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Indication of user-driven progress

An evaluation of the impact of progress indicator design on user experience and performance

Master of Science Thesis

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Abstract

The present study analyzes the how the indication of progress during a user-driven task can be improved by means of changing the way it's visualized in the UI.

The author identifies a number of contexts in which progress indication can be used and attempts a summary of the multitude of ways progress can be visualized in HCI contexts. Thereafter, by means of an interview and two focus group sessions with users of different technical background, the author explores user experiences, preferences and opinions on the indicators mentioned. Following that, an empirical study of 2230 respondents of a playful quiz is used to measure a select few indicators' impact on the break-off rate.

The result is a qualitative and quantitative analysis of how different progress indicators affect user experience and behavior. In the end, it turns out that users tend to favor the partitioning of tasks, and that this should be reflected in the design of the progress indicator. Furthermore, discussions indicate that the overall user experience can be improved by building immersion or curiosity for the task at hand. On the other hand, the results of the empirical study show that the de facto standard progress bar results in a high performance.

Conclusively, the author interprets the findings, formulating guidelines for user-driven progress and presents an example of best practice for progress indication in general.

Keywords: *Interaction design, interface design, progress, user input, progress Indication, progress indicator, progress bar, time perception*

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Glossary

AJAX	Asynchronous JavaScript And XML, a group of interrelated web development techniques used on the client-side to create asynchronous web applications.
Break-off rate	The number of users that “break off” from (quit) a survey or similar activity put in relation to the total number of participants.
Gamification	A process focusing on identifying what makes games compelling and important to us and uses those techniques to motivate behavioral change in areas that are not traditionally considered to be fun.
MPP	Machine Progress of Processing, one of the four progress contexts defined for the study.
MPL	Machine Progress of Loading, one of the four progress contexts defined for the study.
UIP	User Input Progress, one of the four progress contexts defined for the study.
UGCP	User Game Control Progress, one of the four progress contexts defined for the study.

"The system should always keep users informed about what is going on, through appropriate feedback within reasonable time."

– Jakob Nielsen, 1st law of heuristics

CHAPTER 1
Introduction

Background and related work

When in front of a computer or mobile device, users are constantly presented with progress indicators of various kinds. The most common and obvious ones are probably those communicating that the computer is busy finishing a task, as it takes no more than a couple of seconds before an indication of progress is required in order not to consider the fact that something has gone wrong (Microsoft Windows Development Center, 2012).

Less apparent indicators of progress are the ones that keep track of user-driven progress – i.e. when it's the user's actions are linked to progress toward a goal. Cheema & Bagchi (2011) indicate that in a general situation, when a person is working toward an intangible goal, he or she is more likely to be motivated to reach it if the progress made is clearly visualized. Regardless, even though basically all computer usage is goal-oriented, user-driven progress is generally scarcely indicated in the UI. Where it is displayed, however, it is lacking in creativity when it comes to visualization: The design space for a progress indicator is seemingly endless, but still the same counters or progress bars traditionally used to track computer progress are re-purposed without apparent reason.

There are areas where this is not the case, however. In video games, progress indicators are more often creatively visualized to increase immersion and create a visually pleasant experience in addition to their purpose of measuring (and potentially, increasing) performance. Over the past few years, these indicators have shown tendencies to appear more and more often out of gaming contexts as the values from games are integrated into a traditional non-gaming context through the process of gamification. It's reasonable to believe that the values progress indicators convey in a game context can – to at least some extent – be harnessed in non-gaming contexts and through that improve the user experience and/or performance of user progress.

Most of the related research available tends to focus on online surveys, which allows for a decent reflection of the state of the art. There's an adequate amount of research data on the subject, but with the drawback that the context is rather static. In online surveys, user performance (referred throughout the scope of this report as

synonymous to the break-off rate) is much more important than an enjoyable user experience, albeit one can argue that the two are closely related by means of the second one leading to the first.

Either way, the consensus of such research by Matzat et al (2009) is that the displaying of a progress indicator in the UI does have some effect – however potentially subtle – on break-off rates as opposed to not displaying one at all. In a more specific study by Crawford et al (2001) where progress was monitored and visualized during a survey of one-click answers, a modest but reliable decrease in break-off rates was noted when a progress indicator was displayed. Harrison et al (2007), and Callegaro et al (2010) further show that not only the presence but also the mechanics behind progress visualization can have a major impact on break-off rates.

Conrad et al (2010) explored the notion that a critical component to whether progress indication is interpreted as positive or negative is to which degree it confirms the user's expectations – in particular, expectations about duration. If the length of the task appears longer than what the user have expected, they suggest that the presence of a progress indicator is bound to result in a higher break-off rate. Conversely, if the indicator suggests that the task is shorter than that user had initially expected, its presence will have a positive effect on user performance.

Tying into this, it's important to note that there is a significant difference between the *actual* and *perceived* duration of time, a notion explored among others by Missig and Dickison (2004). Thus, we need to be aware that in a context where a progress indicator is displayed, the actual progress *made* is of less importance than the progress that the indicator *signifies* has been made. Explorations of this notion has been made by Beauquel & Roose (2007) and Callegaro et al (2010), both coming to the conclusion that indicators that followed a particular "fast-to-slow" mechanic (expressing that progress is made quicker in the beginning of a task only to gradually slow down a corresponding amount near the end) enjoyed significantly lower break-off rates.

Thus, as it is the designer's choice how to model the indicator, it gives him or her a powerful tool to influence users. Putting the pieces together, we find that the use and design of progress indication has plenty of opportunities to affect user behavior. It suggests that progress indication in an application can be a part of a good user experience (what the user likes), which in turn is likely to be interconnected with the user's motivation to finish the underlying task (how the user performs).

As the outcome of changes in progress mechanics are already relatively established, this report aims to explore how progress indication can be visualized, as well as what impact such visualizations may have on the user.

Since the empirical test in the later stage of this report takes place in a playful context, this will be the primary focus for the study. Ultimately, however, the report aims to contribute toward enhancing the user experience by proposing guidelines on

how to visualize progress in a way that's engaging and meaningful regardless of context.

Research Question

The main contribution of this paper is that it will increase our knowledge of what (if any) influence the design of progress indication can have on the user. In the process of doing so, the author hopes to contribute toward understanding users' relation to, and expectations on, progress indication in general.

The main research question of this report is:
How can the design of user-driven progress indicators affect user experience and performance?

The meaning of "affect" is for the scope of this report being separated into two parts:

- The qualitative sense: The idea that the indicator provides an *improved user experience* through fuzzy notions such as having the user describing it as "looking and feeling nice", "making sense" and being "fun", "interesting" or "engaging".
- The quantitative sense: A measure of *user performance* - the hands-on measurement of the indicator's impact on break-off rates.

These two will be analyzed for a number of progress indicators and will together provide results of their efficiency as well as general guidelines and bases for future studies on how to better indicate progress.

Delimitations

Due to the nature of the quantitative study, the study will only be able to find results in a particular playful context. Its results will thus only reflect a small part of the complex span of all progress indication usage.

Another prominent delimitation of the study is the omission of any combinations of multiple indicators. The aggregation of two or more progress indicators is immensely common, but testing them all would exponentially increase the number of test cases. Thus, in order to keep the study from becoming too complex and "diluted", combinations are omitted.

For the same reason, not even all progress indication types identified over the course of the theoretical and qualitative study will be used in the quantitative test. Instead, the qualitative study serves the purpose to weed out the indicators that are considered to be of less importance when it comes to their likelihood to influence user experience or performance.

Finally, the study is limited to progress indication *visualization*. There have been studies on audial by Crease and Brewster (1998) and tactile progress indication by Brewster and King (2005), but these are considered to be out of scope for this study for several reasons.

How does this study differ from others?

Previous studies have settled that progress indication does indeed have some impact on user behavior. What the span of that impact may be, however, is subject to debate as most related work tend to focus on either:

1. How the displaying of a progress indicator at all impacts break-off rates.
2. How minor characteristics of a particular indicator may be modified to lower break-off rates.

Following are the main areas in which this study differs from similar ones in the field:

- ### Visualization breadth

  The study strives towards an exhaustive classification of the ways one can use to communicate progress to the user. Current research (with basically no exempts) treats "progress indication" and "progress bar" synonymously, and no qualitative studies explore the user attitudes toward them. In response, this study presents a broad spectrum of possible progress indicators as well as user-centered discussions about their potential consequences on the task at hand.

- ### Well-defined context

  The progress made in qualitative study is taking place in a *playful context*. It's a voluntary quiz without any significant purpose other than "being fun", which can be reached only from a web community focused on entertainment and social interaction. Most (if not all) studies done in the field are primarily focused on how progress indicators relate to the result of *online surveys* or similar - an area quite but not entirely similar to the one this study covers (as will be explained in greater detail later in this report).
  Hence, for many applications, one should be careful to view the conclusions made in this report as directly applicable, but rather seen as framework to consider for each particular purpose. Surveys, for example, cannot risk its result being skewed by the influence of something ultimately irrelevant to its purpose. In games or other playful contexts, the importance of the user experience is at least as important as performance, and this notion is a foundation for this report.

- ### Result assessment

  Result quality is not a relevant measurement by witch to judge the qualitative results. In some surveys, the number of optional fields filled out and how

much is written in free-text fields can for example be a measure of quality. In this study, answers to each question are given by a single mouse click, and while they do indeed have a correct and an incorrect answer, the result is not relevant to anyone but the user. Hence, the breakoff rate – a solely quantitative measurement – is the only way by which the *efficiency* of the progress indicator's capability to engage the user can be assessed.

By conducting research in the area I argue that I will not only further solidify previous research in the area, but also provide and share new ideas about how and why different visualizations of progress can affect user experience and performance at a task at hand.

Chapter 2
Theoretical Background

Introduction

In order to explore the notion of how progress indication can be improved, we must first understand its underlying principles. First, we must understand and define what progress is from a computer's point of view in order to realize its possibilities and limitations. Second, we should use this information to explore the available design space progress indicators. Third, the different contexts in which progress can be visualized should be defined in order to be able to separate the needs of each. After studying indicators from all contexts, reasons if and why progress should be visualized differently across them will be pursued.

With this foundation, we can move on to narrowing the context to a user-driven and playful one and start exploring the user reception of each indicator.

What is progress?

In its most general sense, measuring and indicating progress in a generic task revolve around dividing it into small pieces (henceforth referred to as *sub-tasks*) and counting the ones that have been completed. These sub-tasks aren't necessarily partitions logical in the user's point of view, but are generally so strictly in a computational sense.

When the overall task and its sub-tasks are of a well defined, known size, it can be referred to as *determinate* progress. Conversely, when the size of the encompassing task or its relation to the sub-task is unknown, it is referred to as being *indeterminate*.

Why indicate progress?

As have been established, simply displaying a progress indicator is prone to improve the user experience as well as increase the user motivation to complete the task at hand. In a practical example, indicators can make users feel better about a task that may seem to be moving slowly and thus to reduce the chances that they will abort it (Conrad et al, 2010).

Obviously, there are more factors than just progress indicators that motivate user performance. The primary reason for performance is incentive, and one of the major incentives – at least in games – is some kind of fulfillment as well as the notion of having fun. An unfinished task would reasonably indicate a genuine indifference toward it, and/or because it provided an unfulfilling/uninteresting user experience.

While the former is out of reach for a UI designer, there is hope for contribution when it comes to gaining an understanding on how to minimize the latter.

How can progress be indicated?

For clarification of the concept, this part is divided in two components. The first one, *basic indication*, means the use only of the fundamental components of progress – direct numerical values. For the second part, *visualizations and aids* are applied on the basic indication, potentially radically changing the impression of the indicator without being any less true to the concept.

Basic indication

Indeterminate Counters

The most basic way to indicate progress is through the use of an indeterminate **counter** that is incremented for each sub-task that is completed. However, indicating progress as such does not make a lot of sense to the user due to the lack of a point of reference. For example, what does it actually mean for a user to currently be "at 8" when making progress?
The counter is generally used for progress that has an indeterminate or implicit goal, or when the goal for other reasons (such as game rules) cannot be revealed.

Determinate counters

In most cases, programmatic measures are taken to transform the counter into a determinate one. This is done by calculating or estimating the number of unfinished subtasks and putting them in relation to the finished ones, resulting in a much more meaningful measurement. They come in two variations depending on whether they're counting up or down.

Figure 1: A determinate counter being used as part of the progress indication when copying files in Mac OS X

Percentages

Determinate counters are often displayed as a **percentage**, tracking progress *made* or *remaining*), which is a simple normalization of the above.

These basic numeric progress measurements make up the very basis of all progress indication. While being seemingly obvious, they can be found to be lacking when

used on their own and may require some sort of labeling to explain their purpose in the user interface using labels and/or icons.

Visualizations and aids

In many cases, progress is presented to the user in a visually pleasant and quickly recognizable way by abstracting the basic measurements and/or by the use of logical and visual aids placed on top of any of the basic indicators.

Throbber

When it comes to visualizing indeterminate progress, there's basically only one option. This indicator, a symbol or image whose continuous animation suggests that progress is being made, is known as a **throbber**. Common examples include the spinning beach ball in Mac OS and the ever-turning hourglass of older Windows versions. As of late, it can be commonly seen in the form of an indeterminate progress bar which should be used whilst the computer makes estimations and calculations that will eventually transform the progress bar into a determinate one (Mac OS X Human Interface Guidelines, 2012).

It's worth noting that it's debatable whether the throbber is an indicator of progress or of state. As its only function is to communicate that the computer isn't stuck, the indication is not of progress is being made, but rather the lack of non-progress. It is however so commonly used in conjunction with other progress indicators that it can classify as one here.

Progress Bar

It's safe to say that in in the field of human-computer interaction, progress is generally associated with the aptly named **progress bar**. It has even come as far as turning into a de facto state indicator communicating that "the application is currently in a state where progress can be made".
Ultimately being no more than a visualization of a percentage, it has found itself being used widely in almost any context. There are, however, situations where it can be omitted and displayed in its more basic terms (countdowns or percentages), including when:

- The number of sub-tasks is too small for a progress bar to make sense.
- There are spatial limitations on the UI.
- The exact number is more important than an approximation.

Progress bars don't necessarily have to be a bar (it has for example been seen visualized as a pie chart gradually filling up) but the underlying concept obviously remains the same.

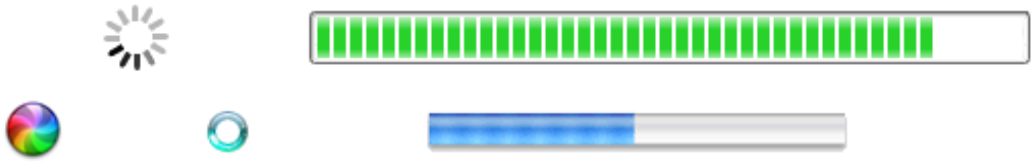

Figure 2: Common throbbers and progress bars

Time Remaining

If the sub-tasks are of determinate *duration*, this can be weighed into the calculation and allow for an approximation of **time remaining**. This kind of abstraction is very common, likely due to the fact that it's the most relevant and easily understandable for the user.

Task Partitioning

If the task at hand is rather extensive or complex, a very common aid is to use **task partitioning**. As the name suggests, it's about dividing and displaying the main task in the form of groups that makes sense to the user (rather than to the system, in accordance with Nielsen's second law of heuristics[1] (Nielsen, 1994)). Each partition typically makes use of a separate progress indicator, and more often than not an indicator of the overall progress is used as well.
One of many examples of this technique can be found when starting up Adobe Photoshop which displays its progress in the startup phase in terms of "initializing", "reading preferences", "initializing panels", etc.

[1] "*The system should speak the users' language, with words, phrases and concepts familiar to the user, rather than system-oriented terms. Follow real-world conventions, making information appear in a natural and logical order.*"

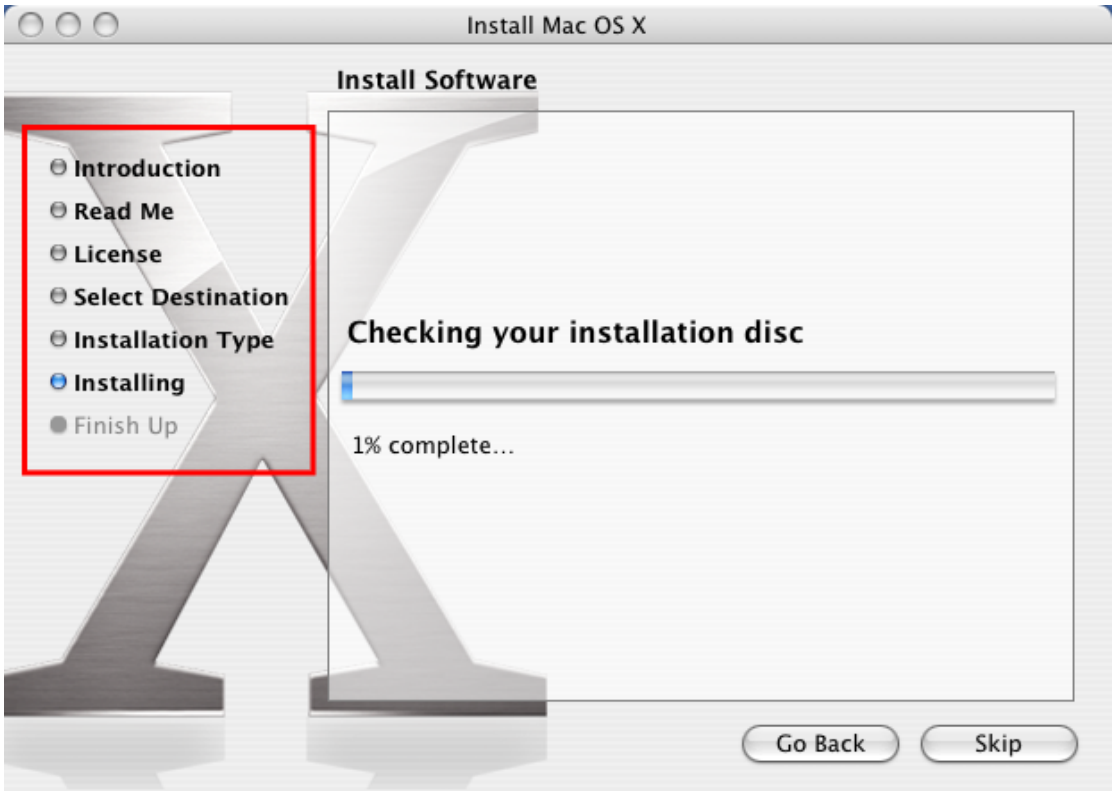

Figure 3: Task partitioning in the installation wizard of Mac OS X Leopard.

Goal visualization

The final aid identified is **goal visualization**. Its basic idea is to merge progress and task by visualizing the goal of the task at hand and making it gradually "more available" to the user as he or she progresses.

It's easy to argue that goal visualization can be used as a tool for creating immersion, explaining why it's most commonly found in game contexts such as the iconic collecting of Triforce- or heart pieces in the Zelda series.

Figure 4: Two examples of goal visualization in the Zelda series: Legend of Zelda (1986) and Legend of Zelda: A link To The Past (1991).

An example of the same aid can be found outside of the gaming context when starting up Parallels Desktop for Mac from a suspended state. When starting the

application, it displays the Windows desktop in the same state as it was left in when the virtual machine was suspended, blurred out and heavily desaturated. When resuming the virtual machine, the image gradually sharpens, gets saturated and transitions seamlessly into the ready-to-use application as it finishes loading.

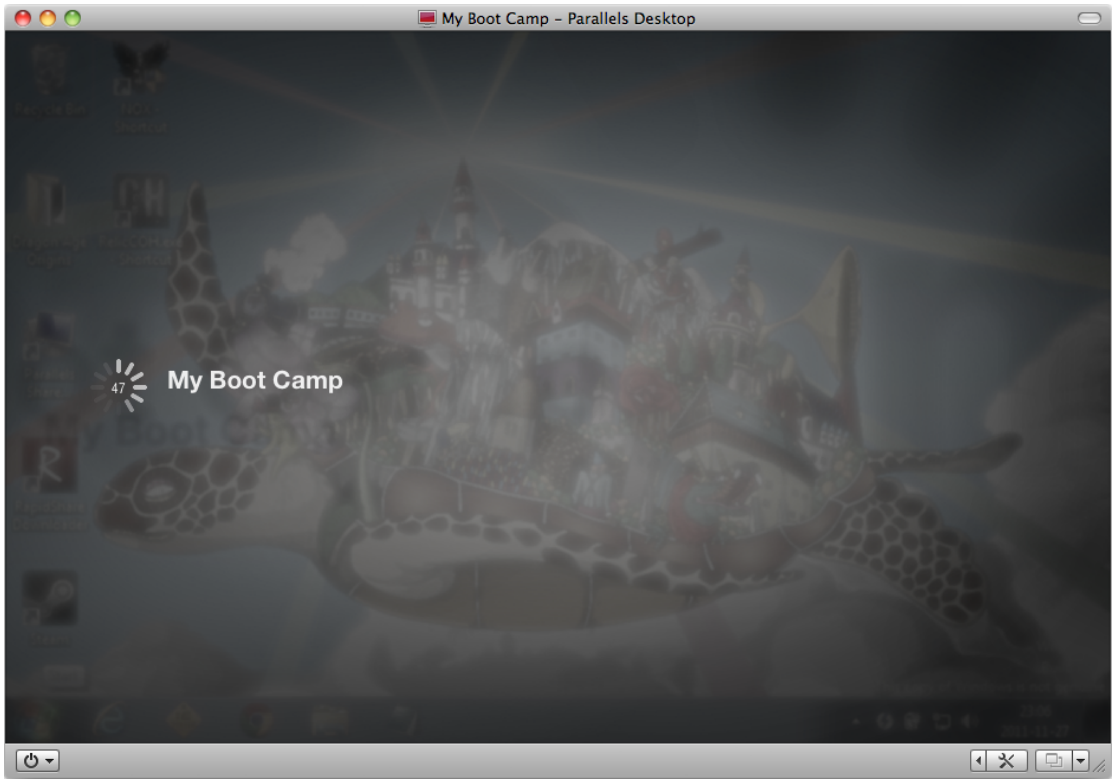

Figure 5: Goal visualization (along with a throbber and a percentage progress indicator) used to visualize the progress made while resuming Parallels Desktop from a suspended state.

Four contexts of progress

Four contexts in which progress can be made lie in focus for this report, and their characteristics are described in the section below. They are defined as *Machine Progress of Processing* (MPP), Machine Progress of Loading (MPL), User Input Progress (UIP) and User Game Control Progress (UGCP). The key to understanding the idea behind the context separation lies in imagining the four types in a 2x2 grid as such:

	Application Context	Game Context
User waiting for the computer to finish something	**Machine Progress of Processing (MPP)**	**Machine Progress of Loading (MPL)**
Computer waiting for the user to finish something	**User Input Progress (UIP)**	**User Game Control Progress (UGCP)**

Figure 6: The Progress Context Table

While the y-axis uses a distinct differentiation, it's obvious that the x-axis us much less so. The line between UIP and UGCP is fuzzy, but the distinction isn't necessarily as crucially important anyway, considering the rise of gamification whose purpose is to make the line between the two even fuzzier.

Machine Progress of Processing (MPP)

The kind of progress that is being made by the computer, typically during a task such as memory allocation or reading/writing data to disk is referred to as *processing progress*. Examples can be seen in the process of a computer starting up, or when installing and opening applications. Common indicators used to signify MPP include progress bars, time remaining, throbbers and the use of task partitioning.

Machine Progress of Loading (MPL)

When the computer is rendering graphics or other data between two states of a game, the progress made is called Machine Progress of Loading. A typical example (not uncommon to take 20 or more seconds) would be when the player loads a save file, requiring the computer to draw the game world, preload areas, model characters, etc. Progress bars and task partitioning are both very commonly used to display this type of progress.

Games take a radically different approach to "waiting for the computer" as opposed to MPP because they *have to,* finding themselves in a playful context. "Loading…"-screens have historically been such a staple of the game medium to the point where it arguably has become a part of the product, responsible for building or retaining

the player's immersion and quenching any frustration over the waiting times. In short, loading progress strives toward make waiting *fun* or *engaging* – a fundamental aspect of the gamification process that may potentially be injected into other progress contexts.

User Input progress (UIP)

When progression is derived from user input, the notion is referred to as User Input Progress. It can be found when filling out a form, answering a quiz, proceeding through a checkout flow in an online store or other similar (and generally minor) tasks without a narrative context.

User Input Progress is often seen paired with the task partitioning aid in order to divide the overhanging big task into less tedious groupings. It is also very common to make use of progress bars, even though they often do not always make logical sense due to the discrete nature of tasks to be completed.

Use of UIP indication is unquestionably increasing and becoming a more and more common sight in many applications. It's primarily gaining ground on the web in order to encourage the user to finish tasks that typically take longer than a few seconds. Examples of such can be completing a purchase in an online store, filling out your newly registered profile in a web service or answering a quiz.

User Game Control Progress (UGCP)

UIP put in a game context is potentially much more complex due to the game's rules. Game progress may require hours upon hours of continuous input, and is generally not measured in direct input such as clicks or keystrokes but through a series of complex interactions. Thus, even though the progress may not necessarily be fundamentally different from UIP from the system's point of view – the user progresses by reaching predefined milestones through interaction with the computer – it is often visualized dramatically different.

The reason UGCP indication traditionally differs from its UIP counterpart is that in a game, the player makes progress because it's part of the game experience and being something entertaining and/or fulfilling. For UIP on the other hand, indication has been/is more often used as an aid to communicate control and oversight to make a more "neutral" task more motivating to finish.

Moving forward

With this base of progress indication and visualization across different applications established, as well as the contexts in which they are typically found, the report will turn its focus to trying to learn which ones users prefer, what they expect from them, as well as if they can be assumed to be of good use out of their ordinarily seen contexts.

CHAPTER 3
User Study

Introduction

This study makes use of a combination of qualitative and quantitative studies in order to draw its conclusions on how progress should be indicated in the UI.

The first step of the study is to gain knowledge of users' needs, expectations and preferences of progress indication. In order to do so, an interview and two focus groups were established in order to explore participants' previous experiences and opinions as well as exhaust further explorative visualization methods serving as possible candidates for the quantitative study.

After an adequate amount of data has been collected, a small number of potentially interesting progress indicators will be implemented in HTML, CSS and JavaScript. These indicators will be used in an empirical study using a quiz game modeled in a way similar to an online survey but in a solely playful context. Test groups will be given separate progress indicators and simple qualitative metrics (such as the number of questions answered) will be collected. The result of this study will hopefully give a good measurement of how users performance rate is affected by the different indicators.

Finally, results will be merged with insights regarding user behavior and thought process in order to explain study outcomes and formulate conclusive guidelines.

Methodology

Qualitative Studies

Interview

For the inception of the qualitative study, a semi-structured interview was used. Among its key values are open-ended questions that allow for explorative detours. As a complement to focus groups, the interview allows for more in-depth discussions and a relaxed atmosphere, ensuring that the session is carried out with focus on brainstorming and the sharing of opinions without potential social limitations.

The interview was carried through in order to gain insight in the knowledge of a "power user" as well as for finding if the protocol prepared for the focus group was to the point and of appropriate length.

Focus group discussions

Focus groups offer a more time-efficient method to shed light on the respondents' perceptions, opinions and attitudes towards progress indication. They can provide wider - but predominantly *more* - information on the subject, as listening to others' verbalized experiences can stimulate memories, ideas and experiences within the group (Lindlof & Taylor, 2002).

The primary motive of the focus groups is to take the respondents' opinions into consideration for picking the final progress indicator candidates and polishing/implementing them for the study.

Quantitative Study

The third and final step of the study is an empirical analysis in order to provide a solid measurement of how each indicator affects user performance. Following results and conclusions drawn from the qualitative study, four progress indicators will be implemented and tested. The break-off rates for each progress indicator will be measured and used as a basis for conclusions and discussions.

Study Result Analysis

The qualitative studies will be used to draw conclusions regarding attitudes toward progress indication and how it may affect the user experience. In addition to making use of this information to prepare the qualitative study, some of the particularly interesting findings will be converted into conclusive guidelines.
Analysis of the data mined from the quantitative study will be used to support or disprove conclusions and assumptions made during the qualitative study phase as well as the formulated hypotheses.

Research

Qualitative Studies

Interview

An extensive interview were conducted with an internet-savvy young man with genuine interest and broad comprehensive experience of playing – and to a lesser extent – programming games, both computer- and browser based. The interviewee have seen and judged a multitude of progress indicators, and is very familiar with quiz-based games such as the one in focus for this study.

By interviewing such a *power user* it is possible to get a relatively wide perspective of progress indication, considering the he have seen plenty of both. Using the interviewee's experiences and opinions, the focus group manuscript could be further developed and evaluated to make sure they were relevant and to the point.

Furthermore, an important aspect of the interview was to try to exhaust the possibility that no potentially interesting progress indicator were left out of the study.

Examples of the primarily experience-related questions asked in order to fill the above purposes were:

- *Have you seen any other progress indicators other than counters and progress bars? How did you like them, and why do you remember them?*
- *Would you consider progress indication to be rewarding in itself?*

Interview Results

Over the course of the interview, which extended over more than two hours, data was collected to rephrase the focus group manuscript rather extensively in order to get more to the point and steer away from unnecessary time sinks.
Apart from only aiding the preparation and moderation of the focus group, some interesting thoughts and opinions were noted during the interview:

- Considering the fact that as long as MPP and MPL indication always accompanies waiting time, the user will most likely multitask whenever possible – especially when in a web environment. Hence, waiting times must be kept at a minimum in order to keep the user focused.
- There seems to be an interesting paradoxical attitude toward unconventional progress indication:
    - There's skepticism toward "pushing" gamification (such as a progress indicator) on tasks that are blatantly "not fun". To quote the interviewee: "Forced gamification can keep me away from Facebook-liking stuff that I otherwise would have liked".
    - On the other hand, the interviewee admits that the very presence of a progress indicator implies an underlying challenge, and that he can't help feeling intrigued by it. To further quote him: "If one can get 100% at something, I will! I play to improve myself, and if progress indicators or ranking systems are present, they motivate me to care about the task no matter how insignificant it may be."

  This ambiguity seems to imply that it is the design and presentation of the progress indicator (or other gamification element) that ultimately determines the attitude toward it.
- Variation of progress indicators can make a task much more interesting, especially in a game context. The interviewee actually found it to be boring – or even irritating – when all progress seems to be modeled after the same standard regardless of the task it represents. This implies that the novelty effect of displaying creative progress indicators would alone be enough to motivate the user further in his task to fill them. Whether or not this novelty effect is "a good user experience" or simply "misleading", however, is base for a different discussion.

Focus groups

During the theoretical background phase, a collection of progress indicators and contexts were found. These were all inserted into an indicator/context table (appendix A) that was used throughout both focus group interviews. The table was designed so that it proposed the matching of all identified progress indicators with all identified contexts, and the respondents got to discuss whether or not they liked the pairing and come to a conclusive "yes" or "no" answer for each.
To enable the attendees to keep a broad view of progress as a whole and to encompass the entire spectrum when brainstorming, all four contexts were included on this table. Primary focus, however, revolved around UIP and UGCP.

Two focus group sessions of seven and eight participants each were held, being of little more than an hour of length. One group contained only participants with a very strong technical background – video game developer and artists, software engineers and testers. The other group was comprised of less tech-savvy people, albeit with some limited experience of Internet usage and (casual) gaming of some kind. Both groups had clearly, whether they'd reflected over the fact or not, been exposed to several types of progress indicators in many different contexts. For easier reference, they will henceforth be referred to as the *expert* and *novice* group respectively.

The focus groups were conducted using a protocol refined slightly from after the interview. As no regard was taken to the skill and experience of the focus group respondents, the protocol used was the same, and it was structured approximately as follows for both the novice and expert groups:

1. A brief walkthrough of focus group discussion protocol. This section was to make sure that all participants comprehended the idea of focus groups and that opinions and experiences are more important and that notions of "right" and "wrong" did not exist.
2. A background as well as warm-up question to make sure there's little to no ambiguity in regard to what the focus of the discussion was. Examples of the warm-up questions included:
    a. What is a progress indicator?
    b. In what contexts are they used?
    c. How do they generally look/work?
3. Presentation of the four progress contexts, using the Progress Context Table (figure 6).
4. Discussions revolving around approximately 15 screenshots of progress indicators and mechanics in vastly different applications and contexts.
5. Finally, the groups were presented with nine prototypes of candidates for the upcoming quantitative study in accordance with the result of the focus groups (Appendix A). They were each modeled after one of the nine progress indication types, visualizations and aids described in the theoretical background. For each prototype, a discussion was held regarding why or why not it would be a preferred indicator in each of the four different contexts.

In the end, four indicators were favored as interesting candidates for the empirical study.

Focus Group Results

- If MPP is of a long duration, time remaining should always be displayed. It's better to display an optimistic duration than a pessimistic one, as the focus groups were in agreement that it's better to check back too early than too late.
- In addition, in both MPP and MPL, time remaining was considered to give good feedback. For UIP and UGCP, however, the respondents had a hard time finding a useful purpose for it.
- For progress indication in general, and MPP in particular, it was concluded that as much underlying detail as possible should be communicated. The expert group found it to be absolutely necessary and the members of the novice group, when asked, emphasized that they didn't really mind the extra info.
- For any progress made in UGCP or other playful context, however, unnecessary focus on details can break the immersion.
- When doing task partitioning, there's no need to limit the number of partitions. The groups were in agreement that more partitions are always than less, and that finishing sub-tasks is always a positive experience.
- Unsurprisingly, no indeterminate indicator was preferred for a determinate task. For measurement of indeterminate progress, however, the throbber was consistently considered to be the preferred one to display.

Regarding the table of suitable progress indicators, it's worth mentioning that at least some of the answers may have been affected by its grouping. For example, a counter (up) may have been considered to be a reasonable indicator had it not been placed next to the counter (down) which turned out to be was the most favorable of the two.

The study found that among the determinate progress types, only the count (up) was considered a good indicator across all four contexts. The interviewees and focus group attendants all agreed that it is more rewarding to see the number go up rather than down.

Over the entire qualitative study, no progress indicator or aid that was not already taken into consideration by the author was mentioned. This would indicate that the study is less likely to have missed any significantly important progress indicator.

Conclusive Result – Progress indicators selected for the quantitative study

After taking into account the theoretical background and both qualitative studies, four progress indicators were selected and implemented for the quantitative test as per the result of the indicator/context table (Appendix A).

- ### Determinate Counter (up)

  For the first progress indicator, a simple determinate count was selected; displaying the number of answered questions alongside the total number for finishing the quiz (20). Being the only direct progress measurement, it is incorporated in the study not only because it was selected as a good indicator by the qualitative study, but also to double as a reference to the efficiency of aids and abstractions in general as that encompasses all the three aids that follow, considering it's the only basic indicator.

- ### Progress Bar

  The second progress indicator selected was a standard run of the mill progress bar, filling up with 1/20th for each answered question. Being not only the most standard progress indicator, but also a direct abstraction of the one described above, the two together will provide a good measurement of the efficiency of the current standard measurements.

- ### (Generic) Task Partitioning

  The task partitioning aid divides the twenty questions into four groups of five questions each. Every group gets an individual determinate counter (up), and a total counter is also displayed in combination with the partitions, per its de facto standard.

  This aid was selected because it was hailed by the focus groups as a progress aid that should almost never be omitted (under the premises that the task was either long or logically dividable). However, the quiz game for the quantitative study is neither (and shall remain so in order to not tinker with the underlying game mechanic), so it would seem counter-intuitive to use it.

  Thus, it was surprising to hear that the majority of the respondents believed that the presence of task partitioning would *still* make them stick around longer. The main reasoning behind this was that the division of the overlaying task into smaller pieces was considered to make completion feel less tedious, but more intricate and ethically questionable arguments were also heard:
  It was voiced that the novelty effect of seeing such an intricate progress indicator for such a seemingly simple would *imply* a logical structure in the question mechanics, which further would motivate progress because the player would be interested in potentially finding out what that structure was.

  Regardless of this being an ethically sound reason to use a certain progress indicator, it makes for an interesting entry in the study if nothing else but for its similarity to the determinate counter (up).

- ### Goal Visualization

  The goal visualization was selected as the forth and final progress indicator for he qualitative study because it was, by far, the best-received indicator of them all.
  Out of all the focus group respondents, no one could remember even having seen goal visualization used outside games before. Actually, in most cases an example had to be presented for them to even realize what the concept means. As it was explained, however, the reception was overwhelmingly positive, and “Gratifying” and “pleasant” were among the superlatives used to describe the indicator.

Quantitative Study

System Description

Introduction

In order to test the chosen indicators' affect on a quantitative measure (break-off rates), an empirical study was prepared using the social network site "Skout" as a platform. In order to gain a deeper understanding of the study and its results, it's important to have some knowledge of its context and underlying systems.

Skout

Skout is a multi-platform social network/dating platform whose main focus lies in using the user's location as a major factor, allowing for broad social interaction between users. Its main focus lies however in supporting actual real-life meet-ups between users with similar interests. The network has circa 500 000 active[2] users, with a broad majority (99.96%) using the iPhone and Android apps[3].

In order to be able to use Skout through its website[4], the user is required to sign up using Facebook Connect, a one-click authentication method that also allows Skout access to a Facebook-provided API and thus some information from the user's Facebook profile such as profile picture and interests.

Skout Discovery

After logging in to Skout's website, a quiz game, Skout Discovery, is available through the click of a prominent internal ad stating the game's name and "*Know your friends? Quiz away to find out!*". Under this simple premise, the user joins the game unknowing of his or her anonymous contribution to this study.

Skout Discovery's core mechanic is to state 20 questions, one after another, about the players' friends based on an aggregation of their publicly available Facebook profile information. A typical question can be: *"Who doesn't read books?"*, and the answer is given by simply clicking on of the two profile pictures displayed – one corresponding to the correct answer, and one the wrong. There are also options to skip certain questions or exclude friends from the quiz.

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[2] Defined here as *Weekly Active Users* (WAU) - Users who have logged in at least once over the past week.
[3] http://itunes.apple.com/us/app/skout/id302324249, https://market.android.com/details?id=com.skout.android
[4] http://www.skout.com

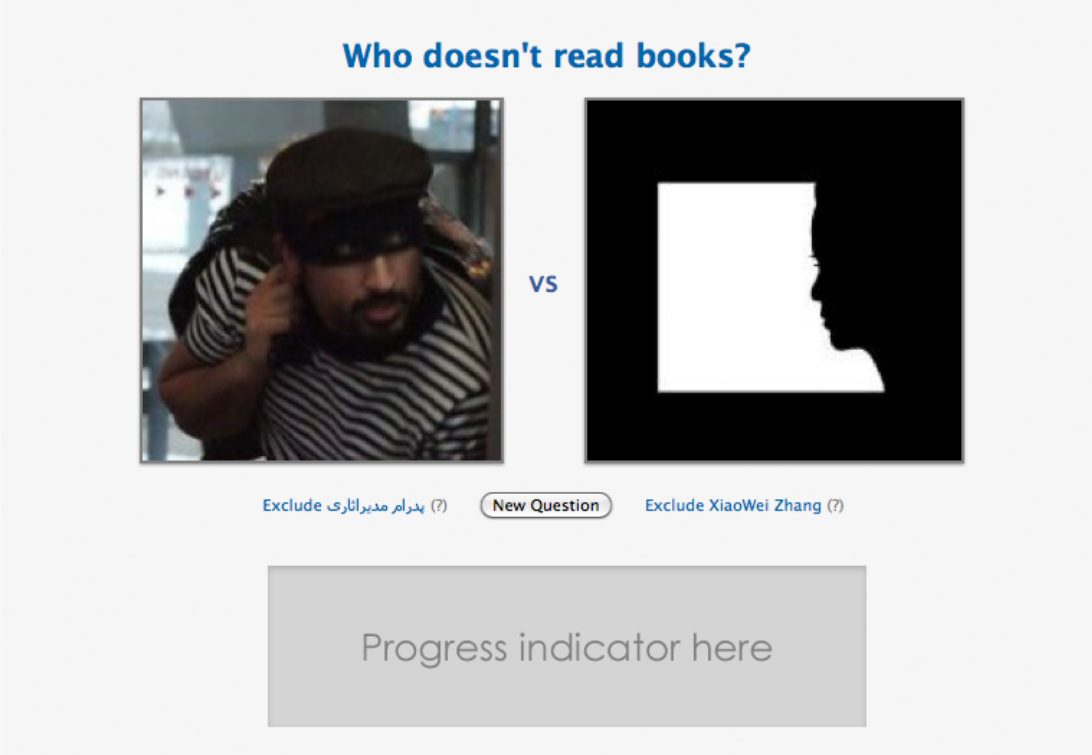

Figure 7: A typical Skout Discovery game screen

After answering all questions, the player is presented with a report card visualizing his results. The user is at this stage also given the option to share his or her results with friends on Facebook. The game takes approximately two to five minutes to finish, a time being principally dependent on the time needed for consideration of the answer. After finishing the quiz, the player can choose to seamlessly restart the game in order to try to beat his or her high score.

On the game screen, one of the four indicators will be displayed to display the player's progress from start to finish is displayed. Upon answering a question, the progress indicator is updated immediately using AJAX in order to strengthen the correlation between "giving an answer" and "making progress". Following that, the game fetches new data, reloads the question and its potential answers and the question loop restarts.

Maximizing the validity of the study

It would be naïve to believe that progress indicators would be the only factor to influence the user's engagement to answering questions. Hence, it's important to analyze other potentially influential factors in order to minimize their impact and thus maximize the validity of the study.

The table below is the result of an attempt to identify the influential factors as well as what arrangement that could be made in order to minimize their impact on the study result.

If left be, these factors – as well as potential other unidentified ones - are likely to cause a general percentage increase in break-off rates. They will leave the distribution of study answers even and consequently not favor any group over the other. In conclusion, the nullification of as many of these factors as possible will result in a more significant result for the same number of data points.

Influential Factor	Correctional Arrangement
Player Skill/Result It's reasonable to assume that a player with 9 out of 10 correct answers is less likely to break off than a player with only one correct answer after the same amount of questions.	Don't display any result until the game over screen displays the final score.
Player Social Relations The relation between the player and his/her randomized Facebook friends is likely to affect break-offs. For example, it can be assumed that commitment may be lost if the questions revolve around people that the player don't know very well or for other reasons may hesitate to interact with.	There is (un) fortunately no way to affect this factor or to determine its impact on the final result.
Distractions (from Skout) Chat messages and other notifications from the Skout community are displayed live on same page as the game. These provide the player an enticing incentive to quit the game prematurely and thus likely nullify the impact of the progress indicator.	Since these factors are community-driven and based on an impossible amount of variables (A player may, for example, be more likely to be contacted if he or she lives in a large city), the solution is to simply hide all types of notifications until the game is over.
Player Impatience If loading times are long, players are likely to multitask or in any other way lose interest in, or focus on, the game.	Programmatic measures were taken in order to keep loading times at a minimum.
The Competitive Factor The notion of competition motivates some types of people, such as the interviewee in the qualitative study. Others may conversely be turned off by the potential publicity.	Don't advertise or display options for sharing your result until after the game is over.

The one factor that cannot be removed due to its random nature is the one dependent on the social relation between the player and his/her randomized Facebook friends. What this means in practice is that if a player breaks off from the game, it is impossible to determine if this was due to social issues or a lost interest in the game in general. To minimize this social issue, a feature was built giving the player an active tool to avoid awkward situations by skipping certain questions or friends.

By involving a large enough number of test subjects as well as removing all design factors that may affect the player's drive to finish the quiz, the result of how the progress indicator alone affects the motivation to finish the quiz can be further ensured.

Quantitative Study Description

Study framework

The following guidelines were defined to control and explain the data collection of the study:

- When a user first enters the game screen, he is immediately put in one of four test groups. Using the following formula, each player reaching the game gets assigned into one of the four test groups by generating a corresponding group ID.

  $$test\ group\ ID = Skout\ user\ ID\ modulo\ 4$$

  Due to the nature of the Skout user ID being persistent, so is the focus group ID. Thus, regardless of the number of times the user plays the game, he or she will only see the same progress indicator. Though the group ID s a numerical value from 0 to 3, it will for the sake of clarity be referred to with the corresponding letters A, B, C and D respectively in this report.
- When a player **finishes the game**, it means he or she answered at least 20 questions and reached the game over screen. Whether the player continues to play afterwards does not affect this.
- A case where the user doesn't answer any of the questions is referred to as an **immediate break-off**.
- A case in which user answers one or more questions, but not the entire quiz of 20 questions, is referred to as a **break-off**.
- The game can be restarted after the game over screen have been reached, and is playable as many times as the user wishes. Regardless, only the result of the first session is recorded for the study as it's assumed that this is the time frame where the progress indicator makes its greatest impression on the player.

Characteristics of each progress indicator

All progress indicators show the ratio of completed tasks in relation to the total number. Colors, fonts and icons are picked to match Skout Discovery's general design guidelines to the greatest extent possible.

Group A: Determinate counter (up)

Figure 8: Progress indicator A: Determinate Counter (up)

Apart from the flexibility of color and size, there's not much of a design space available for a progress indicator such as this. Hence, it was designed in order to simply match the general style of Skout Discovery.

Group B: Progress Bar

Figure 9: Progress indicator B: Progress Bar

The progress bar was designed to be thin and segmented in accordance with Beauquel and Roose (2007) that describes this as most satisfactory design from a time perception standpoint.

Group C: (Generic) task partitioning

Figure 10: Progress Indicator C: (Generic) Task Partitioning

Regarding the number of partitions the questions should be divided into; the two focus groups had different opinions. The expert group expressed that they would be discouraged if the number of partitions exceeded three to six, describing it as potentially "overwhelming". The novice group voiced no concerns about this matter and welcomed "as many partitions as would be necessary or useful for the purpose".

In the end, the number of partitions was set to four. The reasoning behind this was primarily based on the limited number of questions in the quiz coupled with an inclusiveness of expert users in an assumption that the expert group's opinions were valid for a greater number of people.

Coloring and names for each group was used to reinforce the (logically nonsensical) partitioning. The names of the partitions (*phase 1* through *4*) were selected to sound as generic as possible, as the intent was not to try to mislead the player by implying some sort of nonexistent question sorting. The aim, after all, was to try to measure the impact of the indicator (and its relation primarily to the determinate counter (up)) without trying to imply characteristics of the quiz's mechanics that in turn could affect player performance.

Group D: Goal Visualization

This indicator displays a mockup of the quiz's goal and reward – the report card – as a thumbnail image. It is initially partly hidden behind 20 padlocks, which gets systematically removed for each question answered, gradually revealing it until it is completely visible.

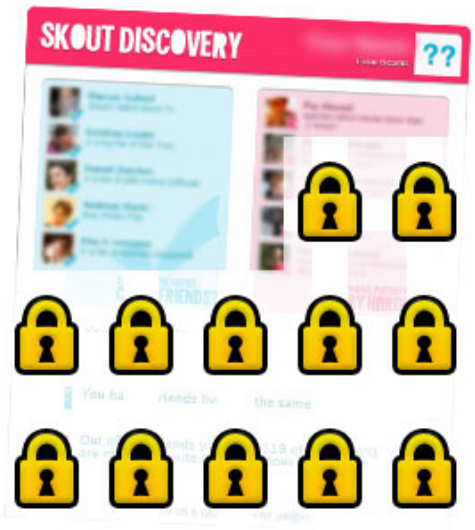

Figure 11: Progress Indicator D: Goal Visualization

The goal visualization aid was designed to match native Skout Discovery colors. The design of the padlock– a basic iconographic symbol of something being locked but having the attribute of being unlockable – is the same as one used widely throughout Skout's web page and apps.

Hypotheses

Using data collected in the earlier studies, hypotheses about the qualitative study result can now be stated:

H1. The progress indicator type will have an effect on the players' performance.

H2. Groups with a visualization or aid will show an improvement in the players' performance compared to the group with basic indication.

H3. The groups with Task Partitioning or Goal Visualization will be the best performing ones.

The hypotheses can be proven or disproven by observing the following results:

H1. At least one of the test groups will have a statistically significant difference in break-off rates compared to any other.

H2. Groups B, C and D will have a reduced break-off rate compared to Group A.

H3. Group C and D will have the lowest break-off rates.

The reasoning behind the hypotheses is primarily derived from the results of the focus groups when presented with the progress indicators.

Data Collected

To prove or disprove the hypotheses, the following data was collected for each player:

- An identifier for which progress indicator the player got; the "group ID".
- The number of questions answered.

Quantitative Study Results

Participant characteristics

After little more than a month, the study-specific implementation of the quiz was taken offline. The number of valid data points had then reached 2230, giving an average of almost 560 users per group. As the group ID for each user was generated by doing a modulo operation on their unique user ID, this lead to a slightly uneven distribution of group participants. The difference was small, but the answers were still normalized by comparing percentage instead of numeric results for greater validity.

Of the participants of the study, 42% were female and 58% were male. They were fairly evenly spread out throughout the world except for a clear skew towards the United States of America, which was the country of residence for 61% of the total number of players.

A minor mishap

A small backlash to the study was discovered when its results were being analyzed. It did not affect a major part of the study, but it was initially hoped that immediate break-off rates would be able to be taken into consideration for conclusions regarding the novelty effect's impact on choosing to begin playing at all.

Unfortunately, it turned out that the first data about the user was logged as soon as he or her first entered the game – before actually making the decision to accept or deny the Facebook connection and thus actually get to see Skout Discovery. In brief, this means that *users with 0 answers most likely never got to see their progress indicator*, thus never allowing it to affect their motivation to continue or break off.

As a result, a characteristic of a usable data point had to have one or more questions answered, and a secondary, less valid performance measurement was incorporated in an attempt to provide an indication of the data that was lost.

Performance measurement

There are two ways of measuring the performance of each group. The first is the most commonly used in related studies, and revolves around comparing the break-off rate for each group. The quiz is 20 questions long, and a break-off is defined to occur if the user quits the game before having answered all of these.

In order to get a hint of how the novelty effect affected user performance, it was decided to also count the number of answered questions per individual. Its validity for this purpose is questionable, but it may still be useful for the result analysis.

Result Data

The characteristics of the data for each group can be seen in figure 12 below:

Group	Progress Indicator	# Players	# Finished	# Break-offs	Break-off rate
A	Determinate Counter (up)	**565**	**222**	**343**	**61%**
B	Progress Bar	**516**	**238**	**278**	**46%**
C	(Generic) Task Partitioning	**564**	**251**	**313**	**55%**
D	Goal Visualization	**585**	**263**	**322**	**55%**

Figure 12: Table of Break-off rates per group

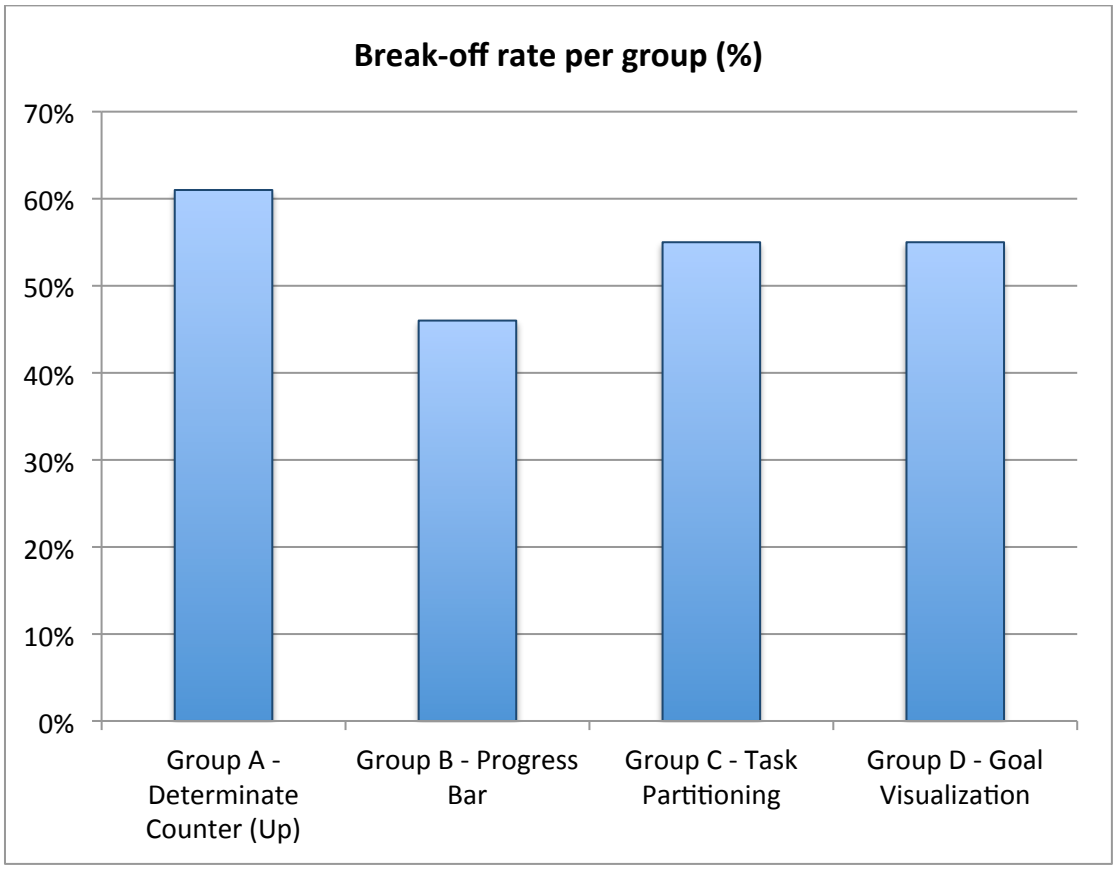

Figure 13: Bar Chart of break-off rates per group

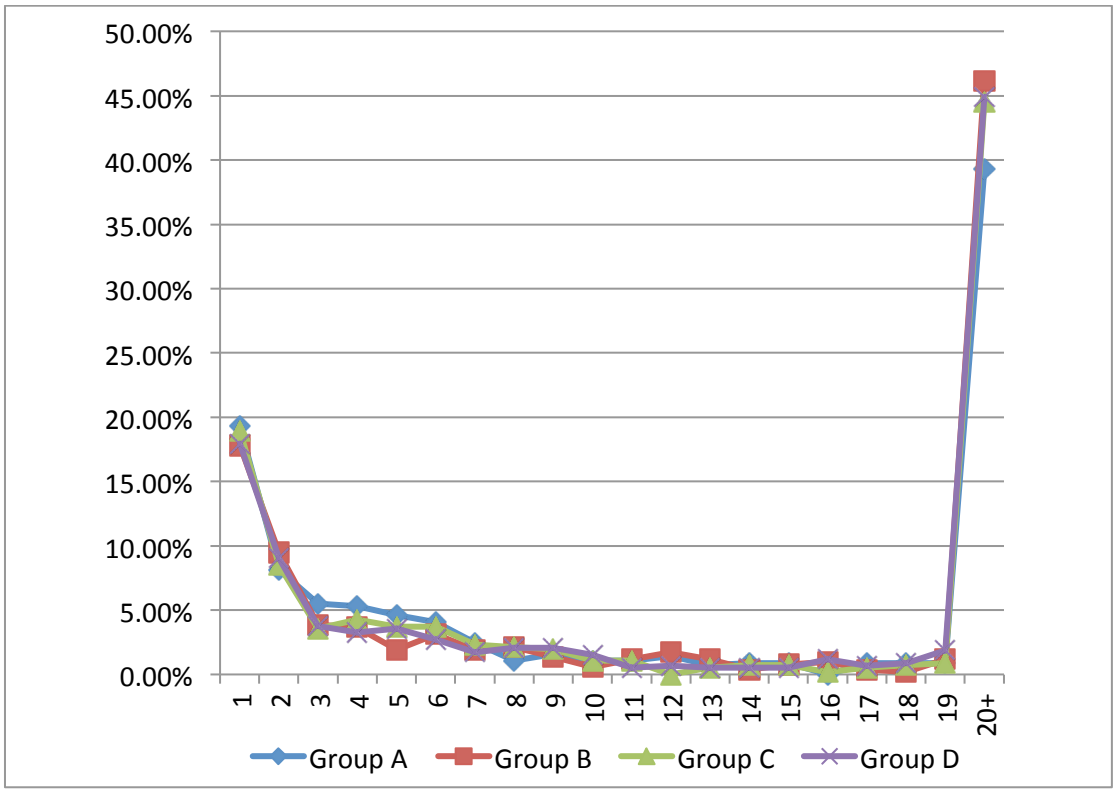

Figure 14: Line diagram of break-off rates per question

Data analysis and evaluation

Validity of the result

Unfortunately, there are too few data points to draw any certain conclusions. At he very least, the result is indicative toward the fact that indicator does indeed have some impact on the player's performance, which would render **H1** to be true. The difference between the highest and lowest break-off rate were as much as 15 percentage points.

H2 also turned out to be true, as group A had the highest break-off rate of all the indicators. However, this was not nearly as convincing as **H1** since the experimental groups (C and D) both only differed from group A with a mere 6 percentage units.

Regarding **H3**, however, it turned out to be false. Apparently the more experimental progress indicators didn't result in a high performance at all, as the regular progress bar bested them both by 9 percentage units.

Unsurprisingly, the break-offs that did occur was early in the quiz. Most likely, the quiz game didn't fulfill the player expectations. After having reached around 7 questions, the variance in drop-off rates between the groups were negligible. Between 3 and six questions, group A had more drop-offs but the differences seems generally so evenly distributed that no conclusions – not even indications of such – can be drawn from this particular data.

Conclusion and Discussion

After collecting all results, the following progress indication guidelines can be formulated:

The common use of progress bars seems motivated.
From a performance perspective, the progress bar turned out to have the lowest break-off rate of all indicators from the qualitative study. Even though it wasn't hailed as contribute to a particularly exciting user experience during the focus group interviews, it is likely that its de-facto standard that its presence implies a challenge or task at first glance. Furthermore, its neutrality makes it suitable in many areas. This study presents no new insights about the design of the indicator, but recommends following the guidelines proposed by Beauquel & Roose (2007).

Avoid basic progress indication
No basic indicator was popular among the focus group respondents, but the *least unpopular one* was the determinate counter (up). Incidentally, it was also the least efficient indicator in terms of performance in the qualitative study. This gives a solid reason to believe that basic progress indication should be avoided as far as possible.

Progress can be designed as a reward
The results of the interview and the focus groups imply that progress indication can be implemented to be a solid part of the user experience. Some people want to make progress only for the sake of making progress, and this could motivate enormous creativity when it comes to visualizing it. Outside of the playful context, however, it's important to make sure the indicator itself does not interfere with the user's focus on the task at hand.

Task partitioning is (always) useful
The focus group hailed the task partitioning aid as very useful, and although it wasn't by a large degree, it still performed better (by 9 percentage points) than its very similar counterpart, the determinate counter (up). The diagram of individual break-offs does indeed indicate that this is due to some novelty effect, but the validity of such a claim is questionable at best.

What motivated the overwhelmingly positive attitude toward the task partitioning aid is more likely that the underlying mechanic of approaching a task – dividing it into smaller logical partitions – is the one that helps creates a better user experience *regardless of context*. Following this, incorporating its use for progress indication may then simply imply the mechanic to the user manner.

Display the approximate time a task will take
The focus groups were in agreement that time remaining as a way to indicate progress was an annoyance more than anything else. They did however also welcome the idea to see how long time a task would take before starting it. The

general reasoning behind that was that an approximation of time was more useful for motivation than an exact number of seemingly indeterminate tasks.

Consider the user's skill level when designing the indicator
Finally, the technical level of progress indicators and -feedback should as far as possible be adapted to the users. It became clear during the focus group sessions that users with technical background felt more secure when taking part of as much technical detail as possible about the ongoing task – regardless of context or type. The novice users were in agreement that they weren't turned off by the extra information, even though it wasn't very useful for them either.
In conclusion, the best solution seems to be to display a "details" link allowing users to choose themselves how much data they want access to during task progression.

Design example for progress indication contributing to a pleasant user experience

Putting the guidelines together, a final conclusion is reached; a proposition on how progress indication should be designed in a general case in order to cater for a pleasant user experience.

- Display an approximate time the task will take before the user chooses to start it.

- Separate the task at hand into logical partitions, as many as can be considered useful to the user. Nest task partitions if necessary.

- When the task has begun, display an indicator for each partition (preferably a progress bar, if performance is an important factor) as well as overall progress toward the goal.

- The overall progress indicator may very well make use the goal visualization aid if it makes sense in the context and in regard to the reward.

- At any time, additional details about the task and the user's progress should be made readily available within short reach.

Further studies

Primarily, it would be interesting to see similar studies whose result may shed further light on the conclusions of this one. It would be interesting to take part in a study that, for example, increased the number of questions that are to be answered. The number of questions in this experiment is low – perhaps too low to give the progress indicator the weight it needs in the eyes of the user. Optimally, the conclusive guidelines of this study would be implemented and put to further tests.

Another intriguing study could potentially incorporate the adding of audial feedback to UIP. A “positive” sound effect such as a chime is very commonplace to accompany progress made in most UGCP contexts, but limitations of a study such as this one makes it impossible to incorporate them. Even if we disregard the fact that simply playing a sound in a web browser is far from reliable, there’s no way to know if the player’s volume is turned down to completely nullify the effect, or way up, resulting in a shockingly negative user experience.

Furthermore, it would be fascinating to see the results of a study using the “time remaining” indicator during a series of tasks that vary in workload. A good example would be the completion of a profile, where different fields and tasks take varying time to complete. If an adaptive algorithm could be implemented to accurately estimate the actual time left, it would be even more interesting. In brief: During a task, is a message of “70% left” more motivating than “approximately 9 minutes left”? Or, to put it in a less abstract example; would it be appreciated if road signs calculated and declared the time it would take for you to reach your destination rather than stating how far away it is?

Finally, it’d be extremely interesting to see an ethical discussion about progress indication. The evidence seems conclusive that when lying about progress feedback (fast-to-slow) indication, the task is perceived as to complete faster. It’d be interesting to learn more opinions on whether or blatant manipulation of the user’s perception of time could lead to a positive user experience.

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Appendix A: Progress Indicators and their usefulness in different contexts

	Application Context		Game Context	
	User Input Progress	**Machine Progress of Processing**	**User Game Control Progress**	**Machine Progress of Loading**
Indeterminate Progress Type *Progress toward an unknown goal*				
Indeterminate Count *"4 tasks completed"*	**NO**	**NO**	**NO**	**NO**
Determinate Progress Types *Progress toward a known goal*				
Determinate Counter (down) *"4 of 8 tasks remaining"*	**NO**	**NO**	**NO**	**NO**
Determinate Counter (up) *"4 of 8 tasks completed"*	**YES**	**YES**	**YES**	**YES**
Percentage (down) *"50% of the tasks remaining"*	**NO**	**NO**	**NO**	**NO**
Percentage (up) *"50% of the tasks completed"*	**NO**	**YES**	**NO**	**YES**

Visualizations & Aids *E.g.; a progress bar instead of a percentage*				
Throbber *Beach ball, hourglass, spinner, etc.*	**NO**	**YES**	**NO**	**YES**
Time Remaining *"(Approximately) 6 minutes left"*	**NO**	**YES**	**NO**	**YES**
Progress Bar *The standard percentage visualization*	**NO**	**YES**	**YES**	**YES**
Task partitioning *Step 1 -> step 2 -> step 3*	**YES**	**YES**	**YES**	**YES**
Goal Visualization *E.g. A desaturated reward being continuously saturated*	**YES**	**NO**	**YES**	**YES**