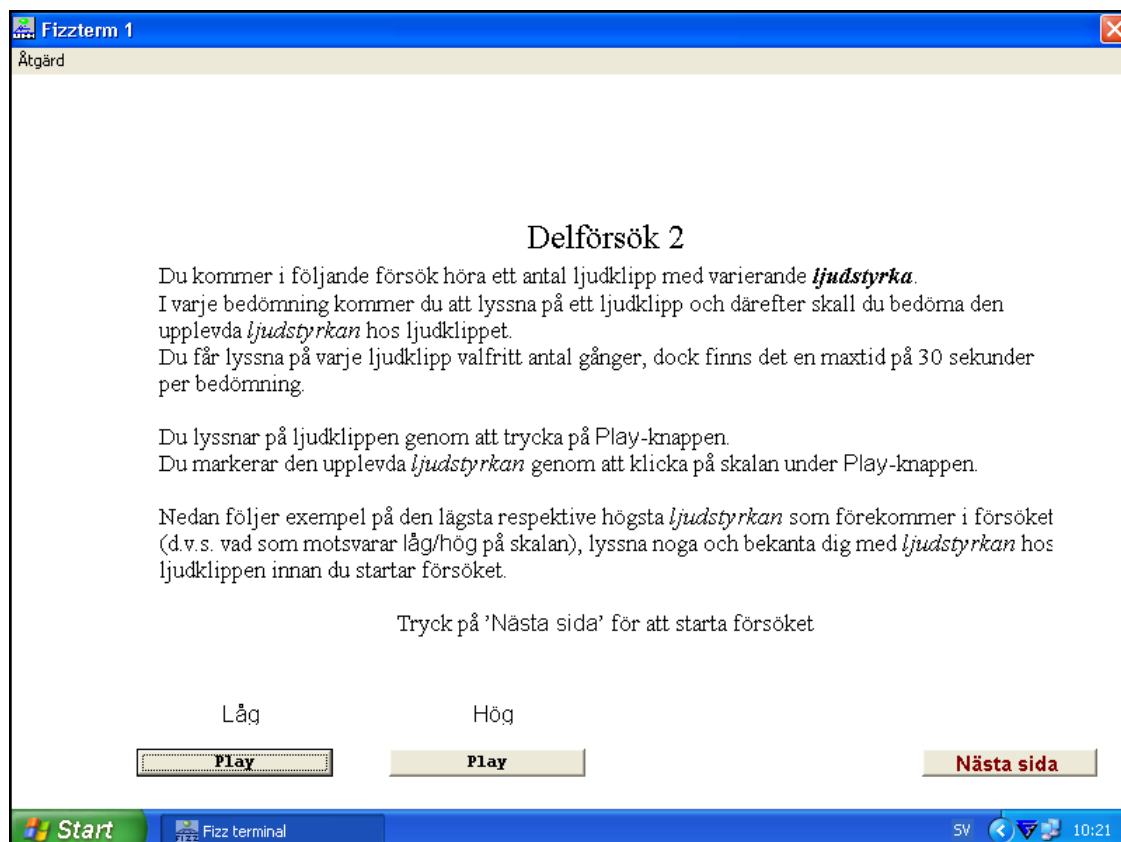
iii : Instructions Part I



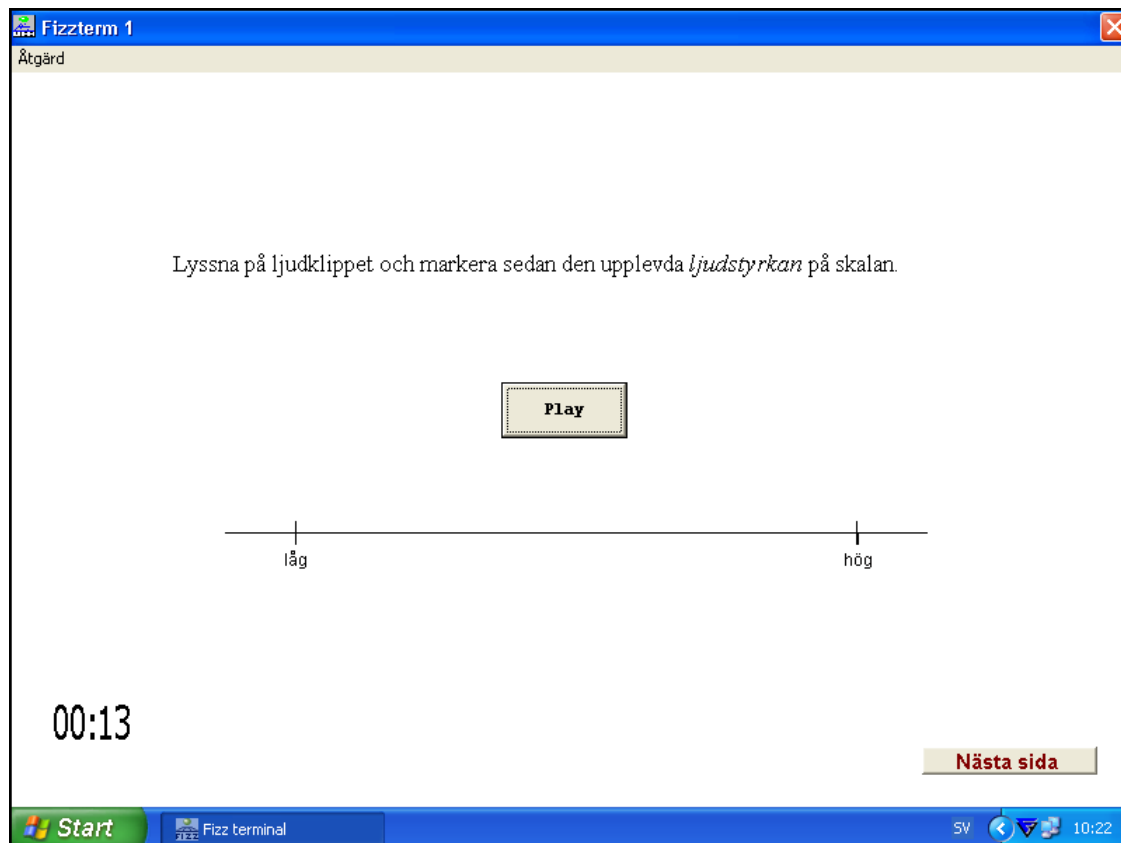
iv : Judgement Part I, repeated 24 times



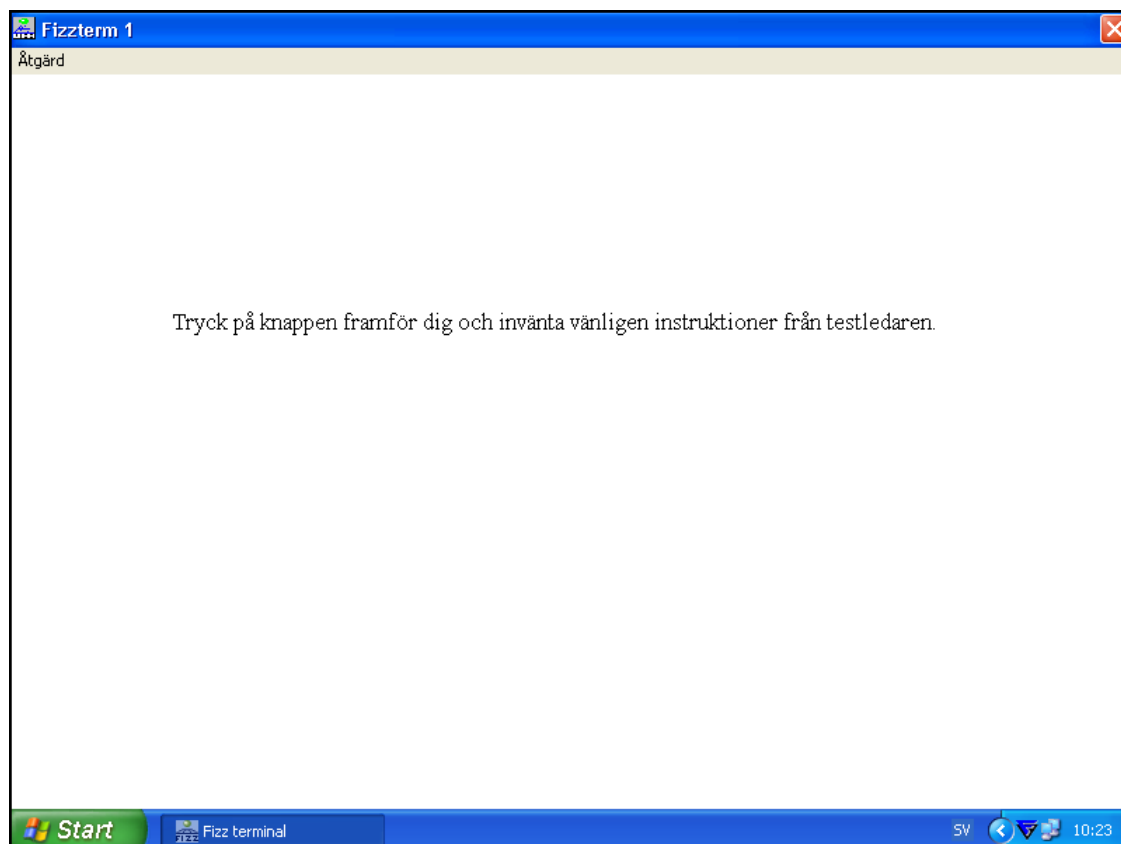
v : End of Part I



vi : Instructions Part II



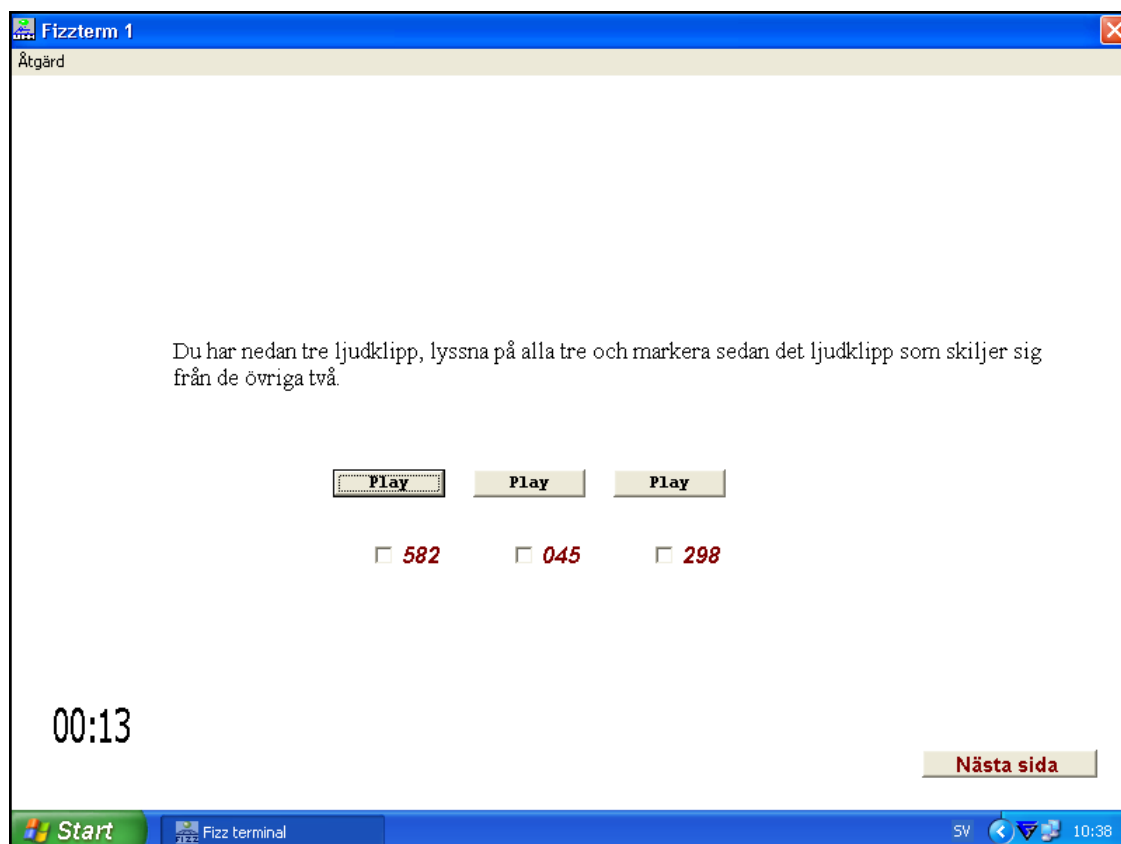
vii : Judgement Part II, repeated 15 times



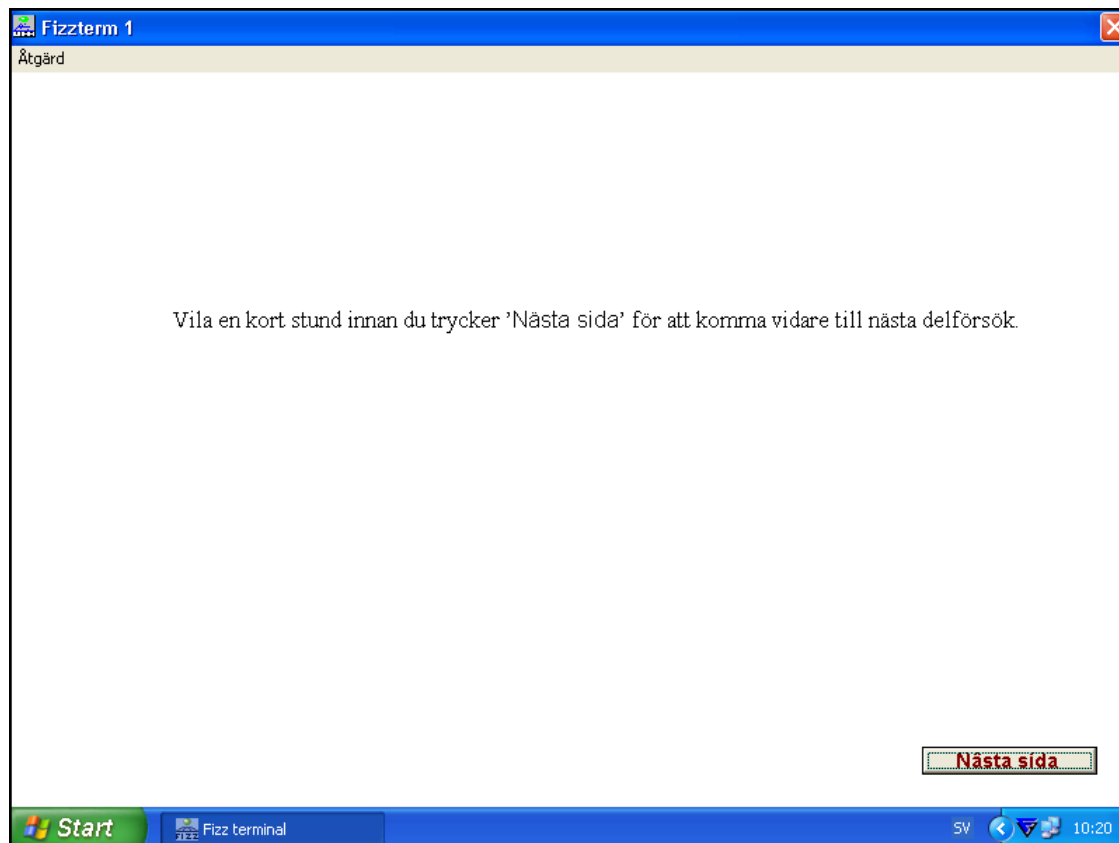
viii : End of Part II and Block I



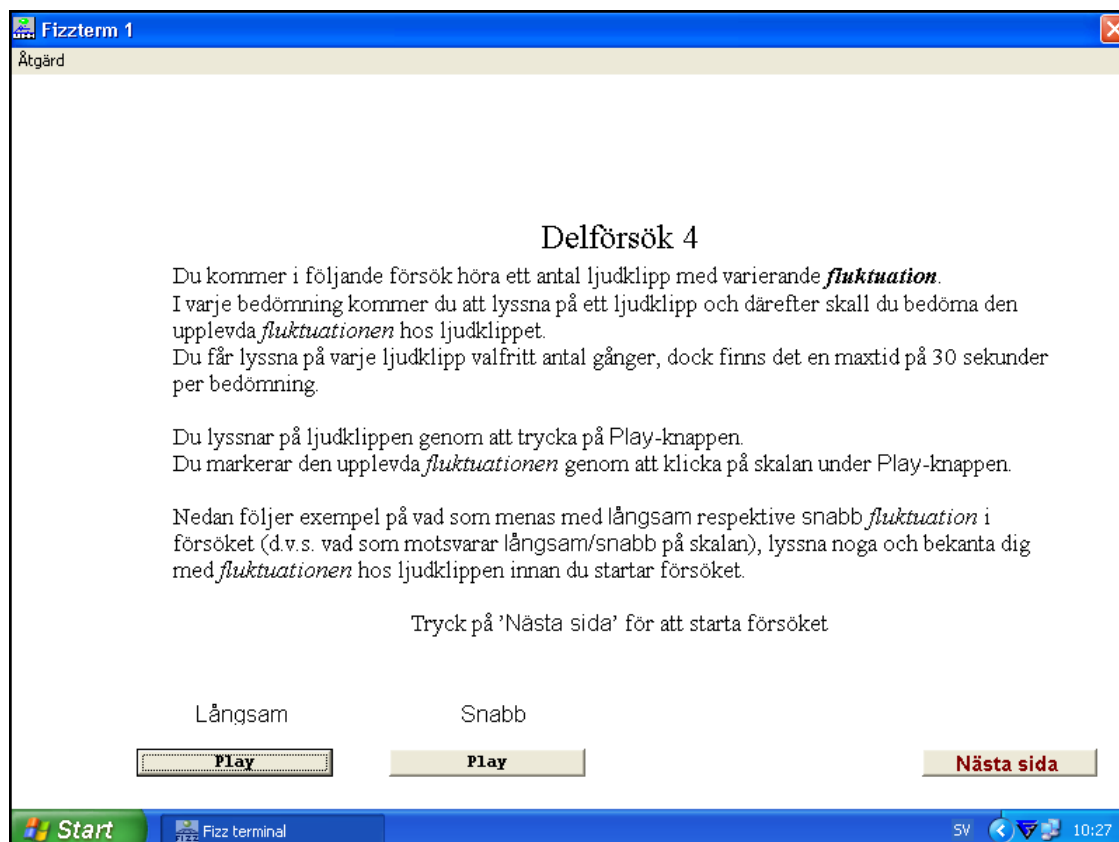
ix : Instructions Part III



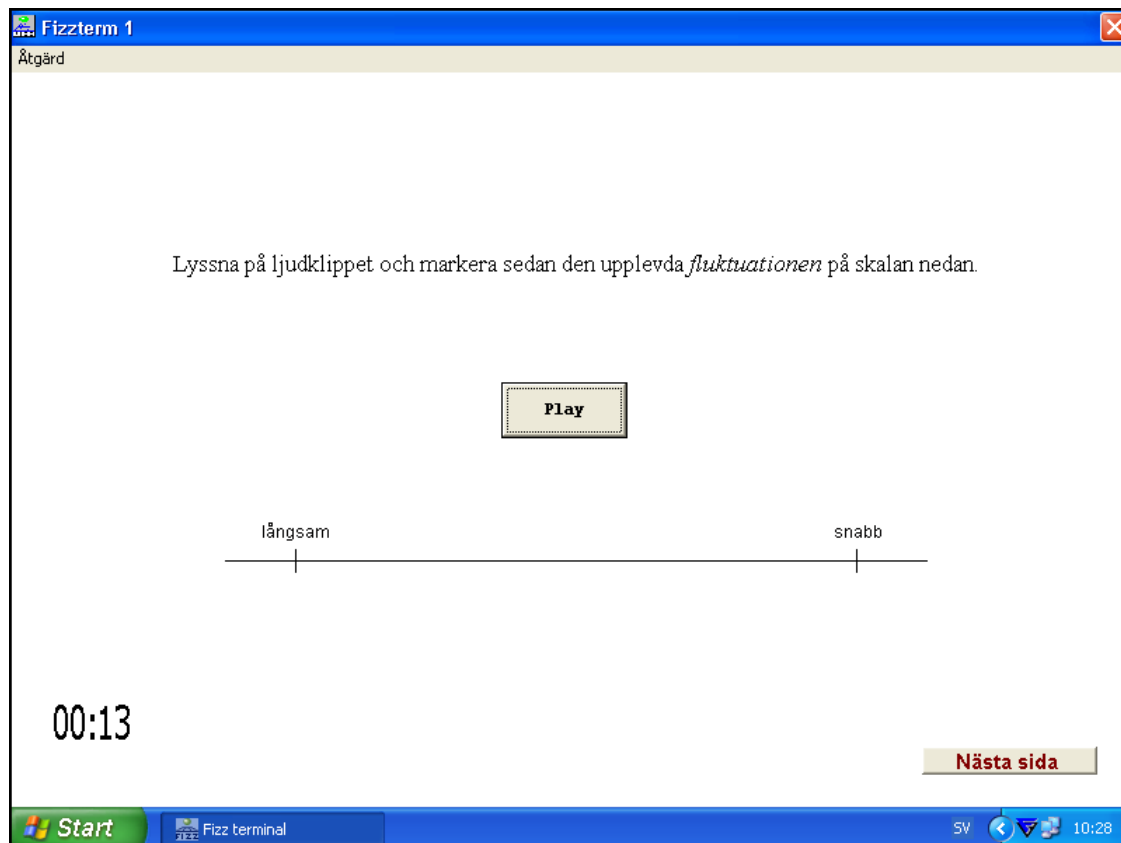
x : Judgement Part III, repeated 24 times



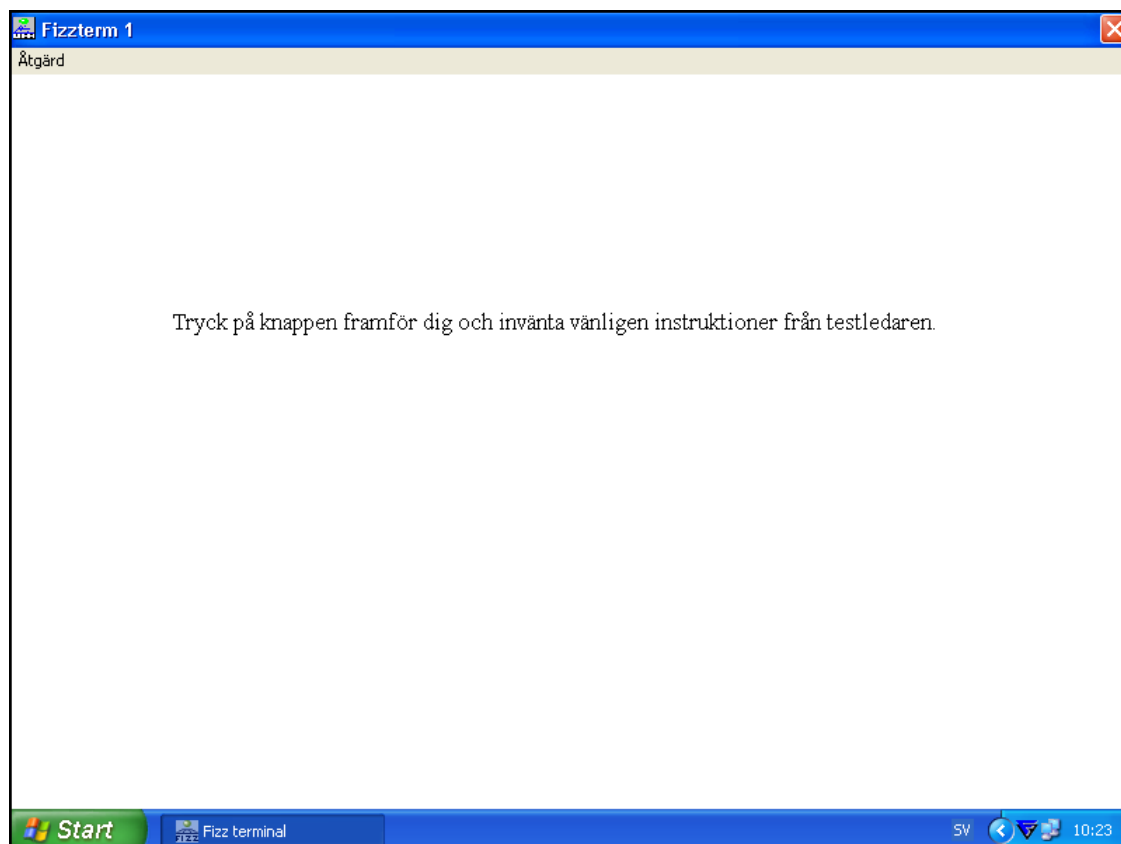
xi : End of Part III



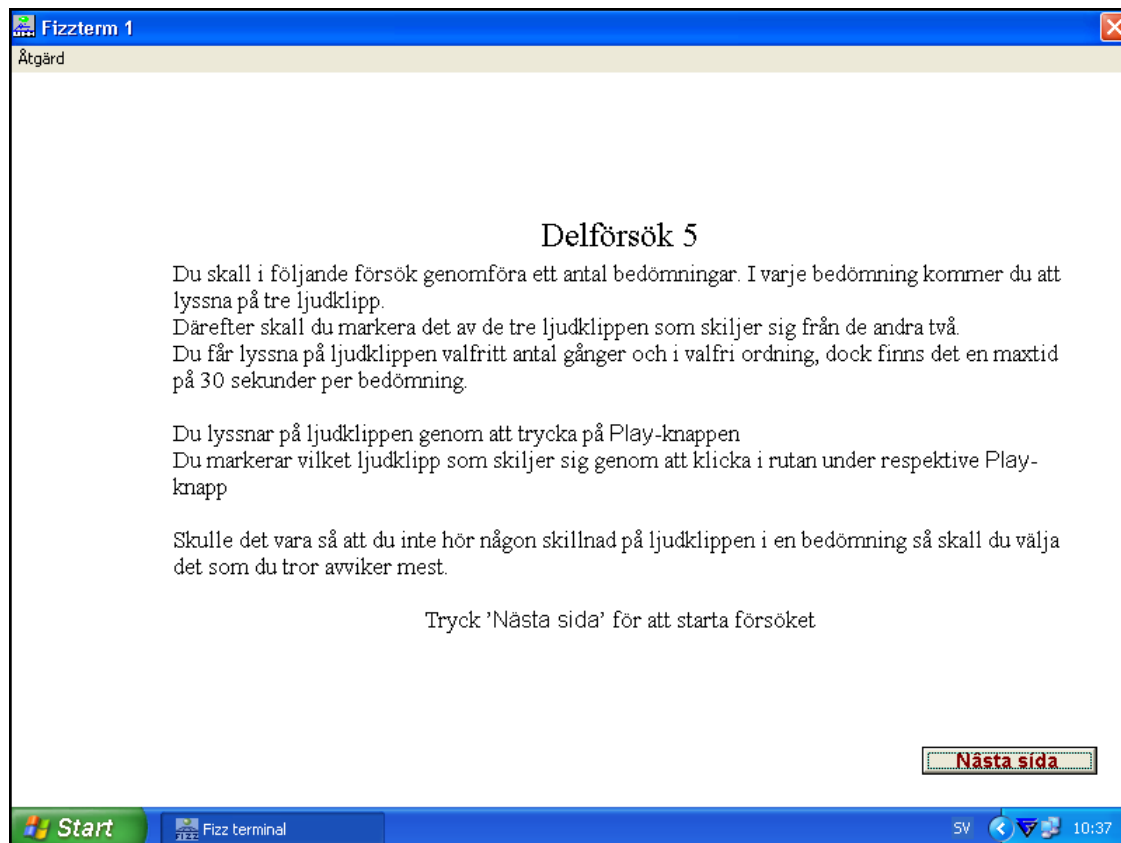
xii : Instructions Part IV



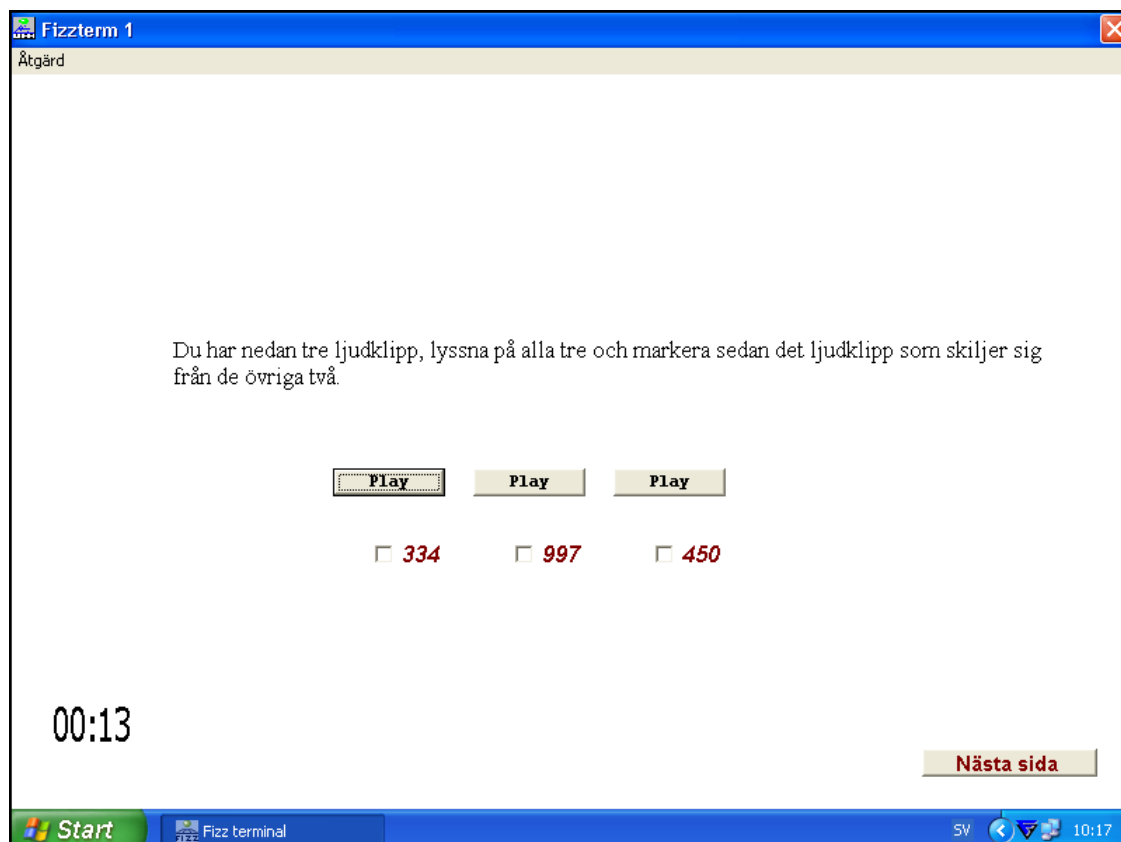
xiii : Judgement Part IV, repeated 15 times



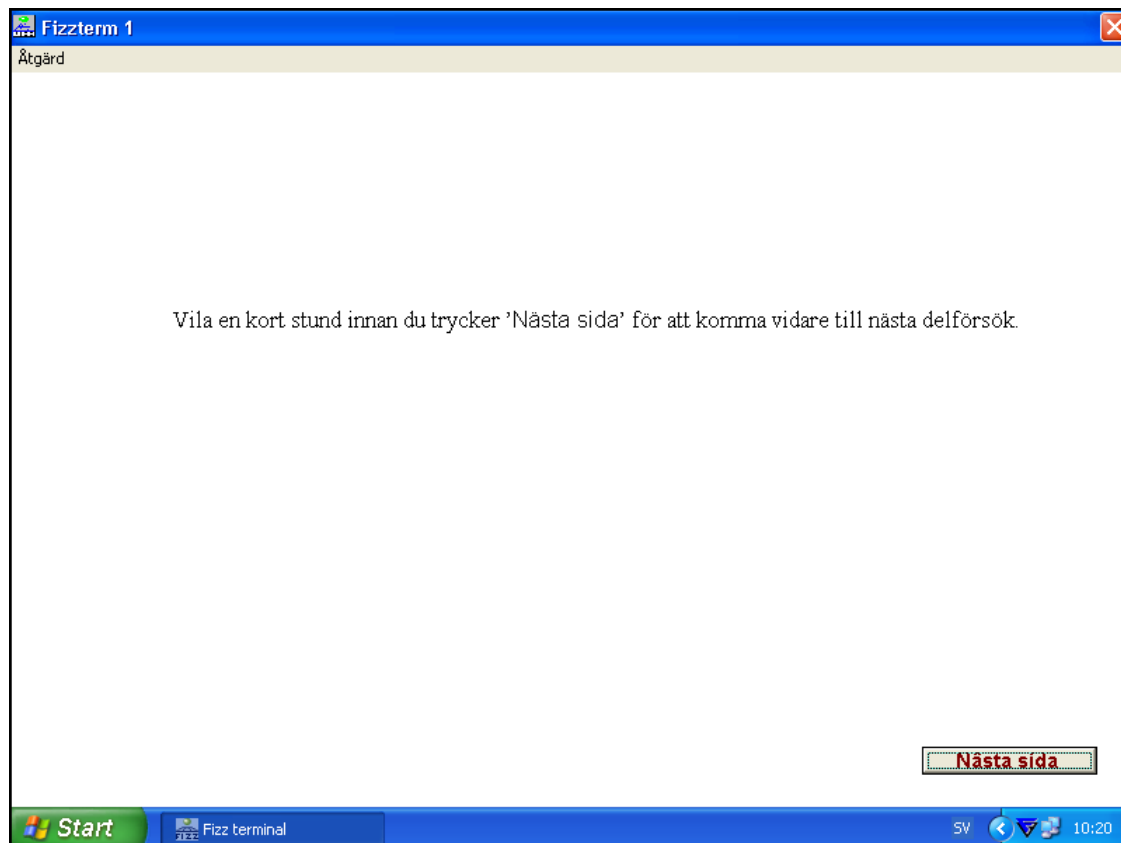
xiv : End of Part IV and Block II



xv : Instructions Part V



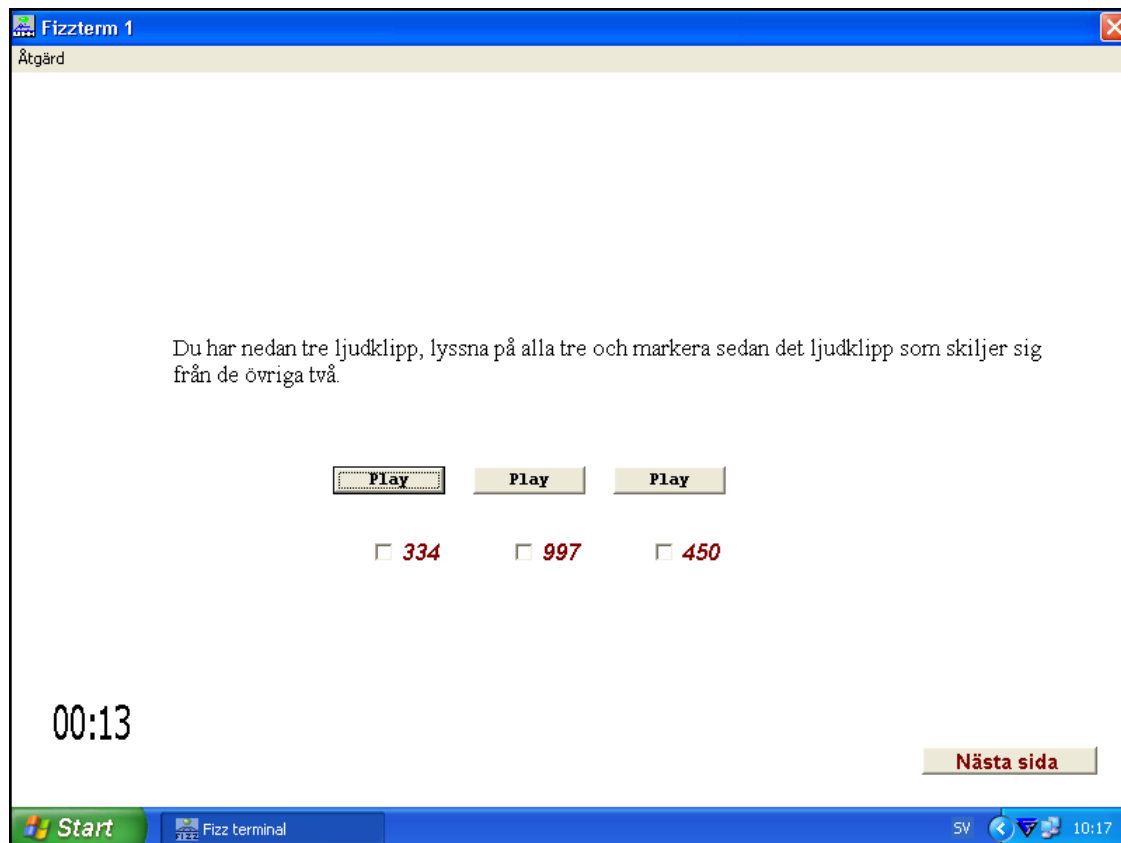
xvi : Judgement Part V, repeated 24 times



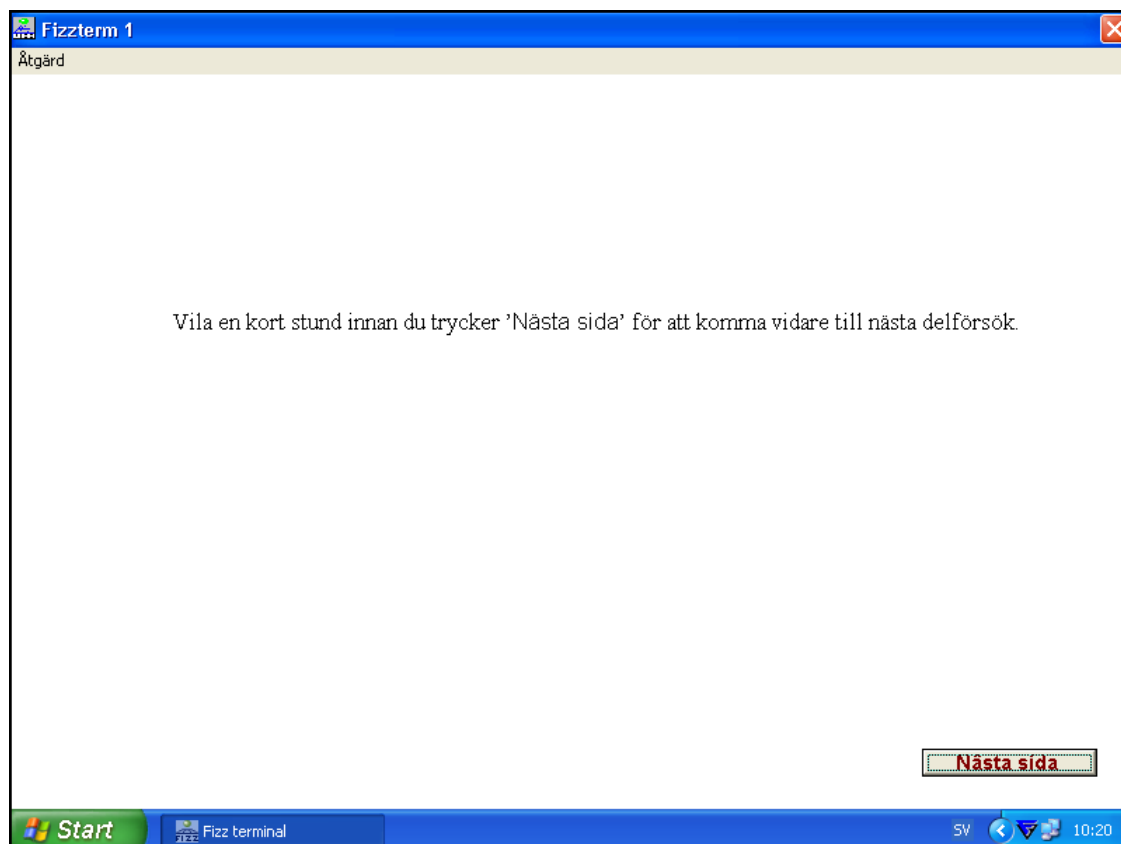
xvii : End Part V



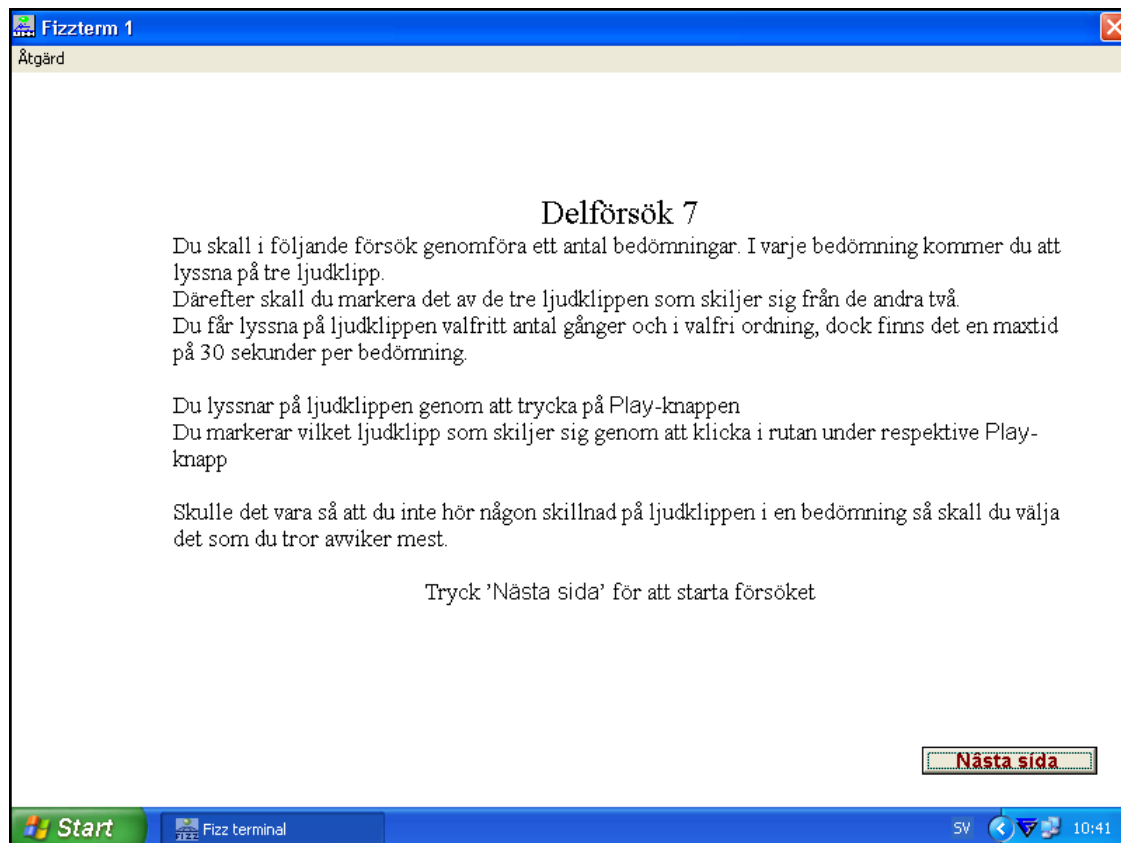
xviii : Instructions Part VI



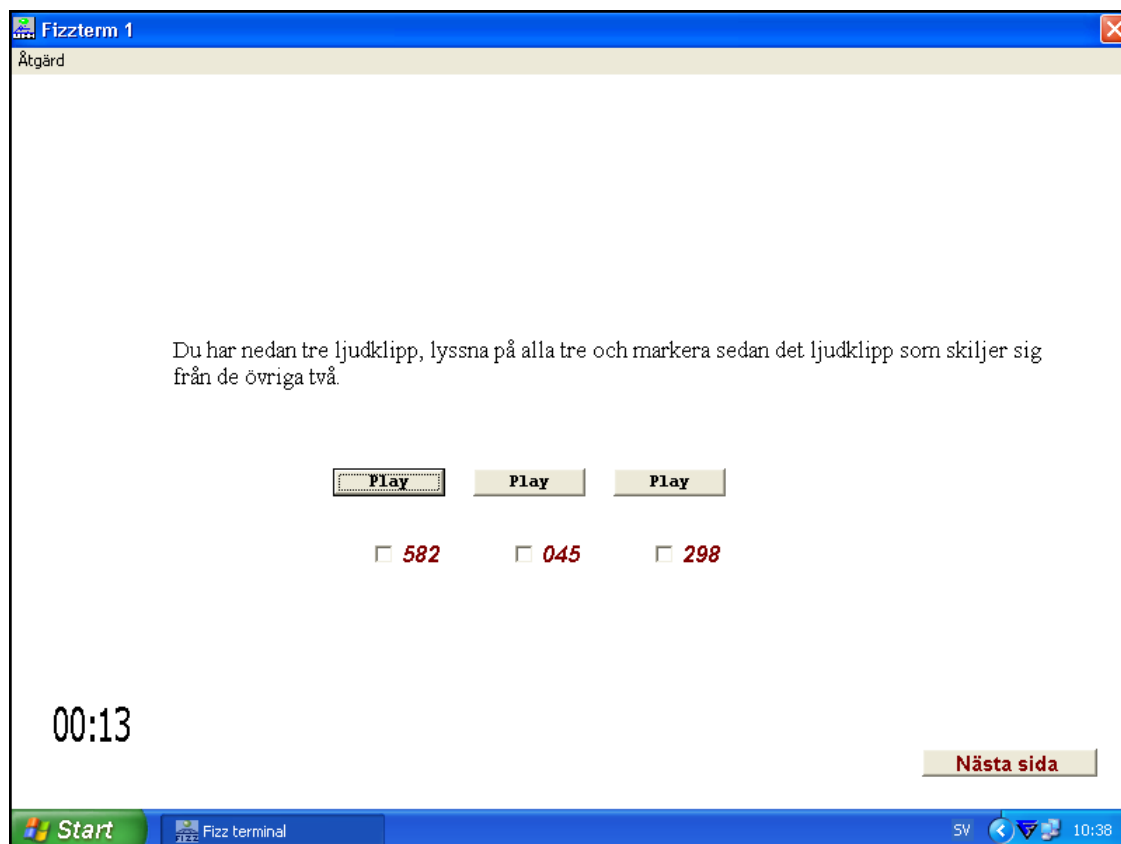
xix : Judgement Part VI, repeated 24 times



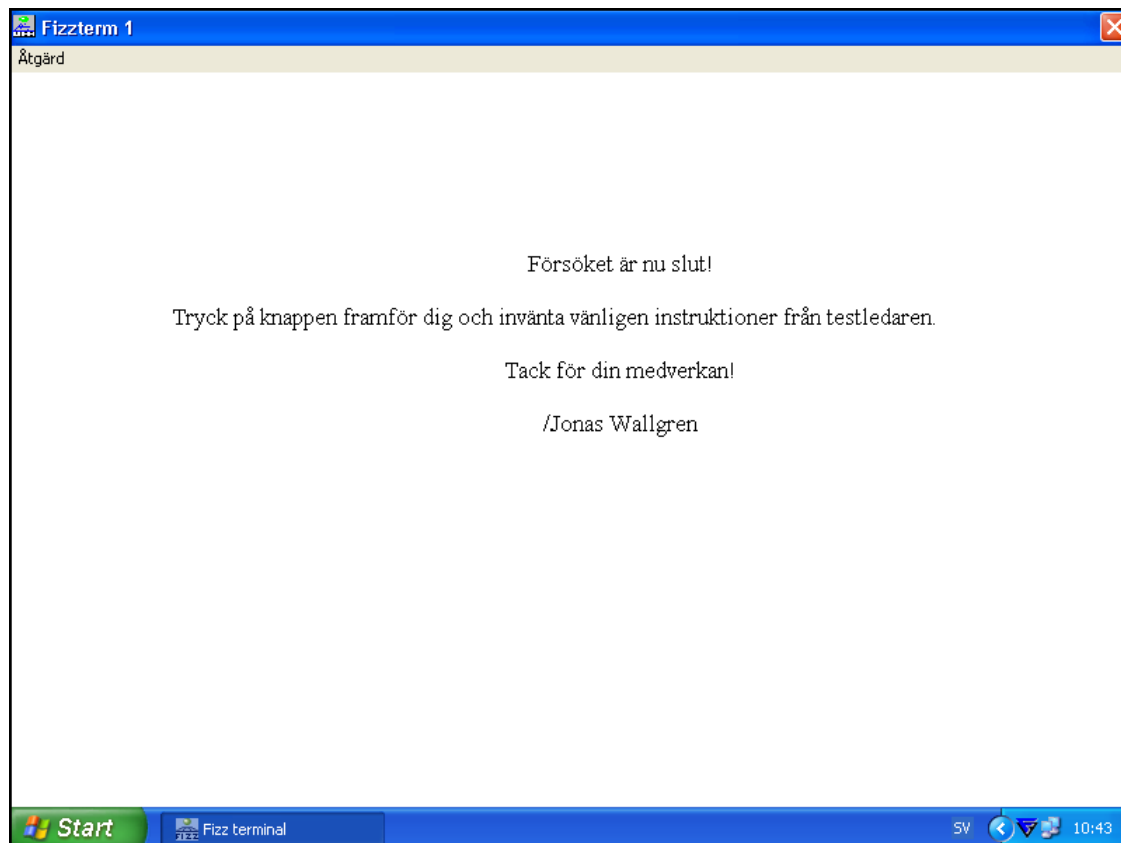
xx : End Part VI



xxi : Instructions Part VII



xxii : Judgement Part VII, repeated 24 times



xxiii : End of Part VII, Block III and listening test

Appendix G – Presentation Order

Triangle	Sound Pair Part I, III and V	Sound Pair Part VI and VII
1	1 & 4	2 & 4
2	1 & 4	1 & 4
3	2 & 4	2 & 4
4	1 & 4	3 & 4
5	2 & 4	1 & 4
6	3 & 4	2 & 4
7	2 & 4	3 & 4
8	3 & 4	1 & 3
9	1 & 3	2 & 4
10	3 & 4	3 & 4
11	1 & 3	1 & 3
12	1 & 3	1 & 2
13	1 & 2	3 & 4
14	1 & 3	1 & 3
15	1 & 2	1 & 2
16	1 & 3	2 & 3
17	1 & 2	1 & 3
18	2 & 3	1 & 2
19	1 & 2	2 & 3
20	2 & 3	1 & 4
21	1 & 2	1 & 2
22	2 & 3	2 & 3
23	2 & 3	1 & 4
24	2 & 3	2 & 3

Appendix H – Results Screening Test

Table 7.1 Results Block I Part I - Loudness

Code	T:1	T:2	T:4	T:3	T:5	T:7	T:6	T:8	T:10	T:9	T:11	T:12	T:14	T:16	T:13	T:15	T:17	T:19	T:21	T:18	T:20	T:22	T:23	T:24
SIK_03	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1	1	1	1	1	1	0
SIK_04	1	1	1	1	1	1	1	1	1	1	1	0	1	1	1	1	1	1	1	0	0	1	0	0
SIK_06	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
SIK_07	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	1	1	1	1	1	1	0	1
SIK_10	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
SIK_11	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	1	1
SIK_15	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	1	1	0
SIK_18	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
SIK_19	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
CTH_01	1	1	1	1	1	1	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1	0	0	0
CTH_03	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1	0	0	0	0
CTH_04	1	0	1	1	1	1	1	1	1	1	0	1	1	1	1	1	1	0	1	1	0	0	1	0
CTH_06	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
CTH_07	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1	1	0	1
CTH_10	1	1	1	1	1	1	1	1	1	1	1	0	1	1	1	0	0	1	1	0	1	1	1	0
CTH_12	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1	1	0	1	1	1
CTH_13	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
CTH_14	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
CTH_15	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0

Table 7.2 Results Block I Part II - Loudness

Code	Sound 1			Sound 2			Sound 3			Sound 4			Sound 5		
SIK_03	90	74	90	86	68	79	87	70	89	24	19	34	9	10	19
SIK_04	77	72	76	49	49	60	73	69	53	45	52	26	17	19	16
SIK_06	77	72	71	75	56	51	23	18	45	14	17	15	10	10	11
SIK_07	82	85	86	66	80	52	36	29	68	14	13	11	3	8	6
SIK_10	90	90	86	23	51	37	38	32	21	11	10	10	10	9	10
SIK_11	90	90	90	54	44	44	16	44	62	10	16	10	10	10	10
SIK_15	88	88	88	86	87	87	88	87	87	25	15	14	14	14	12
SIK_18	97	95	99	90	97	84	80	66	81	25	49	35	10	17	10
SIK_19	75	72	90	71	72	74	59	48	49	25	30	37	11	10	12
CTH_01	62	55	75	66	78	82	78	62	86	50	47	28	11	28	10
CTH_03	89	89	89	83	87	85	63	67	69	33	27	16	11	11	11
CTH_04	90	90	85	68	52	57	49	29	47	15	15	13	12	10	10
CTH_06	88	74	90	68	72	80	65	59	46	37	21	20	10	20	9
CTH_07	83	80	85	76	79	72	72	68	63	28	31	12	18	29	11
CTH_10	80	72	87	61	60	72	79	86	84	80	51	70	52	57	52
CTH_12	84	87	75	54	51	69	52	60	38	17	20	28	15	15	12
CTH_13	90	90	82	46	61	48	85	77	83	25	30	18	11	20	11
CTH_14	88	90	90	79	82	85	82	76	61	37	54	10	11	14	10
CTH_15	84	82	86	71	66	83	65	68	78	50	50	31	14	27	15

Table 7.3 Block II Part III – Fluctuation Strength

Code	T:1	T:2	T:4	T:3	T:5	T:7	T:6	T:8	T:10	T:9	T:11	T:12	T:14	T:16	T:13	T:15	T:17	T:19	T:21	T:18	T:20	T:22	T:23	T:24
SIK_03	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1	1	1
SIK_04	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	1	1	1
SIK_06	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
SIK_07	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0
SIK_10	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1	1	1	1	1	0	0	1
SIK_11	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1	1	1	1
SIK_15	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1	1	1	1	1	1	0	1
SIK_18	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1
SIK_19	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
CTH_01	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1	1	1	1	1	1	0	1	0
CTH_03	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
CTH_04	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0
CTH_06	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
CTH_07	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
CTH_10	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
CTH_12	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	1	0
CTH_13	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
CTH_14	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
CTH_15	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1

Table 7.4 Block II Part IV – Fluctuation Strength

Code	Sound 1			Sound 2			Sound 3			Sound 4			Sound 5		
SIK_03	10	10	23	17	25	29	33	26	56	77	82	90	90	90	90
SIK_04	21	25	21	28	35	39	57	66	34	69	67	63	75	82	84
SIK_06	11	13	12	40	48	48	47	35	47	50	44	60	90	88	90
SIK_07	10	8	6	22	11	17	26	46	46	71	69	73	95	81	98
SIK_10	13	13	15	12	11	15	18	10	11	72	86	86	91	90	93
SIK_11	34	10	19	47	12	16	44	19	14	90	77	87	90	90	85
SIK_15	14	15	15	14	15	14	13	15	14	21	15	12	85	83	81
SIK_18	10	5	2	20	21	10	49	35	31	21	66	74	90	90	90
SIK_19	25	26	11	22	26	20	34	26	51	90	85	80	90	91	90
CTH_01	10	23	59	52	17	22	40	18	23	30	42	34	90	87	91
CTH_03	11	11	10	22	31	39	36	20	28	59	54	47	88	89	88
CTH_04	49	35	38	36	45	25	43	38	32	38	77	40	83	84	86
CTH_06	10	10	13	42	13	25	31	35	29	60	57	80	90	90	89
CTH_07	11	20	20	29	36	36	40	48	46	58	54	54	79	82	69
CTH_10	19	25	24	74	79	65	73	74	66	76	88	83	80	82	89
CTH_12	12	13	14	16	16	12	17	13	30	49	63	57	76	82	87
CTH_13	17	11	12	21	24	16	23	37	49	79	74	57	90	89	89
CTH_14	23	16	16	33	29	17	30	48	48	74	71	68	90	89	86
CTH_15	13	15	24	41	33	31	37	24	28	69	64	71	90	90	89

Table 7.5 Block III Part V – Roughness

Code	T:1	T:2	T:4	T:3	T:5	T:7	T:6	T:8	T:10	T:9	T:11	T:12	T:14	T:16	T:13	T:15	T:17	T:19	T:21	T:18	T:20	T:22	T:23	T:24
SIK_03	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
SIK_04	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	1	1	1
SIK_06	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
SIK_07	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1	1	0	1
SIK_10	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	1	1
SIK_11	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1	0	1	1	0	1
SIK_15	1	1	1	1	1	1	0	1	0	0	1	1	1	1	1	0	0	0	1	1	0	1	1	1
SIK_18	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
SIK_19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CTH_01	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1	1
CTH_03	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	1	1	1
CTH_04	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1	1	1	1	1	1	1
CTH_06	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	1
CTH_07	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
CTH_10	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	1	0
CTH_12	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
CTH_13	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
CTH_14	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1	1
CTH_15	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1

Table 7.6 Block III Part VI – Tonality

Code	T:1	T:3	T:6	T:9	T:2	T:5	T:20	T:23	T:4	T:7	T:10	T:13	T:8	T:11	T:14	T:17	T:12	T:15	T:18	T:21	T:16	T:19	T:22	T:24
SIK_03	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0
SIK_04	1	1	0	1	1	1	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1	1
SIK_06	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1	0	1
SIK_07	1	1	0	1	1	1	1	0	1	1	1	1	1	0	1	1	1	1	1	1	0	1	0	0
SIK_10	1	1	1	1	1	1	1	1	1	1	0	1	0	1	1	1	1	1	1	1	1	1	1	1
SIK_11	1	1	0	1	1	1	1	1	1	0	1	1	1	0	1	1	1	1	1	1	1	1	1	1
SIK_15	1	1	1	1	1	1	1	1	1	1	0	1	1	1	1	0	1	1	0	1	1	1	1	1
SIK_18	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
SIK_19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CTH_01	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1	0	1	0	0	0	0	1	1
CTH_03	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
CTH_04	1	1	1	1	1	1	1	1	1	1	1	1	0	1	0	1	1	0	0	0	1	1	1	1
CTH_06	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1	0	0	0	1	1	1	1	1	1
CTH_07	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
CTH_10	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
CTH_12	1	1	1	1	1	1	1	1	1	1	1	1	0	1	1	1	0	0	1	1	1	0	0	1
CTH_13	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
CTH_14	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
CTH_15	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1

Table 7.7 Block III Part VII – Sharpness

Code	T:1	T:3	T:6	T:9	T:2	T:5	T:20	T:23	T:4	T:7	T:10	T:13	T:8	T:11	T:14	T:17	T:12	T:15	T:18	T:21	T:16	T:19	T:22	T:24
SIK_03	1	1	1	1	1	1	1	1	1	1	1	0	1	1	1	1	0	1	1	1	1	1	1	1
SIK_04	1	1	1	1	1	1	1	1	1	1	1	0	1	1	1	1	1	1	0	0	1	1	1	1
SIK_06	1	1	1	1	1	1	1	1	0	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1
SIK_07	1	1	1	1	1	1	1	1	0	1	0	1	1	0	1	1	0	0	1	1	1	1	1	1
SIK_10	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
SIK_11	1	1	1	1	1	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1	1	1
SIK_15	1	1	1	1	1	1	1	1	0	1	0	1	1	1	1	1	0	1	1	1	1	0	1	1
SIK_18	1	1	1	1	1	1	1	1	1	0	0	0	1	1	1	1	1	1	0	1	1	1	1	1
SIK_19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CTH_01	0	1	1	1	1	1	1	1	1	1	0	1	1	1	1	1	0	0	1	0	1	1	1	1
CTH_03	1	1	1	1	1	1	1	1	0	0	1	0	1	1	1	1	1	0	1	1	1	1	1	1
CTH_04	1	1	1	1	1	1	1	1	0	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1
CTH_06	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
CTH_07	1	1	1	1	1	1	1	1	0	1	0	1	1	1	0	1	1	1	1	1	1	1	1	1
CTH_10	1	1	1	1	1	1	1	1	1	0	1	0	1	1	1	1	1	1	1	1	1	1	1	1
CTH_12	0	1	1	1	1	1	1	1	0	1	0	0	0	0	1	1	0	1	1	0	0	0	1	1
CTH_13	1	1	1	1	1	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1	1	1
CTH_14	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1	1	1	1	1	1	1
CTH_15	1	1	1	1	1	1	1	1	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1

Appendix I – Table for Triangle Tests

Critical number of correct responses in a triangle test. Entries are the minimum number of correct responses required for significance at the stated α -level for the corresponding number of respondents, n . [14, 21]

Number of Tests n	Significance Level (α)										
	0.40	0.30	0.20	0.10	0.05	0.04	0.03	0.02	0.01	0.005	0.001
3	2	2	3	3	3	-	-	-	-	-	-
4	3	3	3	4	4	-	-	-	-	-	-
5	3	3	4	4	4	5	5	5	5	5	-
6	3	4	4	5	5	5	5	5	6	6	-
7	4	4	4	5	5	6	6	6	6	7	7
8	4	4	5	5	6	6	6	6	7	7	8
9	4	5	5	6	6	7	7	7	7	8	8
10	5	5	6	6	7	7	7	7	8	8	9
11	5	5	6	7	7	7	8	8	8	9	10
12	5	6	6	7	8	8	8	8	9	9	10
13	6	6	7	8	8	8	9	9	9	10	11
14	6	7	7	8	9	9	9	9	10	10	11
15	6	7	8	8	9	9	10	10	10	11	12
16	7	7	8	9	9	10	10	10	11	11	12
17	7	8	8	9	10	10	10	11	11	12	13
18	7	8	9	10	10	11	11	11	12	12	13
19	8	8	9	10	11	11	11	12	12	13	14
20	8	9	9	10	11	11	12	12	13	13	14
21	8	9	10	11	12	12	12	13	13	14	15
22	9	9	10	11	12	12	13	13	14	14	15
23	9	10	11	12	12	13	13	13	14	15	16
24	10	10	11	12	13	13	13	14	15	15	16
25	10	11	11	12	13	14	14	14	15	16	17
26	10	11	12	13	14	14	14	15	15	16	17
27	11	11	12	13	14	14	15	15	16	17	18
28	11	12	12	14	15	15	15	16	16	17	18
29	11	12	13	14	15	15	16	16	17	17	19
30	12	12	13	14	15	16	16	16	17	18	19
31	12	13	14	15	16	16	16	17	18	18	20
32	12	13	14	15	16	16	17	17	18	19	20
33	13	13	14	15	17	17	17	18	18	19	21
34	13	14	15	16	17	17	18	18	19	20	21
35	13	14	15	16	17	18	18	19	19	20	22
36	14	14	15	17	18	18	18	19	20	20	22
37					18	18	19	19	20	21	22
38					19	19	19	20	21	21	23
39					19	19	20	20	21	22	23
40					19	20	20	21	21	22	24
41					20	20	20	21	22	23	24
42					20	20	21	21	22	23	25
43					20	21	21	22	23	24	25
44					21	21	22	22	23	24	26
45					21	22	22	23	24	24	26
46					22	22	22	23	24	25	27
47					22	22	23	23	24	25	27
48					22	23	23	24	25	26	27
49					23	23	24	24	25	26	28
50					23	24	24	25	26	26	28
60					27	27	28	29	30	31	33
70					31	31	32	33	34	35	37
80					35	35	36	36	38	39	41
90					38	39	40	40	42	43	45
100					42	43	43	44	45	47	49