Final report B6

This report was made by master students of the Faculty of Industrial Design Engineering at the Delft University of Technology within the course 'Usability and User eXperience Assessment in Design'.

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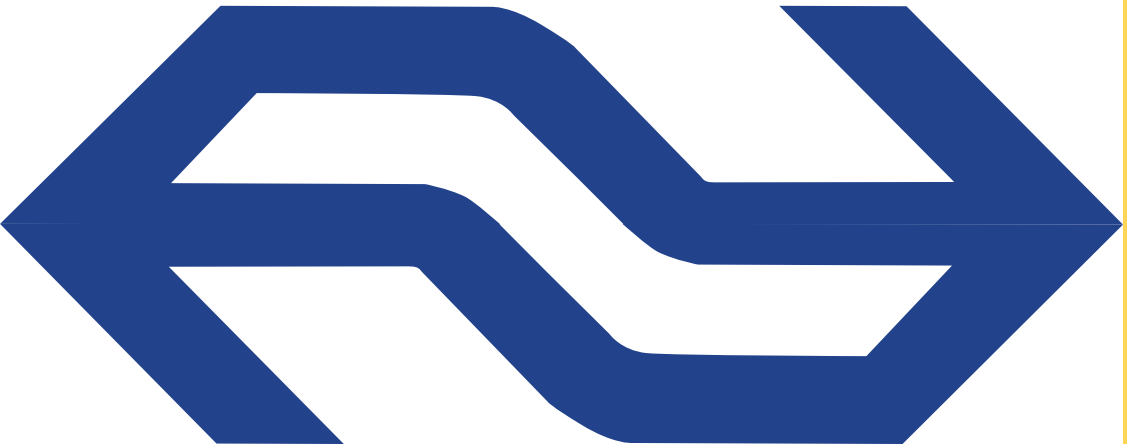

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INTRODUCTION

This report is the result of the course "Usability and User Experience Assessment in Design" at the Faculty of Industrial Design Engineering at Delft University of Technology. Our group consists of five master students in the master program "Design for Interaction". The project has been initiated by the NS, the Dutch Railways, and has been running for the past twenty weeks.

Our team investigated the interaction with the 'touchpoints', the electronic gates and poles for checking in and out, at the NS stations. After researching possible problems we decided to focus our project on error recovery. In a big public transport system there will always be users encountering problems or technical errors, we decided to put our efforts into making such problems as easy to recover as possible.

This project is therefore about providing a clear, effective and convenient solution for error recovery making users eventually love and trust the system despite of its faults.

In this report we would like to summarize our results about the usability and user experience assessment of error recovery using a personal OV-chipcard.

EXECUTIVE SUMMARY

After the introduction of OV-chipcard in 2009, several usability issues of the system surfaced. NS considers the usability of the system of high importance as it is the company's obligation to make public transport accessible to everyone, and because it wants to increase client loyalty by maintaining and/or increasing customers' satisfaction.
– Design brief from the NS

For the past twenty weeks we have been working on a design brief provided by the NS. They asked us to look into the usability issues of the OV-chipcard and come up with a design proposal that addresses these issues.

We started out by assessing the current situation of the OV chipcard, which we have done in multiple ways. We gathered information from literature, directly from travellers and our personal experiences.

Our first impression was that there are indeed several usability and user experience issues, and that most of them are based on uncertainty. The travellers are often unsure about the status of their card; whether they have checked in or out, and what their amount of credit is. They feel they have no control over what happens with their card and the fear of doing something wrong and paying too much causes a non-relaxed feeling during travelling.

These issues are very closely related to the one-sided feedback of the system and also to the error unfriendliness of the system; the system is not forgiving when an error occurs. The usability of the system and how to recover an error are important factors in how the users perceive the system.

From this we have decided to put the focus of our project on improving the error-friendliness of the OV chipcard system. For our usability study we specified our subject even further, concentrating on the check in/out touch points on the station. These touch points are the first, and sometimes only, place where travellers can get feedback on the status of their card, therefore being the most interesting for us to research.

In our first user study we staged three different errors on OV chip cards. The errors were blocked, not activated and broken with the messages 'Probeer opnieuw', 'Inchecken niet mogelijk' and no message at all respectively. We asked our participants to act out a scenario as if it was their own card. We were particularly interested in how they attempted to solve the problem they were presented with; what considerations they made and why.

The problem solving strategy of the participants was largely influenced by individual differences in how the error messages were interpreted. Still, we identified five phases users go through when coping with an error; identification, attribution, prioritizing, trying out and resolving. All phases were again influenced by how the error messages were interpreted. One very obvious conclusion of the user study was that the error messages were too ambiguous and did not guide the user towards a solution in any way.

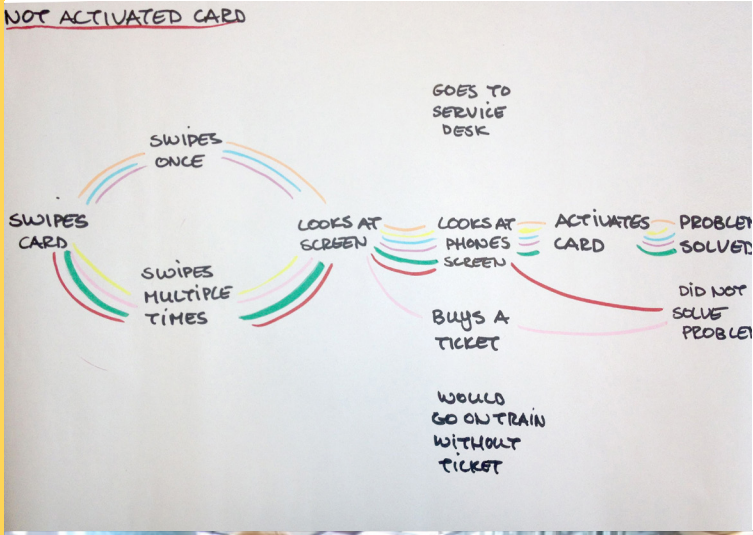
From this study we defined our design goal: 'Make error recovery effortless for users by redesigning the feedback of the OV-chipcard system.' With the focus on resolving errors that might occur while using a check in/out touchpoint with your OV-chipcard. When something goes wrong the touchpoints are the first place where you can get feedback, yet it is not always clear for the user what the problem is or how to proceed with solving this problem. By redesigning this feedback we can help the users in this process.

Our goal for the user experience is to have "users see the OV-chipcard system as a servant, and not as a big bureaucratic system". With the system as a servant, users feel that they are catered to their needs. Furthermore, we think "The user should feel that NS is taking charge over the error situation, and being one step ahead of the user in the error recovery." By being a step ahead the NS relieves the users of making decisions and guides them towards the right solution, it gives the impression that NS is taking charge over the situation. The system should convey that NS knows what is wrong and how to solve this. This way NS is seen as the system that takes responsibility and helps you, not as a system that is counteracting you.

In this report we propose an alternative way for checking in, using a smartphone. The mobile check in would be added functionality of the existing NS application. The smartphone will provide additional information while checking in or out, like credit status and previous travels. Since the focus of our project is on error recovery, we gave phone the role of a mediator when a problem arises while checking in. The mobile check in provides users with direct information when they experience an error. It clearly states what the problem is, and how the users can solve it; guiding the users towards the solution of the problem quickly and efficiently.

We tested our design in a second user study, similarly to the set-up of the first user study. This study proved that the redesign is providing more effective error recovery compared to the current system, as it can guide users to the steps we want them to take in a larger degree. The redesign is also proven very efficient in guiding the users to the solution. Firstly it takes less effort to find out what to do, which makes more users start the error recovery process at the train station. Secondly it guides the users to the closest spot to solve the problem, either by providing maps to service desks at the station, or by solving the problem directly on the phone.

We can conclude that the redesign provides clearer guidance for error recovery than the current system. It makes the process of error recovery more effective, efficient and pleasurable.



ANALYSIS OF THE CURRENT SYSTEM

THE OV-CHIPCARD

Before introducing our design goal and proposal we would like to give a short overview of the current situation of the OV system. We will give a short introduction to the system, followed by our first impressions on usability and user experience. This together with our first user study formed the basis of our design proposal.

The OV-chipcard was first introduced in 2009. After a long implementation period, the whole public transportation sector in the Netherlands is now using the OV-chipcard. The idea is relatively simple; one card for all public transportation. The OV-chipcard can be ordered online for €7,50. There are three different possibilities to choose from, a personal card, an anonymous card and a student card. After receiving the card, it has to be activated at a special charging station, and charged with credit. There is a minimum amount of credit necessary to travel; €20 for the anonymous and €10 for the personal and student card. The old fashioned ticket machines can be used to pick up subscriptions and charge the OV-chipcard.

Since the beginning of 2012 every traveller is obligated to check in with their card at the beginning at their travel. When you have reached your place of destination, you need to check out again. The card works like a prepaid deposit system, when checking in the NS removes the deposit from the card, and gives you back this deposit (minus the travelling costs) when you check out.

Figure 1: An overview of the components of the current system.

FIRST IMPRESSIONS ON USABILITY AND USER EXPERIENCE

Based on personal experiences, word of mouth and a literature search we created a general first impression on the user experiences and the usability issues of the OV-chipcard. The most important issues that arose in the field of user experience where:

Distrust - Travellers have a lack of trust in the check in, check out touchpoints. The one-sided interaction makes them feel as if they feel they have no control over what happens with their card, and like the machines are 'taking their money'. This also results in distrust and irritation towards the NS.

Alertness - The system requires a constant alertness from the traveller; they have to remember to charge their cards, check in and check out; which is very much unlike the security and easiness of a paper ticket. The fear of doing something wrong or paying too much for their ticket causes a non-relaxed feeling during travelling.

Uncertainty - Travellers are often unsure about the status of their card; whether they have check in or out, and if what their amount of credit is. As mentioned, they miss the security of a paper ticket, which does not require more actions than buying one.

The issues mentioned above are closely related to the feedback from the system, which is often one-sided and gives insufficient information. We feel that the source for these negative user experiences is the error unfriendliness of the system; the system is not forgiving when an error occurs. The usability of the system and how to recover an error are important factors in how the users perceive the system.

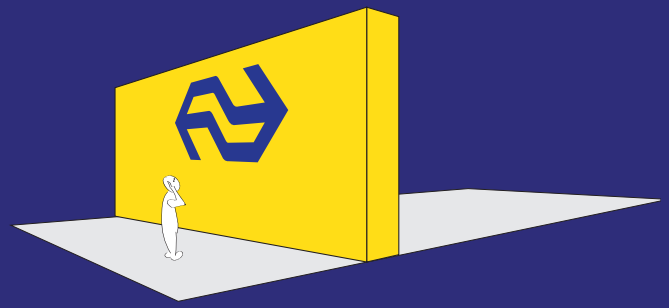


Figure 2: Users feel small and helpless against a big system when trying to recover from an error.

The usability refers to the ease of use and learnability of the system. Overall it seems that the usability is quite good, the system is doing what it promised; simplifying the use of public transportation. But in the event of an unexpected situation, travellers are pushed out of their comfort zone and do not know what to do. At this moment, the touch points do not provide enough information or guidance, so it often proves difficult to resolve an error.

This is again related to the user experience, bad usability causes bad user experiences. For example, in situations where travellers are unable to check in or out, the costs are usually settled on the travellers. Getting this overpayment back is often a bureaucratic hassle which can cost the traveller more time and money than was lost in the first place. Users encountering these errors feel small and helpless against a big impenetrable NS-wall.

[1] OV-loket collects OV-chipcard related complaints and regularly publishes reports. https://www.ovloket.nl/?ac=Rapportages-17-1
[2] The Dutch political party Groenlinks collects OV-chipcard related complaints that are available upon request.

Figure 3: A representation of the terms we addressed as interesting regarding the user experience of the current system.

DEFINING THE FOCUS OF OUR PROJECT

While forming this first impression, we noticed that the error-friendliness was a domain in which many improvements can be made that can directly improve the user experience and usability of the OV-chipcard.

The focus of our project has been to improve the error-friendliness. In such a big system as with the OV-chipcard there will always be errors, either technical or human. We set out to make these situations as painless as possible for th ones who encounter them.

For our usability study we specified our subject even further, concentrating on the check in/out touch points on the station. These touch points are the first, and sometimes only, place where travellers can get feedback on the status of their card, therefore being the most interesting to research.

USER STUDY ONE: ERROR RECOVERY

The first usability study was a generative study to map out the problems users encounter in error recovery with the OV-chipcard. This was done through an observational study with a staged scenario. The participants were given a malfunctioning OV-chipcard (see table 3), and asked to act out a scenario as if it was their own card. We were particularly interested in how they attempted to solve the problem they were presented with; what considerations they made and why. In total 16 travellers participated in the study.

When the participants tried to check in – and thereby experienced the error – we observed the situation without interrupting. When they mentioned what they suspected was wrong, they were encouraged to act out further steps on what they would do next. The test was stopped when the participant stated that the next step would be to enter the train.

A short semi-structured interview followed the observation study. The questions were follow-ups on interesting situations from the observation, as well as a wrap up of their thoughts and experiences.

Total participants: 16	Male	Female
Student	5	3
High school student	0	1
Worker (young)	1	1
Worker (middle aged)	2	2
Retired	0	1

Table 1: Participant demographics of study one.

Tested touchpoints	Stations used in test	Appearance
Standalone poles	Delft Den Haag HS Den Haag Laan van NOI Schiedam Centrum	
Closed gates	Schiedam Centrum	

Table 2: Both stations with standalone poles and stations with closed gates were tested

Tested scenarios	Error message	Feedback	Appearance
Blocked card	“Probeer opnieuw” (“Try again”) Every time you try.	Error sound Blinking red light Yellow screen	
Broken card	No message/reaction “In/uitchecken” (check in/out) Continuously on screen	No sound Continuous green light Continuous black screen	
Card not activated	“Inchecken niet mogelijk” (“Check-in not possible”)	Error sound Blinking red light Red screen	

Table 3: Three different error situations were tested

FINDINGS

The problem solving strategy of the participants was largely influenced by individual differences in how the different error messages were interpreted. Still, we identified five phases users go through when coping with an error, which are visualised in a model as seen in figure 4.

The ambiguous error messages seem to be the main reason why users can not solve their problem; because they cannot identify what is wrong. Ambiguity of information is the ability to express more than one interpretation. In the case of ambiguous screens of the error messages we mean that most of the information confuses users because it could guide them in multiple directions.

Other findings from the user study are elaborated in the progress report from the interim presentation May 3rd 2012.
In appendix 1 a table with more precise user actions can be found.

Ambiguous error messages

The error messages of the poles and gates are too ambiguous and do not provide the user with a clear direction for problem solving.

Blocked card message:
"Try Again" (in loop)

Broken card message:
No reaction

Inactivated card message:
"Check-in not possible"

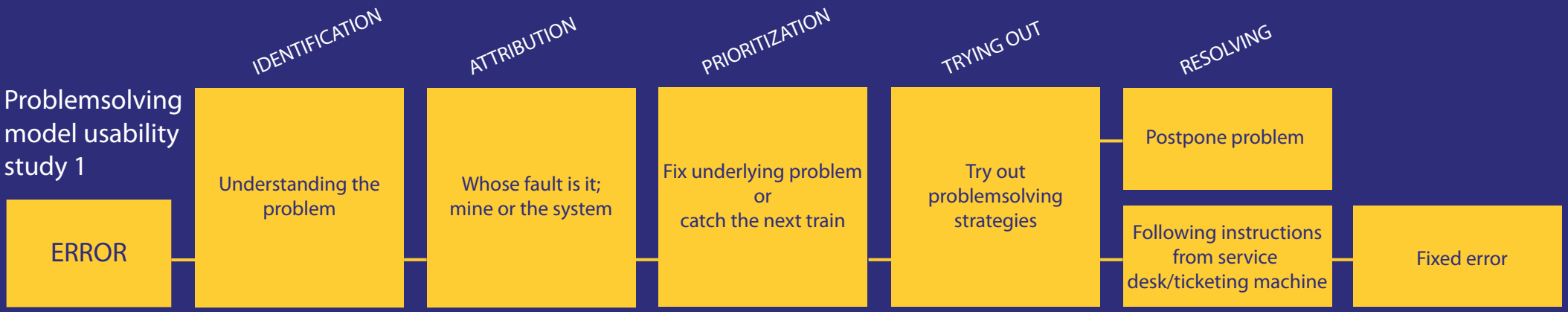


Figure 4: The user study concluded in an error recovery model for the current system. Users have to go through these phases in order to fix their error.

Identification

When users encounter an error they first try to understand what the problem is. The feedback messages from the touchpoints are unclear and do not help the user to identify the problem. Inconsistent guidelines confuse the users in understanding the error.

The identification phase ends in our user test when participants are able to state what the error is, either by themselves or as an answer to an affirmation question.

Attribution

The users try to find out if the error was caused by the system, e.g. A malfunctioning touch point, or if they caused it, for example they forgot to check out. Students and monthly subscribers are more likely to blame NS for the problem, and feel they have the right to travel for free.

The attribution phase ends if participants are at ease with whether it is their own or NS its fault. Not all participants go trough this phase.

Prioritization

Regular touchpoints do not form a barrier to the platform, which gives users the option to ignore the error message and board the train anyway. In the prioritization phase users make the decision to either fix the problem before they get on the train or board the train regardless of the error.

We noticed that most participants prioritized to board the train, and did not consider that the card might still be malfunctioning when they have to travel at another time.

Prioritizing catching the train or prioritizing the problem with the card greatly influences their coping strategy. Closed gates makes the users feel they are prevented from finding a solution (conductor) and this causes bad user experiences.

The prioritization phase ends when participants state whether they prioritize catching the next train or they begin trying out problem solving strategies. The user test ends if the participants prioritize catching the next train.

Trying out

During the trying out phase users look for the nearest point or person that can help them solve their problem. If this does not solves the problem, they keep looking for another way to solve it.

People seek human representatives which are seen as more knowledgeable and forgiving than machines.

NS representatives supply more information than ticket machines or touch points. Also users know from experience that conductors can turn a blind eye when you have trouble checking in.

The trying out phase ends when participants have found a confirmed functional strategy for their error recovery.

Resolving

In the resolving phase users either decide to postpone the problem or they have solved their problem. If people do not succeed in solving the error, they feel the need of proof that they have tried, or to show the conductor they have a subscription that allows them to travel for free.

The conductors are seen as nice and reasonable, some participants were allowed on the train for free after explain their problem, which gave a positive user experience though the underlying problem of their card remains unsolved. The users did not seem aware that they probably would have the same problem on the way back.

The resolving phase ends when the underlying problem is resolved.

Plans for discontinuing paper tickets and installing closed gates

The fact that NS has planned to discontinue all paper tickets and install gates at all major train stations by 2013 makes error recovery even more interesting; users are left with fewer options to legitimately board the train in situations where there is an error with their card. We believe that this will result in more negative user experiences, therefore we see a lot of design opportunities in this area.

DESIGN GOAL

Based on the findings of the first usability study we formulated the following goal we want to achieve with our design:

Make error recovery effortless for users by redesigning the feedback of the OV-chipcard system.

Problem definition
Our focus is on resolving errors that might occur while using a check-in/out touchpoint with your OV-chipcard. When something goes wrong the touchpoints are the first place where you can get feedback, yet it is not always clear for the user what the problem is or how to proceed with solving this problem.

Design specifications
NS has stated that the hardware for the gates is already ordered and paid for, so it is not feasible to redesign the touchpoints themselves. We can however redesign the user interface and more specifically: the way feedback is given. Service desks and conductors cannot always directly help you or point you to the right direction, with clear feedback from the touchpoints problems might be solved more easily and quickly.

User experience target
User experience focuses on the way a person feels while using a product or system. We set out to give the users the feeling of being in control. Rather we found through our usability study that by giving people the right feedback to solve their error quickly and efficiently, they do not necessarily feel in control but guided.

Our goal for the user experience is to have "users see the OV-chipcard system as a servant, and not as a big bureaucratic system". With the system as a servant, users feel that they are catered to their needs.

Furthermore, we think that the users should feel that NS is taking charge over the error situation, and being one step ahead of the user in the error recovery. By being one step ahead the NS relieves the users of making decisions and gives the impression that NS is taking charge over the situation. This way NS is seen as the system that takes responsibility and helps you, not as a system that is counteracting you.

"The user should feel that NS is taking charge over the error situation, and being one step ahead of the user in the error recovery."

"Users should see the OV-chipcard system as a servant, not as a big bureaucratic system".

DESIGN PROPOSAL

THE IDEA

The idea for our design proposal rose from the need of having more information about your OV-chipcard immediately available when encountering an error. Currently you need the NS touchpoints to get information about your OV chipcard. But what if your card could be a source of information instead?

Looking at the existing technology available in smartphones today, we believe that in the near future smartphones could serve as an addition to the current OV-chipcard. It would become an OV-chipcard which could provide more information in a straightforward way. Looking at the roles smartphones play in our daily life, we feel that the transition of using your telephone as a mobile check in will be very natural.

The mobile check in would be added functionality of the existing NS application, which you can activate to unlock the checking in capabilities of the phone. The smartphone will provide additional information while checking in or out, like credit status and previous travels. Since the focus of our project is on error recovery, we gave phone the role of a mediator when a problem arises while checking in. It will guide you towards the solution of the problem quickly and efficiently.

In the ideal situation users can resolve the error on the spot, by activating their card or charging their credit directly on their phone. The resolvement of some error situations may still have to be done outside the application on the phone, for instance by going to a service desk. In these situations the objective of the design proposal ends when the users have been guided to the place where they can resolve their error.

BENEFITS

With this system users are provided with more and clearer information than with the current system and they are provided with the means to solve problems that occur while checking in. We expect people to be less confused by error messages and know what the underlying problem of the error is (identification), if it is their fault or not (attribution) and solve their problems in fewer steps (trying out).

The system will guide users towards solving their problem quickly and efficiently. Now users are approaching multiple NS employees in order to find a solution. Solving problems using just the application or going to the right NS employee straight away relieves the NS of strain of users approaching multiple employees.

HOW DOES IT WORK?

Near Field Communication (NFC) is a technology appearing more and more in smartphones. In 2011 the first smartphones with NFC were introduced on the market. Now all new smartphones that are being made will have NFC integrated. Within a few years every smartphone user will have access to this technology. NFC is based on RFID (radio frequency identification, the technology used in the current OV-chipcard system), the main difference being that NFC capable smartphones are capable of two-way communication. Smartphones with NFC capabilities have a chip that can switch between passive and active mode. In passive mode it behaves just like a regular card, in active mode two-way communication is possible that is a prerequisite for the added functionality our design provides.

The users can use this system just like they would use an OV-chipcard; by swiping it at the touch points. On the phone they would need to install an application that enables this functionality, which could be integrated in the official NS application.

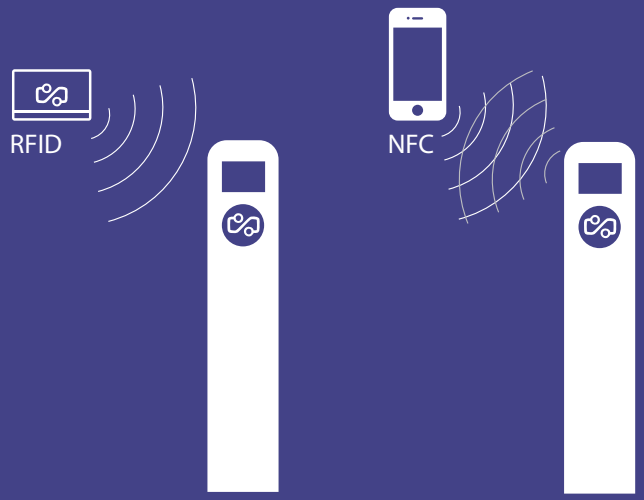


Figure 5: Communication technology of the OV-chipcard and the proposed smartphone solution:
The check-in touchpoints need to be able to both send and receive data with the proposed solution.

LIMITATIONS

NFC technology is still very new; meaning that implementing this form of checking in now would not reach many people. It also takes years to develop such a system. We therefore developed the design for the future and set certain limitations.

From 2013 onwards all major stations will have gates that open when you check in. This means that when something goes wrong during checking in the user cannot approach a conductor but have to solve the problem before you are allowed on the platform. (Of course it is possible to jump the gates, but that is not something we want to encourage.) The user would have to figure out what the problem is on their own or find a service desk. We took this situation into account when designing the problem solving steps.

In the future smartphones will be different from the current phones. We designed for the current models and their user interfaces with the addition of a NFC chip.

The actual resolvement of some error situations may still have to be done outside the application on the phone, for instance by going to a service desk. In these situations the objective of the design proposal ends when the users have been guided to the place where they can resolve their error. However, for some of the error situations, we were able to make solutions for resolvement on the spot, for instance by activating the travel product by choosing class, or topping up your credit.

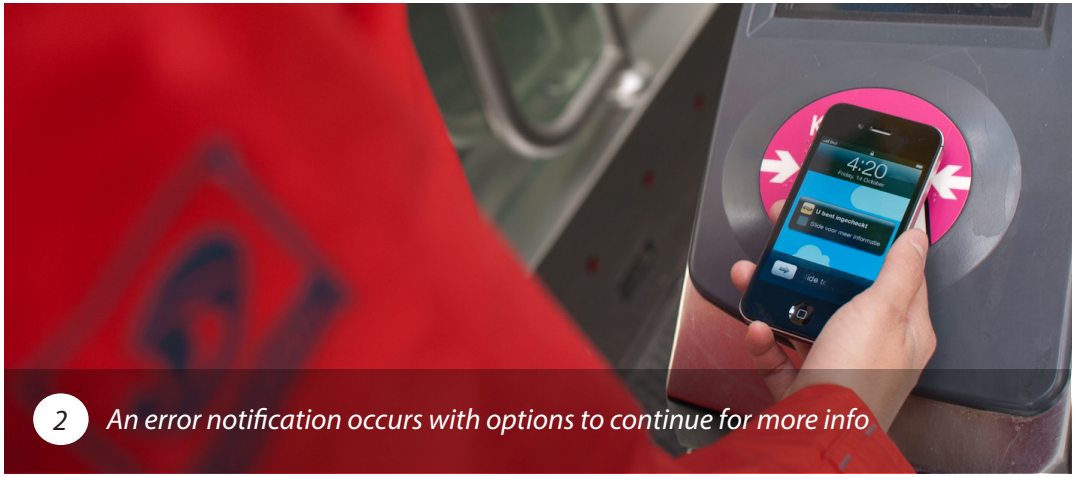
USE SCENARIO

When the user checks in by swiping their phone at the gate, they get a message on the screen of the gate and on the screen of the phone. The phone vibrates as they swipe, drawing attention to the phone.

On the phone there is an option to get more information, which is dependent on the status of the travel product. If nothing is wrong the users receive information on his current credit status. If something is wrong the users receive information on the error and steps on how to solve the problem.

1 *User tries to check in with her mobile*

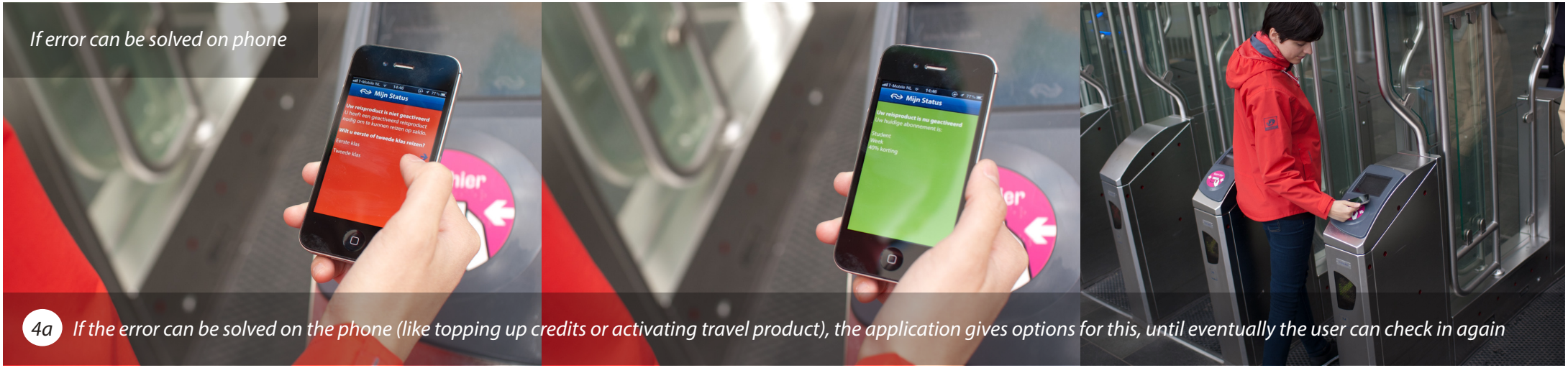
Figure 6: An illustrated sequence for two of the possible error situations addressed with our design



2 *An error notification occurs with options to continue for more info*

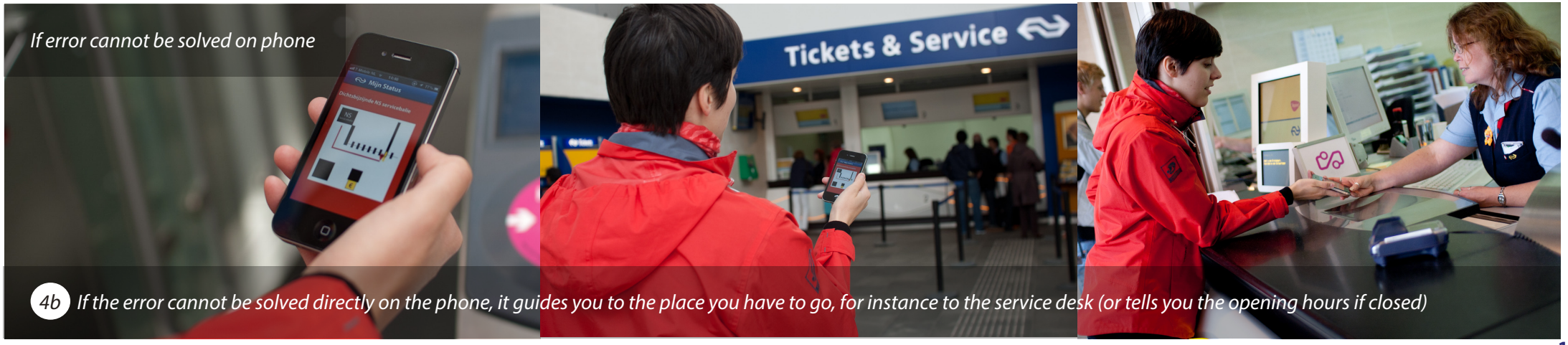
3 *The next screen shows further info about the error and options to solve it.*

If error can be solved on phone



4a *If the error can be solved on the phone (like topping up credits or activating travel product), the application gives options for this, until eventually the user can check in again*

If error cannot be solved on phone



4b *If the error cannot be solved directly on the phone, it guides you to the place you have to go, for instance to the service desk (or tells you the opening hours if closed)*

USER STUDY TWO

USER STUDY TWO

The second user study was conducted to evaluate the added value of the design proposal, and to reveal possible new usability issues. As the first study was conducted to investigate the general usability and user experience of error recovery with the OV-chipcard, the second study was more focused on evaluating the added value of our redesign.

The study was restricted to only be conducted at the station of Schiedam Centrum because this is a station with closed gates. In 2013 most stations in the Netherlands will be closed by gates, so Schiedam Centrum function as a good representation of the future context. The test was conducted in a real context – with service desk, ticket machines and information poles – instead of a more controlled environment. This was because the test setup was designed to address the added value of our redesign in relation to the usability and user experience of error recovery at the station. Therefore the test did not focus that much on the evaluation of the user interface of the application itself.

The studies were recorded on video and were analyzed by mapping out results in relation to our research aims and questions. The behaviour pattern was mapped out in a similar manner as user study one and the time usage was also compared. The quantitative results that were measured were compared to the Schiedam Centrum-results from user study one. The qualitative results were compared with all results of study one.

Aims

The aim of user study two was to evaluate the added value of our product in the process of error recovery.

- Find out if the new systems provides clear guidance for error recovery.
- Find out if the new systems decreases uncertainty in the error recovery process.
- Find out the differences in behaviour patterns of users in the error recovery process in comparison to the first user study.

Research questions

In order to evaluate our design proposal, we set up a list of research questions that touched upon the aspects we wanted to assess:

- Does the OV-phone help the participants identify the source of the problem?
- Does the OV-phone help the participants in figuring out how to solve the problem?
- Does the OV-phone guide the participants towards the right solution at the first try? (Do the users go where we want them to go?)
- Did the participants need fewer steps to solve the problem compared to the first study?
- Do the participants follow the instructions on the mobile phone?
- Do the participants feel confident in the resolving strategy they are presented with?
- Did the participants still feel the need to seek assistance from a NS representative in order to understand their situation?

SETUP

The study was an observational study with a staged scenario. In order to make the error feel unexpected, the participants were initially demonstrated a scenario of successful check-in by the test leader. The participants were then handed the phone and given a scenario where they would have to be in Amsterdam in one hour. They were asked to think out aloud and act out the situation as if it was their own OV-chipcard. The prototype was staged with one of two error situations (see table 5), and we observed how the participants dealt with the situation. The test leader could probe for clarification with small questions in situations where research questions were not answered by observation alone. The test stopped when the participants followed the instructions on the screen until the end, or when they stated that they would choose another strategy. The test was rounded up with an evaluating interview.

The participants were selected from people waiting at or outside the station, and that had five minutes available time. We sought to get as much variety as possible when it comes to age, gender, travel habits and experience with OV-chipcard and experience with smartphones, in order to get a good representation of the people currently using NS services.

Total participants: 15	Male	Female
Student	3	2
High school student	2	1
Worker (young)	3	1
Worker (middle aged)	2	1
Retired	0	0

Table 4: Participant demographics of study two.

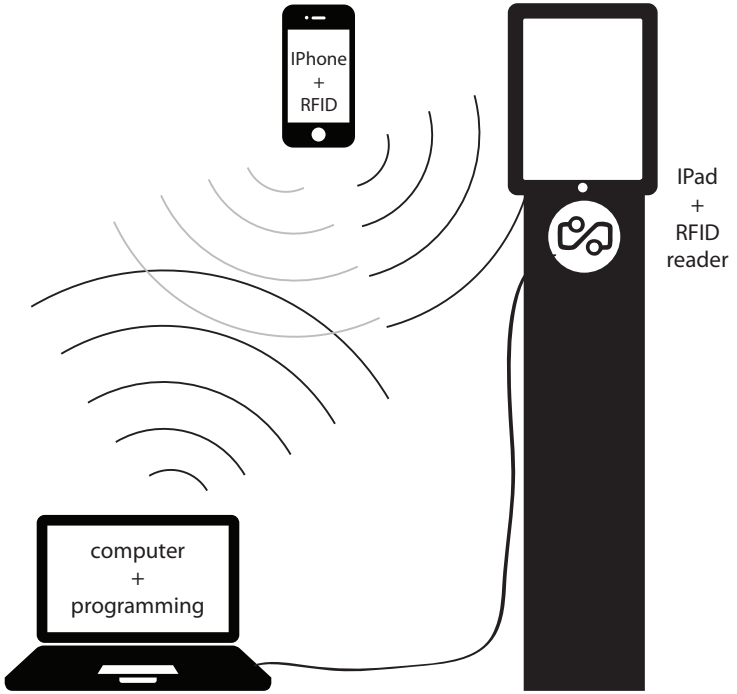
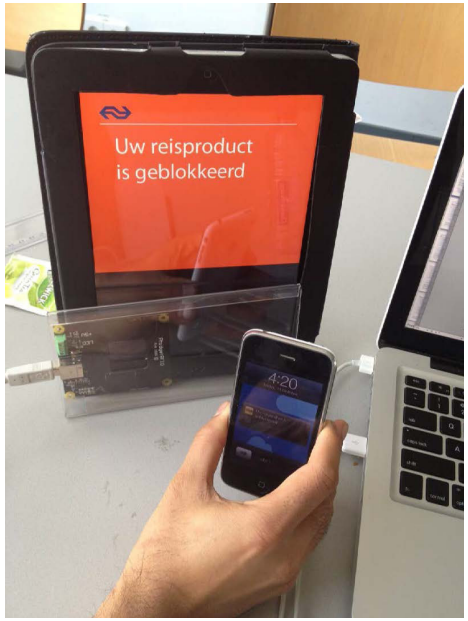


Figure 7: Our design proposal was prototyped with an iPhone as the OV-chipcard, and an iPad simulating the screen of the gate. The prototype was run through a computer managing the logics of which scenario to be run, and how the feedback was to be provided. The prototype was then installed on a gate at Schiedam Centrum station.



TESTED SCENARIOS

	Gate feedback	Phone feedback	Screen 1	Screen 2	Screen 3
Blocked *Scenario where the problem itself has to be solved at the service desk.*	Uw reisproduct is geblokkeerd + Error sound	 + Vibration			
Not activated *Scenario where the problem can be solved directly on the phone.*	Uw reisproduct is niet geactiveerd + Error sound	 + Vibration			

Table 5: Feedback sequences for the intended error recovery of the two scenarios staged in the test

RESULTS

From this study we have analyzed the behaviour and the problem solving patterns of the participants with our design proposal.

12 out of 15 participants were able to identify the problem from the feedback on the gates with the rewritten error messages; also 12 out of 15 participants used the application for more information. In the end 11 out of 15 participants were able to solve the problem with the application. 3 out of the 4 participants that were not able to solve the problem with the phone mentioned they would have liked to talk to a conductor. None of the other participants who did succeed mentioned a conductor as an option, which contrasts the first study where this was a common need. For more detailed user actions see appendix 2.

In these results we could see a clear pattern in the resolving strategies. For both the not-activated and the blocked card we can see that there is a clear pattern most participants follow in solving the error. Most participants go through different actions in the way we wanted them to; not many detours are taken and the problem is to a large degree solved.

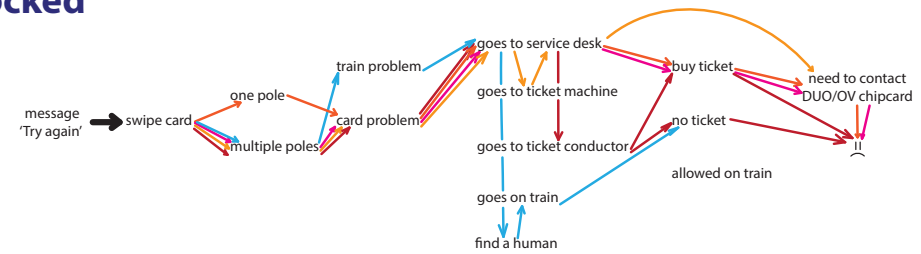
The patterns of user study two differentiates clearly from user study one in consistency, as illustrated in table 6.

"If the phone clearly says what is wrong and how you can solve it, the error is not a problem anymore"
Male participant (ca 20 y/o)

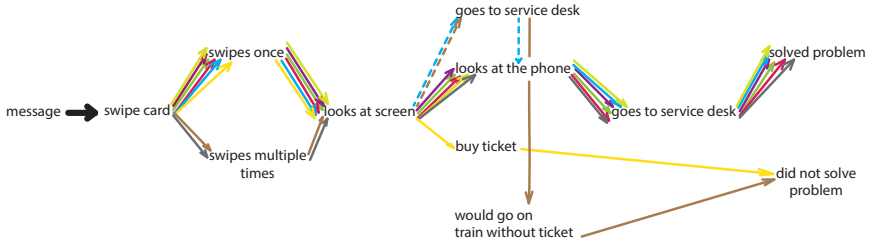
Problem solving patterns

Blocked

Study 1

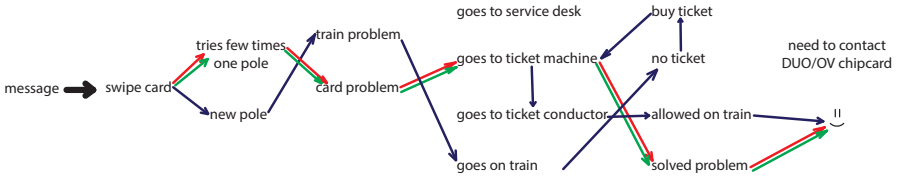


Study 2



Not activated

Study 1



Study 2

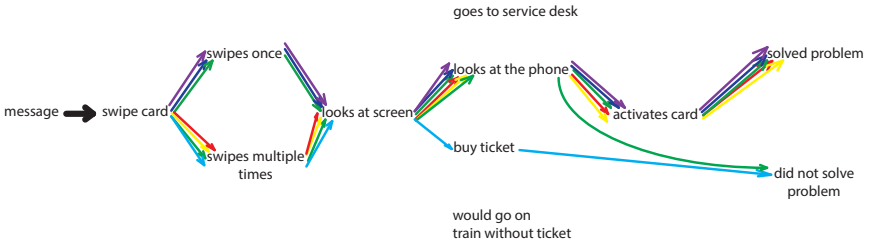


Table 6: For both the not-activated and the blocked card we can see that there is a more clear problem solving pattern emerging from the participants of user study two. Most participants go through the different actions in the way we wanted them to; not many detours are taken and the problem is to a large degree solved.

Resolving efficiency

Another factor we considered was the time in which participants were able to solve the problem. Time is relevant to our design because when travelling seconds do count at the train station. Resolving an error in less time results to a more positively user experience because of less related stress. We can only really compare the blocked card scenario at Schiedam Centrum station from both studies, because these were done in similar circumstances. Here we can see that it took the participants only two thirds of the time.

The scenario of the not-activated card was not tested at Schiedam Centrum in the first user study, so we cannot compare it, but it did took the participants an average of only 28 seconds to activate their card.

Scenario	Study 1	Study 2
Blocked at Schiedam C.	75 seconds	50 seconds
Not Activated at Schiedam C.	n/a	28 seconds

Table 7: The average time spent before the problem was solved among the participants who solved it successfully. Estimates start when participants first encounter an error and stop when they either have checked in correctly (not activated) or reached the service desk (blocked).

"It was fast, reassuring"
Male participant (ca 40 y/o)

User experience

From a user experience perspective we observed that the participants were more relieved at the end of the test and surprised they could solve their problem this quick. In the first user study we had encountered mostly frustration, and a feeling of being small and helpless against a rigid NS system.

The participants felt more guided in the resolving process, whereas in the first user study they were often confused about what to do. 10 out of 12 participants who read the instructions on the phone indicated they felt confident in the resolving strategy they were presented with. 3 participants native to the station mentioned going to the service desk before they saw the instructions on the phone. However they felt even more confident in the solving strategy when the telephone also suggested this option they had thought of themselves.

"It is convenient that you immediately get information about where you can go to best solve your problem."
Male participant (ca 30 y/o)

"At first I thought 'Damn, here we go again' but then I saw that I had to go to the service desk, so there was immediately a solution available."
Female participant (ca 30 y/o)

"An OV-chipcard is something extra that you have to carry around with you, which can bend and break, with your phone you are always very careful"
Male participant (ca 40 y/o)

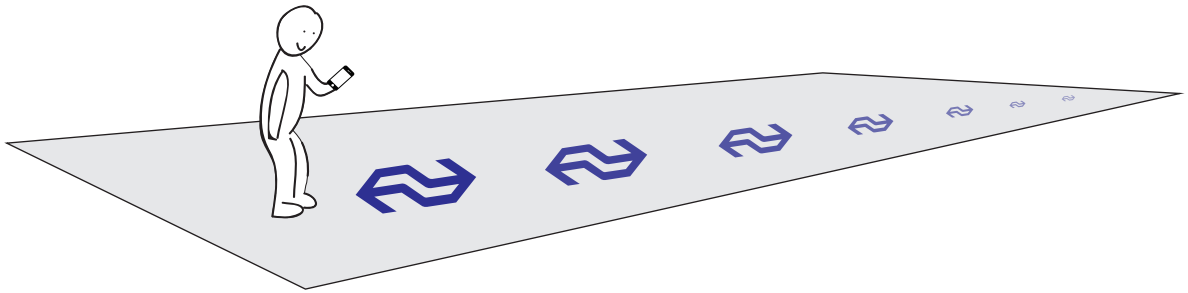


Figure 8: The users felt guided in the process – the frustration of helplessness was not evident anymore.

DISCUSSION

Comparing the two user studies was somewhat difficult because both studies were done with different purposes in mind. The first user study was an explorative study to gain insights in user experience and usability issues. The second study was set up to validate our design proposal, and thus more focused. Nevertheless we have found some valid points in which we could compare the two studies. Furthermore we feel that the second user study has really informed us about the extra value of our new system, and gave us some indications on what still has to be improved as well. However we did encounter some limitations and difficulties in the second user study that might have influenced our results.

- Participants used a phone with a RFID tag taped to the backside while it will be integrated in the phone.
- The participants were only able to use one gate; the one where we had installed our prototype, so were not able to test the prototype at different gates, while they might have done so in a real-life situation.
- In the prototype you could only progress in the menu by swiping but the screens were designed as buttons. The test leader occasionally had to remind the users of this limitation when they tried to touch a button. This could have influenced users to explore the application in some scenarios more often than they would in real life.
- The user test was only addressing two of the error situations we had designed for. Therefore some structural flaws may still be present in the scenarios that weren't tested.
- In some cases the prototype program did not respond as planned making these tests useless.
- Some users could identify and solve the problem, but we were not sure if they really understood what the problem was. It might be negative that the feedback was not clear, yet it does show that people can solve the problem even though they do not really understand it.
- We noticed that during the test, although we selected people on this, still some seemed to be distracted because of time constraints. This decreased the immersion of the participants in the test and could result into not understanding clearly the application.
- A few participants mentioned that none of the gates opened, because we weren't able to fake this it left out a conformation for people that they successfully checked in.
- Some users were familiar with the station, therefore these users didn't feel the need to use the applications advice and went to the service desk straight away.
- The prioritization phase is also considerably influenced by whether the station has closed gates or not. This means that the user study results of this phase is not only controlled by the redesign itself, but also the context of the station.
- The people who still wanted to catch the train in user study two (with or without ticket) were the ones who actually did not read the messages on the phone.

CONCLUSIONS FROM USER STUDY TWO

We can conclude from the second user study that the redesign provides clearer guidance for error recovery than the current system. It makes the process of error recovery more effective, efficient and pleasurable.

Comparing the results of user two with the error recovery model from user study one, we can see that error recovery with the redesign results in an adapted model to describe the phases travellers go through when recovering an error, which can be seen in figure 9.

This new model is improved a great deal from the first model. The main reason for this is that our concept has eliminated the 'trying out' phase, and also merged the 'identification' and 'attribution' phase together. This results in a much shorter total resolving time. We also noticed some differences in the other phases in comparison to user study 1. In the following section each phase will be discussed separately.

Identification / attribution phase are merged

The concept makes this phase a lot more effective and less ambiguous. The messages are informative and clear. The users instantly identify and attribute the error after reading just the first feedback on the phone.

The concept also effectively makes the users move forward with the error recovery form this stage onwards, as more information is immediately available on the phone.

Trying out phase is eliminated

The redesign invites more people to begin solving the underlying problem at the spot, because they are offered a solution, there was less tendency to go on the train with or without a paper ticket.

Every participant who read the instructions on the telephone prioritized to fix the problem with the travelling product.

Prioritizing phase more in favour of fixing the problem

This is the phase which is the most affected by our redesign. It changed from user seeking solutions to their problem all over the station to following the instructions on the phone and being guided right into the resolving phase.

The behaviour patterns that evolved in user study two indicate that the amount of people struggling without any guidance to find out how to solve the problem is dramatically decreased.

Resolving phase consists of following instructions on the phone

The resolving phase is now done either on the telephone, or at the service desk.

From the test of the "not activated travel product", recovering from an error solely through your phone proved to be very efficient. Users did not even have to move a foot in order to solve the problem, and they felt relieved after recovering from an error so effortlessly.

In the case of the blocked card the users still had to go to the service desk, yet they were happier to do so because they knew there was a solution available for them there.

"Why would it be blocked? Oh, I have forgotten to check out multiple times.."
Male participant (ca 60 y/o)

"I would check the application for more solutions before going to the service desk" (woman with green back)
Female participant (ca 30 y/o)

"It is convenient that you immediately get information about where you can go to best solve your problem."
Male participant (ca 30 y/o)

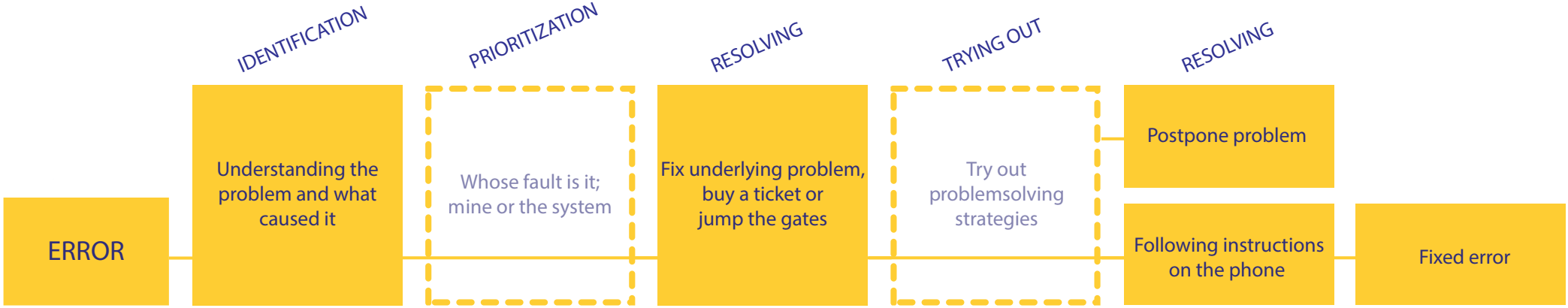


Figure 9: The problem solving model of user study two: Phases of error recovery of the proposed redesign.

REDESIGN RECOMMENDATIONS BASED ON USER STUDY TWO

Although the second user study was focused on validating our concept, we also encountered some issues in the design of our concept. The content of the feedback was not always clear enough, especially in the 'not-activated' scenario.

The user interface lacked some functionalities that users expected to be there and the feedback in form of vibration and sound was not always sufficient to guide users to the telephone.

From these issues we created a list of recommendations that could be implemented in the final design of our concept.

User interface issues
Home/Back button need to be added to let users go back to their previous step.
The action buttons need to be presented more like a button.

Descriptive text could be outside the button, but a clear action should be written on the button.
All options should be stated as options with button.

The mobile icon on the screen of the gate has to be noticeable and guiding (e.g. Stating it in clear text; present a bigger icon; have a longer vibration pattern in the phone)

Content issues
We need to change the messages on phone to more understandable and clear phrases ("your card is not activated" to "you have to choose a travelling class before you can travel") which are not just describe the situation but also suggest the next step.

After the activating process, additional confirmation is needed to make it clear that the user has to check in after activation. (e.g. "You are now ready to check in" and maybe with an added confirming sound/ vibration.)

The map has to contain easily identifiable objects and good location specification (e.g. Using top view photograph of the station)
Text size should be bigger as some users struggled to read small text.

Feedback issues
The error feedback on the phone needs to differentiate from the feedback of successful check-ins. (E.g. Different vibration and sound patterns: long for errors, short for success)

FINAL REDESIGN

FINAL REDESIGN

After the analysis of user study two, we noticed a couple of aspects that could be improved.
We have implemented these improvements into a final redesign, of which the "blocked travel product" is shown. Other error scenarios that were not tested can be seen in appendix 3-6.

- There was still some ambiguity in the messages, for instance "Uw reisproduct is niet geactiveerd." is not informing the user what the next step should be. The messages are now more to the point.
- Some people had difficulty reading the messages; the final redesign uses a bigger font size, to increase legibility.
- We noticed that people did not recognize buttons as such; buttons now have a box around them so they are perceived more as buttons.
- There were some screens that had text that could be mistaken as a button, this information is now communicated in a different way as to avoid confusion.
- Many people were initially looking at the gate for more information and did not notice the phone icon; the icon is now bigger to be more noticeable.
- The map of the station and the service desk had too many objects that did not help to navigate the station. The map now has less 'clutter' and objects like the gates are easier to recognize.
- The phone vibrated in the same way for every message. By having a short vibration signal for a successful check in and a long vibration for errors, we attract more attention to the phone.

SCENARIO: BLOCKED TRAVEL PRODUCT

Screen on gate

Screen on smartphone

Vibrational feedback

Two different situations

Figure 10: The blocked scenario

SCENARIO: NOT ACTIVATED TRAVEL PRODUCT

Screen on gate

Screen on smartphone

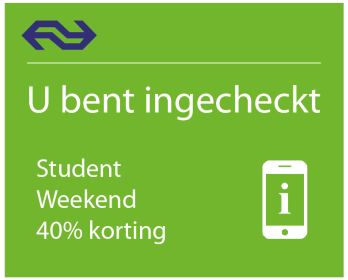
Vibrational feedback

Two different options

Figure 11: The inactivated scenario

SCENARIO: SUCCESFUL CHECK-IN

Screen on gate



Screen on smartphone

Vibrational feedback

Figure 12: The successful check in scenario

CONCLUSIONS

CONCLUSIONS

The redesign is providing effective error recovery compared to the current system, as it can guide users to the steps we want them to take in a larger degree. The redesign is also proven very efficient in guiding the users to the solution. Firstly it takes less effort to find out what to do, which makes more users start the error recovery process at the train station. Secondly it guides the users to the closest spot to solve the problem, either by providing maps to service desks at the station, or by solving the problem directly on the phone.

The concept has changed the previously made model for error recovery a great deal. But it has also changed the user experience and usability of error recovery with the OV chipcard.

Usability

User study two shows that the redesign facilitates more consistent error recovery behaviour among users. Additionally, the users are choosing the strategies we as designers intended them to go for. They were guided towards the right solution at the first try instead of trying out different strategies themselves. An important implication of this is that the participants did not need to go through an uncertain "trying out" phase before they came to the final solution, making the error recovery more efficient and use friendly than it was before.
The redesign helps the participants to identify the source of the problem at an earlier stage and with less ambiguity. A challenge was getting some participants to actually look at their phone, but once they did, they followed the instructions on the phone and were relieved to be guided. This quick identification results in a more effective resolving process, where almost all participants were able to solve the problem.
We received a lot of positive about the convenience of using a phone as the OV-chipcard. A shift from a card to a smartphone based solution can be seen as an opportunity to redefine the usability reputation of the OV-chipcard.

User experience

The redesign helps users reduce uncertainty when deciding problem solving strategy. The information provided on the phone is trusted as the optimum strategy for error recovery, which makes the users feel more certain about the strategy they go for. The participants were also more persistent in resolving the error, as they knew the instructions on the screen were the best solution for them. Most importantly, they felt more guided in the process; they were not left alone in an unfortunate situation. Furthermore, participants were relieved at the end of the test as they could solve the problem without much effort, some were even surprised they could solve it this quick

In the first study, we found that the participants had a higher tendency to give up their strategy if they met a small hindrance. A closed service desk from the metro company already discouraged them, and they did not continue looking for a desk from NS. In user study two, most participants kept looking as they knew that there was supposed to be an open NS service desk at the station.

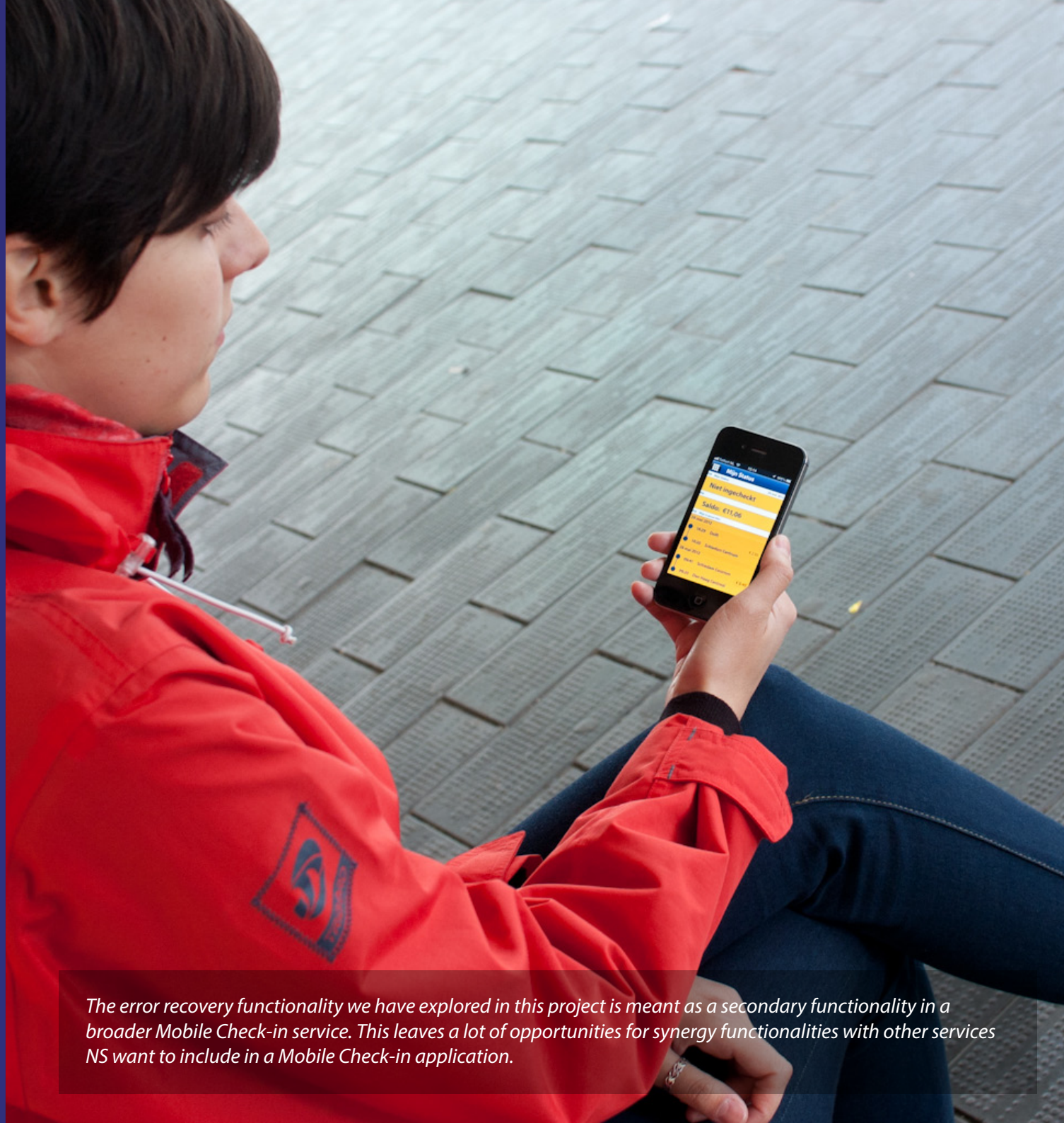
Because users are more confident with their strategy, they also have less need to seek assistance from a NS representative in order to understand their situation. In other words, by increasing the confidence of the users, the redesign decreases the need of human assistance. This causes a shift in user experience, when the users are guided in such a way they do not need additional assistance, which gives them a more pleasurable user experience

Figure 14: Before and after: The users are now feeling guided by NS – they no longer feel small and helpless against an ambiguous and rigid system

RECOMMENDATIONS

The concept as we developed it so far is mainly focused on error recovery. Along the way we encountered many more opportunities were our concept could be beneficial. These opportunities we did not design for because they were outside the scope of our research. Still we think they are worth to mention and will eventually contribute to the overall user experience of travellers while travelling with the NS. These recommendations can still be implemented and should therefore be seen as suggestions for the final design.

- Implement an option to set up automatic charging if you have low credit (also have a 'do not ask again option' for people who do not want to do so.)
- Implement an option to easily get a refund for situations that may apply (OV-butler style).
- Create a notification for when the traveller is low on credit when they have checked in or out.
- Have an option for alert when you get too far from a station without checking out.
- If the pole is broken, activate a backup system that sends message to 'out of order' to the screens of the poles and gates.
- Option to have the application in English for foreigners.
- Make 2nd class default, so you don't have to activate the card.
- Make it possible to personalize sounds and vibrations. This becomes especially important for frequent use with other functionalities on the phone (calling/music).
- Reminder when you are about to get your card blocked.
- Credit and check-in status should be visible at all times.



The error recovery functionality we have explored in this project is meant as a secondary functionality in a broader Mobile Check-in service. This leaves a lot of opportunities for synergy functionalities with other services NS want to include in a Mobile Check-in application.

APPENDIX

APPENDIX 1

Results table user study one

	Inactivated card tested at poles	Blocked card tested at poles	Blocked card tested at gates	Broken card tested at poles
IDENTIFICATION Error message	**"Check-in not possible"**	**"Try again"**	**"Try again"**	**"In-/uitchecken"** (default screen)
IDENTIFIACTION Visual feedback	Error sound Blinking red light Red screen with white lettering	Error sound Blinking red light Yellow screen with black lettering	Error sound White screen with black lettering	No reaction from touchpoint Continuous green light Black screen with white lettering
ATTRIBUTION Interpretation of the feedback	Something is wrong. Not clear whether problem lies with the card or the pole, or is the user's own fault.	Something is wrong Not clear whether problem lies with the card or the pole. Suspected the error to be a technical malfunction. Expected the problem to be temporary because the card can still be read.	Something is wrong Not clear whether problem lies with the card or the gate. Suspected the error to be a technical malfunction. Expected the problem to be temporary because the card can still be read.	Realizes there is a serious problem with the card Expected that the card probably has to be replaced.
PRIORITZING	Prioritized boarding the train (1 out of 5) Prioritized underlying error of the card (2 out of 5) Did not know what to do (2 out of 5)	Prioritized boarding the train (2 out of 2)	Prioritized boarding the train (2 out of 6) Prioritized underlying error of the card (4 out of 6)	Prioritized boarding the train (1 out of 3) Prioritized underlying error of the card (2 out of 3)
TRYING OUT Actions	Went to ticket machine, (2 out of 5) Went to conductor (1 out of 5) Did not know what to do (2 out of 5)	Went on train without ticket (2 out of 2)	Went to service desk (5 out of 6) Went to ticket machine (1 out of 6)	Went to service desk (3 out of 3)
RESOLVING Solution	Charged card (2 out of 5) Got allowed on train for free (1 out of 5) Did not solve problem (2 out of 5)	Went on train without ticket (2 out of 2)	Got a telephone number of web address from service desk to solve the problem at a later time (5 out of 6) Ticket machine told the participant the card was blocked and he needed to go to a service desk (1 out of 6)	Got a telephone number of web address from service desk to solve the problem at a later time (3 out of 3)
RESOLVING Buy ticket or not	Would check in after solving problem (2 out of 5) Got allowed on the train for free by a conductor (1 out of 5) Did not specify (2 out of 5)	Would not buy ticket (2 out of 2)	Would buy ticket (4 out of 6) Would not buy ticket (2 out of 6)	Would buy ticket (2 out 3) Got allowed on the train for free by a conductor (1 out of 3)
Details	Participants with previous experience knew how to solve the error. When stating actual error participant was allowed on train for free. The 'not possible' in the message gave the participants the idea there was nothing they could do.	They did not figure out what the problem was, but stated they would call the helpdesk or consults the NS website at a later time. Participants felt the problem was the responsibility of NS so they did not feel the need to buy a ticket	The gates prevented the participant from going on the train, and therefore they had to prioritize the card problem. It should be possible to unblock the card at the service desk, yet no NS official suggested to do so. Would try to get on the train without a ticket because they have the student right to travel for free so they would not feel the need to buy a ticket	One participant looked for a conductor at first, but could not find one, so he went to the service desk instead. It is not possible to order a new card at the service desk.

APPENDIX 2

Results table user study two

	Inactivated card 7 participants	Blocked card 8 participants
IDENTIFICATION Error message	**"Uw reisproduct is niet geactiveerd"**	**"Uw reisproduct is geblokkeerd"**
Feedback on screens of gate	Error sound Red screen with white lettering Telephone icon	Error sound Red screen with white lettering Telephone icon
Feedback on phone	Vibration Notification: "**Uw reisproduct is niet geactiveerd"**	Vibration Notification: "**Uw reisproduct is geblokkeerd"**
Interpretation of the feedback of gates	The travel product is not activated so it is not possible to check in (5 out of 7)	The travel product is blocked so it is not possible to check in (7 out of 8)
Interpretation of the feedback of phone	The product needs to be activated before travel (6 out of 7) Did not look at feedback on the phone (1 out of 7)	The product is blocked (3 out of 8) The product is blocked because I forgot to check out multiple times (3 out of 8) Did not look at feedback on the phone (2 out of 8)
PRIORITZING	Prioritized underlying error of the card (6 out of 7) Prioritized boarding the train (1 out of 7)	Prioritized underlying error of the card (6 out of 8) Prioritized boarding the train (2 out of 8)
RESOLVING Solution	Activated product using the application (5 out of 7) Did not solve problem (2 out of 7) Would go on train with ticket (1 out of 2)	Went to service desk following instructions (6 out of 8) Did not solve problem (2 out of 8) Would go on train with ticket (1 out of 2) Would go on train without ticket (1 out of 2)
Details	The participant who did not solve the problem was the one who did not look at the feedback on the phone One participant went back to the main menu of the IPhone instead of continuing through the steps of the application The users could identify and solve the problem, but we were not sure if they really understood what the problem was. (2 out of 7) Greenpeace chick, cigarette guy 1 6 out of 7 participants had previous experience with smartphones	The two participants who did not solve the problem where the ones who did not look at the feedback on the phone 3 out of 8 participants would go to service desk even before they had looked at the telephone, they were familiar at the station 8 out of 8 participants had previous experience with smartphones

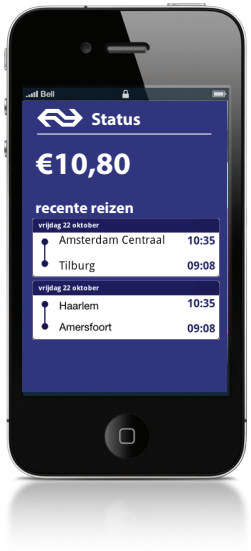
APPENDIX 3

Previous designs for Mobile Check-in

Situation: Standby

gate:

mobile:



APPENDIX 4

Previous designs for Mobile Check-in

Situation: Succesful check in

gate:

U bent ingecheckt

Saldo € 20,35

mobile:

APPENDIX 5

Previous designs for Mobile Check-in

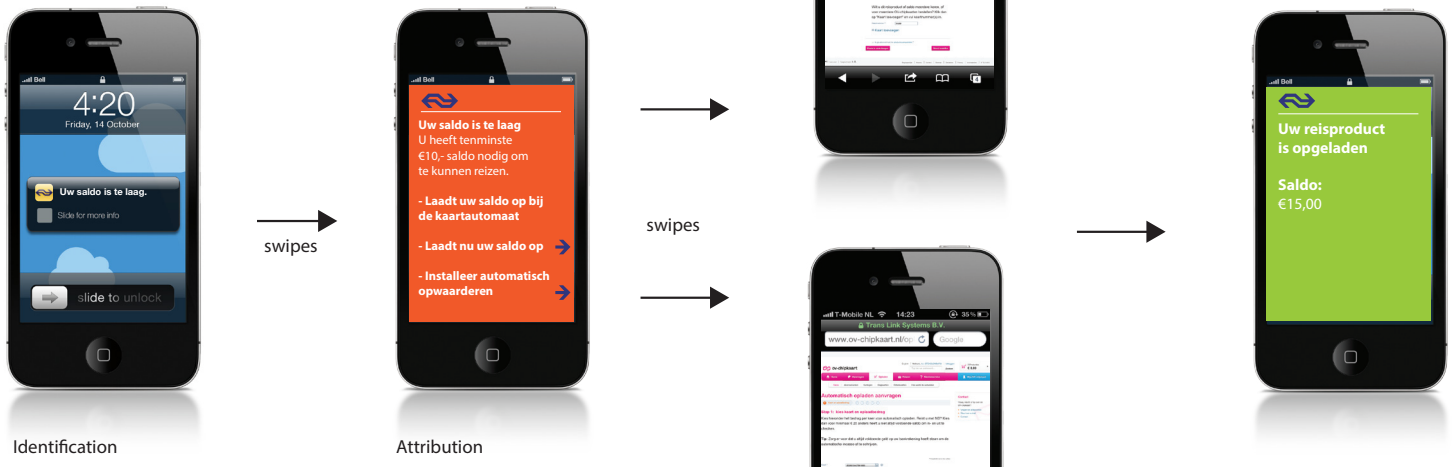
Situation: Low credit

gate:

Saldo te laag

€8.20

mobile:



Identification

Attribution

Resolving

APPENDIX 6

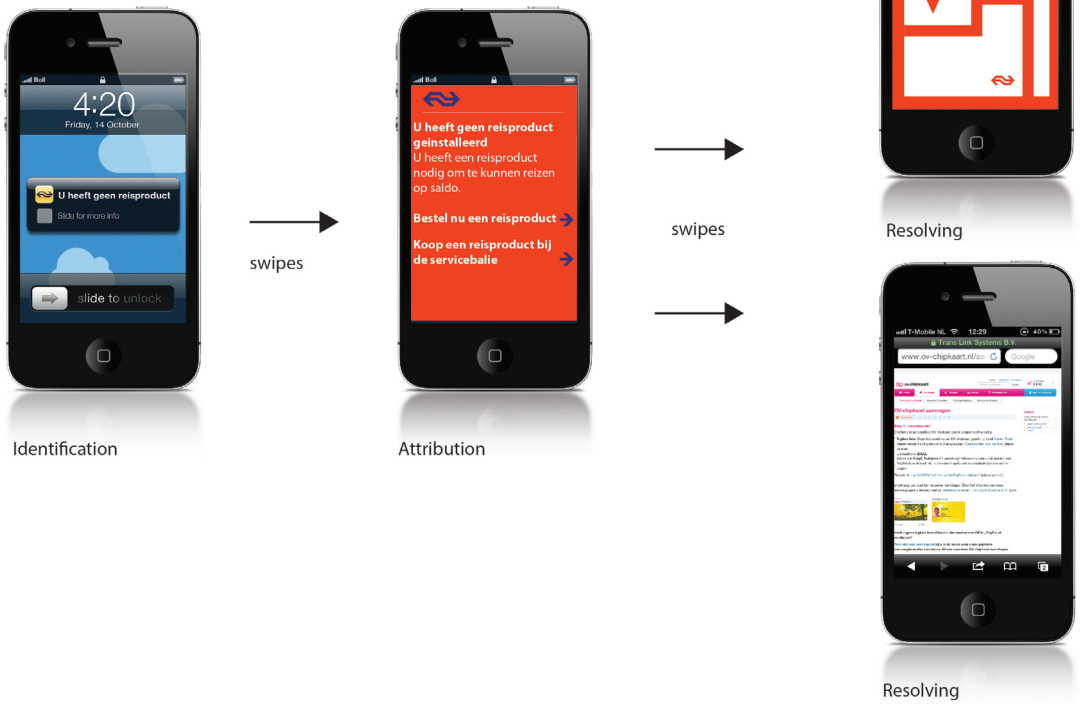
Previous designs for Mobile Check-in

Situation: No subscription

gate:

U heeft geen reisproduct geinstalleerd.

mobile:



Progress report by B6


STATION
KIOSK
LINGERIE
BOEK ENED
TICKETS
SHOARMA