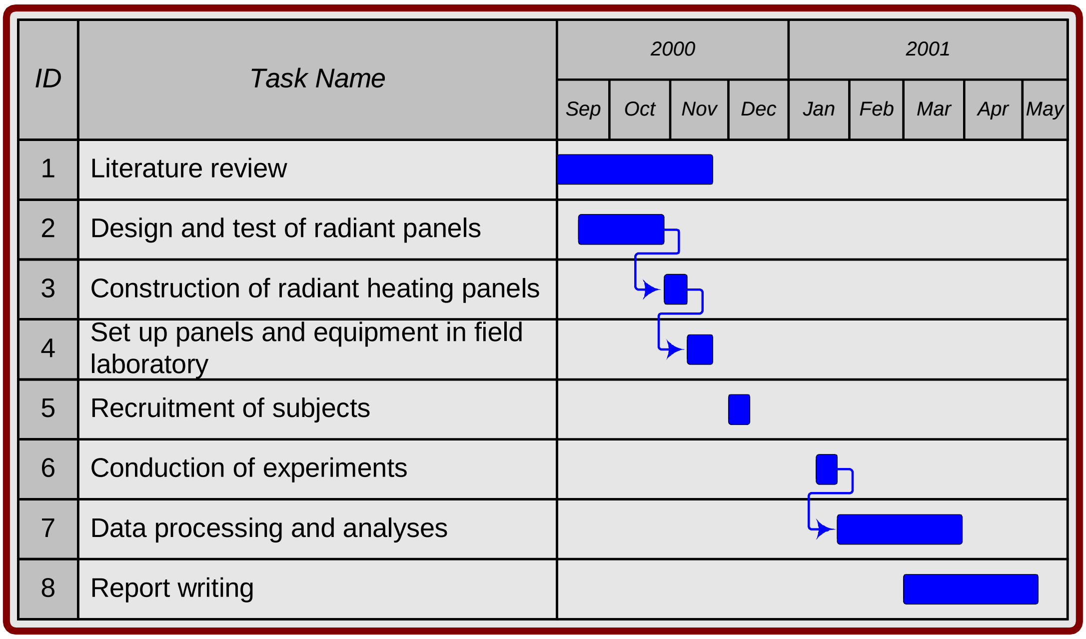
Appendices

Appendix A Project Timeline....................96
Appendix B Ideal Experimental Conditions....................97
Appendix C Data Logging: Temperature and Humidity....................98
Appendix D Statistics....................99
Appendix E Radiant Heating Panel Surface Temperature Measurements....................106
Appendix F Determination of Shape Factors between Seated Body and Radiant Heating Panels with Thermal Manikin....................109
Appendix G Workstation Heat Load....................112
Appendix H Optimal Clothing Insulation and Operative Temperature Relationship....................114
Appendix I Tabulated Clothing Insulation Values....................115
Appendix J Photos from the Experimental Sessions....................117
Appendix K Results....................121
Appendix L Project Diary....................145
Appendix M Questionnaires....................161

Appendix A Project Timeline

The Gantt chart below illustrates the project timeline.



Appendix B Ideal Experimental Conditions

- The temperature at the reference condition should represent a typical, comfortable indoor environment for the time of year at which the experiments are conducted. According to ISO 7730, an operative temperature of 23°C will be comfortable for occupants wearing a medium clothing ensemble (0.8 clo).
- The air temperature at the cool condition should be sufficiently low for an impact to be observed. Earlier studies have failed to show any effect on performance using air temperatures in the range of 18.7°C - 20°C. In the light of these studies, an even lower air temperature of 18°C is recommended. At the same time the temperature difference between reference condition and the cool condition should be maximised without causing thermal discomfort ($\Delta T > 4$°C recommended to obtain an effect).
- The subjects should be in thermal neutrality at all conditions.
- The air at the reference condition should be of good quality, i.e. the ventilation rate should be sufficient and no substantial pollution sources should be present. The air quality should preferably be reduced by reducing the ventilation rate, but could also be reduced by introducing a pollution source.
- The subjects should wear the same clothing under all conditions, so that clothing and air temperature would not be confounded.
- No local thermal discomfort should be experienced. This could be caused by radiant temperature asymmetry, draught or vertical temperature differences.
- Air humidity is not investigated, and should not have an impact on the results, and was thus kept constant.
- All other factors influencing the perception of the indoor environment (e.g. light and noise) should be kept constant and at a level that causes no dissatisfaction.

Appendix C Data Logging: Temperature and Humidity

Temperature measurements

HPVee [channel] card 1	PLACEMENT OF THERMISTORS			Callibration [±0.1°C]
1	Workstation 1	right side panel	middle height	
2	Workstation 1	back panel	middle height	
3	Workstation 1	left side panel	middle height	
4	Workstation 1	table panel	above thighs	
5	Workstation 1	air	1 m	x
6	Workstation 2	right side panel	middle height	
7	Workstation 2	back panel	middle height	
8	Workstation 2	left side panel	middle height	
9	Workstation 2	table panel	above thighs	
10	Workstation 2	air	1 m	x
11	Workstation 3	air	0.1 m	
12	Workstation 3	right side panel	middle height	
13	Workstation 3	air	0.6 m	
14	Workstation 3	back panel	bottom	
15	Workstation 3	back panel	middle height	
16	Workstation 3	back panel	top	
17	Workstation 3	left side panel	bottom	
18	Workstation 3	left side panel	top	
19	Workstation 3	left side panel	middle height	
20	Workstation 3	table panel	above thighs	
21	Workstation 3	table top	in front of keyboard	
22	Workstation 3	air	1 m	x
23	Workstation 4	right side panel	middle height	
24	Workstation 4	back panel	middle height	
25	Workstation 4	air	1 m	x
26	Workstation 4	table panel	above thighs	
27	Workstation 4	left side panel	middle height	
28	Wall	North	1.5 m	
29	Wall	West	1.5 m	
30	Wall	South	1.5 m	
31	Window	East	middle height	
32	Ceiling			
33	Workstation 3	floor		
34	Indoor air	outside workstations	1 m	
35	Outdoor air			
36	Air conditioner	outlet air		
37	Workstation 3	table panel	above knees	

Humidity measurements

HPVee [channel] card 2	Measurement	Sensor placement [Vaisala HMP 133Y sensor]
0		-
1		-
2	temperature	Workstation 2
3	RH	Workstation 2
4	temperature	Workstation 1
5	RH	Workstation 1
6		-
7		-
8	temperature	Workstation 4
9	RH	Workstation 4
10	temperature	Workstation 3
11	RH	Workstation 3
12	temperature	Measuring stand
13	RH	Measuring stand

$$\text{Relative humidity}\,[\%] = 100 \cdot \left(\frac{\left(\text{absolute humidity}\left[{}^{g}\!/\!{}_{m^3}\right]\right)\cdot (T + 273.15)}{e^{\left(24.35 - \frac{4043}{T+235.57}\right)}} \right)$$

(Rode, 1998)

Appendix D Statistics

This appendix contains more detailed information about the statistical test used for this study. Moreover, the appendix contains examples of the program syntax used for data analysis in the statistical software SAS.

The appendix contains:

D.1 Testing for Normal Distribution 100
D.2 Residual and Quantile Plots 101
D.3 Wilcoxon's test vs. Estimated t-test 102
D.4 Satterthwaite's DF Approximation 102
D.5 General Linear Model (GLM) Syntax 102
D.6 General Linear Model (GLM) output 105

D.1 Testing for Normal Distribution

The data was initially subjected to a general linear model (GLM), which required data of normal distribution. The first step was thus to test whether the data in the model follow a normal distribution. The data (y) can be expressed by a model ($\hat{y}$) and an error term (ε).

$$y_{ijk} = \hat{y}_{jki} + \varepsilon_{ijk}$$

$$\textit{Observed value} = \textit{Predicted value} + \textit{Residual}$$

A residual is the difference between the predicted value of the model and the observed value (data). A common misconception when testing for normality is that the observations (y) must follow a normal distribution. This is objectively wrong. The reason being that the individual data series (e.g. observations for one condition) is affected by different combinations of the other factors (e.g. workstation) and therefore not necessarily will attain a normal distribution (Figure 1).

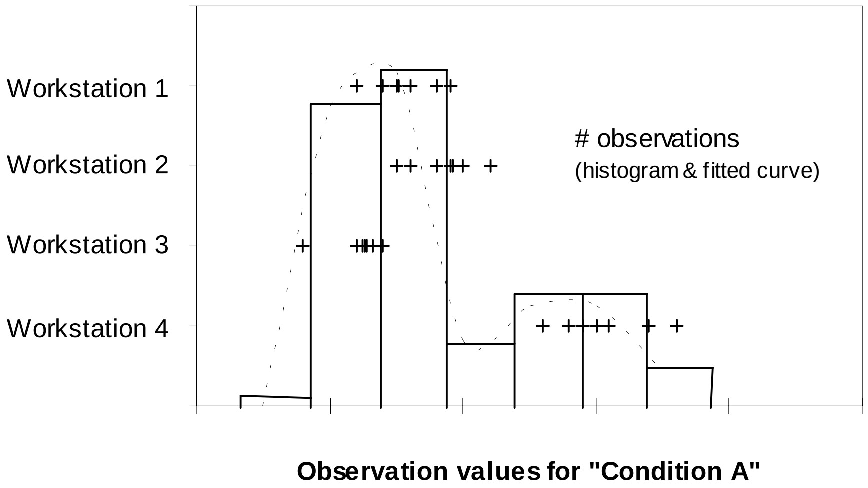


Figure 1 Fabricated data displaying why observations cannot be used for testing of normal distribution. Here the observations made for Condition A are not normally distributed because the observations are grouped in four clusters due to the difference between workstations (e.g. the typing speed has been influenced by quality of the keyboard at each workstation). The histogram and the fitted curve show the distribution of the observations.

The statistical model will account for the inter- and intra-conditional variances (e.g. from workstations shown in Figure 1). Thus, it is the residuals generated by the model, which must be tested for normality, as these will be evenly scattered and attain a normal distribution insofar the model fits the observations well. For demonstration purposes an example is brought below. The same data lay the foundation to both histogram plots, the only difference being that the first figure plots the data, while the second figure plots the residuals. Both plots are fitted with curves for normal distribution, and the matches are markedly different.

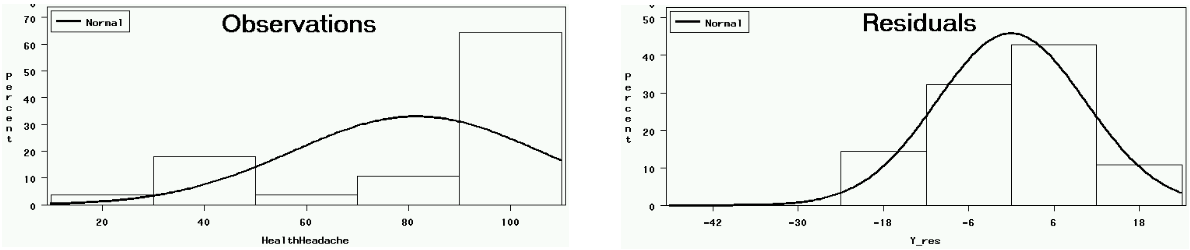


Figure 2 The two figures are made from real data collected in this study. To the left, the actual observations. To the right, the model residuals.

The figure shows that it makes no sense to test the observed data for normal distribution, as each observation is affected by a cocktail of different factors. The complex interaction of factors is accounted for in the model and it is therefore the residuals that must be tested for normality.

D.2 Residual and Quantile Plots

The residuals are commonly plotted for a visual test of normality. Two common plots are a) residuals vs. the predicted values, which should yield an evenly scattered cloud of values around zero and b) sorted residuals vs. quantiles, which should yield a straight line. Examples of the plots are included below.

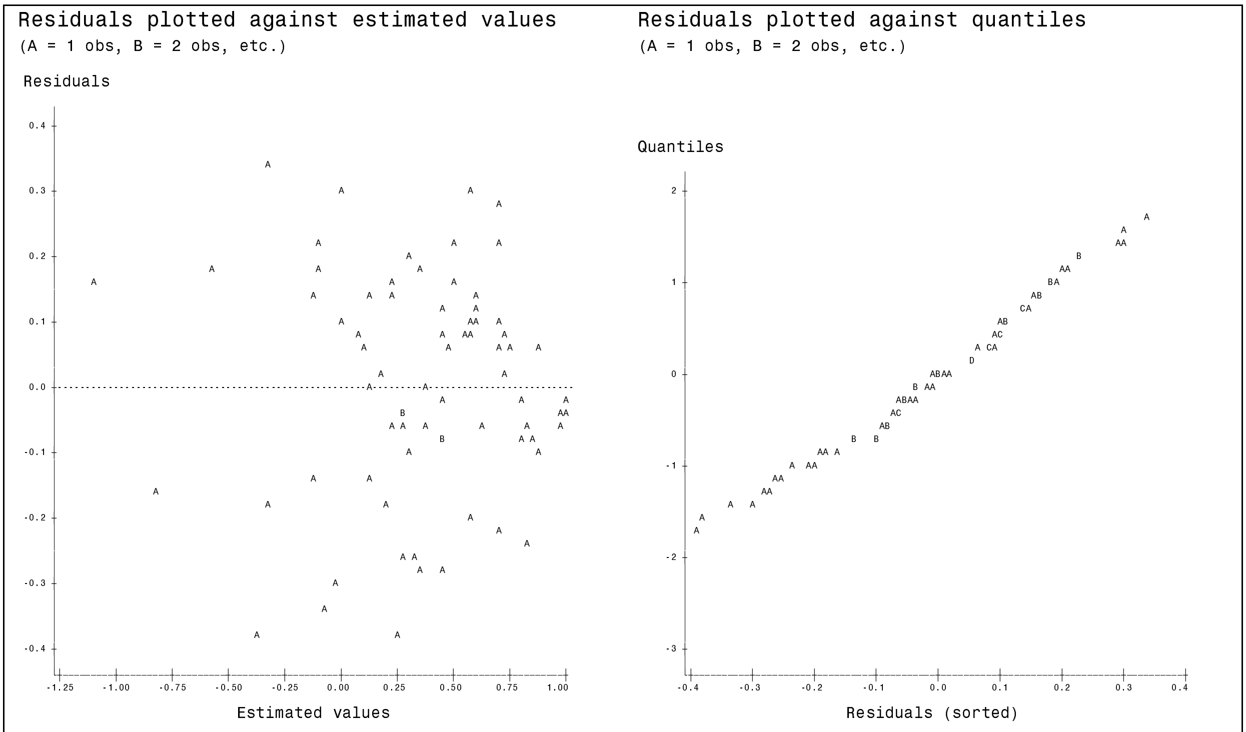


Figure 3 Residual plots for visual determination of normal distribution. Residuals plotted against the predicted values should lie evenly scattered around zero, while residuals plotted against the quantiles should form a straight line. The same data have been used for both plots. Neither of the plots contains outliers that jeopardize the normal distribution. However, a slight skew to the right is observed.

Plotted values that lie aside from the bulk of the data are called outliers. These values must be examined and may only be excluded if a reason can be given (e.g. the subject was sick that day or the entering of data was at error). Insofar data are excluded the analysis must be repeated. If some outliers cannot be excluded then the subsequent tests requiring normal distribution must be used with care. If many outliers occur a test not requiring normal distribution must be applied (see Wilcoxon's test vs. Estimated t-test, page 102).

A visual check of residual and quantile plots is usually employed by statisticians when checking for normal distribution. However, the test for normality can also be performed numerically. These tests are popular among people with limited statistical experience because normality is determined by a single number and not by a dubious visual judgement. Never the less, the visual interpretations are more highly ranked among statisticians because the numerical test may be a bit crude. For example, the numerical tests will not inform the user whether a distribution falls short of qualifying as a normal distribution because of one or two outliers, which may be eliminated. For this study, however, the numerical Shapiro-Wilk's *w*-test will be used as the principal test of normal distribution.

D.3 Wilcoxon's test vs. Estimated t-test

Data that does not fulfil the criteria for parametric testing in the GLM must be tested with non-parametric tests. Other studies often make use of Wilcoxon's test, but for this study it was decided to use an estimated t-test instead; the argumentation follows below.

Unlike Wilcoxon's test, the estimated t-test does not require normal distribution. Moreover, the estimated t-test is stronger than the Wilcoxon's test, except in a few cases when normal distribution does not occur (Conradsen 1995). Thus, the Wilcoxon's test will not be used.

The principle behind an estimated t-test is to pool certain means of squares in the analysis of variance to increase the degrees of freedom for the estimate of error. An estimated t-test makes uses Satterthwaite's method of linear combinations of mean squares (see section below).

D.4 Satterthwaite's DF Approximation

For the estimated t-test, the degrees of freedom (DF) are adjusted for unequal group variances as described in the SAS-help file:

$$DF = (w1 + w2)^2/(w1^2/(n1-1) + w2^2/(n2-1))$$

where

$w1 = s1^2/n1$, $w2 = s2^2/n2$, $s1^2$ and $s2^2$ are the sample variances for groups 1 and 2, respectively, and n1 and n2 are the number of observations for groups 1 and 2, respectively.

D.5 General Linear Model (GLM) Syntax

An example of the syntax of the GLM in the SAS-software is given below. The syntax also includes Bartlett's test and t-tests, and scatter plots of residuals and quantiles as well as a boxplot of data. A horizontal line to make the syntax easier to read separates each procedure. Note that the observations to be analysed by the GLM is given the name “variable”.

```
title1 'Analysis: text typing speed';
DATA B;
SET tasks.texttyping_info;
variable = (textcharactersprminute);
run;
PROC SORT DATA=B;
```

```
BY condition;
run;
```

```
proc boxplot data=B;
plot (textcharactersprminute)*condition
     / caxis = BLACK cframe = WHITE ctext = BLACK cboxes = BLACK cboxfill =
     WHITE
     idcolor = BLUE idsymbol = SQUARE  boxstyle = SKELETAL waxis = 1 name =
     'perf'
     description = "Box Plot" npanel = 15 vaxis = -1 to 1 by 0.5;
run; quit;
```

```
proc means data=B n mean std skewness kurtosis;
      var textcharactersprminute;
      class condition;
      output out=WORK.means_text_spd MEAN= STD = / autoname;
      attrib _all_ label='';
run;
```

```
PROC SORT DATA=B;
BY temperature subjectno appearance pollution;
run;
```

```
PROC GLM DATA = B;
CLASS temperature subjectno appearance pollution group sex
      problemsettexttyping weekday
      timeofday station;
MODEL variable = temperature pollution appearance group sex weekday
      timeofday
      problemsettexttyping station subjectno(group sex) /ss3;
RANDOM subjectno(group sex) group weekday timeofday problemsettexttyping;
quit;
```

```
PROC GLM DATA = B outstat=prob_text_spd;
CLASS temperature subjectno appearance pollution group sex
      problemsettexttyping weekday
      timeofday station;
MODEL variable = temperature pollution appearance group sex station
      subjectno(group sex) /ss3;
RANDOM subjectno(group sex) group;
LSMEANS temperature pollution sex station
      appearance/out=work.lsmeans_text_spd;
OUTPUT out=work.residuals Residual=Y_res Predicted=Y_est L95M U95M;
quit;
```

```
ods output ttests=ttests_text_spdd;
DATA ttest;
SET residuals;
if condition = 'B' then delete;
run;
```

```
proc ttest data=ttest;
class condition; var variable;
run;
```

```
ods output ttests=ttests_text_spdb;
DATA ttest;
SET residuals;
if condition = 'D' then delete;
run;
```

```
proc ttest data=ttest;
class condition; var variable;
run;
```

```
PROC sort DATA=work.residuals;
by Y_res; run;
```

```
DATA normalplot;
set work.residuals;
```

```
p=(_n_ - 0.5)/79;
fraktil=probit(p);
run;
```

```
proc plot; plot fraktil*Y_res;  run;
proc plot; plot Y_res*Y_est;    run; quit;
```

```
proc univariate normal;
var Y_res;
output out=work.normal_text_spd normal=normal probn=probn probm=probm
probt=probt probs=probs;
run;
quit;
filename grafout "c:\my documents\experiments\graphs\performance";
```

```
goptions device=imggif gsfname=grafout gsfmode=replace ctext=BLACK
htext=1.8 cells;
proc gplot data=normalplot;
   plot variable * condition  /
      name='perf' description="Scatter Plot" caxis = BLACK ctext = BLACK
      cframe = white
      hminor = 0 vminor = 0 vaxis = axis1 haxis = axis2;
      run;
quit;
```

```
filename;
goptions;
data fugt;
set work.normalplot;
run;
```

```
proc sort;
by condition;
run;
```

```
proc means vardef=df noprint;
var variable;
by condition;
output out=mean n=n var=var css=css;
run;
```

```
data temp;
set mean;
k=1;
fi=n-1;
filogs1i=fi*log10(var);
fis1i=css;
run;
```

```
proc means data=temp noprint;
var filogs1i fis1i fi k;
output out=bartest sum=filogs1i fis1i f sumk;
run;
```

```
data bartlett_text_spd;
set bartest;
s2=1/f*fis1i;
krit=2.3026*(f*log10(s2)-filogs1i);
niveau=probchi(krit,sumk-1,0);
chi10=cinv(0.10,sumk-1,0);
chi05=cinv(0.05,sumk-1,0);
if krit lt chi10 then accept10='*';    /* Accept*/
else accept10=' ';
if krit lt chi05 then accept05='*';    /* Accept*/
else accept05=' ';
drop _TYPE_ _FREQ_;
run;
title2 'Niveau should be below the chosen level (niveau)- e.g. 0.05';
```

```
proc print;
run;
title1;
title2;
title3;
```

D.6 General Linear Model (GLM) output

A screen dump of the effects computed by the GLM is brought below. The (Pr>F)-values less than 0.05 are significant at the 5%-level. The factors, which are not significant, can be eliminated for subsequent analysis of yet another and more refined GLM. The main factors of interest (e.g. temperature and pollution) are always kept in the model.

Source	DF	Type III SS	Mean Square	F Value	Pr > F
Temperature	1	0.24852078	0.24852078	3.90	0.0567
Pollution	1	0.10789997	0.10789997	1.69	0.2021
Appearance	2	0.29206446	0.14603223	2.29	0.1169
Group	5	0.68426403	0.13685281	2.15	0.0841
Sex	1	0.36173203	0.36173203	5.68	0.0231
Weekday	5	0.37188259	0.07437652	1.17	0.3459
TimeOfDay	1	0.05002944	0.05002944	0.79	0.3819
Station	3	0.00782421	0.00260807	0.04	0.9888
Subjectno(Group*Sex)	20	6.08820710	0.30441036	4.78	<.0001

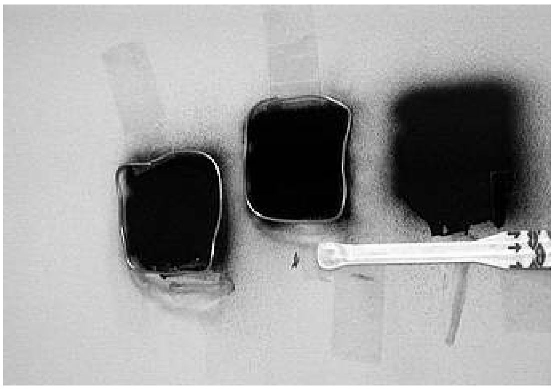
Appendix E Radiant Heating Panel Surface Temperature Measurements

The surface temperature of the radiant heating panels was measured with thermistors. For practical reasons only one thermistor was used for each panel. It was therefore important, that the measured temperature was correct, and a good measure of the mean surface temperature.

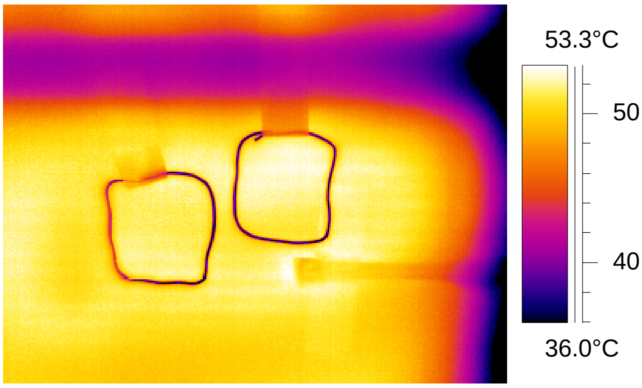
Correct measurement of surface temperature is not easily achieved using thermistors or thermocouples. In order to make a good measurement, the thermistor must be small and have an insignificant heat capacity. It must have the same heat conducting and radiative properties as the material on which it is fastened with good thermal contact.

In this study, the thermistors were fastened with tape on the radiant heating panels. A temperature drop across the thermistor was anticipated. This was investigated with a thermographic camera. The camera, an Agema 570, had previously been calibrated. When used correctly it had an accuracy of approximately 0.1°C.

Firstly, the emissivity of the panel covering was measured. An emissivity of 0.95 was assumed, and this value was used with the camera. Three small areas on one of the radiant panels were painted with matte, black spray paint to increase the emissivity. Photos were taken with the thermographic camera at a range of temperatures, and the corresponding thermistor temperature reading was recorded. The painted areas were surrounded by a metal wire, for the areas to be visible on the thermographic camera. A photo of the painted panel, and a corresponding thermographic photo are seen below.



Normal photo



Thermographic photo

The thermographic photos showed no difference in temperature between the painted and the non-painted areas. This indicated that the emissivity of the covering was high, and that assuming an emissivity of 0.95 was reasonable.

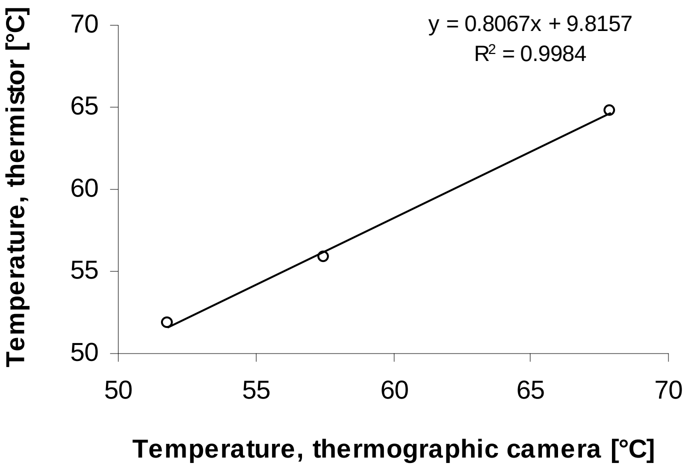
A series of photos were taken with the thermographic camera, to investigate the relationship between thermistor reading and thermographic results.

The above thermographic photo clearly shows the thermistor. Thus, the outer surface of the thermistor had a different (lower) temperature than the panel surface. It was investigated, if the temperature measured by the thermistor (assumed to be a mean temperature across the thermistor) corresponded to the true surface temperature measured with the thermographic camera.

The figure below shows the critical range of temperatures.

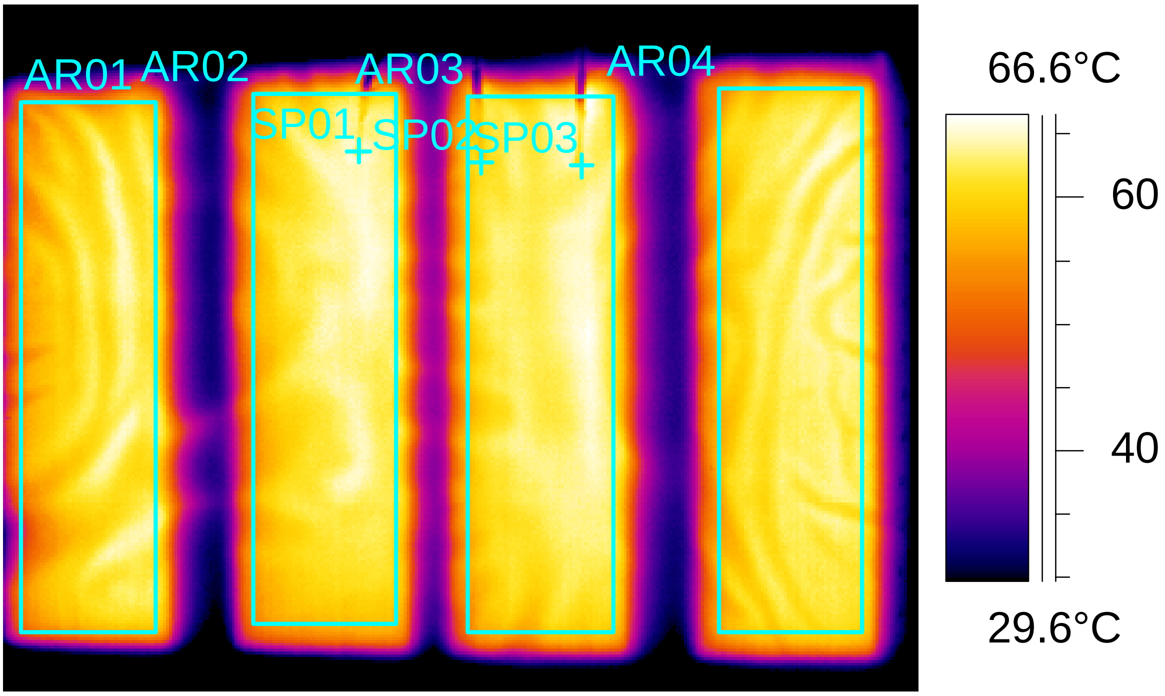
Measured temperature [°C]

Thermography	Thermistor
51.8	51.8
57.5	55.9
67.9	64.7



It was found, that the thermistor underestimated the temperature when it was above 50°C. Below this level, the thermistor readings corresponded to the readings from the thermographic camera. This was considered acceptable, since the surface temperatures that were relevant for the experiments were in the range of 35-45°C.

It was also investigated, whether the temperature measured with the thermistors were a reasonable expression of the mean surface temperature. To this end, a thermographic photo of an entire panel was taken. The photo is seen below.



Above, a thermographic photo of a side panel is seen. The Arxx and SPxx codes correspond to the results from the analysis, as seen below.

Thermographic analysis					
Spot	Temperature [°C]	Mean [°C]	Min [°C]	Max [°C]	Area [°C]
		60	44.9	65.4	AR01
SP01	62.2	61.6	51.8	66.1	AR02
SP02	61.4	62.3	45	67.6	AR03
SP03	63.1	62.3	45	67.6	AR03
		61.9	53.2	65.8	AR04

Note: The ”Spot” values correspond to the three spot measurements seen on the photo above. They have been located in the table, next to the “Area”'s in which they are located.

The panel is rotated 90° to the left. The four bands of heating foil are easily seen. It is seen that the temperature between the bands is approximately 30°C. The covering therefore functions as a heat distributor, but the effect is not sufficiently strong to even the temperature.

Three thermistors are seen at the top of the photo, in the right side of the panel.

The temperature is not completely uniform within the bands of heat foil. The foil folds up a little, so that the thermal contact of some parts of the foil is reduced.

The analysis revealed whether the measured temperatures corresponded to the true surface temperature as measured thermographically. The spot measurements to the left in the table above were located so that they measured the temperature of a thermistor. They are located next to the mean value of the temperature in the area, in which they are located.

It is seen, that spot and mean area measurements differ by no more than 1°C. It was concluded, that this was sufficiently accurate for the purpose of this study.

Appendix F Determination of Shape Factors between Seated Body and Radiant Heating Panels with Thermal Manikin

The surface temperatures measured in the field lab were: floor, ceiling, three walls and the window. The radiation of each surface contributes to the operative temperature. The estimated shape factors for workstation 3 without radiant panels are given in the table below. Apart from the window temperature, all the surface temperatures typically fall within 2°C of each other.

	Floor	Ceiling	North wall	West wall	South wall	Window	TOTAL
Shape factors	0.3	0.2	0.2	0.1	0.1	0.1	1

The shape factors were used to calculate the mean radiant temperature of the room surfaces ($t_{surf.}$). The mean radiant temperature (t_r) in the workstation was dependent on the radiant panels. The radiant panels were regulated collectively by two different controls. One control regulated the side panels and the back panel (group 1), whereas the second control regulated the table panel (group 2). Each of the panel groups was given a shape factor, F_1 and F_2, for determination of the mean radiant temperature.

$$t_r = F_{side/back\ panels} \cdot t_{side/back\ panels} + F_{table\ panel} \cdot t_{table\ panel} + (1 - F_{side/back\ panels} - F_{table\ panel}) \cdot t_{surf.}$$

$$\Leftrightarrow t_r = F_1 \cdot t_1 + F_2 \cdot t_2 - (1 - F_1 - F_2) \cdot t_{surf.}$$

The temperature of the table panel (t_1) was measured above the thighs. The temperature of the side and back panels was measured half way up, as a small vertical temperature gradient of approx. 2°C was observed. The panels were identically built and therefore attained similar temperatures (<5°C difference). The average of the three panel temperatures yielded t_2.

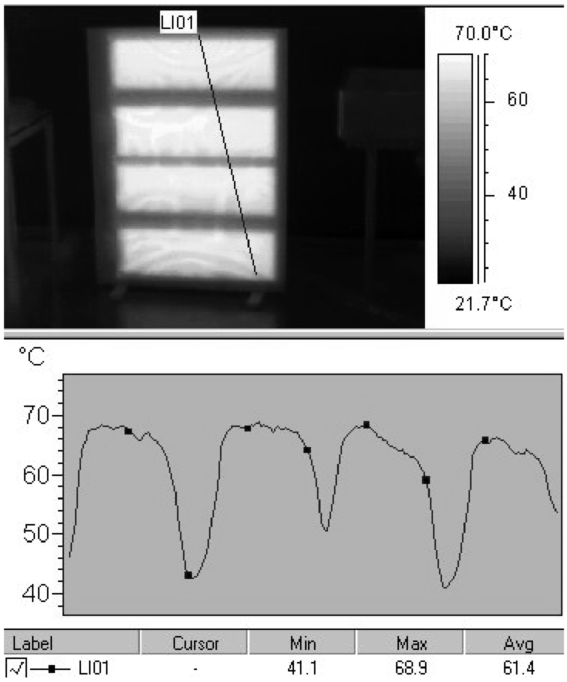


Figure 4 Thermographic picture of side panel. The temperature level across the panel is of relative uniform temperature apart from the bands between the heating foils.

F.1 Thermal Manikin for Shape Factor Determination

The dry heat loss of the manikin ($H_{manikin}$) was correlated with the mean radiant temperature using Fanger's comfort equation. First, the dry heat loss is used to determine metabolism had it been a normal person occupying the space. To the dry heat loss of the manikin must be added heat losses from respiration, sweating and diffusion of water vapour through the skin.

The metabolism (M) is found by the following set of formulae (Tanabe et al., 1994):

$$M = H_{manikin} + Q_{res} + E_s$$

$$Q_{res} = 1.7 \cdot 10^{-5} \cdot M \cdot (5867 - Pa) + 0.0014 \cdot M \cdot (34 - t_a)$$

$$E_s = 3.05 \cdot 10^{-3} \cdot (5733 - 6.99 \cdot M - Pa) + 0.42 \cdot (M - 58.15)$$

The equations are solved iteratively, as the metabolism (M) appears in all the equations. Q_{res} is the respiratory heat loss and is dependant on M, Pa (partial vapour pressure) and t_a (air temperature). E_s is the heat loss from the surface of the skin and is dependant on M and Pa. The table below contains the measurements of Pa, t_a and $H_{manikin}$ and the subsequent iterated results for Q_{res}, E_s and M.

Table 1 Values for computation of the metabolism (M) of the thermal manikin.

		Pa [Pa]	t_a [°C]	$H_{manikin}$ [W/m²]	Q_{res} [W/m²]	E_s [W/m²]	M [W/m²]
a.	No radiant panels turned on	738	17.9	48.8	8.84	22.9	80.6
b.	Table panel turned on	731	17.9	46.9	8.44	21.5	76.8
c.	Table panel + back and side panels turned on.	724	18.3	40.7	7.02	16.4	64.1

The computed values of metabolism (M) corresponds to metabolic rates of 1.39 met, 1.32 met and 1.11 met, respectively. The mean radiant temperature can now be computed by "going the other way" by utilisation of the Ashrae Thermal Comfort Program version 1.00. This software is based on Fanger's PMV. The output is the PMV-value (predicted mean vote), which in this case should be zero because the manikin was in perfect thermal comfort. The input of the Ashrae thermal comfort program is:

$$f(t_a, t_r, RH, clo, met, v_{air}) = PMV$$

Now, the mean radiant temperature (t_r) can easily be determined, because all the other input values are known including the output value. The mean radiant temperature determined by the Ashrae-software must now be matched by the factual measurements by adjustment of the two shape factors of the radiant panels (F_1 and F_2). The Ashrae and the factual mean radiant temperature should match at each of the three manikin conditions. This iteration process was complex because along the way the shape factors changed the computed operative temperature and therefore demanded new clo-values to be calculated. Numerous iterations were carried out yielding the following two shape factors (Table 2).

Table 2 The measured input data for each of the three manikin experiments (a, b and c) and their respective outputs, i.e. mean radiant temperatures. The best match between mean radiant temperatures is reached with shape factors F_1=0.075 and F_2=0.103. The correlation of shape factors and temperatures is: $t_r = F_1 \cdot t_1 + F_2 \cdot t_2 - (1 - F_1 - F_2) \cdot t_3$

	input					input					output		
	I: ASHRAE-software method					II: Shape factor method					I	II	
Exp.	Met [-]	Clo [-]	v_{air} [m/s]	RH [%]	t_a [°C]	t_1 [°C]	t_2 [°C]	t_3 [°C]	F_1 [-]	F_2 [-]	t_r [°C]	t_r [°C]	Δt_r [°C]
a	1.39	1.37	0.15	36.0	17.9	25.2	18.2	17.9	0.075	0.103	18.4	18.4	0.0
b	1.32	1.37	0.15	35.6	17.9	43.9	18.7	18.0	0.075	0.103	20.0	20.0	0.0
c	1.11	1.37	0.15	34.4	18.3	43.9	51.7	18.2	0.075	0.103	23.5	24.1	0.6

The shape factors, which yield the smallest divergence between the calculated mean radiant temperatures, are F_1=0.08 and F_2=0.1 (only given with one significant figure). The total shape factor of all the radiant panels (0.18) is relatively close to the estimated value of 0.2 used thus far. It is noted, that the table panel (F_1) has a relatively high share of the total radiant panel shape factors. The reason being that the table panel is placed closest to the body and perhaps that the hot air from the panel heats the thighs slightly and therefore adds to the shape factor.

Appendix G Workstation Heat Load

The assumptions and calculations regarding the determination of the workstation heat load are described in the following.

The table below contains basic assumptions regarding the conditions and the physical properties of air.

Basic properties of air

Variable	Value
T_{air} [K]	291
$T_{side\ panel}$ [K]	*
$T_{table\ panel}$ [K]	313
Beta [1/K]	0.00331
Alpha [m²/s]	0.0000225
ν [m²/s]	0.0000159
Pr_{air} [-]	0.69
k_{air} [W/m K]	0.0267
ε [–]	0.9
σ [W/m2K4]	5.67E-08
Ψ	0.34

* The side panel temperature was varied.

The table below contains the panel dimensions.

	Height [m]	Length [m]	Number	Total area [m²]
Side panels	1	0.8	2	1.6
Back panel	0.8	0.5	1	0.4
Table	0.5	0.8	1	0.4

The calculation of the convective and radiative transfer was carried out as sketched below. The following equations were used. For the radiant exchange (Mills 1992):

$$Q = \frac{\sigma \cdot (T_{panel}{}^4 - T_{room\,surfaces}{}^4)}{\frac{1}{\varepsilon_{panel}} + \frac{1}{\varepsilon_{room\ surfaces}} - 1} \quad \left[W / m^2\right]$$

Where

σ is Stefan Boltmans constant, $\sigma = 5.67 \cdot 10^{-8} \frac{W}{m^2 K^4}$

ε is the emissivity [-]

The convective heat exchange was calculated by first determining the Rayleigh number (*Ra*). As this was within the range of laminar flows, the Nusselt number for the vertical panels was calculated as (Mills, 1992):

$$Nu_L = 0.68 + 0.670 \cdot (Ra_L \cdot \Psi)^{0.25} \quad [-]$$

And for the horizontal table panel, the Nusselt number was calculated as:

$$Nu_L = 0.82 \cdot (Ra_L)^{0.2} \quad [-]$$

Workstation heat load: Convective and radiative heat transfer

	Ra [-]	Nu [-]	Convective [W/m²]	Radiative [W/m²]	Heat load [W]
Side panels	2.00E+09	109.04	64.0	112.6	283
Back panel	1.02E+09	92.34	67.8	112.6	72
Table panel	2.50E+08	39.2	46.0	112.6	63
Other equipment					402
TOTAL					820

Appendix H Optimal Clothing Insulation and Operative Temperature Relationship

The clothing insulation was estimated with the aim of reaching a PMV of zero. For the 18°C air temperature condition, the air velocity was expected to be approximately 0.20 m/s. The optimal clothing insulation level was therefore determined for various air velocities and operative temperatures, as seen below. The operative temperature relevant for the experiments was 20.5°C. The calculations were done with the ASHRAE Thermal Comfort Tool. A relative humidity of 33% and a metabolic rate of 1.2 met were used.

Clothing insulation for PMV = 0 [clo]			
T_{op}	v_{air} = 0.10 m/s	v_{air} = 0.15 m/s	v_{air} = 0.20 m/s
19.0	1.50	1.57	1.62
19.5	1.42	1.49	1.54
20.0	1.33	1.40	1.45
20.5	**1.25**	**1.32**	**1.37**
21.0	1.17	1.24	1.29
21.5	1.09	1.16	1.21
22.0	1.00	1.07	1.12
22.5	0.92	0.99	1.04
23.0	0.84	0.91	0.96
23.5	0.76	0.83	0.88
24.0	0.68	0.75	0.80

Appendix I Tabulated Clothing Insulation Values

A table of clothing insulation values was compiled based on the ISO 9920 and ASHRAE 55 standards. As neither contained all the pieces of clothing worn by the subjects during the experiments, values have been determined by interpolating between pieces of clothing with known values.

The clothing insulation values are found in the table below. A fabric is given, when possible. A reference is made to ISO 9920 or ASHRAE 55 for clothing insulation values found in either of the two standards.

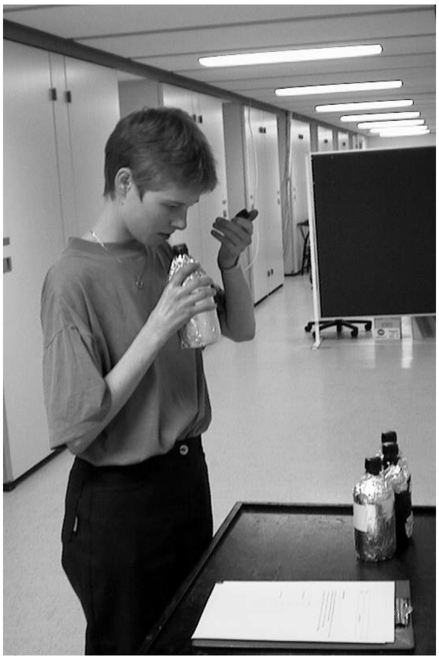
			Reference	
	I_{cl} [clo]	Fabric	ISO 9920	Ashrae 55
Footwear				
Shoes, light	0.02	Any	262	-
Shoes, medium	0.03	Any	260	-
Shoes, heavy	0.04	Any		-
Ankle boots, light	0.04	Any		-
Ankle boots, medium	0.05	Any	258	-
Ankle boots, heavy	0.06	Any	-	-
Boots, light	0.09	Any	-	-
Boots, medium	0.1	Any	-	Yes
Boots, heavy	0.11	Any	-	-
Underwear				
Panties	0.03	Any	Yes	Yes
Men's briefs	0.04	Cotton	Yes	Yes
Long underwear bottoms	0.15	Thermal	-	Yes
Chemise	0.1	Thin	-	-
Bra	0.01	Any	Yes	Yes
Body stocking, sleeveless	0.1	Any	-	-
Body stocking, sleeves	0.11	Any	-	-
T-shirt				
T-shirt	0.1	Cotton	31	-
Shirt, sleeveless	0.06	Cotton	13	-

	I_{cl} [clo]	Fabric	Reference ISO 9920	Reference Ashrae 55
Blouse				
Light, sleeveless, turtleneck	0.14		-	-
Light, sleeveless	0.13		-	Yes
Light, sleeveless, low	0.12		-	-
Light, short sleeves	0.17			
Light, long sleeves, turtleneck	0.26	Cotton 50%/Polyester 50%	147	-
Light, long sleeves	0.25		-	Yes
Light, long sleeves, low	0.24		-	-
Medium, sleeveless, turtleneck	0.19		-	-
Medium, sleeveless	0.18		-	Yes
Medium, sleeveless, low	0.17		-	-
Medium, short sleeves, turtleneck	0.23			
Medium, short sleeves	0.22		145	-
Medium, long sleeves, turtleneck	0.31	Cotton/wool	-	-
Medium, long sleeves	0.3	Cotton/wool	-	-
Medium, long sleeves, low	0.29	Cotton/wool	-	-
Heavy, sleeveless, turtleneck	0.23		-	-
Heavy, sleeveless	0.22		-	Yes
Heavy, sleeveless, low	0.21		-	-
Heavy, long sleeves, turtleneck	0.37	Wool 85%	148	
Heavy, long sleeves	0.36			Yes
Shirt				
Medium, short sleeves	0.19		77	Yes
Medium, long sleeves	0.25	Cotton/Polyester	75	Yes
Heavy, short sleeves	0.27		-	-
Heavy, long sleeves	0.34		-	Yes
Trousers				
Light, Jeans, cotton	0.15			Yes
Medium, Jeans, cotton	0.18	Cotton	89	-
Medium, Jeans, flannel	0.18			
Medium, Jeans, fløjl	0.18			
Heavy, Jeans, cotton	0.24			Yes
Socks				
Light, short	0.02			
Light, long	0.02			
Light, pantyhose	0.02		3	Yes
Medium, short	0.02		263	Yes
Medium, long	0.03		264	No
Medium, pantyhose	0.02		3	Yes
Heavy, short	0.05		253	No
Heavy, long	0.06		267	Yes

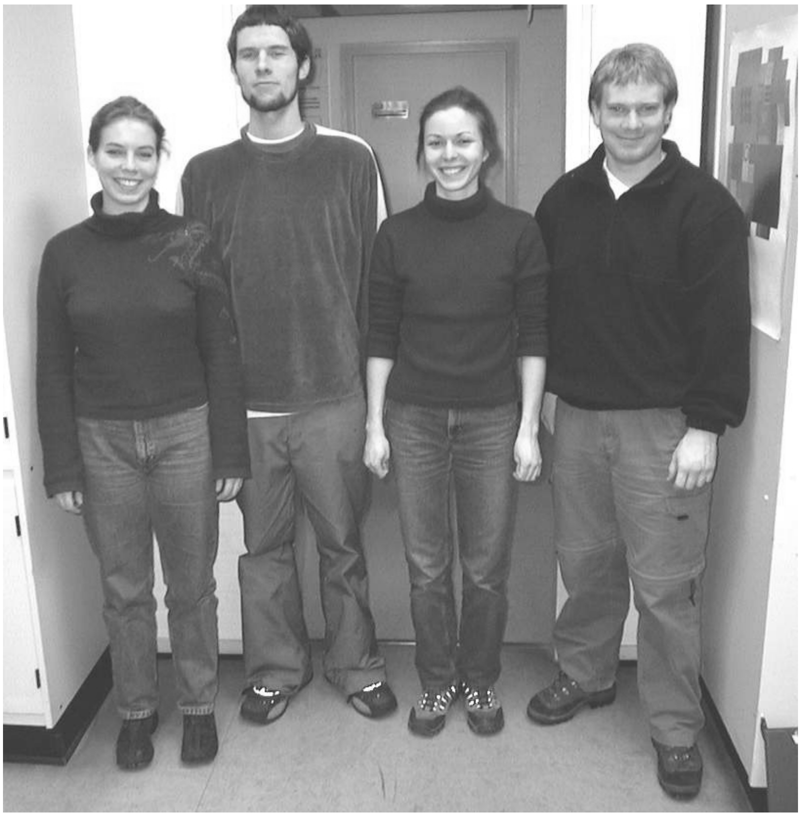
Appendix J Photos from the Experimental Sessions

This appendix contains photos from the experimental session, starting with the introduction and ranking test of the training session. The photos show members of several groups; all have given their content to appear in this report.

Introduction. Given to the subjects as the first part of the training session.



Ranking test. Performed by each subject during the training session.



Group photo. A photo was taking prior to all sessions, to check that the clothes worn by the subjects matched their reports on the Entrance Questionnaire.

Subjects putting on the leg warmers and fleece jackets under the supervision of an experimenter.

An experimenter in the control room continually monitored the experiments.

Subject performing a step-exercise during the experiments.

A group of subjects wearing the leg warmers and fleece jackets that were provided to them.

Appendix K Results

Table of contents

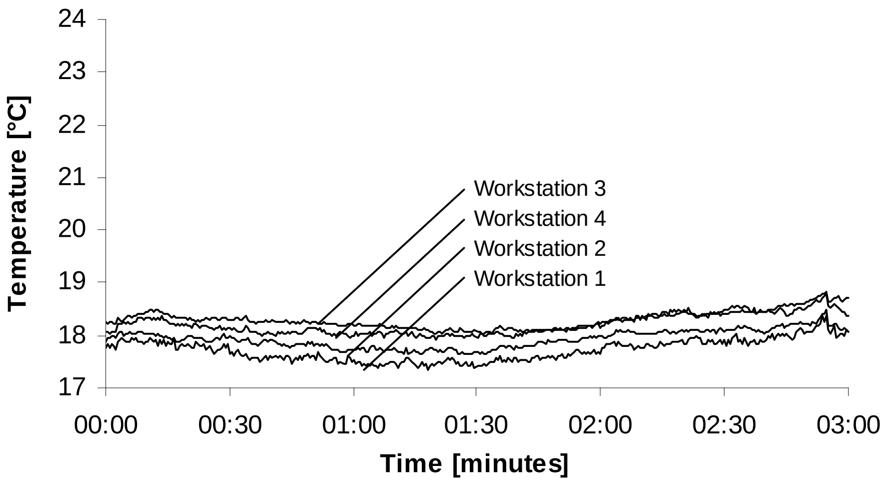
K.1 Physical Measurements 122
K.1.1 Air Temperatures in Workstations 122
K.1.2 Air Velocities 123
K.1.3 Finger Temperature 124
K.2 Thermal Comfort 125
K.3 Factor Analysis of Impacts on Thermal Sensation and Thermal Acceptability of Body 126
K.4 Local Thermal Sensation and Acceptability by Temperature and Time 127
K.4.1 Plots for 18°C air temperature 127
K.4.2 Plots for 23°C air temperature 130
K.5 Air Quality 133
K.5.1 Impact of Sex 133
K.5.2 Statistical Analysis Including all Questionnaires 135
K.6 Performance 137
K.6.1 Impact of Sex 138
K.6.2 Impact of Learning 138
K.7 Perceptions and Symptoms 139
K.7.1 Assessment of Air Movement 141
K.7.2 Assessment of Noise 141
K.7.3 Assessment of the General Indoor Environment 142
K.8 Feedback from Subjects after Experiments 143

K.1 Physical Measurements

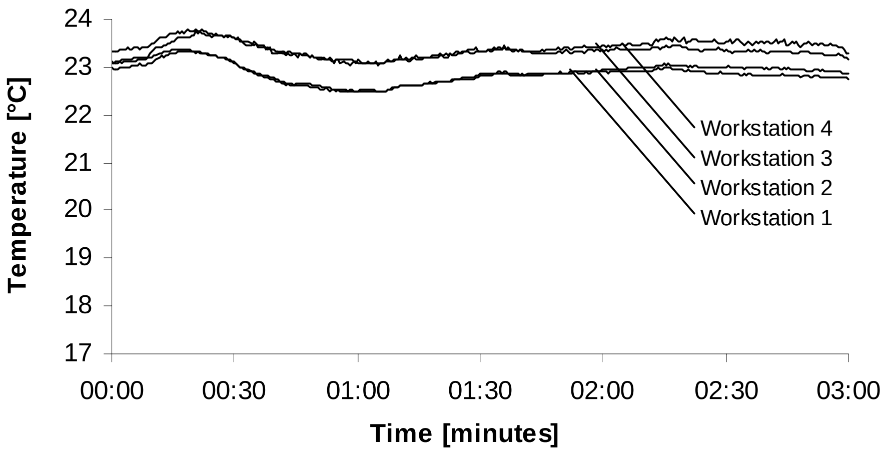
K.1.1 Air Temperatures in Workstations

The mean measured air temperature in the four workstations is shown at the 3 figures below; one for each experimental condition.

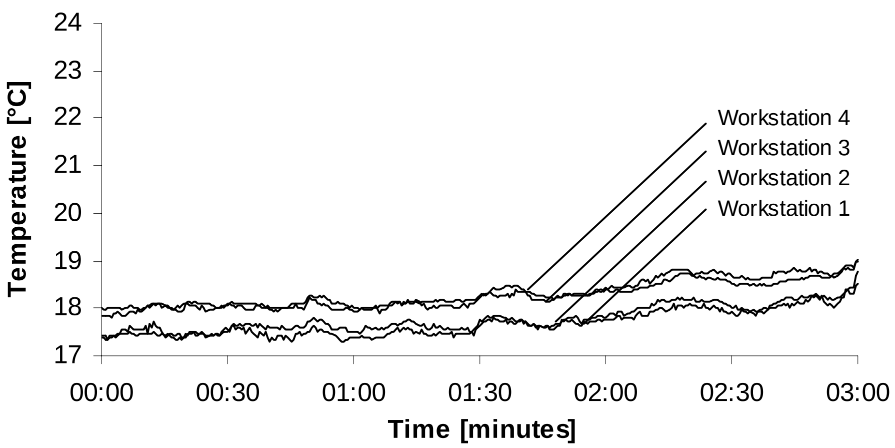
18°C, source present



23°C, source absent



18°C, source absent



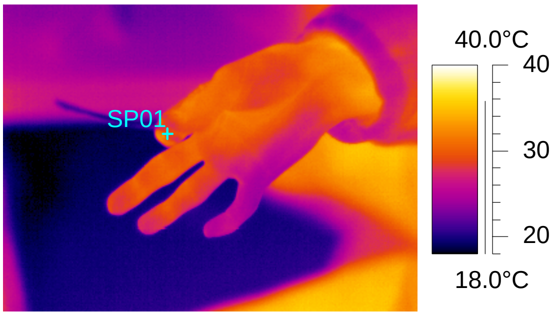
K.1.2 Air Velocities

The table below shows all air velocity and standard deviation measurements. Draught Ratings (DR) have been calculated according to ISO 7730.

		23°C			18°C		
		Height above floor [m]			Height above floor [m]		
		0.2	0.6	1.1	0.2	0.6	1.1
Station 1	Air velocity	0.17	0.12	0.12	0.58	0.21	0.17
	Std. dev.	0.11	0.07	0.05	0.26	0.15	0.07
	DR	21%	12%	11%	100%	45%	25%
Station 2	Air velocity	0.06	0.07	0.11	0.19	0.19	0.24
	Std. dev.	0.05	0.04	0.05	0.12	0.08	0.09
	DR	3%	4%	10%	36%	29%	37%
Station 3	Air velocity	0.11	0.1	0.12	0.23	0.22	0.17
	Std. dev.	0.07	0.04	0.07	0.11	0.07	0.07
	DR	11%	8%	12%	40%	31%	25%
Station 4	Air velocity	0.02	0.08	0.12	0.2	0.13	0.15
	Std. dev.	0.03	0.04	0.07	0.11	0.07	0.07
	DR		6%	12%	36%	19%	22%

K.1.3 Finger Temperature

The temperature of the subject's fingers could be read from the thermographic image of their hands. This was done with a "spot" measuring in the software for the camera. The figure below illustrates how the software works.



Spot temperature measurement for subject 6 at the cold condition; the software returned a temperature of 28.8°C for the measurement.

The results from the thermographic camera were compared with the results from the thermistor measurements. The comparison is found in the table below.

Comparison of thermistor and thermographic measurements of hand temperature

	Temperature [°C]								
	Subject	7	8	5	6	21	22	23	24
18°C	Thermographic camera	19.7	30.8	31.4	28.8	29.7	23.2	28.6	26.6
	Thermistor	19.8	32.7	30.1	29.9	30.1	23.6	29.3	25.6
	Difference	-0.1	-1.9	1.3	-1.1	-0.4	-0.4	-0.7	1
23°C	Thermographic camera	22.5	30.8	21.8	30.9	29.8	29.5	35.7	33.2
	Thermistor	22.1	32	21.3	30.6	22.9	30.4	31.2	28.4
	Difference	0.4	-1.2	0.5	0.3	6.9	-0.9	4.5	4.8

A larger difference between comparable measurements were found for the 23°C condition than the 18°C condition.

K.2 Thermal Comfort

Previous analyses have shown that the thermal acceptability votes for the body were grouped by temperature in favor of the 23°C condition despite similar thermal sensation votes. The explanation for this observed difference may be explained by a) increased local thermal discomfort and the 18°C condition or b) difference in preferred thermal sensation for the two different temperatures.

In order to clarify whether a difference in local thermal discomfort took place between the 18°C and 23°C condition the following figure was devised.

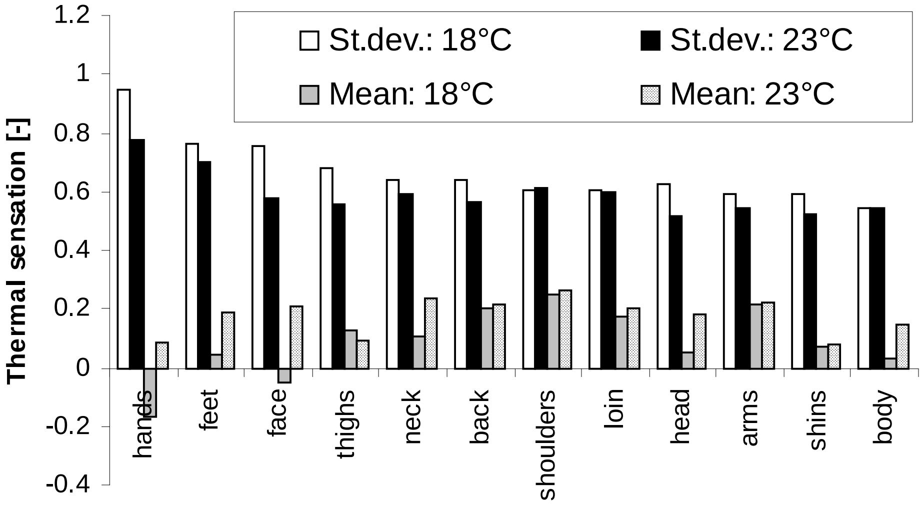


Figure K.1 The average thermal sensation votes for the body parts and their respective standard deviation at the 18°C and 23°C condition. The standard deviation is generally higher for the 18°C condition, whereas the 23°C condition generally is farthest away from a thermal sensation vote of zero.

The numerical analysis of the figure reveals that the standard deviation (i.e. fluctuation) generally is 12% higher for the 18°C condition, whereas the deviation of the mean thermal sensation from zero is 42% higher for the 23°C condition.

K.3 Factor Analysis of Impacts on Thermal Sensation and Thermal Acceptability of Body

A factor analysis could be used to determine the correlation between the thermal sensation of the entire body and the body parts. The intention was to perform a more detailed analysis of the local thermal discomfort at the temperature conditions of 23°C and 18°C. The factor analysis, which included the thermal sensation votes of each of the body parts, is found in the table below.

Table K.1 Factorial analysis of the influence of thermal sensation (TS) of body parts on the thermal sensation of the body.

Factor analysis for thermal sensation of the body

	23°C condition	18°C condition
TSHead	0.86	0.67
TSNeck	0.81	0.71
TSBack	0.84	0.74
TSLoin	0.81	0.66
TSThighs	0.74	0.50
TSShins	0.78	0.37
TSFeet	0.65	0.16
TSHands	0.82	0.54
TSArms	0.82	0.66
TSShoulders	0.81	0.67
TSFace	0.82	0.58
Communal estimate	0.91	0.82

The table shows a clear difference in magnitude of the correlation factors for the two temperature conditions. For the 23°C condition, the correlation factors were high and similar to one another indicating a uniform thermal sensation of the entire body. The corresponding correlation factors of the 18°C condition were smaller and less uniform indicating a higher degree of local thermal discomfort than at the 23°C condition. The higher uniformity of the thermal sensation of the body for the 23°C condition is also reflected by the communal estimate, which is markedly higher (0.91) than for the 18°C condition (0.82). Thus, the factor analysis strongly indicates that the local thermal discomfort has been higher for the 18°C condition than for the 23°C condition.

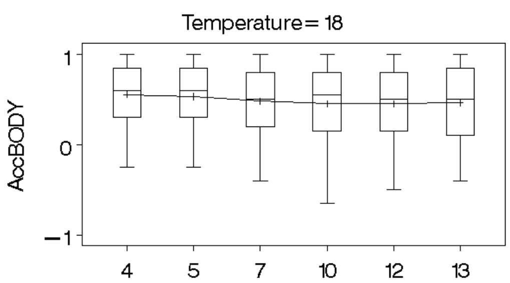
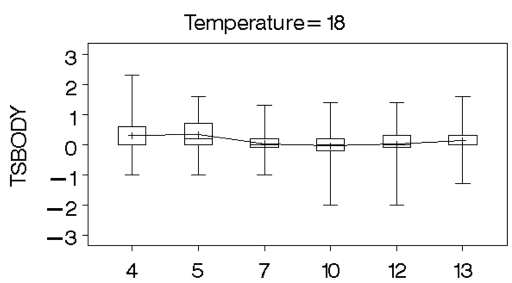
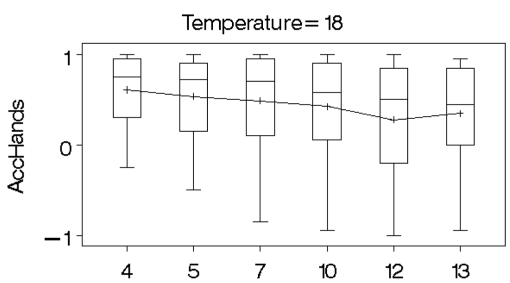
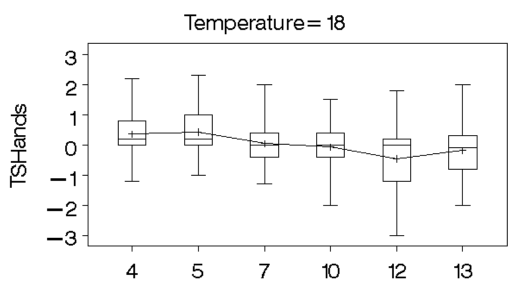
K.4 Local Thermal Sensation and Acceptability by Temperature and Time

The appendix contains box plots of the time-course of thermal sensation and thermal acceptability for the two temperatures. Thus, the plots related to the 18°C condition are means of the two conditions conducted at 18°C.

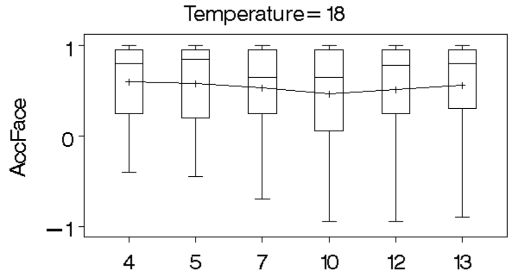
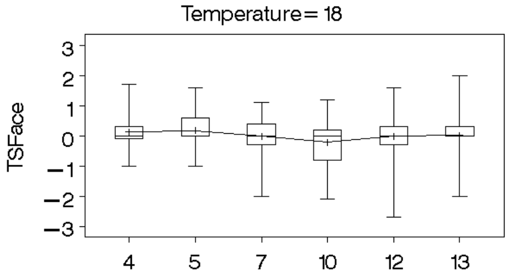
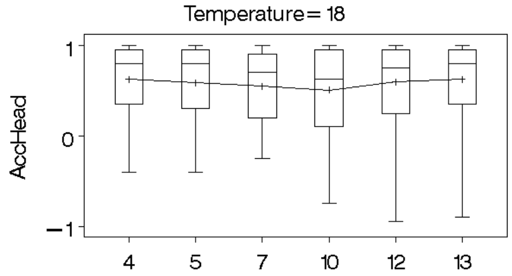
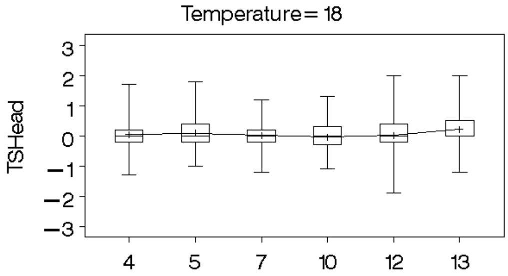
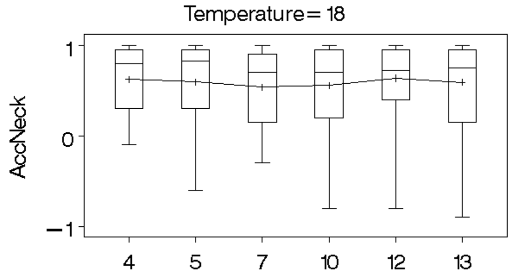
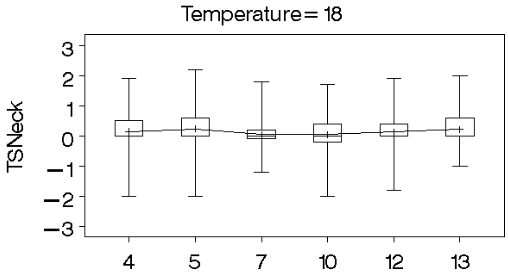
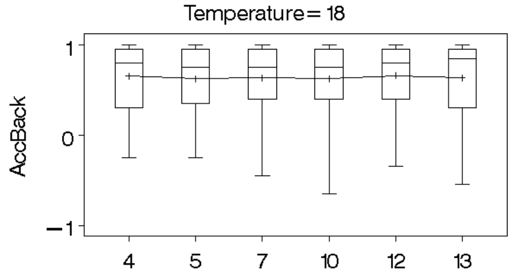
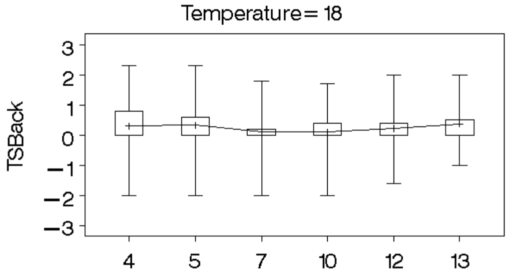
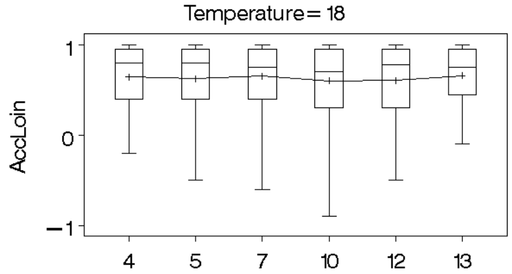
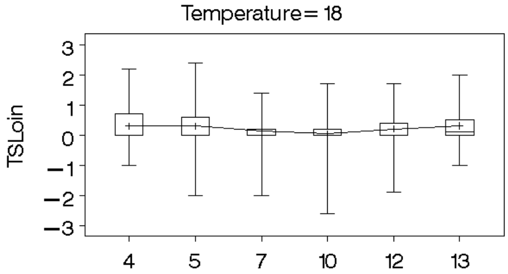
The x-axis values are the unique numbers the questionnaires were given, and refer to a point in time:

Questionnaire	Time [minutes]
4	24
5	41
6	64
10	86
12	129
13	169

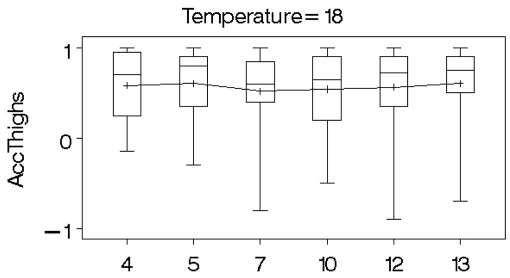
K.4.1 Plots for 18°C air temperature

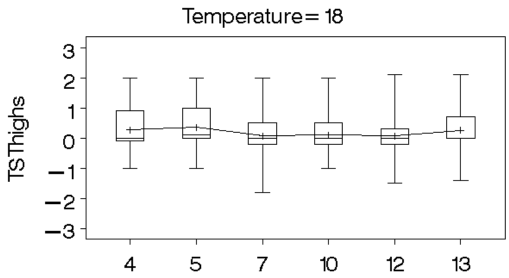
ACCEPTABILITY	THERMAL SENSATION
	
	

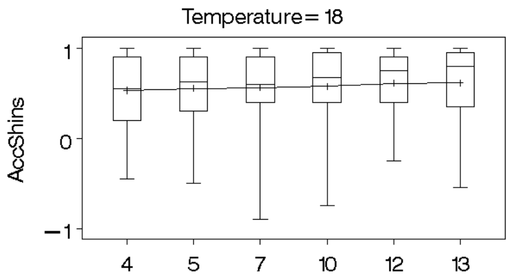
Appendix K

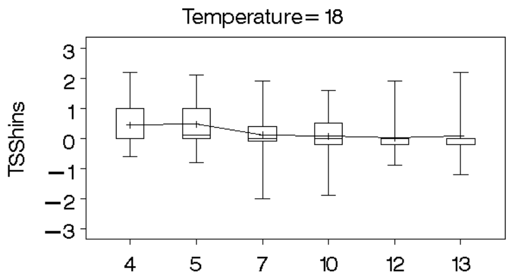
ACCEPTABILITY	THERMAL SENSATION
	
	
	
	
	

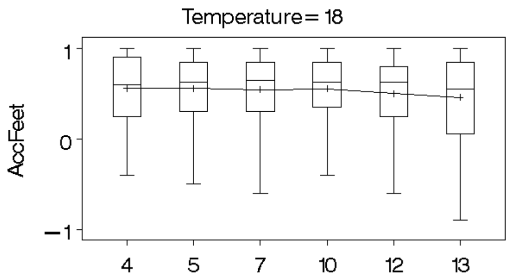
ACCEPTABILITY	THERMAL SENSATION

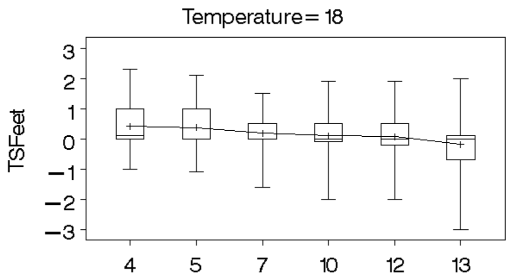


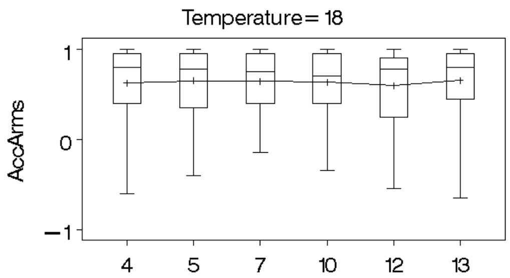


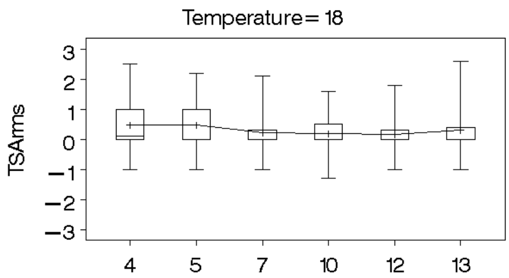


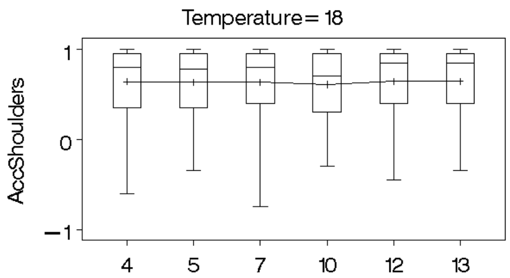


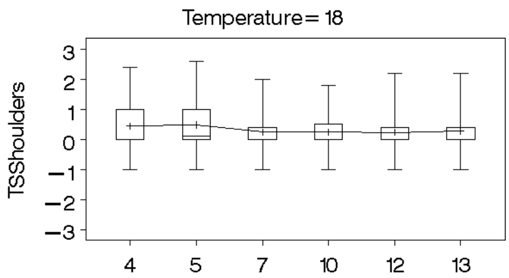




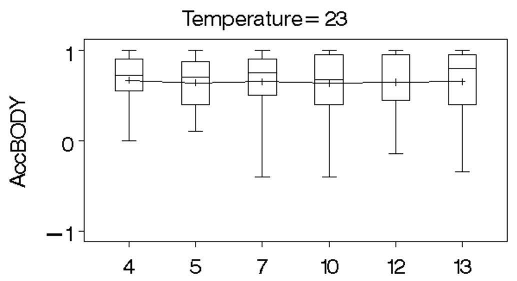
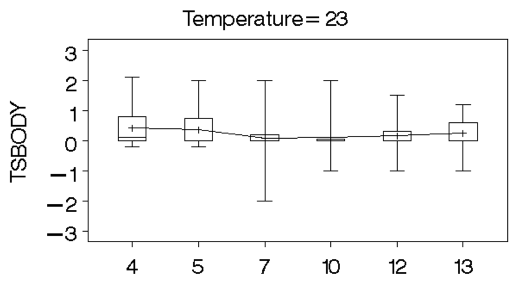
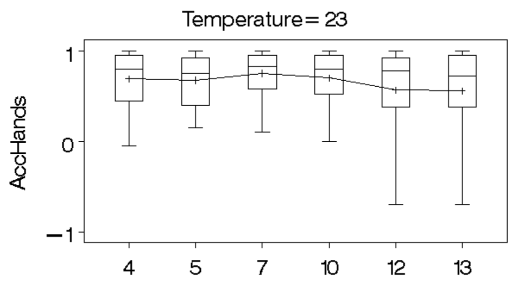
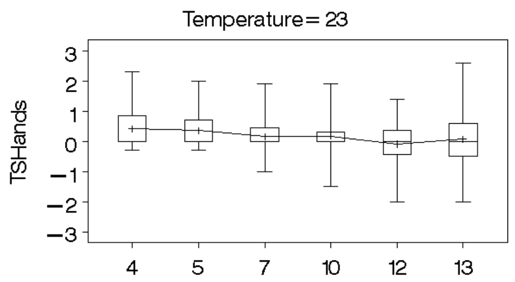
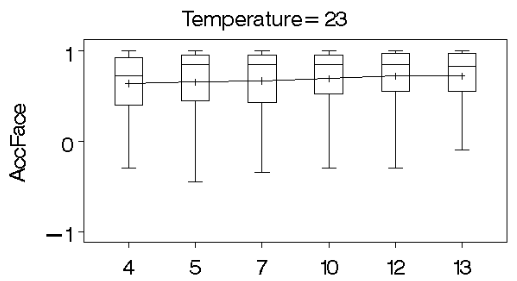
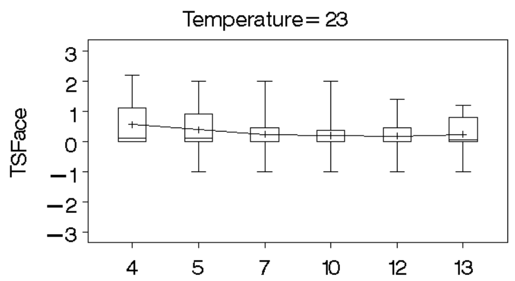
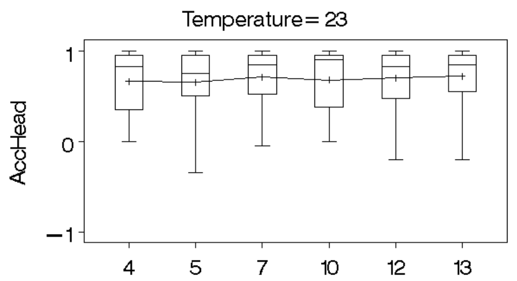
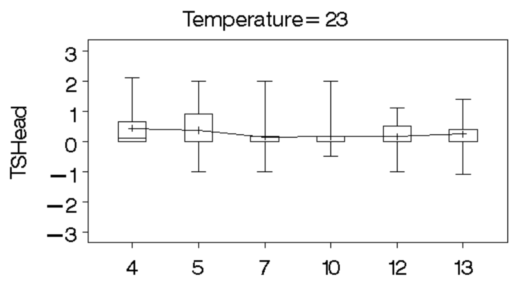
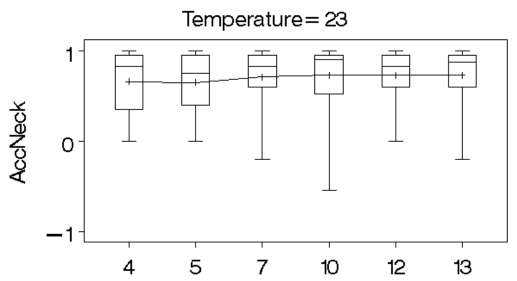
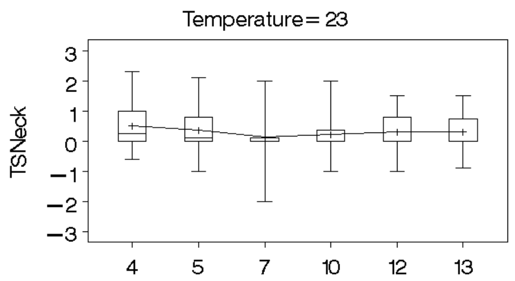


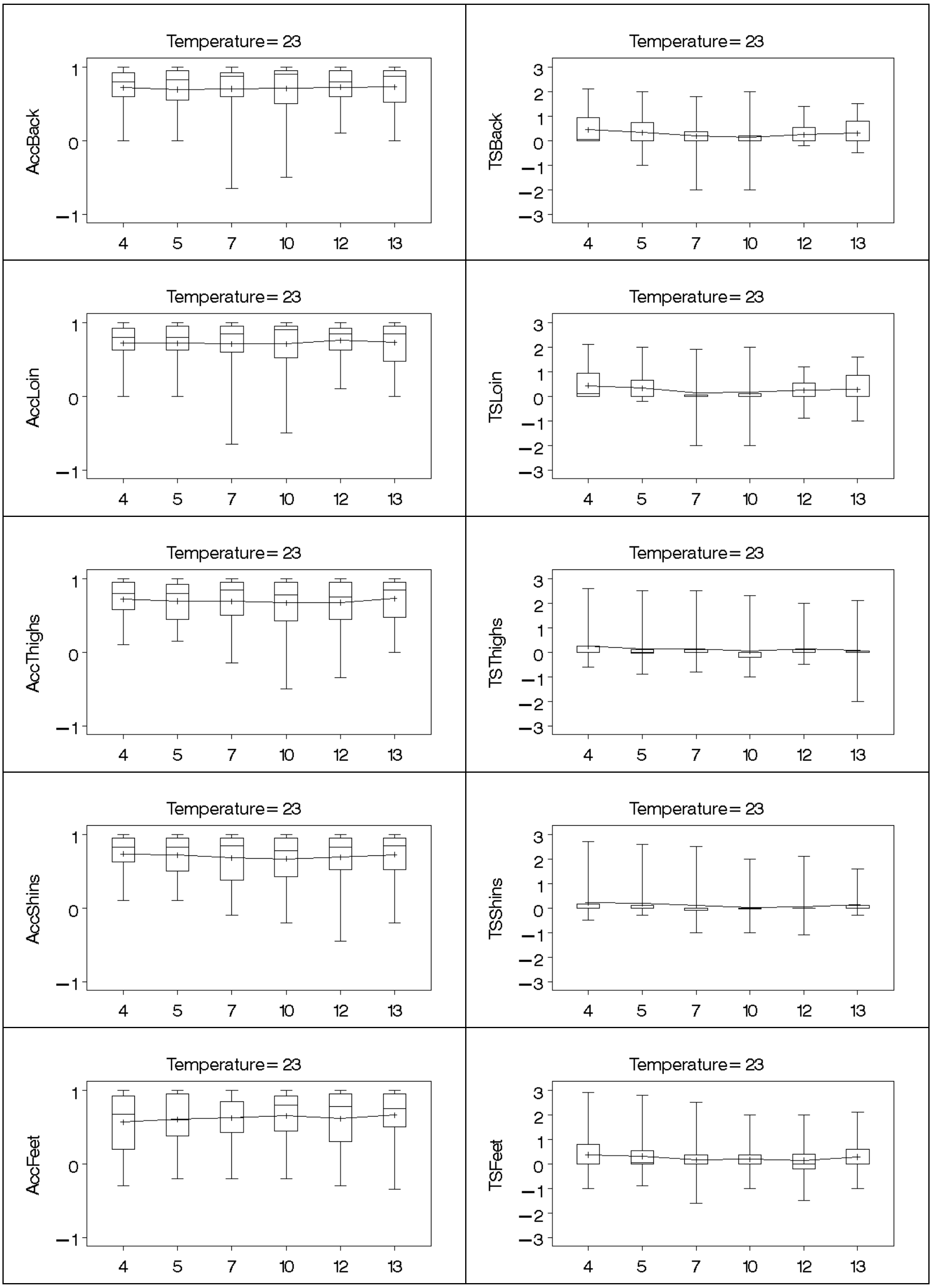






K.4.2 Plots for 23°C air temperature

ACCEPTABILITY	THERMAL SENSATION
	
	
	
	
	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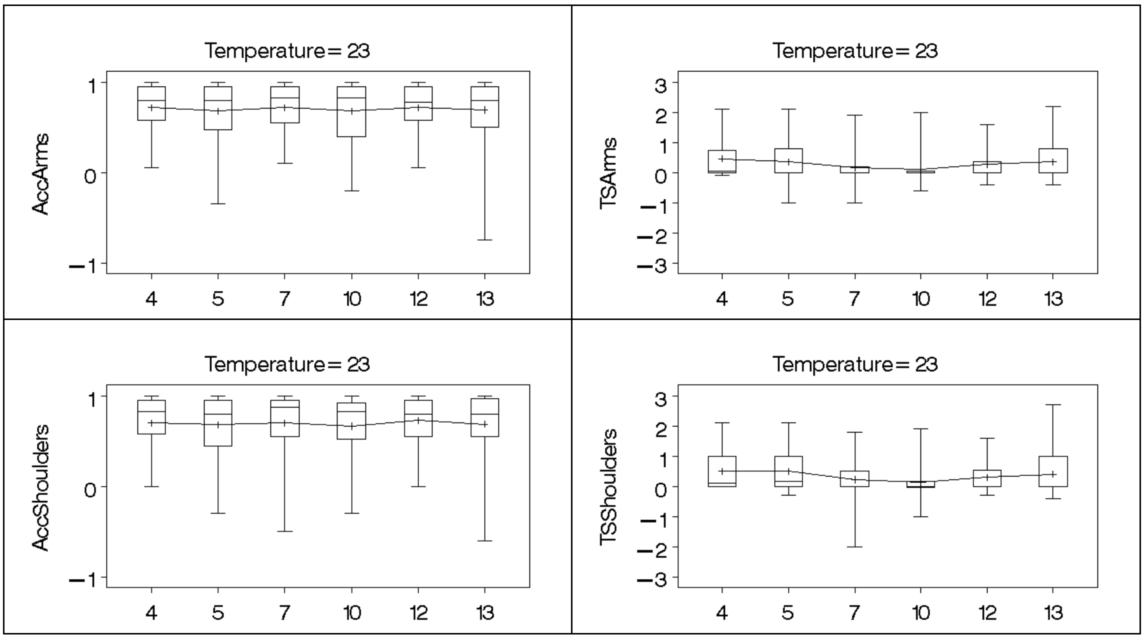
TSBack
AccLoin
TSLoin
AccThighs
TSThighs
AccShins
TSShins
AccFeet
TSFeet
4
5
7
10
12
13

Appendix K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−2
−3
4
5
7
10
12
13
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−1
4
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10
12
13
Temperature=23
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3
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1
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−2
−3
4
5
7
10
12
13

K.5 Air Quality

The table below contains mean acceptability (ACC) votes by time and conditions. Eight assessments were made by each subject during each exposure. Before the "Entry" and "Re-entry" assessments, they refreshed their senses in the corridor. The remaining six assessment were made while sedentary, as part of the Thermal Comfort questionnaire.

ACC ± SD [-]	Time [minutes]							
	(Entry)							(Re-entry)
Condition	6	24	41	64	86	129	169	180
23°C, no source	0.21 ± 0.4	0.4 ± 0.3	0.38 ± 0.3	0.45 ± 0.4	0.4 ± 0.4	0.46 ± 0.3	0.5 ± 0.3	0.18 ± 0.4
18°C, no source	0.47 ± 0.5	0.53 ± 0.3	0.54 ± 0.3	0.54 ± 0.3	0.58 ± 0.2	0.56 ± 0.3	0.61 ± 0.3	0.48 ± 0.4
18°C, source	0.31 ± 0.4	0.49 ± 0.3	0.54 ± 0.3	0.41 ± 0.4	0.44 ± 0.4	0.45 ± 0.4	0.45 ± 0.4	0.39 ± 0.5

K.5.1 Impact of Sex

The mean acceptability of the air by sex and condition is seen in the table below for each assessment.

	18°C source		23°C no source		18°C no source	
Time	Females	Males	Females	Males	Females	Males
6	0.15	0.45	0.22	0.20	0.41	0.54
24	0.35	0.62	0.39	0.41	0.47	0.60
41†	0.41	0.64	0.31	0.45	0.48	0.60
64	0.20	0.61	0.45	0.46	0.51	0.56
86	0.33	0.55	0.35	0.46	0.59	0.56
129	0.24	0.56	0.45	0.48	0.48	0.65
169	0.31	0.58	0.46	0.54	0.65	0.58
180†	0.17	0.61	0.14	0.21	0.44	0.52
Average	0.28	0.57	0.35	0.40	0.50	0.58

† For these completions, sex showed a significant impact on the GLM.

It was found with the GLM, that sex had a significant impact on the model of the completions at 24, 41, 64, 129 and 180 minutes (though only 3 tests are valid, strictly speaking). The mean acceptability scores were shown above.

The table below investigates, if the impact of sex was stronger on any one condition than on others. T-tests were used on the two completions that were significantly impacted by sex. For each condition, a t-test was used to compare the votes by the two sexes. The table shows, that only one of these t-tests showed a significant difference between the votes on the 5%-level, namely that of 24 minutes.

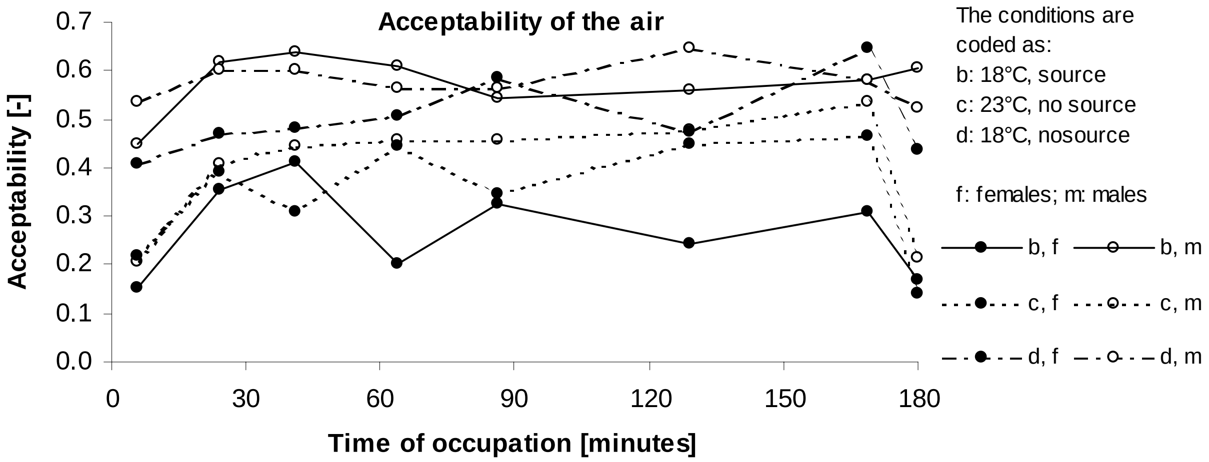
It also shows a clear trend towards the 18°C with source-condition being the condition that is impacted the most by sex, as the p-values for this condition is lower much lower than the p-values for the other conditions.

It is noted, that with 28 subjects exposed to each conditions, the t-tests can only test 14 subjects of one sex against 14 subjects of the opposite sex. With such a limited number of subjects, large differences are required for a t-test to show significance. It seems a reasonable assumption, that the two sexes voted significantly different at the reduced air quality condition, but that the limited number of subjects makes the t-test turn out mainly insignificant.

T-test p-value	Time	23°C no source	18°C no source	18°C source
	24	0.91	0.29	0.027
	129	0.82	0.19	0.24
	180	0.45	0.60	0.076

This is also illustrated by the figure below, which shows the time course of the acceptability by sex and condition. Notice that the axis only shows positive acceptabilities, and that it has been cut off at 0.7.

No particular difference between the sexes in the assessments of conditions c and d are noticed. In contrast, condition b (18°C, source present) is assessed much worse by the females than the males.



K.5.2 Statistical Analysis Including all Questionnaires

An analysis was made, in which all 8 eight assessments were included in the model, and the time of assessment was used as a factor. The other factors included in the general linear model were: Temperature, pollution source, subject, sex, group, appearance, weekday and time of day.

This approach does *not* meet the basic requirement of independent samples for an analysis of variance, but it provides indications of the impact of each factor, if any. The data are normally distributed and the conditions are of homogeneous variance. The results are seen in Table K.2, and it is repeated, that since the samples are not independent, the results can be used as indications only.

Table K.2 General linear model of all 8 air quality assessments for all 28 subjects.

	DF	SS	F	PR > F
Temperature	1	2.8	47.9	< 0.0001
Pollution	1	0.5	9.2	0.003
Sex	1	1.9	32.4	< 0.0001
Time of day	1	0.7	12.4	< 0.0001
Task (questionnaire number)	7	2.7	6.5	< 0.0001
Group	6	6.2	17.4	< 0.0001
Weekday	6	0.9	2.6	0.019
Workstation	3	0.5	3.0	0.029
Subject	20	24.7	20.9	< 0.0001
Error	572	33.7		

Due to the considerable amount of data, the effects of all model parameters are found to have a significant impact on the effects. It was also found that there was no difference in the way the subjects voted during the first session in which they participated and the way the voted at the last session. This was investigated by including the “appearance”-number in the model as a factor; this factor turned out not to be significant.

The results from the model are shown in the table below. The values are based on the model estimates, which represent the isolated effect of each factor.

Acceptability of air based on model estimates							
Temperature							
18 [°C]				23 [°C]			
0.54 ± 0.022				0.25 ± 0.028			
Pollution source							
No source				Source			
0.45 ± 0.014				0.35 ± 0.029			
Sex							
Females				Males			
0.34 ± 0.018				0.46 ± 0.018			
Time of day							
Early				Late			
0.36 ± 0.02				0.44 ± 0.016			
Time, order of completion							
1	2	3	4	5	6	7	8
0.28 ± 0.029	0.43 ± 0.029	0.43 ± 0.03	0.42 ± 0.029	0.43 ± 0.03	0.44 ± 0.03	0.47 ± 0.029	0.3 ± 0.03
Workstation							
1		2		3		4	
0.4 ± 0.024		0.35 ± 0.023		0.45 ± 0.024		0.4 ± 0.024	

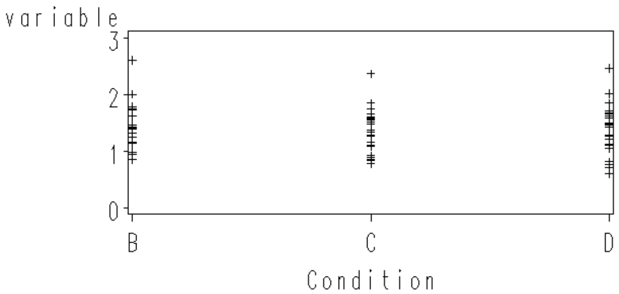
K.6 Performance

Scatter plots of all 8 analyses are found below. Scatter plots are used to identify outliers, and to estimate whether the variance of data is homogeneous between conditions.

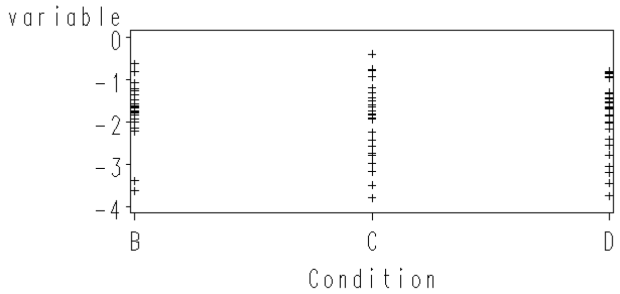
Conditions were coded as follows:

B: 18°C, source; C: 23°C, no source; D: 18°C, no source

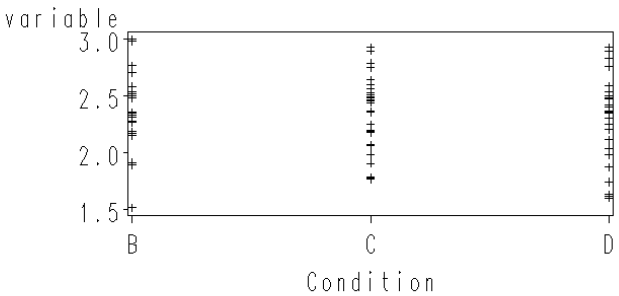
Analysis: Multiplication speed



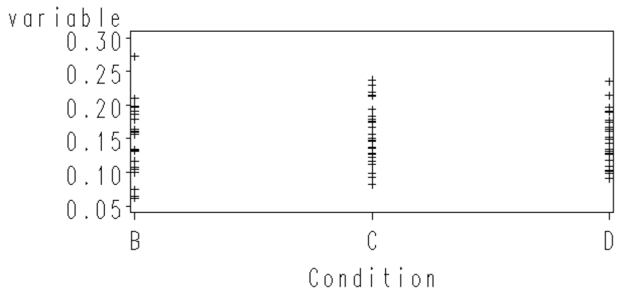
Analysis: Multiplication error ratio



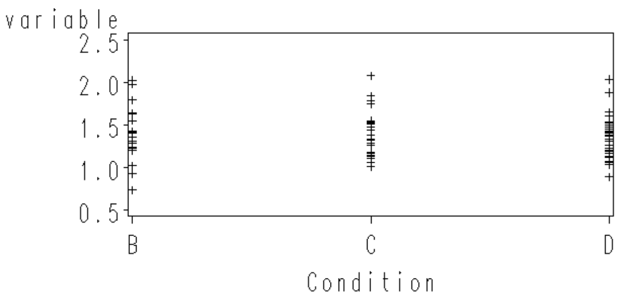
Analysis: proof reading speed



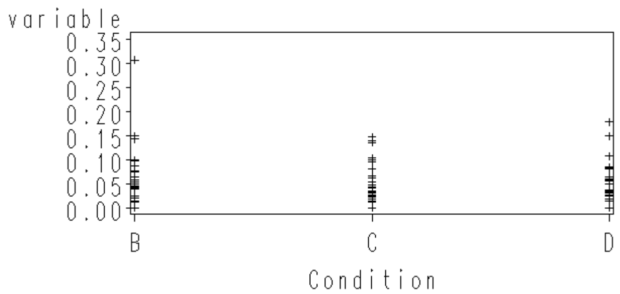
Proof reading, error ratio



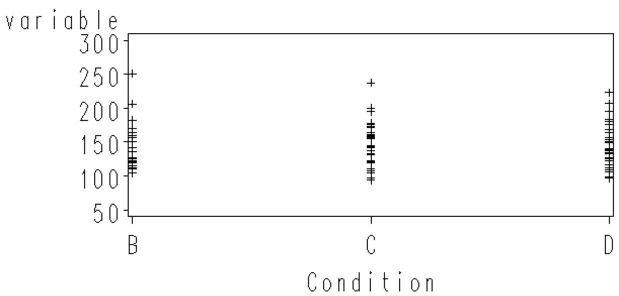
Analysis: Addition speed



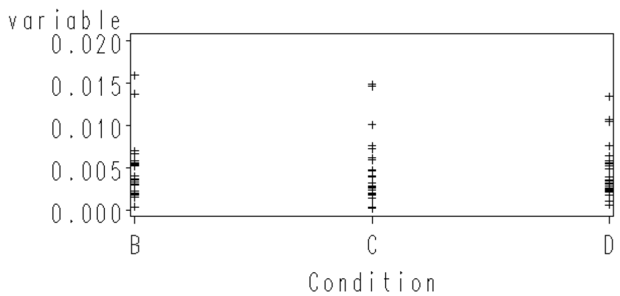
Analysis: addition error ratio



Analysis: text typing speed



Text typing error ratio



The plots showed that the task most strongly influenced by outliers was the addition error ratio, but that most tasks had outliers to an extent.

K.6.1 Impact of Sex

The mean performance by sex and condition is seen in the table below.

		Multiplication		Proof reading		Addition		Text typing	
		Speed	Error ratio	Speed	Error ratio	Speed	Error ratio	Speed	Error ratio
18°, source	Females	1.49	0.164	10.1	0.161	4.07	0.0494	136	0.0043
	Males	1.35	0.230	12.0	0.138	4.19	0.0842	156	0.0054
23°C, no source	Females	1.38	0.123	10.3	0.171	3.96	0.0382	139	0.0037
	Males	1.33	0.250	11.7	0.137	4.35	0.0624	154	0.0053
18°C, no source	Females	1.40	0.149	9.7	0.170	3.84	0.0413	139	0.0038
	Males	1.35	0.248	11.6	0.129	4.19	0.0529	153	0.0047

K.6.2 Impact of Learning

The mean performance by number of appearance and condition is seen in the table below.

Learning					
Number of appearance		2	3	4	5
Speed	Multiplication	1.23	1.34	1.46	1.56
	Proof reading	10.2	10.7	11.4	11.9
	Addition	3.98	4.06	4.41	4.22
	Text typing	142	151	143	150
Error ratio	Multiplication	0.229	0.212	0.165	0.135
	Proof reading	0.149	0.155	0.152	0.152
	Addition	0.233	0.211	0.206	0.207
	Text typing	0.00446	0.00472	0.00425	0.00427

It is seen that the speed increases and the error ratio decreases, with increasing number of appearance.

K.7 Perceptions and Symptoms

An overview of the mean votes for the perceptions and symptom assessments is found in the table below. The table first presents the results of Bartlett's and Shapiro-Wilk's tests, in order to determine whether a GLM could be used. This was the case for the 8 sets of data that are marked with a "yes" in the "GLM valid" column.

The remaining 14 sets of data were investigated with estimated t-tests.

The p-values from the estimated t-tests are presented in the table following on the next page, as are the mean votes for each statement and condition.

	Mean votes ± SD (see main report for scales)				Assumption checks		
	23°C no source	18°C no source	18°C source	Mean	Bartlett's†	Shapiro-Wilk's‡	GLM valid
Odor Intensity	0.7 ± 0.6	0.4 ± 0.4	0.6 ± 0.5	0.6 ± 0.5	0.96	0.0012	-
Eyes	0.5 ± 0.4	0.4 ± 0.6	0.6 ± 0.7	0.5 ± 0.6	0.95	0.0002	-
Nose	0.4 ± 0.5	0.4 ± 0.6	0.3 ± 0.4	0.4 ± 0.5	0.76	0.054	yes
Throat	0.3 ± 0.5	0.4 ± 0.7	0.2 ± 0.3	0.3 ± 0.6	1.00	0.0000	-
Dryness of air	55 ± 15	56 ± 16	53 ± 12	55 ± 14	0.60	0.26	-
Stuffyness of air	35 ± 17	72 ± 24	69 ± 22	58 ± 27	0.79	0.86	-
Lighting level	45 ± 9	45 ± 8	45 ± 11	45 ± 9	0.55	0.64	-
Noise level	61 ± 13	59 ± 16	58 ± 16	60 ± 15	0.66	0.079	yes
Dryness, nose	32 ± 26	34 ± 23	35 ± 25	34 ± 25	0.19	0.041	yes
Dryness, throat	55 ± 34	55 ± 31	56 ± 29	55 ± 31	0.31	0.33	-
Dryness, eyes	46 ± 33	49 ± 30	51 ± 35	48 ± 32	0.26	0.030	yes
Headache intensity	82 ± 24	83 ± 22	78 ± 26	81 ± 24	0.34	0.0000	yes
Difficulty in thinking	70 ± 24	69 ± 22	71 ± 24	70 ± 23	0.18	0.20	-
Dizziness	88 ± 18	91 ± 14	84 ± 24	88 ± 19	0.96	0.0000	-
Tiredness	70 ± 27	66 ± 24	59 ± 28	66 ± 26	0.33	0.072	yes
Difficulty in concentration	69 ± 25	70 ± 24	66 ± 25	69 ± 24	0.030	0.78	-
Sleepiness	33 ± 30	29 ± 27	36 ± 27	33 ± 28	0.21	0.53	-
Work ability	80 ± 13	82 ± 11	80 ± 11	81 ± 11	0.53	0.57	-
Overall performance (from Exit Quest.)	86 ± 11	85 ± 10	85 ± 9	85 ± 10	0.40	0.40	-
Can feel air movement	0.54 ± 0.5	0.82 ± 0.4	0.91 ± 0.3	0.75 ± 0.4	0.98	0.0003	-
Air movement acceptable††	0.65 ± 0.4	0.24 ± 0.5	0.2 ± 0.5	0.33 ± 0.5	0.73	0.16	-
Noise acceptable	0.32 ± 0.6	0.28 ± 0.5	0.18 ± 0.5	0.26 ± 0.5	0.30	0.076	yes
Indoor environment acceptable	0.35 ± 0.4	0.4 ± 0.4	0.12 ± 0.5	0.3 ± 0.4	0.26	0.084	yes

† Homogeneity of variance tested with Bartlett's test, with an accept criteria of p<0.90.

‡ Normal distributed data tested with Shapiro-Wilk's *w*-test, with an accept criteria of p<0.10.

†† Only questionnaires were included in the analysis, for which the answer to the question "do you feel air movement" was "yes".

Perceptions and Symptoms (p-values)

	Estimated t-tests			General linear model						
	C vs B	C vs D	GLM valid	Temp	Pollution	Group	Sex	Weekday	Time of day	Subject
Odor Intensity	0.85	0.08	-	0.30	0.46	0.03		0.06		0.01
Eyes	0.40	0.67	-	0.62	0.03	0.00				0.00
Nose	0.25	0.81	yes	0.76	0.21	0.03				0.03
Throat	0.41	0.45	-	0.33	0.14	0.19				0.04
Dryness of air	0.62	0.77	-	0.71	0.45					0.44
Stuffyness of air	<0.0001	<0.0001	-	0.00	0.66					0.02
Lighting level	0.94	0.88	-	0.62	0.40				0.04	0.00
Noise level	0.46	0.45	yes	0.01	0.20	0.00		0.05		0.00
Dryness, nose	0.71	0.75	yes	0.58	0.43	0.00	0.01			0.00
Dryness, throat	0.92	0.96	-	0.95	0.87		0.06			0.00
Dryness, eyes	0.62	0.75	yes	0.62	0.97	0.00	0.01			0.00
Headache intensity	0.61	0.76	yes	0.69	0.39	0.09	0.63			0.00
Difficulty in thinking	0.97	0.81	-	0.78	0.71	0.03				0.02
Dizziness	0.47	0.47	-	0.38	0.10	0.00				0.00
Tiredness	0.14	0.53	yes	0.39	0.10		0.05			0.00
Difficulty in concentration	0.66	0.88	-	0.85	0.44		0.15			0.00
Sleepiness	0.70	0.53	-	0.39	0.17		0.01			0.00
Overall performance (from Exit Quest.)	0.83	0.73	-	0.64	0.75					0.0001
Work ability	0.84	0.61	-	0.50	0.43		0.13			0.00
Can feel air movement	0.0018	0.022	-	0.00	0.21		0.00			0.00
Air movement acceptable	0.0037	0.0079	-	0.03	0.59	0.01				0.10
Noise acceptable	0.35	0.82	yes	0.59	0.20	0.00				0.00
Indoor environment acceptable	0.077	0.65	yes	0.55	0.0067	0.00				0.03

Note: Missing values indicate factors with no significant impact on the model.
The estimated t-test results are valid for all factors.
The GLM results are valid for results marked by “GLM valid”, as found on the previous page.
The conditions were coded as follows: C: 23°C, no source; B: 18°C, source, D: 18°C, no source.

K.7.1 Assessment of Air Movement

Some subjects indicated that they found the air movement unacceptable, even though they had indicated that they did not feel any air movement at the previous question. The number and percentage of answers to the questions regarding air movement are found in the table below.

Acceptability	Total	Can feel air movement		Can feel air movement & air movement unacceptable		Finds air movement unacceptable	
	N	N	%	N	%	N	%
18°C, source	23	21	91	6	26	8	35
23°C, no source	28	15	54	1	4	11	39
18°C, no source	28	23	82	5	18	10	36

"N" is the number of answers among the total answers for a condition. "%" is the corresponding percentage.

K.7.2 Assessment of Noise

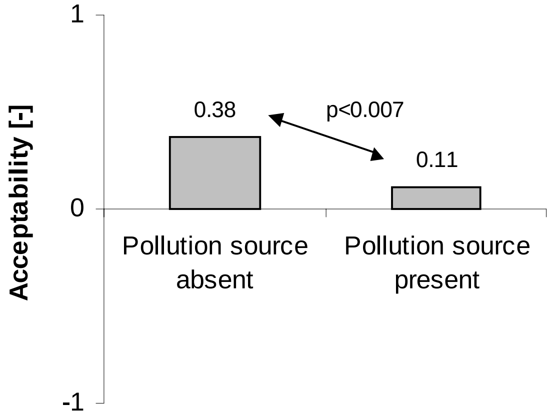
The votes for the subjective measurement of noise are found in the table below.

	Total	Unacceptable		
	N	N	%	Acceptability
23°C, no source	28	7	25	0.32 ± 0.6
18°C, no source	28	7	25	0.28 ± 0.5
18°C, source	23	8	35	0.18 ± 0.5
Mean	79	22	28	0.26 ± 0.5

"N" is the number of answers among the total answers for a condition. "%" is the corresponding percentage.

K.7.3 Assessment of the General Indoor Environment

The GLM was a valid test for the general indoor environment assessment, and showed a significant impact of the pollution source ($p<0.007$). Based on the model estimates, mean values for the two pollution source factors were calculated, using a least squares method. The result is seen on the figure below.



The figure shows that the acceptability was 0.38 without the pollution source present, but that the acceptability was 0.11 with the pollution source present.

K.8 Feedback from Subjects after Experiments

A questionnaire was sent to all the subjects 2-3 weeks after the conclusion of the experiments. The intention with the questionnaire was to get an impression of what the subjects thought the experiments were all about, while they were going on. As some questionnaires were returned with several or none check-marks to each answer the percentages do not always sum up to 100%, as each value relates to the total amount of questionnaires received. Questionnaires were returned by 17 out of 28 subjects.

Q1) Which working environment did you perceive to be most comfortable?	
a: The cold experiments	41%
b: The warm experiments	59%
Q2) In which working environment did you feel most productive?	
a: The cold experiments	65%
b: The warm experiments	35%
Q3) How did you perceive the heat coming from the partitioning wall and the tabletop?	
a: Sufficient to keep me warm	53%
b: Insufficient to keep me warm	41%
c: Too high. I became too hot	12%
Q4) Were you of the impression that the heated surfaces were regulated during the cold experiments?	
a: Yes	18%
b: No	29%
c: Sometimes	41%
Q5) If "yes", were the heated surfaces regulated to fulfil your wishes on the frequent thermal comfort questionnaires?	
a: Yes	12%
b: No	6%
c: Sometimes	24%
Q6) We experienced that many did not perform well on the tasks during the first experiment. How did you perform during the following experiments?	
a: I became markedly better at solving the tasks from one experiment to the next	6%
b: I became slightly better at solving the tasks from one experiment to the next	41%
c: I solved the tasks equally well during each of the experiments	47%
Q7) Did you think that the quality of your task work had an important influence on the analysis of the experiments?	
a: Yes	59%
b: No	35%
Q8) Which factors were decisive for your performance from one experiment to the other?	
a: Factors that did not relate to the experiments, e.g. motivation level and well rested ness	76%
b: Factors that were related to the indoor climate during the experiments	65%
Q9) Did cold fingers mean lower productivity?	
a: No	29%
b: Yes, only during text typing	47%
c: Yes, for seveal of the tasks	24%
Q10) In which of the 4 workstations did you experience most draught?	
a: Right workstation close to the door	0%
b: Right workstation close to the window	41%
c: Left workstation close to the window	24%
d: Left workstation close to the door	12%
Q11) When do you work the best?	
a: When I am thermally neutral	82%
b: When I am slightly cool	0%
c: When I am slightly warm	12%

K.8.1 Analysis of Feedback from Subjects After Experiments

The following interesting **general** observations were made:

A. Many people felt at bit too cold
B. Most people were not aware that the radiant panels were regulated to their advantage

Specific observations of interest:

1. Even though the subjects prefer the warm experiments, they believe they are more productive during the cold experiments. (Q1 + Q2)
2. Approx. one third of the subjects did not think that their solving of the tasks had a significant effect on the analysis of the experiments. Thus, their level of performance may have varied more than for those people, who did their best each time. (Q7)
3. The majority of the subjects believed that the decisive factors of their performance were not related to the experiments. (Q8)
4. About half of the subjects thought their text typing productivity decreased due to cold fingers. (Q9)

Appendix L Project Diary

A project diary was kept during the project. It reflects the process we have been through, the concerns and problems at a given period of time. However, the diary is not purely professional. Occasional comments to the happenings in room 009 (our office) and whereabouts are included.

In particular, it documents our work in the first part of the process, as this is covered much in the main report.

L.1 Week 36: September 4 – 8, 2000.

September 4th was the official start of the exam project. However, the paper work (exam project form) and the main objectives of the project had been agreed upon in the spring semester of this year. The aim of the project is to “test whether people at thermal comfort become more productive when subjected to lowered air temperature and elevated radiant temperature”. This hypothesis was to be tested in the field laboratory at the Centre of Indoor Climate and Energy by the end of October over a period of six weeks.

Much of the week was reviewing our initial ideas from the spring semester, as both of us had been busy doing other things over the entire summer. We outlined a project plan with deadlines for the individual weeks until New Years and discussed it with Jørn. The field laboratory will be in use until the fall break; thus, we agreed to move our 1-week fall vacation to Christmas, as we will surely be very busy up till the experiments commence.

We were given an office in the “student” room in building 402, i.e. room no. 9. We share the office with two Bulgarians, Kiril and George, and with Jan, who is Polish; all of them seem to be nice persons. The office and the entire lower floor were rather messy because new floors are being laid in the offices. We spent some time arranging ourselves in the office and tidying up the room. To our great satisfaction we had been given two computers. They both are connected to the internet, but they are not new. However, they will surely fulfil our needs for this project, as we do not expect to do simulation work that requires much computational power. Unfortunately, Czech students, who had installed Czech-versions of different software, had previously used the computers. Thus, it has been necessary to reinstall programs and/or format the computers.

Our office only has one phone line, which is shared by all the students in the room. We found this to be a dissatisfactory situation because everybody is on the alert whenever the phone rings. We therefore tried to investigate whether it would be possible to get our own phone line. There were apparently no technical hindrances to this solution, however, our request for an individual phone line was rejected with the argumentation that the employees at the department were so accustomed to dialling 4009 to the student room that this could not be changed. The suggestion of having one phone with different ringing signals for the individual students was also rejected. We intend, however, to continue the battle to get our own phone line as the rejections we have receive so far seem to originate from old fashioned stubbornness rather than from sound reasoning. And isn’t it true that ringing phones is one of the major nuisance factors in office environments?

L.2 Week 37: September 11 – 15, 2000.

More detailed work on the prototype. Foil prices were higher than we had expected, which encouraged a further study of what was actually needed. The idea of uniform, low-temperature walls was given up on this account, much encouraged by Jørn and the budget-bullies. Instead smaller, warmer panels were considered. This required a study of required foil temperatures at various foil areas. We decided to write a small piece of matlab-code that could determine shape factors for a geometry loosely resembling the prototype. This took us some days, but Peter got to know matlab a lot better, for which he will be ever grateful. It is concluded that the smaller panels probably will work. It is noted that there the subjects might experience cold backs.

The availability of various foils and controls was loosely studied, but without reaching final conclusions on what to buy.

We got a personal telephone, but still need our own number.

L.3 Week 38: September 18-23, 2000.

A choice between the Carawarm and Ecoflex foils is to be made. Carawarm is suitable but expensive, whereas ecoflex is cheaper and more flexible – but might not be able to sustain the temperatures needed. Thus, Carawarm is ordered along with a small piece of ecoflex.

We talked to Jørgen Berrild at Eltek. He was helpful and gave us valuable information on various control principles, besides offering to help us further, should we need it. He also suggested that Eltek might have some equipment that we could use in the experiments, such as power transformers. Then he also made it clear that anyone who had not had Servo Control I + II could not consider himself an engineer.

Inspired by JB, we concluded that an on/off relay control would be a non-optimal solution, considering the power needed for the foils and the resulting risks of power-bursts. Instead a TRIAC control supplied by OJ Electronics was chosen, along with a regulator and sensor from PR electronics. We ordered these products.

Helped dismantling the climate chambers. The fact that we needed to use one of the chambers reduced the joy of helping. We talked to Jørn, who assured us that we would be able to use the chamber. A few days later that was modified to “a chamber”.

L.4 Week 39: September 24 - October 1, 2000.

The PR Electronics regulator arrived AT LAST. Centre-breakfast. Meeting with Jørn. Schedule changed again. Expectations lowered. Talk of perhaps only using 3 conditions. Will reduce time-usage and cost – and our benefit from the project.

All the important parts for the prototype are available, which in principle enables us to start construction next week. Fingers crossed. Installed SAS on computers.

Talked to Thomas about the assumptions for the tests, and the experiences with the different tests so far.

Voted yes to the euro, but in vain.

L.5 Week 40: October 2 – October 8, 2000.

Monday: With the regulator available, we were ready to start working on the prototype set-up. Work went smoothly. Using whatever materials we could find, we made a very crude workplace in the room next to our own. It was empty, as it was waiting for paint and a new floor. This location was far from ideal, but the best that we could get.

The crucial part was making the control system function as intended. It turned out that installation was logic, and that the complete system worked in the first try. We installed the two side panels and the two front panels.

We used whatever materials we could find for the set-up, which reduced aesthetics but increased construction speed.

Tuesday: We installed the data logger, and started arranging thermocouples. The control system work by varying the time that the power to the foil is on during a 45 second-period. This causes the surface temperature to oscillate somewhat. We wanted to quantify these oscillations.

Wednesday: Had the system running all day and collected data at various set point temperatures. Observed that the time to reach equilibrium after a 10 degree-change of set point was around 20 minutes.

The system still ran as supposed. Spent the afternoon reading statistics.

Gunnar gave us the specifications of a foil (Tehlco) at a quarter of the price of the carawarm foil. We ordered a sample of the Tehlco foil.

Thursday: Had the statistics lecture in the morning. Spent the afternoon preparing a meeting with Geo and Fanger. We were to present whatever findings and results we had at the moment. Unfortunately it turned out that Fanger would not be able to come. We decided to have the meeting nonetheless.

Visited the climate chamber at the Department of Energy and Buildings. It turned out to be a basement room, which happened to be at a fairly constant temperature of 18.5°C. There had been a cooling system, but it did not work anymore due to a Freon leak. Installing the heating foils and other equipment would cause the room air temperature to rise; it was obvious that we could not use the room. Instead we decided to continue using the – so far – unused office next to our own. By installing a fan to supply outdoor air to the room, we should be able to decrease the temperature towards the desired temperature of 16-18° C.

Friday: Had breakfast with the department; Geo offered Gammel Dansk to celebrate his birthday.

Had a meeting with Jørn, Geo and Richard de Dear. Presented the project, and received valuable feedback.

Installed the Tehlco foil, which functioned as expected. The weather was warm for early October, which kept the cubicle air temperature above 20° C. In the afternoon the fuse of the transformer that supplied the foils kept blowing. We were unable to find the reason for this. The day ended early.

Formulas for the function of temperature and resistance for the thermal sensors used:

Anne's correlation: -53.2 log(R) + 226.49

Gunnar's correlation: $399.883 - 71.5580 \ln(R) + 4.027 (\ln(R))^2 - 0.1064 (\ln(R))^3$

Neither correlation was found to be sufficiently exact at 0°C or 100°C.

L.6 Week 41: October 9 – October 15, 2000.

Monday: Gregers arrives late after a sleepless night. Peter considers this a fine time for a table tennis return match – but looses.

We installed another transformer for the foils, so that only two foils are connected to each transformer. This seems to prevent the fuse blowing. Outdoor temperature was around 10° C, which allowed the room air temperature to achieve a steady 16° C. But with the foils on in the cubicle, the air temperature hardly remained below 20° C.

Had a meeting with Fanger and Jørn where the overall message was that the field laboratory has to be "office like" and that it would be difficult to establish thermal comfort at air temperatures below 18°C. Moreover, Fanger wanted people to be able to adjust their clothing whereas we prefer them to be more or less identically clothed and to ensure thermal comfort solely via radiation. See meeting summary for more details.

Calculated a statistics example with Henrik Spliid using Lei Fang's data for "number of lines read" at different conditions. Did a two-side variance analysis, which in accordance with Lei Fang findings showed that there was not significance. The data was entered for all test-persons including those who had not come for one or two of the conditions. Our calculations showed that the data would be statistically significant if the productivity of 30 test persons improved by 5%.

We borrowed two large 4500 VA transformers (220 – 40 Volts) from Mr. Berril (Eltek). The transformers can be connected in parallel to yield the double voltage (80 V). Care must be taken to connect the transformers correctly, namely in series and with the plus connected to the minus on the output side.

L.7 Week 42: October 16 – October 20, 2000.

Purchased materials for prototype of side panels and worked late hours to build it. The result was satisfactory in that the 120 cm high and 90 cm wide panel looked like a screen that can be bought in IKEA. The sandwich construction consists of a centrepiece of flamingo (5 cm) flanked by two foils (1 x 0.8 m) and by two masonite plates. The panel was tested at temperatures up to approx. 70°C where two disadvantages were discovered. First of all the masonite is rather smelly, but this odour may decrease after the material has been warmed up a few times. The second disadvantage was the expansion of the masonite at elevated temperatures, which made the plate bend. Moreover, the thermal response time for an 80% increase in a 30°C temperature increase was found to be 10 minutes as opposed to 2 minutes for a freely exposed foil. This somewhat lengthy response time will most likely cause difficulty for the individual control of the panels. These experiences were expensive to get as we managed to get a parking ticket (kr. 480) during one of the visits to the hardware store Anders Fog.

Some of the potential materials for the foil encapsulation are:

Material	Price	Smell	Comments	Tried "full scale"
Masonite	approx. 100 kr./m²	yes (at least for 2 days)	expands when heated	Y
"Plexi-glass" used by Love	approx. 700 kr./m² (perhaps half price)	?		N
Glass	middle	no	too difficult to work with	N
Aluminium	100 kr./m²	yes (according to Edvard)	must be painted due to low emissivity	N
Rubber	150 kr./m²	yes, a little	rather soft	N
Plastic	?	yes (according to Edvard)		N

Material	Price	Smell	Comments	Tried “full scale”
Plastic grid	?	perhaps	may increase response time for side-panels, however too high convective heat loss	N
Metal-grid	?	maybe	too high convective heat loss	N
Laminat	85 kr./m²	None from the front, but the rear side smells a little. Must be sealed.	Big expansion, somewhat brittle	Y
Book binding plastic	?	less than masonite	bubbly surface when heated i.e. does not look good	N
PE (poly-ethylene)	35 kr./m²	No	max. 60°C. Expands a lot.	Y
Teflon	very expensive	no		N
Nylon	159 kr./m²	?	bends heavily	N

L.8 Week 43: October 23 – October 27, 2000.

Realised that the PE plate expanded considerably when heated, and thus was not perfectly suitable. There was no smell from it, though.

Decided to try the laminate supplied by Krydsfinér-centralen, and drove to Rødovre to get it. Built the panel using the laminate, and this time we also made a wooden frame, and used mineral wool as the insulation material, since the styrofoam was evaporating slowly. This construction only expanded a little and we realised that there was practically no smell being emitted from the surface. The rear side was different; a slight but noticeable smell was emitted. It was decided to try sealing the panel, by gluing plastic elbows to the edges, or by using tape.

Attended lecture given by Edward Arens (University of California, Berkeley) who is head of the Environmental Design department at the university. For the past 20-30 years he has been working within the field of environmental quality and energy efficiency. He is currently running a project concerning simulation of human comfort at exposures to outdoor and indoor environments; at the moment, the model is used for thermal comfort simulation in cars. The program “Poser” uses a model of a human being that is split into 16 parts. However, a much finer subdivision is possible. The program is very relevant for our project because it is able to calculate the skin temperature by calculating the radiant view factors from each single surface of the body. The results are displayed using a visually pleasing 3D image. Edward Arens was willing to help us simulate the thermal conditions for our workstation set-up, which is very kind of him and valuable to our project.

We prepared a description of the set-up, which Jørn sent to Charlie Huizinger, the person doing most of the work on the model at Berkeley. He responded quickly and seemed eager to help.

We discussed whether an interior window of plexi glass was really needed, as the inner surface temperature of the existing glass might not get unacceptably low. Calculations indicated that the window surface temperature would be around 14 °C, at an outdoor temperature of 5 °C.

We used the CFD program Fluent in order to evaluate the temperature field around a seated person at a workstation. Work will continue on this task.

We moved the prototype set-up from the office next door, to the field lab, which Thomas left this week.

L.9 Week 44: October 30 – November 3, 2000.

Installed the temperature logging equipment, and were ready to make the first tests in the field lab. We adjusted the cooling unit to maximum cooling, and were somewhat disappointed to realise that the room temperature remained at about 20 °C. Cooling equipment is expensive, and therefore Jørn required BSim2000 calculations that could identify our cooling need before new equipment was bought.

The Bsim2000 simulations indicated that the required cooling power was heavily dependent of the ventilation rate; if a low ventilation rate is desired, the majority of the heat generated by the foils, people and equipment must be removed by an air conditioning unit. This would require a cooling power of approximately 8 kW. If an increased ventilation rate is chosen, the required cooling power can be reduced considerably.

Work on the Fluent CFD model continued. This does not have top priority at the moment. The results indicate a possible problem. The partition wall that divides the room might hinder the cooling of the part of the room in which the workstations are installed. Fans might reduce this problem, which experiments in the field laboratory will clarify further.

The foil walls were tested for the first time in the field lab at the lowest possible air temperature: 20 °C at the workstation, which is achieved at a ventilation rate of 3 h^{-1}. Thus thermal discomfort problem cannot be expected to a large extend, and indications could be psychological as much as real. However, it seemed that the back of the subject might not be sufficiently warm for comfort. Various solutions to this problem have been thought of, and it is agreed that this kind of problem *can* be solved, possibly by installing a modest number of extra foil walls. The set-up was tested without a heating foil installed under the tables, which seems to cause cold thighs. This result is preliminary, and requires testing at lower air temperatures.

An attempt was made to make the web-based software for addition tests and thermal comfort evaluations work. The attempt was not successful, which turned out to be because the required software was not available. Further work will have to be done to test the system. As time is very limited at this stage, the web-based system has been given low priority, as it is not required for the experiments to be performed – as opposed to a lot of other tasks.

Different cooling systems were researched. If possible, it will advantageous to rent a system instead of buying a new one. The price of a 9.1 kW system is approximately 35,000 kr.

More detailed plans for the recruitment and content of the experiments were made. Thomas' experiences were valuable as input to the planning.

An elaborate attempt was made to waive the parking ticket, which was received earlier. A sympathy-provoking letter was written to local authorities, which is expected to do the job.

From this week on, Gregers has been suffering from immense pain due to a rearrangement of his dental region. The underlying logic behind this is somewhat dim, but his dentist now drives a larger car. The already booming budget of the project is now also suffering from the painkillers, which is Gregers' main source of nutrition. He has applied for a transfer to a nursery home, but so far has not received a reply.

L.10 Week 45: November 6 - November 10, 2000.

Researched availability of mobile air conditioners for renting -> possible at 90 kr/day pr. 2 kW

A meeting was held Tuesday to determine the course of the experiments. The meeting concluded that

- If possible, the experiments should be performed this side of Christmas. If not, the PV group must wait.
- Using the highest possible ventilation rate of 30 l/s/pers = 180 l/s should be sufficient for cooling. No serious noise problems expected. Odour sources can be added, if desired.
- Cooling equipment should not be added for various reasons
- Using only 4 subjects at a time through a 3-week period would be acceptable
- Reducing the number of conditions to 2 would be a shame, and thus is not an option
- The exact conditions were only mentioned sporadically; there seemed to be an understanding on the scheme that could evaluate the effects of low air temperature and low ventilation rate, which, as mentioned, might as well be achieved by using a high ventilation rate and a pollution source.
- It was decided to have another meeting late on the day of Thursday, November 9. At this time further heat balance calculations should be available. Further experiments should also be made in the field lab, to determine the air temperature at 3 and 6 air changes per hour (corresponding to 15 and 30 l/s/person).
- It will then be decided whether subjects should be recruited in order to perform the experiments before Christmas as planned, or whether a new strategy should be adopted.

Work during the rest of the week focused on revealing the exact cooling power, as well as the exact heat load that was to be expected.

It was discovered that the cooling system already installed had an outdoor temperature range of 20° C to 40° C, and thus there was a risk of system failure. We discussed the problem with the experts on first floor, and came to some possible solutions.

L.11 Week 46: November 13 - November 18, 2000.

We discussed how to properly measure power consumption with Berril at Eltek, who once again proved himself helpful. It was complicated, and required the right meter. We mentioned this for Jørn, and ordered some product catalogues. A few days later, Jørn had bought an expensive-looking instrument that apparently could do the job, including transmitting data to a computer for logging. Installing the meter took some time, and almost turned out fruitful.

We built another side panel and a back panel, so that we now had a full set of panels. Each took about 4 hours to built for 2 persons. We installed these in the field lab, and also added a foil under the table. As outdoor air temperature now was quite low, it was possible to do tests at temperatures that were within the range we wanted, i.e. approximately 18° C at the workstation. We tested comfort at various temperature levels, and also monitored the power consumption. This allowed us to determine the expectable power consumption at a given operative temperature.

Worked on the CDF model of the field lab, this time with the help of Lars Voigt. Made some improvements, but without achieving a satisfying model. Some key lessons were 1) the radiation can be switched ON/OFF in the model, so far it had been OFF; when the radiation is ON each surface has to be given radiation characteristics 2) the validity of the results are easily tested by the insertion of "monitoring points"; high residuals do not necessarily means unstable solutions for the area one is interested in 3) the grid looked was too fine; the ratios should be about 20 in order to yield stabile simulations 4) the "solver model" should use the turbulence "standard KE" model.

Went to a Danvak meeting titled "To what degree is the perception of the indoor climate dependent on psychological effects?" The main conclusion was that it is very difficult to draw conclusions from questionnaires; questions about the subjects' self-perception will increase the accuracy of the questionnaire analysis.

Went to a IDA-seminar on the possibilities for newly graduated engineers. Not that relevant for our project, but it still seemed as a good idea. It was a pleasant day, but slightly disturbed by numerous bike-punctures. These continued to occur for the rest of the week, to the great distress of the entire group.

As Fanger planned to leave the country by Saturday, we wanted to have a meeting with him Friday. This failed, but we talked to Jørn. Again the main topic was our schedule. It now seemed advantageous to postpone the experiments until January. Not doing this had been decided in September, and giving up on this point did not feel good. But it wasn't at all certain that we could postpone the experiments at all, as Arsen Melikov's group of PV-People had made an oral reservation of the field lab after Christmas. Jørn would talk to Arsen about this. The alternative would be to split the experiments, which to the group seemed to be the worst solution by far.

The test conditions were discussed again, this time also focusing on humidity, as the temperatures had now been somewhat agreed upon. The discussion was whether to aim for constant relative humidity, absolute humidity or enthalpy at all conditions. We did some work on this subject later in the week.

L.12 Week 47: November 20 - November 24, 2000.

Spent much of the week and weekend testing the field laboratory on others and ourselves. The foils in the back and on the sides (Eswa, the cheap foils) are controlled by a triac while the table foil (P.O.Thomsens efterfølger, expensive foil) is controlled separately with a vario. This split control of the foils will allow for a more detailed regulation of the temperatures. Moreover, it is important that the table foil does not get too warm as it heats air that will rise and enter the breathing zone. The idea is to have the table temperature more or less constant, namely at the minimal temperature for attainment of thermal comfort on thighs and hands. The final achievement of thermal comfort will be provided through adjustment of clothing and temperature regulation on the remaining foils that have less influence on the air temperature in the breathing zone.

The temperature controls should probably not be given to the subjects because

1) they may turn the power up to a level, where the air temperature cannot be kept down (i.e. insufficient cooling) and
2) subject may have a difficulty controlling the foils, which is one of the conclusion of a previous study (Rasmussen 1997).

Hence, the subjects will fill out questionnaires at 15 minute intervals. These should be the standardised PMV-questionnaires, which can be used by us to adjust the temperature at each workstation for maximum comfort.

We measured the air change rate in the field lab at maximum airflow, and concluded that it reached the expected 6 h^{-1}.

In the beginning of the week it became apparent, that the Personalised Ventilation group of the Centre were expecting to use the Field Lab during the same period in January, as we were. This was unexpected, and suddenly the conduction of our experiments was at risk. We had numerous time-consuming discussions with everyone involved. It was obvious that no-one at the centre has an overview of the use of the facilities, and no-one has the authority to allocate resources. This came as a surprise, probably caused by naivety. A transcript of each party's opinion is found below.

Arsen

Made it clear, that we could not officially rely on using the field lab after January 15. Unofficially maybe January 20, but absolutely not later. Had some ideas about what we could do instead:

- End the experiments by Jan 15 (thus starting on new years eve)
- Use the "old meeting room" across from the field lab. An air conditioner would have to be installed, but that's simple. He said.
- Use climate chamber 3. This is good for thermal investigations, but has a bad smell and is not well suited for air quality evaluations.
- Have the PV group do their experiments in the old meeting room. Jan was sceptical, but didn't have any real arguments apart from the fact that the room may not be available in January/February (see time schedule below).

Geo

Was very busy. Considered the use of climate chamber 3 to be out of the question. Primarily because of the smell, and secondarily because it has no resemblance to an office.

Jan

Was not eager at all to postpone the PV experiments. They plan on having their workstations ready by January 20, at which time they will move into the field lab and start the calibration of the system, which is expected to take some time. Due to the ducting of the system, it is not an option to calibrate it at another location. We agree. They don't want to postpone because:

The experiments will last at least two months.

Cold outdoor air is essential. They need to control the air temperature, and want to heat outdoor air. They claim that cooling it is not an option. This sounds like a vague argument to us.

Qiunfang

(the Chinese guy) has to return by May, and want time for data analysis while in Denmark. We understand.

Love

Was helpful. He suggested using the field lab at Östersund, which is vacant in January. Some work has to be done, and equipment borrowed at the Centre. It is 1000 km away, and we will have no place to live up there. But cold air is available. He also suggested that the PV experiments could be performed there, but this was not well received.

We considered using Östersund, but concluded that it would be too time consuming.

Love planned on using the former meeting room at least until the end of January, which collided with any ideas of us using the room at that time. But according to him, it should be possible to easily equip the room so that it satisfies our needs.

Ole

According to Love, Ole is going to use the former meeting room after Love has moved out.

Later in the week, Jørn spoke to Arsen regarding the placement of our experiments in the field laboratory in January 2001. Apparently, it is possible for the PV-group to postpone their experiments until the beginning of February, but on the condition that we HAVE TO be out of the room by this time. This was great news because it allows us to use the field laboratory instead of the climate chamber. However, we must talk to the PV-group and hear whether this delay is fully acceptable to them. We very much hope so!

Perhaps it will not be necessary to run the experiments for more than two weeks. With 7 groups of 4 persons and with 2 sessions each day it will be possible to finish the entire ordeal in 2 weeks insofar we conduct experiments each day of the week. If we start the experiment on Monday 15th of January we will thus be able to run the last experiment on Sunday the 28th of January. This will allow for a few days of catching-up experiments should it be necessary.

We discussed with Thomas and others whether it will be possible to have subjects coming on Fridays, Saturdays and Sundays. The idea is to have afternoon and evening sessions on week days, while the experiments will be carried out on mornings and afternoons in the weekends. No one had any objections on us doing as planned, so we decided to proceed.

We tested the thermal comfort at the workstation. One group member would be working in the workstation, while the other controlled the temperatures. Thus the subject was unaware of anything but his own thermal sensation. We concluded that it was possible for the subject to obtain thermal comfort at the workstation. Only slight discomfort was observed at the neck and feet region. Another observation was that thermal comfort was achieved at the foil temperature levels we had previously predicted.

The discomfort problem was discussed with Richard de Dear, who suggested that we supplied fleece jackets for the subjects, since they have a high neck. He also suggested that we supplied standardised foot wear so that we had better control of this sensitive region. Thick socks and cheap indoor shoes would be sufficient. We discussed this among ourselves and with Jørn, and concluded that it was not a good idea, since we want to make the subjects feel as much “at home” as possible. As a backup solution for lightly clad subjects, it might be an option.

We also tried the 3-hour succession of tasks and questionnaires to which we plan to expose the subjects. It is dead boring; doing multiplication and addition tasks for half-hours is not a fun way to pass the time. Gregers made a few comments, which are found below:

Comments to tasks:

1. Thorough instruction for the different tasks at training session. Confusion may arise for the proof reading task, where people may sit a look for all kinds of complicated grammatical errors. Thus, examples for each kind of error should be demonstrated and preferably included on the first page of this task.
2. Some questions at the entrance questionnaire are a bit personal (frequency of bathing etc.) and could be omitted. Instead we could ask whether "relative" questions, i.e. "has more time elapsed since your last bath / change of underwear than usual?"
3. The 15 minutes for the admittance questionnaire and PMV questionnaire is too long, as it will only take 5 minutes for a trained person to fill out. However, the extra time is a good buffer for people to arrive in time for the solving of the first task (multiplication).
4. The key-board should be placed next to the monitor from the beginning, as the key-board will not be used until text typing task. Hopefully this placement of the key-board will allow it to be pre-heated, so their fingertips do not get cold.
5. The multiplication is dead boring and tiring => perfect! Maybe people have to be instructed in the multiplication techniques so they do not get all the calculations wrong. Another option would be to give the answer to, say, the first four problems at the training session for practice. The multiplication task could have three columns instead of two. Moreover, arrows could indicate the order at which the calculations should be solved as those containing low numbers (especially ones) are easier to solve than those with high numbers (eighths and nines).
6. More time is needed for the filling of the "big comfort questionnaire SBS"; it would also be nice to exercise after the filling of this questionnaire.
7. The typing is very loud; perhaps this noise bothers some of the subjects.
8. The final questionnaire should include an estimated performance evaluation of the subject on a scale from 0 - 100 %.

Suggestions for training session A:

1. General introduction of the centre, staff, activities and ourselves.
2. Stressing of the fact that everybody **has** to show up each time. Otherwise their entire participation is of no use, and we will have wasted a lot of money. However, if they fall sick, then we may be able to arrange something.
3. Thorough explanation of the tasks and questionnaires
4. Special questionnaire asking them about their tendencies to get cold/hot feet, hands etc.
5. Abbreviated run-through of the tasks, which allows time for interview of each subject.
   - we want to know their spontaneous reaction to the office environment. What is annoying?
   - we want to establish a personal relation ship to the subjects so they feel an moral obligation to show up each time. It would thus be helpful to learn their names.

Based on these positive experiences, we ordered the materials we needed for the construction of the remaining panels. As we had realised that we could only have four subjects in the field lab at a time, we would need four workstations. Each comprised 2 side panels and a back panel. Two side panels could be shared, so we needed a total of 6 side panels and 4 back panels. We also needed to build something for the tables, but postponed that.

L.13 Week 48: November 27 - December 1, 2000.

With our location problems solved, this week was dedicated to constructing the remaining panels. That took up the majority of the days Monday to Friday. We industrialised the process using all available power tools. This sped up things, and we had all side and back panels ready by the end of week.

The table and front panels still remained unsolved. We decided that the angle factor of the front panel was small compared to the power it consumed, due to the distance to the subject. This caused us to conclude that it would be advantageous to build the table panel in such a way, that we didn't have to use the front panel. We build a prototype, which proved satisfactory.

Tuesday Kiril and George left the office. They had been good company. We exchanged email addresses.

We had discussed the experimental plan with Henrik Spliid last week, and he had agreed that it was good. We created the poster we needed for the recruitment, and also a website, since we planned to use the internet for recruitment as much as possible. Later we talked to Spliid again. He now suggested that it would be a good idea to arrange to groups of subjects, so that subjects came both afternoons and evenings, instead of one time of day only. We gave this some thought, but decided to have a final discussion with Spliid before publishing our posters.

Wednesday we decided to have a short talk to Svend Svendsen, a Professor at the Department of Buildings and Energy whom we had previously considered having as supervisor for our project. We wanted to inform of us of our project. He was particularly interested in the practical applications, something he found the Centre often neglected. We had a long discussion of this, and other subjects.

On a quiet Sunday morning we observed the wildlife in the yard outside our office window. It was a mild day, and thus a lot of animals were out in search of nuts and other foods. Firstly, we noticed a large squirrel in the larger of the trees. It stayed there for a while, and its presence attracted a rarer guest; the Australian Dear. We fed both of them nuts, and actually believed that we were able to communicate with the Dear, in its own language. A very fascinating experience.

On the occasion of Christmas, we added some decorations to the office. 2 kg of clay was transformed into a Christmas Pakistani and a Christmas Fish. These home-made items were accompanied by a calendar from Ingeniøren, a counting candle and various obscenely ugly Christmas objects from Netto. We placed these items in the lounge section of the office.

L.14 Week 49: December 4 - December 8, 2000.

The most important task to complete as the week started was choosing an experimental design. We talked to Spliid Monday, and chose the design in which the subjects will come both afternoons and evenings. We finalised our poster, and the website. It turned out that our email address indeklima@et.dtu.dk was not set up properly. We sent an email to Andreas, and he was kind enough to return to DTU and correct this, even though it was after his normal work hours.

Gregers was keen on going to Africa to watch the solar eclipse and do a safari. The easiest way to achieve that was winning the quiz held by Ingeniøren. Most of the questions could be answered by using the paper's own website – but still we failed a few answers!

Other indoor climate experiments were being conducted these weeks by Love, Ole and Jana. They gave us their list of subjects, and we sent emails to everyone on that list. Minutes later the first positive replies arrived, which was surprisingly fast. We made a few photocopies of our poster in various sizes; some 1500 in total. Everything was ready. We decided to keep the spontaneous answering machine message that Peter had recorded when we installed the machine.

Tuesday morning was spent putting up posters at DTU and the surrounding residences. There was a considerable interest. The weekend group was the most popular, probably since it paid the best.

We decided to communicate with the subjects using email only. It quickly turned out that we thus saved ourselves considerable amounts of time.

But still, adding prospective subjects to the database and handling the communication took a lot of time. We spent some days doing that necessary task, which unfortunately isn't very productive project-wise. Time was running short. We had started the recruitment, but had only two and a half week until Christmas, at which time everything had to be finished. And a few lose ends still had to be sorted out.

One lucky side effect of the recruitment was the humorous answers to the questionnaires, and the like-wise answering machine messages. One favourite was Pxxxx Kxxxxxx, who had terrible sneeze attacks due to over-size dust particles and who had a troubled blinking-reflex. And his parents own a scale.

We had not heard from Arens & Huizenga at Berkeley for a while, so we wrote them a note, describing the latest changes to the set-up that we had added. They replied that they had build the geometry for the model, but still had not had time to do simulations.

L.15 Week 50: December 11 - December 15, 2000

The week was dedicated to the construction and completion of the set-up in the field lab.

Still, we started Monday by solving some problems in the *Statistical Design and Planning of Experiments*-course that we take with Niels.

We had expected to spend the afternoon working on the project, but this should not be so. It had been decided to host the Christmas reception in our office, since all other rooms were occupied. Fine with us, but unfortunately it was a complete mess, since everyone considered this exact room their private dumping ground for whatever items they did not plan to use for a few years or more. We were encouraged to give a hand cleaning it up, which we did with Jan, the other student in the room. It took some hours but admittedly, the room looked somewhat nicer afterwards.

We then proceeded to the field lab. We built the remaining three panels for the tables, and installed them under the tables as planned. We removed two workstations from the lab, so that there was a total of four left. We installed the wires and the triac controls. All controls were installed in the room next door to the field lab, which also served as department library.

At the same time that we will be testing the set-up and running experiments, other experiments will be conducted in the surrounding rooms and the corridor. These require an air temperature of 23° C be maintained in the corridor. As the main air extract from the field lab is under the door to the corridor, we will be blowing up to 180 l/s of air at approximately 20° C into the corridor. Measures should be taken to solve this.

The accuracy of the temperature control in the field lab had not been tested yet. Accurate control is crucial for the experiments. We could only use the cooling on Tuesdays, Thursdays and weekends, which made it more difficult to test the system.

For temperature measurements we would use thermistors; the Centre, mainly due to the low price, used these. The calibration data for the thermistors that we had available was based on results from an earlier study, and these data could not be verified. We decided to calibrate the thermistors ourselves, a potentially time-consuming process. Ideally, each thermistor should be tested individually, and a regression formula for each should be used when analysing the data. We were short on time, and decided to test them all at one time. We did this using a simple set-up. This could cause a slightly reduced accuracy, but greatly sped up the process. It turned out that the results were good.

We had a meeting with Jørn Thursday, in order to give him a general update. We decided to use a thermographic camera and a thermal manikin to further evaluate the set-up.

Friday was spent mainly selecting subjects, which turned out to be very time-consuming. We had received roughly 130 enquiries, which was more than we had hoped for. Questionnaires were sent to each, and these had to be evaluated for us to select the subjects that we needed. Luckily we got what we needed. It even turned out that we had no problems recruiting for the groups that were to work in the weekends and on Friday night. A total of 28 healthy young men and women were selected, 14 of each sex.

L.16 Week 51: December 18 - December 22, 2000

We spent a lot of time installing the thermistors that we had now calibrated. Though it was time-consuming, it was good to see the set-up finally starting to take shape. Installing the thermistors was the last step. We got this finished just in time for the walk-through of a complete session with Jørn, that we had planned for Tuesday.

The walk-through was successful. We were in general terms able to provide thermal comfort. Jørn reported cold feet and a warm upper body. The latter was caused by the fact that we hadn't fine-tuned the temperature controls, which caused the operative temperature to slightly exceed the intended value of 20.5° C, which is the optimum for clothing with an insulation of approximately 1.15 clo. The cold feet were no surprise, but due to the heavy amounts of air that we circulated, this could not be different. We considered various solutions.

We also installed the stout woman Nille at one of the workstations. Naked she weighs approximately 80 kg. Nille is the thermal manikin belonging to the Centre. We wanted to use her to quantify local thermal discomfort and possibly the angle factor for a seated person towards the radiant panels. The heat flux for each of the 16 limbs of the manikin adjusts itself thermal comfort is reached according to Fangers comfort equation that links skin temperature to heat flux.

We made the field lab tidy and left for an extended Christmas break, which was well justified, as we had not taken any days off during the fall break.

L.17 Week 2: January 8 - 12, 2001

Returned to Denmark on Thursday and resumed work on DTU on Friday. Took care of all the practical things that had to be done before the initialisation of the experiments on Monday, so that kept us busy all weekend.

The experiments were randomised and the questionnaires and tasks were photocopied. Biscuits and mineral water for bought for the subjects during the experiments. Fleece jackets were also purchased for each workstation. One of the subjects had reclined to come, so we had to get hold of a new person. An interview for each of the subjects was prepared.

The three newly bought ultrasonic humidifiers that had broken down just before Christmas were sent back to the vendor, John Anderberg, with a letter requesting three new ones at the very latest by Wednesday the following week. The vendor promised over the phone this would not be a problem.

L.18 Week 3: January 15 - 19, 2001

The humidifier vendor called to let us know that contrary to what he told us last week it would not be possible to send us three new ultrasonic humidifiers. The reason being that he only had one in stock. He offered us to send three steam humidifiers instead, but we reclined his offer, partly because the centre already has several steam humidifiers in the storage, and partly because they are known to give off odour. Unfortunately, John Anderberg is the only vendor in Denmark to sell noise- and odourless ultrasonic humidifiers, so we had no choice but to order the last one in stock and then hope for the best with the existing steam humidifiers. The next day, we received a steam humidifier from John Anderberg and not an ultrasonic humidifier. The reason being that John Anderberg had tested his own ultrasonic humidifier and found that it had a production error, which caused the transformer to burn off. Moreover, the humidifiers could not be repaired until sometime next week as they had to order the spare parts from Germany. Very unfortunate! Instead, John Anderberg offered that we could borrow some pulverising humidifiers from Dansk Indeklima, which we did. Little did we know that these humidifiers were very noisy and bulky making them unfit for the experiments. So, we ended up using three steam humidifiers, which fortunately did not have any noticeable odour problems. However, they each consume 420 W, which may give a heat problem if the weather gets too warm.

Each of the 7 groups of 4 subjects started with a training session. This meant that Monday and Tuesday purely consisted of training sessions where we got to optimise the temperature control according to the subjects' comfort questionnaires and got to practice the routines in between the tasks. Moreover, we used the training session to interview each of the subjects individually in order to get their immediate impressions to the test set-up with regard to suggestions to improvements. Another reason for the interview was to establish a "personal friendship" with each of the subjects to minimise their absence from the experiments, as they will surely find them very boring.

The preliminary training session turned out to be a very good idea, partly because many of the subjects had to get "accustomed" to the tasks. For example, some of the subjects had forgotten the technique for multiplication. And one of the subjects accidentally added the numbers instead of multiplying them. Moreover, some of the subjects commented on some annoyances about the test set-up, which could be improved before the real experiments started. Some of these comments related to the noise level, ergonomics and key-board standard. Moreover, a considerable amount of subjects complained of cold feet and calves even though they used the supplementary socks. This led us to buy 4 pairs of knitted leg warmers and this seemed to solve the problem. A training session can thus be highly recommended.

We started the week by buying 41 packets of Digestive biscuits, as these along with water are served the subjects during the experiments. We estimated that the subjects would devour about a third of these, which left the rest to us. A simple task, as we wouldn't have time to cook during the experiments.

We found that with cold weather around 0°C it was not problem to cool the field lab to have an air temperature below 18° C in the workstations. It was difficult to keep the hands of the subjects warm – but this was both a problem at the hot and cold condition. In fact, the fingertip measurements showed that some subjects were able to get finger temperatures that were lower than the room temperature. A bit surprising - and mysterious! The phenomenon will be examined further when the pictures from the heat cam (thermographic camera) are analysed. So far, a big temperature drop from the palm of the hand to the fingertips has been observed on some of the subjects.

The experiments run in two sessions of 3 hours each day – also in the weekends. So it is a lot of work and hard psychologically not to have any days off!

L.19 Week 4: January 22 - 26, 2001

The experiments continued as planned. A skimming of the air quality questionnaires showed that the carpet condition does not seem to have a significant effect on the air quality perceptions. As a matter of fact, a surprisingly big number of subjects are not particularly fond of the air quality at the cool condition without carpet when first entering the field lab. Perhaps the air seems too cold to them.

The preferred thermal state of many of the subjects was found to be "slightly warm" rather than "neutral" as first assumed. Since we do the controlling of the temperature and since we only became aware of this fact after the first week the subjects have felt a greater degree of comfort in the second week of experiments. The results should not be significantly affected by this fact since the experiments are balanced.

We found out that a few errors have snug into the distribution of tasks so that some of the subjects have gotten the same addition, multiplication and text typing task twice. This is not viewed to be critical to the outcome of the results – especially not with regard to the addition and multiplication, because it is not possible to remember the correct answers from one experiment to the other. For the text typing, however, it may be possible to recall certain text sequences. Moreover, the subjects complained of psychological strain of retyping the same text. We have to estimate what effect this has on the results. Perhaps it would be a good idea to discuss it with Thomas, who probably has experienced something similar during some of his experiments.

The thermal manikin was available from Wednesday afternoon to Friday morning. It was therefore decided to use it for clo-value and angle-factor determination after the experiments Wednesday night (10 pm). We had five conditions we wanted to expose the manikin to, and for each condition it takes one to two hours for the manikin to reach an equilibrium – in other words, we had to pull an all-nighter!

While the experiments are running - and for some hours before and after the experiments - we spend the time in the department library where our control and data logging equipment is found because it is next to the field lab. The library is a fairly small room, and quite full from books and equipment since not only we but also another group use it as control room for their experiments. The library has no windows, and the air is very warm and stale, since it is not ventilated either. It is noisy (>45 dB(A)) and there isn't enough room to work, either. All in all we are not quite satisfied with the indoor climate in the library belonging to the International Centre of Indoor Environment and Energy. On the other hand, time spent in there must subtract from the time that has to be spent in hell, when that time arrives.

We had intended to type in as many of the questionnaires as possible while the experiments were running. This was done for a few sessions only. We usually had enough of various tasks to keep us busy through the mornings before the experiments started. Moreover, it was difficult to concentrate in the library (see above) and working space was limited. During the experiments, one person functioned as the session supervisor, by giving the subjects instructions to the tasks, collecting questionnaires and measuring for example fingertip temperatures. He also had to monitor the temperatures at each workstation, and respond to the comfort questionnaires. This left little time to other tasks. The person not being session supervisor for that day was also present during the experiments, but had time to do other tasks. Often he spent the time relaxing, arranging food and various practical matters since the long days were tiring us down.

CLOSING REMARKS FROM THE SUBJECTS:

During the experiments the subjects often asked of the purpose of the experiments. They wanted to know what parameters were changed from time to time. We refused to tell them anything until the experiments had finished as to not affect the outcome of the results. We did, however, have some interesting talks with the subjects after their last experiment where we disclosed what the experiments were all about and they told us of their thoughts during and after the experiments. Some of these thoughts are brought here:

1. The test persons in group no. 3 believed we tried to measure their performance from time to time. However, they said that it was not necessarily the office environment that they were subjected to that determined their efficiency but rather their pre-experiment factors such at tiredness and motivation on that given day. They therefore asked us to give attention to the self-evaluation scale (0 – 100%) at the end of the experiment.
2. Subject no. 5 asked whether it we purposely made them freeze every time, but she was also the most sensitive person to cold of all 28 subjects. One of the other subjects (no. 8) also thought it often had been cold. So, cold that it was difficult to concentrate. Subject no. 7 from the same group commented that he thought it had been hot. He had, for example not used his fleece jacket for condition C (23°C), which the other two had. It shows that there is a big variation among people as to how sensitive they are to cold. However, it also shows that some of the subjects were of the opinion that we purposely made them freeze, which has some psychological implications on their performance. Studies by Wyon have shown that

acceptability of the indoor environment significantly increases when people are able to control their own micro-climate.

L.20 Week 5: January 29 – February 2, 2001

The additional two experiments (condition B, 18°C with carpet as pollution source) were carried out Monday afternoon and evening. On Tuesday the experimental set-up was removed, so Jan and Quinfang could take over the field lab. It had been agreed that they should get the room no later than February 1st.

Paid a visit to the student office to inquire about the possibilities for prolongation of our project deadline by one month. It turned out that the deadline for application was the very same day; the next deadline would not be until 3 weeks later. Thus, we wrote an application and turned it in the same day with ours and Geo's signature.

We took Wednesday off (our first day off since January 11th).

Thursday and Friday were spent on various things like returning borrowed items (e.g. steam humidifiers) and initialising the elaborate entering of experimental data. According to Thomas it would take approximately 1 month for the two of us to enter the data and perform a basic analysis.

Took the entire weekend off – the first of its kind this year!

L.21 Week 6: February 5 – 9, 2001

The main activity this week was entering of questionnaire data. We started with the most extensive questionnaire (the PMV-questionnaire), from which approx. 14000 unique numbers had to be read from the questionnaires. One would place an overhead over the questionnaire and read the values aloud, while the other would type it into the computer. For uniformity reasons the one person would to the same task for each type of questionnaires.

We were contacted by Lars Hallgreen (CAT) with regard to Bsim2000 simulations for performance evaluation of Convec panels and agreed to assist him.

The salary forms for the subjects were passed on to Gunnar Langkilde in time for them to get paid before the end of this month. We also included our own salary forms for tidying the student room for the Christmas reception.

Thursday was a half day and Gregers took Friday off, as he had appointments at Rockwool and the Architectural School, respectively.

L.22 Week 7: February 12 - 16, 2001

This week was also primarily spent by entering and double-checking data. A very laborious job, which made the days seem very long. In fact, some of them were, as we have decided to continue the habit of working late (approx. 23 o'clock) Mondays and Wednesdays.

A few errors were detected during the double-checking, but not enough to affect the conclusions. However, it is still comforting to have made a double check before starting the detailed analysis.

A database of 150 persons, who had shown interest in participating in our experiments, was made to facilitate the recruitment of subjects in the future. The database was mailed to Jan, Quinfang and Fang Lei, as they are all about to recruit subjects. Moreover, the database was sent to Jørn encouraging him to keep the database updated.

Wrote an email to all the subjects informing them of their salary transferral and asking them to fill out a questionnaire / evaluation form of the experiments. Most of them replied.

Presented our work with Bsim2000 to Lars Hallgreen and gave him a general introduction to the program. He seemed pleased.

L.23 Week 8: February 19 - 23, 2001

Continued the laborious work of entering and double-checking data. Preliminary analyses indicate that the different conditions yield no significant effect on performance. However, the data must be analysed in more detail – not least because the experiments were not perfectly balanced (see Week 4).

Attended the master thesis presentation "Optimisation of a Solar Collector" given by Jesper and Søren. They gave a good presentation and got the grade 11 – not bad!

Called Henrik Spliid to hear whether we have to comply with a deadline with regard to our "Design of Experiments" report. This was not the case.

Spent half of the Sunday working on the data entering and analysis. All the data has now been entered and double-checked. What a relief! Now the interesting part of analysing the data can begin. However, we need to familiarise ourselves with the program SAS, which seems to be very useful for handling data sets and performing statistical analysis. Jørn is an experienced user and is willing to assist us, so we will surely manage.

L.24 Week 9: February 26 – March 2, 2001

Spent much time double-checking whether the data were labelled with regard to session, task, subject etc. Tedious but necessary work, and "luckily" a few errors were detected. The data sets were prepared for SAS-format, so the real analysis could begin.

Much time was also spent familiarising ourselves with SAS. We got assistance from Jørn and did also arrange a SAS-support meeting with Henrik Spliid. Working efficiently with SAS is definitely not easy, as we are not extremely confident within the field of statistics.

There seems to be no doubt, however, that our results will not be statistically significant – at least not on performance. We knew that it would prove difficult to get significant results, so it does not come as a surprise to us. However, it is always more interesting to be able to present significant results than ones that are not. The analysis will surely bring about many other conclusions, yet, not as interesting.

Our collaboration with Lars Hallgreen regarding the Bsim2000 calculations came to an (abrupt) end due to a misunderstanding on the departments Bsim license.

L.25 Week 10: March 5 - 9, 2001

This week was primarily spent on report writing, reading and statistical analysis.

As it is sometimes difficult to use the SAS program for statistical analysis an alternative program, Statistica, was used. However, this program was not able to import data properly. Thus, the sometimes bothersome analysis with SAS continued.

A few meetings regarding the opening of the new climate chambers (March 19th) were held. Most people at the centre will take part in this event. Our responsibility will be to assist with the serving of beverages/food, guiding of guests, preparing demonstration test set-up concerning air velocity in one of the climate chambers and assisting Jørn with his presentation of our results. On one hand we would very much like to participate in the preparations and the opening festivities, but we would also like to minimize the time spent on these activities as our master thesis has very high priority. Do not forget that we have applied to postpone the deadline for our report.

The statistical analysis continued and we sought more advice from Henrik Spliid. Below is a list of points concerning our statistical analysis:

1. Non-parametric statistical tests are frequently used (among other places at our centre), because they do not have rigorous requirements to the data-set with regard to normal distribution. However, it is much better to check and possibly transform the data so that they fulfil the requirements for parametric tests, as these tests are much stronger than the non-parametric tests. The disadvantage with non-parametric tests is that they omit much of the information in a data-set. This makes it difficult to obtain significant results; only in the best case will a non-parametric statistical test yield equally significant results as the parametric statistical tests. Moreover, one of the requirements for the frequently used tests for comparison of means is that the data for each of the two data sets are of normal distribution and of equal variance. This requirement is often neglected when the test is applied and results are presented.
2. In order to test whether a data set is normally distributed one must make a sorted probability plot of the residuals. If this does not fit a normal distribution, the residuals of the logarithm of the results can be used instead. The logarithm must be taken because the effect (e.g. performance during text typing) is increased/decreased by a percentage (e.g. 5%) instead of being increased/decreased by a constant additive factor (e.g. an additional page typed, no matter how much time is spent). For the data to be evenly distributed the estimated residual plot must lie on a straight line; moreover, it must be evenly distributed around the middle with only a few outliers. If an outlier is found, it may be removed, if an explanation exist of why that specific data differs from the rest of the data. Some sort of transformation was mentioned as a method to streamline the data, but we do not expect to go into this level of detail.
3. The GLM (general linear model) does not care whether the experiments are balanced and whether the amounts of data for each condition are equal.
4. The GLM yields two outputs, type I and type III. It is output of type III that should be used for determination of significance for each factor.

5. The "estimate coefficients" comparing class variables (e.g. groups) in between themselves is of little use; the computed p-values cannot be used without transformation and can be obtained in alternative ways.
6. For the Newman-Keuls Test care must be taken when comparing variables that are nested. For example, the variable "subjectno" is nested under "groups" and "sex". The variance of the subjects (subjectno) is for instance much greater than the variance of the groups (group), which intuitively makes it difficult to determined whether there is a marked difference between groups. SAS incorrectly tests the group variation against the mean square variation of the error. However, in this case it is not the mean square of the error but rather the much larger mean square of the subjects that should be used for division to determine the F-value and the subsequent p-value of the group variation.

To summarise, Henrik Spliid thought that our model and experimental design looked fine. The slightly unbalanced design was not estimated to have a significant effect on the outcome of the results. The preliminary analysis of addition and text typing data indicated an acceptable normal distribution of the data

L.26 Week 11: March 12 - 16, 2001

Participated in the preparations for the inauguration of the climate chambers next week. Helped Jørn screening off the end wall of climate chamber 3 and prepared some graphs/pictures for his presentation at the seminar following the inauguration, as the topic of his presentation will be our project.

Continued writing the report. The literature chapter required additional search for articles to which we only had second hand recounts.

Invited people at the centre to join our two weekly jogging tours in Dyrehaven; Jørn wanted to participate but was hindered due to too much work. Learned that Fanger has a long career of running marathons and stills in an active runner. Impressive! Perhaps he would like to join for one of ours jogs, if he promises not to run too fast!

Attended the master thesis presentation of two of our classmates.

L.27 Week 13: March 19 - 23, 2001

The new climate chambers were inaugurated Monday with a big ceremony attended by 100-150 representing more than 20 countries. Among the guest were the minister of education, Margrethe Vestager, and the DTU vice chancellor (Hans Peter Jensen), pro-vice chancellor (Knut Conradsen) and director (Anne Grete Holmsgaard).

After one hour of speeches the guest had a chance to socialise and to get a 1-hour tour of the new and old chambers, each of which contained an experimental set-up that was demonstrated to the guests.

The inauguration celebration was in all respects successful, and the event enjoyed good media coverage in radio, newspaper (top story in Berlingske Tidende) and television.

The following day a full-day indoor climate seminar was held, which also proved to be a success. All in all two very positive days.

For the remainder of the week we continued working on our report. Apart from writing the main task left to still consists in data analysis.

L.28 Week 14: March 26 - 30, 2001

The activities of this week can be briefly summarised: Report writing and data analysis. Jørn had been given a print of the report written thus far and gave thorough and valuable comments. His main criticism was that the report contained too much discussion and too many considerations in the "Method" chapter. His expressed wishes for a shorter, more concise and straight-to-the-point approach. Discussions and considerations should be left to be included in the "Discussion" chapter at the end of the report. Another comment, which we had discussing among ourselves, was the question of which tense to use. Jørn recommended past tense was used until the discussion chapter.

Had a fruitful meeting with Henrik Spliid, where we settled the final questions relating to our data analysis. One fundamental point, which had been a little unclear, was how data should be tested for normal distribution. It was our impression that the practice at the Centre generally is to test for normality on the raw data. According to Spliid, this is "objectively wrong", as he put it. It is the residuals computed by the descriptive model (in our case a GLM), which must be tested for normality. The reason being that the raw data may be strangely distributed – not necessarily because they are not normally distributed but rather because the raw data are affected by a cocktail of different factors in different combinations. The statistical model takes this cocktail of factors into consideration, and yields normally distributed residuals insofar the model fits the data well.

Spent the weekend writing our report to Spliid – the report, which marks the determination of our course with him. It has been a most positive experience working with Spliid; he has been very patient, kind and helpful throughout the entire process.

L.29 Weeks 15 – 20: March 31 – May 4, 2001

These weeks were used to write the report. Numerous tests and calculations were done. We were busy throughout the period, but finished on May 4 as planned in a satisfactory manner.

It was time to make new plans and start new projects. Summer started in those very days, and we were looking forward to enjoying it.

L.30 May 4 – the last day

After some weeks of only working days, and some particularly long days this week, we are about ready to print the report. We bought cake for our colleagues at the Centre this morning, which they appreciated.

We are now really, really looking forward to submitting the report! The last corrections have now been made, and no further words will be added to the report. It is 12:37. These are the final words of Peter and Gregers – we will print now!

Appendix M Questionnaires

The following pages contain the questionnaires used in this study.

Communication with Subjects prior to the Experiments:

M.1 Introductory Letter Sent to all Subjects Selected for the Experiments 162

Questionnaire filled in by all applicants for the positions as subjects prior to selection:

M.2 Questionnaire Concerning Health 163

Questionnaires filled in during the experimental sessions:

M.3 Entrance Questionnaire 168
M.4 Thermal Comfort Questionnaire 172
M.5 Comfort Questionnaire 174
M.6 Exit Questionnaire 177

All questionnaires and communications are in Danish.

M.1 Introductory Letter Sent to all Subjects Selected for the Experiments

Kære forsøgsdeltager,

Vi kan hermed meddele, at du er udvalgt som forsøgsperson til indeklimaforsøg på Center for Indeklima og Energi. Vi forbeholder os dog ret til at udelukke dig fra forsøgene, hvis 1. forsøgsgang, mod forventning, ikke forløber tilfredsstillende.

Du er blevet valgt til GRUPPE 1. Du skal derfor deltage i forsøg på følgende dage:

Mandag d. 15/1 kl. 15-18

Torsdag d. 18/1 kl. 19-22

Mandag d. 22/1 kl. 15-18

Torsdag d. 25/1 kl. 19-22

Vær venlig at bekræfte dette ved at svare på denne email, meget gerne inden onsdag d. 20/12.

Du bedes læse nedenstående grundigt igennem. Vær også venlig at afkrydse forsøgsdagene i din kalender allerede nu, da det er vigtigt at du kommer alle dage.

Forsøgene foregår i Lyngby på Center for Indeklima og Energi, Danmarks Tekniske Universitet (DTU) i Bygning 402, 2. sal (se kort på www.ie.dtu.dk/rekruttering). Der vil være skilte der viser vej til vores mødelokale.

Forsøgene omhandler menneskers komfort og præstation i forskellige kontormiljøer. Vi gør opmærksom på, at forsøgene ikke indebærer nogen risiko for dig. Du vil kun blive udsat for forhold, som svarer til dem, du er udsat for i en almindelig kontorbygning. Dine data vedrørende din livsstil og helbredsstatus vil ikke blive videregivet til uvedkommende.

Du skal møde til forsøgene i almindeligt tøj der passer til en vinterdag. Din påklædning må ikke variere fra gang til gang - allerbedst er det, hvis du benytter det samme sæt tøj til alle forsøgsgangene. Det er særligt vigtigt at du er iført et par kraftige bukser (f.eks. jeans), samt varme sokker og sko. Dertil en varm trøje.

I løbet af forsøgene skal du udføre en række forskellige opgaver og bedømme indeklimaet, herunder luftkvalitet. Det er derfor vigtigt, at du i lugtmæssig henseende fremstår så neutral som muligt. Du må ikke indtage stærkt krydret mad, f.eks. hvidløg, stærk chili eller paprika dagen før forsøgene og på selve forsøgsdagene. Brug af stærkt parfumerede hygiejneprodukter bør ligeledes undgås på forsøgsdagene. Du må ikke drikke stærk kaffe eller te, ligesom du heller ikke må ryge, i timen før forsøgene starter. Det er også vigtigt, at du er frisk på forsøgsdagen. Derfor må du f.eks. ikke drikke meget alkohol aftenen før forsøgene og på selve forsøgsdagene. Du skal også sørge for at få en god nats søvn. Ikke desto mindre skal du i løbet af dagen, før forsøgene starter, lave de ting, du plejer at lave, f.eks. gå i skole, læse, osv.

I løbet af eksperimenterne vil der ikke være tid til at læse eller lave egne lektier.

Det er vigtigt at du møder til tiden. Du skal derfor være opmærksom på transporttiden, så du kan overholde mødetidspunktet. Forsøgene skal begyndes i fysisk veludhvilet tilstand, hvorfor det er vigtigt at du ikke har skyndt dig til DTU. Før du kommer til forsøgene, skal du sørge for at være mæt, fordi du under forsøgene kun har mulighed for at spise kiks og drikke kildevand. Du skal dog heller ikke spise for meget: Du skal bare spise som du plejer.

Du kommer til at deltage i ialt 12 timers forsøg, for hvilket du vil blive betalt 1436 kr. inklusiv tillæg for arbejde udover normal arbejdstid, samt feriepenge. Du bedes medbringe dit skattekort den første forsøgsgang.

Det er - som tidligere nævnt - meget vigtigt at du møder alle forsøgsgange. Gør du ikke det, vil dine resultater ikke kunne bruges.

Bliver du forhindret i at deltage i forsøgene, er det vigtigt, at du kontakter os så hurtigt som muligt. Du kan ringe på telefonnummer 4525 4009, eller bruge indeklima@et.dtu.dk. Har du flere spørgsmål angående forsøgene, er du også velkommen til at kontakte os.

Vi vil sende dig en email med de sidste oplysninger en uge før forsøgenes start i januar.

Med venlig hilsen

Peter Foldbjerg & Gregers Reimann

M.2 Questionnaire Concerning Health

INSTRUKTION

Besvar de stillede spørgsmål ved at sætte et kryds ud for det svar (evt. de svar), du mener er korrekt. Sæt kun flere kryds, hvis det direkte er angivet som en mulighed. Enkelte spørgsmål besvares ved, at du angiver et tal, andre ved at du skriver nogle få.

Samtlige oplysninger bliver behandlet fortroligt, og vil således kun komme til projektgruppens kendskab.

PERSON DATA

1. Fornavn:
2. Efternavn:
3. Privat adresse:
4. Postnummer og by:
5. Tlf. privat:
6. Tlf. arbejde:
7. Køn (M/K):
8. Alder (år):
9. Højde (cm):
10. Vægt (kg):
11. Beskæftigelse:
12. Hvor mange timer arbejder du i gennemsnit dagligt (i alt på arbejde, i skole, hjemme, osv.) med en computer?:
13. Har du tidligere deltaget i indeklimaforsøg på Center for Indeklima og Energi?
    A: Nej
    B: Ja, tidspunkt: ________________

LIVSSTIL

14. Er du ryger (sæt ”x”)?
    A: Ja, ryger stadig:
    B: Nej, men har røget tidligere:
    C: Nej, men aldrig røget
15. Hvis du ryger: Hvor mange cigaretter ryger du i gennemsnit dagligt?:
16. Hvis du tidligere har røget, men nu er holdt op: Hvornår stoppede du (årstal)?:
17. Hvis du stadig ryger eller tidligere har røget men nu er holdt op: Hvor gammel var du, da du startede med at ryge regelmæssigt (årstal)?:
18. Hvor mange kopper kaffe eller te drikker du i gennemsnit dagligt?
    A: Kopper te om dagen:
    B: Kopper kaffe om dagen:
19. Hvor mange genstande (alkohol) drikker du i gennemsnit om ugen?
    A: Flasker øl om ugen:
    B: Glas vin om ugen:
    C: Genstande (2 centiliter) i form af stærk spiritus:
20. Hvor mange timers motion får du i gennemsnit om ugen?:
21. Cykler du dagligt på arbejde/til skole (”ja” eller ”nej”)?:
    A: Hvis ja, hvor mange kilometer til arbejde/skole?:

HELBRED

22. Hvordan føler du dig helbredsmæssigt (sæt ”x”)?
    A: Helt i top:
    B: Nogenlunde:
    C: Dårligt:
23. Opfatter du dig mere følsom end andre overfor:
    A: Støj (”ja” eller ”nej”)?:
    B: Varme (”ja” eller ”nej”)?:
    C: Kulde (”ja” eller ”nej”)?:
    D: Luftbevægelse/træk (”ja” eller ”nej”)?:
    E: Lys (”ja” eller ”nej”)?:
    F: Dårlig luftkvalitet (”ja” eller ”nej”)?:
    G: Dårligt indeklima (”ja” eller ”nej”)?:
24. Oplever du tør luft hjemme (tørre slimhinder og/eller tørt svælg)?
    A: Ja, ofte (hver uge) (sæt ”x”)?:
    B: Ikke så ofte (sæt ”x”)?:
    C: Nej, aldrig (sæt ”x”)?:
25. Oplever du tør luft på arbejde (tørre slimhinder og/eller tørt svælg)?
    A: Ja, ofte (hver uge) (sæt ”x”)?:
    B: Ikke så ofte (sæt ”x”)?:
    C: Nej, aldrig (sæt ”x”)?:
26. Har du indenfor de sidste 10 år haft én eller flere af følgende sygdomme, og er du blevet lægebehandlet herfor?
    Alle spørgsmål udfyldes og flere kryds ”x” i hver række er acceptabelt, hvis nødvendigt.

    A: Hjerte-karsygdomme?
    Nej( ) Ja( )
    Hvis ja: Er du stadig syg( ) Er du blevet behandlet af en læge( )
    B: Kronisk bronchitis?
    Nej( ) Ja( )
    Hvis ja: Er du stadig syg( ) Er du blevet behandlet af en læge( )
    C: Astma?
    Nej( ) Ja( )
    Hvis ja, Er du stadig syg( ) Er du blevet behandlet af en læge( )
    D: Andre lungesygdomme?
    Nej( ) Ja( )
    Hvis ja, Er du stadig syg( ) Er du blevet behandlet af en læge( )
    E: Høfeber?
    Nej( ) Ja( )
    Hvis ja, Er du stadig syg( ) Er du blevet behandlet af en læge( )
    F: Allergi?
    Nej( ) Ja( )
    Hvis ja, Er du stadig syg( ) Er du blevet behandlet af en læge( )
    G: Migræne?
    Nej( ) Ja( )
    Hvis ja, Er du stadig syg( ) Er du blevet behandlet af en læge( )
    H: Psykiske sygdomme?
    Nej( ) Ja( )
    Hvis ja, Er du stadig syg( ) Er du blevet behandlet af en læge( )
    I: Epilepsi?
    Nej( ) Ja( )
    Hvis ja, Er du stadig syg( ) Er du blevet behandlet af en læge( )
    J: Stofskiftesygdomme?
    Nej( ) Ja( )
    Hvis ja, Er du stadig syg( ) Er du blevet behandlet af en læge( )
    K: Sukkersyge (diabetes)?
    Nej( ) Ja( )
    Hvis ja, Er du stadig syg( ) Er du blevet behandlet af en læge( )
    L: Nyresygdomme?

Nej( ) Ja( )
Hvis ja, Er du stadig syg( ) Er du blevet behandlet af en læge( )
M: Leversygdomme?
Nej( ) Ja( )
Hvis ja, Er du stadig syg( ) Er du blevet behandlet af en læge( )
N: Kræftsygdomme?
Nej( ) Ja( )
Hvis ja, Er du stadig syg( ) Er du blevet behandlet af en læge( )
O: Hudsygdomme?
Nej( ) Ja( )
Hvis ja, Er du stadig syg( ) Er du blevet behandlet af en læge( )
P: Andre sygdomme?
Nej( ) Ja( )
Hvis ja, Er du stadig syg( ) Er du blevet behandlet af en læge( )
Hvilke?:

27. Hvor mange gange har du indenfor de seneste 12 måneder haft følgende infektionssygdomme?
Alle linier bedes afkrydset, hver med kun et "x".
A: Forkølelser:
Ingen( ) 1-2 gange( ) 3-5 gange( ) Mere end 5 gange( )
B: Bihulebetændelser:
Ingen( ) 1-2 gange( ) 3-5 gange( ) Mere end 5 gange( )
C: Halsbetændelser:
Ingen( ) 1-2 gange( ) 3-5 gange( ) Mere end 5 gange( )
D: Lungebetændelser:
Ingen( ) 1-2 gange( ) 3-5 gange( ) Mere end 5 gange( )

28. Tager du jævnligt medicin?
Spørgsmålet omfatter både recept- og håndkøbsmedicin. Alle linier krydses af med et "x".
A: P-piller:
Ja( ) Nej( )
B: Hovedpinetabletter:
Ja( ) Nej( )
C: Øjendråber/salve:
Ja( ) Nej( )
D: Næsedråber/spray:
Ja( ) Nej( )
E: Nervemedicin:
Ja( ) Nej( )
F: Astma/allergi-medicin:
Ja( ) Nej( )
G: Sovepiller:
Ja( ) Nej( )
H: Anden medicin:
Hvilken?:

29. Har du indenfor de seneste 12 måneder haft følgende gener/symptomer?
Du bedes udfylde alle linier med kun et "x".

A: Åndenød:
Mindre end 2 gange pr. måned( )
Ja, mindst 2 gange om måneden( )
Ja, mindst 2 gange ugentligt( )
Ja, dagligt( )

B: Trykken for brystet:
Mindre end 2 gange pr. måned( )
Ja, mindst 2 gange om måneden( )
Ja, mindst 2 gange ugentligt( )

Ja, dagligt(   )

C: Kvalme:
Mindre end 2 gange pr. måned(   )
Ja, mindst 2 gange om måneden(   )
Ja, mindst 2 gange ugentligt(   )
Ja, dagligt(   )

D: Mavesmerte:
Mindre end 2 gange pr. måned(   )
Ja, mindst 2 gange om måneden(   )
Ja, mindst 2 gange ugentligt(   )
Ja, dagligt(   )

E: Hovedpine:
Mindre end 2 gange pr. måned(   )
Ja, mindst 2 gange om måneden(   )
Ja, mindst 2 gange ugentligt(   )
Ja, dagligt(   )

F: Svimmelhed:
Mindre end 2 gange pr. måned(   )
Ja, mindst 2 gange om måneden(   )
Ja, mindst 2 gange ugentligt(   )
Ja, dagligt(   )

G: Søvnbesvær:
Mindre end 2 gange pr. måned(   )
Ja, mindst 2 gange om måneden(   )
Ja, mindst 2 gange ugentligt(   )
Ja, dagligt(   )

H: Unormal træthed:
Mindre end 2 gange pr. måned(   )
Ja, mindst 2 gange om måneden(   )
Ja, mindst 2 gange ugentligt(   )
Ja, dagligt(   )

I: Irritation i øjnene:
Mindre end 2 gange pr. måned(   )
Ja, mindst 2 gange om måneden(   )
Ja, mindst 2 gange ugentligt(   )
Ja, dagligt(   )
Ja, dagligt i sæsonen(   )

J: Rindende øjne:
Mindre end 2 gange pr. måned(   )
Ja, mindst 2 gange om måneden(   )
Ja, mindst 2 gange ugentligt(   )
Ja, dagligt(   )
Ja, dagligt i sæsonen(   )

K: Nysen:
Mindre end 2 gange pr. måned(   )
Ja, mindst 2 gange om måneden(   )
Ja, mindst 2 gange ugentligt(   )
Ja, dagligt(   )
Ja, dagligt i sæsonen(   )

L: Nedsat lugtesans:

Mindre end 2 gange pr. måned(   )
Ja, mindst 2 gange om måneden(   )
Ja, mindst 2 gange ugentligt(   )
Ja, dagligt(   )
Ja, dagligt i sæsonen(   )

M: Hæshed:
Mindre end 2 gange pr. måned(   )
Ja, mindst 2 gange om måneden(   )
Ja, mindst 2 gange ugentligt(   )
Ja, dagligt(   )
Ja, dagligt i sæsonen(   )

N: Irritation i hals/svælg:
Mindre end 2 gange pr. måned(   )
Ja, mindst 2 gange om måneden(   )
Ja, mindst 2 gange ugentligt(   )
Ja, dagligt(   )
Ja, dagligt i sæsonen(   )

O: Hoste:
Mindre end 2 gange pr. måned(   )
Ja, mindst 2 gange om måneden(   )
Ja, mindst 2 gange ugentligt(   )
Ja, dagligt(   )
Ja, dagligt i sæsonen(   )

P: Hudgener:
Mindre end 2 gange pr. måned(   )
Ja, mindst 2 gange om måneden(   )
Ja, mindst 2 gange ugentligt(   )
Ja, dagligt(   )
Ja, dagligt i sæsonen(   )

Q: Andre gener:
Hvilke?:
Mindre end 2 gange pr. måned(   )
Ja, mindst 2 gange om måneden(   )
Ja, mindst 2 gange ugentligt(   )
Ja, dagligt(   )
Ja, dagligt i sæsonen(   )

M.3 Entrance Questionnaire

Adgangsskema

Navn:	Forsøgsperson nr.:
Dato:	Kode:

Hvad tid vågnede du i dag? ca. kl. ....
Hvor mange timer har du sovet i nat? ca. .... timer
Hvornår har du sidst været i bad? ....

Hvad lavede du i formiddags inden du ankom hertil? (afkryds flere bokse hvis nødvendigt):

- ☐ Jeg har været i skole/på universitetet i ca. .... timer.
- ☐ Jeg har læst hjemme i ca. .... timer.
- ☐ Jeg har arbejdet på kontor i ca. .... timer.
- ☐ Jeg har arbejdet på (hvor?) .... i ca. .... timer.
- ☐ Jeg har fået ca. .... timers motion.
- ☐ Andet .... i ca. ....timer.

Hvordan er du kommet hertil (afkryds kun en boks)?

- ☐ Med bus
- ☐ I bil
- ☐ På motorcykel/knallert
- ☐ På cykel. Jeg har cyklet ca. .... km.

Hvornår har du sidst spist i dag? Ca. kl. ....
Hvis du ryger: Hvor mange cigaretter har du røget i dag? ca. .... cigaretter
Hvis du ryger: Hvornår har du sidst røget i dag? ca. kl. ....
Hvor mange kopper kaffe har du drukket i dag? ca. .... kopper
Hvor mange kopper te har du drukket i dag? ca. .... kopper

Har du taget piller i dag (f.eks. mod hovedpine, høfeber, migræne, osv.)?

☐ Ja

☐ Nej

Hvis ja: Mod hvad?..

....

....

Hvordan føler du alt i alt, dit helbred er i dag:

☐ Godt

☐ Ikke så godt

Hvis du ikke har det så godt: Angiv venligst hvorfor? (f.eks. forkølelse, migræne, osv.)

....

....

....

....

Egen beklædning (eksklusiv udleveret tøj)

Afkryds de beklædningsdele du bærer nu. Sæt så mange krydser, som du finder det passende.

Fodtøj Evt. beskrivelse:

☐ Sko ☐ Ankelstøvler ☐ Lange støvler ____________

☐ Tynde ☐ Middel ☐ Kraftige ____________

Undertøj

☐ Trusser ☐ Boxershorts ☐ Lange Underbukser ____________

☐ Chemise ☐ BH/top ____________

☐ Bodystocking, korte ærmer ☐ Bodystocking, lange ærmer ____________

Overkrop

T-shirt/undertrøje

☐ T-shirt ☐ Undertrøje ____________

Bluse/trøje/sweater

☐ Tynd ☐ Middel ☐ Kraftig ____________

☐ Uden ærmer ☐ Korte ærmer ☐ Lange ærmer ____________

☐ Høj hals ☐ Rund hals ☐ Lav udskæring ____________

Skjorte

☐ Tynd ☐ Middel ☐ Kraftig ____________

☐ Uden ærmer ☐ Korte ærmer ☐ Lange ærmer ____________

Kjole

☐ Tynd ☐ Middel ☐ Kraftig ____________

☐ Uden ærmer ☐ Korte ærmer ☐ Lange ærmer ____________

☐ Høj hals ☐ Rund hals ☐ Lav udskæring ____________

Fortsætter ⇨

Underkrop

Bukser			Evt. Beskrivelse:
☐ Tynde	☐ Middel	☐ Kraftige	______________________
☐ Jeans	☐ Jogging		______________________
☐ Bomuld	☐ Flannel	☐ Fløjl	______________________
Nederdel			
☐ Tynd	☐ Middel	☐ Kraftig	______________________
☐ Kort	☐ Lang		______________________
Strømper			
☐ Tynde	☐ Middel	☐ Kraftige	______________________
☐ Korte	☐ Lange	☐ Strømpebukser	______________________
☐ Nylon			______________________

Evt. andet:

____

____

____

____

____

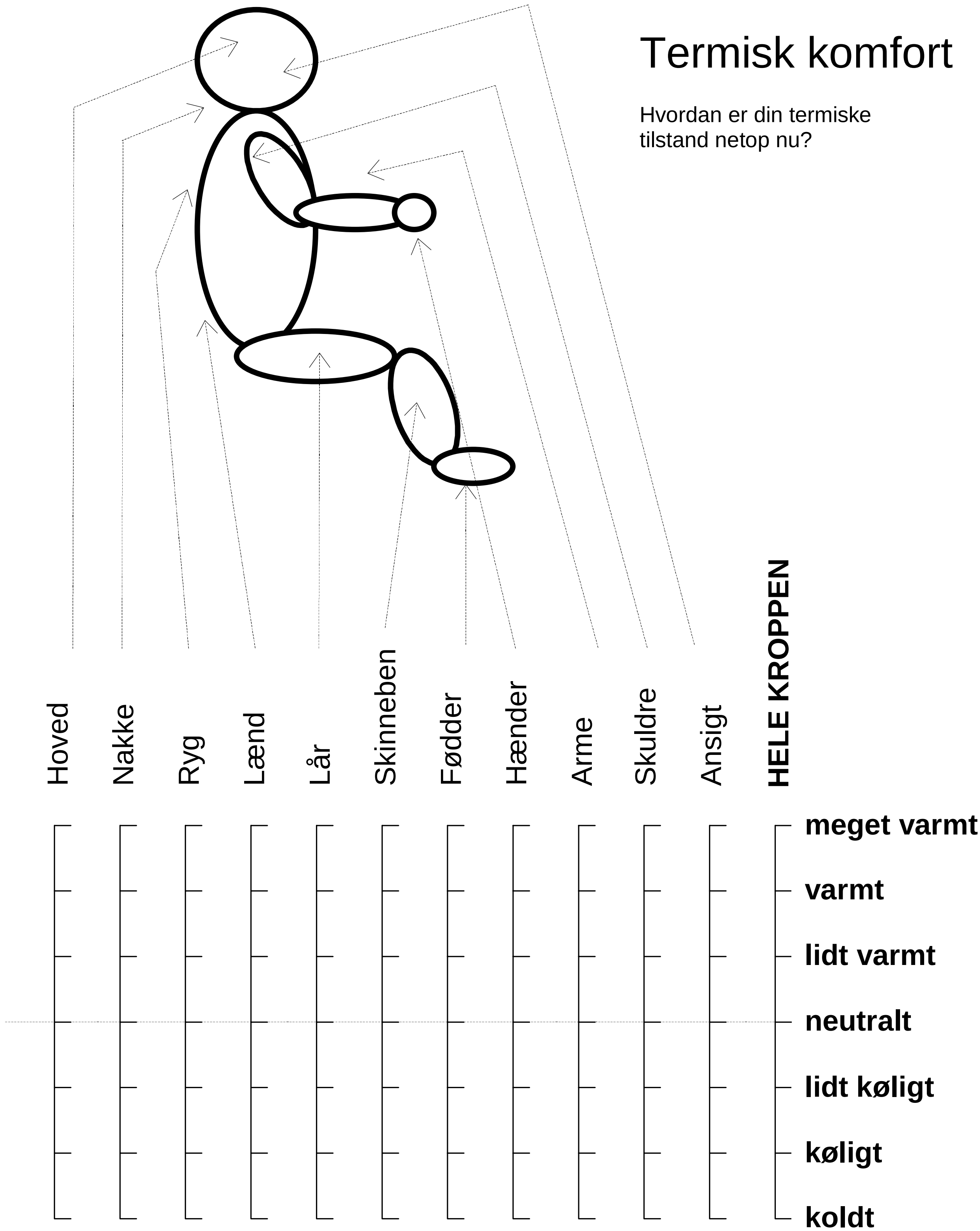
____

M.4 Thermal Comfort Questionnaire

Navn:	Forsøgsperson nr.:
Dato:	Kode:

Termisk komfort

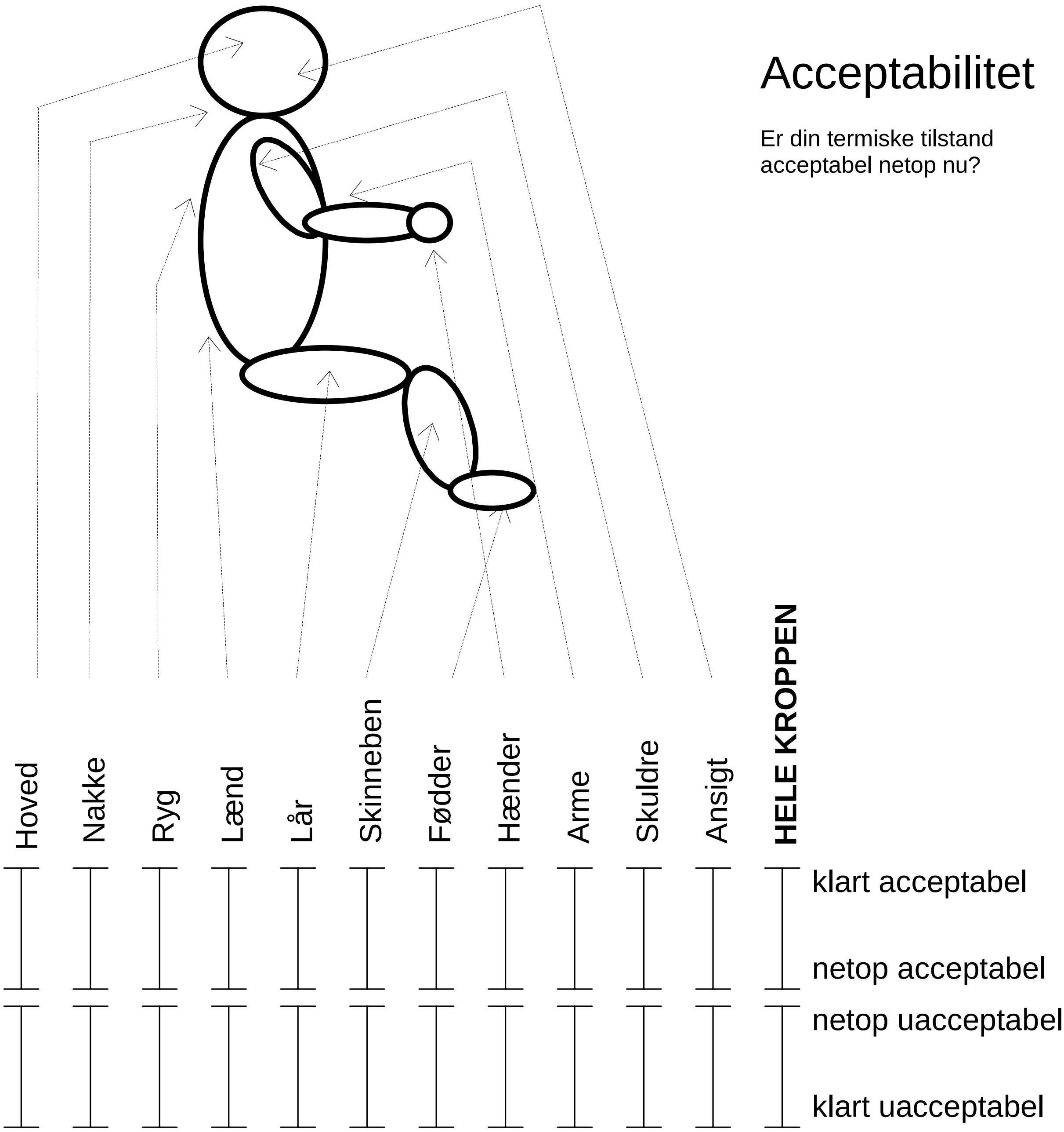
Hvordan er din termiske tilstand netop nu?



VEND ⇨

Acceptabilitet

Er din termiske tilstand acceptabel netop nu?



Luftkvalitet

Forestil dig at du i det daglige arbejde bliver udsat for den luft, som du netop nu oplever i kontoret.

Hvordan oplever du luftkvaliteten?

klart acceptabel

netop acceptabel

netop uacceptabel

klart uacceptabel

M.5 Comfort Questionnaire

Navn:	Forsøgsperson nr.:
Dato:	Kode:

Komfortskema

Bedømm lugtintensiteten:

- Ingen lugt
- Svag lugt
- Moderat lugt
- Meget stærk lugt
- Overvældende lugt

Bedøm irritationen i:

Øjne Næse Hals

- Ingen irritation
- Svag irritation
- Moderat irritation
- Meget stærk irritation
- Overvældende irritation

Indeklimaet i dette kontor kan netop nu beskrives ved:

Luften for fugtig ——— Luften for tør

Indelukket luft ——— Frisk luft

For lidt lys ——— For meget lys

For stille ——— For støjende

Min helbredstilstand kan netop nu beskrives ved:

Tør næse	|—————|	Løbende næse
Tør hals	|—————|	Ikke tør hals
Tørre øjne	|—————|	Ikke tørre øjne
Stærk hovedpine	|—————|	Ingen hovedpine
Svært at tænke	|—————|	Nemt at tænke
Svimmel	|—————|	Ikke svimmel
Træt	|—————|	Udhvilet
Svært at koncentrere sig	|—————|	Nemt at koncentrere sig
Vågen	|—————|	Søvnig

Jeg kan netop nu arbejde:

0 %	|—————|	100 %

Kan du mærke luftbevægelse?

- ☐ Ja
- ☐ Nej

Hvis ja, synes du at luftbevægelsen er:

Klart acceptabel

Netop acceptabel

Netop uacceptabel

Klart uacceptabel

Forestil dig, at du i dit daglige arbejde bliver udsat for den støj, som du netop nu oplever i kontoret:

Klart acceptabel

Netop acceptabel

Netop uacceptabel

Klart uacceptabel

Forestil dig, at du i dit daglige arbejde bliver udsat for det indeklima, som du netop nu oplever i kontoret:

Klart acceptabel

Netop acceptabel

Netop uacceptabel

Klart uacceptabel

M.6 Exit Questionnaire

Navn:	Forsøgsperson nr.:
Dato:	Kode:

Udleveret beklædning (fleece-jakke, benvarmere og sokker)

Afkryds de udleverede beklædningsdele du har båret i dag. Sæt krydser.

Det udleverede tøj:

Hvor meget af tiden brugte du den udleverede **fleece-jakke**? **Evt. kommentarer:**

☐ Den 1. time ☐ Den 2. time ☐ Den 3. time

Hvis du lige nu har fleece-jakken på, er den så:

☐ Helt åben ☐ Halvt åben ☐ Helt lukket

Hvis du lige nu har fleece-jakken på, er kraven så:

☐ Slået op ☐ Slået ned

Hvor meget af tiden brugte du de udleverede **benvarmere**?

☐ Den 1. time ☐ Den 2. time ☐ Den 3. time

Hvis du lige nu har benvarmerne på, sidder de så:

☐ Til under knæet ☐ Til over knæet ☐ Halvt op af skinnebenet

Hvor meget af tiden brugte du de udleverede **sokker**?

☐ Den 1. time ☐ Den 2. time ☐ Den 3. time

Din arbejdsindsats i dag:

Hvordan vil du vurdere den indsats du har ydet i dag, i forhold til din maksimale arbejdsindsats?

0 % 50 % 100 %

Fortsætter ⇨

Kontoret og indeklimaet:

Har din indsats i dag været påvirket i *positiv* retning af forhold der har med kontoret eller indeklimaet at gøre?

Hvilke? ____

____

____

____

Har din indsats i dag været påvirket i *negativ* retning af forhold der har med kontoret eller indeklimaet at gøre?

Hvilke? ____

____

____

____