

Spoken Language Dialogue Systems

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Evaluation of Spoken Dialogues

User Test with a Simulated Speech Recogniser

Volume 3: Appendices in English

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CCS - Centre for Cognitive Science, Roskilde University

CST - Centre for Language Technology, Copenhagen

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Brief introduction

Appendices 8-16 contain different analyses of the transcriptions (cf. Appendix 7) from the user test of the Danish dialogue system.

Appendix 8 provides an overview of dialogue-related system problems and user errors found in the data material from the user test.

Appendix 9 shows for each dialogue expected and actual user input. Each deviation between expected and actual user input has been analysed in detail and used for the location of system problems and user errors of which Appendix 8 gives an overview.

Appendix 10 provides for each problem type and for each error type an overview of the scenarios in which instances of it occur.

In Appendix 11 all the problems found in Appendix 9 are divided according to their type and each concrete system problem and user error is analysed in detail.

Appendix 12 gives an overview of tasks and dialogues from the user test.

Appendix 13 presents transaction failures.

All system problems were measured against a set of co-operative principles which we had developed during design and implementation of the dialogue module of the Danish dialogue system. These principles are presented in Appendix 14 and it is indicated which of them were violated in the user test material.

All scenarios came in two versions (cf. Appendix 3): a text version and a graphic version. The impact of scenario versions on dialogues is investigated in Appendix 15.

Users are only allowed to initiate meta-communication through use of the keywords 'change' and 'repeat'. The system can initiate meta-communication either by telling that it did not understand what was said or by asking if the user is still around. The latter possibility is only used after a long pause from the user. Appendix 16 describes the amount of meta-communication and how it was initiated in the dialogues from the user test.

Appendix 8 Overview of problem type occurrences for each scenario

This appendix provides an overview of dialogue-related system problems and user errors found in the data material from the user test of the Danish dialogue system. Two different scenario types were used (graphic scenarios (G) and text scenarios (T), cf. Appendix 3) which is reflected in the data material below. In the tables below, U refers to user errors, and GP and SP to system problems. A GP or an SP in parenthesis after a U indicates that the user error was caused by a system problem. Scenarios which led to transaction failures are boldfaced.

(a) Graphic scenarios: system problems and user errors

GRAPHIC SCENARIOS	PROBLEMS
G-1-1-a	U1, U10 (SP4)
G-1-2-a	-
G-1-3-a	U3
G-1-4-a	GP1, GP1, GP1, GP1, GP1, SP5, SP10
G-2-1-a	-
G-2-2-a	GP5, GP5, U5, U7, U7
G-2-3-a	U5
G-2-4-a	SP8, SP11, U2
G-3-1-a-1	U1, U7
G-3-1-a-2	SP11, SP11
G-3-2-a	SP11, SP11, U10 (SP4)
G-3-3-a	GP1, GP1, U1, U1
G-3-4-a	U1, U1, U10 (SP4)
G-4-1-a	-
G-4-2-a	-
G-4-3-a	U1
G-4-4-a	SP8, U9, U10 (SP4)
G-5-1-a	U1
G-5-2-a	U1, U1
G-5-3-a	U4
G-5-4-a-1&2	SP5, U6
G-1-1-b	GP6
G-1-2-b	U2
G-1-3-b	GP3, GP3
G-1-4-b	-

(b) Text scenarios: system problems and user errors

TEXT SCENARIOS	PROBLEMS
T-1-1-a	-
T-1-2-a	U5
T-1-3-a	U1, U5 (GP1 + SP6), U8 (SP6), U8 (SP6)
T-1-4-a	SP8
T-2-1-a	SP2, U1, U10 (SP4), U10 (SP4)
T-2-2-a- α	U1, U4, U4, U10 (SP4), U10 (SP4)
T-2-2-a- β	U10 (SP4)
T-2-3-a	U10 (SP4)
T-2-4-a	U10 (SP4)
T-3-1-a-1	U6, U6, U6 (GP1)
T-3-1-a-2	U3, U3, U4, U10 (SP4)
T-3-2-a	GP1, GP1, SP10, SP10, U2, U4, U6, U10 (SP4)
T-3-3-a	U1
T-3-4-a	SP8, U3
T-4-1-a	U10 (SP4), U10 (SP4), U10 (SP4), U10 (SP4), U10 (SP4), U10 (SP4)
T-4-2-a	U10 (SP4), U10 (SP4)
T-4-3-a	U10 (SP4), U10 (SP4), U10 (SP4)
T-4-4-a	GP1, U10 (SP4), U10 (SP4)
T-5-1-a- α	GP1, GP1, GP1, GP1, GP1, SP2, SP10, SP10, U4, U4, U4, U4, U4, U4, U4, U6
T-5-1-a- β	U10 (SP4)
T-5-2-a	GP7, GP7, U1, U6
T-5-3-a- α	GP6, GP6, GP6, GP6, U6, U6
T-5-3-a- β	GP6, U4
T-5-3-a- γ	GP6
T-5-4-a-1&2	U6, U10 (SP4), U10 (SP4)
T-1-1-b- α	U4, U6 (GP1)
T-1-1-b- β	-
T-1-2-b- α	U2, U4, U4 (GP1), U10 (SP4)
T-1-2-b- β	U4
T-1-3-b	U3, U6, U10 (SP4), U10 (SP4)
T-1-4-b- α	U6, U6, U10 (SP4)
T-1-4-b- β	-

Appendix 9 Expected and actual user answers to each scenario: locating problems

This appendix shows, for each dialogue, key contents of the expected and the actual user input. Each deviation between expected and actual user input has been analysed in detail and used for the location of the problems and errors of which Appendix 8 gives an overview.

The meta-communication keywords 'change' and 'repeat' may be used anywhere during a dialogue but are for brevity left out from the column indicating normative user answers. α and β are used to indicate that a scenario is repeated. Comments are in brackets whereas key contents of system output are in parentheses in the column containing actual user answers.

In the problem column below, U refers to user errors, and GP and SP to system problems. A GP or an SP in parenthesis after a U means that the user error was caused by a system problem. Scenarios which led to transaction failures are marked as 'failed'.

Scenario: G-1-1-a User: 2 Date: January 13 1995			
System questions	Normative user answers	Actual user answers	Problems
System already known	no / yes	no	
Customer number	4	4	
Number of travellers	2	2	
ID-numbers	4, 2	4, 2	
Departure airport	Copenhagen	Copenhagen	
Arrival airport	Karup	Karup	
Return journey	no	no	
Interested in discount	-	-	
Day of departure (out)	January 13 / any day in January after January 12	a Friday (January 13) change January 6 (before today) January 13	U1
Hour of departure (out)	before noon	about 10:45 (not understood) 10:45 (no departure) yes [wants one from list] 9:10	U10 (SP4)
Day of departure (home)	-	-	
Hour of departure (home)	-	-	
Delivery	airport [< 3 days]	-	
More	no / yes	no	

Scenario: G-1-2-a User: 2 Date: January 13 1995			
System questions	Normative user answers	Actual user answers	Problems
System already known	no / yes / -	yes	
Customer number	3	3	
Number of travellers	1	1	
ID-numbers	1	1	
Departure airport	Aalborg	Aalborg	
Arrival airport	Copenhagen	Copenhagen	
Return journey	yes	yes	
Interested in discount	yes [red]	yes	
Day of departure (out)	February 1	February 1	
Hour of departure (out)	around 11:00 / around 13:00	13 o'clock (no departure) yes [wants one from list] 12:20	
Day of departure (home)	February 3	February 3	
Hour of departure (home)	around 19:00 / around 18:00	18 o'clock (no departure) yes [wants one from list] 19:45	
Delivery	airport	airport	
More	no / yes	no	

Scenario: G-1-3-a User: 2 Date: January 13 1995			
System questions	Normative user answers	Actual user answers	Problems
System already known	no / yes / -	yes	
Customer number	4	4	
Number of travellers	4	4	
ID-numbers	1, 4, 3, 2	1, 4, 3, 2	
Departure airport	Copenhagen	Saturday (not understood) Copenhagen	
Arrival airport	Sønderborg	Sønderborg	
Return journey	yes	yes	
Interested in discount	yes (green)	yes	
Day of departure (out)	January 14 (all flights fully booked) [probably] January 13	Saturday (January 14, all flights fully booked) Friday (January 13)	U3
Hour of departure (out)	around 9:00 [according to scenario but not possible since flights on Saturday fully booked] [probably] evening	18 o'clock (no departure) 22:15	
Day of departure (home)	January 15	Sunday (January 15)	

Hour of departure (home)	around 16:00	15:30 (no departure) yes [wants one from list] 17:00	
Delivery	airport [< 3 days]	-	
More	no / yes	no	

Scenario: G-1-4-a User: 2 Date: January 13 1995			
System questions	Normative user answers	Actual user answers	Problems
System already known	no / yes / -	yes	
Customer number	3	3	
Number of travellers	1	1	
ID-numbers	2	2	
Departure airport	Aalborg	Aalborg	
Arrival airport	Copenhagen	Copenhagen	
Return journey	yes	yes	
Interested in discount	no / yes	yes	
Day of departure (out)	January 16	Monday (January 16)	
Hour of departure (out)	7:20	7:20 (no departure) 7:20 (no departure) no, change [does not want one from list; change not caught by system] 7:20 (no departure) no [does not want one from list] 7:20 (no departure) no [does not want one from list] change [hour of departure] yes [out-day is January 16] 7:20 (no departure) change [hour of departure] change [day of departure] no [does not want discount] yes [out-day is January 16] yes [hour of departure is 7:20]	GP1, SP10 GP1 GP1 GP1 SP5 GP1
Day of departure (home)	January 16	Same day (January 16)	
Hour of departure (home)	17:45	17:45	
Delivery	airport / send	airport	
More	no	no	

Scenario: G-2-1-a User: 4 Date: January 16 1995			
System questions	Normative user answers	Actual user answers	Problems
System already known	no / yes	yes	
Customer number	4	4	
Number of travellers	1	1	
ID-numbers	2	2	
Departure airport	Copenhagen	Copenhagen	
Arrival airport	Rønne	Rønne	
Return journey	no	no	
Interested in discount	-	-	
Day of departure (out)	January 23	Monday January 23 1995	
Hour of departure (out)	10:10 [no departure] 10:15	10:10 (no departure) yes 10:15	
Day of departure (home)	-	-	
Hour of departure (home)	-	-	
Delivery	airport / send	send	
More	no / yes	yes	

Scenario: G-2-2-a User: 4 Date: January 16 1995 FAILED			
System questions	Normative user answers	Actual user answers	Problems
System already known	no / yes / -	-	
Customer number	4	yes [4]	
Number of travellers	3	3	
ID-numbers	1, 2, 3	1, 2, 3	
Departure airport	Copenhagen	Copenhagen	
Arrival airport	Aalborg	Aalborg	
Return journey	yes	yes	
Interested in discount	yes	yes	
Day of departure (out)	January 23	January 23 [misunderstood] January 23 [misunderstood] January 16	GP5 GP5 U7
Hour of departure (out)	no preferences	does not matter (not understood) around noon (sold out) afternoon (sold out) evening yes 19:45	U5
Day of departure (home)	January 27	January 20	U7
Hour of departure (home)	no preferences	afternoon yes [12:20]	
Delivery	airport / send	- [< 3 days]	

More	no / yes	yes	
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Scenario: G-2-3-a User: 4 Date: January 16 1995			
System questions	Normative user answers	Actual user answers	Problems
System already known	no / yes / -	-	
Customer number	4	yes (4)	
Number of travellers	4	4	
ID-numbers	1, 4, 6, 7	1, 4, 6, 7	
Departure airport	Copenhagen	Copenhagen	
Arrival airport	Aarhus	Aarhus	
Return journey	yes	yes	
Interested in discount	yes	yes	
Day of departure (out)	January 21	Saturday January 21	
Hour of departure (out)	between 7:00 and 9:00	between 7:00 and 9:00 (sold out between 9:00 and 12:00 yes 9:20	U5
Day of departure (home)	January 22	Sunday January 22	
Hour of departure (home)	between 20:30 and 23:00	between 20:30 and 23:00 (20:30 recognised)	
Delivery	airport / send	send	
More	no / yes	yes	

Scenario: G-2-4-a User: 4 Date: January 16 1995 FAILED			
System questions	Normative user answers	Actual user answers	Problems
System already known	no / yes / -	-	
Customer number	4	yes (4)	
Number of travellers	4	4	
ID-numbers	1, 4, 6, 7	1, 4, 6, 7	
Departure airport	Copenhagen	Copenhagen	
Arrival airport	Aarhus	Aarhus	
Return journey	yes	yes	
Interested in discount	no	no	
Day of departure (out)	January 26	Thursday January 26	
Hour of departure (out)	around 7:30	around 7:30 (understood as 19:30)	SP11, U2
Day of departure (home)	January 26	Thursday January 26	

Hour of departure (home)	around 17:00	17:20 (home journey may not be before out journey) 21 (not understood) 9 o'clock (home journey may not be before out journey) 21:00 (no departure) yes 22:30	SP8
Delivery	airport / send	send	
More	no	no	

Scenario: G-3-1-a-1 User: 7 Date: January 19 1995			
System questions	Normative user answers	Actual user answers	Problems
System already known	no / yes	no	
Customer number	2	2	
Number of travellers	1	1	
ID-numbers	3	3	
Departure airport	Copenhagen	Copenhagen	
Arrival airport	Aarhus	Aarhus	
Return journey	no	no	
Interested in discount	-	-	
Day of departure (out)	January 20	January 19	U1
Hour of departure (out)	around 8:00	8:30 at the latest [understood as 8:30] yes [wants one from list] 8:15	U7
Day of departure (home)	-	-	
Hour of departure (home)	-	-	
Delivery	airport (< 3 days)	-	
More	yes	yes change yes [8:15 is correct] yes [more]	

Scenario: G-3-1-a-2 User: 7 Date: January 19 1995 FAILED			
System questions	Normative user answers	Actual user answers	Problems
System already known	-	-	
Customer number	2	yes [2]	
Number of travellers	2	2	
ID-numbers	1, 4	1, 4	
Departure airport	Copenhagen	Copenhagen	
Arrival airport	Aalborg	Aalborg	
Return journey	yes	yes	
Interested in discount	no	no	
Day of departure (out)	January 23	January 23	
Hour of departure (out)	around 7:30	7:45 [understood as 19:45] change no [19:45 is not correct] 7:45 [understood as 19:45] user hangs up	SP11 SP11
Day of departure (home)	January 23		
Hour of departure (home)	around 17:00		
Delivery	send		

More	no / yes		
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Scenario: G-3-2-a User: 7 Date: January 19 1995			
System questions	Normative user answers	Actual user answers	Problems
System already known	no / yes / -	yes	
Customer number	3	3	
Number of travellers	3	3	
ID-numbers	6, 3, 4	6, 3, 4	
Departure airport	Aalborg	Aalborg	
Arrival airport	Copenhagen	Copenhagen	
Return journey	yes	yes	
Interested in discount	no / yes	no	
Day of departure (out)	February 4	February 4	
Hour of departure (out)	around 7:15	around 7 o'clock [understood as 19:00] change no [19:00 is not correct] 7:15 yes [7:20]	SP11
Day of departure (home)	February 5	February 5	
Hour of departure (home)	around 22:30	around 22 o'clock (not understood) around 22 (not understood) 22 (not understood) 10 o'clock (no departure) no [does not want one from list] late (not understood) 21 o'clock (no departure) yes [wants one from list] 22:40	SP11 U10 (SP4)
Delivery	airport / send	send	
More	no / yes	no	

Scenario: G-3-3-a User: 7 Date: January 19 1995			
System questions	Normative user answers	Actual user answers	Problems
System already known	no / yes / -	yes	
Customer number	2	2	
Number of travellers	2	2	
ID-numbers	2, 1	2, 1	
Departure airport	Copenhagen	Copenhagen	
Arrival airport	Aalborg	Aalborg	
Return journey	yes	yes	
Interested in discount	no / yes	yes	
Day of departure (out)	February 9	February 16	U1
Hour of departure (out)	[probably] evening	21 o'clock (no departure) yes [wants one from list] repeat [does not repeat list] repeat [does not repeat list] 21:30 (no departure) yes [wants one from list] 22:40	GP1 GP1
Day of departure (home)	February 12	February 19	U1
Hour of departure (home)	[probably] before noon	8 o'clock (no departure) yes [wants one from list] 10:10	
Delivery	airport / send	send	
More	no / yes	yes	

Scenario: G-3-4-a User: 7 Date: January 19 1995			
System questions	Normative user answers	Actual user answers	Problems
System already known	no / yes / -	-	
Customer number	3	no [not 2] 3	
Number of travellers	2	2	
ID-numbers	5, 4	5, 4	
Departure airport	Aalborg	Aalborg	
Arrival airport	Copenhagen	Copenhagen	
Return journey	yes	yes	
Interested in discount	no	no	
Day of departure (out)	January 24	January 26	U1
Hour of departure (out)	around 8:00	8 o'clock (no departure) yes [wants one from list] 7:50	
Day of departure (home)	January 24	same day (January 26)	U1

Hour of departure (home)	around 18:30	18 o'clock (no departure) yes [wants one from list] 17:45	U10 (SP4)
Delivery	airport / send	send	
More	no	no	

Scenario: G-4-1-a User: 9 Date: January 19 1995			
System questions	Normative user answers	Actual user answers	Problems
System already known	no / yes	no	
Customer number	4	4	
Number of travellers	2	2	
ID-numbers	2, 5	2, 5	
Departure airport	Copenhagen	Copenhagen	
Arrival airport	Billund	Billund	
Return journey	yes	yes	
Interested in discount	no	no	
Day of departure (out)	January 31	January 31	
Hour of departure (out)	[probably] morning	8 o'clock	
Day of departure (home)	January 31	January 31	
Hour of departure (home)	[probably] evening	18:10	
Delivery	airport / send	send	
More	no / yes	yes	

Scenario: G-4-2-a User: 9 Date: January 19 1995			
System questions	Normative user answers	Actual user answers	Problems
System already known	no / yes / -	-	
Customer number	4	yes (4)	
Number of travellers	2	2	
ID-numbers	1, 4	1, 4	
Departure airport	Copenhagen	Copenhagen	
Arrival airport	Esbjerg	Esbjerg	
Return journey	yes	yes	
Interested in discount	yes	yes	
Day of departure (out)	January 28 / January 29	January 29	
Hour of departure (out)	around 11:30	11 o'clock (no departure) yes [11:15]	
Day of departure (home)	January 29	January 29	
Hour of departure (home)	around 18:00	18:30	
Delivery	airport / send	send	
More	no / yes	yes	

Scenario: G-4-3-a User: 9 Date: January 19 1995			
System questions	Normative user answers	Actual user answers	Problems
System already known	no / yes / -	-	
Customer number	4	yes [4]	
Number of travellers	2	2	
ID-numbers	4, 2	4, 2	
Departure airport	Copenhagen	Copenhagen	
Arrival airport	Odense	Odense (not understood) Odense	
Return journey	yes	yes	
Interested in discount	yes	no	U1
Day of departure (out)	January 25	January 25	
Hour of departure (out)	between 11:00 and 15:00	11 o'clock	
Day of departure (home)	January 28	January 28	
Hour of departure (home)	between 11:00 and 15:00	14 o'clock (no departure) yes [11:55]	
Delivery	airport / send	send	
More	no / yes	yes	

Scenario: G-4-4-a User: 9 Date: January 19 1995			
System questions	Normative user answers	Actual user answers	Problems
System already known	no / yes / -	-	
Customer number	2	no [4] 2	
Number of travellers	1	1	
ID-numbers	4	4	
Departure airport	Copenhagen	Copenhagen	
Arrival airport	Aalborg	Aalborg	
Return journey	no	no	
Interested in discount	-	-	
Day of departure (out)	January 26	January 26	
Hour of departure (out)	6:45	6:45	
Day of departure (home)	-	-	
Hour of departure (home)	-	-	
Delivery	airport	do not send [understood as send] change no [the ticket should not be sent] airport	U9, U10 (SP4) SP8
More	no	no	

Scenario: G-5-1-a User: 10 Date: January 25 1995			
System questions	Normative user answers	Actual user answers	Problems
System already known	no / yes	yes	
Customer number	4	4	
Number of travellers	3	3	
ID-numbers	4, 1, 2	4, 1, 2	
Departure airport	Copenhagen	Copenhagen	
Arrival airport	Aalborg	Aalborg	
Return journey	yes	no	U1
Interested in discount	yes / no	-	
Day of departure (out)	January 27	January 27	
Hour of departure (out)	between 7:00 and 8:00	7:30	
Day of departure (home)	January 27	-	
Hour of departure (home)	between 16:30 and 19:30	-	
Delivery	airport [< 3 days]	-	
More	no / yes	no	

Scenario: G-5-2-a User: 10 Date: January 25 1995			
System questions	Normative user answers	Actual user answers	Problems
System already known	no / yes / -	yes	
Customer number	4	4	
Number of travellers	3	3	
ID-numbers	1, 4, 3	1, 4, 3	
Departure airport	Copenhagen	Copenhagen	
Arrival airport	Esbjerg	Esbjerg	
Return journey	yes	yes	
Interested in discount	yes	yes	
Day of departure (out)	February 4	Saturday (January 28)	U1
Hour of departure (out)	around 11:30	11:15	
Day of departure (home)	February 5	Sunday (January 29)	U1
Hour of departure (home)	around 18:00 / any time	does not matter (not understood) not decided [system provides list] yes [wants one from list] 12:20	
Delivery	airport / send	send	
More	no / yes	yes	

Scenario: G-5-3-a User: 10 Date: January 25 1995			
System questions	Normative user answers	Actual user answers	Problems
System already known	no / yes / -	-	
Customer number	2	no (4) 2	
Number of travellers	1	1	
ID-numbers	1	1	
Departure airport	Copenhagen	Copenhagen	
Arrival airport	Vojens	Vojens	
Return journey	yes	yes	
Interested in discount	no / yes	no	
Day of departure (out)	February 11 (February 10)	Saturday in week number 6 [February 11, understood as January 28] wrong [understood as 'change'] no [day of departure is not January 28] February 11	U4
Hour of departure (out)	around 10:00 (not possible)	17:00	
Day of departure (home)	February 12	Sunday (February 12)	
Hour of departure (home)	around 18:00	18:00	
Delivery	airport / send	send	
More	no / yes	yes	

Scenario: G-5-4-a-1 User: 10 Date: January 25 1995 FAILED			
System questions	Normative user answers	Actual user answers	Problems
System already known	no / yes / -	-	
Customer number	2	yes (2)	
Number of travellers	1	1	
ID-numbers	4	4	
Departure airport	Copenhagen	Copenhagen	
Arrival airport	Karup	Karup	
Return journey	no	yes	SP5
Interested in discount	-	no	
Day of departure (out)	January 31	January 31	
Hour of departure (out)	around 7:30 / around 19:30	16:50	
Day of departure (home)	-	February 1	

Hour of departure (home)	-	18:10 (no departure) no [does not want one from list] 15:45 from Esbjerg [no departure from Karup] yes [wants one from list] 16:20	U6
Delivery	airport / send	send	
More	yes	no	

Scenario: G-5-4-a-2 User: 10 Date: January 25 1995 FAILED			
System questions	Normative user answers	Actual user answers	Problems
System already known	-		
Customer number	2		
Number of travellers	1		
ID-numbers	4		
Departure airport	Esbjerg		
Arrival airport	Copenhagen		
Return journey	no		
Interested in discount	-		
Day of departure (out)	February 1		
Hour of departure (out)	around 18:00		
Day of departure (home)	-		
Hour of departure (home)	-		
Delivery	airport / send		
More	no		

Scenario: G-1-1-b User: 12 Date: January 25 1995			
System questions	Normative user answers	Actual user answers	Problems
System already known	no / yes	no	
Customer number	4	4	
Number of travellers	2	1 adult and 1 child [understood as 1] change no 2	
ID-numbers	4, 2	4, 2	
Departure airport	Copenhagen	Copenhagen	
Arrival airport	Karup	Karup	
Return journey	no	no	
Interested in discount	-	-	
Day of departure (out)	January 27	January 27	
Hour of departure (out)	before noon	before noon yes [9:10]	GP6
Day of departure (home)	-	-	
Hour of departure (home)	-	-	
Delivery	airport [< 3 days]	-	
More	no / yes	yes	

Scenario: G-1-2-b User: 12 Date: January 25 1995			
System questions	Normative user answers	Actual user answers	Problems
System already known	no / yes / -	-	
Customer number	3	yes [4] change no [not 4] 3	U2
Number of travellers	1	1	
ID-numbers	1	1	
Departure airport	Aalborg	Aalborg	
Arrival airport	Copenhagen	Copenhagen	
Return journey	yes	yes	
Interested in discount	yes (red)	yes	
Day of departure (out)	February 1	Wednesday February 1	
Hour of departure (out)	around 11:00	before noon yes [10:50]	
Day of departure (home)	February 3	Friday February 3	
Hour of departure (home)	around 19:00	after 19 (not understood) evening 19:45	
Delivery	airport	airport	
More	no / yes	yes	

Scenario: G-1-3-b User: 12 Date: January 25 1995			
System questions	Normative user answers	Actual user answers	Problems
System already known	no / yes / -	yes	
Customer number	4	no [not 3] 4	
Number of travellers	4	4	
ID-numbers	1, 4, 3, 2	1, 4, 3, 2	
Departure airport	Copenhagen	Copenhagen	
Arrival airport	Sønderborg	Sønderborg	
Return journey	yes	yes	
Interested in discount	yes [green]	yes	
Day of departure (out)	January 28	Saturday January 28	
Hour of departure (out)	around 9:00	morning (sold out) morning (sold out) 9:15	GP3 GP3
Day of departure (home)	January 29	Sunday January 29	
Hour of departure (home)	around 16:00	afternoon yes [17:00]	

Delivery	airport / send	send	
More	no / yes	yes	

Scenario: G-1-4-b User: 12 Date: January 25 1995			
System questions	Normative user answers	Actual user answers	Problems
System already known	no / yes / -	-	
Customer number	3	no [not 4] 3	
Number of travellers	1	1	
ID-numbers	2	2	
Departure airport	Aalborg	Aalborg	
Arrival airport	Copenhagen	Copenhagen	
Return journey	yes	yes	
Interested in discount	no	no	
Day of departure (out)	January 26	Thursday January 26	
Hour of departure (out)	7:20	7:20	
Day of departure (home)	January 26	Thursday January 26	
Hour of departure (home)	17:45	17:45	
Delivery	airport [< 3 days]	-	
More	no	no	

Scenario: T-1-1-a User: 3 Date: January 13 1995			
System questions	Normative user answers	Actual user answers	Problems
System already known	no / yes	no	
Customer number	4	4	
Number of travellers	2	2	
ID-numbers	4, 2	4, 2	
Departure airport	Copenhagen	Copenhagen	
Arrival airport	Karup	Karup	
Return journey	no	no	
Interested in discount	-	-	
Day of departure (out)	January 13	today (January 13)	
Hour of departure (out)	11:50	11:50	
Day of departure (home)	-	-	
Hour of departure (home)	-	-	
Delivery	airport [< 3 days]	-	
More	no / yes	no	

Scenario: T-1-2-a User: 3 Date: January 13 1995			
System questions	Normative user answers	Actual user answers	Problems
System already known	no / yes / -	yes	
Customer number	3	3	
Number of travellers	1	1	
ID-numbers	1	1	
Departure airport	Aalborg	Aalborg	
Arrival airport	Copenhagen	Copenhagen	
Return journey	yes	yes	
Interested in discount	yes	yes	
Day of departure (out)	February 1	Wednesday February 1	
Hour of departure (out)	10:50	10 minutes to 11	
Day of departure (home)	February 3	Friday February 3	
Hour of departure (home)	19:45	which possibilities (not understood) a quarter to 8 (19:45)	U5
Delivery	airport	airport	
More	no / yes	no	

Scenario: T-1-3-a User: 3 Date: January 13 1995			
System questions	Normative user answers	Actual user answers	Problems
System already known	no / yes / -	yes	
Customer number	4	4	
Number of travellers	4	2 adults and 2 children (2 persons) change [number of persons] no [not 2 persons] 4	
ID-numbers	1, 4, 3, 2	1, 4, 3, 2	
Departure airport	Copenhagen	Copenhagen	
Arrival airport	Sønderborg	Sønderborg	
Return journey	yes	no	U1
Interested in discount	yes	-	
Day of departure (out)	January 14 [all flights fully booked] [probably] January 13	Saturday [January 14] (not understood) Saturday (January 14, all flights fully booked) Friday (January 13)	

Hour of departure (out)	9:15 [according to scenario but not possible since flights on Saturday fully booked] [probably] evening	cheap (not understood) cheap (not understood) 9:15 (no departure) yes [wants one from list] 11:15	U8 (SP6) U8 (SP6)
Day of departure (home)	January 15	-	
Hour of departure (home)	17:00	-	
Delivery	airport [< 3 days]	-	
More	no / yes	have I got discount [understood as 'change'] yes [hour of departure is 11:15]	U5 (GP1 & SP6)

Scenario: T-1-4-a User: 3 Date: January 13 1995			
System questions	Normative user answers	Actual user answers	Problems
System already known	no / yes / -	yes	
Customer number	3	3	
Number of travellers	1	1	
ID-numbers	2	2	
Departure airport	Aalborg	Aalborg	
Arrival airport	Copenhagen	Copenhagen	
Return journey	yes	yes	
Interested in discount	no	no	
Day of departure (out)	January 16	Monday (January 16)	
Hour of departure (out)	7:15 [no departure] 7:20	a quarter past 7 (7:15, no departure) yes (7:20)	
Day of departure (home)	January 16	Same day (January 16)	
Hour of departure (home)	17:45	a quarter to 6 [6:45] (home journey may not be before out journey) 17:45	SP8
Delivery	airport / send	send	
More	no	no	

Scenario: T-2-1-a User: 5 Date: January 16 1995 FAILED			
System questions	Normative user answers	Actual user answers	Problems
System already known	no / yes	no	
Customer number	4	4	
Number of travellers	1	1	
ID-numbers	2	2	
Departure airport	Copenhagen	Copenhagen	
Arrival airport	Rønne	Rønne	
Return journey	no	no [understood as yes]	SP2, U10 (SP4)
Interested in discount	-	yes	
Day of departure (out)	January 23	January 23	
Hour of departure (out)	10:15	10:15	
Day of departure (home)	-	January 30	U1

Hour of departure (home)	-	about the same time [understood as 11:00] yes 9:05 [understood as 10:05] yes 9:05 [understood as 10:05] yes 11:10	U10 (SP4)
Delivery	airport / send	airport	
More	no / yes	yes	

Scenario: T-2-2-a- α User: 5 Date: January 16 1995			
System questions	Normative user answers	Actual user answers	Problems
System already known	no / yes / -	-	
Customer number	4	no 4	
Number of travellers	3	3	
ID-numbers	1, 2, 3	1, 2, 3	
Departure airport	Copenhagen	Copenhagen	
Arrival airport	Aalborg	Aalborg	U10 (SP4)
Return journey	yes	yes	
Interested in discount	yes	no	U1
Day of departure (out)	January 23	January 23	
Hour of departure (out)	9:40 / 11:10	9:40 or 11:10 (11:10 sold out) yes 9:40 [understood as 22:40]	
Day of departure (home)	January 27	no 9:40 [attempt to change hour of departure but understood as February 4]	U4
Hour of departure (home)	19:00 / 22:15	no January 27 [attempt to change home day but understood as 15:25] yes 19:00	U4 U10 (SP4)
Delivery	airport / send	airport	
More	no / yes	yes	

Scenario: T-2-2-a- β User: 5 Date: January 16 1995			
System questions	Normative user answers	Actual user answers	Problems
System already known	no / yes / -	-	
Customer number	4	yes [4]	
Number of travellers	3	3	
ID-numbers	1, 2, 3	1, 2, 3	
Departure airport	Copenhagen	Copenhagen	
Arrival airport	Aalborg	Aalborg	
Return journey	yes	yes	
Interested in discount	yes	yes	
Day of departure (out)	January 23	Monday January 23	
Hour of departure (out)	9:40 / 11:10	9:40 or 11:10 (11:10 sold out) yes [wants one from list] 6:45	
Day of departure (home)	January 27	Friday January 27	

Hour of departure (home)	19:00 / 22:15	19:00 or 22:15 [understood as 20:15] yes 19:00 [understood as 14:30] yes 19:00	U10 (SP4)
Delivery	airport / send	airport	
More	no / yes	yes	

Scenario: T-2-3-a User: 5 Date: January 16 1995			
System questions	Normative user answers	Actual user answers	Problems
System already known	no / yes / -	-	
Customer number	4	yes [4]	
Number of travellers	4	4	
ID-numbers	1, 4, 6, 7	1, 4, 6, 7	
Departure airport	Copenhagen	Copenhagen	
Arrival airport	Aarhus	Aarhus	
Return journey	yes	yes	
Interested in discount	yes	yes	
Day of departure (out)	January 21 (or 20) or January 28 (or 27)	Friday January 27	
Hour of departure (out)	9:20	9:20 (no departure) yes [10:55]	
Day of departure (home)	January 22 or January 29	January 29	
Hour of departure (home)	22:30	22:30	U10 (SP4)
Delivery	airport / send	[system broke down before this point was reached]	
More	no / yes	-	

Scenario: T-2-4-a User: 5 Date: January 16 1995			
System questions	Normative user answers	Actual user answers	Problems
System already known	no / yes / -	no	
Customer number	4	4	
Number of travellers	4	4	
ID-numbers	1, 4, 6, 7	1, 4, 6, 7	
Departure airport	Copenhagen	Copenhagen	
Arrival airport	Aarhus	Aarhus	
Return journey	yes	yes	
Interested in discount	no	no	
Day of departure (out)	January 26	January 26	
Hour of departure (out)	7:20	7:20	
Day of departure (home)	January 26	January 26	
Hour of departure (home)	17:30	17:30	U10 (SP4)
Delivery	airport / send	airport	
More	no	no	

Scenario: T-3-1-a-1 User: 6 Date: January 16 1995			
System questions	Normative user answers	Actual user answers	Problems
System already known	no / yes	yes	
Customer number	2	2	
Number of travellers	1	1	
ID-numbers	3	3	
Departure airport	Copenhagen	Copenhagen	
Arrival airport	Aarhus	Aarhus	
Return journey	no	no	
Interested in discount	-	-	
Day of departure (out)	January 20	Friday [January 20] at 8:15 [misunderstood] Friday [January 20] at 8:15 [misunderstood] January 20	U6 U6
Hour of departure (out)	8:15	8:15	
Day of departure (home)	-	-	
Hour of departure (home)	-	-	
Delivery	airport / send	send	
More	yes	yes two people to Aalborg on Monday January 23 in the morning	U6 (GP1)

Scenario: T-3-1-a-2 User: 6 Date: January 16 1995 FAILED			
System questions	Normative user answers	Actual user answers	Problems
System already known	-	-	
Customer number	2	no [not 2] id-numbers 1 and 4 [understood as 4]	U3, U4, U10 (SP4)
Number of travellers	2	2	
ID-numbers	1, 4	1, 4	
Departure airport	Copenhagen	Copenhagen	
Arrival airport	Aalborg	Aalborg	
Return journey	yes	no send the tickets [understood as yes]	U3
Interested in discount	no	no	
Day of departure (out)	January 23	January 23	
Hour of departure (out)	6:45 / 7:30	6:45 or 7:30 [understood as 7:30]	
Day of departure (home)	January 23	January 23	
Hour of departure (home)	17:20 / 19:00	17:20 or 19:00 [understood as 17:20]	

Delivery	send	send	
More	no / yes	yes	

Scenario: T-3-2-a User: 6 Date: January 16 1995		FAILED	
System questions	Normative user answers	Actual user answers	Problems
System already known	no / yes / -	-	
Customer number	3	no [not 4] 3 [understood as 10] 3	U10 (SP4)
Number of travellers	3	3	
ID-numbers	6, 3, 4	6, 3, 4	
Departure airport	Aalborg	Aalborg	
Arrival airport	Copenhagen	Copenhagen	
Return journey	yes	yes	
Interested in discount	no / yes	yes	
Day of departure (out)	February 4	first weekend in February [understood as Friday February 10]	
Hour of departure (out)	7:20	Saturday at 7:20 [attempt to change Friday] no [does not want one from list] Saturday at 7:20 (no departure) yes [10:50]	U2, U4, SP10, GP1 U6, GP1, SP10
Day of departure (home)	February 5	Sunday February 5 [understood as Sunday February 12]	
Hour of departure (home)	22:40	22:40	
Delivery	airport / send	send	
More	no / yes	yes	

Scenario: T-3-3-a User: 6 Date: January 16 1995			
System questions	Normative user answers	Actual user answers	Problems
System already known	no / yes / -	-	
Customer number	2	no [not 3] 2	
Number of travellers	2	2	
ID-numbers	2, 1	2, 1	
Departure airport	Copenhagen	Copenhagen	
Arrival airport	Aalborg	Aalborg	
Return journey	yes	yes	
Interested in discount	no / yes	no	

Day of departure (out)	February 2	on Thursday in a fortnight [misunderstood] Thursday in a fortnight [misunderstood] Thursday 26 (January 26)	U1
Hour of departure (out)	19:45	19:45	
Day of departure (home)	February 5	Sunday February 29	
Hour of departure (home)	10:10	10:10	
Delivery	airport / send	airport	
More	no / yes	yes	

Scenario: T-3-4-a User: 6 Date: January 16 1995			
System questions	Normative user answers	Actual user answers	Problems
System already known	no / yes / -	-	
Customer number	3	no [not 2] 3	
Number of travellers	2	2	
ID-numbers	5, 4	5 [understood as 6], 4	
Departure airport	Aalborg	Aalborg [understood as 'change'] no [id-number 6 is not correct] 5 yes [id-number 4 is correct] Aalborg	
Arrival airport	Copenhagen	Copenhagen	
Return journey	yes	yes	
Interested in discount	no	no	
Day of departure (out)	January 17 / January 24	Tuesday January 24	
Hour of departure (out)	around 8:00	must arrive at 9:30 at the latest [understood as 10:30] 8:40 [chosen from list]	U3
Day of departure (home)	January 17 / January 24	Same day January 24	
Hour of departure (home)	around 18:30	at 8 o'clock in the evening (out journey may not be before home journey) evening yes [wants one from list] 19:45	SP8
Delivery	airport / send	send	
More	no	no	

Scenario: T-4-1-a User: 8 Date: January 19 1995			
System questions	Normative user answers	Actual user answers	Problems
System already known	no / yes	no	
Customer number	4	4	
Number of travellers	2	2	
ID-numbers	2, 5	2, 5	U10 (SP4)
Departure airport	Copenhagen	Copenhagen	
Arrival airport	Billund	Billund	
Return journey	yes	yes	
Interested in discount	no	not in this case (not understood) no	
Day of departure (out)	January 31	January 31	U10 (SP4)
Hour of departure (out)	8:00	8 o'clock	U10 (SP4)
Day of departure (home)	January 31	Same day January 31 [understood as January 32] January 31	U10 (SP4)
Hour of departure (home)	19:50	19:50	U10 (SP4) U10 (SP4)
Delivery	airport / send	send	
More	no / yes	no	

Scenario: T-4-2-a User: 8 Date: January 19 1995			
System questions	Normative user answers	Actual user answers	Problems
System already known	no / yes / -	yes	
Customer number	4	4	U10 (SP4)
Number of travellers	2	2	
ID-numbers	1, 4	1, 4	
Departure airport	Copenhagen	Copenhagen	
Arrival airport	Esbjerg	Esbjerg	U10 (SP4)
Return journey	yes	yes	
Interested in discount	yes	yes	
Day of departure (out)	January 28	January 28	
Hour of departure (out)	11:15	11:15	
Day of departure (home)	January 29	January 29	
Hour of departure (home)	18:30	18:30	
Delivery	airport / send	send	
More	no / yes	yes	

Scenario: T-4-3-a User: 8 Date: January 19 1995			
System questions	Normative user answers	Actual user answers	Problems
System already known	no / yes / -	-	
Customer number	4	yes [4]	
Number of travellers	2	2	
ID-numbers	4, 2	4, 2	
Departure airport	Copenhagen	Copenhagen	
Arrival airport	Odense	Odense [understood as Billund]	U10 (SP4)
Return journey	yes	change no change [arrival airport is not Billund] yes [departure airport is Copenhagen] no [arrival airport is not Billund] Odense yes [departure airport is Copenhagen] yes [return journey]	U10 (SP4) U10 (SP4)
Interested in discount	yes	yes	
Day of departure (out)	January 25	next week, Wednesday (January 25)	
Hour of departure (out)	noon or early afternoon [13:00 or 14:55]	around noon yes [wants one from list] 13:00	
Day of departure (home)	January 28	Saturday (January 28)	
Hour of departure (home)	noon or early afternoon [11: 55]	11:55	
Delivery	airport / send	send	
More	no / yes	yes	

Scenario: T-4-4-a User: 8 Date: January 19 1995			
System questions	Normative user answers	Actual user answers	Problems
System already known	no / yes / -	-	
Customer number	2	no [4] 2	U10 (SP4)
Number of travellers	1	1	
ID-numbers	4	4	
Departure airport	Copenhagen	Copenhagen	
Arrival airport	Aalborg	Aalborg	

Return journey	no	no	
Interested in discount	-	-	
Day of departure (out)	January 26	January 26	
Hour of departure (out)	6:45	repeat 6:45	GP1 U10 (SP4)
Day of departure (home)	-	-	
Hour of departure (home)	-	-	
Delivery	airport	airport	
More	no	no	

Scenario: T-5-1-a- α User: 11 Date: February 9 1995			
System questions	Normative user answers	Actual user answers	Problems
System already known	no / yes	no	
Customer number	4	4	
Number of travellers	3	3	
ID-numbers	4, 1, 2	4, 1, 2	
Departure airport	Copenhagen	Copenhagen	
Arrival airport	Aalborg	Aalborg	
Return journey	yes	yes	
Interested in discount	yes / no	yes	
Day of departure (out)	February 10 / February 17	Friday February 10	
Hour of departure (out)	7:30	7:30 (no departures) no, a normal departure at 7:30 (does not want a red departure from list) no, a normal departure at 7:30 (does not want a red departure from list) I want to change (understood as yes)	GP1, SP10 U4, GP1 U4, GP1 U4, SP2,
Day of departure (home)	February 10 / February 17	Same day [February 10] (not possible when red discount) does not want red discount [understood as February 10 so not possible when red discount] does not want red discount [understood as February 10 so not possible when red discount] I change [understood as 'change'] no, I want to change [hour of departure is not 19:45, understood as 'no'] in the morning 7:30 and back again at 19:00 (no departure) no [does not want one from list] 7:30 (no departure) user hangs up	SP10 U4 U4 U4 U4 U6, GP1 GP1
Hour of departure (home)	17:20 or 19:00		
Delivery	airport / send		
More	no / yes		

Scenario: T-5-1-a-β User: 11 Date: February 9 1995			
System questions	Normative user answers	Actual user answers	Problems
System already known	no / yes / -	yes	
Customer number	4	4	
Number of travellers	3	3	
ID-numbers	4, 1, 2	4, 1, 2	
Departure airport	Copenhagen	Copenhagen	
Arrival airport	Aalborg	Aalborg	
Return journey	yes	yes	
Interested in discount	yes / no	no	
Day of departure (out)	February 10 / February 17	Friday February 10	U10 (SP4)
Hour of departure (out)	7:30	7:30	
Day of departure (home)	February 10 / February 17	Friday February 10	
Hour of departure (home)	17:20 or 19:00	19 o'clock	
Delivery	airport (< 3 days)	-	
More	no / yes	no	

Scenario: T-5-2-a User: 11 Date: February 9 1995			
System questions	Normative user answers	Actual user answers	Problems
System already known	no / yes / -	yes	
Customer number	4	4	
Number of travellers	3	3	
ID-numbers	1, 4, 3	1, 4, 3	
Departure airport	Copenhagen	Hellerup [understood as to Karup] Hellerup [understood as from Aalborg] (no route) Copenhagen	GP7 GP7
Arrival airport	Esbjerg	no, change [arrival airport is not Karup, understood as 'no'] Esbjerg yes [departure airport is Copenhagen]	U6
Return journey	yes	yes	
Interested in discount	yes	no	U1
Day of departure (out)	February 18	Saturday February 18	
Hour of departure (out)	11:15	11:15	
Day of departure (home)	February 19	February 19	
Hour of departure (home)	18:30	18:30	
Delivery	airport / send	send	

More	no / yes	no	
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Scenario: T-5-3-a- α User: 11 Date: February 10 1995			
System questions	Normative user answers	Actual user answers	Problems
System already known	no / yes / -	yes	
Customer number	2	2	
Number of travellers	1	1	
ID-numbers	1	1	
Departure airport	Copenhagen	Copenhagen	
Arrival airport	Vojens	Vojens	
Return journey	yes	yes	
Interested in discount	no / yes	no	
Day of departure (out)	February 11 / February 10	February 11	
Hour of departure (out)	around 10:00 [not possible]	10:45 (no departure) no [does not want one from list] 9 o'clock (no departure) no, change [does not want one from list, understood as 'no'] from Copenhagen at 8 o'clock in the morning (no departure) no [does not want one from list] 7 o'clock (no departure) [user hangs up]	GP6 GP6 U6 GP6, U6 GP6
Day of departure (home)	February 12		
Hour of departure (home)	around 18:00		
Delivery	airport / send		
More	no / yes		

Scenario: T-5-3-a-β User: 11 Date: February 10 1995			
System questions	Normative user answers	Actual user answers	Problems
System already known	no / yes / -	yes	
Customer number	2	2	
Number of travellers	1	1	
ID-numbers	1	1	
Departure airport	Copenhagen	Copenhagen	
Arrival airport	Vojens	Vojens	
Return journey	yes	yes	
Interested in discount	no / yes	no	
Day of departure (out)	February 11 / February 10	February 11	
Hour of departure (out)	around 10:00 (not possible)	10:45 (no departure) no [does not want one from list] Friday February 10 (not understood) change no [out day is not February 11] February 10 [system breaks down but the user does not realise this; while waiting the user says:] 20 o'clock repeat	GP6 U4
Day of departure (home)	February 12		
Hour of departure (home)	around 18:00		
Delivery	airport / send		
More	no / yes		

Scenario: T-5-3-a-γ (continued after break down) User: 11 Date: February 10 1995			
System questions	Normative user answers	Actual user answers	Problems
System already known	no / yes / -	yes	
Customer number	2	2	
Number of travellers	1	1	
ID-numbers	1	1	
Departure airport	Copenhagen	Copenhagen	
Arrival airport	Vojens	Vojens	
Return journey	yes	yes	
Interested in discount	no / yes	no	
Day of departure (out)	February 11 / February 10	February 11	

Hour of departure (out)	around 10:00 (not possible)	10:45 (no departure) yes [17:00]	GP6
Day of departure (home)	February 12	February 12	
Hour of departure (home)	around 18:00	18:30 (no departure) yes [18:00]	
Delivery	airport (< 3 days)	-	
More	no / yes	no	

Scenario: T-5-4-a-1 User: 11 Date: February 10 1995			
System questions	Normative user answers	Actual user answers	Problems
System already known	no / yes / -	yes	
Customer number	2	4 no change [understood as 4] change no [not 4] 2	U6 U10 (SP4)
Number of travellers	1	1	
ID-numbers	4	4	
Departure airport	Copenhagen	Copenhagen	
Arrival airport	Karup	Karup	
Return journey	no	no	
Interested in discount	-	-	
Day of departure (out)	February 21	February 21	
Hour of departure (out)	around 7:30	7:45 (no departure) yes [wants one from list] 7:30	
Day of departure (home)	-	-	
Hour of departure (home)	-	-	
Delivery	airport / send	send	
More	yes	yes	

Scenario T-5-4-a-2 User: 11 Date: February 10 1995			
System questions	Normative user answers	Actual user answers	Problems
System already known	-	-	
Customer number	2	yes [2]	
Number of travellers	1	1	U10 (SP4)
ID-numbers	4	4	
Departure airport	Esbjerg	Esbjerg	
Arrival airport	Copenhagen	Copenhagen	
Return journey	no	no	
Interested in discount	-	-	
Day of departure (out)	February 22	February 22	
Hour of departure (out)	around 18:00	18 o'clock (no departure) yes [wants one from list] 18:10	
Day of departure (home)	-	-	
Hour of departure (home)	-	-	
Delivery	airport / send	send	
More	no	no	

Scenario: T-1-1-b- α User: 13 Date: February 10 1995			
System questions	Normative user answers	Actual user answers	Problems
System already known	no / yes	no	
Customer number	4	4	
Number of travellers	2	2, 1 adult and 1 child [understood as 1]	
ID-numbers	4, 2	not 1 but 2, 1 adult and 1 child [attempt to change but understood as id-number 1]	U4
Departure airport	Copenhagen	change no [not 1], id-number 4 Copenhagen	
Arrival airport	Karup	Karup	
Return journey	no	no	
Interested in discount	-	-	
Day of departure (out)	February 11	February 11	
Hour of departure (out)	11:50	around noon (not understood) around noon at 11:50	
Day of departure (home)	-	-	
Hour of departure (home)	-	-	
Delivery	airport [< 3 days]	-	
More	no / yes	yes one more ticket like this	U6 (GP1)

Scenario: T-1-1-b- β User: 13 Date: February 10 1995			
System questions	Normative user answers	Actual user answers	Problems
System already known	no / yes / -	-	
Customer number	4	yes [4]	
Number of travellers	1	1	
ID-numbers	2	2	
Departure airport	Copenhagen	Copenhagen	
Arrival airport	Karup	Karup	
Return journey	no	no	
Interested in discount	-	-	
Day of departure (out)	February 11	February 11	
Hour of departure (out)	11:50	11:50	
Day of departure (home)	-	-	
Hour of departure (home)	-	-	
Delivery	airport [< 3 days]	-	
More	no / yes	yes	

Scenario: T-1-2-b- α User: 13 Date: February 10 1995			
System questions	Normative user answers	Actual user answers	Problems
System already known	no / yes / -	yes	
Customer number	3	yes [4]	U2
Number of travellers	1	1	
ID-numbers	1	1	
Departure airport	Aalborg	no not JH but LBL [attempt to change, but not understood] Aalborg	U4 U10 (SP4)
Arrival airport	Copenhagen	Copenhagen	
Return journey	yes	yes	
Interested in discount	yes [red]	yes	
Day of departure (out)	February 15	February 15	
Hour of departure (out)	10:50	10:50	
Day of departure (home)	February 17	February 17	
Hour of departure (home)	19:45	19:45	
Delivery	airport	airport	
More	no / yes	yes a change	U4 (GP1)

Scenario: T-1-2-b- β User: 13 Date: February 10 1995			
System questions	Normative user answers	Actual user answers	Problems
System already known	no / yes / -	yes	
Customer number	3	3	
Number of travellers	1	wants to change JH to LBL (not understood) 1	U4
ID-numbers	1	1	
Departure airport	Aalborg	Aalborg	
Arrival airport	Copenhagen	Copenhagen	
Return journey	yes	yes	
Interested in discount	yes [red]	yes	
Day of departure (out)	February 15	February 15	
Hour of departure (out)	10:50	10:50	
Day of departure (home)	February 17	February 17	
Hour of departure (home)	19:45	19:45	
Delivery	airport	airport	
More	no / yes	no	

Scenario: T-1-3-b User: 13 Date: February 10 1995			
System questions	Normative user answers	Actual user answers	Problems
System already known	no / yes / -	yes	
Customer number	4	4	
Number of travellers	4	4	
ID-numbers	1, 4, 3, 2	1, 4, 3, 2	
Departure airport	Copenhagen	Copenhagen	
Arrival airport	Sønderborg	Sønderborg	
Return journey	yes	yes	
Interested in discount	yes (green)	yes	
Day of departure (out)	February 11	February 11	
Hour of departure (out)	9:15	9:15	
Day of departure (home)	February 12	17 o'clock [understood as March 6] change change yes [hour of departure is 9:15] no, change [home day is not March 6, understood as 'no'] February 12	U3 U6 U10 (SP4)
Hour of departure (home)	17:00	17 o'clock	U10 (SP4)
Delivery	airport (< 3 days)	-	
More	no / yes	yes	

Scenario: T-1-4-b-α User: 13 Date: February 10 1995			
System questions	Normative user answers	Actual user answers	Problems
System already known	no / yes / -	-	
Customer number	3	no [not 4] change yes [more] [system is broken down from here but continues asking questions in a kind of loop] [at last user hangs up]	U6 U6 U10 (SP4)
Number of travellers	1		
ID-numbers	2		
Departure airport	Aalborg		
Arrival airport	Copenhagen		
Return journey	yes		
Interested in discount	no		
Day of departure (out)	February 13		

Hour of departure (out)	7:15		
Day of departure (home)	February 13		
Hour of departure (home)	17:45		
Delivery	airport / send		
More	no		

Scenario: T-1-4-b- β User: 13 Date: February 10 1995			
System questions	Normative user answers	Actual user answers	Problems
System already known	no / yes / -	yes	
Customer number	3	3	
Number of travellers	1	1	
ID-numbers	2	2	
Departure airport	Aalborg	Aalborg	
Arrival airport	Copenhagen	Copenhagen	
Return journey	yes	yes	
Interested in discount	no	no	
Day of departure (out)	February 13	February 13	
Hour of departure (out)	7:15	7:15	
Day of departure (home)	February 13	February 13	
Hour of departure (home)	17:45	17:45	
Delivery	airport / send	send	
More	no	no	

Appendix 10 Overview of scenarios for each problem type

Each dialogue-related problem located in the dialogues in Appendix 9 was analysed and categorised. The categorisation led to a division into system problems and user errors. System problems were categorised according to which generic (GP) or specific principle (SP) (cf. Appendix 13) of co-operative dialogue had been violated. Appendix 10 provides for each problem type and for each error type an overview of the scenarios in which instances of the problem or the error occur.

(a) System Problems (GP, SP)

System Problem Type	Problem Occurrences in Dialogue
GP1: Be informative enough	T13a, T31a1, T32a, T32a , T44a, T51a/α, T51a/α, T51a/α, T51a/α, T51a/α, T11b/α, T12b/α G14a, G14a, G14a, G14a, G14a, G33a, G33a
GP3: Avoid falsehood	G13b, G13b
GP5: Be relevant	G22a, G22a
GP6: Avoid obscurity	T53a/α, T53a/α, T53a/α, T53a/α, T53a/β, T53a/γ G11b
GP7: Avoid ambiguity	T52a, T52a
GP1-SP2: Give feedback on each piece of user information	T21a , T51a/α
GP10-SP4: Communicate what the system can and cannot do	T21a, T21a , T22a/α, T22a/α, T22a/β, T23a, T24a, T31a2, T32a , T41a, T41a, T41a, T41a, T41a, T41a, T42a, T42a, T43a, T43a, T43a, T44a, T44a, T51a/β, T54a1, T54a2, T12b/α, T13b, T13b, T14b/α G11a, G32a, G34a, G44a
GP10-SP5: Give instructions on how to interact	G14a, G54a1-2
GP11-SP6: Take user inference into account	T13a, T13a, T13a
GP12-SP8: Provide enough task domain knowledge and inference	T14a, T34a G24a , G44a
GP13-SP10: Start meta-commu-	T32a, T32a , T51a/α, T51a/α

nication if inconsistent user input	G14a
GP13-SP11: Start meta-communication if ambiguous user input	<i>G24a, G31a2, G31a2</i> , G32a, G32a

Table 1. Typology of dialogue management problems identified during the user test. Boldface indicates transaction failures. Italics indicate likely cause of transaction failure. 86 individual problems occurred.

(b) User Errors (U)

User Error Type	Error Occurrences in Dialogue
U1. Misunderstanding of scenario	T13a, T21a , T22a/α, T33a, T52a G11a, G31a1, G33a, G33a, G34a, G34a, G43a, G51a, G52a, G52a
U2. Ignoring clear feedback	T32a , T12b/α G24a , G12b
U3. Responding to a question different from system's clear question	T31a2 , T31a2 , T34a, T13b G13a
U4. Correction through comments	T22a/α, T22a/α, T31a2 , T32a , T51a/α, T51a/α, T51a/α, T51a/α, T51a/α, T51a/α, T53a/β, T11b/α, T12b/α, T12b/α, T12b/β G53a
U5. Asking questions	T12a, T13a G22a , G23a
U6. Answering several questions at a time	T31a1, T31a1, T31a1, T32a , T51a/α, T52a, T53a/α, T53a/α, T54a1, T11b/α, T13b, T14b/α, T14b/α G54a1-2
U7. Thinking aloud	G22a , G22a , G31a1
U8. Indirect answer	T13a, T13a
U9. Non-co-operativity	G44a
U10. Overlapping speech	T21a , T21a , T22a/α, T22a/α, T22a/β, T23a, T24a, T31a2 , T32a , T41a, T41a, T41a, T41a, T41a, T41a, T42a, T42a, T43a, T43a, T43a, T44a, T44a, T51a/β, T54a1, T54a2, T12b/α, T13b, T13b, T14b/α G11a, G32a, G34a, G44a

Table 2. Typology of user errors identified during the user test. Boldface indicates transaction failure. Italics indicate likely cause of transaction failure. 98 individual user errors occurred.

(a) System Problems per Scenario Type (GP, SP)

System Problem Type	T	G	Problem Occurrences in Dialogue
GP1: Be informative enough	12	7	T13a, T31a1, T32a, T32a , T44a, T51a/α, T51a/α, T51a/α, T51a/α, T51a/α, T11b/α, T12b/α G14a, G14a, G14a, G14a, G14a, G33a, G33a
GP3: Avoid falsehood		2	G13b, G13b
GP5: Be relevant		2	G22a, G22a
GP6: Avoid obscurity	6	1	T53a/α, T53a/α, T53a/α, T53a/α, T53a/β, T53a/γ G11b
GP7: Avoid ambiguity	2		T52a, T52a
GP1-SP2: Give feedback on each piece of user information	2		T21a , T51a/α
GP10-SP4: Communicate what the system can and cannot do	29	4	T21a, T21a , T22a/α, T22a/α, T22a/β, T23a, T24a, T31a2, T32a , T41a, T41a, T41a, T41a, T41a, T41a, T42a, T42a, T43a, T43a, T43a, T44a, T44a, T51a/β, T54a1, T54a2, T12b/α, T13b, T13b, T14b/α G11a, G32a, G34a, G44a
GP10-SP5: Give instructions on how to interact		2	G14a, G54a1-2
GP11-SP6: Take user inference into account	3		T13a, T13a, T13a
GP12-SP8: Provide enough task domain knowledge and inference	2	2	T14a, T34a G24a, G44a
GP13-SP10: Start meta-communication if inconsistent user input	4	1	T32a, T32a , T51a/α, T51a/α G14a
GP13-SP11: Start meta-communication if ambiguous user input		5	G24a, G31a2, G31a2 , G32a, G32a
Totals	60	26	

Table 3. Typology of dialogue management problems identified during the user test. Boldface indicates transaction failures. Italics indicate likely cause of transaction failure. 86 individual problems occurred. 'T' means text scenarios, 'G' means graphic scenarios.

(b) User Errors per Scenario Type (U)

User Error Type	T	G	Error Occurrences in Dialogue
U1. Misunderstanding of scenario	5	10	T13a, T21a , T22a/α, T33a, T52a G11a, G31a1, G33a, G33a, G34a, G34a, G43a, G51a, G52a, G52a
U2. Ignoring clear feedback	2	2	T32a , T12b/α G24a , G12b
U3. Responding to a question different from system's clear question	4	1	T31a2 , T31a2 , T34a, T13b G13a
U4. Correction through comments	16	1	T22a/α, T22a/α, T31a2 , T32a , T51a/α, T51a/α, T51a/α, T51a/α, T51a/α, T51a/α, T51a/α, T53a/β, T11b/α, T12b/α, T12b/α, T12b/β G53a
U5. Asking questions	2	2	T12a, T13a G22a , G23a
U6. Answering several questions at a time	13	1	T31a1, T31a1, T31a1, T32a , T51a/α, T52a, T53a/α, T53a/α, T54a1, T11b/α, T13b, T14b/α, T14b/α G54a1-2
U7. Thinking aloud		3	G22a , G22a , G31a1
U8. Indirect answer	2		T13a, T13a
U9. Non-co-operativity		1	G44a
U10. Overlapping speech	29	4	T21a , T21a , T22a/α, T22a/α, T22a/β, T23a, T24a, T31a2 , T32a , T41a, T41a, T41a, T41a, T41a, T41a, T42a, T42a, T43a, T43a, T43a, T44a, T44a, T51a/β, T54a1, T54a2, T12b/α, T13b, T13b, T14b/α G11a, G32a, G34a, G44a
Totals	73	25	

Table 4. Typology of user errors identified during the user test. Boldface indicates transaction failure. Italics indicate likely cause of transaction failure. 98 individual problems occurred. 'T' means text scenarios, 'G' means graphic scenarios.

User errors were sometimes triggered by system problems. In each such case the occurrence of the user error was copied to the relevant system problem type. All 33 occurrences of U10 (overlapping speech) were caused by the system not adhering to SP4 (communicate what the system can and cannot do). Hence the 33 occurrences were copied to SP4. In a similar way, one occurrence of U4, one occurrence of U5 and two occurrences of U6 were copied to GP1, and one occurrence of U5 and two occurrences of U8 were copied to SP6.

Appendix 11 Categorisation and analysis of each identified problem

All the problems found in Appendix 9 were analysed and categorised according to their type. The categorisation led to a division into system problems and user errors. System problems were categorised according to which generic (GP) or specific principle (SP) (cf. Appendix 14) for co-operative dialogue had been violated. Appendix 11 gives a detailed analysis of each concrete system problem and user error. For each system problem the symptom (**S**) is described, a diagnosis (**D**) is given, and a cure (**C**) is proposed. For each user error the error (**ER**) is described, an explanation (**EX**) is given and a preventive measure (**PM**) is proposed whenever possible. In the following, a normal S means system and U means user. In some cases a concrete system problem is a copy of a user error. This occurs when a user error was triggered by a system problem.

(a) System Problems (GP, SP)

System Problem Type	Problem Occurrences in Dialogue
<p>GP1.</p> <p>Make your contribution as informative as is required (for the current purposes of the exchange).</p>	<p>T13a (copy from U5) S: S: Do you want more? U: Did I get a discount? D: The user wants discount and does not know that this is unavailable on one-way journeys. C: The system should take into account users' background knowledge, e.g. by mentioning if the user has chosen one-way tickets that discount cannot be obtained. Revise question into: 'Do you want to make another reservation?'.</p> <hr/> <p>T31a1 (copy from U6) S: S: Do you want more? U: Yes, I have two people who are going to Aalborg on Monday January 23 in the morning. D: The system's question is too open and non-specific, and invites the user to take the initiative. C: Revise question into: 'Do you want to make another reservation?'.</p> <hr/> <p>T32a, T32a (misleading system utterance) S: U: interested in discount (red) + out departure time 7:20. The system tells that there is no departure at 7:20. D: The system provides insufficient information. It does not tell that there is a blue departure at 7:20. C: The system should provide sufficient information, e.g. by telling that there is no <u>red</u> departure.</p> <hr/> <p>T44a (incomplete system response) S: S: Thursday, January 26; hour of departure out? U: repeat. S: hour of departure out? The system only repeats its question, not its feedback (January 26). D: 'Repeat' does not cause the latest system utterance to be repeated in its entirety. C: Let the system repeat its entire previous utterance (as promised in the introduction) since it is impossible to know in advance which part a user will be most interested in having repeated.</p> <hr/> <p>T51a/α, T51a/α, T51a/α, T51a/α, T51a/α (misleading system utterance) S: U: interested in discount (red) + out departure time 7:30. The system tells that there is no departure at 7:30. D: The system provides insufficient information. It does not tell that there is a blue departure at 7:30. C: The system should provide sufficient information, e.g. by telling that there is no <u>red</u> departure.</p>

System Problem Type	Problem Occurrences in Dialogue
<p>GP1. (continued)</p> <p>Make your contribution as informative as is required (for the current purposes of the exchange).</p>	<p>T11b/α (copy from U6) S: S: Do you want more? U: Yes please, I want to book one more ticket like this. D: The system's question is too open and non-specific, and invites the user to take the initiative. C: Revise question into: 'Do you want to make another reservation?'.</p> <hr/> <p>T12b/α (copy from U4) S: S: Do you want more? U: Yes, I have a correction. D: The user wants to change the name of the traveller in the previous reservation and probably thinks that there may be an easy way in which to do this. C: Revise question into: 'Do you want to make another reservation?'.</p> <hr/> <p>G14a, G14a, G14a, G14a, G14a (misleading system utterance) S: U: interested in discount (red) + out departure time 7:20. The system tells that there is no departure at 7:20. D: The system provides insufficient information. It does not tell that there is a blue departure at 7:20. C: The system should provide sufficient information, e.g. by telling that there is no <u>red</u> departure.</p> <hr/> <p>G33a, G33a (incomplete system response) S: S: no departure at 21:00, closest departures are 19:45 and 22:40, which departure time? U: repeat; S: no departure at 21:00, which departure time?. D: The system only repeats part of its previous response excluding the list of possible departures, and asks again which departure the user wants. C: Let the system repeat its entire previous utterance since it is impossible to know in advance which part a user will be most interested in having repeated.</p>

System Problem Type	Problem Occurrences in Dialogue
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<p>GP3.</p> <p>Do not say what you believe to be false.</p>	<p>G13b, G13b (database error)</p> <p>S: S: departure time? U: morning; S: the green morning departures are fully booked (happens twice).</p> <p>D: There is no grammar failure. According to the flight file the first departure on the given day is 9:15 which is not considered morning but 'before noon' by the database, and which is not fully booked. However, the system's message should then have been that there are no morning departures. [See log]</p> <p>C: Find and repair the bug in the database. Widen 'morning' concept.</p>
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System Problem Type	Problem Occurrences in Dialogue
<p>GP5. Be relevant, i.e. be appropriate to the immediate needs at each stage of the transaction.</p>	<p><i>G22a, G22a</i> (irrelevant response) S: The user asks to depart on January 23. S: today is not the 23rd of January. D: A system misrecognition (grammar failure) triggers an error message which may seem rather irrelevant to the user who did not mention today at all. C: Two possibilities: 1. The grammar should handle the input in question (the journey start on January 23). 2. Use threshold values (score values) to evaluate the probability of correct recognition and start repair if the score is too low.</p>

System Problem Type	Problem Occurrences in Dialogue

<p>GP6.</p> <p>Avoid obscurity of expression.</p>	<p>T53a/α, T53a/α, T53a/α, T53a/α (misleading system utterance)</p> <p>S: U: out departure time 10:45. S: no departure at 10:45, the closest other departure is at 17:00.</p> <p>D: The system provides misleading information since the departure at 17:00 is the only departure that day.</p> <p>C: The system should provide non-obscure information, e.g. by telling that the departure at 17:00 is the only departure that day.</p> <hr/> <p>T53a/β (misleading system utterance)</p> <p>S: U: out departure time 10:45. S: no departure at 10:45, the closest other departure is at 17:00.</p> <p>D: The system provides misleading information since the departure at 17:00 is the only departure that day.</p> <p>C: The system should provide non-obscure information, e.g. by telling that the departure at 17:00 is the only departure that day.</p> <hr/> <p>T53a/γ (misleading system utterance)</p> <p>S: U: out departure time 10:45. S: no departure at 10:45, the closest other departure is at 17:00.</p> <p>D: The system provides misleading information since the departure at 17:00 is the only departure that day.</p> <p>C: The system should provide non-obscure information, e.g. by telling that the departure at 17:00 is the only departure that day.</p> <hr/> <p>G11b (grammatically incorrect response)</p> <p>S: The system's output is difficult to understand due to incorrect grammar. S: there is a departure at 9:10 and 11:50 sold out. The meaning is that only the 9:10 departure has free seats whereas the departure at 11:50 is already fully booked.</p> <p>D: Grammatically the combination of output phrases is incorrect and obscure.</p> <p>C: Rewrite the output phase and make sure that the information is provided in a grammatically correct form.</p>
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System Problem Type	Problem Occurrences in Dialogue
<p>GP7.</p> <p>Avoid ambiguity.</p>	<p>T52a, T52a (possible GP7)</p> <p>S: S: where does the journey start? U: from Hellerup / it starts in Hellerup (the system question is asked and answered twice. The system understands the first answer as 'to Karup' and the second answer as 'from Beldringe.</p> <p>D: Grammar failures. Low scores (-89.000000 in both cases). The user thinks of the travellers home as the point of departure, and not the airport. Possibly there is also a priming effect from the scenario.</p> <p>C: 1. Add more names (hardly feasible). 2. The system should ask for departure airport and not just where the travel starts (or ends). This is not obviously necessary because of the possibility that the user was primed by the scenario.</p>

System Problem Type	Problem Occurrences in Dialogue
<p>SP2.</p> <p>Provide feedback on each piece of information provided by the user.</p>	<p><i>T21a</i> (missing feedback)</p> <p>S: The user asks for a one-way ticket. However, this is understood as a return ticket by the system but the misunderstanding only shows later in the dialogue, first indirectly, then directly.</p> <p>D: There is no direct system feedback on the user's answer to whether s/he wants a return journey. It is therefore difficult to detect misunderstandings at once unless one knows the system/domain well. There also is a grammar failure and the score is low (-141.000000).</p> <p>C: Provide system feedback to all user answers. Consider using score threshold value.</p> <hr/> <p><i>T51a/α</i> (missing feedback)</p> <p>S: The user does not want the red departure offered by the system. However, the answer is understood as yes and the system just continues with its next question. The misunderstanding is only discovered later in the dialogue.</p> <p>D: There is no direct system feedback if the system offers only one departure time and the user accepts. It is therefore very difficult to detect misunderstandings at once unless one knows the system/domain well. There also is a grammar failure and the score is low (-119.000000).</p> <p>C: Provide system feedback to all user answers. Consider using score threshold value.</p>

System Problem Type	Problem Occurrences in Dialogue
<p>SP4.</p> <p>Provide clear and comprehensible communication of what the system can and cannot do.</p>	<p>T21a (copy from U10) S: S: Do you want a return ticket? U: No we will book that one later.[Pause] U: It is okay. They are not going back. S: Red discount is possible on certain weekday departures... D: Phatic. A common way for humans in which to express that they follow the conversation and are interested while the interlocutor talks. In particular pauses may be filled in this way. However, the system does not listen during its own turns, and users were not informed on this. C: Inform users that the system does not listen during its own turns.</p> <hr/> <p>T21a (copy from U10) S: S: At 11:10. U: Yes, please. S: You have now booked ... D: Phatic. A common way for humans in which to express that they follow the conversation and are interested while the interlocutor talks. In particular pauses may be filled in this way. However, the system does not listen during its own turns, and users were not informed on this. C: Inform users that the system does not listen during its own turns.</p> <hr/> <p>T22a/α (copy from U10) S: S: To Aalborg. U: Yes. S: Do you want a return ticket? D: Phatic. A common way for humans in which to express that they follow the conversation and are interested while the interlocutor talks. In particular pauses may be filled in this way. However, the system does not listen during its own turns, and users were not informed on this. C: Inform users that the system does not listen during its own turns.</p> <hr/> <p>T22a/α (copy from U10) S: At 19:00. U: Yes, please. S: You have now booked ... D: Phatic. A common way for humans in which to express that they follow the conversation and are interested while the interlocutor talks. In particular pauses may be filled in this way. However, the system does not listen during its own turns, and users were not informed on this. C: Inform users that the system does not listen during its own turns.</p> <hr/> <p>T22a/β (copy from U10) S: At 19:00. U: Yes, please. S: You have now booked ... D: Phatic. A common way for humans in which to express that they follow the conversation and are interested while the interlocutor talks. In particular pauses may be filled in this way. However, the system does not listen during its own turns, and users were not informed on this. C: Inform users that the system does not listen during its own turns.</p>

System Problem Type	Problem Occurrences in Dialogue
<p>SP4. (continued)</p> <p>Provide clear and comprehensible communication of what the system can and cannot do.</p>	<p>T23a (copy from U10) S: At 22:30. U: Yes, please. S: You have now booked ... D: Phatic. A common way for humans in which to express that they follow the conversation and are interested while the interlocutor talks. In particular pauses may be filled in this way. However, the system does not listen during its own turns, and users were not informed on this. C: Inform users that the system does not listen during its own turns.</p> <hr/> <p>T24a (copy from U10) S: At 17:30. U: Yes, please. S: You have now booked ... D: Phatic. A common way for humans in which to express that they follow the conversation and are interested while the interlocutor talks. In particular pauses may be filled in this way. However, the system does not listen during its own turns, and users were not informed on this. C: Inform users that the system does not listen during its own turns.</p> <hr/> <p>T31a2 (copy from U10) S: S: Customer number 2. Is that correct? U: No id-numbers 1 and 4. S: Customer number 4. U: Wrong, the customer number is 2. S: How many people will travel? D: Change through comments. However, the system does not listen during its own turns, and users were not informed on this. C: Inform users that the system does not listen during its own turns.</p> <hr/> <p>T32a (copy from U10) S: S: Customer number 3. U Yes. S: How many people will travel? D: Phatic. A common way for humans in which to express that they follow the conversation and are interested while the interlocutor talks. In particular pauses may be filled in this way. However, the system does not listen during its own turns, and users were not informed on this. C: Inform users that the system does not listen during its own turns.</p> <hr/> <p>T41a (copy from U10) S: S: Id-numbers 2 and 5, RH and AH. U: Yes. S: Where does the journey start? D: Phatic. A common way for humans in which to express that they follow the conversation and are interested while the interlocutor talks. In particular pauses may be filled in this way. However, the system does not listen during its own turns, and users were not informed on this. C: Inform users that the system does not listen during its own turns.</p>

System Problem Type	Problem Occurrences in Dialogue
<p>SP4. (continued)</p> <p>Provide clear and comprehensible communication of what the system can and cannot do.</p>	<p>T41a (copy from U10) S: S: Tuesday, January 31. U: Yes. S: At which time? D: Phatic. A common way for humans in which to express that they follow the conversation and are interested while the interlocutor talks. In particular pauses may be filled in this way. However, the system does not listen during its own turns, and users were not informed on this. C: Inform users that the system does not listen during its own turns.</p>
	<p>T41a (copy from U10) S: S: At 8:00. U: Yes. S: On which date will the return journey start? D: Phatic. A common way for humans in which to express that they follow the conversation and are interested while the interlocutor talks. In particular pauses may be filled in this way. However, the system does not listen during its own turns, and users were not informed on this. C: Inform users that the system does not listen during its own turns.</p>
	<p>T41a (copy from U10) S: S: Tuesday, January 31. U: Yes. S: At which time? D: Phatic. A common way for humans in which to express that they follow the conversation and are interested while the interlocutor talks. In particular pauses may be filled in this way. However, the system does not listen during its own turns, and users were not informed on this. C: Inform users that the system does not listen during its own turns.</p>
	<p>T41a (copy from U10) S: At 19:50. U: Yes. S: You have now booked ... D: Phatic. A common way for humans in which to express that they follow the conversation and are interested while the interlocutor talks. In particular pauses may be filled in this way. However, the system does not listen during its own turns, and users were not informed on this. C: Inform users that the system does not listen during its own turns.</p>
	<p>T41a (copy from U10) S: S: You have now booked ... The total price is 1360 kr. U: Yes. S: Should the tickets be sent or will they be picked up at the airport? D: Phatic. A common way for humans in which to express that they follow the conversation and are interested while the interlocutor talks. In particular pauses may be filled in this way. However, the system does not listen during its own turns, and users were not informed on this. C: Inform users that the system does not listen during its own turns or change the system so that it listens during its own turns.</p>

System Problem Type	Problem Occurrences in Dialogue
<p>SP4. (continued)</p> <p>Provide clear and comprehensible communication of what the system can and cannot do.</p>	<p>T42a (copy from U10) S: S: Customer number 4. U: Yes. S: How many people will travel? D: Phatic. A common way for humans in which to express that they follow the conversation and are interested while the interlocutor talks. In particular pauses may be filled in this way. However, the system does not listen during its own turns, and users were not informed on this. C: Inform users that the system does not listen during its own turns.</p>
	<p>T42a (copy from U10) S: S: To Esbjerg. U: Yes. S: Do you want a return ticket? D: Phatic. A common way for humans in which to express that they follow the conversation and are interested while the interlocutor talks. In particular pauses may be filled in this way. However, the system does not listen during its own turns, and users were not informed on this. C: Inform users that the system does not listen during its own turns.</p>
	<p>T43a (copy from U10) S: S: To Billund. U: No. S: Do you want a return ticket? D: Change through comments. However, the system does not listen during its own turns, and users were not informed on this. C: Inform users that the system does not listen during its own turns.</p>
	<p>T43a (copy from U10) S: S: The journey ends in Billund. U: Change. S: Is that correct? D: Change through keyword. However, the system does not listen during its own turns, and users were not informed on this. C: Inform users that the system does not listen during its own turns.</p>
	<p>T43a (copy from U10) S: S: To Odense. U: Yes. S: The journey starts in Copenhagen. Is that correct? D: Phatic. A common way for humans in which to express that they follow the conversation and are interested while the interlocutor talks. In particular pauses may be filled in this way. However, the system does not listen during its own turns, and users were not informed on this. C: Inform users that the system does not listen during its own turns.</p>
<p>T44a (copy from U10) S: S: Customer number 2. U: Yes. S: How many people will travel? D: Phatic. A common way for humans in which to express that they follow the conversation and are interested while the interlocutor talks. In particular pauses may be filled in this way. However, the system does not listen during its own turns, and users were not informed on this.</p>	

	C: Inform users that the system does not listen during its own turns.
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System Problem Type	Problem Occurrences in Dialogue
<p>SP4. (continued)</p> <p>Provide clear and comprehensible communication of what the system can and cannot do.</p>	<p>T44a (copy from U10) S: At 6:45. U: Yes. S: You have now booked ... D: Phatic. A common way for humans in which to express that they follow the conversation and are interested while the interlocutor talks. In particular pauses may be filled in this way. However, the system does not listen during its own turns, and users were not informed on this. C: Inform users that the system does not listen during its own turns.</p> <hr/> <p>T51a/β (copy from U10) S: S: Friday, February 10. U: Yes. S: At which time? D: Phatic. A common way for humans in which to express that they follow the conversation and are interested while the interlocutor talks. In particular pauses may be filled in this way. However, the system does not listen during its own turns, and users were not informed on this. C: Inform users that the system does not listen during its own turns.</p> <hr/> <p>T54a1 (copy from U10) S: S: Customer number 2. U: Yes. S: How many people will travel? D: Phatic. A common way for humans in which to express that they follow the conversation and are interested while the interlocutor talks. In particular pauses may be filled in this way. However, the system does not listen during its own turns, and users were not informed on this. C: Inform users that the system does not listen during its own turns.</p> <hr/> <p>T54a2 (copy from U10) S: S: 1 person. U: Yes. S: Please state the id-number of the person. D: Phatic. A common way for humans in which to express that they follow the conversation and are interested while the interlocutor talks. In particular pauses may be filled in this way. However, the system does not listen during its own turns, and users were not informed on this. C: Inform users that the system does not listen during its own turns.</p> <hr/> <p>T12b/α (copy from U10) S: S: From Aalborg. U: Yes. S: Where does the journey end? D: Phatic. A common way for humans in which to express that they follow the conversation and are interested while the interlocutor talks. In particular pauses may be filled in this way. However, the system does not listen during its own turns, and users were not informed on this. C: Inform users that the system does not listen during its own turns.</p> <hr/> <p>T13b (copy from U10) S: S: Sunday, February 12. U: Yes. S: At which time?</p>

	<p>D: Phatic. A common way for humans in which to express that they follow the conversation and are interested while the interlocutor talks. In particular pauses may be filled in this way. However, the system does not listen during its own turns, and users were not informed on this.</p>
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	<p>C: Inform users that the system does not listen during its own turns.</p>
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System Problem Type	Problem Occurrences in Dialogue
<p>SP4. (continued)</p> <p>Provide clear and comprehensible communication of what the system can and cannot do.</p>	<p>T13b (copy from U10) S: At 17:00. U: Yes, please. S: You have now booked ... D: Phatic. A common way for humans in which to express that they follow the conversation and are interested while the interlocutor talks. In particular pauses may be filled in this way. However, the system does not listen during its own turns, and users were not informed on this. C: Inform users that the system does not listen during its own turns.</p> <hr/> <p>T14b/α (copy from U10) S: S: 15:45 is not a valid time. U: Change. S: At which time? D: Change through keyword. However, the system does not listen during its own turns, and users were not informed on this. C: Inform users that the system does not listen during its own turns.</p> <hr/> <p>G11a (copy from U10) S: S: ... Do you want one of these departures? U: Yes 9:10. [typed 'yes'] S: Which? U: 9:10. U: 9:10. D: User response is simultaneous with system question. C: Inform users that the system does not listen during its own turns.</p> <hr/> <p>G32a (copy from U10) S: At 22:40. U: Yes. S: You have now booked ... D: Phatic. A common way for humans in which to express that they follow the conversation and are interested while the interlocutor talks. In particular pauses may be filled in this way. However, the system does not listen during its own turns, and users were not informed on this. C: Inform users that the system does not listen during its own turns.</p> <hr/> <p>G34a (copy from U10) S: At 17:45. U: Yes. S: You have now booked ... D: Phatic. A common way for humans in which to express that they follow the conversation and are interested while the interlocutor talks. In particular pauses may be filled in this way. However, the system does not listen during its own turns, and users were not informed on this. C: Inform users that the system does not listen during its own turns.</p> <hr/> <p>G44a (copy from U10) S: S: The ticket will be sent to you in a couple of days. U: Change. S: Do you want anything else? D: Change through keyword. However, the system does not listen during its own turns, and users were not informed on this. C: Inform users that the system does not listen during its own turns.</p>

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System Problem Type	Problem Occurrences in Dialogue
<p>SP5.</p> <p>Provide clear and sufficient instructions to users on how to interact with the system.</p>	<p>G14a (insufficient instruction to users about the use of 'change')</p> <p>S: The user wants to deselect discount and enters a loop. Eventually the user guesses that 'change' can be used repeatedly in order to backtrack more than one step.</p> <p>D: The user has not been told about repeated use of 'change'.</p> <p>C: Provide sufficient user instructions on repeated use of 'change'.</p> <hr/> <p><i>G54a1-2</i> (undersupported user navigation)</p> <p>S: When asked about home departure hour for the second time, the user tries and fails to input a departure airport for the home journey that is different from the arrival airport for the out journey.</p> <p>D: Roundtrip tickets can only be handled as two separate single reservations in P2. The system does not provide information on how to handle roundtrips.</p> <p>C: The system should inform users on its limitations with respect to roundtrip reservations.</p>

System Problem Type	Problem Occurrences in Dialogue
<p>SP6.</p> <p>Take into account possible (and possibly erroneous) user inferences by analogy from related task domains.</p>	<p>T13a, T13a (copy from U8)</p> <p>S: S: At what time? U: It must be as cheap as possible. When the system asks the same question again the user answers 'Cheap'.</p> <p>D: The user wants a discount ticket but since s/he has asked for a one-way ticket this is not possible and the system does not offer it. However, the user does not know this and wants to let the hour of departure depend on when there is a cheap departure.</p> <p>C: None, except T13a (U5).</p> <hr/> <p>T13a (copy from U5)</p> <p>S: S: Do you want more? U: Did I get a discount?</p> <p>D: The user wants discount and does not know that this is unavailable on one-way journeys.</p> <p>C: The system should take into account users' background knowledge, e.g. by mentioning if the user has chosen one-way tickets that discount cannot be obtained. Revise question into: 'Do you want to make another reservation?'.</p>

System Problem Type	Problem Occurrences in Dialogue
<p>SP8.</p> <p>Provide sufficient task domain knowledge and inference.</p>	<p>T14a (inference problem) S: U: out journey at 7:20 and home journey at a quarter to six; S: error message telling that home journey may not be before out journey. D: Hour of departure for home journey: first the relation to the out journey with respect to time is checked. The home departure time 'a quarter to six' is as default understood as am. However, in the present context it is not ambiguous and should have been understood as 17:45. C: If out and home journey on the same day and the home departure time is 'a quarter to six' then understand the answer as '17:45'.</p> <hr/> <p>T34a (inference problem) S: U: out journey at 8:40 and home journey at eight o'clock in the evening; S: error message telling that home journey may not be before out journey. D: Hour of departure for home journey: first the relation to the out journey with respect to time is checked. The home departure time '8 o'clock' is as default understood as am. However, in the present context it is not ambiguous and should have been understood as 20:00. C: If out and home journey on the same day and the home departure time is '8 o'clock' then understand the answer as '20:00'. [Grammar: allow 'klokken otte om aftenen'.]</p> <hr/> <p>G24a (inference problem) S: U: out journey at 19:30 and home journey at nine o'clock; S: error message telling that home journey may not be before out journey. D: Hour of departure for home journey: first the relation to the out journey with respect to time is checked. The home departure time '9 o'clock' is as default understood as am. However, in the present context it is not ambiguous and should have been understood as 21:00. C: If out and home journey on the same day and the home departure time is '9 o'clock' then understand the answer as '21:00'.</p> <hr/> <p>G44a (inference problem) S: U: change; S: the tickets should be sent; is this correct; U: no; S: should the tickets be sent or will they be picked up in the airport. D: The system makes no inference but asks again whether tickets should be sent or will be picked up in the airport, even if it is obvious what the user wants. C: The system should not ask superfluous questions but deduce what the user wants when obvious. If only two possible answers then understand confirmation or rejection of one of them. [Compare G44a-U5]</p>

System Problem Type	Problem Occurrences in Dialogue
<p>SP10.</p> <p>Initiate clarification meta-communication in case of inconsistent user input.</p>	<p>T32a, T32a (inconsistent user input) S: U: red discount + out departure time at 7:20; S: no departure at 7:20. However 7:30 does exist, but without discount. D: S gives priority to discount over time without reason. C: S should ask U about priority: 7:20 is not a discount departure. Red discount can be obtained on the departures at x, y and z. Which departure do you want. [If U provides a new departure time: S: do you still want discount. If U: no; S: non-discount departures.</p> <hr/> <p>T51a/α (inconsistent user input) S: U: red discount + out departure time at 7:30; S: no departure at 7:30. However 7:30 does exist, but without discount. D: S gives priority to discount over time without reason. C: S should ask U about priority: 7:30 is not a discount departure. Red discount can be obtained on the departures at x, y and z. Which departure do you want. [If U provides a new departure time: S: do you still want discount. If U: no; S: non-discount departures.</p> <hr/> <p>T51a/α (inconsistent user input) S: U: red discount + home journey on the same day as out journey; S: not possible when discount. D: S gives priority to discount over time without reason. C: S should ask U about priority: do you want discount or home journey on the same day?</p> <hr/> <p>G14a (inconsistent user input) S: U: red discount + out departure time at 7:20; S: no departure at 7:20. However 7:20 does exist, but without discount. D: S gives priority to discount over time without reason. C: S should ask U about priority: 7:20 is not a discount departure. Red discount can be obtained on the departures at x, y and z. Which departure do you want. [If U provides a new departure time: S: do you still want discount. If U: no; S: non-discount departures.</p>

System Problem Type	Problem Occurrences in Dialogue
<p>SP11.</p> <p>Initiate clarification meta-communication in case of ambiguous user input.</p>	<p><i>G24a</i> (ambiguous user input) S: 7:30 wrongly understood as 19:30 by the system. No user reaction although according to the scenario the time of departure understood by the system is not correct and later the user asks for a departure time for the home journey which is earlier than the departure time for the out journey. D: All departure times which may be understood as being before noon (am), e.g. 7:30, are automatically understood as such. If there is no flight, the dialogue description automatically adds 12 hours to the departure time. If there is a flight at this time, input will be interpreted as being PM, e.g. 19:30. C: Ask the user in case of ambiguous input which cannot be resolved by context.</p> <hr/> <p><i>G31a2, G31a2</i> (ambiguous user input) S: 7:45 wrongly understood as 19:45 by the system. The user tries to change the departure time understood by the system. D: All departure times which may be understood as being before noon (am), e.g. 7:45, are automatically understood as such. If there is no flight, the dialogue description automatically adds 12 hours to the departure time. If there is a flight at this time, input will be interpreted as being PM, e.g. 19:45. C: Ask the user in case of ambiguous input which cannot be resolved by context.</p> <hr/> <p><i>G32a</i> (ambiguous user input) S: 7 o'clock wrongly understood as 19 o'clock by the system. The user tries to change the departure time understood by the system. D: All departure times which may be understood as being before noon (am), e.g. 7 o'clock, are automatically understood as such. If there is no flight, the dialogue description automatically adds 12 hours to the departure time. If there is a flight at this time, input will be interpreted as being PM, e.g. 19 o'clock. C: Ask the user in case of ambiguous input which cannot be resolved by context.</p> <hr/> <p><i>G32a</i> (ambiguous user input) S: 10 o'clock wrongly understood as 10:00 instead of 22:00 by the system. The user tries to change the departure time understood by the system. D: All departure times which may be understood as being before noon (am), e.g. 10 o'clock, are automatically understood as such. If there is no flight the dialogue description automatically adds 12 hours to the departure time. If there is a flight at this time, input will be interpreted as being PM, e.g. 22 o'clock. If not, the departure time will be interpreted as being before noon and the system will mention the closest departures. C: Ask the user in case of ambiguous input which cannot be resolved by context.</p>

(b) User Errors (U)

User Error Type	Error Occurrences in Dialogue
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U1.

**Misunderstanding
of scenario**

T13a

ER: The user asks for one-way tickets instead of return tickets.**EX:** The user has not read the scenario text sufficiently carefully.**PM:** Make scenarios as clear as possible and encourage users to carefully study their scenarios.

T21a

ER: The user invents a date for the home journey. The system takes the user's 'no' to return journey for a 'yes', but there is no immediate feedback. Because of the misunderstanding the system later asks for a date for the home journey.**EX:** The user probably gave up on changing the return into one-way.**PM:** Provide feedback on all user answers and provide easy ways in which to change misunderstandings. I.e. solve S13 and provide information on repeated use of 'change'.

T22a/α

ER: The user is not interested in discount.**EX:** The user has not read the scenario text sufficiently carefully.**PM:** Make scenarios as clear as possible and encourage users to carefully study their scenarios.

T33a

ER: The user asks for January 26 as departure date.**EX:** The departure date should have been one week later but apparently the user miscalculated the absolute date from the relative date expression in the scenario (Thursday in a fortnight).**PM:** Happens in real life. Encourage users to carefully study their scenarios.

T52a

ER: The user is not interested in discount.**EX:** The user has not read the scenario text sufficiently carefully.**PM:** Make scenarios as clear as possible and encourage users to carefully study their scenarios.

G11a

ER: The user chooses January 6 as departure date.**EX:** January 6 is before 'today' but probably the user is confused by the relative date indication in the scenario: the indications of 'today' and 'day of departure' coincide on the graphic date line.**PM:** Make scenarios as clear as possible.

G31a1

ER: The user chooses a departure date one day too early.**EX:** The user has problems with the relative date indications in the scenario (graphic date line).**PM:** Happens in real life. Encourage users to carefully study their scenarios.

User Error Type	Error Occurrences in Dialogue
<p data-bbox="147 296 350 327">U1. (continued)</p> <p data-bbox="147 373 399 443">Misunderstanding of scenario</p>	<p data-bbox="448 260 607 291">G33a, G33a</p> <p data-bbox="448 296 1203 327">ER: The user chooses a departure date one week too early.</p> <p data-bbox="448 331 1292 401">EX: The user has problems with the relative date indications in the scenario (graphic date line).</p> <p data-bbox="448 405 1281 474">PM: Happens in real life. Encourage users to carefully study their scenarios.</p>
	<p data-bbox="448 522 607 554">G34a, G34a</p> <p data-bbox="448 558 1382 590">ER: The user chooses a Thursday instead of a Tuesday as departure date.</p> <p data-bbox="448 594 1292 663">EX: The user has problems with the relative date indications in the scenario (graphic date line).</p> <p data-bbox="448 667 1281 737">PM: Happens in real life. Encourage users to carefully study their scenarios.</p>
	<p data-bbox="448 785 521 816">G43a</p> <p data-bbox="448 821 984 852">ER: The user is not interested in discount.</p> <p data-bbox="448 856 1268 888">EX: The user has not read the scenario text sufficiently carefully.</p> <p data-bbox="448 892 1382 961">PM: Make scenarios as clear as possible and encourage users to carefully study their scenarios.</p>
	<p data-bbox="448 1010 521 1041">G51a</p> <p data-bbox="448 1045 1252 1077">ER: The user asks for one-way tickets instead of return tickets.</p> <p data-bbox="448 1081 1268 1113">EX: The user has not read the scenario text sufficiently carefully.</p> <p data-bbox="448 1117 1382 1186">PM: Make scenarios as clear as possible and encourage users to carefully study their scenarios.</p>
	<p data-bbox="448 1234 607 1266">G52a, G52a</p> <p data-bbox="448 1270 1203 1302">ER: The user chooses a departure date one week too early.</p> <p data-bbox="448 1306 1292 1375">EX: The user has problems with the relative date indications in the scenario (graphic date line).</p> <p data-bbox="448 1379 1281 1449">PM: Happens in real life. Encourage users to carefully study their scenarios.</p>

User Error Type	Error Occurrences in Dialogue
<p>U2.</p> <p>Ignoring clear system feedback</p>	<p><i>T32a</i></p> <p>ER: The user only tries to change part of a misunderstood date. The system feedback on date of departure is 'Friday February 10'. The user has asked for Saturday February 4. However, s/he is only aware that Friday is wrong and tries to change this through a comment.</p> <p>EX: The user ignores part of the feedback.</p> <p>PM: People sometimes do not listen sufficiently carefully. They may also care less than in real life.</p> <hr/>
	<p><i>T12b/α</i></p> <p>ER: The user answers yes to the system's question if the customer number is 4. According to the scenario the correct answer would have been 3. The user only becomes aware that something is wrong when the system provides feedback on id-number: the name of the traveller is wrong.</p> <p>EX: The user ignores part of the feedback.</p> <p>PM: People sometimes do not listen sufficiently carefully. They may also care less than in real life.</p> <hr/>
	<p><i>G24a</i></p> <p>ER: The user asks for a departure time at 7:30. The system feedback is 19:30. The user does not change this.</p> <p>EX: The user ignores part of the feedback.</p> <p>PM: People sometimes do not listen sufficiently carefully. They may also care less than in real life.</p> <hr/>
	<p><i>G12b</i></p> <p>ER: The user answers yes to the system's question if the customer number is 4. According to the scenario the correct answer would have been 3. The user, however, becomes aware of the mistake during the following echo feedback and changes it.</p> <p>EX: The user ignores part of the feedback.</p> <p>PM: People sometimes do not listen sufficiently carefully. They may also care less than in real life.</p>

User Error Type	Error Occurrences in Dialogue
<p>U3.</p> <p>Responding to a question different from the clear system question</p>	<p>T31a2</p> <p>ER: The user answers no to the system's question if the customer number is 2. Instead s/he says that id-numbers are 1 and 4. The user becomes aware of the mistake when the system's feedback on customer number is 4.</p> <p>EX: The user responds to a different question from that asked by the system.</p> <p>PM: People sometimes do not listen sufficiently carefully.</p> <hr/>
	<p>T31a2</p> <p>ER: The user answers 'no, send the tickets' to the question if s/he wants a return journey.</p> <p>EX: The user responds to a different question from that asked by the system.</p> <p>PM: People sometimes do not listen sufficiently carefully.</p> <hr/>
	<p>T34a</p> <p>ER: The user indicates the intended time of arrival indicated in the scenario when asked for departure time.</p> <p>EX: The user responds indirectly to the system's question.</p> <p>PM: The user is co-operative. How to handle indirect responses to questions? NB: Theoretically important. Not really U2(D).</p> <hr/>
	<p>T13b</p> <p>ER: The user answers 17 o'clock to the question of departure date.</p> <p>EX: The user responds to a different question from that asked by the system.</p> <p>PM: People sometimes do not listen sufficiently carefully.</p> <hr/>
	<p>G13a</p> <p>ER: The user answers 'Saturday' to the question of departure airport.</p> <p>EX: The user responds to a different question from that asked by the system.</p> <p>PM: People sometimes do not listen sufficiently carefully.</p>

User Error Type	Error Occurrences in Dialogue
U4. Change through comments	<p>T22a/α ER: S: 22:40 hrs. At which date do you want to return? U: No, 9:40 hrs. EX: The user is too occupied with the present problem to remember to use 'change'. PM: 'Change' is not natural. Prefer mixed-initiative meta-communication.</p>
	<p>T22a/α ER: S: Saturday 4.2. At what time? U: No thanks, I want to return on the 27.1. EX: The user is too occupied with the present problem to remember to use 'change'. PM: 'Change' is not natural. Prefer mixed-initiative meta-communication.</p>
	<p>T31a2 ER: S: Customer number 2. Is that correct? U: No, id-numbers 1 and 4. EX: The user is too occupied with the present problem to remember to use 'change'. PM: 'Change' is not natural. Prefer mixed-initiative meta-communication.</p>
	<p>T32a ER: S: Friday 10.2. At what time? U: It should be Saturday at 7:20. EX: The user is too occupied with the present problem to remember to use 'change'. PM: 'Change' is not natural. Prefer mixed-initiative meta-communication.</p>
	<p>T51a/α, T51a/α, T51a/α, T51a/α, T51a/α, T51a/α, T51a/α ER: U: No, then I would like to have a normal departure at 7:30. U: No thanks, I would like to have a normal departure at 7:30 Friday. U: I want to change. I would like to have a normal departure a morning flight at 7:30. U: I do not want red discount. I want a return ticket Friday 10.2. U: I do not want red discount. I repeat, I do not want red discount. U: I change. I do not want red discount. U: No, I want to change. . EX: The user is too occupied with the present problem to remember to use 'change'. PM: 'Change' is not natural. Prefer mixed-initiative meta-communication.</p>
	<p>T53a/β ER: S: At what time? U: I want to depart on Friday 10.2. EX: The user is too occupied with the present problem to remember to use 'change'. PM: 'Change' is not natural. Prefer mixed-initiative meta-communication.</p>

User Error Type	Error Occurrences in Dialogue
<p>U4. (continued)</p> <p>Change through comments</p>	<p>T11b/α</p> <p>ER: S: 1 person. State the id-number of this person. U: It was not 1 person. It was two persons, one adult and one child.</p> <p>EX: The user is too occupied with the present problem to remember to use 'change'.</p> <p>PM: 'Change' is not natural. Prefer mixed-initiative meta-communication.</p>
	<p>T12b/α</p> <p>ER: S: Id-number 1, Jens Hansen. Where does the journey start? U: No it was not Jens Hansen. Id-number 1 is Lars Bo Larsen.</p> <p>EX: The user is too occupied with the present problem to remember to use 'change'.</p> <p>PM: 'Change' is not natural. Prefer mixed-initiative meta-communication.</p>
	<p>T12b/α (copy to GP1)</p> <p>ER: S: Do you want more? U: Yes, I have a correction.</p> <p>EX: The user wants to change the name of the traveller in the previous reservation and probably thinks that there may be an easy way in which to do this.</p> <p>PM: Revise question into: 'Do you want to make another reservation?'.</p>
	<p>T12b/β</p> <p>ER: S: Customer number 3. How many persons will travel? U: I just ordered a ticket to Aalborg and I want it to be for Lars Bo Larsen and not for Jens Hansen.</p> <p>EX: The user is too occupied with the present problem to remember to use 'change'.</p> <p>PM: 'Change' is not natural. Prefer mixed-initiative meta-communication.</p>
	<p>G53a</p> <p>ER: S: Saturday 28.1. At what time? U: Wrong.</p> <p>EX: The user is too occupied with the present problem to remember to use 'change'.</p> <p>PM: 'Change' is not natural. Prefer mixed-initiative meta-communication.</p>

User Error Type	Error Occurrences in Dialogue
<p>U5.</p> <p>Asking questions</p>	<p>T12a ER: S: At what time? U: Which are the possibilities? EX: This is a very natural question when the user does not know the exact departure times. PM: Mixed-initiative. Reservation is informed reservation.</p> <hr/> <p>T13a (copy to GP1) (copy to SP6) ER: S: Do you want more? U: Did I get a discount? EX: The user wants discount and does not know that this is unavailable on one-way journeys. PM: The system should take into account users' background knowledge, e.g. by mentioning if the user has chosen one-way tickets that discount cannot be obtained. Revise question into: 'Do you want to make another reservation?'.</p> <hr/> <p>G22a ER: S: Red afternoon departures are fully booked. At what time? U: What about in the evening then? EX: The user reply is an indirect answer expressed as a question. The question stems from the fact that two earlier attempts to indicate departure time have failed because flights were booked. So the context is unusual. PM: None. Indirect answers normally contain the time expressions expected by the system.</p> <hr/> <p>G23a ER: S: Green morning departures are fully booked. At what time? U: Is there anything between 9 and 12 o'clock? EX: The user reply is an indirect answer expressed as a question. The question stems from the fact that one earlier attempt to indicate departure time has failed because flights were booked. So the context is unusual. PM: None. Indirect answers normally contain the time expressions expected by the system.</p>

User Error Type	Error Occurrences in Dialogue-1
<p>U6.</p> <p>Answering several questions at a time</p>	<p>T31a1 ER: S: At what date does the journey start? U: The journey starts on Friday at 8:15. EX: Natural user answer. PM: Allow naturally related information, like date and time, to be given in the same user answer, cf. our route solution.</p>
	<p>T31a1 ER: S: At what date does the journey start? U: The journey starts on Friday January 23 at 8:15. EX: Natural user answer. PM: Allow naturally related information, like date and time, to be given in the same user answer, cf. our route solution.</p>
	<p>T31a1 (copy to GP1) ER: S: Do you want more? U: Yes, I have two people who are going to Aalborg on Monday January 23 in the morning. EX: The system's question is too open and non-specific, and invites the user to take the initiative. PM: Revise question into: 'Do you want to make another reservation?'.</p>
	<p>T32a ER: S: At what time? U: Saturday at 7:20. EX: Natural user answer. By saying Saturday the user wants to make a change. PM: Allow naturally related information, like date and time, to be given in the same user answer, cf. our route solution.</p>
	<p>T51a/α ER: S: At what time? U: I want to travel in the morning at 7:30 and return at 19:00. EX: Natural user answer. PM: Allow out and home time, on the same day, to be combined in user input.</p>
<p>T52a ER: S: The destination is Karup. Is that correct? U: No, change. EX: Natural user answer. PM: Let the system accept the two answers and act on 'change'.</p>	

User Error Type	Error Occurrences in Dialogue-2
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<p>U6. (continued)</p> <p>Answering several questions at a time</p>	<p>T53a/α ER: S: There is no departure at 9 o'clock. The closest other departure is at 17:00. Do you want this departure? U: No, change. EX: Natural user answer. PM: Let the system accept the two answers and act on 'change'.</p>
	<p>T53a/α ER: S: At what time? U: From Copenhagen at 8 o'clock in the morning. EX: The user may be influenced by misleading system utterance (GP6). PM: None, except for GP6.</p>
	<p>T54a1 ER: S: Please state your customer number. U: Four, no sorry, change. Change. EX: The user confuses customer number and id-number and discovers the mistake. PM: None (slip).</p>
	<p>T11b/α (copy to GP1) ER: S: Do you want more? U: Yes please, I want to book one more ticket like this. EX: The system's question is too open and non-specific, and invites the user to take the initiative. PM: Revise question into: 'Do you want to make another reservation?'.</p>
	<p>T13b ER: S: Return Monday 6.3.? Is that correct? U: No, change. EX: Natural user answer. PM: Let the system accept the two answers and act on 'change'.</p>
	<p>T14b/α ER: S: Customer number 4. Is that correct? U: No, change. EX: Natural user answer. PM: Let the system accept the two answers and act on 'change'.</p>
	<p>T14b/α ER: S: At what time? U: At 7:15 and back at 17:45. EX: Natural user answer. PM: Allow out and home time, on the same day, to be combined in user input.</p>
	<p>G54a1-2 ER: S: At what time? U: 15:45 from Esbjerg. EX: The user may be influenced by S10. PM: None, except for S10.</p>

User Error Type	Error Occurrences in Dialogue
<p>U7.</p> <p>Thinking aloud</p>	<p>G22a</p> <p>ER: S: At which date does the journey start? U: I suppose the date of departure must be 16.1.</p> <p>EX: The system has twice misunderstood January 23 which was the date of departure for the out journey given in the scenario. Then the user seems to conclude that this date must be wrong since the system apparently will not accept it. Instead s/he chooses a date for the out journey one week earlier than indicated in the scenario.</p> <p>PM: The user's first answer to date of departure was quite straightforward: 'the journey starts on January 23'. For some reason this is misrecognised by the text recogniser although it should be acceptable. The best cure would be to ensure a better grammar coverage.</p> <hr/> <p>G22a</p> <p>ER: S: At which date does the home journey start? U: The home journey must be 20.1.</p> <p>EX: The system has twice misunderstood January 23 which was the date of departure for the out journey given in the scenario. Then the user seems to conclude that this date must be wrong since the system apparently will not accept it. Instead s/he chooses dates for out and home journey one week earlier than indicated in the scenario.</p> <p>PM: The user's first answer to date of departure was quite straightforward: 'the journey starts on January 23'. For some reason this is misrecognised by the text recogniser although it should be acceptable. The best cure would be to ensure a better grammar coverage.</p> <hr/> <p>G31a1</p> <p>ER: S: At what time? U: Well, let me see, at 8:30 at the latest.</p> <p>EX: The user seems to want to gain time while examining the (graphic) scenario.</p> <p>PM: None. People sometimes have to make inferences during reservation, e.g. from the intended arrival time. The expression 'at the latest' should be incorporated in the system's vocabulary and be understood together with the quantitative expression '8:30'.</p>

User Error Type	Error Occurrences in Dialogue
<p>U8.</p> <p>Indirect answer</p>	<p>T13a, T13a (copy to SP6)</p> <p>ER: S: At what time? U: It must be as cheap as possible. When the system asks the same question again the user answers ‘Cheap’.</p> <p>EX: The user wants a discount ticket but since s/he has asked for a one-way ticket this is not possible and the system does not offer it. However, the user does not know this and wants to let the hour of departure depend on when there is a cheap departure.</p> <p>PM: None, except T13a (U5).</p>

User Error Type	Error Occurrences in Dialogue
<p>U9.</p> <p>Non-co-operativity</p>	<p>G44a</p> <p>ER: S: Should the ticket be sent or will it be picked up in the airport? U: It should not be sent.</p> <p>EX: The user obviously tries to test the system. As (probably) expected, the system misunderstands the user’s answer and says in the feedback that the ticket will be sent.</p> <p>PM: None. Non-co-operative users will always be able to fool a system.</p>

User Error Type	Error Occurrences in Dialogue
<p>U10.</p> <p>Overlapping speech</p>	<p>T21a (copy to SP4) ER: S: Do you want a return ticket? U: No we will book that one later.[Pause] U: It is okay. They are not going back. S: Red discount is possible on certain weekday departures... EX: Phatic. A common way for humans in which to express that they follow the conversation and are interested while the interlocutor talks. In particular pauses may be filled in this way. However, the system does not listen during its own turns, and users were not informed on this. PM: Inform users that the system does not listen during its own turns or change the system so that it listens during its own turns.</p> <hr/> <p>T21a (copy to SP4) ER: S: At 11:10. U: Yes, please. S: You have now booked ... EX: Phatic. A common way for humans in which to express that they follow the conversation and are interested while the interlocutor talks. In particular pauses may be filled in this way. However, the system does not listen during its own turns, and users were not informed on this. PM: Inform users that the system does not listen during its own turns or change the system so that it listens during its own turns.</p> <hr/> <p>T22a/α (copy to SP4) ER: S: To Aalborg. U: Yes. S: Do you want a return ticket? EX: Phatic. A common way for humans in which to express that they follow the conversation and are interested while the interlocutor talks. In particular pauses may be filled in this way. However, the system does not listen during its own turns, and users were not informed on this. PM: Inform users that the system does not listen during its own turns or change the system so that it listens during its own turns.</p> <hr/> <p>T22a/α (copy to SP4) ER: At 19:00. U: Yes, please. S: You have now booked ... EX: Phatic. A common way for humans in which to express that they follow the conversation and are interested while the interlocutor talks. In particular pauses may be filled in this way. However, the system does not listen during its own turns, and users were not informed on this. PM: Inform users that the system does not listen during its own turns or change the system so that it listens during its own turns.</p> <hr/> <p>T22a/β (copy to SP4) ER: At 19:00. U: Yes, please. S: You have now booked ... EX: Phatic. A common way for humans in which to express that they follow the conversation and are interested while the interlocutor talks. In particular pauses may be filled in this way. However, the system does not</p>

	<p>listen during its own turns, and users were not informed on this.</p>
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PM: Inform users that the system does not listen during its own turns or change the system so that it listens during its own turns.

User Error Type	Error Occurrences in Dialogue
<p>U10. (continued)</p> <p>Overlapping speech</p>	<p>T23a (copy to SP4) ER: At 22:30. U: Yes, please. S: You have now booked ... EX: Phatic. A common way for humans in which to express that they follow the conversation and are interested while the interlocutor talks. In particular pauses may be filled in this way. However, the system does not listen during its own turns, and users were not informed on this. PM: Inform users that the system does not listen during its own turns or change the system so that it listens during its own turns.</p> <hr/> <p>T24a (copy to SP4) ER: At 17:30. U: Yes, please. S: You have now booked ... EX: Phatic. A common way for humans in which to express that they follow the conversation and are interested while the interlocutor talks. In particular pauses may be filled in this way. However, the system does not listen during its own turns, and users were not informed on this. PM: Inform users that the system does not listen during its own turns or change the system so that it listens during its own turns.</p> <hr/> <p>T31a2 (copy to SP4) ER: S: Customer number 2. Is that correct? U: No id-numbers 1 and 4. S: Customer number 4. U: Wrong, the customer number is 2. S: How many people will travel? EX: Change through comments. However, the system does not listen during its own turns, and users were not informed on this. PM: Inform users that the system does not listen during its own turns or change the system so that it listens during its own turns.</p> <hr/> <p>T32a (copy to SP4) ER: S: Customer number 3. U Yes. S: How many people will travel? EX: Phatic. A common way for humans in which to express that they follow the conversation and are interested while the interlocutor talks. In particular pauses may be filled in this way. However, the system does not listen during its own turns, and users were not informed on this. PM: Inform users that the system does not listen during its own turns or change the system so that it listens during its own turns.</p> <hr/> <p>T41a (copy to SP4) ER: S: Id-numbers 2 and 5, RH and AH. U: Yes. S: Where does the journey start? EX: Phatic. A common way for humans in which to express that they follow the conversation and are interested while the interlocutor talks. In particular pauses may be filled in this way. However, the system does not listen during its own turns, and users were not informed on this.</p>

	PM: Inform users that the system does not listen during its own turns or change the system so that it listens during its own turns.
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User Error Type	Error Occurrences in Dialogue
<p>U10. (continued)</p> <p>Overlapping speech</p>	<p>T41a (copy to SP4) ER: S: Tuesday, January 31. U: Yes. S: At which time? EX: Phatic. A common way for humans in which to express that they follow the conversation and are interested while the interlocutor talks. In particular pauses may be filled in this way. However, the system does not listen during its own turns, and users were not informed on this. PM: Inform users that the system does not listen during its own turns or change the system so that it listens during its own turns.</p> <hr/> <p>T41a (copy to SP4) ER: S: At 8:00. U: Yes. S: On which date will the return journey start? EX: Phatic. A common way for humans in which to express that they follow the conversation and are interested while the interlocutor talks. In particular pauses may be filled in this way. However, the system does not listen during its own turns, and users were not informed on this. PM: Inform users that the system does not listen during its own turns or change the system so that it listens during its own turns.</p> <hr/> <p>T41a (copy to SP4) ER: S: Tuesday, January 31. U: Yes. S: At which time? EX: Phatic. A common way for humans in which to express that they follow the conversation and are interested while the interlocutor talks. In particular pauses may be filled in this way. However, the system does not listen during its own turns, and users were not informed on this. PM: Inform users that the system does not listen during its own turns or change the system so that it listens during its own turns.</p> <hr/> <p>T41a (copy to SP4) ER: At 19:50. U: Yes. S: You have now booked ... EX: Phatic. A common way for humans in which to express that they follow the conversation and are interested while the interlocutor talks. In particular pauses may be filled in this way. However, the system does not listen during its own turns, and users were not informed on this. PM: Inform users that the system does not listen during its own turns or change the system so that it listens during its own turns.</p> <hr/> <p>T41a (copy to SP4) ER: S: You have now booked ... The total price is 1360 kr. U: Yes. S: Should the tickets be sent or will they be picked up at the airport? EX: Phatic. A common way for humans in which to express that they follow the conversation and are interested while the interlocutor talks. In particular pauses may be filled in this way. However, the system does not listen during its own turns, and users were not informed on this.</p>

	PM: Inform users that the system does not listen during its own turns or change the system so that it listens during its own turns.
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User Error Type	Error Occurrences in Dialogue
<p>U10. (continued)</p> <p>Overlapping speech</p>	<p>T42a (copy to SP4) ER: S: Customer number 4. U: Yes. S: How many people will travel? EX: Phatic. A common way for humans in which to express that they follow the conversation and are interested while the interlocutor talks. In particular pauses may be filled in this way. However, the system does not listen during its own turns, and users were not informed on this. PM: Inform users that the system does not listen during its own turns or change the system so that it listens during its own turns.</p> <hr/> <p>T42a (copy to SP4) ER: S: To Esbjerg. U: Yes. S: Do you want a return ticket? EX: Phatic. A common way for humans in which to express that they follow the conversation and are interested while the interlocutor talks. In particular pauses may be filled in this way. However, the system does not listen during its own turns, and users were not informed on this. PM: Inform users that the system does not listen during its own turns or change the system so that it listens during its own turns.</p> <hr/> <p>T43a (copy to SP4) ER: S: To Billund. U: No. S: Do you want a return ticket? EX: Change through comments. However, the system does not listen during its own turns, and users were not informed on this. PM: Inform users that the system does not listen during its own turns or change the system so that it listens during its own turns.</p> <hr/> <p>T43a (copy to SP4) ER: S: The journey ends in Billund. U: Change. S: Is that correct? EX: Change through keyword. However, the system does not listen during its own turns, and users were not informed on this. PM: Inform users that the system does not listen during its own turns or change the system so that it listens during its own turns.</p> <hr/> <p>T43a (copy to SP4) ER: S: To Odense. U: Yes. S: The journey starts in Copenhagen. Is that correct? EX: Phatic. A common way for humans in which to express that they follow the conversation and are interested while the interlocutor talks. In particular pauses may be filled in this way. However, the system does not listen during its own turns, and users were not informed on this. PM: Inform users that the system does not listen during its own turns or change the system so that it listens during its own turns.</p>

User Error Type	Error Occurrences in Dialogue
<p>U10. (continued)</p> <p>Overlapping speech</p>	<p>T44a (copy to SP4)</p> <p>ER: S: Customer number 2. U: Yes. S: How many people will travel?</p> <p>EX: Phatic. A common way for humans in which to express that they follow the conversation and are interested while the interlocutor talks. In particular pauses may be filled in this way. However, the system does not listen during its own turns, and users were not informed on this.</p> <p>PM: Inform users that the system does not listen during its own turns or change the system so that it listens during its own turns.</p> <hr/>
	<p>T44a (copy to SP4)</p> <p>ER: At 6:45. U: Yes. S: You have now booked ...</p> <p>EX: Phatic. A common way for humans in which to express that they follow the conversation and are interested while the interlocutor talks. In particular pauses may be filled in this way. However, the system does not listen during its own turns, and users were not informed on this.</p> <p>PM: Inform users that the system does not listen during its own turns or change the system so that it listens during its own turns.</p> <hr/>
	<p>T51a/β (copy to SP4)</p> <p>ER: S: Friday, February 10. U: Yes. S: At which time?</p> <p>EX: Phatic. A common way for humans in which to express that they follow the conversation and are interested while the interlocutor talks. In particular pauses may be filled in this way. However, the system does not listen during its own turns, and users were not informed on this.</p> <p>PM: Inform users that the system does not listen during its own turns or change the system so that it listens during its own turns.</p> <hr/>
	<p>T54a1 (copy to SP4)</p> <p>ER: S: Customer number 2. U: Yes. S: How many people will travel?</p> <p>EX: Phatic. A common way for humans in which to express that they follow the conversation and are interested while the interlocutor talks. In particular pauses may be filled in this way. However, the system does not listen during its own turns, and users were not informed on this.</p> <p>PM: Inform users that the system does not listen during its own turns or change the system so that it listens during its own turns.</p> <hr/>
	<p>T54a2 (copy to SP4)</p> <p>ER: S: 1 person. U: Yes. S: Please state the id-number of the person.</p> <p>EX: Phatic. A common way for humans in which to express that they follow the conversation and are interested while the interlocutor talks. In particular pauses may be filled in this way. However, the system does not listen during its own turns, and users were not informed on this.</p> <p>PM: Inform users that the system does not listen during its own turns or</p>

	change the system so that it listens during its own turns.
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User Error Type	Error Occurrences in Dialogue
<p>U10. (continued)</p> <p>Overlapping speech</p>	<p>T12b/α (copy to SP4) ER: S: From Aalborg. U: Yes. S: Where does the journey end? EX: Phatic. A common way for humans in which to express that they follow the conversation and are interested while the interlocutor talks. In particular pauses may be filled in this way. However, the system does not listen during its own turns, and users were not informed on this. PM: Inform users that the system does not listen during its own turns or change the system so that it listens during its own turns.</p> <hr/> <p>T13b (copy to SP4) ER: S: Sunday, February 12. U: Yes. S: At which time? EX: Phatic. A common way for humans in which to express that they follow the conversation and are interested while the interlocutor talks. In particular pauses may be filled in this way. However, the system does not listen during its own turns, and users were not informed on this. PM: Inform users that the system does not listen during its own turns or change the system so that it listens during its own turns.</p> <hr/> <p>T13b (copy to SP4) ER: At 17:00. U: Yes, please. S: You have now booked ... EX: Phatic. A common way for humans in which to express that they follow the conversation and are interested while the interlocutor talks. In particular pauses may be filled in this way. However, the system does not listen during its own turns, and users were not informed on this. PM: Inform users that the system does not listen during its own turns or change the system so that it listens during its own turns.</p> <hr/> <p>T14b/α (copy to SP4) ER: S: 15:45 is not a valid time. U: Change. S: At which time? EX: Change through keyword. However, the system does not listen during its own turns, and users were not informed on this. PM: Inform users that the system does not listen during its own turns or change the system so that it listens during its own turns.</p> <hr/> <p>G11a (copy to SP4) ER: S: ... Do you want one of these departures? U: Yes 9:10. [typed 'yes'] S: Which? U: 9:10. U: 9:10. EX: User response is simultaneous with system question. PM: Inform users that the system does not listen during its own turns or change the system so that it listens during its own turns.</p> <hr/> <p>G32a (copy to SP4) ER: At 22:40. U: Yes. S: You have now booked ...</p>

	<p>EX: Phatic. A common way for humans in which to express that they follow the conversation and are interested while the interlocutor talks. In particular pauses may be filled in this way. However, the system does not listen during its own turns, and users were not informed on this.</p> <p>PM: Inform users that the system does not listen during its own turns or change the system so that it listens during its own turns.</p>
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User Error Type	Error Occurrences in Dialogue
<p>U10. (continued)</p> <p>Overlapping speech</p>	<p>G34a (copy to SP4)</p> <p>ER: At 17:45. U: Yes. S: You have now booked ...</p> <p>EX: Phatic. A common way for humans in which to express that they follow the conversation and are interested while the interlocutor talks. In particular pauses may be filled in this way. However, the system does not listen during its own turns, and users were not informed on this.</p> <p>PM: Inform users that the system does not listen during its own turns or change the system so that it listens during its own turns.</p> <hr/> <p>G44a (copy to SP4)</p> <p>ER: S: The ticket will be sent to you in a couple of days. U: Change. S: Do you want anything else?</p> <p>EX: Change through keyword. However, the system does not listen during its own turns, and users were not informed on this.</p> <p>PM: Inform users that the system does not listen during its own turns or change the system so that it listens during its own turns.</p>

Appendix 12 Overview of tasks and dialogues

Each scenario typically contained one task. Only one scenario contained two tasks which is marked by an appended 1 or 2 in the table below. One other scenario could only be solved by splitting it into two reservations which is marked by an appended 1&2 below. If users did not succeed in achieving their goal the first time they would sometimes initiate a new dialogue and perform the same scenario again. Such cases are marked by α , β and γ below. Scenarios leading to transaction failures are boldfaced.

Tasks	Text-based dialogues	Graphics-based dialogues
1	T-1-1-a	G-1-1-a
2	T-1-2-a	G-1-2-a
3	T-1-3-a	G-1-3-a
4	T-1-4-a	G-1-4-a
5	T-2-1-a	G-2-1-a
6	T-2-2-a- α	G-2-2-a
	T-2-2-a- β	
7	T-2-3-a	G-2-3-a
8	T-2-4-a	G-2-4-a
9	T-3-1-a-1	G-3-1-a-1
10	T-3-1-a-2	G-3-1-a-2
11	T-3-2-a	G-3-2-a
12	T-3-3-a	G-3-3-a
13	T-3-4-a	G-3-4-a
14	T-4-1-a	G-4-1-a
15	T-4-2-a	G-4-2-a
16	T-4-3-a	G-4-3-a
17	T-4-4-a	G-4-4-a
18	T-5-1-a- α	G-5-1-a
	T-5-1-a- β	
19	T-5-2-a	G-5-2-a
20	T-5-3-a- α	G-5-3-a
	T-5-3-a- β	
	T-5-3-a- γ	
21	T-5-4-a-1&2	G-5-4-a-1&2
22	T-1-1-b- α	G-1-1-b
	T-1-1-b- β	
23	T-1-1-b- α	G-1-2-b
	T-1-2-b- β	
24	T-1-3-b	G-1-3-b
25	T-1-4-b- α	G-1-4-b
	T-1-4-b- β	

Appendix 13 Transaction failures

Totally, subjects were given 50 tasks distributed on 48 scenarios. The number of recorded dialogues was 57 because users sometimes reiterated a failed dialogue and eventually succeeded with the task. A *task* consists in ordering one or more tickets for one route. A *dialogue* is one path through the dialogue structure.

Transaction failures	T21a, T31a2, T32a G22a, G24a, G31a2, G54a1-2
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Table 1. The user test produced six transaction failures. The scenarios on which users failed are listed in the table.

Task transaction success = $43/50\% = 86\%$

Dialogue transaction success = $43/57\% = 75.4\%$

Successes include:

- reservations according to the scenario specification;
- reservations according to the user's mistaken interpretation of the scenario.

Failures include:

- reservations in which the user failed to get what was asked for.

The seven transaction failures were caused by:

- SP2: missing feedback (T21a)
- U10 (SP4): overlapping speech (T31a2)
- U2: ignoring feedback (T32a)
- GP5: irrelevant response (G22a)
- SP11+U2: ambiguous user input + ignoring feedback (G24a)
- SP11: ambiguous user input (G31a2)
- SP5: undersupported user navigation (G54a1-2)

Appendix 14 Violated co-operative principles

All system problems found in the user test material were measured against a set of co-operative principles which we had developed during design and implementation of the dialogue module of the Danish dialogue system. These principles are presented below and it is indicated which of them were violated in the user test material.

DIALOGUE ASPECT	GP No.	GENERIC PRINCIPLE
GROUP 1: INFORMATIVENESS	GP1	*MAKE YOUR CONTRIBUTION AS INFORMATIVE AS IS REQUIRED (FOR THE CURRENT PURPOSES OF THE EXCHANGE).
	GP2	*DO NOT MAKE YOUR CONTRIBUTION MORE INFORMATIVE THAN IS REQUIRED.
GROUP 2: TRUTH AND EVIDENCE	GP3	*DO NOT SAY WHAT YOU BELIEVE TO BE FALSE.
	GP4	*DO NOT SAY THAT FOR WHICH YOU LACK ADEQUATE EVIDENCE.
GROUP 3: RELEVANCE	GP5	*BE RELEVANT, I.E. BE APPROPRIATE TO THE IMMEDIATE NEEDS AT EACH STAGE OF THE TRANSACTION.
GROUP 4: MANNER	GP6	*AVOID OBSCURITY OF EXPRESSION.
	GP7	*AVOID AMBIGUITY.
	GP8	*BE BRIEF (AVOID UNNECESSARY PROLIXITY).
	GP9	*BE ORDERLY.
GROUP 5: PARTNER ASYMMETRY	GP10	INFORM THE DIALOGUE PARTNERS OF IMPORTANT NON-NORMAL CHARACTERISTICS WHICH THEY SHOULD TAKE INTO ACCOUNT IN ORDER TO BEHAVE CO-OPERATIVELY IN DIALOGUE.
GROUP 6: BACKGROUND KNOWLEDGE	GP11	TAKE PARTNERS' RELEVANT BACKGROUND KNOWLEDGE INTO ACCOUNT.
	GP12	TAKE INTO ACCOUNT LEGITIMATE PARTNER EXPECTATIONS AS TO YOUR OWN BACKGROUND KNOWLEDGE.
GROUP 7: REPAIR AND CLARIFICATION	GP13	INITIATE REPAIR OR CLARIFICATION META-COMMUNICATION IN CASE OF COMMUNICATION FAILURE.

Figure 1. The generic principles that were *not* found violated in the user test are indicated in dark shading. Generic principles were either violated directly or via their specific siblings (see Figure 2).

DIALOGUE ASPECT	GP No.	SP No.	SPECIFIC PRINCIPLE
GROUP 1: INFORMATIVENESS	GP1	SP1	BE FULLY EXPLICIT IN COMMUNICATING TO USERS THE COMMITMENTS THEY HAVE MADE.
	GP1	SP2	PROVIDE FEEDBACK ON EACH PIECE OF INFORMATION PROVIDED BY THE USER.
GROUP 2: TRUTH AND EVIDENCE			
GROUP 3: RELEVANCE			
GROUP 4: MANNER	GP7	SP3	PROVIDE SAME FORMULATION OF THE SAME QUESTION (OR ADDRESS) TO USERS EVERYWHERE IN THE SYSTEM'S DIALOGUE TURNS.
GROUP 5: PARTNER ASYMMETRY	GP10	SP4	PROVIDE CLEAR AND COMPREHENSIBLE COMMUNICATION OF WHAT THE SYSTEM CAN AND CANNOT DO.
	GP10	SP5	PROVIDE CLEAR AND SUFFICIENT INSTRUCTIONS TO USERS ON HOW TO INTERACT WITH THE SYSTEM.
GROUP 6: BACKGROUND KNOWLEDGE	GP11	SP6	TAKE INTO ACCOUNT POSSIBLE (AND POSSIBLY ERRONEOUS) USER INFERENCES BY ANALOGY FROM RELATED TASK DOMAINS.
	GP11	SP7	SEPARATE WHENEVER POSSIBLE BETWEEN THE NEEDS OF NOVICE AND EXPERT USERS (USER-ADAPTIVE DIALOGUE).
	GP12	SP8	PROVIDE SUFFICIENT TASK DOMAIN KNOWLEDGE AND INFERENCE.
GROUP 7: REPAIR AND CLARIFICATION	GP13	SP9	PROVIDE ABILITY TO INITIATE REPAIR IF SYSTEM UNDERSTANDING HAS FAILED.
	GP13	SP10	INITIATE CLARIFICATION META-COMMUNICATION IN CASE OF INCONSISTENT USER INPUT.
	GP13	SP11	INITIATE CLARIFICATION META-COMMUNICATION IN CASE OF AMBIGUOUS USER INPUT.

Figure 2. The specific principles that were *not* found violated in the user test are indicated in dark shading.

Grice's Co-operative Principle (CP) says that, to act co-operatively in conversation, one should make one's "conversational contribution such as is required, at the stage at which it occurs, by the accepted purpose or direction of the talk exchange in which one is engaged" (Grice, 1975). Grice proposes that the CP can be further explicated in terms of four groups of simple maxims. These maxims are marked with an asterisk in Figure 1.

In spoken language dialogue systems design, maximise the naturalness of user and system dialogue within the constraints imposed on the development process by science, technology and resources.

Appendix 15 Priming and vocabulary

Appendix 16 Meta-communication

The need for repair and clarification meta-communication is quite common in general and is very important in spoken language dialogue systems (SLDSs). However, state-of-the-art SLDSs are not capable of handling free mixed initiative dialogue as would be required if users were allowed to meta-communicate as they are used to from human-human dialogue. Therefore the optimal solution seems to be to minimise the need for meta-communication. The dialogue model for the Danish dialogue system was designed to be as co-operative as possible in order to avoid the need for free repair and clarification dialogue which the system would not be able to handle. However, given the present quality of speech recognisers, the need for making corrections still exists no matter how co-operative the dialogue is. In the Danish dialogue system the user is offered the possibility of initiating repair meta-communication to correct misunderstandings by using the keyword 'change'. Users are also allowed to initiate clarification dialogue through the use of the keyword 'repeat'. With respect to domain communication the system is completely system-directed. The system's possibilities of initiating meta-communication are limited to informing the user that it did not understand the input and, if the user does not answer for a long time, to ask if s/he is still present.

15.1 User meta-communication

Whenever the user uses words and/or grammar that do not belong to the system's sub-language there is a good chance that the system will misunderstand the user. In situations of misunderstanding, we experienced during the user test that, as expected, the use of keywords is not an optimal solution. It is an unnatural form of communication and users tend to forget it, in particular when they are trying to solve some problem and thus are overloaded in other respects already. Then users tend to fall back on what they are used to do which is not the use of a keyword but an entire sentence expressing what they want to repair. Such freely expressed repair utterances are a problem in system-directed dialogue. It is very unlikely that the system will understand them correctly. Typically, the system will either misunderstand such utterances or not understand them at all. In our user test material of 57 dialogues performed by 12 subjects, we found 17 cases of attempts to correct through comments, cf. Table 1. Only in one of these was the user's intention correctly understood. This was when the user used another (out-of-vocabulary) keyword than 'change' which the system interpreted as 'change'. In the 16 remaining cases the system either totally misunderstood the utterance, understood only part of the utterance (e.g. 'no') but not what the user intended to repair, or did not understand at all, cf. Appendix 11. Such free-style corrections tend to consist in long utterances. The maximum user utterance length should preferably not exceed 10 words. In 17 cases in the user test longer utterances were registered of which non-keyword corrections counted for the majority.

In 31 cases subjects used the keyword 'change' when they wanted to initiate repair dialogue. Only in 19 cases the keyword 'change' was used entirely correctly. In 8 cases 'change' was preceded by 'yes' or 'no' or 'no thanks' and hence subjects actually answered two questions at a time, cf. Appendix 11. In 4 other cases the user said 'change' during a pause in the system's turn. The system does not listen during its own turn, however, and hence does not react to what the user might have said in this time slot. Unfortunately, users were never told that the system does not listen during its own turns. Normally, users found out. But in one case where the user had made a correction through a comment while the

system did not listen, this became the cause of a transaction failure. The user erroneously thought that the correction had been executed, cf. Appendices 11 and 13.

‘Change’ can be used repeatedly if the user needs to change information which was not given in the most recent user utterance. Users were not informed on this. One user actually found out by trial and error and exploited it to solve the task correctly. In a couple of other cases users managed to get two steps backward in the dialogue by accident and not because they wanted to do so. This happened in the following way: The user says ‘change’ with the purpose of correcting the most recent piece of information. The system repeats its feedback on the most recent user utterance and asks if it is correct. The user says ‘no, change’. If this is understood as change, the system will go one step further backwards and ask if the penultimate piece of information provided by the user is correct. The dialogue should be made more clear so that the user will not use ‘change’ in cases where this is not needed, or when the system asks ‘is that correct’ and the user answers ‘no, change’ this should be interpreted as ‘no’ and not as ‘change’.

The need for clarification dialogue was very modest. Only in 4 cases did users initiate clarification dialogue through the use of the keyword ‘repeat’. Two of these cases more or less served to fill a pause. No attempts were observed of the use of comments to have the system repeat its latest utterance. However, one user question was a request for clarification (‘Did I get a discount?’). This question was triggered because the system does not mention discount in connection with one-way ticket reservation. However, the user believed that discount might be possible in this case and expected the system to mention it. When it turned out that it did not do so the user asked a clarification question.

User test		
No. of subjects	12	
No. of dialogues	57	
	User	System
No. of turns	998	998
No. of turns > 10 tokens	17	253
Turns > 10 tokens in % of all turns	1.70	25.35
Corrections through comments	17	-
Corrections through ‘change’ preceded by yes or no	8	-
Corrections through ‘change’ only	19	-
Corrections through ‘change’ but overlap with system turn	4	-
No. of ‘repeat’	4	-
No. of ‘Sorry, I did not understand’	-	15
No. of ‘Sorry’ + repetition		9
No. of ‘are you still there’	-	0

User turn correction ratio in %	4.41	-
User turn meta-communication ratio in %	4.81	-
System turn meta-communication ratio in %	-	2.40

Table 1. Data on meta-communication in the user test corpus. The total percentage of turns spent on meta-communication was 3.61.

15.2 System meta-communication

The system's possibilities of initiating meta-communication were limited, as mentioned, to telling the user that it had not understood what was said and, if the user did not answer for a long time, the system would say that it was waiting for an answer. The latter case did not occur in the user test. The former case occurred in two variations. Whenever the parser did not deliver anything at all to the dialogue handler or delivered non-usable values different from 'yes' and 'no', the system would say 'sorry, I did not understand'. If the dialogue handler instead received a 'yes' or 'no' from the parser in situations where these were not usable answers, e.g. if the user had been asked for a date of departure, the system would say 'sorry' and repeat its previous question. The first variation was found in 15 cases, the latter in 9 cases. Both variations basically occurred as a result of insufficient system sub-language. In about half of the cases the user answers were actually to the point but included words or grammar outside of the sub-language. In the other half, user answers were not exact or not to the point and also contained words or grammar outside of the system's sub-language.

The message 'I did not understand' is not very informative. Obviously it would be preferable if the system could express more precisely what it did not understand. This could be done by handling partial understanding. For instance, the system could express such partial understanding by saying 'you want to travel in January but on which day of the month?'. Or, if the system was not confident in having understood the user correctly, it could ask the user to confirm the correctness of what it had understood.