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# DAMAGED TEXT IN ORIGINAL

# **EMERGENCY INSTRUCTIONS**

### FIRE

### IF YOU DISCOVER A FIRE:

- Operate the nearest fire alarm.
- 2. Ring extension 222, giving location of fire
  - name of person reporting
  - any other relevant information
- If it is safe to do so, tackle the fire with the fire fighting equipment provided.

# THE CONTINUOUS RINGING OF THE FIRE ALARM BELL WILL SIGNIFY FULL EVACUATION IF YOU HEAR THE CONTINUOUS RINGING OF THE FIRE ALARM BELL:

Evacuate the room, floor or building and report to the nearest assembly point in a quiet and orderly manner.

Use the nearest available exit.

Do not stop to collect personal belongings.

Do not use lifts.

Do not re-enter the buildings unless authorised to do so by the Security Staff.

THE INTERMITTENT RINGING OF THE FIRE ALARM
BELL IS A WARNING THAT AN INCIDENT HAS
BEEN REPORTED. FULL EVACUATION SHOULD NOT
BE INITIATED AT THIS STAGE.

### ACCIDENT

In case of accident contact the department/local first aider, whose name, location and telephone number are displayed on first aid boxes and at strategic points throughout buildings. **DO NOT DELAY**-if difficulty is experienced in locating a qualified first aider – ring Security Office, Main Building, extension 222, giving location and brief details of incident and indicate whether a qualified first aider is in attendance.

If it is considered necessary to call for an ambulance, this information together with your name and the exact location of the accident should be passed to the Security Office, extension 222.

**OUT OF OFFICE HOURS.** Accident calls should be made to the Security Office, Main Building, extension 222, or 359-2922 for outside calls. This office will be manned continuously 24 hours per day, 7 days per week.

### **HEALTH CENTRE**

An urgent call may be made direct to the University Physician at the Health Centre, if the emergency services are not required, by dialling extension 4505 or 4506, or 359-6706 out of office hours.

ASTON UNIVERSITY
LIBRARY AND
INFORMATION SERVICES

Start Experiment

SDT Study: Instructions and Task
Appendix Bl

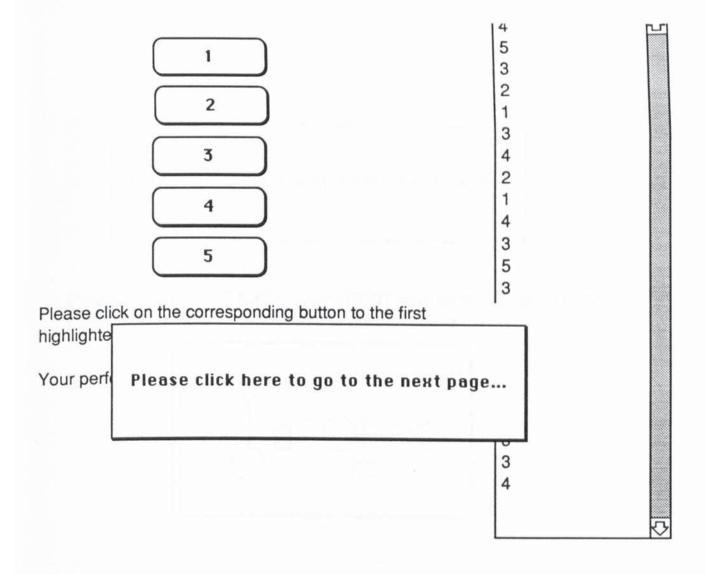
### Introduction

In the following experiment you will be required to deal with alarms in a simulated nuclear power plant. The task is to assign appropriately the alarm presented as either a non-target or a target alarm. Missing target alarms in a real nuclear power plant would result in a major incident such as in Three Mile Island or Chernobyl. Please try to behave as if you are in the environment described. You will also be required to attend to a secondary task when the primary task allows you to. Please do this experiment to the best of yor ability. There will be a £5 first prize in each of the nine groups taking part for the best performance.

You do not have to remember the instructions at this stage, just understand them.

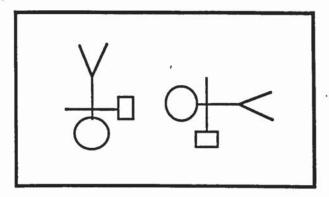
When you happy that you have understood this introduction click on the button below to go to the next page...

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Please click here to go to the next page...

Please press on the SAME or DIFFERENT keys on the keyboard for this task....Your performance is shown in the box above...



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### Instructions

You will now be required to do both tasks together as part of an experiment into alarms in a simulated nuclear power plant. The task is to assign appropriately the alarm presented as either a non-target or a target alarm. Missing target alarms in a real nuclear power plant would result in a major incident such as in Three Mile Island or Chernobyl. Please try to behave as if you are in the environment described. You will also be required to attend to a secondary task when the primary task allows you to. Please do this experiment to the best of your ability. There will be a £5 first prize in each of the nine groups for the best performance.

Do you understand the instructions? If not please call the experimenter.

When you happy that you have understood this introduction click on the button below to go to the next page...

next page...

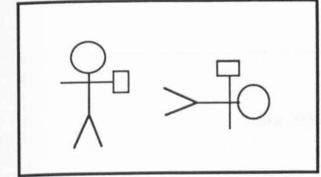
NON TARGET

CORE TEMPERATURE HIGH

LP HTR 1/2 DANGEROUSLY HIGH

PRIMARY CIRCUIT LEAKAGE

DRUM LEVEL HIGH EMERGENCY



TURBINE CONTROL OIL PS FAULTY SUPERVISORY CHANNEL INOPERATIVE RE HTR OUTLET STEAM TEMP ABNORMAL LP HTR 1/2 DANGEROUSLY HIGH REHEAT SPRAY 71/72 VALUE AT MIN REHEAT DESUP SPRAY 71/72 HELD OUT GAS IN COOLANT AUTO VENTING REHEAT SPRAY 73/74 HELD OUT SUPERHEATER OUT STEAM TEMP ABNORMAL CONDENSOR VACUUM LOW UNLOADING GEAR OPERATING GAS IN COOLANT AUTO VENTING FEED SYSTEM PROP TRIPS INOPERATIVE DESUPERHTR SPRAY PUMP MASTER TRIP S/S BFP 71 GLAND SEAL FAULT S/S BFP 72 GLAND SEAL FAULT S/S BFP AUTO START VETOED GAS IN COOLANT AUTO VENTING GAS IN COOLANT AUTO VENTING HP HEATERS DRAINS TANK LOW WATER LVL HP HTRS 6&7 BLEED STEAM VALVES INHBTD DRUM WATER LEVEL ABNORMAL GAS IN COOLANT AUTO VENTING DRUM WATER LEVEL EMERGENCY HIGH

Thank you for taking part in this investigation....

Please call experimenter....

Save RESULTS>>>

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# ANOVA Summary Table for Macintosh HD:StatView II:sdt data

Source of Variation	df .	Sum of Squares	Mean Square	F	p	Epsilon Correction
R	2	.039	.020	.769	.4719	
T	2	.174	.087	3.387	.0463	
RT	4	.002	.000	.016	.9994	
Error	32	.820	.026			

Primary Task Results
Appendix B2

# Upper Triangle: .05 level ; Lower Triangle: .01 level

A. T 1 X S S S S C T 3 - X - X

Primary Task Results Appendix B 2

# Total secondary task output

# Anova table for a 2-factor Analysis of Variance on Y1: total secondary

Source:	df:	Sum of Squares:	Mean Square:	F-test:	P value:
ratio (A)	2	14885.911	7442.956	1.431	.2523
temporal (B)	2	3842.844	1921.422	.369	.6937
AB	4	7495.289	1873.822	.36	.8351
Error	36	187207.6	5200.211		

There were no missing cells found.

### The AB incidence table on Y1: total secondary

	temporal:	one	four	eight	Totals:
T	A	5	5	5	15
	two	64.2	98	85.2	82.467
ratio	- 1	5	5	5	15
2	six	68.8	50	76.8	65.2
T	4	5	5	5	15
	ten	86.2	136.8	105.2	109.4
Tatalar		15	15	15	45
	Totals:	73.067	94.933	89.067	85.689

2

# ASTON UNIVERSITY



### ALARM HANDLING QUESTIONNAIRE

### **Neville Stanton**

Completion of this questionnaire is voluntary, but I hope that you will take part. It should take no more than 25 minutes. The purpose of this research is to develop an understanding of human reactions to alarm systems to improve future design. A summary of the findings will be made available to you. Thank you for your time and help in completing this questionnaire. Please read the following instructions:

- Your answers are confidential, so please do not put your name on the questionnaire.
- There are no right or wrong answers, so just answer as honestly as possible.
- Use the first answer you think of; this is the natural one.
- It is your opinion that I am interested in, so please do not seek anyone else's advice.

1.	How long have you been a Control Desk Engineer?years.
2.	What was the alarm system designed for?
3.	What information do you get from alarms?
	** 1 1 1 1-11 1-100
4.	How do you use alarms in your daily activities?
-	

Appendix C

5.	Which to you is the more important activity:
	a) rectifying an alarm that has already occurred? please b) preventing an alarm from occurring? tick
6.	What percentage of your time in alarm handling situations do you spend in the following activities:
	% of time
	Looking for alarms
	Assessing the situation
	Diagnosising the fault
	Correcting the fault
	Checking the effects of your actions
7.	Do you deliberately scan for alarms every so often? If YES, how often?
	Every minute
	Every hour please tick
	Once per shift
8.	What proportion of alarms have to be dealt with urgently?
	All
	Most
	Some please tick
	None
9.	When did you, or anyone you have worked with, last miss an alarm? (remember, this information is confidential and will only be used for research purposes)
	approx. date
10.	Why was it missed?

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ast exattern order	in general, he sperience	ow do you	diagno Most d	se faults occasions	using a	alarm in	formation?	pleas

13.	Estimate the percentage of occasions when alarms appear thrushed into making decisions:	nat you are
**	% of occasions	*
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14.	If you are rushed into decisions, do these decisions relate to	:
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	Product	please
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	work practices	
	Other	
If oth	her, please state:	
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	( ) - Mark - Mark - ( ) - Mark	
15.	Please rank the following in order of importance to you in yo (1= most important, 6= least important):	ur job
	Increasing efficiency	
70 <sup>7</sup>	Reducing the number of alarms	
	Following operational procedures	
	Ensuring safety	
	Meeting production targets	
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16.	Please tick any of the following if they hinder diagnosis of the cause of alarm:
	Too little information
	Too much information
* **	Information too difficult too find
	Information too difficult to interpret
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	Cont. Cont.
	Do you ever feel that you are under pressure to clear the alarm display:  from your supervisor  from your colleagues  other  her then please state:
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18.	Could you give brief examples of what you did:  a) last time an alarm occurred in a critical incident:
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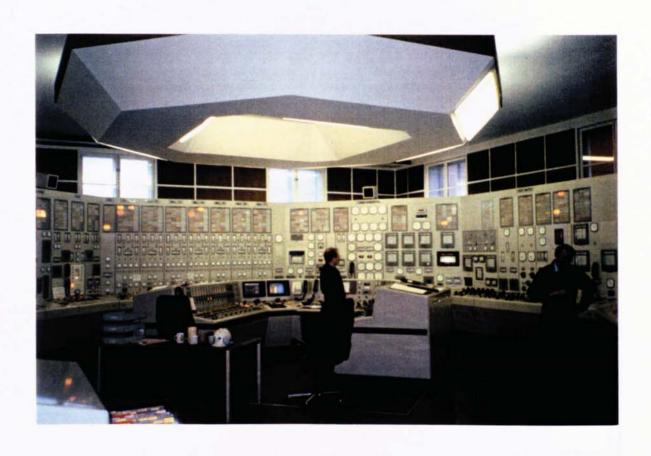
20.	Do you this	nk that you wou	ld resist a ch	ange in you	ır alarm syst	em?
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	If YES, ple	ase tick which of	f the followin	g that appl	les:	
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		New system m	ight fail			
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21.	Have you why?	used other alarn	n systems? I	f you have,	did you pref	er them and
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								Preceding Standard	Action
								Non standard No action maintenence	on .
- timi sati								Inside CCR Outside CCR Via phone	Action Place
								e.g. relate grouped alarms to particular events, comment on any difficulties experienced, or any problemsencountered with the alarm system	Remarks

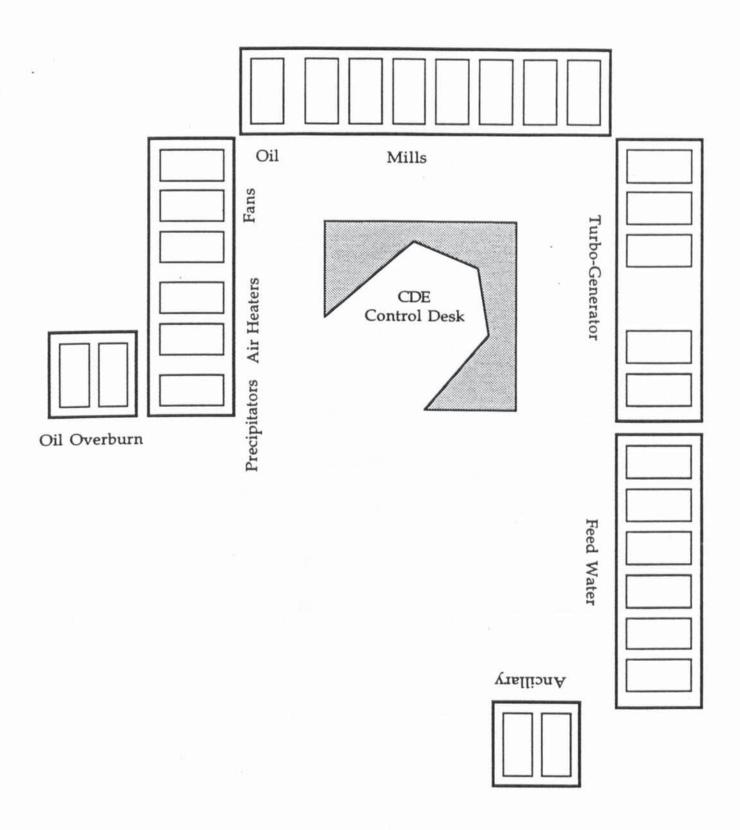
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Grid Reference System for Annunciator Alarm Panels





Rugeley Control Room
Appendix F 1



Schematic representation of annunciator panel layout (not to scale)

	A	В	С	E
1				
1 2 3 4 5 6 7 8 9			• •	
3			٠.,	
4				
5				•
6				
7				
8				
9				
10				

Annunciator tile grid reference

OIL OVERBURN

**PRECIPITATORS** 

AIR HEATERS

FANS

OIL

MILLS

TURBO-GENERATOR

FEEDWATER

ANCILLARY

PANEL	GRID REF	MESSAGE .
OIL OVERBURN	7C 9C 9D 2D	AUX BLR B2 WATER LEVEL ABNORMAL AUX BLR FLUE GAS OXYGEN LOW AUX BLR SMOKE DENSITY HIGH O.R.F. TO BOILERS PRESS. CONTROL V/V OPEN/CLOSED
AIR HEATERS 1	1A	MAIN AIR HTRS TEMPERATURE ABNORMAL
AIR HEATERS 2	4A 5A 6A 4B 5B 6B	MILL HTR 71 S'BY LUBE OIL PUMP RUNNING MILL HTR 71 GAS OUT DAMP 70% OPEN MILL HTR 71 GAS OUT DAMP 20% OPEN MILL HTR 72 S'BY LUBE OIL PUMP RUNNING MILL HTR 72 GAS OUT DAMP 70% OPEN MILL HTR 72 GAS OUT DAMP 20% OPEN
FANS 1	3A	ID 72 A/M STN DISCREPENCY
FANS 3	1A 1C 3C	PA 71 BEARING TEMP HIGH O <sup>2</sup> IN FLUE HIGH/LOW MSD HYD PACK 71 LOW OIL LVL
OIL	6A 9A	BOILER LOOP CONTROL AIR PRESS LOW SOOT BLOWER FAULT
MILLS	1A 3A 10A 5B 1C	
TG = TURBO GENERA	TOR	
TG1	6A 3B 5B 2C	LUB OIL PRESS LOW PILOT FLUID FILTER CHOKED FEEDER MOTOR PROT OPER'D TURNING GEAR FAILED
TG2	4A 5A 6A 3B 1C 3C	HYDROGEN DRYER FAIL HIGH PRESSURE GLAND STEAM TEMP HIGH HIGH PRESSURE GLAND STEAM TRAP LOW H <sub>2</sub> /SEAL OIL SYSTEM FAULT GAS IN COOLANT AUTO VENTING COOLING SYSTEM GENERAL FAULT GAS IN COOLANT ABNORMAL
TG3	3B 6B	PERM MAGNET GENERATOR 71 FAILURE PERM MAGNET GENERATOR 72 FAILURE
TG4	4A 5A 9A 9B 2B	LOW PRESS EXHAUST TEMP HIGH LOW PRESS EXHAUST SPRAY OPER'G GEN TRANS OIL LEVEL LOW TURBINE CONTROL OIL PS FAULTY LOW POWER VT SUPPLY FAILED

PANEL	GRID REF	MESSAGE
TG5	108 1C 8C 10C	EXPANSIONS ABNORMAL Q/S AIR EXHAUSTER PROT OPER'D SUPERVISORY CHANNEL INOPERATIVE RE HTR OUTLET STEAM TEMP ABNORMAL REHEAT SPRAY 71/72 VALUE AT MIN REHEAT DESUP SPRAY 71/72 HELD OUT REHEAT SPRAY 73/74 HELD OUT SUPERHEATER SAFETY VALVE LFTD SUPERHEATER OUT STEAM TEMP ABNORMAL CONDENSER VACUUM LOW UNLOADING GEAR OPERATING
FEED WATER 1	1B 7B	FEED SYSTEM PROP TRIPS INOPERATIVE DESUPERHTR SPRAY PUMP MASTER TRIP RELAY OPERATED
FEED WATER 2	1B 7B 8B 3C	S/S BFP 71 STANDBY LUB OIL PUMP ON S/S BFP 71 GLAND SEAL FAULT S/S BFP 72 GLAND SEAL FAULT S/S BFP AUTO START VETOED
FEED WATER 3	3C 6C	DC HTR EXT PUMP 74A FILT CHOKED DC HTS EXT PUMP 74A PROT OPER'D
FEED WATER 4	8B 1C 7C	HP HEATERS DRAINS TANK LOW WATER LVL B. LINE D.A. FLASHBOX LEVEL HIGH HP HTRS 6 & 7 BLED STEAM VALVES OPERATION INHIBITED
FEED WATER 5	7A 8A 1B 3B 4B 7C	DRUM WATER LEVEL ABNORMAL DRUM WATER LEVEL EMERGENCY HIGH DRUM LEVEL SIGNAL LH/RH DISCREPANCY BFP TURNING GEAR OIL PRESSURE LOW MBFP VIBRATIONS FAULT DETECTED BEP 7 TEMP MONITOR WARNING
FEED WATER 6	10A 5B 9B 10B 1C 2C 3C 7C	BFP 7 BEARING OIL PRESSURE LOW RECIRC PUMP 71 DIFF TEMP HIGH RECIRC PUMP 71 WARM UP VALVE SHUT RECIRC PUMP 74 WARM UP VALVE SHUT BFP TRIP PLUNGER RESET FAULT MBFP AXIAL POSN ABNORMAL BFP 7 TEMPERATURE ABNORMAL BFP 7 GLAND SEAL INLET PRESSURE LOW BFP 7 GLAND SEAL DIFF PRESSURE LOW
ANCILLARY 1	2A 5A 9A	CONDENSATE DISSOLVED OXYGEN HIGH SAT STEAM SODIUM HIGH ECONOMISER INLET O <sup>2</sup> HIGH
ANCILLARY 2	1C 4C	METAL TEMP COLD JUNCTION CUB 71 FAULT METAL TEMP COLD JUNCTION CUB 74 FAULT

Phase	Activity	Alarms
1	Fill boiler, start fans, start firing, open vents	No data
2	Close vents, pressure rises	Oil = 4 Mills = 8 T.G. = 6 F/W = 1
3	Warm pipework between boiler and turbine	A.H. = 4 Oil = 1 F/W = 9
4	Vacuum rising, turbine warming, watching turbine for faults	T.G. = 10 F/W = 1
5	Run down, blades expanding too quickly, moving beyond allowable tolerences, allow to cool, wait	A.H. = 1 Mills = 2 T.G. = 2 F/W = 1
6	Run turbine up to 2000 r.p.m.	Oil = 2 Mills = 3 T.G. = 2
7	Increase firing on boiler, put mills into service, increase load	Oil = 1 Mills = 3 T.G. = 2 F/W = 4

# ALARMS BY PHASE IN START-UP

	Alarm	Status Indicator		Total	
Arrive	1]. 5	2] 7	3] 5		
	E 3.49	E 7.92	E 5.59	. 17	
Shift	4] .	5] 18	6] 14	20	
	E 8.01	E 18.16	E 11.84	39	
Depart	7] 3	8] 9	9] 5	17	
	E 3.49	E 7.92	E 5.59	17	
TOTAL	15	34	24	73	GRAND TOTAL
Cell 2: E	= 3	$\frac{15 \times 17}{73} = 3$ $\frac{34 \times 17}{73} = 7$ $\frac{24 \times 17}{73} = 5$ $\frac{15 \times 39}{73} = 5$ $\frac{34 \times 39}{73} = 1$	7.92 5.59 3.01 18.16	$= \frac{(7 - 7)^{\frac{1}{3}}}{7.9}$ $= \frac{(5 - 5)^{\frac{1}{3}}}{5.5}$ $= \frac{(7 - 8)^{\frac{1}{3}}}{8.0}$ $= \frac{(18 - 1)^{\frac{1}{3}}}{11.8}$ $= (14 - 1)^{\frac{1}{3}}$	$\frac{3.49}{19}^{2} = 1.51 + \frac{7.92}{12}^{2} = 0.11 + \frac{5.59}{10}^{2} = 0.06 + \frac{3.01}{10}^{2} = 0.13 + \frac{18.16}{16}^{2} = 0$
Cell 7: E	= -	15 x 17 73 = 3	3.49	• • • • • • • • • • • • • • • • • • • •	$\frac{3.49}{39}$ = 0.07
		$\frac{34 \times 17}{73} = 7$			$\frac{7.92}{02}$ ) <sup>2</sup> = 0.15
Cell 9: E	= 3	$\frac{24 \times 17}{73} = 5$	5.59	= (5 -	$\frac{5.59}{5.59}$ = $\frac{1}{0.06}$

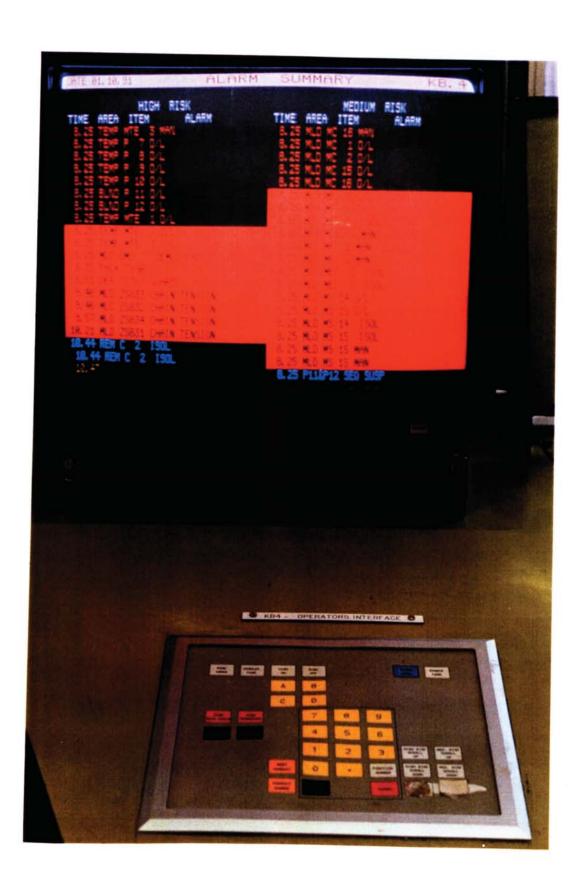
df = 4 Not significant

 $\chi^2 = \frac{(0-E)^2}{E}$ 

= 2.48

# Minimum Character Size for Displays and Legends

Distance	Routine marking with high illumination (mm)	Critical marking with high illumination or routine marking with low illumination (mm)	Critical marking with low illumination (mm)
36 cm	0.76	1.3	2.0
71 cm	1.3	2.5	3.8
91 cm	1.5	3.3	4.8
1.5 mtrs	2.8	5.3	8.1
3.0 mtrs	5.6	11.0	16.5
6.1 mtrs	11.0	22.0	33.0



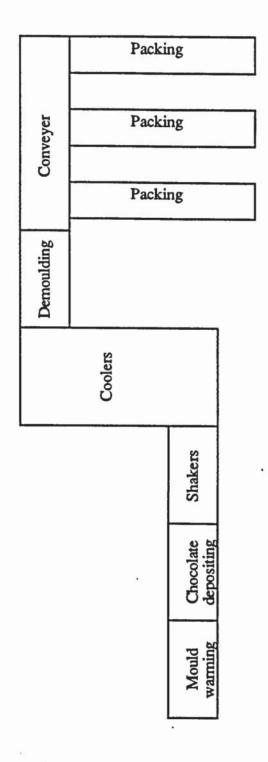
Moulding 1
Appendix G 1



Moulding 2
Appendix G 2



Moulding 3
Appendix G 3



Mould warming	Chocol	ate	Cres depos	me sitor	Mouldin	g	Cooling	Demoulding
Cr	eme product	ion			VDU1  Central Control Room	VDU	2	Conveyor
			Convey	or/		200		
Packing	Packing			Packing		Packing		

<date> ALARM SU</date>	MMARY KB4
HIGH RISK	MEDIUM RISK
TIME AREA ITEM ALARM	TIME AREA ITEM ALARM
<last alarm="" list="" on=""></last>	<last alarm="" list="" on=""></last>
<time></time>	<plant status=""></plant>

<page title=""></page>	<time> <date></date></time>
	<chosen display variable&gt;</chosen 
<page selected=""></page>	ALARMS F4VO72 C1LO21 BATALARM F3V131 AL.0P02
<messages></messages>	

=	I	DEXTERITY SCREEN	
	ALAF	RM LIST DISPLAY	
Option	7 = top, 4 = scrol 1 = fwd	9 = bottom, $8 = first ackr$ ll fwd, $5 = scroll back$ , one, $2 = back$ one	nowledged alarm
<olde< td=""><td>st alarm not ac</td><td>ccepted</td><td>&gt;</td></olde<>	st alarm not ac	ccepted	>
<mos< td=""><td>t recent alarm</td><td>not accepted</td><td>&gt;</td></mos<>	t recent alarm	not accepted	>
700000			
<olde< td=""><td></td><td>oted but not cleared&gt;</td><td></td></olde<>		oted but not cleared>	
<olde< td=""><td></td><td>•</td><td></td></olde<>		•	
<olde< td=""><td></td><td>•</td><td></td></olde<>		•	
<olde< td=""><td></td><td>•</td><td></td></olde<>		•	
	st alarm accep	•	
<mos< td=""><td>st alarm accep</td><td>oted but not cleared&gt;</td><td>leared&gt;</td></mos<>	st alarm accep	oted but not cleared>	leared>

## ALARMS PER SHIFT: DAY 2

Ρ
L
A
N
т

S-100	0	P x N = E	[O - E] = D	2 D	<u>D</u> 2 E
1	529	1/3 x 1544 = 514.7	14.3	204.49	0.397
2	204	1/3 x 1544 = 514.7	310.7	96534.49	187.55
3	811	1/3 x 1544 = 514.7	296.3	87793.69	170.57
	1544			€	358.517

$$\vec{z}_2^2 = 358.517$$
; p< 0.01

## STANDING ALARMS: DAY 2

P L A N T					
	0	P x N = E	[O - E] = D	D <sup>2</sup>	<u>D</u> 2 E
1	25	1/3 x 45 = 15	10	100	6.66
2	5	1/3 x 45 = 15	10	100	6.66
3	15 45	1/3 x 45 = 15	0	0	0 13.22

# ALARMS vs. SI: DAY 2

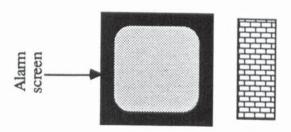
L				<u></u>		
N T	0	P x N = E	[O - E] = D	D <sup>2</sup>	<u>D</u> 2 E	
1	5	1/3 x 16 = 5.33	Ö.33		0.02	
2	3	1/3 x 16 = 5.33	2.33	5.43	1.02	
3	8	1/3 x 16 = 5.33	2.67	7.13	1.34	
	16				2.38	

 $\frac{2}{2}$  = 2.38; p = not significant

## OSCILLATIONS : DAY 2

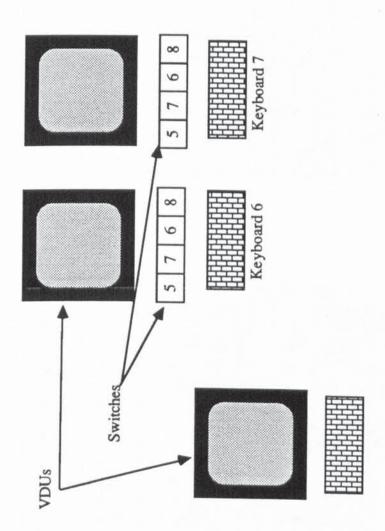
0	P x N = E	[O - E] = D	D <sup>2</sup>	<u>D</u> 2 E
191	1/3 x 234 = 78	113	12769	163.7
17	1/3 x 234 = 78	61	3721	47.7
26	1/3 x 234 = 78	52	2704	34.7
234				246.1

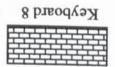
 $\frac{2}{2}$  = 246.1; p< 0.01





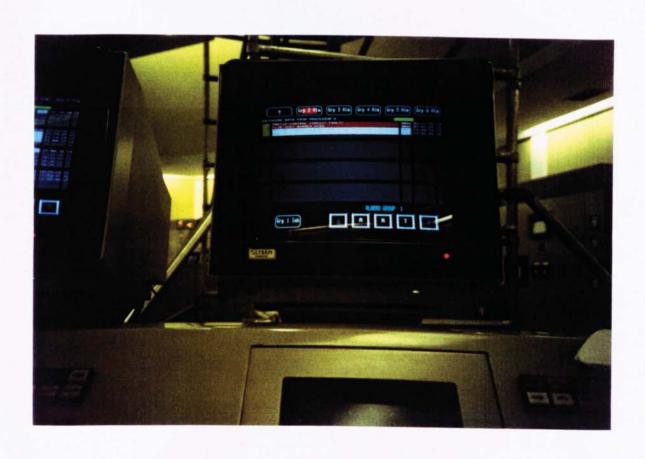
Keyboard 5





Appendix G 13 Switch & keypad in Plant 1

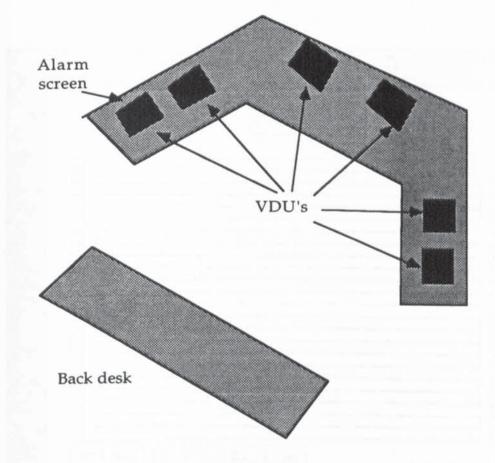




Didcot Control Room
Appendix H 1



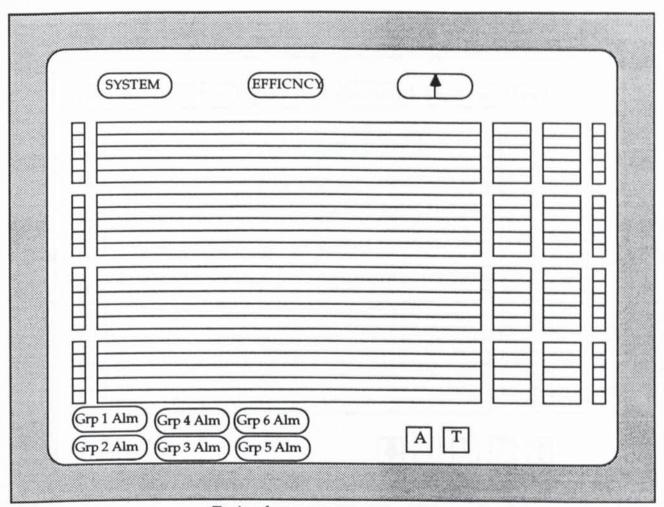
Air Heaters



D Mills A-H H Ħ 9 Feedwater Turbine Generator

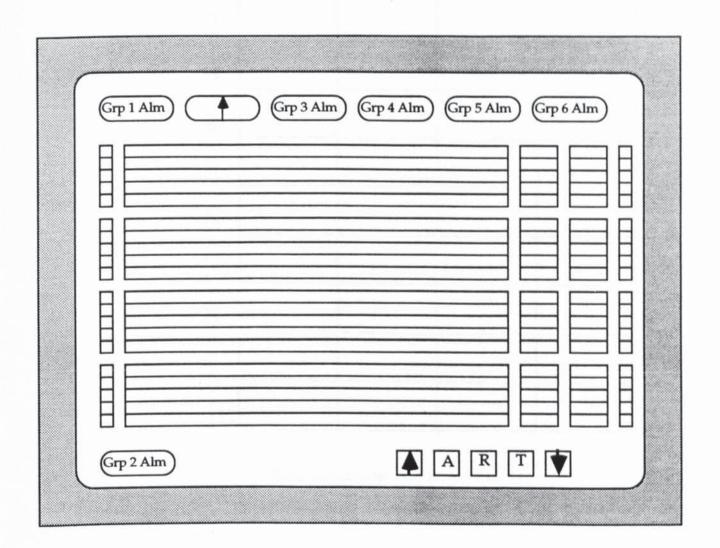
Schematic representation of annunciator panel layout (not to scale)

Appendix H 2



Facia alarm summary screen

Appendix H3



Alarm screen for plant area 2

Appendix H 3

	A	В	С	D
1				
2				
1 2 3 4 5 6 7 8 9				
4				
5				
6				
7				
8				
9				
10				

Grid reference for recording alarms

Appendix H 4

#### DRAUGHT\_A

- SOOTBLOWER EQUIPMENT FAULT
- DIAMOND BLOWERS FAULT
- 48 VOLT SOOTBLOWER CONTROL CCT FAILURE 7.

#### DRAUGHT B

- PRECIP A RAPPING GEAR FAULT
- 30. FLUE DUST BURDEN HIGH

### DRAUGHT C

#### MILLS

- PA FAN A OVERLOADED OR TRIPPED 1.
- MILL A TRIP
- MILL A LUB OIL FAILURE
- FEEDER A TRIP 4.
- PA FAN A TEMPS HIGH 5.
- MILL A STANDING TEMP HIGH 6.
- 7. MILL A BEARING TEMP HIGH
- FEEDER A LOCAL STOP 8.
- 9. PA FAN A LUB OIL FAILURE 10. MILL A OUTLET TEMP HIGH
- 11. MILL A STALLED
- 12. FEEDER A STALLED
- 13. PA FAN A VENT FAN TRIP
- 14. MILL A BALL LOADING FAULT
- 15. MILL A DF BURNING FLAME FAIL

16.

17.

- 18. MILL A MOTOR TEMP HIGH
- 19. MILL A OIL BURNING FLAME FAIL
- 20. MILL A FIRE
- 21.
- 22.
- 23.
- 24. MILL A FIRE ALARM FAULT

#### COMBUSTION MASTER

14. PF FLAME MONITOR FAULTY

#### FB

- 4. SEQ EQUIPT BOILER CUBICLES 1-6 FAULTY
- 15. 415 V UNIT BLR SW BD.B TRIP CIRCUIT FAULTY
- 18. STEAM SODIUM LEVEL HIGH

FC

- CLEAN DRAINS TANK LEVEL LOW
- 13. SUPERHEATER B2 OUTLET TEMP HIGH

#### FD

- 10. S & S FEED PUMP A DISCHARGE PRESS LOW
- 14. S & S FEED PUMP B DISCHARGE PRESS LOW
- 17. S & S FEED PUMP A LEAK OFF IN PROGRESS
- 21. S & S FEED PUMP B LEAK OFF IN PROGRESS

#### TA

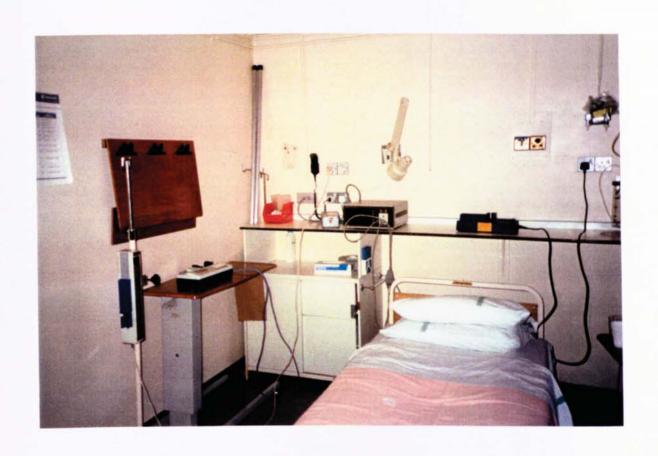
- TURB FP TURB STOP VALVE CLOSED 1.
- 21. FEEDPUMPS GLAND DRAIN TANK LEVEL HIGH

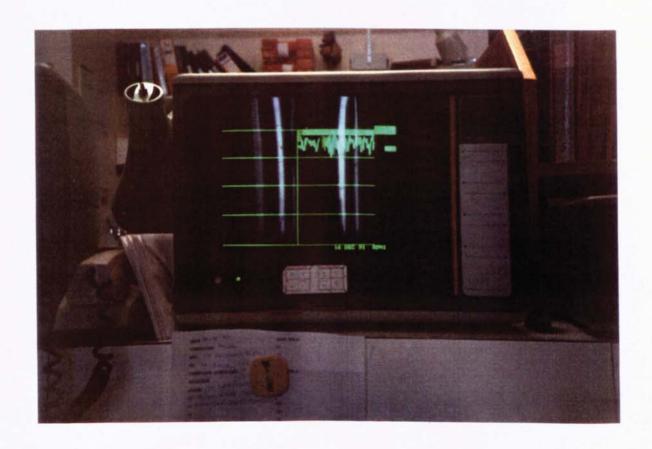
# PLANT PHASES CHI2 ANALYSIS

PHASES	0	P x N = E	[0-E] = D	D <sup>2</sup>	D <sup>2</sup> /E
Shutdown	60.0	≵ x 93.9 = 23.5	36.5	1332.25	56.69
Shut	5.6	1 × 93.9 = 23.5	-17.9	320.41	13.63
Startup	21.0	1 × 93.9 = 23.5	-2.5	6.25	0.26
Normal	7.3	₹ x 93.9 = 23.5	-16.2	262.44	262.44
•	93.9 rate per hour				333.02

$$\frac{22}{3}$$
 = 333.02 P < 0.001

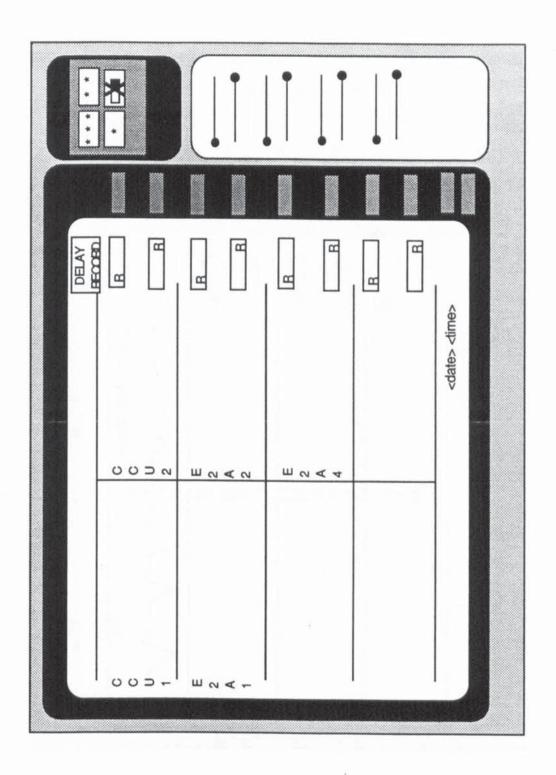
Appendix H 6 Chi-square of alarms by phase





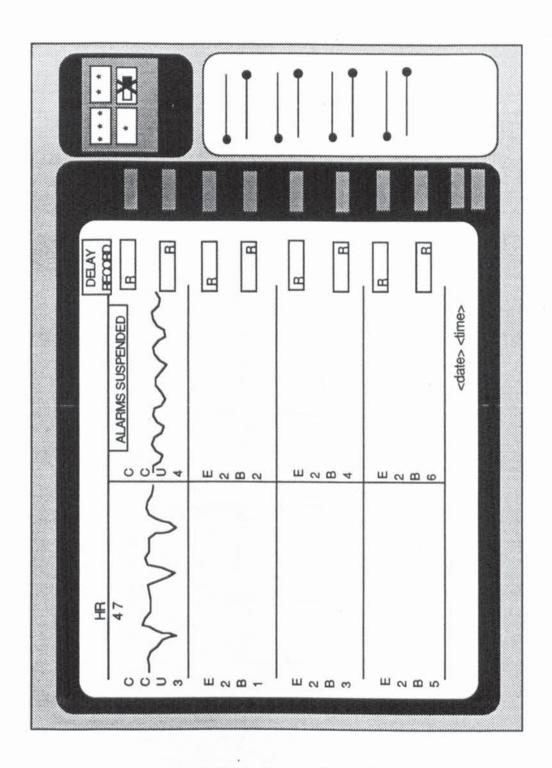
Coronary Care Unit

Appendix I 1



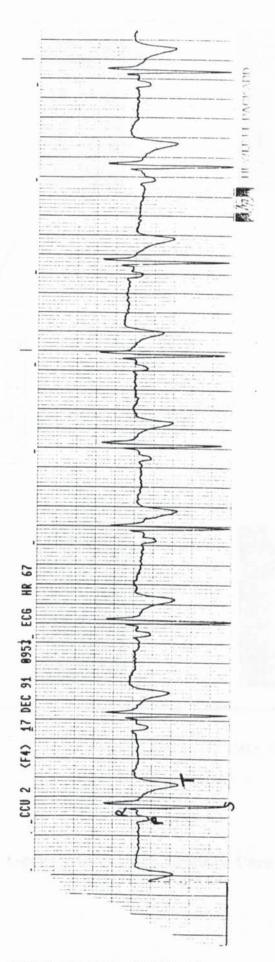
Screen layout of ECG Monitor: VDU 1

Appendix I 2

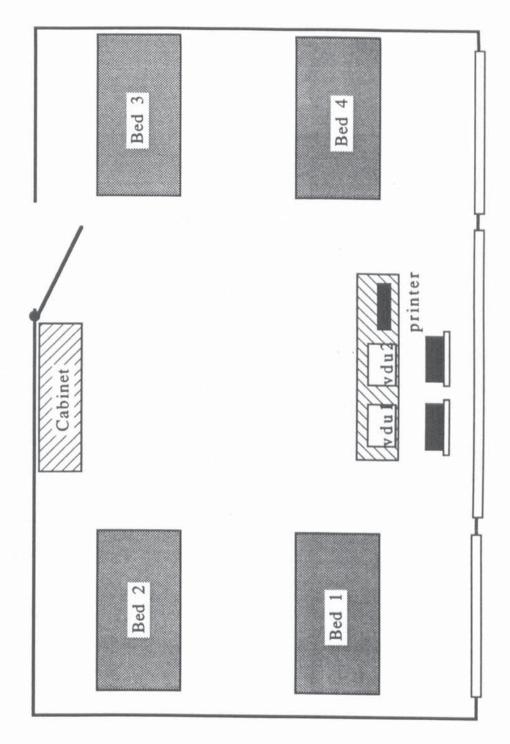


Screen layout of ECG Monitor: VDU 2

Appendix I 2



Print-out from ECG Monitor



Plan of Coronary Care Unit
Appendix I 4

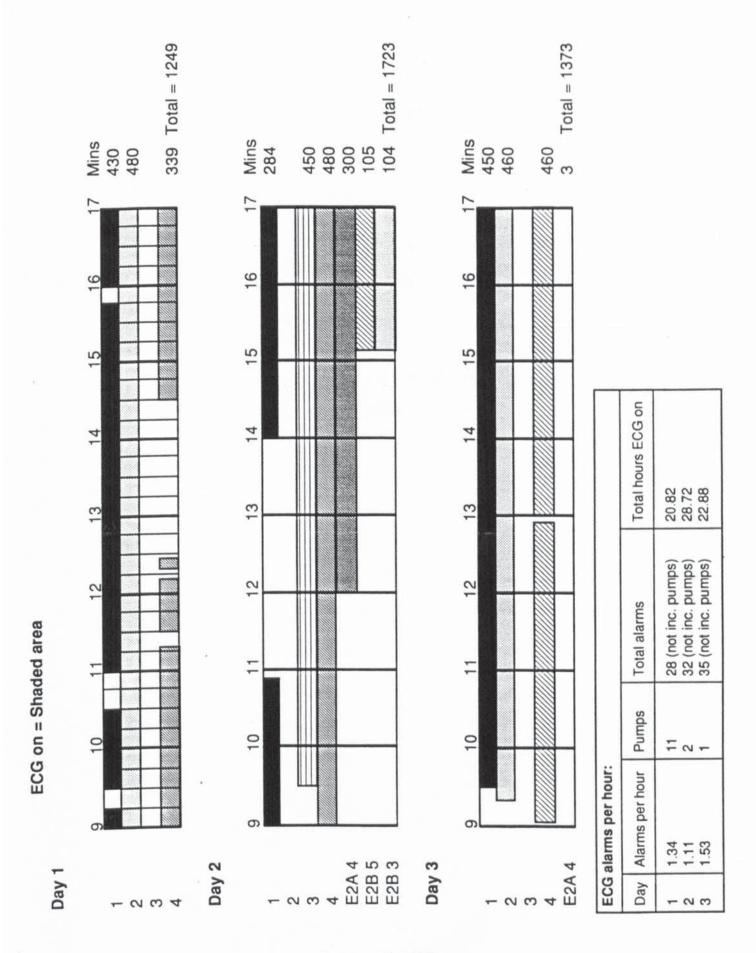
Schematic representation of Coronary Care Unit (not to scale)

# TOTAL ALARMS CHI2 ANALYSIS

0bs	0	P x N = E	[O - E] = D	D <sup>2</sup>	D <sup>2</sup> /E
Day 1	39	1/3 x 109 = 36.33	2.67	7.13	0.196
Day 2	34	1/3 x 109 = 36.33	-2.33	5.43	0.149
Day 3	36	1/3 x 109 = 36.33	-0.33	0.11	0.0003
	109				0.2289

 $Z^2_2 = 0.2289 p = not significant$ 

Appendix I 5



ECG Availability

# CHI2 OF ECG AVAILABILITY

Obs	0	P x N = E	[0 - E] = D	D <sup>2</sup>	D <sup>2</sup> /E
Day 1	20.82	1/3 x 72.42 = 24.14	-3.32	11.02	0.46
Day 2	28.72	1/3 x 72.42 = 24.14	4.58	20.98	0.87
Day 3	22.88	1/3 x 72.42 = 24.14	-1.59	1.59	0.06
	72.42				1.39

 $Z^2_2 = 1.39 p = not significant$ 

Appendix I 7

# EEG ALARMS PER 10 HOURS OPERATIONAL

Obs	0	P x N = E	[O - E] = D	D <sup>2</sup>	D <sup>2</sup> /E
Day 1	13.4	1/3 x 39.8 = 13.27	0.13	0.017	0.000127
Day 2	11.1	1/3 x 39.8 = 13.27	-2.17	4.71	0.35485
Day 3	15.3	1/3 x 39.8 = 13.27	2.03	4.12	0.3105
	39.8				0.665477

 $Z_2^2 = 0.665477 p = not significant$ 

Appendix I 8

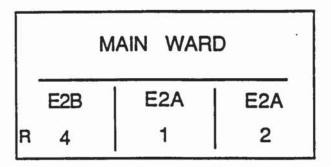
# CHI<sup>2</sup> ANALYSIS OR URGENCY & FREQUENCY

44	HIGH	MED	LOW	TOTAL
DAY 4	1 7	2 15	3 17	39
DAY 1	E 8.94	E 10.73	E 19.32	39
DAY 2	4 10	5 6	6 <sub>18</sub>	34
DA1 2	E 7.8	E 9.36	E 16.84	
DAY 3	7 8	8 g	9 19	36
	E 8.26	E 9.91	E 17.83	
TOTAL	25	30	54	109
	CELL 2: E = 30  CELL 3: E = 30  CELL 4: E = 30  CELL 5: E = 30  CELL 6: E = 30  CELL 7: E = 30  CELL 8: E = 30	$\frac{9 \times 25}{109} = 8.94$ $\frac{9 \times 30}{109} = 10.73$ $\frac{9 \times 54}{109} = 19.32$ $\frac{4 \times 25}{109} = 7.8$ $\frac{4 \times 30}{109} = 9.36$ $\frac{109}{109}$ $\frac{4 \times 54}{109} = 16.84$ $\frac{109}{109}$ $\frac{6 \times 25}{109} = 8.26$ $\frac{109}{109}$ $\frac{6 \times 30}{109} = 9.91$ $\frac{109}{109}$	8.94 (15 - 10.73 10.73 (17 - 19.32 (10 - 7 7.8 (6 - 9.36	$\frac{73}{32}^2 = 1.7$ $\frac{32}{32}^2 = 0.28$ $\frac{.8}{.8}^2 = 0.62$ $\frac{36}{36}^2 = 1.21$ $\frac{84}{.8}^2 = 0.08$ $\frac{26}{.8}^2 = 0.008$
		109	17.83 TOT	

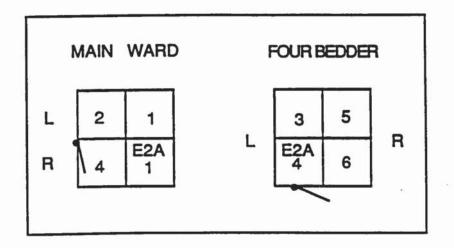
$$Z^{2} = \underbrace{(O - E)^{2}}_{E}$$

$$df = 4$$

$$Z_{4}^{2} = 4.4708 p = not significant$$



### STICKER UNDER SCREEN OF VDU 1



### STICKER UNDER SCREEN OF VDU 2

VDU labels of bed position on Wards

Appendix I 10



Pages removed for copyright restrictions.

### Introduction

Future supermarkets are likely to have reduced numbers of staff on the shop floor, putting the emphasis on a central control room. Sensors on the shop floor will be able to detect variation in the levels of stock on the shelves and any other problems such as breakages or unpriced goods. These sensors will transmit information to the control room and it will be the job of the control room staff to make decisions based on this information.

#### Instructions

In this experiment, you will be asked to take the role of a member of supermarket control room staff. You will hear twenty seven spoken messages. Each message will consist of three words: the product container; the product; and the problem. These are listed, in the vocabulary section, below.

You will listen to each command and assess its urgency. On page two, there are three columns, labelled: Low; Medium; and High. There is also a column for Don't Know. You have to put a circle around the number of the command in the column which you think describes the urgency of that command. After each command there will be a pause of ten seconds. This is quite a short time, so you will have to work quickly.

### Vocabulary

Container				
Bag Bottle Box	Jar Loose Packet	Shrinkwra Tin Wrapped	pped	
Product	€8			
Apple Apple Sauce Beef Bread	Carrot Celery Chocolate Corned Beef Crumpets Custard	Edam Flour Gataeux Milk Mop Nuts	Oil Pickles Pork Sam Smiths Saucepan Sausages	Sugar Tomato Washing Liq
Problem (in order	of Urgency)			
LOW	MEDIUM ·	HIGH		
Misplaced Dressing Returns	Price Low Past Date	Empty Spillage Breakage		

# Rating for Urgency

				<u></u>
	Le	evel of Urgency	•	
	LOW	MEDIUM	HIGH	DON'T KNOW
The second secon	1 2 3 4 5 6 7 8 9 10 11 12 13 14	MEDIUM  1 2 3 4 5 6 7 8 9 10 11 12 13 14	HIGH  1 2 3 4 5 6 7 8 9 10 11 12 13 14	DON'T KNOW  1 2 3 4 5 6 7 8 9 10 11 12 13 14
	15 16 17 18 19 20 21 22 23 24 25 26 27	15 16 17 18 19 20 21 22 23 24 25 26 27	15 16 17 18 19 20 21 22 23 24 25 26 27	15 16 17 18 19 20 21 22 23 24 25 26 27

### Introduction

Future supermarkets are likely to have reduced numbers of staff on the shop floor, putting the emphasis on a central control room. Sensors on the shop floor will be able to detect variation in the levels of stock on the shelves and any other problems such as breakages or unpriced goods. These sensors will transmit information to the control room and it will be the job of the control room staff to make decisions based on this information.

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You will listen to each command and write down the words you have heard. After each command there will be a pause of ten seconds. This is quite a short time, so you will have to work quickly. If you do not know a word, then draw a line Make sure that you record the commands as three words, e.g.								
"Tin Price"								
Vocabulary				i.				
Container								
Bag Bottle Box	Jar Loose Packet	Shrinkwr Tin Wrapped	apped					
Product				<b>₹</b> €				
Apple Apple Sauce Beef Bread	Carrot Celery Chocolate Corned Beef Crumpets Custard	Edam Flour Gataeux Milk Mop Nuts	Oil Pickles Pork Sam Smiths Saucepan Sausages	Sugar Tomato Washing Liq				
Problem (in o	rder of Urgency)							
LOW	MEDIUM	HIGH		•				
Misplaced Dressing Returns	Price Low Past Date	Empty Spillage Breakage						

#### Introduction

Future supermarkets are likely to have reduced numbers of staff on the shop floor, putting the emphasis on a central control room. Sensors on the shop floor will be able to detect variation in the levels of stock on the shelves and any other problems such as breakages or unpriced goods. These sensors will transmit information to the control room and it will be the job of the control room staff to make decisions based on this information.

#### Instructions

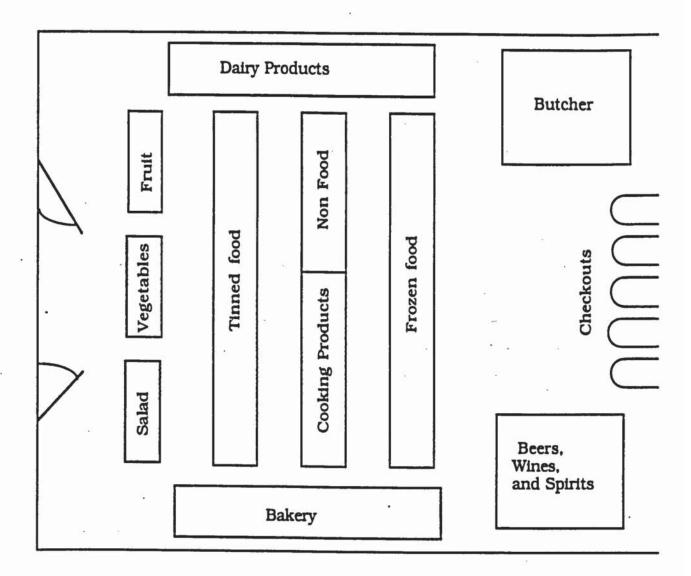
In this experiment, you will be asked to take the role of a member of supermarket control room staff. You will hear twenty seven spoken messages. Each message will consist of three words: the product container; the product; and the problem. These are listed, in the vocbaulary section, below.

You will listen to each command and mark the location of the problem on a map. On page two, there is a map of the supermarket. You have to write the number of the command in the location which you think relates to the command. The first command you hear will be number one, the second command will be number two etc. After each command there will be a pause of ten seconds. This is quite a short time, so you will have to work quickly.

#### Vocabulary

	AND DESCRIPTION			
Container		9 9	700	
Bag Bottle Box	Jar Loose Packet	Shrinkwra Tin Wrapped	pped	,
Product				
Apple Apple Sauce Beef Bread	Carrot Celery Chocolate Corned Beef Crumpets Custard	Edam Flour Gataeux Milk Mop Nuts	Oil Pickles Pork Sam Smiths Saucepan Sausages	Sugar Tomato Washing Liq
Problem (in order	of Urgency)		ä	
LOW	MEDIUM	HIGH		
Misplaced Dressing Returns	Price Low Past Date	Empty Spillage Breakage		

## Map of Supermarket



OF	5	
* Groups	6	
* Cases	58	
Н	42.35	p = .0001
H corrected for ties	43.34	p = .0001
# tied groups	12	1

Group:	Kruskal-Wallis  * Cases:	X 1 : GROUP Y 1 : Σ Rank:	: data Mean_Rank:
urgenthuman	10	419.5	41.95
urgentcomputer	. 10	333.5	33.35
recordhuman	10	489	48.9
recordcomputer	10 -	121.5	12.15
locatehuman	11	298.5	27.14

Group:	* Cases:	Σ Rank:	Mean Rank:
locatecomputer	7	49	7

	Mann-Wh	Itney U X 1	: GROUP	Y 1:data
	Number:	Σ Rank:		Mean Rank:
recordhuman	10	155		15.5
recordcomputer		55		5.5
T.	J		0	
Ū	J-prime		100	- 1 - 1 - 1 - 1 - 1 - 1 - 1 - 1 - 1 - 1
Z			-3.78	p = .0002
2	corrected for ties		-3.97	p = .0001
-	tied groups	and the second second	4	

	Mann-Whi	tney UX 1	: GROUP	Y 1:data
	Number:	Σ Rank:		Mean Rank:
locatehuman	11	142		12.91
ocatecomputer	7	29		4.14
U			1	
U	-prime		76	
Z			-3.4	p = .0007
Z	corrected for ties		-3.42	p = .0006
-	tied groups		5	

	Mann-	Whitney U X 1	: GROUP	Y 1: data	
	Number:	Σ Rank:	_	Mean Rank:	
urgenthuman	10	127		12.7	
urgentcomputer		83		8.3	
U			28		]
U	-prime		72		
Z			-1.66	p = .0963	
Z	corrected for t	ies	-1.7	p = .0885	
#	tied groups	The Control of the Co	4		7

DF	2	
Groups	3	
Cases	31	
4	14.54	p = .0007
H corrected for ties	16.43	p = .0003
* tied groups	6	

	8+	14	
Group:	* Cases:	Σ Rank:	Mean Rank:
urgenthuman	10	177.5	17.75
recordhuman	10	229.5 · ·	22.95
locatehuman	11	89	8.09

	Mann-Whi	Itney U X 1	: GROUP	Y 1: data	
	Number:	Σ Rank:		Mean Rank:	
recordhuman	10	163.5		16.35	]
locatehuman	10208	67.5		6.14	]
U			1.5		
U	-prime		108.5		
Z			-3.77	p = .0002	
Z	corrected for ties		-3.93	p = .0001	
#	tied groups		5		

	Mann-W	hitney U X 1	: GROUP	Y 1:data	
1	Number:	Σ Rank:		Mean Rank:	
urgenthuman	10	143.5		14.35	
locatehuman		87.5		7.95	
<u> </u>			21.5		
Z	I-prime		88.5 -2.36	p = .0183	
Z	corrected for tie	s	-2.39	p = .0167	
-	tied groups		5		

	mann-wn	itney U X 1	: GROUP	Y 1:data	
	Number:	Σ Rank:		Mean Rank:	
urgenthuman	10	89		8.9	1
recordhuman	((2))	121		12.1	
U			34		7
U	-prime		66		7
Z			-1.21	p = .2265	7
Z	corrected for ties		-1.59	p = .1119	7
	tied groups		1		7

DF	2	
* Groups	3	
* Cases	27	
Н	15.43	p = .0004
H corrected for ties	15.53	p = .0004
* tied groups	8 ·	100000 50

Froup:	* Cases:	Σ Rank:	Mean Rank:
urgentcomputer	10	214.5	21.45
recordcomputer .	10	115.5	11.55
locatecomputer	7	48	6.86

	Mann-	Whitney U X 1	: GROUP	Y 1:data	
	Number:	Σ Rank:		Mean Rank:	
recordcomputer	10	108		10.8	
locatecomputer	7	45		6.43	
Tu			17		11111
U	l-prime		53		
Z			-1.76	p = .079	
Z	corrected for t	les	-1.77	p = .077	
	tled groups		5		

5000000	Mann-Wi	nitney U X 1	: GROUP	Y 1: data
	Number:	Σ Rank:		Mean Rank:
urgentcomputer	10	147.5		14.75
recordcomputer		62.5		6.25
			7.5	
T.	l-prime		92.5	
Z			-3.21	p = .0013
Z	corrected for ties	S	-3.23	p = .0012
T-	tied groups		6	

	Mann-W	hitney U X 1	: GROUP	Y 1:data
	Number:	Σ Rank:		Mean Rank:
rgentcomputer	10	122		12.2
locatecomputer		31		4.43
ū			3	
	J-prime		67	
7	:		-3.12	p = .0018
7	corrected for tie	s	-3.13	p = .0017
-	tied groups		5	4

# Recall performance for command/urgent/locate task

)F	5	
# Groups	6	
* Cases	58	
Н	12.8	p = .0254
H corrected for ties	17.3	p = .004
# tied groups	7	

Group:	* Cases:	X 1 : GROUP Y 1 : Σ Rank:	: data Mean Rank:
urgenthuman	10	373	37.3
urgentcomputer	10	190	19
recordhuman	10	419	41.9
recordcomputer	10 -	267	26.7
locatehuman	11	298	27.09

Group:	* Cases:	Σ Rank:	Mean Rank:
locatecomputer	7	164	23.43

# Recall performance (human vs synthesis)

	Mann-W	hitney U X 1	: GROUP	Y 1: data
	Number:	Σ Rank:		Mean Rank:
recordhuman	10	131		13.1
recordcomputer	(ODE 2007)	79		7.9
Tu-			24	
l	J-prime		76	
Z			-1.97	p = .0494
Z	corrected for tie	es	-2.07	p = .0386
-	tied groups		4	

# Recall performance (human vs synthesis)

	Mann-	Whitney U X 1	: GROUP	Y 1: data
	Number:	Σ Rank:		Mean Rank:
urgenthuman	10	135		13.5
gentcomputer	10	75		7.5
U			20	
U	-prime		80	
Z			-2.27	p = .0233
Z	corrected for t	ies	-2.8	p = .0051
	tied groups		4	

# Recall performance (human vs synthesis)

	Mann-V	Vhitney U X 1	: GROUP	Y 1: data	
	Number:	Σ Rank:		Mean Rank:	
locatehuman	11	109		9.91	
ocatecomputer	7	62		8.86	
U			34		
U	l-prime	43			
Z			41	p = .6836	
Z	corrected for ties		56	p = .5743	
	tied groups		2		

#### Introduction

Future supermarkets are likely to have reduced numbers of staff on the shop floor, putting the emphasis on a central control room. Sensors on the shop floor will be able to detect variation in the levels of stock on the shelves and any other problems such as breakages or unpriced goods. These sensors will transmit information to the control room and it will be the job of the control room staff to make decisions based on this information.

#### Instructions

In this experiment you will be asked to take the role of a member of supermarket control room staff. You will hear twenty seven spoken messages. Each message will consist of three words: the product container; the product; and the problem. These are listed in the vocabulary section, below.

You will listen to each message and then decide on your corrective action. After each message there will be a pause of ten seconds. In this time you will write down the corrective action that you believe to be appropriate to the message. Ten seconds is quite a short time so you will have to work quickly. If you do not know what to write, then draw a line ( ).

Container		Vocabulary	<u>′</u>	
Bag Bottle Box		Jar Loose Packet		Shrinkwrapped Tin Wrapped
Product				
Apple Apple Sauce Beef Bread	Carrot Celery Chocolate Corned Beef Crumpets Custard	Edam Flour Gateaux Milk Mop Nuts	Oil Pickles Pork Sam Smiths Saucepan Sausages	Sugar Tomato Washing Liquid
Problem			04404800	
Misplaced Dressing Returns		Price Low Past Date		Empty Spillage Breakage

#### Corrective Action (in BOLD type)

Misplaced -- Replace
Dressing -- Tidy
Returns -- Reshelve

Price -- Check-price
Low -- Top-up
Past date -- Throw out

Empty -- Fill up Spillage -- Mop up Breakage -- Brush up

Correction Task Response Sheet

	. 5/2-2007	,	,	Y 1: Recall	
	Number:	Σ Rank:		Mean Rank:	_
human	34	1256		36.94	
mputer		229		11.45	
_					_
U			19		_
U	-prime		661		
Z			-5.75	p = .0001	
Z	corrected for ties		-6.39	p = .0001	
	tied groups		6	· 4	

	mann-wint	ney U X 1	: Speecn	Y 1: Recall
	Number:	Σ Rank:		Mean Rank:
human	34	1040		30.59
computer		445		22.25
U			235	
L L	l-prime		445	
Z			-1.88	p = .06
Z	corrected for ties		-2.33	p = .0196
	tied groups		4	

### Alarm Messages, for all three Alarm Conditions

- 1. Tank 1 Empty;
- 2. Tank 2 Empty;
- 3. Tank 3 Empty;
- 4. Tank 4 Empty;
- Boiler Empty;
- 6. Output Tank Empty;
- 7. Output Tank Full.

- 8. Condenser Empty;
- 9. Product to Waste;
- 10. Furnace Tripped;
- 11. Boiler Temperature Low;
- 12. Boiler Temperature High;
- 13. Pipe 4 Damaged;

#### Phonetic Alarm Messages

This gives the phonemes that were used to facilitate the most accurate sounding speech alarms.

- 1. Tank 1 Empty = Taennk Wuhn Ehmptee
- 2. Tank 2 Empty = Taennk T4ux Ehmptee
- 3. Tank 3 Empty = Taennk Th2ree Ehmptee
- 4. Tank 4 Empty = Taennk Fo4r Ehmptee
- 5. Boiler Empty = Boyler Ehmptee
- 6. Output Tank Full = Awtpuht Taennk Ful
- 7. Output Tank Empty = Awtpuht Taennk Ehmptee
- 8. Condenser Empty = K3ondehnser Ehmptee
- 9. Product to Waste = Produlkt Tuw Wayst
- 10. Furnace Tripped = Fernih4s Trihpp
- 11. Boiler Temperature Low = Boyler Tehmper4cher Low2
- 12. Boiler Temperature High = Boyler Tehmper4cher Hiy2h
- 13. Pipe 4 Damaged = Piyp Fo4r Daemaeg4d

Numbers were used in conjunction with phonemes to improve the overall tone and sound of the synthesized word. A low number e.g. 1-3, forced the word to take on a low tone and a high number e.g. forced the word to take on a high tone and this precipitated a more comprehensive word/phase understanding.

#### The Training Video

Every subject was shown a ten minute training video, that the experimenter had developed to give the subject precise information on how to operate the simulator, and what the subjects objective in the experiment was.

The training video initially began with the experimenter informing the subject of the objective of the experiment. The experimenter proceeded to show the process plant screen and said

"The experiment you are going to take part in is concerned with operating a chemical processing plant, via a simulator on the computer. The objective of the experiment is to get as much yellow input liquid here (pointing to the yellow liquid on the screen), to green output, in the output tank, (and again the experimenter pointed to the output tank). To get the yellow liquid to green output you will need to open the valves on the pipes, here (pointed to the pipes), this will move the liquid to the boiler. As the liquid moves into the boiler it is then necessary to light the furnace and set the boiler temperature. When the boiler is set to the correct temperature (optimum temp 40 -60° C), the yellow liquid will turn red. When this occurs valves 7 and 8 can be opened, this allows coolant to flow through the condenser, which will facilitate your red liquid to go to green output, if you do not initiate this action the product will go to waste, so it is vital that you make this operation".

The experimenter then explained to the subjects the means by which they could control the process plant simulator. "The process plant can be operated by the F keys at the top of the keyboard (the experimenter points to the keys). As you can see, each F key has a precise operation, which is described on the template below the corresponding F key.

- F1: Open Valves 1-8: therefore to open a valve press F1 and the number of the valve you want to open. Then press the Return key which will activate your operation.
- F2: Close Valve 1-8: therefore to close a valve press F2 and the number of the valve you want to close. Then press the Return key which will activate your operation.
- F3: Light Furnace: therefore to start the furnace up, light it by pressing F3 and then pressing the Return key which will again activate your operation.
- F4: Set Furnace Temperature: 0=minimum heat to 4=maximum heat, therefore to set and reset the furnace temperature press F4 followed by the number (0-4 ie. what you want), then press Return to activate your operation.
- F5: Inspect Tank (1-4): therefore to inspect a tank press F5 and then the number of the tank followed by the Return key to activate the operation.
- F6: Inspect Valve (1-8): therefore to inspect a valve press F6 and then the number of the valve followed by the Return key to activate the operation.

- F7: Inspect Pipe (1-4): therefore to inspect a pipe press F7 and then the number of the pipe followed by the Return key to activate the operation.
- F8: Inspect Output Tank: therefore to inspect the output tank, press F8 followed by the Return key to activate the operation.
- F9: Inspect Boiler Level: therefore to inspect the level of liquid in the boiler press F9 followed by the Return key to activate the operation.
- F10: Inspect Boiler Temperature: therefore to inspect the precise boiler temperature you will need to press F10 followed by the Return key. It should be your intention to get the furnace to remain between 45°C 60°C, which is when your yellow liquid will turn red and can then be processed further.
- F11: Inspect Furnace: therefore to inspect the furnace level, press F11, followed by the Return key to activate the operation.
- F12: Start/Quit: therefore to start or quit the simulator just press F12.

The simulator will at various times inform you of the process operations current state of affair via alarms. Therefore to accept these alarms you will need to press the space bar.

The experimenter then explained that the subject would also be required to attend to a secondary task whilst operating and monitoring the process plant. "In this little box here (point - bottom right hand side of the screen), you will find two little figures periodically come on to the screen. It is for you to determine if the figure on the right is the same as the figure on the left, when rotated. If the figure on the right is the same as the figure on the left, you will need to register your decision via the left-hand key on the mouse, which is labelled (YES). If the figure on the right, is not the same as the figure on the left when rotated you will need to press the right key on the mouse labelled (NO)". The experimenter then demonstrated this task to the subject.

The experimenter then gave a demonstration of how the process plant should be operated, this was facilitated by the experimenter informing the subject which keys she was pressing and for what reason, which was basically a reiteration of what was explained in the second paragraph.

The experiment devised and made three training videos, one for each of the three conditions;

- 1. Text Only;
- Speech Only;
- Speech and Text Only.

Each of the three training videos were exactly the same in content, apart from the alarm message communication medium. Therefore if a subject had been placed in the Speech and Text condition, then the training video was run on the simulator in this condition, so that training was a controlled variable.

#### Instructions Given to Each Subject before Experiment

#### Part 1:- Watching the Training Video

"I would like you to sit here and watch a 10 minute video. The video will inform you about the experiment you are going to take part in and then it will detail all the information you will need to know to operate and control the simulator. Do not worry about remembering every detail as you will be able to practise on the actual simulator, before the actual experiment begins. Therefore just familiarise yourself with the procedures and operations, Thank you."

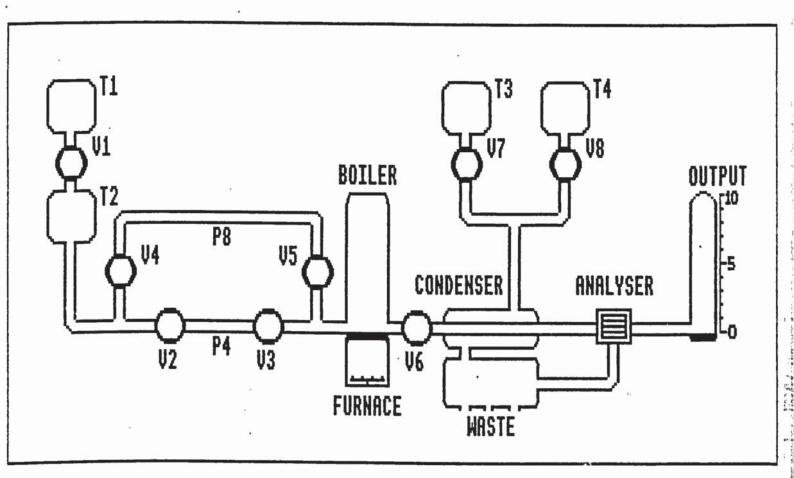
#### Part 2:- Practise Run(s)

"I now want you to run the simulator, to familiarise yourself with controlling the chemical plant, secondary spatial task and maximising output. As alarm messages are instigated it is important that you press the space har."

When the subject had achieved a performance criterion level of 80%, the subject was allowed to move to the actual experiment.

#### Part 3:- Actual Experiment

"I now want you to run the simulator again, but this time the screen will be masked and therefore you will not be able to constantly see the processes you are controlling. Instead you will be able to inspect individual plant components for a few seconds at a time by using the F5-F11 keys, as explained in the training program. Alarm messages will still be used by the system to help you control the plant, and once again these should be accepted by pressing the space bar. The secondary task will also be in operation so you are requested to attend to this task also, - Thank you."

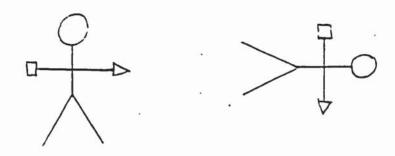


Primary Task Appendix L 4

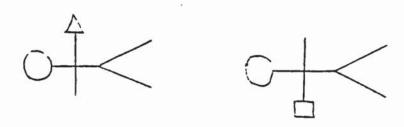
#### Secondary Spatial Task

The two diagrams below show the figures in different orientations, where one is correct when rotated, whilst the other is incorrect.

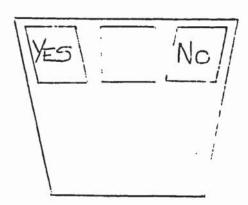
#### a. Correct, (YES)



#### b. Incorrect, (NO)



Subjects choice of correct was registered via a mouse. The left-hand button was labelled YES, i.e. figures were correct when rotated. The right-hand button of the mouse was labelled NO, i.e. figures were not the same when rotated.



#### output performance on process simulator

### One Factor ANOVA X 1 : condition Y 1 : data

#### Analysis of Variance Table

Source:	DF:	Sum Squares:	Mean Square:	F-test:
Between groups	2	6842.85	3421.425	3.744
Within groups	27	24676.025	913.927	p = .0367
Total	29	31518.875		

Model II estimate of between component variance = 250.75

### One Factor ANOVA X 1 : condition Y 1: data

Group:	Count:	Mean:	Std. Dev.:	Std. Error:
speech	10	38.6	32.532	10.287
text	10	74.3	26.612	8.415
st	10	64.85	31.229	9.876

### One Factor ANOVA X 1 : condition Y 1: data

Compartson:	Mean Diff.:	Fisher PLSD:	Scheffe F-test:	Dunnett t:
speech vs. text	-35.7	27.74*	3.486*	2.641
speech vs. st	-26.25	27.74	1.885	1.942
text vs. st	9.45	27.74	.244	.699

\* Significant at 95%

#### accept common alarms

## One Factor ANOVA X 1 : condition Y 1: data

#### Analysis of Variance Table

Source:	DF:	Sum Squares:	Mean Square:	F-test:
Between groups	2	659859779.565	329929889.783	7.418
Within groups	25	1.112E9	44478344.96	p = .003
Total	27	1.772E9 .		

Model II estimate of between component variance = 30740935.596

### One Factor ANOVA X 1 : condition Y 1: data

Group:	Count:	Mean:	Std. Dev.:	Std. Error:
speech	8	11678.075	12289.107	4344.855
text	10	293.97	202.755	64.117
st	10	1741.6	2459.304	777.7

## One Factor ANOVA X 1 : condition Y 1: data

Comparison:	Mean Diff.:	Fisher PLSD:	Scheffe F-test:	Dunnett t:
speech vs. text	11384.105	6515.316*	6.475*	3.599
speech vs. st	9936.475	6515.316*	4.933*	3.141
text vs. st	-1447.63	6142.699	.118	.485

<sup>\*</sup> Significant at 95%

### diagnose common alarms

## One Factor ANOVA X 1 : condition Y 1 : data

#### Analysis of Variance Table

Source:	DF:	Sum Squares:	Mean Square:	F-test:
Between groups	2	101890125.867	50945062.933	1.794
Within groups	27	766907215.1	28403970.93	p = .1856
Total	29	868797340.967		

Model II estimate of between component variance = 2254109.2

### One Factor ANOVA X 1 : condition Y 1: data

Group:	Count:	Mean:	Std. Dev.:	Std. Error:
speech	10	7924.9	5729.671	1811.881
text	10	6469.3	3637.608	1150.313
st	10	10897.7	6257.043	1978.651

## One Factor ANOVA X 1 : condition Y 1: data

Comparison:	Mean Diff.:	Fisher PLSD:	Scheffe F-test:	Dunnett t:
speech vs. text	1455.6	4890.418	.186	.611
speech vs. st	-2972.8	4890.418	.778	1.247
text vs. st	-4428.4	4890.418	1.726	1.858

#### monitor common alarms

## One Factor ANOVA X 1 : condition Y 1 : data

#### Analysis of Variance Table

Source:	DF:	Sum Squares:	Mean Square:	F-test:
Between groups	2	142192590.56	71096295.28	2.012
Within groups	27	953978117.489	35332522.87	p = .1533
Total	29	1096170708.05	5	

Model II estimate of between component variance = 3576377.241

## One Factor ANOVA X 1 : condition Y 1 : data

Group:	Count:	Mean:	Std. Dev.:	Std. Error:
speech	10	11977.8	6817.755	2155.963
text	10	7736.69	4232.102	1338.308
st	10	12657	6450.202	2039.733

### One Factor ANOVA X 1 : condition Y 1: data

Comparison:	Mean Diff.:	Fisher PLSD:	Scheffe F-test:	Dunnett t:
speech vs. text	4241.11	5454.36	1.273	1.595
speech vs. st	-679.2	5454.36	.033	.256
text vs. st	-4920.31	5454.36	1.713	1.851

### One Factor ANOVA X 1 : condition Y 1 : data

#### Analysis of Variance Table

Source:	DF:	Sum Squares:	Mean Square:	F-test:
Between groups	2	309917470.971	154958735.485	21.986
Within groups	24	169149704.214	7047904.342	p = .0001
Total	26	479067175.185	5	

Model II estimate of between component variance = 16639968.504

#### One Factor ANOVA X 1 : condition Y 1: data

Group:	Count:	Mean:	Std. Dev.:	Std. Error:
speech	7	8736.429	5009.537	1893.427
text	10	668.3	570.844	180.517
st	10	1411.4	1318.424	416.922

## One Factor ANOVA X 1 : condition Y 1 : data

Comparison:	Mean Diff.:	Fisher PLSD:	Scheffe F-test:	Dunnett t:
speech vs. text	8068.129	2700.187*	19.015*	6.167
speech vs. st	7325.029	2700.187*	15.674*	5.599
text vs. st	-743.1	2450.379	.196	.626

\* Significant at 95%

## pipe 4 break diagnosis

## One Factor ANOVA X 1 : condition Y 1: data

#### Analysis of Variance Table

Source:	DF:	Sum Squares:	Mean Square:	F-test:
Between groups	2	80942494.067	40471247.033	1.911
Within groups	27	571729069.4	21175150.719	p = .1674
Total	29	652671563.467	7	

Model II estimate of between component variance = 1929609.631

## One Factor ANOVA X 1 : condition Y 1: data

Group:	Count:	Mean:	Std. Dev.:	Std. Error:
speech	10	4701.4	7807.233	2468.864
text	10	1227.5	1484.599	469.472
st	10	1206.5	607.066	191.971

## · One Factor ANOVA X 1 : condition Y 1: data

Compartson:	Mean Diff.:	Fisher PLSD:	Scheffe F-test:	Dunnett t:
speech vs. text	3473.9	4222.501	1.425	1.688
speech vs. st	3494.9	4222.501	1.442	1.698
text vs. st	21	4222.501	5.207E-5	.01

#### pipe 4 break monitor

## One Factor ANOVA X 1 : condition Y 1: data

#### Analysis of Variance Table

Source:	DF:	Sum Squares:	Mean Square:	F-test:
Between groups	2	271540082.539	135770041.27	4.916
Within groups	25	690514368.175	27620574.727	p = .0158
Total	27	962054450.714		

Model II estimate of between component variance = 11646865.628

## One Factor ANOVA X 1 : condition Y 1: data

Group:	Count:	Mean:	Std. Dev.:	Std. Error:
speech	8	10857.875	9192.357	3249.989
text	10	4410.9	2752.113	870.295
st	10	3601.4	1851.463	585.484

#### One Factor ANOVA X 1 : condition Y 1: data

Comparison:	Mean Diff.:	Fisher PLSD:	Scheffe F-test:	Dunnett t:
speech vs. text	6446.975	5134.256*	3.344	2.586
speech vs. st	7256.475	5134.256*	4.236*	2.911
text vs. st	809.5	4840.623	.059	.344

\* Significant at 95%

## in-appropriate actions

DF	2	
* Groups	3	
* Cases	30	
H	8.578	p = .0137
H corrected for ties	8.661	p = .0132
* tied groups	6.	

Group:	# Cases:	Σ Rank:	Mean Rank:
speech	10	217	21.7
text	10	103	10.3
st	10	145	14.5

## in-appropriate actions

	Number:	Σ Rank:		Mean Rank:
eech	10	139.5		13.95
text	10	70.5		7.05
U			15.5	
U	-prime		84.5	
Z			-2.608	p = .0091
Z	corrected for ties		-2.623	p = .0087
-	tied groups		3	

### in-appropriate actions

	Ni maham.	Σ Rank:		Maan Danki
	Number:	132.5	10 125	Mean Rank: 13.25
peech	10	77.5		7.75
Γū			22.5	
Ū	l-prime		77.5	
Z			-2.079	p = .0376
Z	corrected for ti	es	-2.087 p = .0368	
-	tied groups		5	* *

## in-appropriate actions

!	Number:	Σ Rank:		Mean Rank:
text	10	87.5		8.75
st	10	122.5		12.25
U	-prime		32.5 67.5	
Z			-1.323	p = .1859
Z	corrected for the	s	-1.338 p = .1809	
#	tied groups	- Jakile Harris Vices	5	

# secondary task

DF	2	
# Groups	3	
* Cases	30	
Н	3.256	p = .1963
H corrected for ties	3.435	p = .1795
* tied groups	6	

	Kruskal-Wailis X 1 : condition Y 1 : data				
Group:	* Cases:	Σ Rank:	Mean Rank:		
speech	10	116.5	11.65		
text	. 10	186.5	18.65		
st	10	162	16.2		

# secondary task correct

DF	2	
# Groups	3	
* Cases	30	
Н	1.634	p = .4419
H corrected for ties	1.637	p = .4411
* tied groups	7	

Broup:	# Cases:	Σ Rank:	Mean Rank:
speech	10	126	12.6
text	10	171	17.1
st	10	168	16.8

## recall performance on process simulator

)F	2	
# Groups	3	
* Cases	30	
Н	11.228	p = .0036
H corrected for ties	11.571	p = .003
# tied groups	7.	

Group:	# Cases:	Σ Rank:	Mean Rank:
speech	. 10	80	8
text	10	204	20.4
st	10	181	18.1

		nitney U X 1 :		
	Number:	Σ Rank:		Mean Rank:
ext	10	111		11.1
st	10	99		9.9
U			44	
U	J-prime		56	
Z			454	p = .6501
Z	corrected for t	ies	467 p = .6406	
1	tied groups		5	

# recall performance on process simulator

	Number:	Σ Rank:		Mean Rank:
ch	10 73		7.3	
st	10	137		. 13.7
U			18	
U	U-prime		82	
Z			-2.419	p = .0156
Z	corrected for t	les	-2.453	p = .0142
*	tied groups		6	

# recall performance on process simulator

	Number:	Σ Rank:		Mean Rank:
speech	10	62		6.2
text	10	148		14.8
U	-prime		7 93	
Z			-3.25	p = .0012
Z	corrected for ti	es	-3.294	p = .001
-	tied groups		7	

T	/ A	/ M	Sub no.	O/L/P
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Future supermarkets are likely to have reduced numbers of staff on the shop floor, putting the emphasis on a central control room. Sensors on the shop floor may be able to detect variations in the levels of stock on the shelves and any other problems such as breakages or unpriced goods. These sensors will then transmit the information to the control room and it will be the job of the control room staff to make decisions based on this information.

#### Instructions

In this experiment you will be asked to assume the role of a member of the supermarket control room staff. You will be presented with a series of alarm messages. Each message consists of three components: the product container; the product; and the problem.

You are required to read the message(s) and record the order in which they were presented.

Subject Data	¥
How old are you in years? yrs	
Are you male or female? MALE / FEMALE	(circle as appropriate)

## Alarm Listing:

- 1 Bag Bread Breakage
- 2 Bag Flour Low
- 3 Bag Sugar Low
- 4 Bottle Milk Return
- 5 Bottle Sam Smiths Breakage
- 6 Bottle Washing Liquid Empty
- 7 Box Chocolate Breakage
- 8 Box Custard Return
- 9 Box Saucepan Price
- 10 Jar Apple Sauce Dressing
- 11 Jar Oil Misplaced
- 12 Jar Pickles Spillage
- 13 Loose Apple Misplaced
- 14 Loose Carrot Empty
- 15 Loose Mop Return
- 16 Packet Crumpets Low
- 17 Packet Gateaux Spillage
- 18 Packets Nuts Price
- 19 Shrinkwrap Beef Price
- 20 Shrinkwrap Edam Past Date
- 21 Shrinkwrap Pork Past Date
- 22 Tin Corned Beef Misplaced
- 23 Tin Sausages Spillage
- 24 Tin Tomato Empty
- 25 Wrapped Celery Past Date
- 26 Wrapped Sausages Dressing
- 27 Wrapped Tomato Dressing

# ORDER OF PRESENTATION

- 1.
- 2.
- 3.
- 4.
- 5.
- 6.
- 7.
- 8.
- 9.
- 10.
- 11.
- 12.
- 13.
- 14.
- 15.
- 16.
- 17.
- 18.
- 19.
- 20.
- 21.
- 22.
- 23.
- 24.
- 25.
- 26.
- 27.

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Future supermarkets are likely to have reduced numbers of staff on the shop floor, putting the emphasis on a central control room. Sensors on the shop floor may be able to detect variations in the levels of stock on the shelves and any other problems such as breakages or unpriced goods. These sensors will then transmit the information to the control room and it will be the job of the control room staff to make decisions based on this information.

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You are required to read the message(s) and record this on the location where they were presented.

Subject Data	
How old are you in years?	_ yrs
Are you male or female? MALE	/ FEMALE (circle as appropriate)

Т	/ A	/ M	Sub no.	O/L/P
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Future supermarkets are likely to have reduced numbers of staff on the shop floor, putting the emphasis on a central control room. Sensors on the shop floor may be able to detect variations in the levels of stock on the shelves and any other problems such as breakages or unpriced goods. These sensors will then transmit the information to the control room and it will be the job of the control room staff to make decisions based on this information.

#### **Instructions**

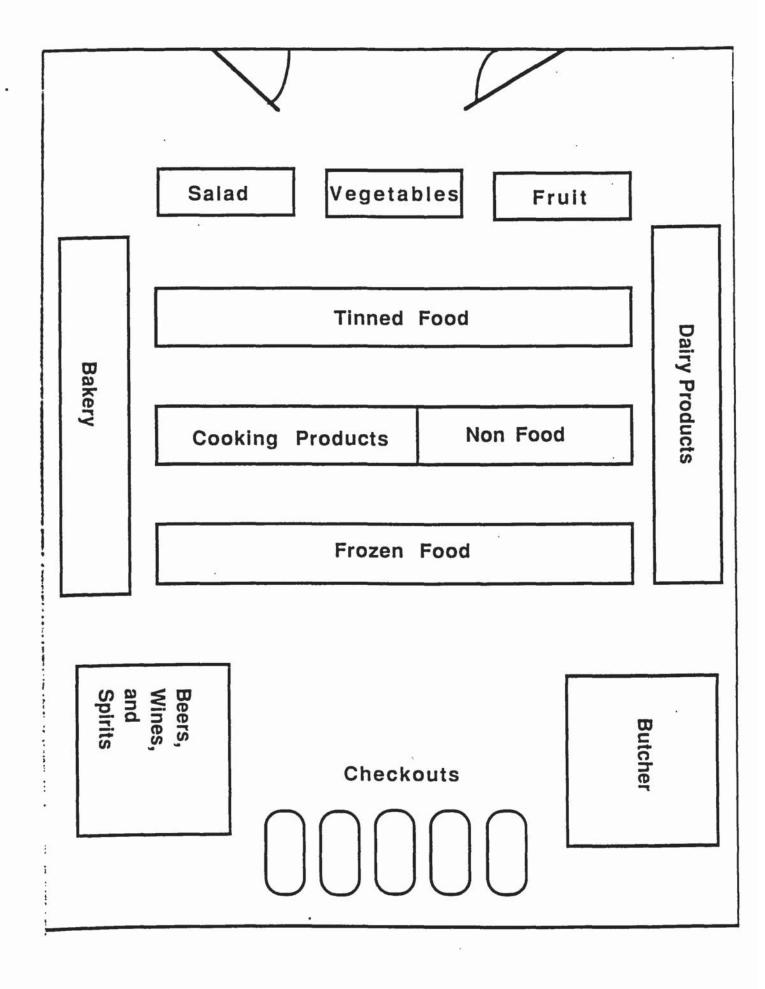
In this experiment you will be asked to assume the role of a member of the supermarket control room staff. You will be presented with a series of alarm messages. Each message consists of three components: the product container; the product; and the problem.

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Subject Data	
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## Alarm Listing:

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- 10 Jar Apple Sauce Dressing
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- 23 Tin Sausages Spillage
- 24 Tin Tomato Empty
- 25 Wrapped Celery Past Date
- 26 Wrapped Sausages Dressing
- 27 Wrapped Tomato Dressing



Т	/ A	/ M	Sub no.		0/	L/P
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Future supermarkets are likely to have reduced numbers of staff on the shop floor, putting the emphasis on a central control room. Sensors on the shop floor may be able to detect variations in the levels of stock on the shelves and any other problems such as breakages or unpriced goods. These sensors will then transmit the information to the control room and it will be the job of the control room staff to make decisions based on this information.

#### Instructions

In this experiment you will be asked to assume the role of a member of the supermarket control room staff. You will be presented with a series of alarm messages. Each message consists of three components: the product container; the product; and the problem.

You are required to read the message(s) and note down the corresponding pattern of alarm messages.

Subject Data	
How old are you in years?	yrs
Are you male or female? MAL	E / FEMALE (circle as appropriate)

Pattern Task Response Sheet: Text Condition

### Alarm Listing:

- 1 Bag Bread Breakage
- 2 Bag Flour Low
- 3 Bag Sugar Low
- 4 Bottle Milk Return
- 5 Bottle Sam Smiths Breakage
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- 25 Wrapped Celery Past Date
- 26 Wrapped Sausages Dressing
- 27 Wrapped Tomato Dressing

Tin Corned Bool Maplesed

d#

Tin Temete Empty

Bottle Sam Smiths Breakage

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V

Leves Cerrot Emply

Jar Pickies Spillage Shrinkwrap Pork Post Dale

Wrapped Bausages Dressing

Shrininerap Edom Pool Date Bottle Washing Liquid Empty Jer Ploties Spillege Shrinkwrap Pork Paul Date

Jer Plekies Spillage Wrapped Souseges Dressing

Box Custord Roturn Boilie Washing Liquid Empty

Strinkurap Pork Peal Date Bottle Washing Liquid Emply

Bottle Weeking Liquid Empty Wrapped Temate Dressing

Jer Pickies Spillage Jer Oil Misplaced Tin Tomoto Empty Wrapped Soucages Dressing

Shrinkurap Edam Peal Date Tin Tamata Empty Bollio Weeking Liquid Empty

Bottle Washing Liquid Empty Wrapped Seusages Dressing

Shrinkwrap Pork Post Dolo

Bottle Weshing Liquid Empty Wrapped Colory Past Date Jar Pickies Spillage Shrinkwrap Park Past Date Wrapped Colory Paul Date Pastel Crusspole Low Boltle Washing Liquid Empty Shrinturum Park Paul Date Bollio Washing Liquid Empty Wrapped Colory Past Date Box Chosolete Breakage Pastets Crumpets Low wite Weeking Liquid Empty Vrapped Colory Post Date Velod Crumpets Law Bristorres Port Post Date

Bottle Weshing Liquid Emply Wrapped Colory Paul Date Thi Sausages Spillage Bollo Weeking Liquid Empty Jer Plekine Spillage Box Chesolate Brestage Shriniarrap Pork Post Dalo Bottle Weeking Liquid Empty Wrapped Colory Paul Date Box Chassiste Brestage Shrinimrap Park Paul Date Bottle Weeking Liquid Empty Pastet Crumpets Low Box Chassists Brestage Shrinturup Pork Past Date

Wrapped Colory Peal Date
Packet Nute Price
Locae Correl Empty
Shrinkers Park Paul Date

Bottle Weeking Liquid Empty Packet Crampote Low Jer Pickies Spillage Shrinimmep Park Paci Date Botto Washing Liquid Empty Wrapped Colory Paul Date Jer Plokies Spillege Packets Crumpets Law

.

Wrapped Colory Part Date Particle Crumpote Low Jor Ptotics Spillage Strinturup Edam Part Date

Bottle Weehing Liquid Empty Wrapped Colory Poel Date Bag Brood Breakage Shrintwrap Pork Poel Date Wrapped Colory Pool Date Posteri Crumpeto Low Box Chassisia Bresings

Bollie Weshing Liquid Empty Wrapped Celery Past Date Box Checolete Breakage Postote Crumpets Lew Box Choselete Breekage Postets Crumpets Low Jes Pietries Spillage Shrinkwrep Pork Post Date Tin Sausages Sprillage Jer Apple Sause Dressing Pooled Crumpets Lew Skrinkernap Edem Pest Date Jer Plotties Sprillage Beg Plour Low Tin Tomate Empty Sotte Weshing Liquid Empt The Seusages Spillage Jer Apple Sause Dressing Peobet Cruspois Lew Beg Breed Breekege Tin Corned Seet Stippleed Beg Plour Lew The Yemate Empty Soile Westing Liquid Empty Soile Westing Liquid Empty

Tin Baucages Spillage Jer Apple Sause Dressing Pecket Nuts Price Shrintwrap Edam Past Date Tin Corned Best Steplesed Bag Flour Low Tin Tomato Empty Bettle Weshire Liverd Empty Bettle Weshire Liverd Empty

Packet Nuts Price
Wrapped Colory Pact Date
Tin Sauseges Spflage
Jer Apple Sause Dreacing
Packet Crumpels Lew
Shriniwrap Edem Pact Date
Tin Corned Sect Mapleced
Bag Flour Lew

Packet Nute Price
Shrinkwrap Edam Post Dete
The Corned Bacel Mapleced
The Sauseges Spiffage
Leace Carrot Empty
Packet Crumpote Law
Jor Apple Bause Dreacing
Bag Plour Law

Tin Bereegee Spillege Jer Apple Bouse Droading Pechel Cresspels Lew Shrinkwap Edam Post Dote Box Constant Return Bag Plour Lew Tin Temate Empty Bottle Weshing Liquid Empty Bottle Weshing Liquid Empty

Tin Bouseges Spillage Jer Apple Souse Dressing Pooted Crumpets Low Wrapped Colory Past Date Tin Corned Best Mapleoed Bag Plour Low Tin Tomete Empty Bottle Weshing Liquid Empty Tin Sevengee Spiflage
Jac Apple Souse Drossing
Peolant Crumpots Lew
Shrinhwrap Edem Past Date
Bex Custord Potura
Beg Plour Lew
Tin Temete Emply
Beltie Washing Liquid Emply

Postet Nute Price Wrapped Colory Past Date The Corned Seof Maplesed The Sausages Spillage Lesse Corrol Empty Bag Breed Breeinge Jor Apple Sause Dressing Bag Plour Law

Box Chorelate Breatage Japas Sapas Sauce Dreasing Peeted Crumpets Lew Birthiterap Edam Past Det The Cornel Beet Whipleoed Bag Flour Lew Tin Tomote Empty Bottle Weehing Liquid Empty Bottle Weehing Liquid Empty

Tin Sounages Spittage Jer Apple Souse Dreasing Paciest Crumpote Lew Shrinkurap Edem Past Date Tin Corned Boot Situpiesed Shrinkurap Boof Price Tin Temete Empty Bottle Waching Liquid Empty Bottle Waching Liquid Empty

Tis Sensopes Spillage der Appie Seuse Dressing Beg Super Lew Shrinkurup Edem Pest Dete Tis Corned Seef Simplesed Beg Fisur Low Tin Tomets Emply Bettle Washing Liquid Emph

Pastel Nute Price Strinterrap Edam Peel Date Wrapped Seusages Dressing Peetel Gateoux Spillage Lease Carrol Empty Tin Corsed Beel Simpleaed Jer Apple Sause Dressing Bag Suger Low Postet Nuts Price
Wrapped Colory Pest Date
Wrapped Boussages Dressing
Postet Sciency: Splings
Lesse Cerrot Empty
Beg Breed Breekage
Jer Apple Sauce Dressing

Tin Sauseges Spitings
Jer Apple Souse Dressing
Packet Crumpote Low
Shrinkways Edem Past Date
Tin Corned Seef Misplaced
Beg Plour Low
Tin Tomels Empty
Sellie Weshing Liquid Empty

Tin Soussgoe Spillage Jer Apple Souse Dressing Pacietic Coursects Low Bog Bread Breaksgo Tin Corned Beef Brisplaced Bag Plour Law Tin Temate Empty Boillo Washing Liquid Emph

Bottle Bors British Breaksge Box Couster Redurn Jar Pistice Spfflege Bog Broad Breaksge Jer Off Mapleced Loose Apple Return Bottle Weshing Liquid Empty Wrapped Gotey Past Date Barteturnep Port Past Date Matte Mills Bahare Bottle Seen Smiths Breakage Bex Cuesterd Return Peofert Geleeux Spllege Seg Breed Breakage Jer Oll Staplesed Loose Aptic Return Bottle Weshing Liquid Empty Wrapped Colory Peet Date Seg Plear Low Bell Mitt Return Settle Mit Return Bettle Born Breithe Breakage Box Custord Roburs Peobled Gelenux Spillege Bag Breed Breakage der Olf Misplaced Wrapped Temoto Droceing Bottle Washing Liquid Emply Wrapped Colery Paul Date Shriniwrap Port Paul Date Shriniwrap Port Paul Date Bottle Mit Roburn Bottle Sem Smiths Bresinge Box Custard Return Pector Excess Spillage Lesse Cerrol Empty Jar Oll Misplesed Lesse Apple Return Bettle Washing Liquid Empty Wrapped Colory Peet Date Shrintwrap Perit Peet Dete

Bottle Som Smithe Breelegd Box Custord Return Puebel Gelenux Spflage Bog Brood Breelegd Jor Off Maplesed Leace Apple Return Shrinkway Boot Price Wropped Colory Paul Date Bag Flour Lew Bottle Sem Smithe Breakage Box Custierd Rehirm Peoled Sciences Spillage Box Checolete Breakage Jar Oll Stepleod Leese Apple Return Bottle Weshing Liquid Empty Wrapped Colory Post Date Shrinkwrap Pork Past Date Settle MR Rehirm Bettle Som Smithe Breatage Jor Apple Sauce Dressing Peoblet Geteaux Spitiop Bag Bread Breatage Jer Oll Biopleced Loose Apple Return Bettle Weshing Liquid Empty Wrapped Colory Peol Date Bag Plour Lew Bettle Mitt Baken Bottle Som Smiths Breeinge Box Custord Refurn Poeted Geleeux Spillage Box Broad Breeinge Jar Oll Himpleced Poeted Crumpots Law Bottle Weehing Liquid Empty Wrapped Colory Paul Date Birliniwrap Poet Poet Dete Birliniwrap Poet Poet Dete

Bottle Som Seethe Breshege Box Custorf Roturn Podest Galeaux Spillage Bog Bread Breshige Jar Oll Milphoed Loose Apple Roturn Bottle Washing Liquid Brepty Wrapped Colory Paul Date Shrinterap Portr Post Date Sarte Marken Bettle Bern Smithe Breeinge Box Custard Return Pechat Colosux Spilage Bag Bread Breeinge Jar Oll Mispleod Leose Apple Rodurn The Tember Emply Wrapped Colory Peel Date Shirishwrap Perk Pool Date Settle Mix Return Bettle Som Smithe Breakage Box Custord Return der Plotice Spillege Bog Bread Breakage Jer Off Mapleced Losee Apple Return Bettle Weeking Liquid Empty Wrapped Colory Post Date Shrintwrap Pork Past Date Settle With Return Bottle Bom Smiths Breeinge Box Custerd Reham Box Buger Low Box Breeinge Jer Oll Blapheed Lesea Apple Return Bottle Washing Liquid Empty Wrapped Cotory Peat Date Shriniversp Port Peat Date

Bottle Seen Smiths Breeinings Bort Custerd Robern Pedact Sateaux Spifinge Bog Super Low Losee Apple Robern Bottle Washing Liquid Empty Wrapped Colory Past Date Skrinkurrap Port Past Date Settle Mith Polyrin Bottle Som Smithe Sreeinge Box Custard Refurs Pooled Geleaux Spillage Bag Sreed Sreeinage Jar Oll Hispiaced Loose Apple Refurs Boilie Washing Liquid Empty Wrapped Cylery Peel Date Bag Plaux Low Bottle Mit Refurs Bettle Barn Smiths Breatage Bex Custored Return Pested Geleaux Spillage Bag Bread Breatage Jer Oil Steplesed Loose Apple Return Bottle Weehing Liquid Empty Box Sassespon Price Shrinkurap Pork Post Date Battle Milk Return Bottle Som Smitte Breakage Jer Apple Sause Dreaeling Peohet Golesux Spillege Beg Breed Breakage Jer Oll Stupleced Lesses Apple Redura Bottle Washing Liquid Empty Wrapped Colory Past Date Shiriniurup Pork Past Date Bottle Mit Redura Peobal Galeoux Spillogo
Jer Apple Sause Dreading
Packet Nuts Price
Laces Cerror Empty
Laces Mep Return
Jer Off Mispleed
Book Develope Laces Apple Mappleed
Box Checolote Breshage
Jer Pickles Spillogo
Tin Sauseges Spillogo
Bog Flour Low
Box Custard Empty
Bog Bresh Merchage
Spillogo Bottle Milks Fleturn

Packet Goleaux Spillage
Jer Apple Bases Dreasing
Bag Super Low
Lesse Gerrot Empty
Lesse Stop Return
Jer Oll Simpleced
Bodile Weshing Liquid Empty
Wrapped Temoire Dreasing
Box Checolete Strakege
Jer Picties Spillage
Tim Sunseque Spillage
Tim Sunseque Spillage
Bag Picut Low
Box Cuelard Empty
Bag Breat Breatage
Beg Esset Seventage
Beg Esset Seventage
Beg Esset Seventage
Bestile Stift Return

Packet Geleaux Spilloge
Jer Apple Sauce Dressing
Sol Saucepen Price
Leese Carret Empty
Leese Hep Return
Jer Oil Hipsheed
Solito Weshing Liquid Empt
Lesse Apple Mispheed
Sol Chesolate Breakage
Jer Ptokies Spilloge
Tin Saucegee Spillage
Bag Pleur Leer
Bos Couland Empty
Bag Breed Breakage
Bettle Mitt Return

Wrapped Temote Dreaming Jer Apple Sease Dreaming Padeots Orampets Lear Lease Certel Respir Lease Step Return Jer Oll Misphaced Bottle Weshing Liquid Empt Lease Apple Misphaced Box Disconsiste Brackings der Pieties Spillings Till Sease-gos Spillings Sea Great Lear Box Countrid Empty Sea Bread Breatungs Series Hit Feshira

Pacinol Geleaux Spillage
Jer Apple Souce Dreaming
Pacinic Crumpole Lew
Lesse Correl Empty
Lesse Carrel Empty
Lesse Carrel Empty
Lesse Indiana
Jer Oil Staplaced
Settle Westle Westles
Westle Westles
Westle Westles
Jer Plottics Spillage
Jer Plottics Spillage
Beg Plour Lew
Beg Causiard Empty
Beg Send Streakage
Bottle Milk Return

Pacinal Galessat Spillage
Jer Apple Sause Creasing
Pacinic Crumpols Lee
Leese Cerval Empty
Leese Map Return
Jer Oll Staplaced
Bottle Weshing Liquid Empt
Leese Apple Shiphaced
Bottle Weshing Liquid Empt
Leese Apple Shiphaced
Bott Checotoles Smallage
Jer Pictics Spillage
Tim Sausegee Spillage
Shirtishirerap Pork Peet Dote
Box Custerd Empty
Bag Small Smallage
Bottle Mills Return

Packet Galeaux Spillage
Jor Apple Sauce Dressing
Bog Super Lew
Losse Carrol Empty
Losse tiep Return
Jer Oll Misploond
Bottle Weshing Liquid Empty
Losse Apple Stisploond
Bottle Weshing Liquid Empty
Losse Apple Stisploond
Bott Cheestels Breeinge
Jer Pickies Spillage
The Sausages Spillage
Bog Flour Low
Bot Custart Empty
Bog Sand Breeinge
Bettle Mitt. Return

Pushel Galeaux Spillago der Apple Baues Drosoling Pushele Crumpets Lew Lesses Correr Empty Lesses Hop Return Wrapped Bauesges Drosoling Bellie Weshing Liquid Empt Lesses Apple Majeneed Bax Cheesdein Brushape der Pistiss Spillage The Sessespes Spillage Bag Fleur Lew Box Ousterd Empty Bag Bred Breskape Beitte Mills Return

Pooled Geleaux Spillege-Jar Apple Boson Droseing Poolets Crumpets Lew Leose Gerel Empty Leose May Return Jer Oll Mispleood Belte Weshing Liquid Empty Leose Apple Mispleood Box Checolete Breatings Jar Plotities Spillege Tis Seusapee Spillege Strickwarp Port Pool Dele Box Custard Empty Bog Bread Streakings Sottle Still Resturn Packet Geleastz Spillage
Jor Apple Source Dressing
Pacteria Crumpets Lew
Bottle Sour Smiths BreekegLaces Step Return
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Set Checotots BreekegJor Pickies Spillage
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Bag Breet Breekegs
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Packet Gelears Spillage
Jer Apple Sause Dressing
Postets Crumpets Lew
Lesse Carrol Empty
Lesse Step Return
Jer Oll Misplessed
Bottle Washing Liquid Empty
Lesse Apple Stephessed
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Jer Pickins Spillage
Jer Pickins Spillage
Sing Plear Lew
Best Custard Empty
Best Custard Empty
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Pachol Bolsour Rpillage
Jer Apple Bouse Dressing
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Lesses Carvel Emply
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Boille Weshing Liquid Empl
Lesses Apple Misplaced
Boille Weshing Liquid Empl
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Bott Checolicie Breshage
Jer Prictice Spillage
Tils Bausages Spillage
Tils Bausages Spillage
Bot Outland Emply
Bog Sreak Emply
Bog Sreak Breshage
Bottle Miffs Return

Posted Science Spillage
Jor Apple Source Dreaming
Postel Nuts Price
Leace Corrol Empty
Leace Stop Peters
Jor Oli Mapliced
South Vectoring Liquid Empty
Leace Apple Mapliced
Sox Chooseles Streetings
Jor Poster Spillage
Tin Samangee Spillage
Sag Flauer Low
Sox Custerd Empty
Sag Secut Low
Sox Custerd Empty
Sag Secut Spillage
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South SMR Resigns

Poshot Golonux Spilinge Jer Apple Souce Oreacing Postote Crumpots Ler Lence Sep Poters The Carried Soot Mapinoed Bottle Weehing Liquid Empty Lence Apple Mapinoed Sox Chescipte Strainage Lence Apple Mapinoe The Source Spilinge The Source Spilinge Sox Conferd Empty Seg Pieter Lence Sox Conferd Empty Seg Sected Strainage Sortic Mitt Potern

Peotet deteurs Spillage der Apple Sauce Dressing Peotete Crumpote Lew Lesee Cerrot Empty Leses Mot Bent Berting State Saucepen Price Bottle Weshing Liquid Empty Leses Apple Mispheed Box Choodels Breetage der Plottes Spillage The Saucepes Spillage Beg Flour Lew Bex Custerd Empty Bog Breed Brechage Bottle Sills Polumn

Jer Oll Hispieced
Jer Apple Baues Dressing
Box Checolete Breekape
Box Custord Return
Leose Apple Mispieced
The Bauseapes Spillinge
Bottle Mith Return
Brintsurap Edem Post Date
Jer Plokies Spillinge
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Leose Cerrol Empty
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Bog Breed Breekape
Leose Hap Return
Wrapped Colory Post Date
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Shrinkrarap Port Post Date
Shrinkrarap Port Post Date
Shrinkrarap Boof Price
Bhrinkrarap Boof Price

Jer Oll Misplaced
Jer Apple Basses Dreaking
Box Checolete Breekage
Box Custerd Return
Lease Apple Misplaced
Tim Beusages Sprilege
Bottle Mith Return
Shrinkurspe Edem Pael DeleJer Plactice Sprilege
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Wrapped Seusages Dreasing
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Jor Apple Sauce Dreading
Bex Checolete Breakage
Box Custard Return
Lesee Apple Misplaced
The Seusages Spillage
Bottle Mittle Return
Bhrinhwrap Edem Paul Date
Jar Pietites Spillage
Poolsed Sateoux Spillage
Lesee Carrel Enerty
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Beg Bread Breakage
Lesee Morp Return
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Jer Apple Boses Droasing
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Box Custord Return
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Bottle Mith Return
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Pechot Gloceux Spittings
Leoce Cerrol Empty
Pechot Crumpets Low
Bog Breed Bresisage
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Jer Apple Bause Dressing
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Jer Apple Basse Dressing
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Beg Breed Breekage
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Bog Super Low
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Box Bauseges Price
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Bhrinkerup Edem Paul Cole

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Shrinkures Edom Past Dele

T/A/M Sub no.	O/L/F	2
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Future supermarkets are likely to have reduced numbers of staff on the shop floor, putting the emphasis on a central control room. Sensors on the shop floor may be able to detect variations in the levels of stock on the shelves and any other problems such as breakages or unpriced goods. These sensors will then transmit the information to the control room and it will be the job of the control room staff to make decisions based on this information.

#### Instructions

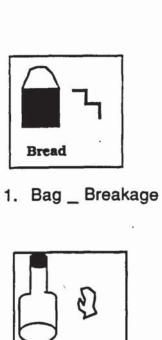
In this experiment you will be asked to assume the role of a member of the supermarket control room staff. You will be presented with a series of alarm messages. Each message consists of three components: the product container; the product; and the problem.

You are required to read the message(s) and record the order in which they were presented.

Subject	Data	
	-34	

How old are you in years? \_\_\_\_\_ yrs

Are you male or female? MALE / FEMALE (circle as appropriate)



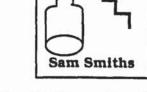




2. Bag \_ Low

3. Bag \_ Low

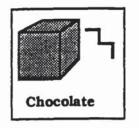


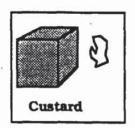


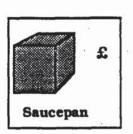


Bottle \_ Return

5. Bottle \_ Breakage 6. Bottle \_ Empty







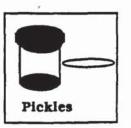
7. Box \_ Breakage

8. Box \_ Return

9. Box \_ Price



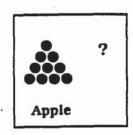




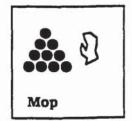
10. Jar \_ Dressing

11. Jar \_ Misplaced

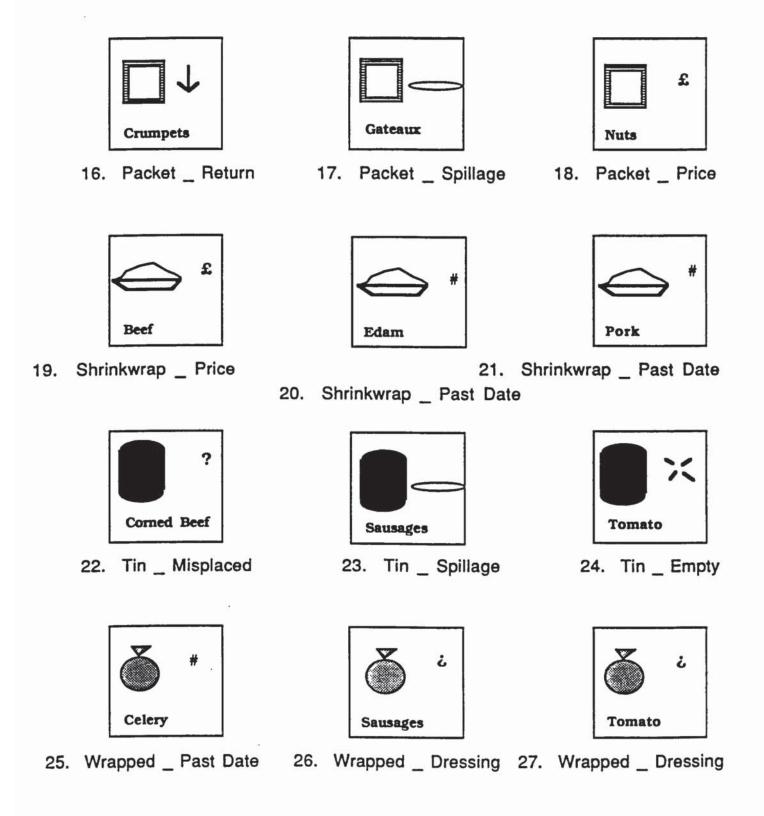
12. Jar \_ Spillage







13. Loose \_ Misplaced 14. Loose \_ Empty 15. Loose \_ Return



### ORDER OF PRESENTATION

- 1.
- 2.
- 3.
- 4.
- 5.
- 6.
- 7.
- 8.
- 9.
- 10.
- 11.
- 12.
- 13.
- 14.
- 15.
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- \_\_\_\_
- 17. 18.
- 19.
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- 21.
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- 24.
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- 27.

T/A/M Sub no. O/L	./H	O/L		no.	Sub	M	A /	Τ/
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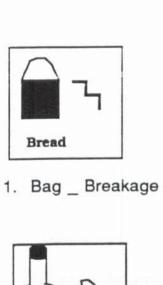
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#### Instructions

In this experiment you will be asked to assume the role of a member of the supermarket control room staff. You will be presented with a series of alarm messages. Each message consists of three components: the product container; the product; and the problem.

You are required to read the message(s) and record this on the location where they were presented.

Subject Data	* *
How old are you in years? yrs	
Are you male or female? MALE / FE	MALE (circle as appropriate)





Bottle \_ Return 4.



2. Bag \_ Low



3. Bag \_ Low



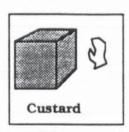


5. Bottle \_ Breakage 6. Bottle \_ Empty





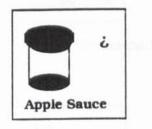
7. Box \_ Breakage



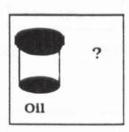
8. Box \_ Return



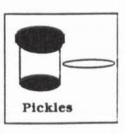
9. Box \_ Price

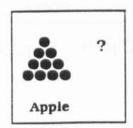


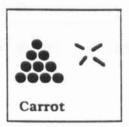
10. Jar \_ Dressing

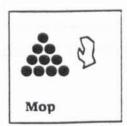


11. Jar \_ Misplaced 12. Jar \_ Spillage

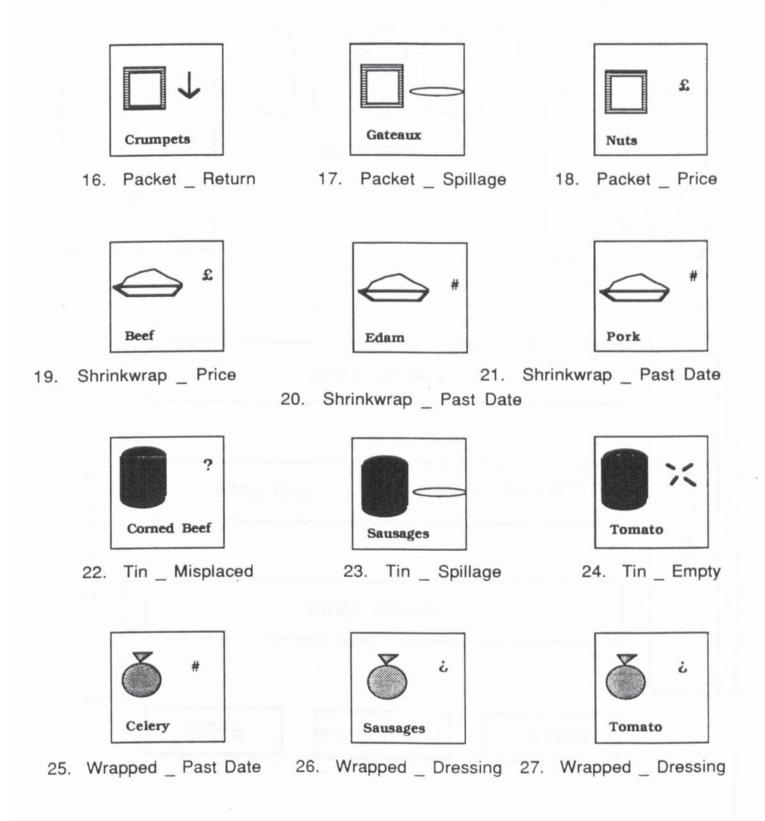








13. Loose \_ Misplaced 14. Loose \_ Empty 15. Loose \_ Return



	Beers, Wines,	Spirits
oducts	Cooking Products Non Food Frozen Food	ıry
Dairy Products	Tinned Food	Bakery
	Salad Vegetables Fruit	

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T/A/M Sub no	. O/L/P
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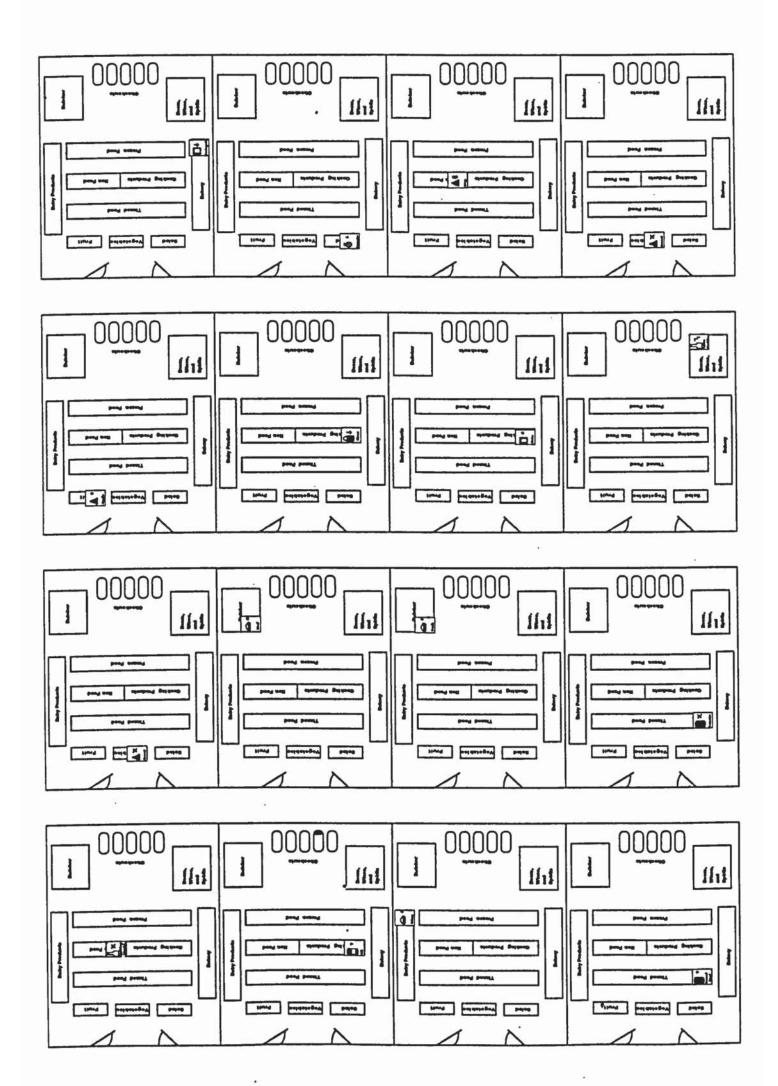
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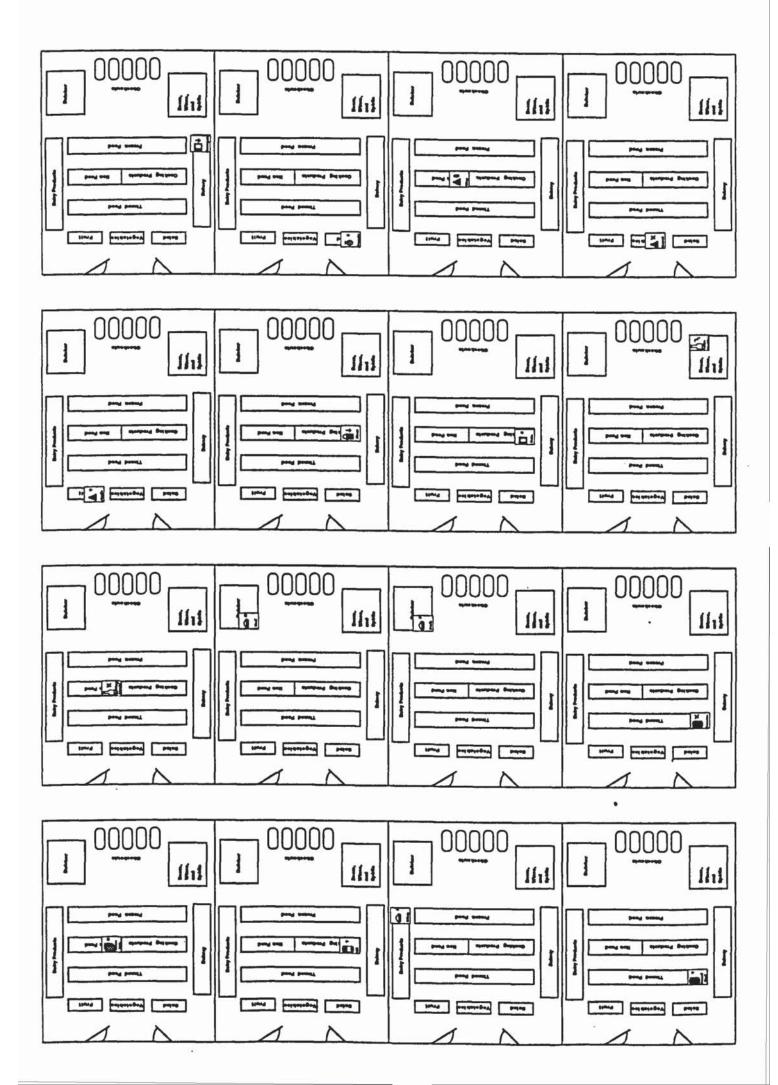
#### Instructions

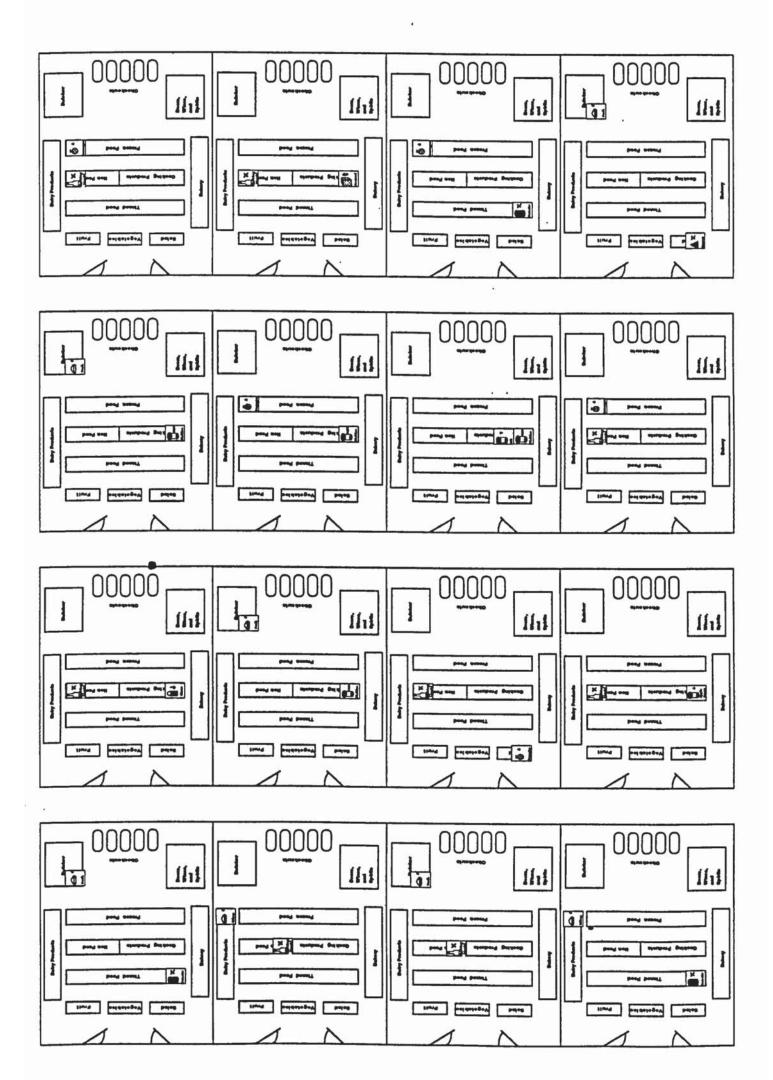
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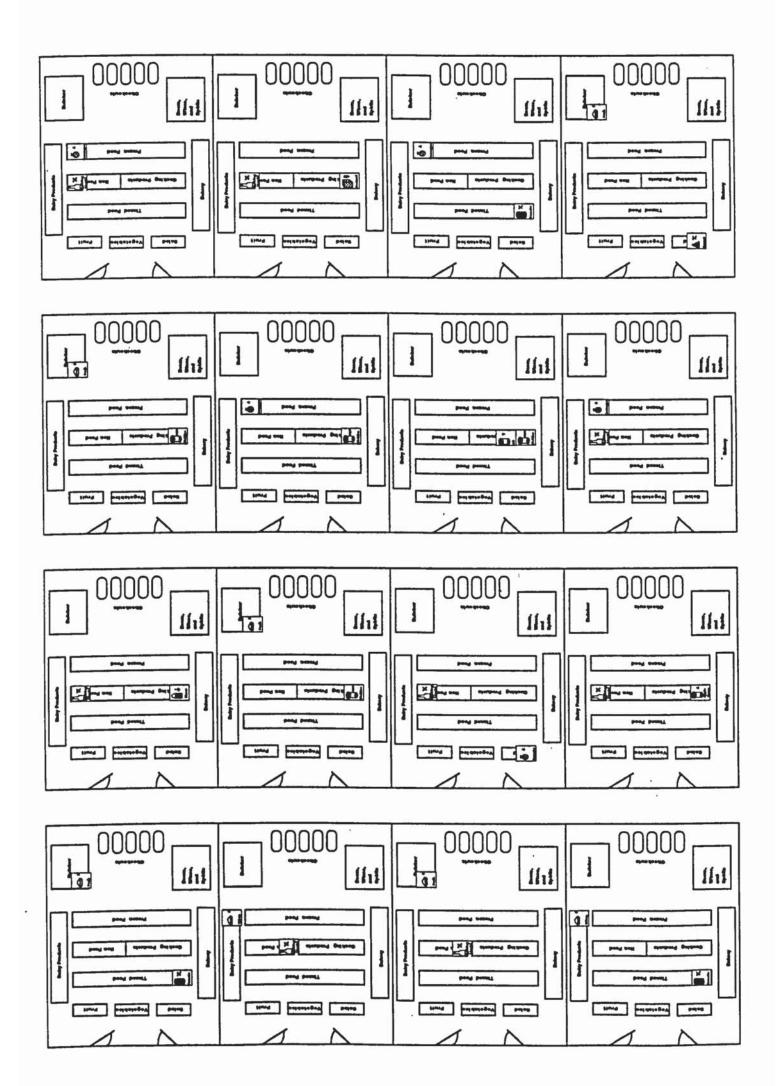
You are required to read the message(s) and note down the corresponding pattern of alarm messages.

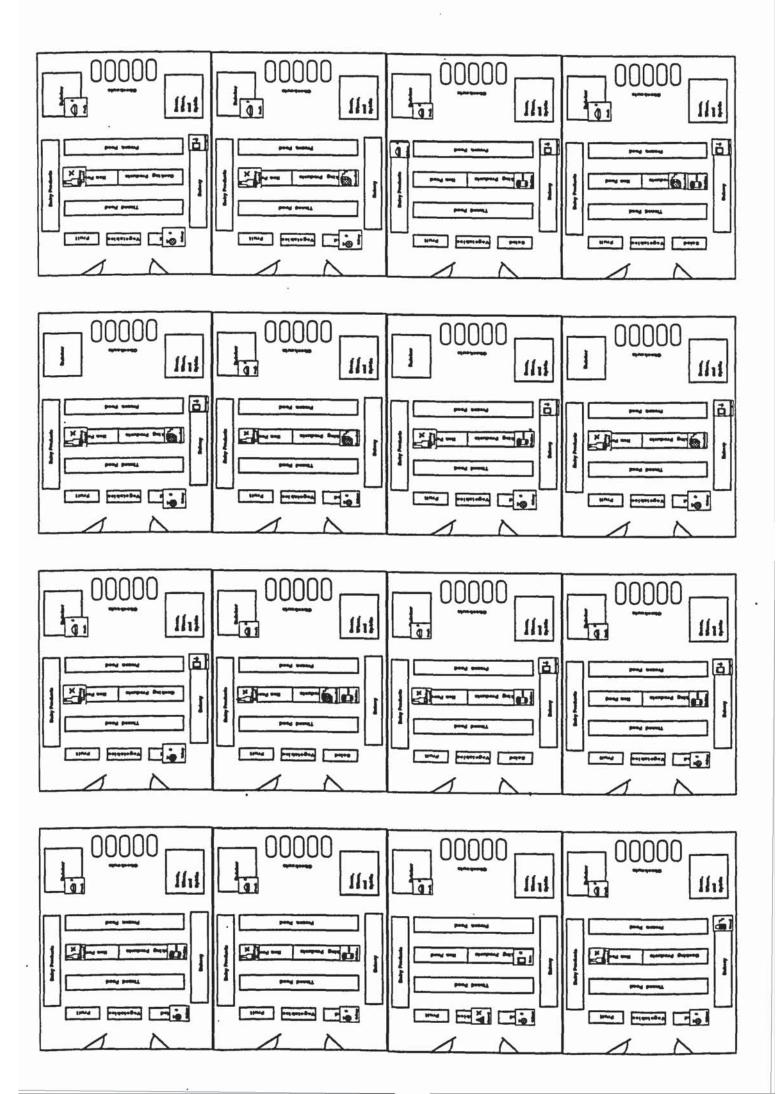
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How old are you in years? yrs	
Are you male or female? MALE / FEMALE (circle as appro-	priate)

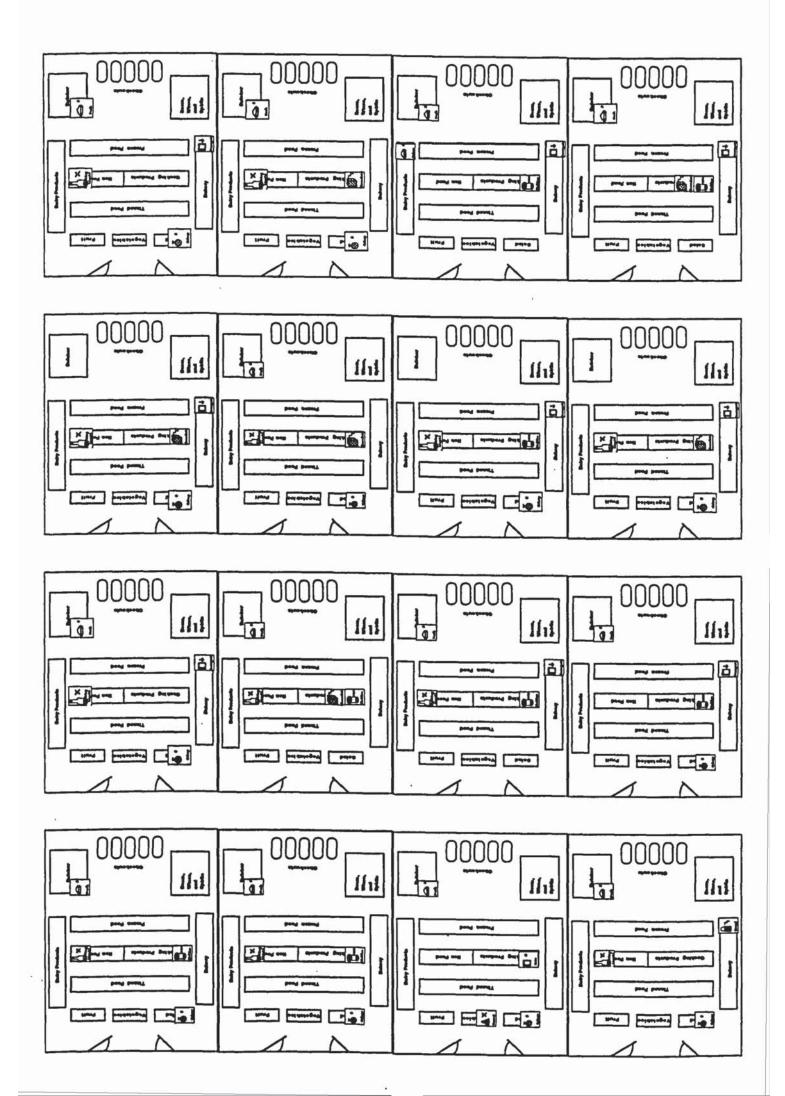


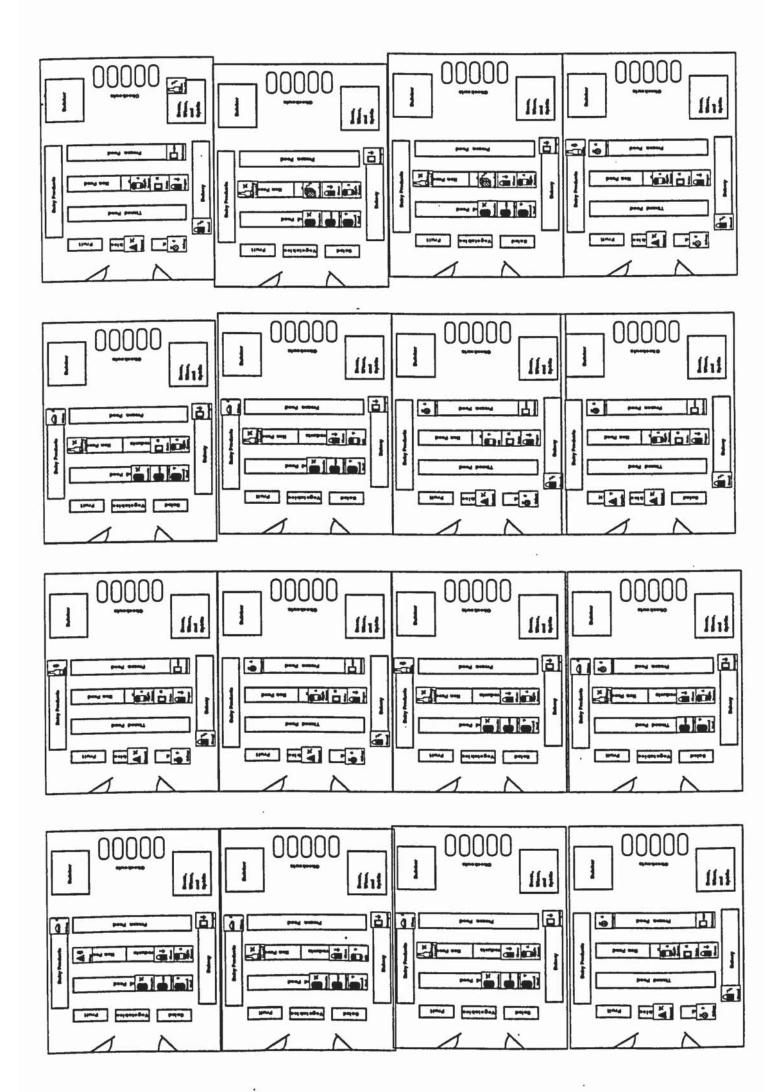


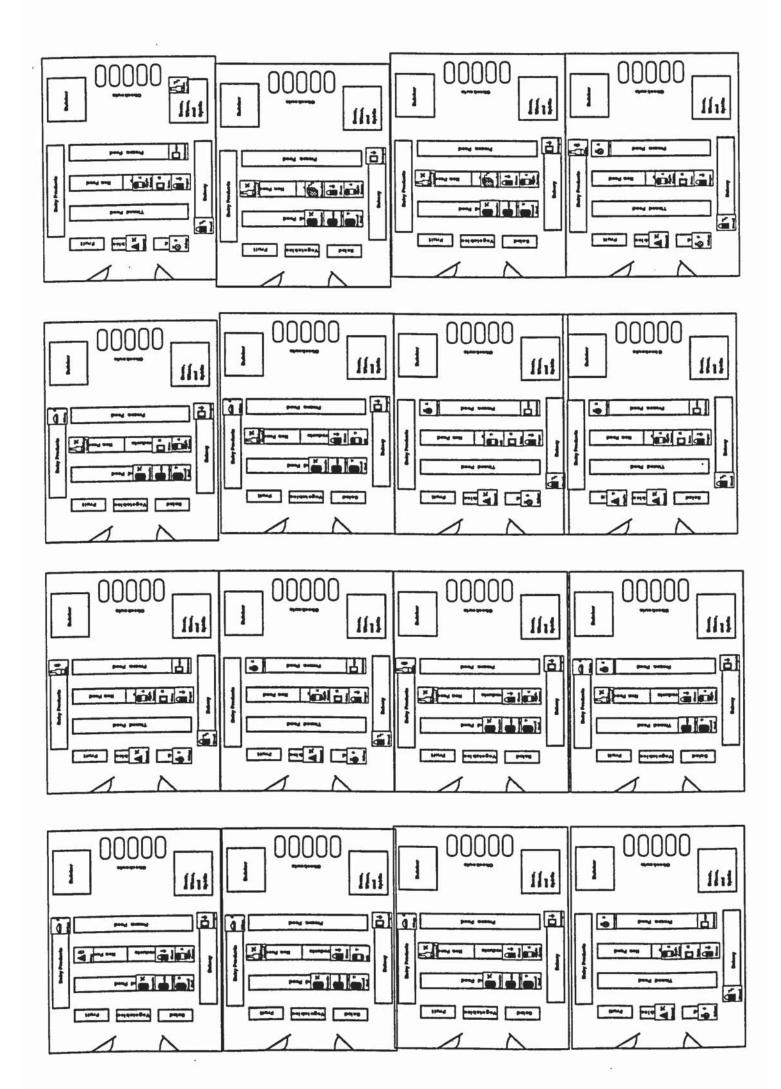


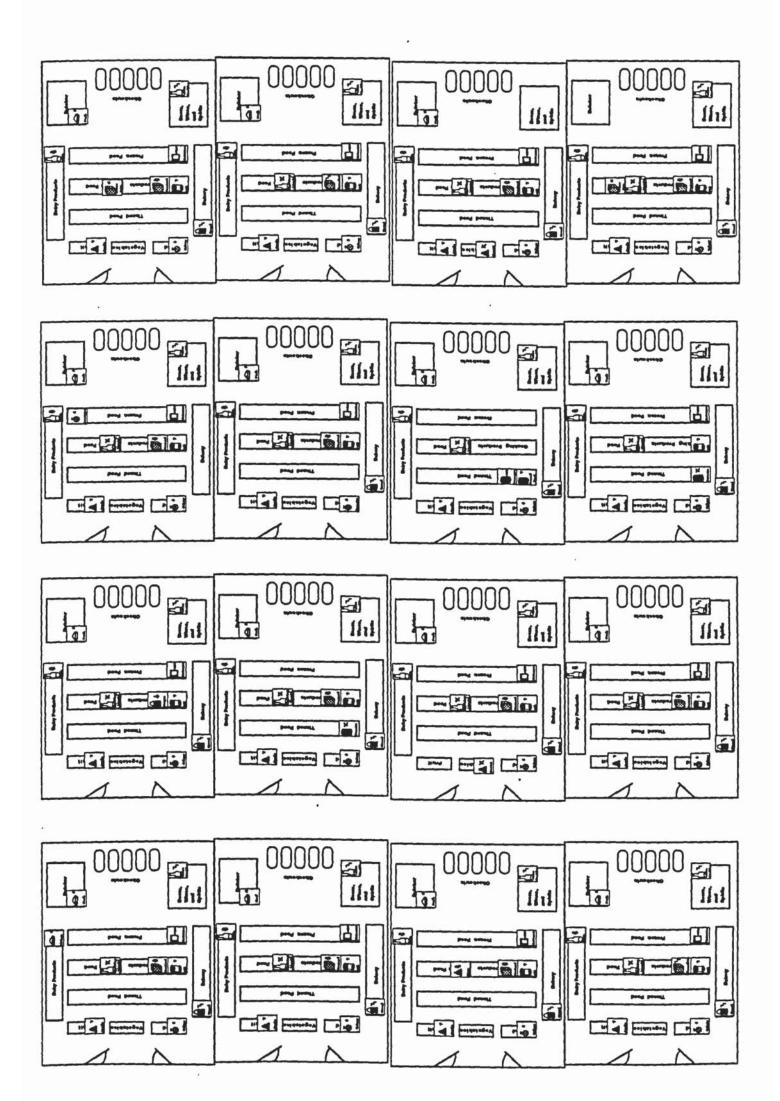


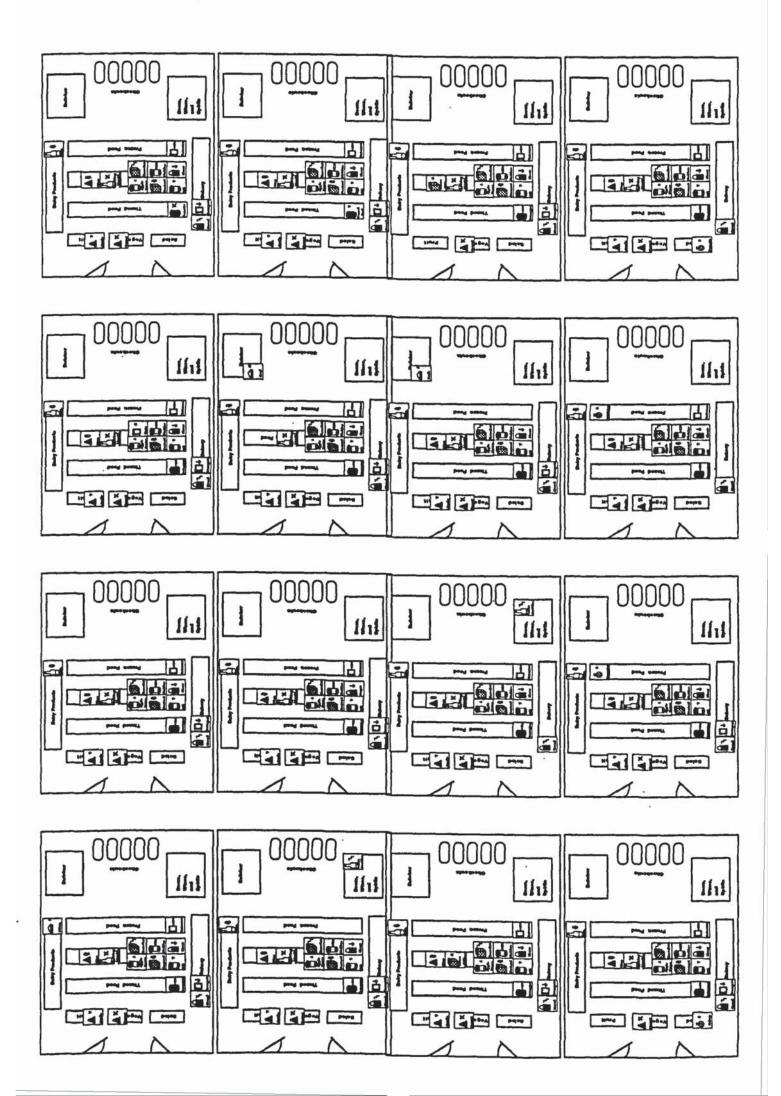


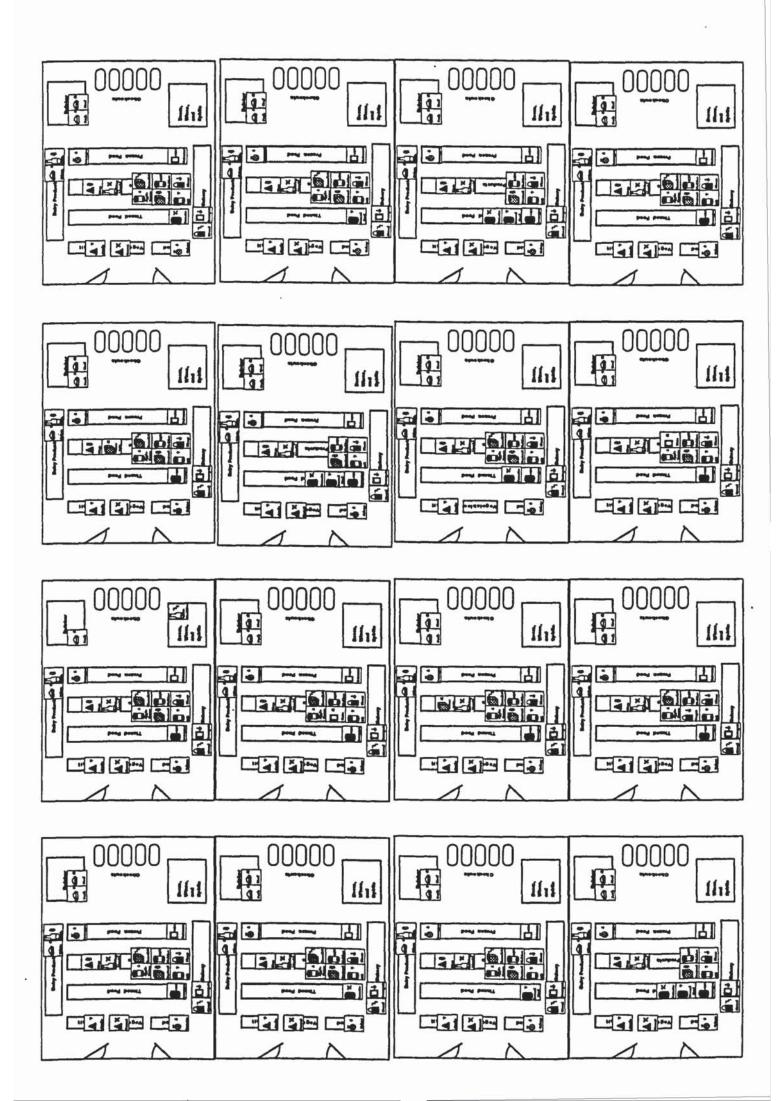


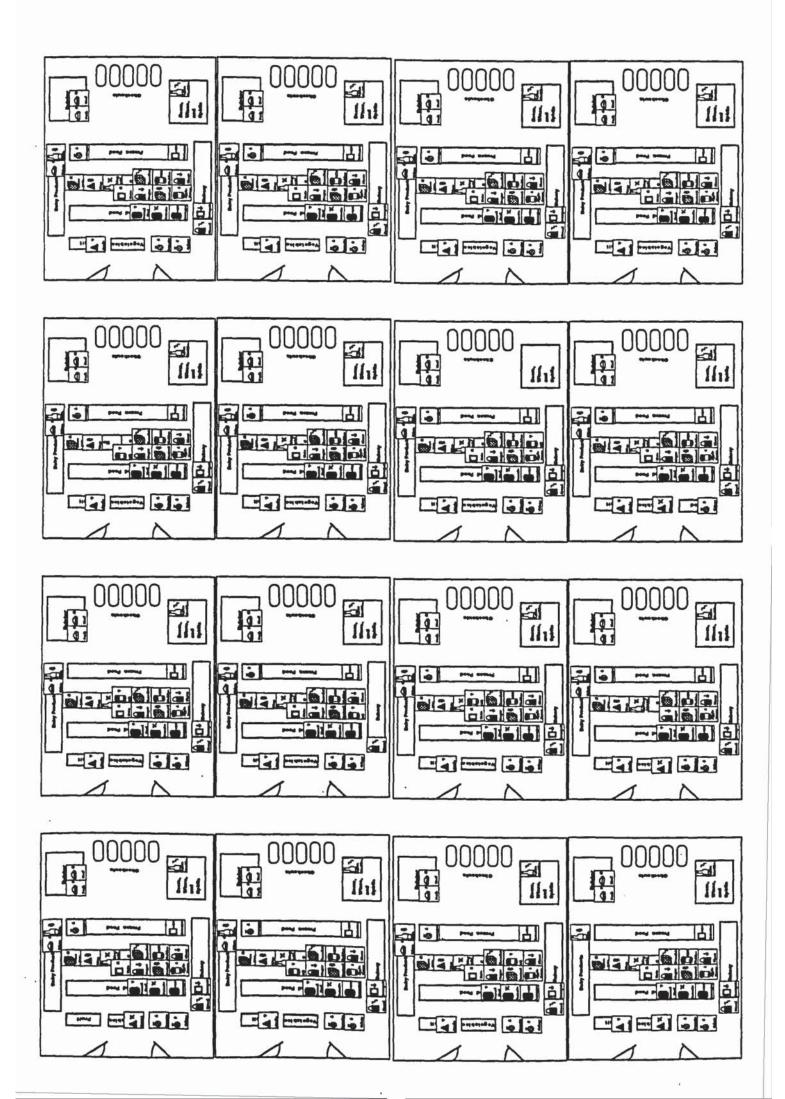


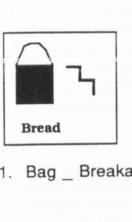












1. Bag \_ Breakage



2. Bag \_ Low



3. Bag \_ Low

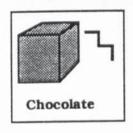


4. Bottle \_ Return

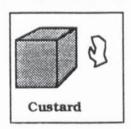


5. Bottle \_ Breakage 6. Bottle \_ Empty

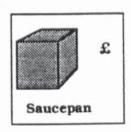




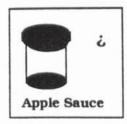
7. Box \_ Breakage



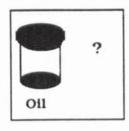
8. Box \_ Return



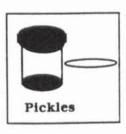
9. Box \_ Price

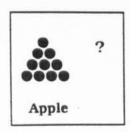


10. Jar \_ Dressing

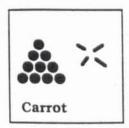


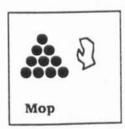
11. Jar \_ Misplaced 12. Jar \_ Spillage





Loose \_ Misplaced





14. Loose \_ Empty 15. Loose \_ Return

T/A/M Sub no. C	) /	1	L	/P
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## Introduction

Future supermarkets are likely to have reduced numbers of staff on the shop floor, putting the emphasis on a central control room. Sensors on the shop floor may be able to detect variations in the levels of stock on the shelves and any other problems such as breakages or unpriced goods. These sensors will then transmit the information to the control room and it will be the job of the control room staff to make decisions based on this information.

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You are required to read the message(s) and record the order in which they were presented.

Subject Data				
How old are you in years?	TTTC			3
110W old are you in years.	yıs		*	
Are you male or female? MAI	F / FEMA	AIF (ci	rcle as ann	ropriate)

10 Shrinkwrap Beef Price Empty	11 Box Saucepan Price Tin Tomato Empty	12 Packet Nuts Price Empty	13 Packet Crumpets Low Jar Pickles Spillage	14 Bag Sugar Low Spillage	15 Bag Flour Low 24 in Sausages Spillage	16 Shrinkwrap Pork 25 Box Chocolate Past Date Breakage	17Shrinkwrap Edam 26 Bag Bread Past Date Breakage	Wrapped Celery Past 27Bottle Sam Smiths
Jar Oil Misplaced			4 Wrapped Tomato Pa Dressing	5 Wrapped Sausages 14 Dressing	6 Jar Apple Sauce Dressing	7 Box Custard Return	8 Bottle Milk Return	

\*

# ORDER OF PRESENTATION

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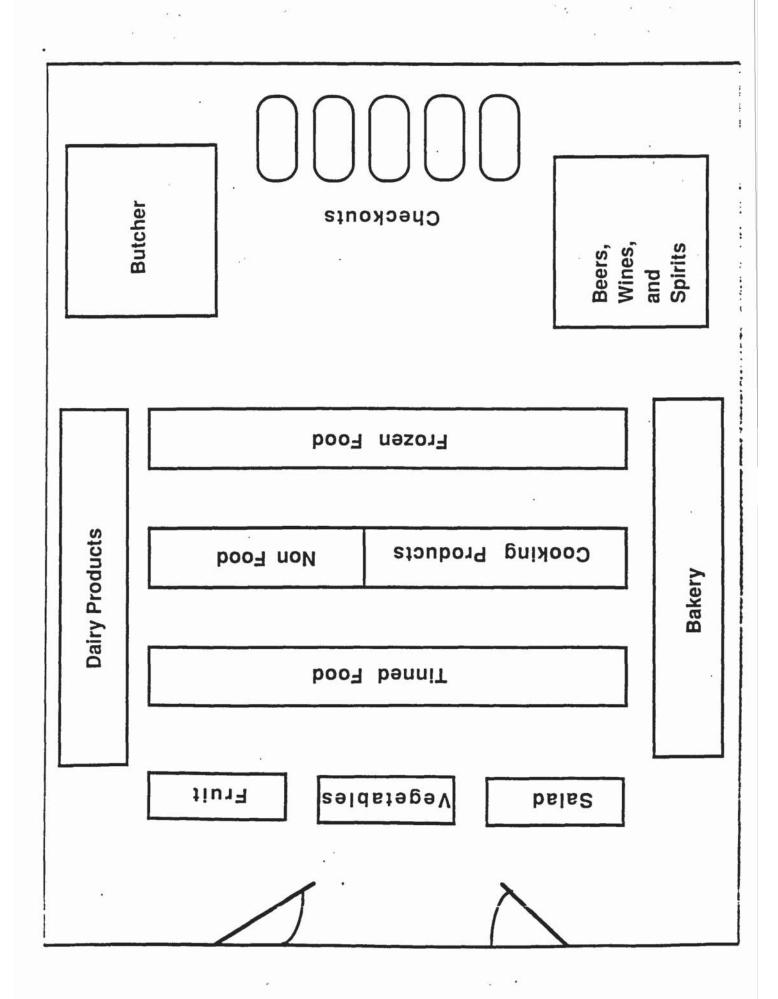
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Subject Data	*
How old are you in years? yrs	
Are you male or female? MALE / FEMALE (circle as appropria	ta)

						-	ž (100 m)	*1
19 Bottle Washing Liquid Empty	20 Tin Tomato Empty	21 Loose Carrot Empty	2.2 Jar Pickles Spillage	23 Packet Gateaux Spillage	<sup>2</sup> 4in Sausages Spillage	2.5 Box Chocolate Breakage	26 Bag Bread Breakage	<sup>27</sup> Bottle Sam Smiths Breakage
10 Shrinkwrap Beef Price	11 Box Saucepan Price	12 Packet Nuts Price	13 Packet Crumpets Low	14 Bag Sugar Low	15 Bag Flour Low	16 Shrinkwrap Pork Past Date	<sup>17</sup> Shrinkwrap Edam Past Date	18Wrapped Celery Past Date
1 Jar Oil Misplaced	2 Tin Corned Beef Misplaced	3 Loose Apple Misplaced	4 Wrapped Tomato Dressing	5 Wrapped Sausages Dressing	6 Jar Apple Sauce Dressing	7 Box Custard Return	8 Bottle Milk Return	9 Loose Mop Return



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Subject Data	
How old are you in years? yrs	
Are you male or female? MALE / FEMALE	(circle as appropriate)

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DF	2	
# Groups	3	
# Cases	18	
Н	12.424	p = .002
H corrected for ties	12.488	p = .0019
# tied groups	2	

		*	#1 0.7
Group:	# Cases:	Σ Rank:	Mean Rank:
Text	6	93	15.5
Annunciator	6	48.5	8.083
Mimic	6 .	29.5	4.917

	Number:	Σ Rank:		Mean Rank:
Text	6	57		9.5
imic		21		3.5
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			-2.882	p = .0039
	corrected for tie	es	-2.903	p = .0037
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Z	corrected for ties		-2.903	p = .0037	
-	tied groups		1		$\neg$

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	Number:	Σ Rank:		Mean Rank:	ri e
Annunciator	6	48.5		8.083	
Mimic		29.5		4.917	
U	l		8.5		٦
	l-prime		27.5		
			-1.521	p = .1282	
Z	corrected for ties		-1.524	p = .1275	
-	tied groups		1		

DF	2	
# Groups	3	
# Cases	18	
Н	11.605	p = .003
H corrected for ties	11.739	p = .0028
# tied groups	2	

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Group:	# Cases:	Σ Rank:	Mean Rank:
Text	6	43.5	7.25
Annunciator	6	34.5	5.75
Mimic	6	93	. 15.5

	Number:	Σ Rank:		Mean Rank:
Text	6	21		3.5
limic		57		9.5
Γ	J		0	
ī	J-prime		36	
2	!		-2.882	p = .0039
7	corrected for t	les	-2.934	p = .0033
- 13	tied groups		1	

	Number:	Σ Rank:		Mean Rank:
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Ū			0	
-	-prime		36	
Z	750. Taylor 10 (1997)		-2.882	p = .0039
Z	corrected for ties		-2.934	p = .0033
	tied groups		1	

	Mann-Whitney	U X 1 : S	patial Y	1 : %Correct	
	Number:	Σ Rank:		Mean Rank:	
Text	6	43.5		7.25	
nunciator	6	34.5		5.75	
U			13.5		
υ	l-prime		22.5		
Z	1 1		721	p = .4712	
Z	corrected for ties		722	p = .4704	
	tied groups		1		

5.F	12	
DF		
# Groups	3	
* Cases	18	
Н	7.693	p = .0214
H corrected for ties	7.939	p = .0189
* tied groups	5	

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Group:	# Cases:	Σ Rank:	Mean Rank:
Text	. 6	69.5	11.583
Annunciator	6	74	12.333
Mimic -	6	27.5	4.583

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	Number:	Σ Rank:		Mean Rank:
Text	6	52.5		8.75
Mimic		25.5		4.25
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υ	l-prime		31.5	
Z			-2.162	p = .0306
Z	corrected for ties		-2.209	p = .0272
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	Number:	Σ Rank:		Mean Rank:	
nnunciator	6	55		9.167	
Mimic	6	23		3.833	
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U	l-prime		34		]
Z			-2.562	p = .0104	1
Z	corrected for t	1es	-2.589	p = .0096	1
	tied groups		3		1

92				1 : %Correct	
Text	Number:	Σ Rank:		Mean Rank: 6.333	
nnunciator		40		6.667	
Г	]		17		٦
ī	J-prime		19		_
7			16	p = .8728	
7	corrected for ties		164	p = .8698	
-	tied groups		4		

# One Factor ANOVA X 1 : Temporal Y 1 : Time (secs)

#### Analysis of Variance Table

Source:	DF:	Sum Squares:	Mean Square:	F-test:
Between groups	2	881070.778	440535.389	14.743
Within groups	15	448199.667	29879.978	p = .0003
Total	17	1329270.444		

Model II estimate of between component variance = 68442.569

### One Factor ANOVA X 1 : Temporal Y 1 : Time (secs)

Group:	Count:	Mean:	Std. Dev.:	Std. Error:
Text	6	502.167	118.454	48.359
Annunciator	6	436.167	137.305	56.054
Mimic	6	935	238.235	97.259

### One Factor ANOVA X 1 : Temporal Y 1 : Time (secs)

Comparison:	Mean Diff.:	Fisher PLSD:	Scheffe F-test:	Dunnett t:
Text vs. Annunciator	66	212.718	.219	.661
Text vs. Mimic	-432.833	212.718*	9.405*	4.337
Annunciator vs. Mimic	-498.833	212.718*	12.492*	4.998

## One Factor ANOVA X 1 : Spatial Y 1 : Time (secs)

#### Analysis of Variance Table

Source:	DF:	Sum Squares:	Mean Square:	F-test:
Between groups	2	142832.333	71416.167	2.9
Within groups	15	369435.667	24629.044	p = .0862
Total	17	512268		

Model II estimate of between component variance = 7797.854

# One Factor ANOVA X 1 : Spatial Y 1 : Time (secs)

Group:	Count:	Mean:	Std. Dev.:	Std. Error:
Text	6	758.833	112.98	46.124
Annunciator	6	597	156.582	63.924
Mimic	6	551.167	191.323	78.107

# One Factor ANOVA X 1 : Spatial Y 1 : Time (secs)

Comparison:	Mean Diff.:	Fisher PLSD:	Scheffe F-test:	Dunnett t:
Text vs. Annunciator	161.833	193.125	1.595	1.786
Text vs. Mimic	207.667	193.125*	2.626	2.292
Annunciator vs. Mimic	45.833	193.125	.128	.506

# One Factor ANOVA X 1 : Pattern Y 1 : Time (secs)

#### Analysis of Variance Table

Source:	DF:	Sum Squares:	Mean Square:	F-test:
Between groups	2	281001	140500.5	9.662
Within groups	15	218115	14541	p = .002
Total	17	499116		

Model II estimate of between component variance = 20993.25

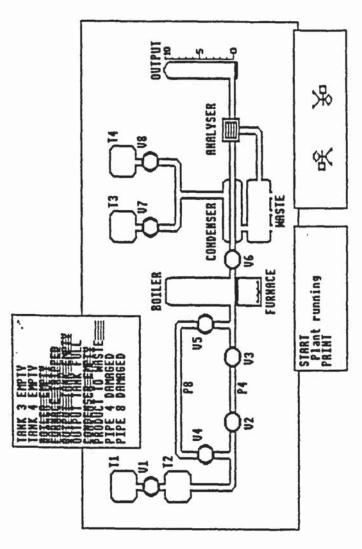
## One Factor ANOVA X 1 : Pattern Y 1 : Time (secs)

Group:	Count:	Mean:	Std. Dev.:	Std. Error:
Text	6	525.833	170.362	69.55
Annunciator	6	268.333	111.315	45.444
Mimic	6	253.833	46.995	19.186

### One Factor ANOVA X 1 : Pattern Y 1 : Time (secs)

Comparison:	Mean Diff.:	Fisher PLSD:	Scheffe F-test:	Dunnett t:
Text vs. Annunciator	257.5	148.392*	6.84*	3.699
Text vs. Mimic	272	148.392*	7.632*	3.907
Annunciator vs. Mimic	14.5	148.392	.022	.208

Alphanumeric Alarm System



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Annunciator Alarm System

Mimic Alarm System

# Instructions given to subjects before each experimental trial

#### Trial 1

I now want you to run the simulator again, but this time you will not be able to constantly see the process you are controlling. Instead you will be able to inspect individual plant components for a few seconds at a time by using the F5 to F11 keys:

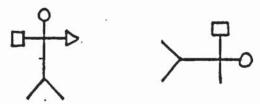
- F5 inspects tanks (press f5, then the number of the tank, then <return>)
- F6 inspects valves
- F7 inspects pipes
- F8 inspects the output level
- F9 inspects the level of fluid in the boiler
- F10 inspects the boiler temperature
- F11 inspects the furnace

However, to help you in controlling the plant you will be provided with an alarm system. Alarms will flash red to indicate the state of plant components, and you must accept the alarms by pressing the <space> bar. Apart from this, you should continue to run the simulator as before.

### Trial 2

I am now going to ask you to run the simulator one last time. It will use the same alarm system as before but this time you will be required to attend to a secondary task as well. You will be shown two figures in a box to the lower right of the screen. Your task is to determine as quickly and as accurately as possible whether the

two figures are the same, to make things more difficult they may be presented in different degrees of rotation. For example,

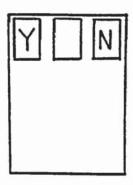


are different, and



are the same.

You respond by pressing the left-hand button of the mouse for YES, and the right-hand button for NO:



OUTPUT Example of plant schematic in operation, showing pipe RHALYSER CONDENSER break and the boiler temperature under inspection. 100 PM 10 FURRICE U BOILER W5 ST ST PRINT

# Total Output

# One Factor ANOVA X 1 : Conditions Y 1: Data

#### Analysis of Variance Table

Source:	DF:	Sum Squares:	Mean Square:	F-test:
Between groups	2	1414.5	707.2	3.3
Within groups	26	5604.9	215.6	p = .0536
Total	28	7019.4		

Model II estimate of between component variance = 50.9

# One Factor ANOVA X 1 : Conditions Y 1: Data

Group:	Count:	Mean:	Std. Dev.:	Std. Error:
mimic	9	91.1	12.4	4.1
text	10	93	10.5	3.3
annunctator	10	77.5	19.4	6.1

# . One Factor ANOVA X 1 : Conditions Y 1: Data

Comparison:	Mean Diff.:	Fisher PLSD:	Scheffe F-test:	Dunnett t:
mimic vs. text	-1.9	13.9	3.9E-2	.3
mimic vs. annunciator	13.6	13.9	2	2
text vs. annunciator	15.5	13:5*	2.8	2.4

#### Mean accept time

## One Factor ANOVA X 1 : Conditions Y 1 : Data

#### Analysis of Variance Table

Source:	DF:	Sum Squares:	Mean Square:	F-test:
Between groups	2	9665447.9	4832724	1.7
Within groups	22	62637403.1	2847154.7	p = .2063
Total	24	72302851		

Model II estimate of between component variance = 240967.1

### One Factor ANOVA X 1 : Conditions Y 1 : Data

Group:	Count:	Mean:	Std. Dev.:	Std. Error:
mimic	10	1495.8	1257.7	397.7
text	7	910	345.5	130.6
annunciator	8	2486.2	2610	922.8

Comparison:	Mean Diff.:	Fisher PLSD:	Scheffe F-test:	Dunnett t:
mimic vs. text	585.8	1724.5	.2	.7
mimic vs. annunciator	-990.4	1659.9	.8	1.2
text vs. annunctator	-1576.2	1811.1	1.6	1.8

## Mean diagnosis time

# One Factor ANOVA X 1 : Conditions Y 1 : Data

#### Analysis of Variance Table

Source:	DF:	Sum Squares:	Mean Square:	F-test:
Between groups	2	7368368.8	36841844	2.2
Within groups	26	43425767.9	1670221.8	p = .1304
Total	28	50794136.7		

Model II estimate of between component variance = 208589

# One Factor ANOVA X 1 : Conditions Y 1 : Data

Group:	Count:	Mean:	Std. Dev.:	Std. Error:
mimic	10	3055.7	1672.7	529
text	9	2202.9	1114.1	371.4
annunciator	10	1877.9	961.1	303.9

Comparison:	Mean Diff.:	Fisher PLSD:	Scheffe F-test:	Dunnett t:
mimic vs. text	852.8	1220.6	1	1.4
mimic vs. annunciator	1177.8	1188	2.1	2
text vs. annunciator	325	1220.6	.1	.5

# Mean recovery time

# One Factor ANOVA X 1 : Conditions Y 1: Data

#### Analysis of Variance Table

Source:	DF:	Sum Squares:	Mean Square:	F-test:
Between groups	2	10213318.8	5106659.4	1.9
Within groups	26	69895220.5	2688277.7	p = .1698
Total	28	80108539.3		

Model II estimate of between component variance = 250475.2

# One Factor ANOVA X 1 : Conditions Y 1 : Data

Group:	Count:	Mean:	Std. Dev.:	Std. Error:
mimic	10	4715.2	2101.9	664.7
text	9	3457.7	1526.7	508.9
annunciator	10	3474.9	1129.7	357.3

Comparison:	Mean Diff.:	Fisher PLSD:	Scheffe F-test:	Dunnett t:
mimic vs. text	1257.5	1548.5	1.4	1.7
mimic vs. annunciator	1240.3	1507.2	1.4	1.7
text vs. annunciator	-17.2	1548.5	2.6E-4	2.3E-2

## Pipe break accept times

### One Factor ANOVA X 1 : Conditions Y 1: Data

#### Analysis of Variance Table

Source:	DF:	Sum Squares:	Mean Square:	F-test:
Between groups	2	5947408.3	2973704.1	.9
Within groups	22	70766153.2	3216643.3	p = .4116
Total	24	76713561.4		

Model II estimate of between component variance = -29482.9

# One Factor ANOVA X 1 : Conditions Y 1 : Data

Group:	Count:	Mean:	Std. Dev.:	Std. Error:
mımic	10	1998.2	2089.6	660.8
text	7	2405.4	1057.1	399.6
annunciator	8	3149.6	1880.9	665

Comparison:	Mean Diff.:	Fisher PLSD:	Scheffe F-test:	Dunnett t:
mimic vs. text	-407.2	1833	.1	.5
mimic vs. annunciator	-1151.4	1764.3	.9	1.4
text vs. annunctator	-744.2	1925	.3	.8

## Pipe break diagnosis times

### One Factor ANOVA X 1 : Conditions Y 1: Data

### Analysis of Variance Table

Source:	DF:	Sum Squares:	Mean Square:	F-test:
Between groups	2	399384.5	199692.3	.3
Within groups	24	15232518.9	634688.3	p = .733
Total	26	15631903.4		

Model II estimate of between component variance = -48332.9

## One Factor ANOVA X 1 : Conditions Y 1: Data

Group:	Count:	Mean:	Std. Dev.:	Std. Error:
mimic	9	1062	1138.6	379.5
text	9	764.1	553.1	184.4
annunciator	9	916.3	549.2	183.1

Comparison:	Mean Diff.:	Fisher PLSD:	Scheffe F-test:	Dunnett t:
mimic vs. text	297.9	775.1	.3	.8 .
mimic vs. annunciator	145.7	775.1	.1	.4
text vs. annunctator	-152.2	775.1	.1	.4

# Total intercommands

DF	2	
* Groups	3	
# Cases	30	
Н	.3	p = .8696
H corrected for ties	.3	p = .8695
# tied groups	5	

Group:	# Cases:	Σ Rank:	Mean Rank:
mimic	10	160.5	16
text	10	161.5	16.1
annunciator	10	143	14.3

# One Factor ANOVA X 1 : Conditions Y 1: Data

#### Analysis of Variance Table

Source:	DF:	Sum Squares:	Mean Square:	F-test:
Between groups	2	1314139.1	657069.5	.9
Within groups	27	19791250.8	733009.3	p = .4198
Total	29	21105389.9		

Model II estimate of between component variance = -7594

# One Factor ANOVA X 1 : Conditions Y 1: Data

Group:	Count:	Mean:	Std. Dev.:	Std. Error:
mimic	10	674	276.4	87.4
text	10	1094.5	1271.1	401.9
annunciator	10	1138.2	712.1	225.2

Comparison:	Mean Diff.:	Fisher PLSD:	Scheffe F-test:	Dunnett t:
mimic vs. text	-420.5	785.6	.6	1.1
mimic vs. annunciator	-464.2	785.6	.7	1.2
text vs. annunctator	-43.7	785.6	6.5E-3	1.1

# Secondary task errors

DF	2	
# Groups	3	
# Cases	30	
Н	2.8	p = .245
H corrected for ties	2.8	p = .243
# tied groups	2.	WMS

Group:	# Cases:	Σ Rank:	Mean Rank:
mimic	10	124.5	12.4
text	10	150.5	15.1
annunciator	10	190	19