TARGET BASED ANALYSIS - A MODEL TO ANALYSE USABILITY TESTS BASED ON MOBILE EYE TRACKING RECORDINGS

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Abstract

This paper addresses the usability evaluation of tangible products by video analysis. Compared to conventionally conducted videos from the third-person perspective, mobile eye trackers allow to capture the user-product interaction from the first person view, and to measure the location of the gaze. Knowing where a user looks, enables to analyse the interaction more granular, and to draw conclusions about cognitive processes. To address the potential of mobile eye tracking for usability tests of tangible products, we introduce the Target Based Analysis (TBA) - a model structuring the video analyses. On the basis of the location of the gaze, the model decomposes each interaction step in the four reoccurring phases: find, recognize, handle and prepare/wait. The model has been tested in a usability study of two 3D printers with 46 participants. It was possible to map each user-product interaction, to generate comprehensive overviews allowing to quickly identify critical steps, and to compare between tasks, user groups, and products. In the future, an integration of eye tracking measures, such as fixation durations, could further amplify the quantification of user-product interactions.

Keywords: Human behaviour in design, User centred design, Experience design, Eye tracking, Usability

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1 INTRODUCTION

The introduction is divided in three sections. First, the concept of usability testing in the field of tangible products is presented. Secondly, the relevance of eye tracking, especially mobile eye tracking, is introduced. Finally, the objectives of this work, and the outline of the paper are described.

1.1 Usability Testing

Currently, the concept of user experience (UX) receives high attention when studying the interaction between a user and a product. User experience is defined as "a person's perceptions and responses that result from the use or anticipated use of a product, system, or service" and it includes the phases before, during, and after the interaction (ISO, 2009). Usability is an essential part within user experience. Kremer and Lindemann (2015) state, that *"in the centre of any User Experience usability still plays an important role ... products have to provide outstanding usability, understandability and a feeling of complete control."* To assess the usability of a user-product interaction usability testing is a widely spread approach. In this paper, we follow the definition of Rubin and Chisnell (2008). They describe usability testing as, "a process that employs people as testing participants who are representative of the target audience to evaluate the degree to which a product meets specific usability criteria." During the usability test, participants perform a predefined task, and the user-product interaction is analysed.
This paper addresses usability testing of tangible products, such as a 3D printer. In contrast to the usability of a website or a software, whereby manual operations are often limited to mouse clicks or keyboard entries, the handling phases of tangible products are much more complex. Furthermore, websites or software can be tested on a desk, whereas tangible products have more differentiating environments, depending on the location of the natural usage of the product. Usability testing of tangible products is often performed by direct observation (shadowing), or recordings from the third person perspective, optionally complemented with the think aloud method, interviews, and/or questionnaires. To evaluate a larger number of participants the interaction is usually recorded first, and analysed in-depth in a subsequent step. Therefore, the recorded videos are replayed, and relevant appearances are systematically noted in a coding scheme (Vermeeren et al., 2002). However, the design of a video coding scheme, which is less addicted to subjective decisions of the analyst, is still a challenge. Balters et al. (2015) strengthen this view by emphasising upon *"[...] the need to quantify human-object interactions in order to get insights into the sensorial variables influencing the actual user-experiences in interaction and human centred design."*

1.2 Eye Tracking

Analysing how users see things, and understanding their cognitive response is highly relevant in design (Crilly et al., 2004). Andersen and Maier (2016) report that:

> "Visual information is vital for user behaviour and thus of utmost importance to design. Consequently, visual processing has increasingly been the target of research within design science, especially as novel methods for tracking the visual operations of users have become more readily available. In particular, the use of eye-tracking devices has shown increasing promise …"

This quote is underlined by an increasing amount of eye tracking related papers, recently presented to the design community (Bansal et al., 2015; Boa and Hicks, 2016; Lohmeyer et al., 2015; Ruckpaul et al., 2015). In their framework of technology-supported design research, Thoring et al. (2015) point out that eye tracking supports the observation of artefact interaction to an extensive degree. This trend is also supported from the market perspective. In 2014, the global eye tracking market size was estimated to be USD 183 Million, and is forecasted to grow to USD 1.028 Million in 2020 (Markets and Markets, 2015). One of the largest application field for eye tracking is usability testing. In the field of website and software usability, remote eye tracking is a frequently used tool with well-established methods (Goldberg et al., 2002; Nielsen and Pernice, 2010). Such studies can be conducted at any desk, whereas the eye tracker is mounted below the screen. However, in the field of tangible products, which are used in differentiating environments, a mobile eye tracker is required. Its accuracy, tracking frequency and the ease of use evolved to a satisfactory level, just recently.

Mobile eye tracking (MET) shows potential to supplement the usability testing setups, state of the art. The tracking system inherently provides four benefits. First, it allows to track the user-product interaction in almost every environment, because all components are integrated in a pair of glasses and a mobile phone. Secondly, it is minimally invasive, as the glasses are lightweight and comfortable. Thirdly, due to the first person view the analyst can access the user's perspective. Finally, the location of the gaze is detected at each point in time (Mussgnug et al., 2014).
When studying human behaviour in naturalistic tasks, the interplay between perception and behaviour plays an important role (Land and Hayhoe, 2001). Even though MET does not capture the cognition of users, by detecting their gaze location (perception), as well as their hands interacting with the product (behaviour), it uncovers deeper insights than the conventional observation from the third person perspective. Figure 1, which is based on the Model Human Processor from Newell and Card (1985), illustrates the interplay between perception, cognition, and behaviour on the left side. On the right side, a frame of a MET video is presented, in which the hands as well as the gaze point (circle) can be seen.

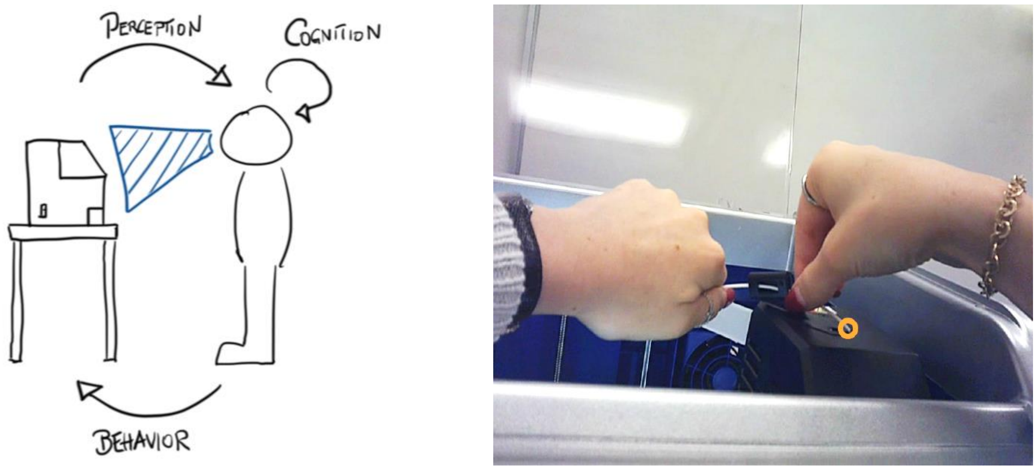

Figure 1. left: illustration of the interplay between perception, cognition and behaviour (based on Newell and Card (1985)); right: frame of mobile eye tracking video

According to the eye-mind hypothesis, the location of the gaze represents what is simultaneously processed in the mind (Just and Carpenter, 1980). In usability testing, in which participants get a clear task and are motivated to fulfil the task to their best, this connection is very strong (e.g. compared to a free viewing task). Hence, seeing the gaze helps to analyse the understanding-process of users. Mussgnug et al. (2015) show that participants analysing the user-product interaction from the MET perspective identified significantly more causes of problems, than participants analysing the same interaction presented from the third person`s perspective.
In comparison to a standard video recording, the information about the location of the gaze coming from the MET creates the possibility to segment the user product interaction finer and more precisely. In the book "Eye tracking the user experience" Bojko (2013) states that, *"… eye tracking metrics typically offer a more granular measurement than other, more conventional UX metrics"*. In the video analysis of MET data for usability testing, the granularity allows to differentiate between a findability and a recognisability problem. Whereas a findability problem describes a situation, in which a user does not see a specific element, a recognisability problem describes a situation, in which a user looks at a correct element, but instead of selecting it, continues searching for it (Bojko, 2013). The concept of findability is also used by Cardello (2014), who reports four different tests to assess low findability on websites.

1.3 Objectives and Approach

MET shows great potential in usability testing of tangible products, being able to quantify the user-product interaction from a user's perspective. However, to systematically compare between interaction steps, products, and user groups, a model is required that uses the gaze information to decompose the complete task in reoccurring phases. Therefore, we introduce the Target Based Analysis model - a model to structure the manual analysis of MET data. This paper proceeds with an introduction to the Target Based Analysis model, in section two. The third section describes an application of the model in a usability study of two 3D printers. Discussions and conclusions are presented in section four.

2 TARGET BASED ANALYSIS MODEL

The Target Based Analysis (TBA) model, illustrated in Figure 2, is designed for usability testing of tangible products on the basis of MET recordings. By decomposing the overall task on the basis of reoccurring steps, it aims to allow the comparisons between different interaction steps, products, and user groups. The TBA model is thought as basis for video coding schemes. It considers both, handling operations, as well as the location of the gaze.

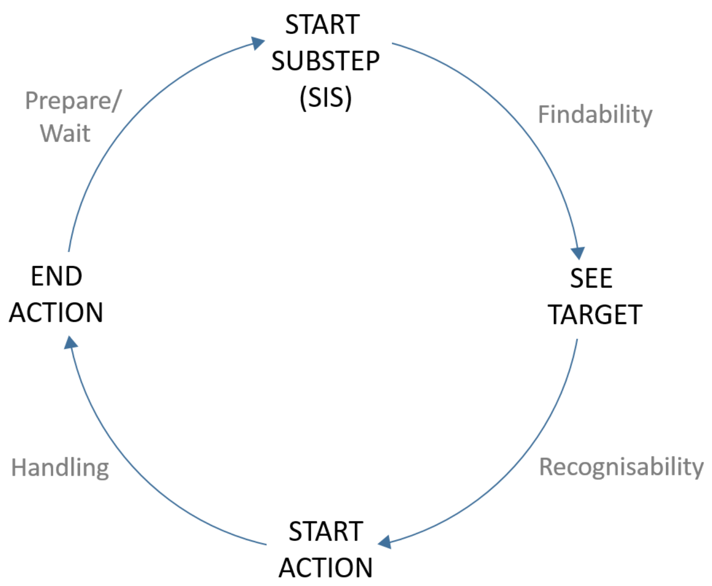

Figure 2. Target Based Analysis (TBA) model

2.1 Elements of TBA

The application of the TBA model starts with the decomposition of a predefined task into substeps, which are further referred to as *Single Interaction Steps (SIS)*. Each SIS describes a single activity the user performs at a specific target on the product (e.g. switch on the printer). A target is defined as the area of the product to be handled in order to fulfil the intended interaction (e.g. ON switch). If the user fulfils all SIS correctly he/she completes the task. To define the SIS, all targets to be handled should be noted, first. Afterwards, around each target an SIS should be formulated. In the TBA model, each of the SIS is further decomposed in four events, whereas each of the events represents a defined point in time.

- **Start Substep (SIS)** is the first event of each SIS. It starts, when the user signals to begin with a SIS, often indicated by redirecting the gaze.
- **See Target** is the point in time, when a user fixates at the correct target of the actual SIS, for the first time. It is irrespective, whether the target has been fixated in any previous SIS.
- **Start Action** describes the point in time, when the correct action for the actual SIS starts. Wrong actions performed at wrong targets, before the correct action, are not considered, because then the nature of the problem would lie in finding or recognizing the correct target, not in handling it.
- **End Action** is the point in time, when the correct action ends.

An example of each event is presented in Figure 3. In-between these four events, four phases arise. They describe the different processing steps, the user passes through, in order to complete each SIS.

- **Findability** is the phase between *Start Substep (SIS)* and *See Target*. It involves the phase the user is searching for the correct target. The measure entry time is often used to evaluate the findability.
- **Recognisability** is the phase between *See Target* and *Start Action*. The recognisability phase is e.g. long, if a user sees the correct target, but doesn`t start to interact with it.
- **Handling** is the phase, in which the user is physically operating the product, from the first touch at the correct target, till letting it go after finishing the handling.
- **Prepare / Wait** does not occur on every SIS. Preparation describes unavoidable side-tasks, which are necessary to run the main task (e.g. carry material). Waiting times appear, if the user is ready to perform the next SIS, but has to wait for the product`s response (e.g. start-up phase of a machine).

2.2 Process of Application

On the basis of a defined task, we recommend a five-step approach to apply the TBA model consisting of: decompose the task (1), code the MET videos (2), identify critical steps (3), perform an in-depth analysis for critical steps (4), and generate new solutions through guiding questions (5).

2.2.1 Task Decomposition

The complete task, given to participants, is decomposed in SIS. Each SIS consists of one target, which has to be handled (press, push, carry …). Each SIS is further decomposed according to the TBA model. Hence, the whole user-product interaction is modelled as a reoccurring process of find, recognize, handle, and prepare/wait. The prepare/wait step does not occur in every SIS, as often a subsequent SIS starts directly after the end of the actual SIS.

2.2.2 Video Coding

Based on the step of task decomposition, a coding scheme is set up. It consists of all events and phases of the TBA model for each SIS. In the video analysis, the analyst watches the MET videos, retraces the gaze and notes the timestamp for each event. Furthermore, the correctness of the phase, which is binary described by "correct" or "problem", is written into the coding scheme. This stepwise analysis forces to assess each interaction step, which gives a more comprehensive view on the interaction, compared to a coding only searching for problematic steps. In this way, phases of good interaction are detected, as well. Table 1 shows an excerpt of a TBA coding scheme.

2.2.3 Identification of Critical Steps

After coding the videos, an overview regarding duration and correctness of the TBA phases is generated. This graphical representation allows to picture the required time and the problem rate in a detailed breakdown, for each SIS. Critical steps can be quickly detected. Furthermore, the nature of the problem is at hand, because the TBA differentiates between *findability*, *recognisability*, *handling*, and *prepare/wait*.

2.2.4 In Depth Analysis

While the video coding step detects whether there is a problem or not, the in-depth analysis helps to understand, why a certain problem occurs. Through the noted time of each TBA phase, the critical steps can be quickly revisited in the MET videos. To analyse the source of the problem, the gaze point and the first person`s perspective are beneficial. The users' interactions can be retraced, the perceptual understanding-process can be analysed, and insights about cognitive processes can be drawn. The in-depth analysis concludes with a problem statement for each critical SIS.

2.2.5 Redesign

Redesigning the product, on the basis of the problems found, is the final step of the TBA process. The generation of solutions can be triggered by the following TBA-related guiding questions, which are based on (Nielsen, 1994) as well as on the experience of the authors. Optimally, the solution generation is performed in a team, including product designers and users.

- **Findability:** To tackle a findability problem, in general, both the cue guiding the user to the target, as well as the target itself, can be taken into account. *What is the guiding que? Do they follow a consistent guiding strategy (colour, orientation …)? Is the target positioned well? Do colour, size and shape call the user's attention?*
- **Recognisability:** *Is the shape, the icon, and the wording clear? Is a consistent colour code applied? Is the position of the object aligned to the order of interaction steps? Is it possible to reduce competitive elements?* Competitive elements are objects, which call the user's attention, but aren`t relevant to perform the task (Bojko, 2013).
- **Handling:** *Is the target well accessible? Can the handling be performed in an ergonomic way? Does the shape and the colour of the target clearly communicate, where to touch, and how to operate the target? Can fiddling interactions be avoided?*
- **Prepare/Wait:** *Is the user properly informed about the system status? Can additional tools, such as screw drivers, scissors, etc., be avoided to reduce preparation time? Can the rearrangement of SIS help to save time (e.g. by overlaying waiting and preparation phases)?*

3 CASE STUDY

The TBA model was tested in a usability study of two 3D printers. In the following section the characteristics of the study are introduced, the data analysis approach is explained, and selected results, emphasizing the impact of the TBA, are presented.

3.1 Study Characteristics

46 participants (on average: 30.1 years (SD 9.5)) performed the following three tasks for two different 3D printers: *print a part from the data medium*, *remove the printed part from the building platform*, and *exchange the filament of the printer*. Eight participants performed the same tasks four times on four different days in order to evaluate the learnability using the 3D printers. All participants (30% female) were novices regarding the tested printers. Hence, the study assessed the intuitive user-product interaction. The participants have been equipped with a binocular mobile eye tracker (SMI Glasses 2W), offering a sampling frequency of 60Hz. A 3-point calibration has been performed. During the execution of the tasks participants were left alone in the room, still simultaneously observed from the control room, via real-time streaming of the MET video signal. The order of usage for the two different printers was counterbalanced.

3.2 Data Analysis

The data quality was sufficient to evaluate the complete sample. The TBA process described in section 2.2 has been applied to analyse the MET data. First, all tasks were decomposed in SIS, which resulted in 18 SIS for the Printer A, and 14 SIS for the Printer B. For each SIS the TBA decomposition has been performed. Figure 3 illustrates the task decomposition of the task *exchange the filament* for Printer B. Nine SIS have been selected, whereas for one SIS the TBA segmentation is shown.

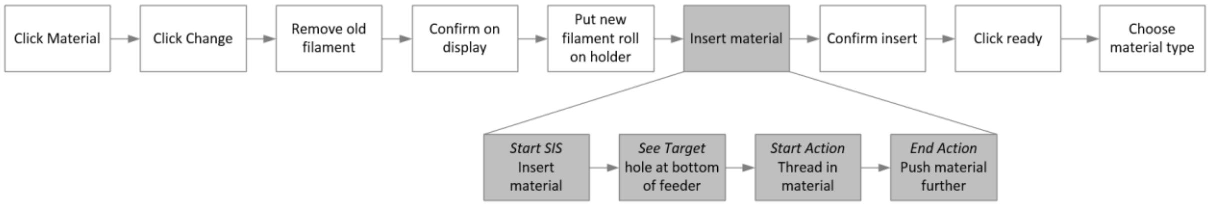

Figure 3. Task decomposition; top line: sequence of SIS; bottom line: TBA segmentation exemplary shown on one of the SIS

After the decomposition, the coding scheme has been prepared. By watching the MET videos and retracing the user`s gaze, the scheme has been filled out, as shown in the excerpt in Table 1. The cells showing a white background have been prepared in advance. Those with a grey coloured background were filled, while analysing the videos. Based on the video coding, an overview of all TBA phases in each SIS was generated. The SIS with the highest problem rates and with the longest durations have been analysed in-depth, by revisiting the critical scenes of the MET videos. In this case study, the isolated usability issues have been presented and reported to the industrial partner, who is currently developing improved solutions for the product's next generation.

Table 1. Excerpt of coding sheet applying Target Based Analysis

SIS	TBA Events	Description of TBA Event	Action Time	Type of Phase	Correct or Problem	Problem Description	Duration of phase	Time on Subtask	Subtask correct?
Confirm cut	START SIS	Start SIS: confirm on display	00:08:43						
	SEE TARGET	see confirm logo	00:08:44	Find	correct		00:00:01	00:00:03	TRUE
	START ACTION	Start press confirm	00:08:46	Reconize	correct		00:00:02		
	END ACTION	End press confirm	00:08:46	Action	correct		00:00:00		
Open side door	START SIS	Start SIS: open side door	00:09:24	Wait	correct		00:00:38		
	SEE TARGET	see handle side door	00:09:42	Find	problem	remove filament from inside	00:00:18	00:00:25	FALSE
	START ACTION	Start open side door	00:09:43	Reconize	correct		00:00:01		
	END ACTION	End open side door	00:09:49	Action	problem	needed two hands	00:00:06		
Remove old filament	START SIS	Start SIS: remove filament	00:09:49	Wait	correct		00:00:00		
	SEE TARGET	See filament roll	00:09:49	Find	correct		00:00:00	00:00:06	TRUE
	START ACTION	Start remove old filament roll	00:09:50	Reconize	correct		00:00:01		
	END ACTION	End remove old filament roll	00:09:55	Action	correct		00:00:05		

3.3 Results

In this section, selected results, pointing out the influence of the TBA model on the usability assessment, are presented. The subsections address the resulting overview graphs, the influence of the segmentation in TBA phases, and the feedback collected after presenting the results to the responsible engineers.

3.3.1 Overview of Results

The video coding with the TBA model resulted in an overview, showing the problem rates and the durations for each TBA phase. Interestingly, there was no SIS completely free of problems. Thus, we focussed on those steps with the highest problem rates (the percentage of participants struggling at a certain SIS). Figure 4 shows an excerpt of the overview. While the average durations of the TBA phases over all participants are displayed on the left side, the problem rates are plotted on the right side. Prepare/Wait is not displayed, as the problem rates of this TBA phase are without exception 0%. On the basis of the overview graphs, for Printer A seven of 18 SIS, and for Printer B six of 14 SIS, were selected to be analysed in-depth. From the given excerpt, the SIS *click the filament button*, *open the top door*, and *remove the old filament* were assessed in-depth.

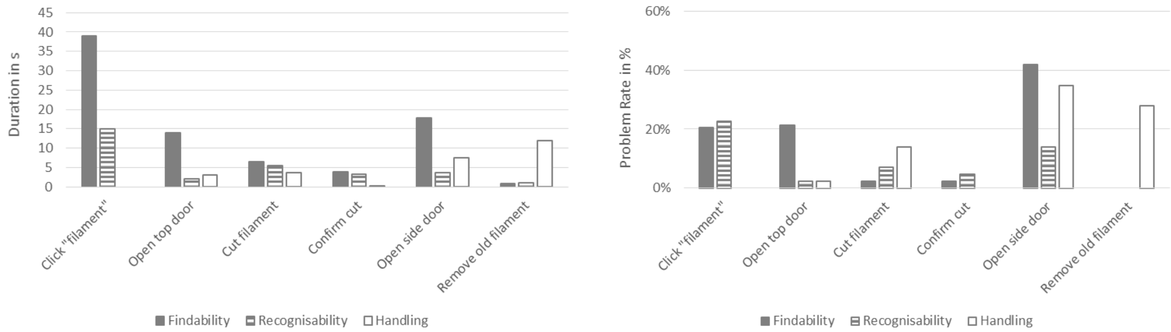

Figure 4. Excerpt of overview Printer A (grey: findability, dashed: recognisability, white: handling); left: Duration of TBA phases; right: Ratio of participants having a problem

3.3.2 TBA Phases

This section presents examples of usability problems in relation to the TBA phases. One specific example is described for each phase. The first example shows, how the detailed decomposition allowed us to compare similar SIS between the two printers. When examining the first SIS: *switch on the printer*, both printers have about the same problem rate, around 60% (see Figure 5). However, the further decomposed TBA overview shows that the problem lies in two different parts of the interaction, and sources in different design problems. Whereas for Printer A, the problem was the waiting time after pressing the ON/OFF switch, participants operating Printer B struggled to find the ON/OFF button.

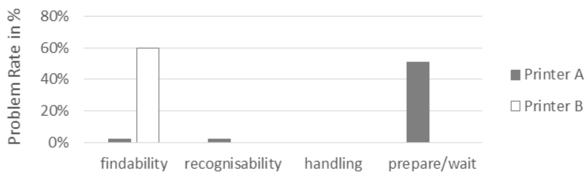

Figure 5. Comparison between the two printers in the SIS "switch on printer"

- *Findability:* 60% of the participants had difficulties finding the ON/OFF switch on Printer B. They visually checked the front side first, before they moved on to the sides of the printer. Even when searching at the backside of the printer, where the ON/OFF switch is actually located, parts of the housing mistakenly called the users' attention, before they were able to find the switch.
- *Wait/prepare:* During the start-up time of Printer A, which takes 32 sec, the user is not informed that the system is about to start. Some users started to gaze at different parts of the printer, in order to search for the reason why the system is not proceeding. Others tapped on the touch display, started checking the cables, or even restarted the printer, assuming they did something wrong.

The next example, which is illustrated in Figure 6, shows two handling problems of different SIS for Printer B. In the handling phase both had about the same problem rate. However, *to remove the old filament* required on average 36 sec more than *to select the print button*. In this example, noting the time was not only helpful to quickly navigate to the critical phase, but also to differentiate between the two problems at hand. A longer duration of the same problem rate indicated the higher severeness of the problem, as the user was distracted for a longer time.

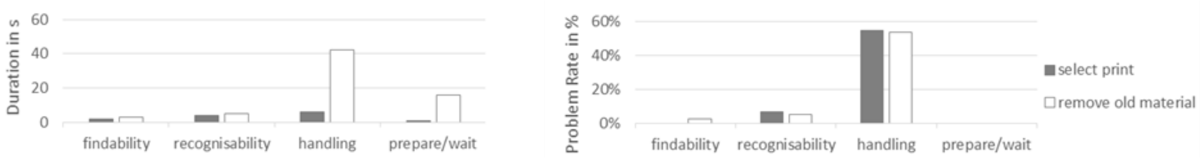

Figure 6. Comparison of two different handling problems in Printer B

- *Handling:* 54% of the participants had problems removing the filament roll from the holder of Printer B. Interestingly, when starting the action, their gaze only stayed shortly at the holder. While the action continued it moved on to explore subsequent targets. As they realized their difficulties with the snap-action mechanism of the holder, their gazes returned to the mechanism, in order to actively guide the hands during the understanding-process.

In the learnability group, eight participants performed the same tasks, on four different days. The first and the last trial were analysed, in order to understand how fast the participants improved over time. Figure 7 shows the average problem rate over all SIS assigned to the TBA phases for Printer A. In all phases, the problem rate declined clearly. Yet, the handling category remained with the highest problem rate. Findability and recognisability problems declined almost to zero, as after the fourth trial it was mostly clear to the users, where to find the correct targets. However, the one persevering recognisability problem in the SIS was *click the filament*, which is required at the beginning of the filament exchange process.

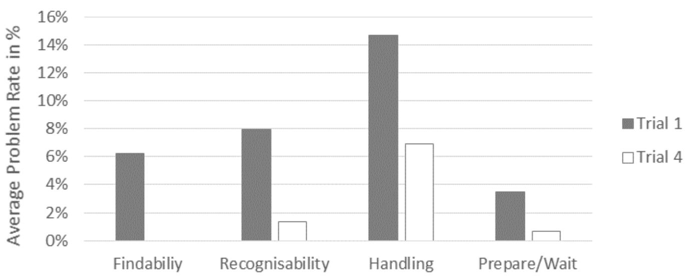

Figure 7. Comparison between first and fourth trial in the learnability condition

- *Recognisability:* 25% of the learnability participants, performing the task on Printer A, still chose the wrong menu button to start the filament exchange process, in the fourth trail. All of them first looked at the correct "filament" button, but then decided to press the incorrect "tools" button. This is a clear recognisability problem, showing that the wording, as well as the icons have potential for improvement.

3.3.3 Communication of Results

The results were presented to the usability and design engineers of one printer. First, the TBA overview was shown. Then, each critical usability problem was described in-depth, through the help of the eye tracking videos snippets. Afterwards, the application of the TBA model on MET videos was discussed. To summarize the qualitative responses, the attendees concluded with the following three points. First, taking the users' perspective and retracing the user-product interaction gave the engineers a high clarity and a common understanding of the problems. Secondly, the attendees only shortly discussed about the relevance of the problems. Instead, they directly started to discuss the problems as such. Thirdly, they commented that the eye tracking videos served as a good basis to derive actionable recommendations. However, the guiding questions were not explicitly considered in the process of generating new solutions. Their integration in the process has to be improved.

4 DISCUSSION AND CONCLUSION

In this paper, the Target Based Analysis (TBA) model is introduced and tested through a usability study with 46 participants on two 3D printers. All conclusions presented in this section, are discussed along the study and are limited to the case at hand.

In the study, the TBA model was able to cover different types of user-product interactions: from selecting a target on a touch GUI, to manually inserting the new filament into the printer. It also allowed to code participants, who deviated from the standard order of SIS. Hence, it was possible to apply the model continuously over all three tasks for both 3D printers.

The segmentation into the four reoccurring phases of *find*, *recognise*, *handle* and *prepare/wait* allowed a comprehensive overview, on the basis of the two measures: duration and problem rate. The overview showed correct as well as problematic SIS. Hence, it enabled to compare different tasks and their SIS, as well as different products, and different participant groups, to each other. Due to the TBA segmentation, the nature of the problematic SIS could be directly extracted from the overview (*e.g. in the recognisability of a target*).

However, this benefit costs time during the manual coding. Especially the manual transfer of the timestamp from the video to the coding scheme, which was realized in an excel sheet, is time-consuming. On average one person needed one day to code both printers of six participants, which is equivalent to about two hours of video material.

On the positive side, this granularity resulted in less subjectivity introduced by the analyst. This is due to two reasons. First, the reoccurring events were defined beforehand by the task, and not by the analyst during the coding. Secondly, the additional information, provided by the MET video, allowed to precisely detect each TBA event. At the *start* of an SIS the users move their head and focus towards the assumed target. The point in time, when the target is initially discovered is measured by the first fixation, hitting the target. S*tart action* and *end action* can be detected on basis of the manual interactions with the hands, which are usually captured by the scene camera of the MET system.

When interpreting the problem rates, in some cases, the binary coding of *correct* or *problem* does not report the severity of a problem precisely enough, as there is no distinction between *big* and *small* problems. In the current version of the TBA model, this difference is not visible in the overview. It could only by detected during the in-depth analysis, later in the process.

Based on the comprehensive overview, the in-depth analysis could be performed very efficiently, due to three reasons. First, all scenes had already been watched, before. Secondly, the overview showed the nature of the problem, which reminds the analyst, what the different problems are. Thirdly, the critical scenes could be revisited quickly, as the time, each problem occurred, are noted precisely.

During the presentation of the results to the designers of the printer, we observed that providing both, an exemplary video snippet showing the user's gaze, as well as the statistics (problem rates and durations) of all participants, is a very convincing combination, which is in line with Bojko (2013). This way of reporting results concluded in less time wasted on discussions about the problems, and on whether they should be considered, or not. Instead, their relevance was clear, and people started directly to generate solutions improving the situation. One participant of the meeting stated: *"Usually, when I send five engineers in the field I get eight different versions of the users' major needs. With this method, we are much closer to our user, and to the reality"*. Even though, this statement is a bit exaggerated regarding the numbers, it represents the participant's opinion about the model.

The application of the TBA model in the learnability group shows that the model is especially suitable for the assessment of first usages, as well as for low-frequently used products. The reason lies in the findability and recognisability phases. Both are highly relevant to perform a new task (with a new product). In contrast, in routine tasks users know the location and the meaning of the targets.

Generally, we see the TBA not only as a model that allows to derive coding schemes for the analysis of usability tests. Moreover, we hope to provide a common ground, enabling to discuss usability problems on the basis of a shared wording. In the future, three aspects should be considered. First, in order to validate the TBA model, it has to be tested in further applications. Secondly, the manual coding should be improved. Semi-automatically guiding the analyst through the predefined SIS (e.g. by capturing the actual time for the correspondent event automatically) and implementing severity levels in the coding procedure, would facilitate the process. Thirdly, considering also quantified eye tracking measures such as *fixation durations* or *saccade amplitudes* could further increase the value of the TBA model.

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