Cleared for take-off: Game-based learning to prepare airline pilots for critical situations

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Appendix A

Background

In this appendix, belonging to Chapter 2, we present an overview of training delivery methods commonly used in airline pilot training.

Appendix A.1
Training delivery methods

Training method	Description
Briefing & debriefing	During the briefing [56, 63, 92, 161], immediately before an exercise, the instructor explains what is expected of the student and answers any questions. Afterwards, the instructor gives a concise debrief of the student's performance, including strengths, weaknesses and suggestions for improvement. The student's own assessment of his performance should also be discussed.
Case-study	In a case study [12, 189], the instructor provides students with an account of a real world situation, for them to learn from the actions taken and outcomes achieved. Students work in groups to review and analyse the case, come to conclusions and think of possible solutions. Case study requires critical thinking.
Chair flying	Chair flying is a visualisation technique that allows the student to practice his thought processes, develop cockpit flows and go through manoeuvres [56, 92]. It is also useful for mentally preparing for a next exercise.
Computer-based training	Computer-based training [12, 56, 92, 189], or e-learning, comes in many formats. Multimedia technology is used to prepare and deliver learning content, and to engage students in their learning process. Computer-based training is usually an interactive tool that allows students to progress at their individual speed.
Demonstration-Performance	Before the demonstration [12, 63, 161, 189], the instructor explains what he is going to do. Then he demonstrates a certain skill, step-by-step. The students observe and then get the chance to practice their performance of each step under supervision, in order to master the skill.
Discussion	In a (guided) discussion [12, 63, 189], the instructor may present a short lecture or introduce a proposition, which is followed by an exchange of views and ideas to explore topics and investigate solutions to a problem. The instructor may encourage all students to participate through asking questions.
Drill & practice	The drill and practice method [12, 189] offers systematic repetition of certain knowledge or skills, to improve retention and to lead to habitual use. The instructor provides opportunities to practice and keeps students focused on the learning objective of the exercise.
Flight Training Devices	Flight training devices [56, 92, 189], or flight simulators, are used in scenario-based training. Different simulators may have different features, such as its fidelity or the use of motion. In the simulator, realistic conditions are created to allow the student to practice his performance in line-oriented situations.
In-seat instruction	In-seat instruction [61, 79, 129, 161] takes places in the actual aircraft and should follow a scripted scenario. After the pre-flight briefing, the instructor performs certain exercises for the purpose of monitoring or intervention by the student. The student should respond according to the behaviour that is expected in line operations.
Lecture	In a lecture or presentation [12, 63, 189], the instructor presents his knowledge on a particular subject. It is a, mostly uninterrupted, one-way transmission of information from the instructor to an audience that can be quite large.
Observation	Throughout an observation [56, 92], a student may observe the performance of other student or of a crew flying an actual aircraft and see how they handle operational issues and work as a team.

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Training method	Description
Print media	Print media, such as books, manuals and handouts, can be used to inform, instruct and motivate students [104]. The instructor can provide the materials, and supplement the reading with other media. Print media provide strictly one-way communication, but can be used in more interactive exercises.
Role-playing	In role-playing exercises [12, 189], two or more people act out different scenarios to practice the relevant behaviour. Students acquire new information, develop skills, connect and manipulate information. Role-playing promotes critical thinking.

Appendix B

The CloudAtlas game: Voluntary play in serious games

In this appendix, belonging to Chapter 4, we present the materials used in the CloudAtlas experiment. In the questionnaires, each group of participants had a set of specific questions relating to their experimental set-up.

Appendix B.1
CloudAtlas pre-experiment questionnaire (Q1)

Welcome in the NLR CloudAtlas Project.

This questionnaire collects some general information about you and tests your prior knowledge. The information is used later on to analyse our data. Only the researchers will have access to any personal information. Before the research data is analysed, all results will be anonymised.

What is your age? *
Please write your answer here:

What is your gender? *
○ Female
○ Male

What pastimes/hobbies are you interested in? *

☐ Cooking/eating out	☐ Reading	☐ Theatre
☐ Computer games	☐ Shopping	☐ Watching TV
☐ Gardening	☐ Social Media	☐ Walking
☐ Movies	☐ Sports	☐ Other

On a scale from 1 to 10, how motivated are you to participate in this experiment? *

	1	2	3	4	5	6	7	8	9	10
Motivation	○	○	○	○	○	○	○	○	○	○

1 = not motivated at all, 10 = extremely motivated

>>> The following questions were asked only in the questionnaires for Experiment 1. <<<

What is the highest level of education you have completed? *
○ Primary education
○ Secondary education
○ Upper secondary education, or vocational
○ Bachelor, Master, Doctoral, or equivalent

For each of the following statements, please indicate how true it is for you.*

	1 Not at all true	2	3 Somewhat true	4	5 Very true
I am personally connected to one of the researchers involved	○	○	○	○	○
I am connected to the NLR, the research institute involved	○	○	○	○	○
I am participating because I would like to win a prize	○	○	○	○	○
I am participating because I am interested in NLR and aviation	○	○	○	○	○
I am participating because I am interested in training and education	○	○	○	○	○
I am participating because I am interested in clouds and meteorology	○	○	○	○	○

>>> The following questions were asked only in the questionnaires for Experiment 2. <<<

Please answer the following questions about your studies.

What school or university are you enrolled in? *
Please write your answer here:

What is your field of study? *
Please write your answer here:

Is this a Bachelor or Master study? *
Please write your answer here:

What is your student number? *
Please write your answer here:

Why are you participating in the CloudAtlas experiment? *
○ I signed up as a volunteer to participate.
○ Participation was assigned as homework.
○ Other.

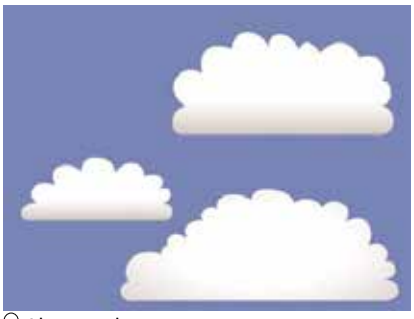
>>> The following question was asked in the questionnaires for Experiment 2 and Experiment 3. <<<

How do you feel about participating in the experiment? *
○ Positive
○ A bit positive
○ Neither positive nor negative
○ A bit negative
○ Negative

>>> The following prior knowledge questions were asked in the questionnaires for Experiment 2 and Experiment 3. <<<

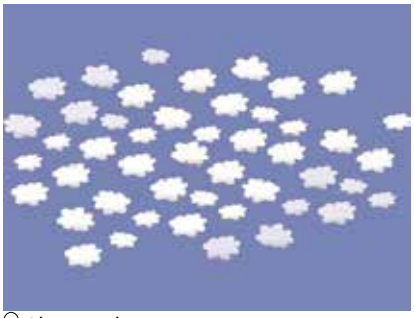
In 1802 British chemist and amateur meteorologist, Luke Howard introduced a classification system for clouds. Which of the following are names that are now used for clouds based on his system? *

☐ Altocumulus	☐ Cirrostratus	☐ Cumulus	☐ Stratocirrus
☐ Altostratus	☐ Cirrus	☐ Nimboaltus	☐ Stratocumulus
☐ Altus	☐ Cumulocirrus	☐ Nimbocumulus	☐ Stratus
☐ Cirrocumulus	☐ Cumulonimbus	☐ Nimbostratus	
☐ Cirronimbus	☐ Cumulostratus	☐ Nimbus	



What is the name of these detached clouds with sharp outlines that look like cauliflowers? *

○ Altocumulus
○ Altostratus
○ Cirrocumulus
○ Cirrostratus
○ Cirrus
○ Cumulonimbus
○ Cumulus
○ Nimbostratus
○ Stratocumulus
○ Stratus



What is the name of these wide sheets of small brilliant white clouds, high up in the air? *

○ Altocumulus
○ Altostratus
○ Cirrocumulus
○ Cirrostratus
○ Cirrus
○ Cumulonimbus
○ Cumulus
○ Nimbostratus
○ Stratocumulus
○ Stratus

What is the name of this thick, grey layer of clouds that produce steady rain? *

○ Altocumulus
○ Altostratus
○ Cirrocumulus
○ Cirrostratus
○ Cirrus
○ Cumulonimbus
○ Cumulus
○ Nimbostratus
○ Stratocumulus
○ Stratus

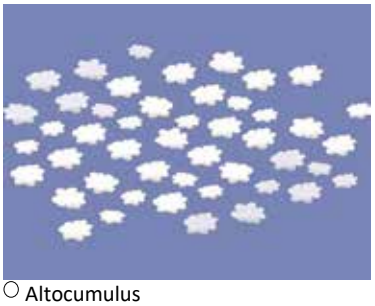
Appendix B.2
CloudAtlas post-experiment questionnaire (Q2)

This is the final survey of the first part of the NLR CloudAtlas Project. You will be asked some questions about clouds to see how much you have learned. Next, we will ask you some questions about the experiment.

*All questions marked with * are mandatory and must be answered.*
If you do not feel ready to take the test yet, you can return to your CloudAtlas Dashboard and spend some more time on the learning materials.

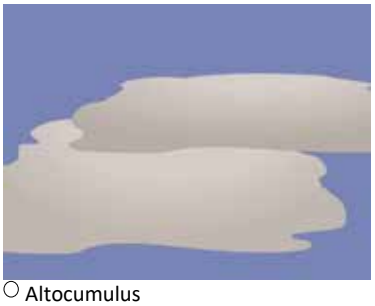
What are the ten main types of clouds? *

- ☐ Altocumulus
- ☐ Altostratus
- ☐ Altus
- ☐ Cirrocumulus
- ☐ Cirronimbus
- ☐ Cirrostratus
- ☐ Cirrus
- ☐ Cumulocirrus
- ☐ Cumulonimbus
- ☐ Cumulostratus
- ☐ Cumulus
- ☐ Nimboaltus
- ☐ Nimbocumulus
- ☐ Nimbostratus
- ☐ Nimbus
- ☐ Stratocirrus
- ☐ Stratocumulus
- ☐ Stratus



What cloud type is this? *

- ○ Altocumulus
- ○ Altostratus
- ○ Cirrocumulus
- ○ Cirrostratus
- ○ Cirrus
- ○ Cumulonimbus
- ○ Cumulus
- ○ Nimbostratus
- ○ Stratocumulus
- ○ Stratus



What cloud type is this? *

- ○ Altocumulus
- ○ Altostratus
- ○ Cirrocumulus
- ○ Cirrostratus
- ○ Cirrus
- ○ Cumulonimbus
- ○ Cumulus
- ○ Nimbostratus
- ○ Stratocumulus
- ○ Stratus

What cloud type is this? *

- ◯ Altocumulus
- ◯ Altostratus
- ◯ Cirrocumulus
- ◯ Cirrostratus
- ◯ Cirrus
- ◯ Cumulonimbus
- ◯ Cumulus
- ◯ Nimbostratus
- ◯ Stratocumulus
- ◯ Stratus

What cloud type is this? *

- ◯ Altocumulus
- ◯ Altostratus
- ◯ Cirrocumulus
- ◯ Cirrostratus
- ◯ Cirrus
- ◯ Cumulonimbus
- ◯ Cumulus
- ◯ Nimbostratus
- ◯ Stratocumulus
- ◯ Stratus

What cloud type is this? *

- ◯ Altocumulus
- ◯ Altostratus
- ◯ Cirrocumulus
- ◯ Cirrostratus
- ◯ Cirrus
- ◯ Cumulonimbus
- ◯ Cumulus
- ◯ Nimbostratus
- ◯ Stratocumulus
- ◯ Stratus

Which cloud types can be seen in this photograph? *
Select all cloud types that are in the photo.

☐ Altocumulus
☐ Altostratus
☐ Cirrocumulus
☐ Cirrostratus
☐ Cirrus
☐ Cumulonimbus
☐ Cumulus
☐ Nimbostratus
☐ Stratocumulus
☐ Stratus

Which cloud types can be seen in this photograph? *
Select all cloud types that are in the photo.

☐ Altocumulus
☐ Altostratus
☐ Cirrocumulus
☐ Cirrostratus
☐ Cirrus
☐ Cumulonimbus
☐ Cumulus
☐ Nimbostratus
☐ Stratocumulus
☐ Stratus

What are the chances of icing, turbulence and lightning for Cumulonimbus? *

	No chance	Small chance	Chance	Good Chance	Certain
Icing	○	○	○	○	○
Turbulence	○	○	○	○	○
Lightning	○	○	○	○	○

What are the chances of icing, turbulence and lightning for Altostratus? *

	No chance	Small chance	Chance	Good Chance	Certain
Icing	○	○	○	○	○
Turbulence	○	○	○	○	○
Lightning	○	○	○	○	○

Which cloud(s) should you absolutely try not to fly through? *

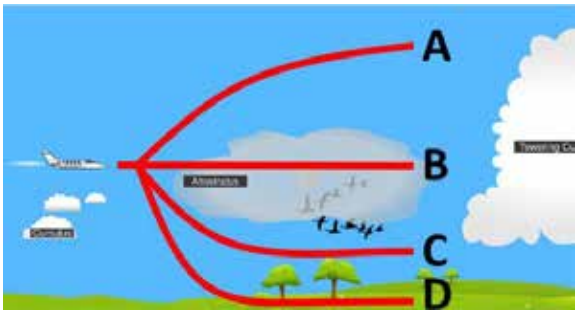
☐ Altocumulus
☐ Altostratus
☐ Cirrocumulus
☐ Cirrostratus
☐ Cirrus
☐ Cumulonimbus
☐ Cumulus
☐ Nimbostratus
☐ Stratocumulus
☐ Stratus

Clouds are generally divided into groups, based on their étage (level). There are high-level, mid-level and low-level clouds, and low-level clouds with vertical development.
Please indicate what level each cloud type is on. *

	High level	Mid level	Low level	Low level + vertical development
Altocumulus	○	○	○	○
Altostratus	○	○	○	○
Cirrocumulus	○	○	○	○
Cirrostratus	○	○	○	○
Cirrus	○	○	○	○
Cumulonimbus	○	○	○	○
Cumulus	○	○	○	○
Nimbostratus	○	○	○	○
Stratocumulus	○	○	○	○
Stratus	○	○	○	○

The following questions contain a picture of the sky with clouds and a short description of a situation. Also several routes are drawn. Which route would you choose for this specific situation?

Look and read quickly, because each picture and description will only be shown for 15 seconds. Select the route you would take and also the main reason(s) why.



Which route would you choose? *

○ Route A ○ Route B ○ Route C ○ Route D

What are the main reasons for you to select this route? *

☐ This route is the fastest
☐ This route is the shortest
☐ This route is most fuel efficient
☐ To avoid the risk of icing
☐ To avoid the risk of turbulence
☐ To avoid the risk of lightning
☐ To avoid a collision
☐ To save oxygen
☐ To pick up the game bonus
☐ Random guess

Which route would you choose? *

○ Route A ○ Route B ○ Route C ○ Route D

What are the main reasons for you to select this route? *

☐ This route is the fastest
☐ This route is the shortest
☐ This route is most fuel efficient
☐ To avoid the risk of icing
☐ To avoid the risk of turbulence
☐ To avoid the risk of lightning
☐ To avoid a collision
☐ To save oxygen
☐ To pick up the game bonus
☐ Random guess

Which route would you choose? *

○ Route A ○ Route B ○ Route C ○ Route D

What are the main reasons for you to select this route? *

☐ This route is the fastest
☐ This route is the shortest
☐ This route is most fuel efficient
☐ To avoid the risk of icing
☐ To avoid the risk of turbulence
☐ To avoid the risk of lightning
☐ To avoid a collision
☐ To save oxygen
☐ To pick up the game bonus
☐ Random guess

You have now finished the NLR CloudAtlas test. Your answers have been stored in our database and will be used to generate test scores later on. If you wish to be informed about your test score afterwards, please contact us.

Please continue to answer the rest of the survey to finish up this part of the experiment.

How often do you play games in everyday life? *

○ Absolutely never
○ Very rarely, only a few times per year
○ A few times per month
○ A few times per week
○ Once every day
○ Multiple times per day

Please include all kinds of games, but not sports. For example: boardgames, video games, mobile games, rpg, puzzles.

What type of games do you play? *

☐ Card games (non-computer)
☐ Board games (non-computer)
☐ Puzzles (non-computer)
☐ Action and adventure games (computer)
☐ Shooter games (computer)
☐ Role playing games (computer)
☐ Strategy and puzzle games (computer)
☐ Card and board games (computer)
☐ Other

What do you think about the game controls? *

○ The game was very easy to control
○ The game was easy to control
○ The game was hard to control
○ The game was very hard to control

Please answer the following questions on a scale of 1 to 10. *

How familiar were you with clouds and meteorology before this experiment?

1	2	3	4	5	6	7	8	9	10
○	○	○	○	○	○	○	○	○	○

Did you enjoy the game?

1	2	3	4	5	6	7	8	9	10
○	○	○	○	○	○	○	○	○	○

Score 1 for the extreme negative, and 10 for the extreme positive answer.

>>> The following questions were asked only in the questionnaires for Experiment 1. <<<

Please answer the following questions on a scale of 1 to 10. *

How interesting do you find the topic of clouds and meteorology?

1	2	3	4	5	6	7	8	9	10
○	○	○	○	○	○	○	○	○	○

How much did you learn from the experiment?

1	2	3	4	5	6	7	8	9	10
○	○	○	○	○	○	○	○	○	○

Score 1 for the extreme negative, and 10 for the extreme positive answer.

>>> The following question was asked only in the questionnaires for Experiment 1 for Voluntary Gameplay. <<<

Please answer the following questions on a scale of 1 to 10. *

Did you feel that you had the freedom to choose to play or not play the game?

1	2	3	4	5	6	7	8	9	10
○	○	○	○	○	○	○	○	○	○

Score 1 for the extreme negative, and 10 for the extreme positive answer.

>>> The following questions were asked only in the questionnaires for Experiment 2 and Experiment 3. <<<

Please answer the following questions on a scale of 1 to 10. *

How interested were you in learning more about clouds and meteorology?

1	2	3	4	5	6	7	8	9	10
○	○	○	○	○	○	○	○	○	○

How engaging did you find this training about clouds?

1	2	3	4	5	6	7	8	9	10
○	○	○	○	○	○	○	○	○	○

Score 1 for the extreme negative, and 10 for the extreme positive answer.

For each of the following statements, please indicate how true it is for you.*

	1 Not at all true	2	3	4 Somewhat true	5	6	7 Very true
I was anxious while working on this task	○	○	○	○	○	○	○
I think that doing this task is useful for training airline pilots.	○	○	○	○	○	○	○
I think this is an important task	○	○	○	○	○	○	○
I am satisfied with my performance at this task.	○	○	○	○	○	○	○
I would describe this task as very interesting.	○	○	○	○	○	○	○
I felt like I had to do this.	○	○	○	○	○	○	○
I felt pressured while doing this task.	○	○	○	○	○	○	○
I thought this was a boring task.	○	○	○	○	○	○	○
I believe this task could be of some value to me.	○	○	○	○	○	○	○
I didn't put much energy into this task.	○	○	○	○	○	○	○
I felt like it was not my own choice to do this task.	○	○	○	○	○	○	○
I put a lot of effort into this task.	○	○	○	○	○	○	○
It was important to me to do well at this task.	○	○	○	○	○	○	○
I tried very hard on this task.	○	○	○	○	○	○	○
This task was fun to do.	○	○	○	○	○	○	○
This task did not hold my attention at all.	○	○	○	○	○	○	○
I was very relaxed in doing this task.	○	○	○	○	○	○	○
I thought this task was quite enjoyable.	○	○	○	○	○	○	○
I did this task because I wanted to.	○	○	○	○	○	○	○
I didn't try very hard to do well at this task.	○	○	○	○	○	○	○

Please answer the following questions on a scale of 1 to 10. *

Did the game help you learn about clouds?

1	2	3	4	5	6	7	8	9	10
○	○	○	○	○	○	○	○	○	○

Score 1 for the extreme negative, and 10 for the extreme positive answer.

>>> The following questions were asked in the questionnaires for Experiment 2 and Experiment 3 for Mandatory Gameplay. <<<

How did it make you feel that you were obligated to play the game for a minimum of 10 min.? *

○ Bad: I wanted to quit before the time was up.
○ Neutral: I did not really notice the time.
○ Good: I liked knowing when I could move on.

Would you have played the game if it wasn't mandatory? *

○ No
○ Probably not
○ Probably yes
○ Yes

How much time would you spend on the game if you were free to decide this? *

○ No more than 2 times
○ Less than 8 minutes
○ About 8 to 12 minutes
○ More than 12 minutes

>>> The following question was asked only in the questionnaires for Experiment 2 for No Gameplay. <<<

Part of the participants in this experiment were given a game to practice their knowledge and understanding of clouds.

Would you have wanted to play this game as part of the training? *
○ Yes
○ No

>>> The following questions were asked in the questionnaires for Experiment 2 and Experiment 3 for Mandatory Gameplay, and in the questionnaires for Experiment 2 for No Gameplay. <<<

Why would you choose to play the game? *
☐ Because it is part of the selected materials.
☐ Because I would hope it adds to the learning materials.
☐ Because I would think it is helpful for my learning process.
☐ Because I am curious and would want to see what it looks like.
☐ Because I like to have variation in learning materials.
☐ Because I like games.
☐ Other

Why would you choose not to play the game? *
☐ Because I don't need any extra material beside the learning materials.
☐ Because I think it is not helpful for my learning process.
☐ Because I think it would not add anything to the learning materials.
☐ Because I don't like to have so many learning materials.
☐ Because I don't like games.
☐ Other

>>> The following questions were asked only in the questionnaires for all three Experiments for Voluntary Gameplay. <<<

Did you play the CloudAtlas game? *
○ Yes
○ No

Why did you choose to play the game? *
☐ Because I don't need any extra material beside the learning materials.
☐ Because I think it is not helpful for my learning process.
☐ Because I think it would not add anything to the learning materials.
☐ Because I don't like to have so many learning materials.
☐ Because I don't like games.
☐ Other

>>> The following questions were asked in the questionnaires for all three Experiments for Voluntary Gameplay, only for participants who did not play the game. <<<

Did you take a look at the game or did you skip it completely? *

○ I skipped it completely.
○ I looked, but didn't play.
○ I tried the game once or twice.
○ I tried the game a couple more times.

Why did you choose not to play the game? *

☐ Because I didn't need any extra material beside the learning materials.
☐ Because I thought it would not be helpful for my learning process.
☐ Because I thought it would not add anything to the learning materials.
☐ Because I don't like to have so many learning materials.
☐ Because I don't like games .
☐ Other

>>> The following questions were asked only in the questionnaires for Experiment 2 and Experiment 3 for Voluntary Gameplay. <<<

For each of the following statements, please indicate how true it is for you. *

	1 Not at all true	2	3	4 Somewhat true	5	6	7 Very true
I believed playing the game could be beneficial to me.	○	○	○	○	○	○	○
I felt like I was expected to play the game.	○	○	○	○	○	○	○
I believed I had a free choice about playing the game.	○	○	○	○	○	○	○
I thought playing the game was an important activity.	○	○	○	○	○	○	○

>>> The following questions were asked only in the questionnaires for Experiment 2. <<<

How did you get involved in the experiment? *

○ I received an invitation by e-mail.
○ I saw an announcement on ERAS.
○ I saw an announcement on my class webpage.
○ I saw an announcement on the school website.
○ I was asked in person.
○ It was announced in class.
○ It was assigned as a homework task.
○ Other**.**

What is the name of the person who told you about the CloudAtlas experiment? *

Please write your answer here:

>>> The following questions were asked only in the questionnaires for Experiment 3. <<<

Do you have a PPL? *
○ No, I do not and I have never been enrolled in flight school.
○ No, I do not, but I have been enrolled in flight school in the past.
○ No, not yet, but I am enrolled in flight school at this time (for PPL, LAPL or RPL).
○ Yes, I have a PPL (or LAPL or RPL).
○ Yes, I have a PPL and more (CPL, ATPL or MPL).

How long have you had your PPL? *
○ Less than 1 year.
○ Less than 5 years.
○ More than 5 years.

What has been your primary reason to start flight training? *
○ To become a professional pilot.
○ Recreational purposes.
○ Other.

Did you take the Meteorology exam? *
○ No, I haven't started on Meteorology yet.
○ No, I am studying Meteorology but haven't taken the exam yet.
○ Yes, I took the Meteorology exam but didn't pass it yet.
○ Yes, I have taken and passed the Meteorology exam.

Are you or have you been a professional pilot? *
○ Yes, I am currently active as a professional pilot.
○ I have been, but not anymore.
○ No, never.

What is or was your line of work? *
○ Airline pilot.
○ Commercial pilot.
○ Both.

How many flight hours do you have? *
Please write your answer here:

>>> The following question was asked only in Experiment 3 for participants without PPL. <<<

Why did you participate in this experiment? *
○ I am interested in aviation.
○ I am interested in meteorology.
○ I am interested in teaching and learning materials.
○ I was curious to see what it was about.
○ Other.

>>> The following question was asked in the questionnaires for all participants in all three experiments. <<<

If you have any comments or remarks for us, please post them here.
Please write your answer here:

>>> The following statement was used in the questionnaires for Experiment 1 and Experiment 2. <<<

Thank you. This concludes the CloudAtlas project.

>>> The following statement was used in the questionnaires for Experiment 3. <<<

Thank you for finishing the first part of the NLR CloudAtlas Project. In a few weeks you will receive an e-mail inviting you to fill in a final survey.

Appendix B.3
CloudAtlas final questionnaires (Q3)

Final questionnaire for Experiment 1

How did you find out about the NLR CloudAtlas project? *
○ I was asked in person (verbally or by email).
○ Through a link on Facebook.
○ Through a link on Twitter.
○ Other

Who has asked you to participate in the project, or through whose Facebook or Twitter page did you find the project? *
Please write your answer here:

What was/were the most important reason(s) for you to register to participate?*
☐ I was asked to.
☐ I was curious to see the content of the project.
☐ I liked participating.
☐ I wanted to win the €100 gift card.
☐ Other:

Which of these statements applied to you?*
☐ I had difficulties with the English language.
☐ It took too long/cost me too much time.
☐ I think the project was uninteresting.
☐ I think the learning content was boring.
☐ I think the learning content was too easy.
☐ I think the learning content was difficult.
☐ I did not like playing the game.
☐ I think the game was too easy.
☐ I think the game was too difficult.
☐ Other:

We would appreciate some explanatory comments on your answers.
If you have any other comments you can write them here as well.
Please write your answer here:

Thank you. This concludes the CloudAtlas project.

Final questionnaire for Experiment 2

What was the main reason for you to participate in the NLR CloudAtlas experiment? *
○ Participation was assigned as homework
○ To earn school credit or participation points
○ I participated voluntarily
○ Other

How was the experiment structured for you? *
○ Learning materials > 10 minute game play > Test
○ Learning materials > optional gameplay > Test
○ Learning materials > Test

Did you experience technical problems during the experiment? *
○ Yes, therefore I could not play the game
○ Yes, but I could still play the game
○ No

Please describe the problems you had.
Please write your answer here:

How much of the learning materials did you read or study? *
○ I read and studied all pages
○ I read all pages once
○ I scanned all pages
○ I read/scanned a few pages
○ I did not look at the learning materials

With what you know about the experiment now, would you participate again? *
○ Yes
○ No

Please elaborate why you would or would not participate again.
Please write your answer here:

Would you play the CloudAtlas game in your free time? *
○ Yes
○ No

Please elaborate why you would or would not play the game in your free time.
Please write your answer here:

Before you participated in the experiment, did you know that: *

	Yes	No
the experiment contained a game?	○	○
the experiment contained reading materials?	○	○
the experiment would take about 30 minutes to complete?	○	○
you could win a gift voucher?	○	○
clouds would be the subject of the experiment?	○	○
this would be a training experiment?	○	○

How did you know in advance that: *

	My teacher told me	I read it in the experiment description	I wasn't sure, but I suspected it
the experiment contained a game	○	○	○
the experiment contained reading materials	○	○	○
the experiment would take about 30 minutes to complete	○	○	○
you could win a gift voucher	○	○	○
clouds would be the subject of the experiment	○	○	○
this would be a training experiment	○	○	○

Did your teacher tell you the experiment would contain a game? *

○ Yes
○ No

For each of the following statements, please indicate how true it is for you.*

	1 Not at all true	2	3	4 Somewhat true	5	6	7 Very true
When it turned out there was no game in the experiment, my motivation decreased.	○	○	○	○	○	○	○
When it turned out there was no game in the experiment, I spent less time on the learning material.	○	○	○	○	○	○	○
The chance of winning the gift voucher was important to me.	○	○	○	○	○	○	○
Participating in experiments like this will help me to improve my performance in my study.	○	○	○	○	○	○	○
Learning about clouds will help me to improve my performance in my study.	○	○	○	○	○	○	○
I participated in this experiment because I wanted to contribute to science.	○	○	○	○	○	○	○
The school credit or participation points that I could earn were important to me.	○	○	○	○	○	○	○
I did my best to do well in this experiment.	○	○	○	○	○	○	○
I didn't try very hard to do well at this task.	○	○	○	○	○	○	○
I am satisfied with my performance at this task.	○	○	○	○	○	○	○
I believe this task could be of some value to me.	○	○	○	○	○	○	○
I think this is an important task.	○	○	○	○	○	○	○
It was important to me to do well at this task.	○	○	○	○	○	○	○
I wouldn't describe this task as very interesting.	○	○	○	○	○	○	○
I did this task because I wanted to.	○	○	○	○	○	○	○
I think that doing this task is useful for training airline pilots.	○	○	○	○	○	○	○
I thought this task was quite enjoyable.	○	○	○	○	○	○	○

If you have any comments or remarks for us, feel free to post them here.

Please write your answer here:

Final questionnaire for Experiment 3

Please rate the amount of obligation you felt on a scale of 1 to 10. *

	1	2	3	4	5	6	7	8	9	10
Obligation	○	○	○	○	○	○	○	○	○	○

1 = no obligation: My participation was totally voluntary
10 = extreme obligation: I had no choice but to participate

How much of the learning materials did you read or study? *

○ I read and studied all pages extensively
○ I read and studied all pages
○ I read all pages once
○ I scanned all pages
○ I read or scanned a few pages
○ I skipped the learning materials

Would you play the CloudAtlas game again? *

○ Yes
○ No

Please elaborate why you would or would not play the game again. *
Please write your answer here:

For each of the following statements, please indicate how true it is for you.*

	1 Not at all true	2	3	4 Somewhat true	5	6	7 Very true
I think that doing this task is useful for training airline pilots.	○	○	○	○	○	○	○
I think this is an important task.	○	○	○	○	○	○	○
I am satisfied with my performance at this task.	○	○	○	○	○	○	○
I would not describe this task as interesting.	○	○	○	○	○	○	○
It was important to me to do well at this task.	○	○	○	○	○	○	○
I thought this task was quite enjoyable.	○	○	○	○	○	○	○
I felt pressured while doing this task.	○	○	○	○	○	○	○
I did this task because I wanted to.	○	○	○	○	○	○	○
I didn't try very hard to do well at this task.	○	○	○	○	○	○	○
I believe this task could be of some value to me.	○	○	○	○	○	○	○
Participating in experiments like this will help me to improve my performance in my study.	○	○	○	○	○	○	○
Learning about clouds will help me to improve my performance in my job or training.	○	○	○	○	○	○	○
I participated in this experiment because I wanted to contribute to science.	○	○	○	○	○	○	○
I did my best to do well in this experiment.	○	○	○	○	○	○	○

Which of these statements apply to you? *

☐ I had difficulties with the English language.
☐ It took too long/cost me too much time.
☐ I think the project was uninteresting.
☐ I think the learning content was boring.
☐ I think the learning content was too easy.
☐ I think the learning content was difficult.
☐ I did not like playing the game.
☐ I think the game was too easy.
☐ I think the game was too difficult.

If you have any comments or remarks for us, feel free to post them here.
Please write your answer here:

Thank you. This concludes the CloudAtlas project.

Appendix B.4
CloudAtlas written materials

1. Learning objectives

A pilot needs to be able to recognize and classify clouds, assess the risks and decide what to do. This learning material will tell you about the classification of clouds, the 10 main cloud types and the hazards associated with clouds. After studying this unit you should be able to:

- Recognize the 10 different cloud types from drawings and photographs.
- Indicate the levels (‘étages’) on which the 10 cloud types can be found.
- Indicate the chances for hazards in the 10 cloud types.
- Know what clouds are safe to fly through.
- Choose the best route in a situation with (a combination of) clouds.
- Explain why you have chosen a certain route.

The learning material consists of 13 pages. It has approximately 2000 words and it should take about 10 minutes to read through once.

>>> The learning objectives were added for Experiment 3. <<<

2. Cloud classification

The importance of meteorology for the safety of civil aviation has been acknowledged since the early days of aviation. Clouds are part of the meteorological conditions that impact aviation.

Clouds are formed when humid air cools down around small particles in the air (like smoke or dust). When the saturation point is reached, the invisible water vapour changes into a visible state. They are the visible indicators of current weather and they are often indicative of future weather.
While clouds appear in infinite shapes and sizes, they all fall into some basic forms. The cloud naming system was introduced by Luke Howard in 1803 and is based on the Latin language. Clouds are classified according to the height of their base in the sky and they are named for their height, shape and behaviour.

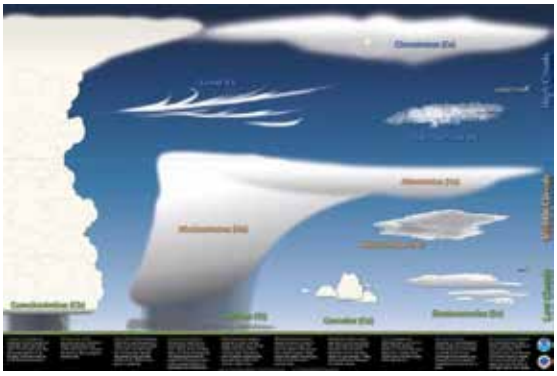
- **Cirriform**: cirrus = tuft or curling lock of hair. Composed of ice crystals, cirriform clouds are whitish and hair-like.
- **Cumuliform**: cumulus = heap or pile. Generally detached clouds, they look like white fluffy cotton balls.
- **Stratiform**: stratus = layer, these clouds are usually broad and fairly widespread appearing like a blanket.

Howard noticed that clouds often have features of two or more categories.
He also designated a special category for rainy clouds.

- **Nimbo-form**: nimbus = rain.

Clouds are vertically divided into three levels:

- **High-level, 5 to 13 km**: Cirrus, Cirrostratus, Cirrocumulus
- **Medium-level, 2 to 7 km**: Altostratus, Altocumulus, Nimbostratus
- **Low-level, 0 to 2 km**: Stratus, Stratocumulus
  - **Low-level with vertical development**: Cumulus (and Towering Cumulus), Cumulonimbus



Source: http://www.srh.weather.gov/jetstream/clouds/basicten.html

3. Cloud type: Cirrus (Ci)

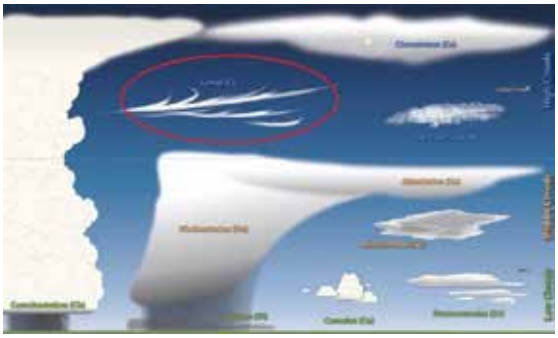
Cirrus (Ci) appears as detached clouds in the form of white, delicate filaments, patches or narrow bands. Composed of ice crystals, these clouds have a hair-like or silky sheen appearance.

Hazards

- Some turbulence
- Small chance of icing

Flying advice

Isolated patches rarely have any great significance, but an extensive deck, increasing from one direction, may indicate an approaching front. Cirrus is often associated with turbulence, but it will generally cause little discomfort to pilots or passengers.



Main characteristics

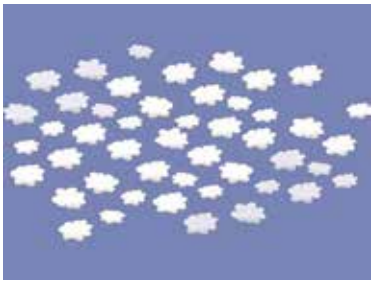
- High-level cloud
- Isolated patches or a layer covering a wide area
- White streaks in many shapes and sizes
- Consist of ice crystals
- Generally occur in fair weather
- May produce fall streaks: falling ice crystals that evaporate before they touch the ground
- May produce optical phenomena such as halos and cloud iridescence

Photographs

Source: The Cloud Appreciation Society

>>> The cloud type abbreviations were added for Experiment 3. <<<

4. Cloud type: Cirrocumulus (Cc)



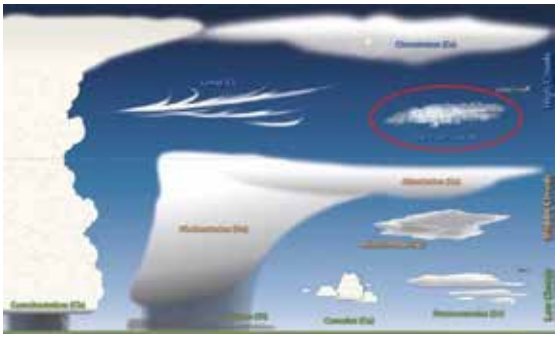
Cirrocumulus (Cc) clouds are thin, white patches or layers without shading. Comprised of super-cooled water, they consist of very small elements in the form of grains or ripples.

Hazards

- Chance of some turbulence
- Chance of icing

Flying advice

No special advice needed.



Main characteristics

- High-level cloud
- Brilliant white with a spotty appearance, no shadows
- Appears in wide, patchy sheets
- Consist of a combination of water droplets and ice crystals
- Do not produce precipitation and are normally associated with fine weather

Photographs

Source: The Cloud Appreciation Society

5. Cloud type: Cirrostratus (Cs)

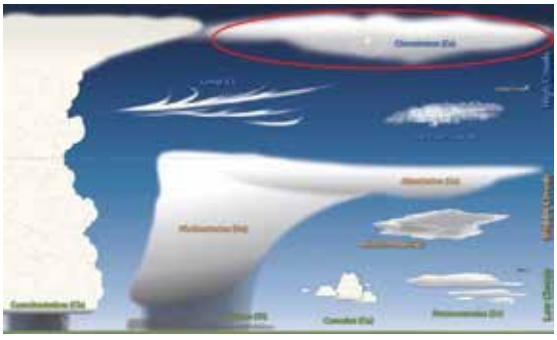
Cirrostratus (Cs) are transparent or semi-transparent, whitish clouds with a hair-like or smooth appearance that totally or partially cover the sky. Composed of ice crystals, they frequently produce a partial or complete halo around the sun or moon.

Hazards

- Small change of turbulence
- Very small chance of icing

Flying advice

Cirrostratus formations may cause slight turbulence at cloud level, but this is unlikely to affect aircraft operations or discomfort passengers.



Main characteristics

- High-level cloud
- An even layer of Cirrus covering a wide area
- In a very thin layer of in strands
- Will often produce optical phenomena such as halos and iridescence

Photographs

Source: The Cloud Appreciation Society

6. Cloud type: Altocumulus (Ac)

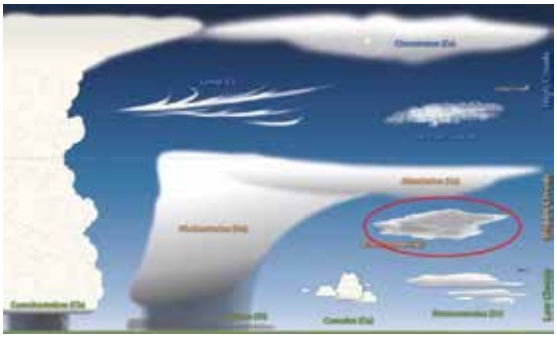
Altocumulus (Ac) clouds are composed of water and they appear as white or grey coloured roll-like elements, bands or individual puffs. They tend to occur in sheets or patches with wavy rolls and are the most common 'middle' cloud.

Hazards

- Some turbulence, and small chance of severe turbulence
- Very small chance of icing

Flying advice

No reason to fly around these clouds, unless a warning for turbulence has been issued. Do keep an eye on the thermometer as icing may occur at below freezing temperatures.



Main characteristics

- Mid-level cloud
- Layer or patches of mostly separated clouds
- Parallel bands or rounded masses
- A portion of altocumulus is shaded
- Altocumulus clouds do not produce rain, but may indicate a forthcoming weather change
- May easily be confused with Cirrocumulus, which is a high-level cloud without any shading

Photographs

Source: The Cloud Appreciation Society

7. Cloud type: Altostratus (As)

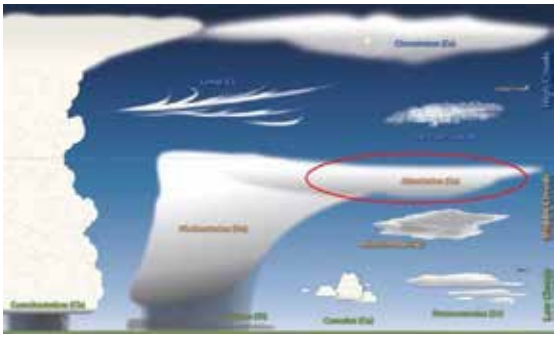
Altostratus (As) clouds are always translucent enough to reveal the sun or moon, but prevent objects on the ground from casting shadows. These clouds also appear to have grey or bluish hues and never produce halos.

Hazards

- Small chance of some turbulence
- Chance of serious icing

Flying advice

A thick deck of Altostratus may be a cause for concern if temperatures within the cloud are below freezing. So keep an eye on the thermometer.



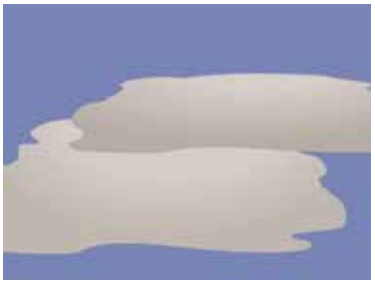
Main characteristics

- Mid-level cloud
- Usually covers the whole sky
- Grey or bluish-grey colour, never white
- The sun (or moon) may shine through, but will appear watery and will not cast shadows
- May easily be confused with Cirrostratus, but Altostratus does not show a halo around the sun or moon
- Altostratus clouds may produce some rain, and they usually form ahead of storms with continuous rain or snow

Photographs

Source: The Cloud Appreciation Society

8. Cloud type: Nimbostratus (Ns)



Nimbostratus (Ns) is a dark grey cloud that produces steady rain. Resulting from thickening Altostratus, the cloud base decreases into the 'low' cloud region as rain increases. It often becomes difficult to distinguish from Stratus clouds.

Hazards

- Some chance of turbulence
- Chance of icing
- Some chance of lightning

Flying advice

Keep an eye on the temperature to know of icing may occur. There may be some turbulence, but nothing too severe.

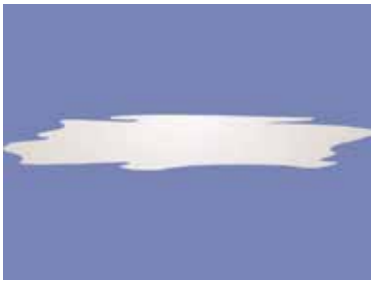
Main characteristics

- Mid-level cloud, with a base height as low as 0.5 km
- Often called rain clouds
- Thick layer with uniform grey appearance
- May have some vertical development
- Bottoms can be blurred due to falling rain or snow
- Produces steady rain or snow

Photographs

Source: The Cloud Appreciation Society

9. Cloud type: Stratus (St)



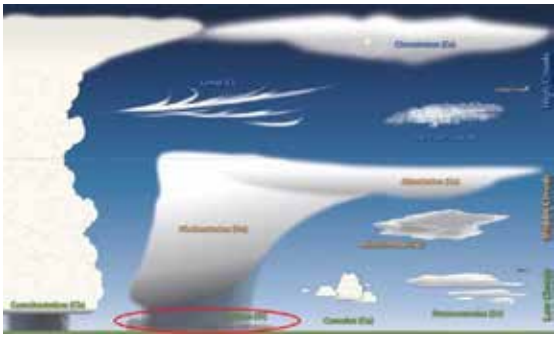
Stratus (St) is a flat, featureless cloud that is low to the ground. It varies in colour from grey to white and usually covers the entire sky. The cloud also appears fragmented during and after periods of rain.
Fog is a Stratus cloud on ground level.

Hazards

- No turbulence
- Some chance of serious icing

Flying advice

Low to the ground it can mask the surrounding terrain. Landing through fog should be avoided.



Main characteristics

- Low-level cloud, with a base height as low as 0 km
- Combination of water droplets, super cooled water and ice crystals
- Wide sheets with ragged, grey appearance
- May produce light precipitation from a thick layer

Photographs

Source: The Cloud Appreciation Society

10. Stratocumulus (Sc)

Stratocumulus (Sc) is generally seen as a low grey or whitish layer showing little vertical development. Individual elements are often arranged in bands or rolls.

Hazards

- Some turbulence
- Small chance of serious icing

Flying advice

No special advice needed.

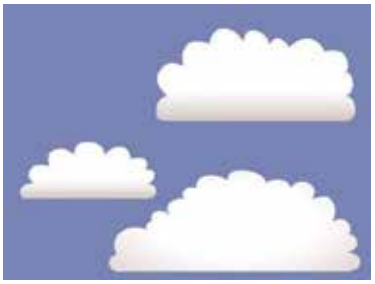
Main characteristics

- Low-level cloud
- One of the two most common clouds
- Various colours, from white to dark grey
- Usually a flat base
- Ragged appearance along the upper surface
- Appears more lumpy than Stratus
- May produce a little bit of precipitation

Photographs

Source: The Cloud Appreciation Society

11. Cloud type: Cumulus (Cu)



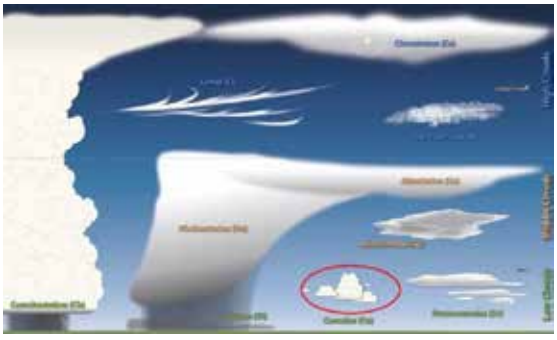
Cumulus (Cu) are detached, generally dense clouds and with sharp outlines that develop vertically in the form of rising mounds, domes or towers with bulging upper parts often resembling a cauliflower. The sunlit parts of these clouds are mostly brilliant white while their bases are relatively dark and horizontal.

Hazards

- Chance of turbulence
- Chance of icing
- Small chance of lightning

Flying advice

Regular Cumulus may give a little bit of a bumpy ride. Towering Cumulus are not Cumulonimbus yet, but they still may give some lightning and bad turbulence.



Main characteristics

- Low-level cloud with vertical development
  The top of a cumulus may reach into the mid and high levels.
- Puffy clouds with flat bases
- Can be white or light grey, with shading
- Appear by themselves or in clusters
- Come in various forms and sizes
- May show a high vertical development: Towering Cumulus
- Produce no precipitation, but can grow into Cumulonimbus

Photographs

Source: The Cloud Appreciation Society

12. Cloud type: Cumulonimbus (Cb)

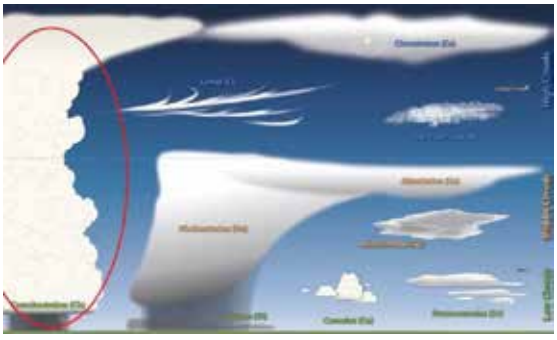
Cumulonimbus (Cb) is the thunderstorm cloud. It is a heavy and dense cloud in the form of a mountain or huge tower. The upper portion is usually smoothed, fibrous or striated and nearly always flattened in the shape of an anvil or vast plume. Under the base of this cloud which is often very dark, there are often low ragged clouds that may or may not merge with the base. They produce precipitation.

Hazards

- Chance of severe turbulence
- Chance of icing
- Big chance of lightning

Flying advice

Do not fly through or under a Cumulonimbus cloud, because there is a great risk of lightning within and under. Land your plane and wait for the storm to pass, or fly over it.



Main characteristics

- Low-level cloud with vertical development
  The top of a cumulonimbus may reach into the mid and high levels.
- Has a grey to almost black colour
- Top shaped like a mushroom or anvil
- Can reach a height of several kilometres
- Produces moderate to heavy showers

Photographs

Source: The Cloud Appreciation Society

13. Hazards

Pilots may encounter some hazards in and around clouds that influence aviation safety and passenger comfort.
The most common are:

1. Turbulence
2. Icing
3. Lightning

13.1. Turbulence

In almost all types of clouds turbulence may occur. Turbulence is any irregular or disturbed airflow in the atmosphere. Its origin may be thermal or mechanical and it may come about either within a cloud or in clear air. Occurrences of turbulence are local in extent and transient in character. Although general forecasts of turbulence are quite good, forecasting precise locations is difficult.

Turbulence hardly ever causes damage to the aircraft; therefore most pilots do not worry and just ride it out. Passengers, however, often experience turbulence as far more severe than it actually is.

13.2. Icing

The most hazardous aspect of structural icing is its aerodynamic effects. The presence of ice on an aircraft decreases lift, thrust, and range, and increases drag, weight, fuel consumption, and stall speed. For icing to form the atmosphere must have super-cooled visible water droplets and the temperature of the free air and the aircraft's surface need to be below freezing.

Clouds are the most common form of visible liquid water and super-cooled water is liquid water found at air temperatures below freezing. Water droplets in the free air do not freeze at 0°C, instead their freezing temperature varies from –10 to –40 °C, forming super-cooled droplets. When these strike an exposed object, such as a wing, the impact induces instant freezing and results in aircraft icing. When flying through a cloud at sub-zero temperatures, icing should be expected.

As a general rule, serious icing is rare in clouds with temperatures below –20°C since these clouds are almost completely composed of ice crystals. However, icing is possible in any cloud when the temperature is 0°C or below.

13.3. Lightning

Lightning is a sudden electrostatic discharge during an thunderstorm between electrically charged regions of a cloud, between two clouds, or between a cloud and the ground. Lightning occurs as a result of a build-up of static charges within a Cumulonimbus cloud. An aircraft passing close to an area of charge can initiate a discharge and this may occur even at some distance from a thunderstorm.

A lightning strike can damage electronic equipment and in rare events it can puncture the skin of an aircraft. Nearby lightning can blind the pilot leaving him momentarily unable to fly the aircraft. Lightning can also induce permanent errors in the magnetic compass when it is nearby or, even at a distance, it can disrupt radio communications.

A lightning strike can be very distressing to passengers and crew, but damage to an aircraft in flight which is sufficient to compromise the safety of the aircraft is rare. The safety of an aircraft in flight is usually not affected.

Appendix C

Creating Shuttle to Mars: a game to provide experience

In this appendix, belonging to Chapter 5, we present the materials used in the job analysis to identify the essential competencies in critical situations. Furthermore, we present the materials used in the *Shuttle to Mars* playtest.

Appendix C.1
Semi-structured interview scheme for job analysis

A. Interviewee background

1. What is your function/position?
2. How long have you been a pilot?
3. How many flight hours do you have?

B. Interviewee experience

1. Have you experienced situations in which the normal procedures did not suffice?
2. How many times?
3. Please describe a few of these situations briefly.
    1. What happened in this situation?
    2. What made this situation difficult (or easy)?
       Would you consider this an emergency?
        a. Was the safety of the aircraft and the passengers at risk?
    3. How did you solve this problem? What did you do?
    4. Was it a situation that was unknown to you? Or mostly unexpected?
       Did you have procedures available?
        a. Were they easy to find?
        b. Did the checklists suffice?
        c. Did you need to deviate from the checklist
    5. How did you feel during this situation? And after?
4. How did these situations differ from one another?
5. What made them non-normal?
    a. Have you been in situations in which it was hard to determine what was happening?
    b. And in situations for which no procedure or checklist was available?

C. Interviewee insight into/vision on competencies

1. Are you familiar with the ICAO list of competencies?
2. What do you think are the most important competencies or skills when everything goes as planned (normal situations)?
3. And when it doesn't go as planned (non-normal situations)?
4. When is a pilot free to turn to creative solutions?

Based on ICAO competencies and other documents I have studied, I have come to this list of competencies which I believe are essential in unknown and unexpected situations:

- *Situation Awareness*
- *Application of procedures*
- *Aircraft Flight Path Management, manual control*
- *Workload management*

- *Problem Solving and Decision Making*
- *Communication*

5. Do you agree that these pilots need these competencies to act adequately in unknown and unexpected situations? Please elaborate.
6. Are any necessary competencies missing from the list, for the non-normal/critical situations?
7. Do you think the current training for airline pilots addresses these (missing?) competencies enough?
8. Do you think these competencies can be trained (to some extent) in a non-realistic setting (such as gaming) and may help develop these competencies?

Appendix C.2
ICAO core competencies and behavioural indicators

Competency	Behavioural Indicators
1. Application of Procedures (AP)	1a. Identifies the source of operating instructions
	1b. Follows SOPs unless a higher degree of safety dictates an appropriate deviation
	1c. Identifies and follows all operating instructions in a timely manner
	1d. Correctly operates aircraft systems and associated equipment
	1e. Complies with applicable regulations
	1f. Applies relevant procedural knowledge
2. Communication (COM)	2a. Ensures the recipient is ready and able to receive the information
	2b. Selects appropriately what, when, how and with whom to communicate
	2c. Conveys messages clearly, accurately and concisely
	2d. Confirms that the recipient correctly understands important information
	2e. Listens actively and demonstrates understanding when receiving information
	2f. Asks relevant and effective questions
	2g. Adheres to standard radiotelephone phraseology and procedures
	2h. Accurately reads and interprets required company and flight documentation
	2i. Accurately reads, interprets, constructs and responds to datalink messages in English
	2j. Completes accurate reports as required by operating procedures
	2k. Correctly interprets non-verbal communication
	2l. Uses eye contact, body movement and gestures that are consistent with and support verbal messages
3. Aircraft Flight Path Management, automation (AFPM-A)	3a. Controls the aircraft using automation with accuracy and smoothness as appropriate to the situation
	3b. Detects deviations from the desired aircraft trajectory and takes appropriate action
	3c. Contains the aircraft within the normal flight envelope
	3d. Manages the flight path to achieve optimum operational performance
	3e. Maintains the desired flight path during flight using automation whilst managing other tasks and distractions
	3f. Selects appropriate level and mode of automation in a timely manner considering phase of flight and workload
	3g. Effectively monitors automation, including engagement and automatic mode transitions

Table continued on next page

Table continued from previous page

Competency	Behavioural Indicators
4. Aircraft Flight Path Management, manual control (AFPM-M)	4a. Controls the aircraft manually with accuracy and smoothness as appropriate to the situation
	4b. Detects deviations from the desired aircraft trajectory and takes appropriate action
	4c. Contains the aircraft within the normal flight envelope
	4d. Controls the aircraft safely using only the relationship between aircraft attitude, speed and thrust
	4e. Manages the flight path to achieve optimum operational performance
	4f. Maintains the desired flight path during manual flight whilst managing other tasks and distractions
	4g. Selects appropriate level and mode of flight guidance systems in a timely manner considering phase of flight and workload
	4h. Effectively monitors flight guidance systems including engagement and automatic mode transitions
5. Leadership and Teamwork (L&T)	5a. Understands and agrees with the crew's roles and objectives
	5b. Creates an atmosphere of open communication and encourages team participation
	5c. Uses initiative and gives directions when required
	5d. Admits mistakes and takes responsibility
	5e. Anticipates and responds appropriately to other crew members' needs
	5f. Carries out instructions when directed
	5g. Communicates relevant concerns and intentions
	5h. Gives and receives feedback constructively
	5i. Confidently intervenes when important for safety
	5j. Demonstrates empathy and shows respect and tolerance for other people
	5k. Engages others in planning and allocates activities fairly and appropriately according to abilities
	5l. Addresses and resolves conflicts and disagreements in a constructive manner
	5m. Projects self-control in all situations
6. Problem-Solving and Decision-Making (PS&DM)	6a. Seeks accurate and adequate information from appropriate sources
	6b. Identifies and verifies what and why things have gone wrong
	6c. Employ(s) proper problem-solving strategies
	6d. Perseveres in working through problems without reducing safety
	6e. Uses appropriate and timely decision-making processes
	* 6f. Sets priorities appropriately
	* 6g. Identifies and considers options effectively
	6h. Monitors, reviews, and adapts decisions as required
	* 6i. Identifies and manages risks effectively
	* 6j. Improvises when faced with unforeseeable circumstances to achieve the safest outcome

Table continued on next page

Table continued from previous page

Competency		Behavioural Indicators
7. Situation Awareness (SA)	*	7a. Identifies and assesses accurately the state of the aircraft and its systems
		7b. Identifies and assesses accurately the aircraft's vertical and lateral position, and its anticipated flight path
	*	7c. Identifies and assesses accurately the general environment as it may affect the operation
	*	7d. Keeps track of time and fuel
	*	7e. Maintains awareness of the people involved in or affected by the operation and their capacity to perform as expected
	*	7f. Anticipates accurately what could happen, plans and stays ahead of the situation
		7g. Develops effective contingency plans based upon potential threats
	*	7h. Identifies and manages threats to the safety of the aircraft and people
		7i. Recognises and effectively responds to indications of reduced situation awareness
8. Workload Management (WM)		8a. Maintains self-control in all situations*
		8b. Plans, prioritises and schedules tasks effectively*
		8c. Manages time efficiently when carrying out tasks
	*	8d. Offers and accepts assistance, delegates when necessary and asks for help early
		8e. Reviews, monitors and cross-checks actions conscientiously
		8f. Verifies that tasks are completed to the expected outcome
	*	8g. Manages and recovers from interruptions, distractions, variations and failures effectively

Behavioural indicators marked with * are selected to be addressed in the *Shuttle to Mars* game.

Appendix C.3
Shuttle to Mars Playtest protocol (Dutch)

Welkom

Welkom. Fijn dat je ons wilt helpen met deze playtest. Het doel is om te bekijken of deze game speelbaar is. Met speelbaar bedoelen we of het duidelijk is hoe je de game bedient en wat je moet doen. Ook zijn we benieuwd of de game leuk en uitdagend is.

We testen vandaag de game, we testen niet hoe handig jij met de game bent. Eigenlijk kun je dus nooit iets fout doen. Het helpt ons heel erg als je hardop zegt wat je probeert te doen. Zeker als iets niet lukt.

Tijdens het testen nemen we het scherm en jouw gezicht op. Dit is om later goed te kunnen zien wat er allemaal gebeurd is in de test. De filmbeelden worden uitsluitend gebruikt voor deze test en alleen getoond aan mensen die betrokken zijn bij dit project als opdrachtgever of als maker.

We beginnen zo eerst met een korte vragenlijst. Daarna is het de bedoeling dat je de game gaat spelen. Deze staat op een iPad. Ik zal je aangeven hoe, wat en in welke volgorde. Ik wil je vragen hardop te vertellen wat je doet, waarom je het doet en wat je van die handeling verwacht.

Ik kijk met je mee wat je doet, en zal je soms vragen iets toe te lichten.

Ik heb deze app niet gemaakt, maar ben alleen gevraagd om het testen te begeleiden. In principe mag ik je niet helpen, tenzij er iets fout loopt in de applicatie. Je mag ook altijd zeggen wat je ergens van vindt tijdens het testen. Zowel positief als negatief. Wij kunnen hier tijdens de test niet op reageren omdat het mogelijk de resultaten beïnvloedt.

<vragenlijst, pagina 1>

Uitleg game

We beginnen met de game. Hier is de iPad. Ik zal je eerst iets over de game vertellen, daarna mag je een account aanmaken.

De game – Shuttle to Mars – speelt zich af in de ruimte. Jij bent een ruimtekoerier en het is jouw taak om je lading (cargo) naar de bestemming te brengen. Hoe minder cargo je verliest onderweg, en hoe beter de staat van je ruimteschip en crew is als je aankomt, des te beter heb je het gedaan.

Er zijn verschillende missies. Iedere missie begint met 1000 stuks cargo, een gezonde crew, een stevig ruimteschip, en een voorraad brandstof en ammunitie. Aan het begin van een missie moet je je route plannen en daarna ga je op pad. Je moet het ruimteschip op koers houden door te sturen. Je gaat vanzelf vooruit. Houd de status van alle systemen goed in de gaten en let ook op wat er buiten gebeurt. Heb je nog vragen?

Aan de slag

Dan gaan we beginnen. Je mag eerst een account aanmaken. Probeer het eerst zelf. Als het nodig is, help ik je. Vertel hardop wat je doet of probeert te doen.

<maak account>

De eerste missie

Nu mag je beginnen met The Long Haul. Dit is een heel eenvoudige missie waarin nog niet zoveel gebeurt. Je hebt dan even gelegenheid om aan de game te wennen.

Ga je gang. Denk hardop. *Wat zie je? Wat verwacht je? Wat doe je?* Als er iets echt niet lukt, zal ik je helpen.

<speel The Long Haul – ca. 10 minuten>

Hier laten we het bij.

Wat is je eerste indruk van de game?

Vond je het makkelijk of moeilijk om het ruimteschip te besturen?

Volgende missie

Dan mag je nu verder gaan met de Tutorial. Om daar te komen moeten we de app even sluiten en opnieuw openen (twee keer op de Home knop klikken en dan de Shuttle to Mars app omhoog swipen, vervolgens de app weer aantikken). Dan kun je de Tutorial kiezen uit het menu.

<speel Tutorial>

In de Tutorial worden de systemen van het ruimteschip uitgelegd. Lees de teksten goed door en denk eraan om weer hardop te denken.

[Nodig: spiekbriefje met de Engine-procedure voor het geval het echt niet lukt deze in te voeren]

Vond je de tutorial nuttig? Was hij duidelijk?

Derde missie

We gaan nu verder met een echte missie. Je mag de Omega missie starten. Bij deze missie moet je eerst je route plannen. Ga je gang.

<speel Omega missie>

[zo nodig helpen bij route plannen]

[belangrijk: pas starten als route helemaal gepland is en het einddoel van de eerste sectie is aangetikt]

Ik laat je nu zelf deze missie spelen. Zou je weer hardop willen denken over wat je ziet, wat je verwacht en wat je doet?

Afronding

Dit waren de missies in de game.

Je kunt nu het tweede deel van de vragenlijst invullen. Ook daarbij wil ik je vragen hardop te denken en je antwoorden toe te lichten.

<vragenlijst, vanaf pagina 2>

Dat was het. Bedankt voor je medewerking. Als kleine beloning mag je wat lekkers uitkiezen.

Mocht je achteraf nog wat te binnen schieten over de game, dan horen we dat graag nog. Je kunt dan mailen naar Esther (esther.kuindersma@nlr.nl).

Bedankt!

Appendix C.4
Shuttle to Mars Playtest questionnaire (Dutch)

Introductievragen Shuttle to Mars – playtest

Naam: _____

De vragenlijst bestaat in totaal uit 4 pagina's. We vragen je hardop te zeggen wat je invult en eventueel een toelichting te geven aan de testbegeleider.

Kun je aangeven waarom je meedoet met deze test en wat je van de test verwacht?

_____
_____
_____

Stelling	Oneens		Neutraal		Eens
Ik sta positief tegenover de inzet van **innovatieve trainingsmethoden** in de (recurrent) training voor verkeersvliegers.	○	○	○	○	○
Toelichting (optioneel):					
Ik sta positief tegenover de inzet van een **virtuele training/game** in de (recurrent) training voor verkeersvliegers.	○	○	○	○	○
Toelichting (optioneel):					
Ik ben iemand die **vaak als eerste** gebruik maakt van nieuwe programma's, technieken en mogelijkheden.	○	○	○	○	○
Toelichting (optioneel):					
Ik speel zelf geregeld **games en spellen**, in welke vorm dan ook (bordspel, kaartspel, computer- of smartphone game, etc).	○	○	○	○	○
Toelichting (optioneel):					

Wacht met het invullen van deel 2 van de vragenlijst tot je de game getest hebt!

Vragen na kennismaking met Shuttle to Mars

Het doel van deze vragenlijst is het krijgen van een volledig beeld van de sterke en zwakke punten van de game, om uiteindelijk een zo goed mogelijk product op te leveren.

We vragen je hardop te zeggen wat je invult en eventueel een toelichting te geven aan de testbegeleider.

Stelling	Oneens		Neutraal		Eens
Het was duidelijk **wat ik moest doen** in de game.	○	○	○	○	○
Toelichting (optioneel):					
De **besturing van de game** (knoppen, manual, etc) was duidelijk.	○	○	○	○	○
Toelichting (optioneel):					
Ik had **controle** over de game.	○	○	○	○	○
Toelichting (optioneel):					
Het **doel** van de game was duidelijk.	○	○	○	○	○
Toelichting (optioneel):					
De game was goed **speelbaar**.	○	○	○	○	○
Toelichting (optioneel):					
De **tutorial** gaf voldoende informatie om de game snel te kunnen spelen.	○	○	○	○	○
Toelichting (optioneel):					
Het kostte (ondanks de tutorial) nog **veel tijd** om het spel goed te kunnen spelen.	○	○	○	○	○
Toelichting (optioneel):					
Het spelen op de **iPad** werkt goed voor deze game.	○	○	○	○	○
Toelichting (optioneel):					
Ik zou deze game liever spelen op een **pc of laptop**.	○	○	○	○	○
Toelichting (optioneel):					

Stelling	**Oneens**		**Neutraal**		**Eens**
De **opdrachten** in de game waren interessant.	○	○	○	○	○
Toelichting (optioneel):					
Ik voelde soms een soort **stress of werkdruk** door de opdachten in de game.	○	○	○	○	○
Toelichting (optioneel):					
Het **verhaal** in de game was interessant.	○	○	○	○	○
Toelichting (optioneel):					
De vormgeving van de game is **aantrekkelijk**.	○	○	○	○	○
Toelichting (optioneel):					
Ik was **zeer betrokken** in de game / ik speelde **fanatiek** mee.	○	○	○	○	○
Toelichting (optioneel):					
Ik zou de game **vaker willen spelen**.	○	○	○	○	○
Toelichting (optioneel):					
Ik zou de game **aanbevelen** aan anderen.	○	○	○	○	○
Toelichting (optioneel):					
Ik zie **overeenkomsten** tussen deze game en het werk als verkeersvlieger.	○	○	○	○	○
Toelichting (optioneel):					

Welke woorden vind jij passen bij deze game?

☐ Leerzaam ☐ Ingewikkeld
☐ Voor volwassenen ☐ Handig
☐ Kinderachtig ☐ Interessant
☐ Duidelijk ☐ Vrolijk
☐ Saai ☐ Voor op het werk
☐ Uitdagend ☐ Spannend
☐ Voor thuis ☐ _____

Wat vond jij het beste aan deze virtuele training/game?

_____
_____
_____

Wat vond jij het minst goede aan deze virtuele training/game?

_____
_____
_____

Hartelijk dank voor deelname aan deze test!

Appendix D

Measuring the Shuttle to Mars experience

In this appendix, belonging to Chapter 6, we present the materials used in the small-scale study to determine to acceptance of a serious game for competency development by airline pilots.

Appendix D.1
Questionnaire 1: StM Start

Welcome!
You have just played the Shuttle to Mars tutorial and your first mission.

Please answer the questions in this questionnaire. After the last question, you will receive a passcode to continue playing the game.

Please enter your personal information. *
Please write your answer(s) here:

- First name:
- Last name:
- Address:
- Postal code:
- City:
- E-mail address:
- Phone number (home):
- Phone number (mobile):

Please enter your birthday. *
Please enter a date:

What year did you graduate from flight academy? *
Please enter a date:

How many years have you worked for an airline since graduation? *
Please write your answer here:

How many flight hours do you have? *
Please write your answer here:

Please indicate to what extent the statement applies to you. *

	1 Not at all true	2	3	4 Somewhat true	5	6	7 Very true
I feel positive about the use of innovative training methods in (recurrent) training for airline pilots.	○	○	○	○	○	○	○
I feel positive about the use of a virtual training or game in (recurrent) training for airline pilots.	○	○	○	○	○	○	○
I am often one of the pioneers in using new technology or software.	○	○	○	○	○	○	○

On a scale from 1 to 10, how motivated are you to participate in this experiment? *

	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Motivation	○	○	○	○	○	○	○	○	○	○

1 = not motivated at all, 10 = extremely motivated

How often do you play games in everyday life? *

- ○ Absolutely never
- ○ Very rarely, only a few time per year
- ○ A few times per month
- ○ A few times per week
- ○ Daily

Please include all kinds of games, but not sports. For example: boardgames, video games, mobile games, rpg, puzzles.

What type of games do you play? *

- ☐ Card games (non-computer)
- ☐ Board games (non-computer)
- ☐ Puzzles (non-computer)
- ☐ Action and adventure games (computer)
- ☐ Shooter games (computer)
- ☐ Role playing games (computer)
- ☐ Strategy and puzzle games (computer)
- ☐ Card and board games (computer)
- ☐ Other:

On average, how many minutes do you spend on games per week? *

Please write your answer here:

For each of the following statements, please indicate how true it is for you. *

	1 Not at all true	2	3	4 Somewhat true	5	6	7 Very true
It is clear to me what I have to do in this game.	○	○	○	○	○	○	○
It is clear to me how to control the game (buttons, switches, manual, etc.).	○	○	○	○	○	○	○
I feel like I am in control of the game.	○	○	○	○	○	○	○
The purpose of the game is clear to me.	○	○	○	○	○	○	○
The tutorial provided sufficient information to play the game.	○	○	○	○	○	○	○
I like the graphics of the game.	○	○	○	○	○	○	○
I look forward to playing the game.	○	○	○	○	○	○	○

When this gaming block was finished, how did you feel? *

- ○ I wanted to continue playing.
- ○ I felt neutral.
- ○ I was relieved that I was done for now.

For each of the following statements, please indicate how true it is for you. *

	1 Not at all true	2	3	4 Somewhat true	5	6	7 Very true
I am more motivated to complete the experiment than to complete the game.	○	○	○	○	○	○	○
I look forward to playing the next mission in the game.	○	○	○	○	○	○	○
Playing the game frustrated me.	○	○	○	○	○	○	○
I believe the gameplay competes with that of commercial adventure games.	○	○	○	○	○	○	○

The Shuttle to Mars game relates to the eight ICAO core competencies for airline pilots. You have received a hand-out with these competencies and their corresponding behaviour.

The next questions focus on these competencies. Please look at the hand-out and then answer the questions.

Please indicate how important you believe each competency is in NORMAL SITUATIONS. *

	1 Not at all important	2	3	4 Somewhat important	5	6	7 Very important
Application of Procedures	○	○	○	○	○	○	○
Communication	○	○	○	○	○	○	○
Aircraft Flight Path Management, automation	○	○	○	○	○	○	○
Aircraft Flight Path Management, manual control	○	○	○	○	○	○	○
Leadership and Teamwork	○	○	○	○	○	○	○
Problem Solving and Decision Making	○	○	○	○	○	○	○
Situation Awareness	○	○	○	○	○	○	○
Workload Management	○	○	○	○	○	○	○

Please indicate how important you believe each competency is in NON-NORMAL SITUATIONS . *

	1 Not at all important	2	3	4 Somewhat important	5	6	7 Very important
Application of Procedures	○	○	○	○	○	○	○
Communication	○	○	○	○	○	○	○
Aircraft Flight Path Management, automation	○	○	○	○	○	○	○
Aircraft Flight Path Management, manual control	○	○	○	○	○	○	○
Leadership and Teamwork	○	○	○	○	○	○	○
Problem Solving and Decision Making	○	○	○	○	○	○	○
Situation Awareness	○	○	○	○	○	○	○
Workload Management	○	○	○	○	○	○	○

Please indicate how important you believe each competency is in EMERGENCIES. *

	1 Not at all important	2	3	4 Somewhat important	5	6	7 Very important
Application of Procedures	○	○	○	○	○	○	○
Communication	○	○	○	○	○	○	○
Aircraft Flight Path Management, automation	○	○	○	○	○	○	○
Aircraft Flight Path Management, manual control	○	○	○	○	○	○	○
Leadership and Teamwork	○	○	○	○	○	○	○
Problem Solving and Decision Making	○	○	○	○	○	○	○
Situation Awareness	○	○	○	○	○	○	○
Workload Management	○	○	○	○	○	○	○

Please select which training method you believe best suitable to train each of the eight ICAO core competencies. *

	Book / syllabus	CBT	Full flight simulator	Lecture / presentation	PC based simulator	Serious game	Training with a coach*
Application of Procedures	○	○	○	○	○	○	○
Communication	○	○	○	○	○	○	○
Aircraft Flight Path Management, automation	○	○	○	○	○	○	○
Aircraft Flight Path Management, manual control	○	○	○	○	○	○	○
Leadership and Teamwork	○	○	○	○	○	○	○
Problem Solving and Decision Making	○	○	○	○	○	○	○
Situation Awareness	○	○	○	○	○	○	○
Workload Management	○	○	○	○	○	○	○

** By 'Training with a coach' we mean a group training session guided by a coach or mentor. We explicitly do not mean a flight training with an instructor.*

Thank you:

Please use code 528624 to gain access to Block 1 of Shuttle to Mars.

Block 1 contains 5 missions. After the missions, there will be a questionnaire.
Please finish Block 1 and the questionnaire within one week from today.

Appendix D.2
Questionnaire 2: StM Block 1

Welcome back.
You have just played Block 1 of the Shuttle to Mars game. Please answer the questions in this questionnaire.

After completing the questionnaire, you will receive a passcode for the next block by e-mail when it is time to continue.

How many flight hours did you log during this gaming block? *
Please write your answer here:

How much time did you spend playing the Shuttle to Mars game, during this gaming block? Please estimate your StM game play time in hours and decimals. For example: 1.25 for 1 hour and 15 minutes. You can round up or down to quarters of an hour. *
Please write your answer here:

Did you play any other games (digital or analogue) during this gaming block? *
- ○ Yes
- ○ No

How much time did you spend playing other games (computer or analogue), during this gaming block? Please estimate your game play time in hours and decimals. For example: 1.25 for 1 hour and 15 minutes. You can round up or down to quarters of an hour. *
Please write your answer here:

What games did you play? Please name the games you have played. *
Please write your answer here:

When this gaming block was finished, how did you feel? *
- ○ I wanted to continue playing.
- ○ I felt neutral.
- ○ I was relieved that I was done for now.

For each of the following statements, please indicate how true it is for you. *

	1 Not at all true	2	3	4 Somewhat true	5	6	7 Very true
I am more motivated to complete the experiment than to complete the game.	○	○	○	○	○	○	○
I look forward to playing the next mission in the game.	○	○	○	○	○	○	○
Playing the game frustrated me.	○	○	○	○	○	○	○
I believe the gameplay competes with that of commercial adventure games.	○	○	○	○	○	○	○

The list below consists of pairs of contrasting attributes that may apply to the Shuttle to Mars game. The circles between the attributes represent gradations between the opposites. For the assessment of the Shuttle to Mars game, please express your agreement with the attributes by ticking the circle that most closely reflects your impression.

Please decide spontaneously. Don't think too long about your decision to make sure that you convey your original impression.

Sometimes you may not be completely sure about your agreement with a particular attribute or you may find that the attribute does not apply completely to the game. Nevertheless, tick a circle in every line.

Please provide your personal opinion. Do not make assumptions for the pilot community.

Please assess the Shuttle to Mars game by ticking one circle per line. *

	1	**2**	**3**	**4**	**5**	**6**	**7**	
Annoying	○	○	○	○	○	○	○	Enjoyable
Not understandable	○	○	○	○	○	○	○	Understandable
Creative	○	○	○	○	○	○	○	Dull
Easy to learn	○	○	○	○	○	○	○	Difficult to learn
Valuable	○	○	○	○	○	○	○	Inferior
Boring	○	○	○	○	○	○	○	Exciting
Not interesting	○	○	○	○	○	○	○	Interesting
Unpredictable	○	○	○	○	○	○	○	Predictable
Fast	○	○	○	○	○	○	○	Slow
Inventive	○	○	○	○	○	○	○	Conventional
Obstructive	○	○	○	○	○	○	○	Supportive
Good	○	○	○	○	○	○	○	Bad
Complicated	○	○	○	○	○	○	○	Easy
Unlikable	○	○	○	○	○	○	○	Pleasing
Usual	○	○	○	○	○	○	○	Leading edge
Unpleasant	○	○	○	○	○	○	○	Pleasant
Secure	○	○	○	○	○	○	○	Not secure
Motivating	○	○	○	○	○	○	○	Demotivating
Meets expectations	○	○	○	○	○	○	○	Does not meet expectations
Inefficient	○	○	○	○	○	○	○	Efficient
Clear	○	○	○	○	○	○	○	Confusing
Impractical	○	○	○	○	○	○	○	Practical
Organized	○	○	○	○	○	○	○	Cluttered
Attractive	○	○	○	○	○	○	○	Unattractive
Friendly	○	○	○	○	○	○	○	Unfriendly
Conservative	○	○	○	○	○	○	○	Innovative

What are your priorities in playing this game? *

- ☐ Arriving at the destination without damage
- ☐ Delivering the cargo to the destination
- ☐ Having fun playing
- ☐ Playing the game by the rules
- ☐ Reaching the destination quickly
- ☐ Other:

Please elaborate on your priorities in playing, and the reasons why you have those priorities. *
Please write your answer here:

Consider the priorities in your work, during the flight. How do they compare to your priorities in the game? *
Please write your answer here:

Thank you:
You will receive a passcode to continue to Block 2 by e-mail when it is time to continue.

Block 2 contains 4 missions. After the missions, there will be a questionnaire.
Please finish Block 2 and the questionnaire within one week from receiving the passcode.

Appendix D.3
Questionnaire 3: StM Block 2

Welcome back.
You have just finished Block 2 of the Shuttle to Mars game. Please answer the questions in this questionnaire.

After submitting the questionnaire, you will receive a passcode for the next block by e-mail when it is time to continue.

How many flight hours did you log during this gaming block? *
Please write your answer here:

How much time did you spend playing the Shuttle to Mars game, during this gaming block? Please estimate your StM game play time in hours and decimals. For example: 1.25 for 1 hour and 15 minutes. You can round up or down to quarters of an hour. *
Please write your answer here:

Did you play any other games (digital or analogue) during this gaming block? *
- ○ Yes
- ○ No

How much time did you spend playing other games (computer or analogue), during this gaming block? Please estimate your game play time in hours and decimals. For example: 1.25 for 1 hour and 15 minutes. You can round up or down to quarters of an hour. *
Please write your answer here:

What games did you play? *
Please write your answer here:

When this gaming block was finished, how did you feel? *
- ○ I wanted to continue playing.
- ○ I felt neutral.
- ○ I was relieved that I was done for now.

For each of the following statements, please indicate how true it is for you. *

	1 Not at all true	2	3	4 Somewhat true	5	6	7 Very true
I am more motivated to complete the experiment than to complete the game.	○	○	○	○	○	○	○
I look forward to playing the next mission in the game.	○	○	○	○	○	○	○
Playing the game frustrated me.	○	○	○	○	○	○	○
I believe the gameplay competes with that of commercial adventure games.	○	○	○	○	○	○	○

For each of the following statements, please indicate how true it is for you. *

	1 Not at all true	2	3	4 Somewhat true	5	6	7 Very true
I am anxious while working on this task.	○	○	○	○	○	○	○
I think that doing this task is useful for training airline pilots.	○	○	○	○	○	○	○
I think this is an important task.	○	○	○	○	○	○	○
I am satisfied with my performance at this task.	○	○	○	○	○	○	○
I would describe this task as very interesting.	○	○	○	○	○	○	○
I feel like I have to do this.	○	○	○	○	○	○	○
I feel pressured while doing this task.	○	○	○	○	○	○	○
I think this is a boring task.	○	○	○	○	○	○	○
I believe this task could be of some value to me.	○	○	○	○	○	○	○
I don't put much energy into this task.	○	○	○	○	○	○	○
I feel like it was not my own choice to do this task.	○	○	○	○	○	○	○
I put a lot of effort into this task.	○	○	○	○	○	○	○
It is important to me to do well at this task.	○	○	○	○	○	○	○
I try very hard on this task.	○	○	○	○	○	○	○
This task is fun to do.	○	○	○	○	○	○	○
This task does not hold my attention at all.	○	○	○	○	○	○	○
I am very relaxed in doing this task.	○	○	○	○	○	○	○
I think this task is quite enjoyable.	○	○	○	○	○	○	○
I do this task because I want to.	○	○	○	○	○	○	○
I don't try very hard to do well at this task.	○	○	○	○	○	○	○
As a professional I felt taken seriously.	○	○	○	○	○	○	○
I feel it is important to play this game seriously.	○	○	○	○	○	○	○
Making errors in this game should feel similar to making errors during a (simulator) training flight.	○	○	○	○	○	○	○

In the pirate encounters, what do you base your actions on?*

- ☐ My shuttle's hull integrity
- ☐ The fun I would have shooting at the pirate ship
- ☐ The amount of resources I have (cargo, fuel, ammo)
- ☐ The distance I still have to travel
- ☐ The other things that are happening
- ☐ Their demand for cargo or fuel
- ☐ Other:

Please elaborate on why you base your actions on these variables. *
Please write your answer here:

The game also has some less eventful moments. How do those moments make you feel?
For the following statements please indicate how true it is for you. *

	1 Not at all true	2	3	4 Somewhat true	5	6	7 Very true
I got bored and did not pay as much attention anymore.	○	○	○	○	○	○	○
I got distracted and did not pay as much attention anymore.	○	○	○	○	○	○	○
I expected things to happen soon and became extra watchful.	○	○	○	○	○	○	○
It didn't change how I felt and how I played.	○	○	○	○	○	○	○

When you are flying an aircraft and not much is happening, what do you do to stay alert? *
Please write your answer here:

Thank you:
You will receive a passcode to continue to Block 3 by e-mail when it is time to continue.

Block 3 contains 4 missions. After the missions, there will be a questionnaire.
Please finish Block 3 and the questionnaire within one week from receiving the passcode.

Appendix D.4
Questionnaire 4: StM Block 3

Welcome back.
You have just finished Block 3 of the Shuttle to Mars game. This is the last gaming block of the NLR Serious Gaming experiment. Please answer the questions in this questionnaire.

After submitting the questionnaire, the researcher will contact you about the final interview.

How many flight hours did you log during this gaming block? *
Please write your answer here:

How much time did you spend playing the Shuttle to Mars game, during this gaming block? Please estimate your StM game play time in hours and decimals. For example: 1.25 for 1 hour and 15 minutes. You can round up or down to quarters of an hour.*
Please write your answer here:

Did you play any other games (digital or analogue) during this gaming block?*
- ○ Yes
- ○ No

How much time did you spend playing other games (computer or analogue), during this gaming block? Please estimate your game play time in hours and decimals. For example: 1.25 for 1 hour and 15 minutes. You can round up or down to quarters of an hour.*
Please write your answer here:

What games did you play?
Please write your answer here:

When this gaming block was finished, how did you feel? *
- ○ I wanted to continue playing.
- ○ I felt neutral.
- ○ I was relieved that I was done for now.

For each of the following statements, please indicate how true it is for you. *

	1 Not at all true	2	3	4 Somewhat true	5	6	7 Very true
I am more motivated to complete the experiment than to complete the game.	○	○	○	○	○	○	○
I look forward to playing the next mission in the game.	○	○	○	○	○	○	○
Playing the game frustrated me.	○	○	○	○	○	○	○
I believe the gameplay competes with that of commercial adventure games.	○	○	○	○	○	○	○

Please read the following statements and answer by marking one of the numbers that best describes your experience.*

	1 Not at all true	2	3	4 Somewhat true	5	6	7 Very true
I enjoyed playing the game.	○	○	○	○	○	○	○
I was frustrated at the end of the game.	○	○	○	○	○	○	○
I was frustrated whilst playing the game.	○	○	○	○	○	○	○
I liked the game.	○	○	○	○	○	○	○
I would play this game again.	○	○	○	○	○	○	○
I was in control of the game.	○	○	○	○	○	○	○
The controllers responded as I expected.	○	○	○	○	○	○	○
I remember the actions the controllers performed.	○	○	○	○	○	○	○
I was able to see on the screen everything I needed during the game.	○	○	○	○	○	○	○
The point of view of the game that I had spoiled my gaming.	○	○	○	○	○	○	○
I knew what I was supposed to do to win the game.	○	○	○	○	○	○	○
There was time when I was doing nothing in the game.	○	○	○	○	○	○	○
The game kept constantly motivating me to keep playing.	○	○	○	○	○	○	○
The graphics of the game were plain.	○	○	○	○	○	○	○
I do not like this type of game.	○	○	○	○	○	○	○
I like to spend a lot of time playing this game.	○	○	○	○	○	○	○
I got bored playing this time.	○	○	○	○	○	○	○
I usually do not choose this type of game.	○	○	○	○	○	○	○
I did not have a strategy to win the game.	○	○	○	○	○	○	○
I felt what was happening in the game was my own doing.	○	○	○	○	○	○	○
I challenged myself even if the game did not require it.	○	○	○	○	○	○	○
I played with my own rules.	○	○	○	○	○	○	○
I felt guilty for the actions in the game.	○	○	○	○	○	○	○
I knew how to manipulate the game to move forward.	○	○	○	○	○	○	○
The graphics were appropriate for the type of game.	○	○	○	○	○	○	○
The sound effects of the game were appropriate.	○	○	○	○	○	○	○
I did not like the music of the game.	○	○	○	○	○	○	○
The graphics of the game were related to the scenario.	○	○	○	○	○	○	○
The graphics and sound effects of the game were related.	○	○	○	○	○	○	○
The sound of the game affected the way I was playing.	○	○	○	○	○	○	○
The game was unfair.	○	○	○	○	○	○	○
I understood the rules of the game.	○	○	○	○	○	○	○
The game was challenging.	○	○	○	○	○	○	○
The game was difficult.	○	○	○	○	○	○	○
The scenario of the game was interesting.	○	○	○	○	○	○	○
I did not like the scenario of the game.	○	○	○	○	○	○	○
I knew all the actions that could be performed in the game.	○	○	○	○	○	○	○

For each of the following statements, please indicate how true it is for you. *

	1 Not at all true	2	3	4 Somewhat true	5	6	7 Very true
I felt like I was in control over the game.	○	○	○	○	○	○	○
The purpose of the game was clear to me.	○	○	○	○	○	○	○
I like the graphics of the game.	○	○	○	○	○	○	○
I enjoyed playing the game.	○	○	○	○	○	○	○
The assignments (missions) in the game were interesting.	○	○	○	○	○	○	○
I felt engaged in the game.	○	○	○	○	○	○	○
I would recommend the game to others.	○	○	○	○	○	○	○
I see resemblances between the game and my job as an airline pilot.	○	○	○	○	○	○	○

We have based the design of the Shuttle to Mars game on events and activities that an airline pilot may experience in their jobs.

For each of the game events in the list below, please describe what situation or task from your work you would match with it. If you are not sure, please say so and take a guess.*

Game event	**Airline pilot task**
Breaking down of engine and steering	_____
Breaking down of indicators for hull integrity, fuel and ammo	_____
Entering authentication calls	_____
Following the blue bubble line	_____
Hard reset procedures	_____
Pirate attack	_____
Pirate negotiation	_____
Red lights and pushing the button	_____
Space ships passing your shuttle	_____

Do you think you can learn something from playing the Shuttle to Mars game? *

	1 Not at all true	2	3	4 Somewhat true	5	6	7 Very true
I can learn something from playing this game.	○	○	○	○	○	○	○

Please elaborate on your answer. For example:

- **What do you think you can learn from playing the game?**
- **How would you learn from it?**
- **Why do you think you may not be able to learn from it?***

Please write your answer here:

Do you think that playing the Shuttle to Mars game can help you do your job in the cockpit? *

	1 Not at all true	2	3	4 Somewhat true	5	6	7 Very true
This game can help me do my job.	○	○	○	○	○	○	○

Please elaborate on your answer. For example:

- **What part of the game can help you?**
- **What can it help you with?**
- **Why do you think playing the game cannot help you do your job?***

Please write your answer here:

Thank you:
You will be contacted about the final interview.
The interview will take about 45 minutes to 1 hour.

Appendix D.5
StM semi-structured interview

Getting started

- *Thank you for participating in the experiment.*
- *Time limit for this interview is set to 1 hour*

1. Heb je bezwaar tegen een audio opname van dit interview? Als ik een letterlijk citaat uit het interview wil gebruiken, dan zal ik hiervoor nog expliciet contact met je opnemen.

A. Reaction

1. Wat vond je van de game?
2. Wat vond je van het spelen van de game?
3. Zou je het je kunnen voorstellen dat je deze game als onderdeel van je training zou spelen, met nog meer missies?
4. Denk je dat je in je werk iets aan deze game zou hebben?
5. Ben je tijdens het spelen van de game “handigheidjes” gaan gebruiken? Heb je manieren gevonden om de regels te omzeilen?

B. Learning

1. Wat heb je geleerd van het spelen van de game?
2. Denk je dat je een of meer van de ICAO core competencies hebt gebruikt om de game te kunnen spelen? Welke?
3. Denk je dat je deze competenties sterker zijn geworden door het spelen (of sterker zouden kunnen worden door meer spelen)?
4. In hoeverre zijn de competenties in de game vergelijkbaar met die in de werkelijkheid?
5. Denk je dat je daar ook buiten de game iets aan hebt?

C. Behaviour

1. Heb je gedurende je deelname aan het experiment op enig moment in de cockpit tijdens je gewone werk aan de game moeten denken?
2. Heeft het spelen van de game effect op hoe je handelt in de cockpit?
3. Denk je dat het (nog meer) effect kán hebben als je het vaker en langer zou spelen?

Conclusion

- *Summarize.*
- *Express gratitude for the cooperation.*
- *Have participants fill out form for reimbursement of (travel) expenses.*
- *If applicable, give prize.*

1. Heb jij nog vragen of opmerkingen?