When 'one fits all' does not fit – study of visualization types for mobile help systems

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ABSTRACT
An open question today is how the visualization of a mobile assistance interface should look like, e.g. if it should disappear automatically after some seconds or a user interaction is required. In this paper a survey is conducted that has the goal to gather practice-oriented interaction design guidelines to support design decisions of mobile help visualizations. The survey is based on four different visualization strategies in order to find the most appropriate. Five usage scenarios from the field of mobile messaging were selected. The study shows the first time that users have a concept of criticality for usage problems and that 'one fits all' solutions fail for (huge) user groups.

Categories and Subject Descriptors
H.1.2 [**User machine systems**]: Human factors. H.5.1 [**Multimedia information systems**]: Evaluation and methodology. H.5.2 [**User interfaces**]: interaction styles / training, help and documentation.

General Terms
Interface design, user support, assistance/help systems, help format, mobile device.

Keywords
Mobile device, online survey, help systems, information visualization.

1. INTRODUCTION
Today many smartphones applications are too manifold for users. Lacking a formal definition of the term, we adopt the definition for a smartphone as a "miniature computer that has phone capability" [1]. As their capabilities and technical complexity have grown far beyond voice calls, address book and text messaging – and will continue to grow according Moore's law [2] – smartphones are the emerging mass market device connecting customers to digital services from the operators' and hardware vendors' point of view.

Besides many other applications (e.g. camera, mp3 player) and services (e.g. multi media messaging service, games) – being native or provided by the telecom providers or 3rd parties – currently mobile internet and so called Web2.0 [3] services are envisaged to reduce the customer churn rate and keep – if not increase the average return per user. With diminishing returns on voice services, value-added interactive services in the mobile internet become the cornerstone for future revenues for a broad range of providers, service accumulators and hardware vendors.

From the customer's point of view devices offer huge functional possibilities, combined with strong hardware restraints (size of screen and interaction elements) [4]. They provide a variety of connectivity options (e.g. WLAN, Bluetooth, USB2.0) and many built-in features: Functions like camera, multimedia player, radio, memory are common – all of which support digital life styles of their users. Mobile internet and mobile media usage have left the niche and become mass market applications (see CeBIT 2009).

This compelling marketing story of the vendors and telecom providers has a drawback though - for the customer it is not all that easy to use. The complexity of possibilities and the cumbersome service initiation scare customers off and they refrain from usage [5] thus the potentials remain underdeveloped - if not untapped. Moreover, this increasing thicket of interaction possibilities also increases the likeliness of usage problems or critical errors (unintended implications of interactions, data-loss, connection fees, breaches of security etc.) while at the same time the abundance of functions need to be easily accessible – without detours.

People rarely use documentation, whether printed or online [6], and show a significant preference for asking others, including help desk and colleagues, over using documentation. But: In a mobile context the preferred sources most likely are not available to support mobile users.

For this, it is the challenge to provide the user with help and additional information in a mobile context.

This paper is organized as follows: In section 2, we refer to related research and section 3 explains the scope of the study. In section 4, the method is described. Section 5 describes the results of the survey, i.e. the ratings and rankings; the discussion is provided in sect. 6. We conclude in sect. 7.

2. RELATED RESEARCH

2.1 Design of help

Nielsen [7] lists in his usability heuristics among other the relevance of help and documentation that has to be 'easy to search', 'focused on user's task', 'list concrete steps to be carried out' and 'not be too large'. The application of adapted heuristics for notification systems [8] showed encouraging results for conducting usability expert evaluations, [9]. The adapted heuristics imply e.g., that notifications have to be 'timely', 'consistent within priority levels' and 'adjustable to fit users' goals'. Latter involves the factors 'interruption' (e.g. control the amount of viewing area), 'reaction' (modification of the actions that are required by a notification) and 'comprehension' (modification of the levels of detail).

2.2 Notifications in on task situations

Applying the heuristics – especially 'timely information' and the factors of adjustability in the context of usage problems for mobile devices, the dilemma of system initiated information ('push') and the probability of task interruption due to the limited screen size of mobile devices is obvious. Mc Crickard et al. [10] define success in notification systems design as achieving the desirable balance between attention and utility.

3. SCOPE OF THE STUDY

For this, it's the challenge to provide appropriate help that solicits users' attention only when it's useful for him, e.g. for critical usage problems.

To understand the requirements and challenges of providing mobile users with live help systems, our directions of research are centered on the issues of system initiative and presentation of information:

a) How to design the help or the hint - of help being available – without causing the user to feel interrupted in his flow of tasks?

b) Are there situations / factors in which the help should interrupt the user? What are the tradeoffs & risks of a 'do not disturb in situations with low importance' vs. 'interfere before serious problems arise' approach?

c) What are user's preferences for design alternatives for different levels of intrusiveness?

This online survey is conducted to support initial design decisions for the development of a mass market service including a mobile help system.

4. METHOD

In this section the scenarios for mobile usage problems and types for mobile help styles are described. Additionally, the design of the study and the sample are provided.

4.1 Scenarios for mobile usage problems

To carry out an online survey to study the user acceptance of design alternatives for mobile assistance formats, a two step procedure of scenario building and -verification is applied.

Scenario building:

Firstly, various usage problems around the use of mobile phones and mobile services are collected and condensed by usability experts into 23 usage problem scenarios. 15 of these are then eventually selected according to their perceived criticality to be included the second step, the scenario verification.

Scenario verification:

To assess the subjective evaluations of perceived severity for the 15 selected usage problem scenarios, a preliminary user survey is conducted by presenting a questionnaire to a sample of 13 respondents (students of computer science and electrical engineering faculties of Ben Gurion University, Israel), all highly experienced with computers, mobile devices and -services.

After the textual scenario description the respondents are asked to rate the perceived severity for each scenario, the perceived importance of receiving help for the specific issue in question and to judge the degree to which they believed help could be beneficial for the individual situation in question.

The analysis shows, that none of the usage problem scenarios receives very low rankings (below 3 on a seven-point scale) but some are clearly considered to be more critical.

Based on the results of this preliminary survey to verify the perceived criticality of certain usage problems, the following five usage scenarios are chosen to represent a broader range of perceived criticality to be the basis for an online survey on a larger scale:

1. **Unintended internet connection:** resulting in usage costs for a non used internet connection
2. **E-Mail has not been send:** due to writing an email while in 'offline' mode
3. **Energy consumption is too high:** improving battery life by reducing the frequency of checking for new emails
4. **CC function is not visible:** informing the user about easier ways for using the cc ('carbon copy') function
5. **Insert a new photo to Multimedia Messaging Service (MMS):** informing the user about the option to send pictures via MMS immediately after taking them

The scenario 'unintended internet connection' and 'energy consumption is too high' are set in a usage situation where the user is not paying attention on his mobile device. The other scenarios are described as on task situations.

4.2 Types of visualizations for mobile help

For the online survey, a set of different visualization & interaction strategies have been displayed to indicate a usage problem. These hints for the usage problem were pushed to the user, but differed in detailedness of the information and their mode of disappearance.

1. **Level of detail**: graphic hint vs. short textual hint vs. detailed advice how to solve the problem
2. **Mode of disappearance:** system initiated after a few seconds (si) vs. user initiated (ui)

Table 1 gives an overview of the inferable and chosen help formats. We decided to reduce the amount of design alternatives to facilitate the decision making for the participants. Moreover, a previous discussion with experts clarified, that neither an advice how to solve a usage problem that has disappears on system initiative nor a graphical hint that disappears by user initiative would be meaningful.

Table 1: Overview of possible and chosen design types

graphic hint		short textual hint		advice	
si	ui	si	ui	si	ui
Type A	-	Type C	Type D	-	Type B

The advice how to solve the usage problem is the identical final state of all four visualizations. But: because of different level of detail of information that is initially provided, the help types differ in the manner the user gets to the advice.

The combination of the two variables results in different impact on the user’s main task (see Figures 1- 4 and Tables 2-5).

In regards to the kind of assistance information initially presented Type A consists of a graphic hint; the others present textual information in two different ways: Whereas Type B offers immediate detailed description (full screen), Type C & D present short textual description of the usage problem with the opportunity to get more information and to solve the problem (partial screen).

Visualization Type B e.g. immediately appears as full screen, thus interrupts the interaction of the user on main task. Therefore this Type B is assumed to be perceived as most intrusive.

In contrast to this, Type A and Typed C are designed in a way that leaves the screen of the main task undisturbed, while offering assistance information at the bottom of the screen only. Also the user may decide when to follow the hint to receive full-screen help. To notice these visualizations the user’s attention on the screen is required.

Table 2: Attributes of visualization for mobile help - Type A

Criterion	Value
Level of detail	graphic hint
Disappearance	by itself after some seconds; system initiated
Consequence on task	task is not interrupted

Figure 1: Visualization of mobile help - Type A

Table 3: Attributes of visualization for mobile help - Type B

Criterion	Value
Level of detail	detailed advice how to solve the problem
Disappearance	by user initiative
Consequence on task	task is interrupted

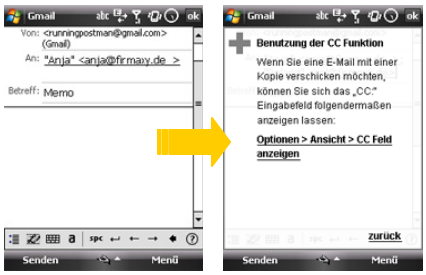

Figure 2: Visualization of mobile help - Type B

Table 4: Attributes of visualization for mobile help - Type C

Criterion	Value
Level of detail	short textual description of the problem
Disappearance	by itself after some seconds; system initiated
Consequence on task	task is not interrupted

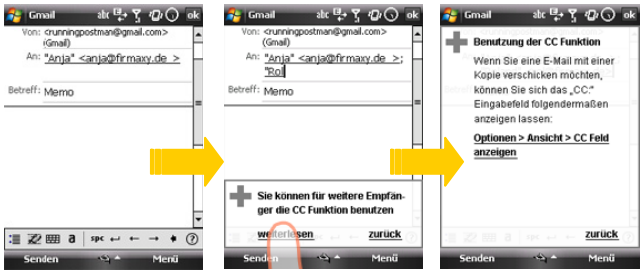

Figure 3: Visualization of mobile help - Type C

Table 5: Attributes of visualization for mobile help - Type D

Criterion	Value
Level of detail	short textual description of the problem
Disappearance	by user initiative
Consequence on task	task is interrupted

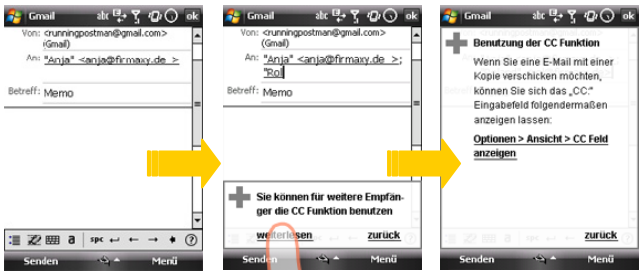

Figure 4: Visualization of mobile help - Type D

4.3 Design of the study

Goal of the survey is to gather practice-oriented interaction design guidelines to support design decisions of mobile help visualizations for mass market product development.

The online survey is conducted with an online experiment system, developed with a PHP platform and run on a private server. It consists of three parts each respondent has to click through consecutively:

The first part is of introductory nature and explains the overall goal and some basic instructions for the further proceeding, and gives an overview on the following steps. Also some questions regarding socio demographic data, experience of - and attitude towards mobile devices and services and prior experience with help for mobile devices and services are addressed.

The following screens of the second part deal with the usage problem scenarios. Each is centered on one scenario. After giving the textual description of the usage problem, all four (A to D) visualization types are presented graphically. This is the focus of the online survey.

In the third part users are asked to rate the criticality of the five initial usage problem scenarios.

In the second part participants are asked to assign distinct ranks for the different types of help visualizations (1 = best to 4 = worst). Each rank may be chosen once only. The criterion for the assignment by the user is the perceived appropriateness of each help visualization type in context of the specific scenario. The assignment of ranks is mandatory and subjects are not able to proceed to the next page / usage problem scenario, if incomplete or inconclusive rankings are given.

After the ranking, subjects are also encouraged to generate textual input as suggestions for improvements of the help visualizations for the each situation. These statements are given voluntarily.

While the order of help visualizations types is kept constant on each screen to increase orientation of the subjects, the order of usage problem scenarios is randomized between the subjects.

In the third part a summary page displays a brief description of all five usage problem scenarios in an overview. There subjects are requested to rate the criticality for all of the scenarios on a five-point rating scale (1 = very uncritical; 5 = very critical). This is done to validate the criticality rating from the preliminary study.

4.4 Sample

Participants are recruited from the German mobile phone market and invited by e-mail (pyramid scheme) to take part to the study on their own computer. The only compensation for the participation in this survey is the chance of winning an iPod in 2 raffles: One amongst all who completed questionnaire forms (independent of performance), one for the best suggestions for improvement on the help visualizations in an open text entry.

The subjects are screened with a pre task online questionnaire for their socio demographic data, affinity towards technology, prior experience to help usage, experience with their mobile phone and its help functions and about their mobile phone provider.

Overall, 139 subjects completed the web study and met the criterion for and appropriate ranking duration.

4.4.1 Socio-demographics

The sample shows quite an even distribution of gender (57% male; 43% female). 44% of the subjects are up to 24 years old; 29% are up to 34 years old; 44% are up to 44; and 13% are older than 54 years.

Most of the participants (47%) have at least an A level school leaving qualification and 45% of them have a graduate or poly-tech school leaving qualification. Only 8% of them have a 'low' school leaving qualification (up to secondary modern school).

Most of the participants are in full employment (39%) or students (33%). The minor part of the participants is scholars (9%), in job training (8%) or part time employed (6.5%).

4.4.2 Experience with mobile devices and services

To get general insights into the participants' experience of - and attitude towards mobile devices and services 3 questions are asked.

1. Self estimation on their knowledge about mobile phone trends:
   32% 'yes'; 41% 'dependent on the topic'; 27% 'no'
2. Self paced investment of time for testing new mobile services and programs:
   17% 'often; 27% 'sometimes'; 29% 'seldom'; 29% 'never'
3. Importance of using all services and features and functions of their mobile phone:
   27% 'yes'; 73% 'no'.

By combining the items "knowledge of mobile phone trends"; and "often" or "sometimes" "self paced investment of time for testing new services" and "importance of using all services and features of mobile phones" we derive the respondents' affinity towards mobile devices and services. Thus 19 % of the subjects meet this criterion.

4.4.3 Experience with help for mobile phones

Considering prior experiences with help on mobile phones, only 20% of the participants have used a help function on their mobile device so far. Asked subsequently about their satisfaction, only 17 % stated to be very satisfied with the help function (50% 'rather satisfied'; 32 % 'rather dissatisfied').

Of the 80% of the participants who have no prior experience with the usage of help functions on their mobile phone, 32% would like a help function on it. 15% of these deny this explicitly. The remaining subjects (53%) state to be undecided or not to care about having a help function on their mobile phone.

For the means, where the respondents turn in case of need for help with their mobile phone, multiple selections were allowed: Participants clearly prefer their social network (51%). Secondly, they prefer to contact the service line (45%). Even searching for help in online communities or forums is frequently chosen (39%). In contrast to this, user manuals do not seem to be attractive (18%).

5. RESULTS

For the analysis of the subjects' rating of the criticality and ranking of help types, non parametric statistical tests are performed. A Freedmann test [11] is conducted to analyze the overall significance of the rankings. A subsequent pair-wise comparison is done by a Wilcoxon test [11]. Effects of demographic data, affinity towards technology and experience

of using help functions on subjects’ rating are analyzed by a Mann-Whitney-U test [11].

5.1 Rating for the perceived criticality of usage problem scenarios

The criticality of the different scenarios as perceived by the subjects is analyzed. Significant different ratings are found (Chi square (4, 139)=311.4, p<0.01).

The usage problem scenario perceived by the participants to be most critical is the ‘unintended internet connection’ (median 4.5), followed by ‘E-Mail has not been send’ and ‘Energy consumption is too high’ (median of 4.21 and 3.83). In contrast to this, the ‘CC function is not visible’ and the ‘Inserting a picture in a MMS’ - scenarios are not perceived to be as critical (median of 2.55 and 2.39).

Neither socio-demographic factors like age, gender, school leaving qualification, state of employment nor level of experience with mobile phones or experience with help for mobile phones have an effect on participants’ criticality rating. Significant differences in the participants’ ranking of the visualization types for help can be found for each scenario , see Table 6.

Table 6: Analysis of the ranking of help types

Scenario	Value (chi square)
Unintended internet connection	(3, 139)=33.9, p<0.01
E-Mail has not been send	(3, 139)=45.5, p<0.01
Energy consumption is too high	(3, 139)=77.53, p<0.01
CC function is not installed	(3, 139)=97.32, p<0.01
Insert a new photo to MMS	(3, 139)=84.1, p<0.01

Independent of perceived criticality of the different scenarios, specific preferences for visualization types can be found. To get an overview of the overall rankings for the types of help visualization for each scenario, see Figure 5.

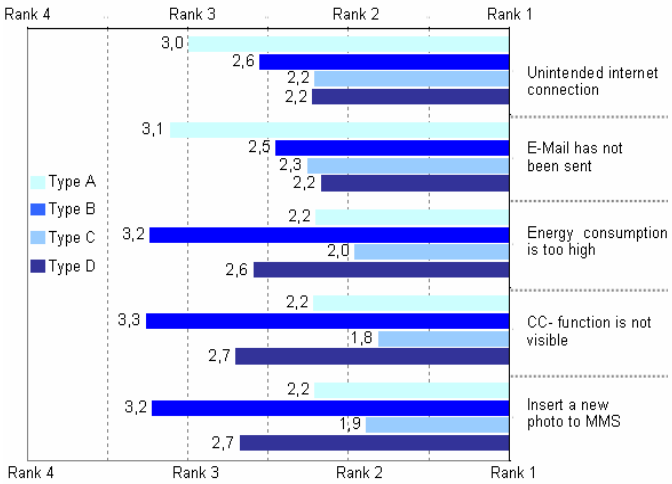

Figure 5: Overall comparison of mean ranks for the help types

The figure shows the mean rank for each visualization type for each scenario. The top scenario is perceived as the most critical one, the bottom as least critical one.

Obviously two distinct ranking pattern can be identified: One group of scenarios (the first and second most critical ones) show a clear misfit of Type A and Type B, while there is no distinction between Type C and Type D. In contrast to this, the second group (of the other three scenarios, perceived to be less critical) show a concordant ranking for all visualization types: Assigned to be most suitable is Type C, followed by Type A, Type D and Type B.

Therefore, we concentrate the following detailed analysis for the usage problem scenarios on the most prominent examples. This allows the analysis of users’ ranking of usage problems with different criticality.

5.1.1 Scenario: Unintended internet connection

Additionally, to the overall analysis of this scenario (see Table 5) pair wise comparisons are conducted on individual help types.

All pair wise comparisons of the participants’ assignments for the different help visualization types show significant differences - except for the comparison of Type C and D, see Figure 6.

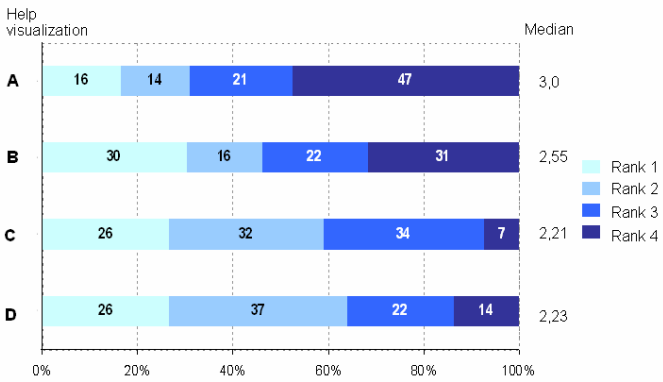

Figure 6: Distribution of assignments (%) for most critical scenario

Overall help visualization Type C is most appropriate for the usage problem scenario ‘Unintended internet connection”, which perceived as the most critical one.

5.1.2 Insert a new photo to MMS

In addition to the overall analysis of this scenario (see Table 5), pairwise comparisons are conducted on individual help types. The participants’ assignments for the different help types are significant. See Figure 7.

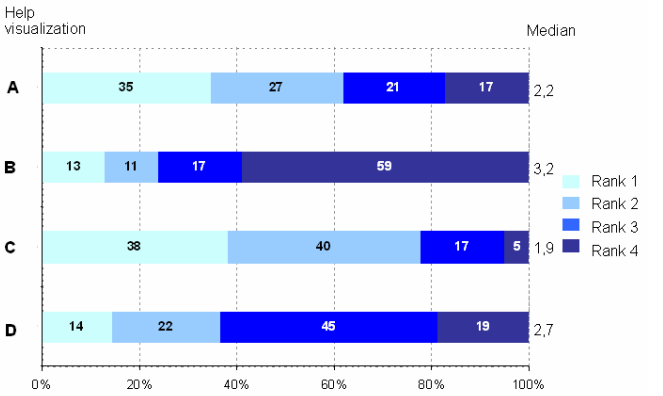

Figure 7: Distribution of assignments (%) for least critical scenario

Overall, help visualization Type C is most appropriate for the usage problem scenario 'Insert a new photo to MMS', which perceived as the least critical one.

5.1.3 Moderating factors on subjects' assignments

In concordance with 5.1 neither socio-demographic factors like age, gender, school leaving qualification, state of employment nor level of experience with mobile phones or experience with help for mobile phones have an effect on participants' assignments.

6. DISCUSSION

In this section the ratings and rankings of the survey are discussed. In addition, the methodical approach is discussed.

6.1 Rating for the perceived criticality of usage problem scenarios

This study shows that respondents have a consistent perception about the criticality of usage problems.

The ratings illustrate that content factors like unnecessary cost (consequence of the scenario 'unintended internet connection') are more relevant than efficiency of completing a task that can be solved by a workaround (scenario 'insert a new photo to MMS').

In regards to the scenario 'E-Mail has not been send' it is derived, that effectiveness is another important factor for the perceived criticality.

Nonetheless, further identification and investigation of the complex of content factors contributing to the perceived criticality will be necessary to gather detailed insight for the design of context sensitive help functions.

6.2 Ranking of types for visualization of mobile help

The analysis for the mass market shows: There is no 'one fits all' solution for usage problems of different criticality.

6.2.1 Scenario: Unintended internet connection

As pair wise comparison between Type C and Type D is not significant, Type C cannot fully be recommended as the only suitable solution.

Since rank 1 is assigned to Type B in 30% of the cases, many users want immediately a detailed description of the problem in this scenario. Type B is not the best visualization, since the ranks are polarized (31% of assignments for rank 4).

47% of the participants' assigned rank 4 for Type A, thus this solution is unsuitable for this scenario.

6.2.2 Scenario: Insert a new photo to MMS

Since pairwise comparison between all help types is significant, Type C can fully be recommended as most suitable solution. This user preference for this scenario is obvious.

Since rank 4 is assigned to Type B in 59% of the cases, many users do not want immediate and detailed description of the problem in this scenario.

The general preference for a help type, that disappears by itself is confirmed by the assignments for Type A (35% rank 1).

6.3 Approach of study

Since the study was conducted as an online survey a higher probability of sample based bias cannot be excluded.

A weakness of the study approach is that users have to conceive described usage problems. To control the external validity of the results the evaluation of help formats in 'real life context' should be conducted: Different results on the preferences may result, when user experience real usage problems. Additionally, factors like 'variation of preferences over time' and 'relevance of (additional) audio or tactile information', when the users' attention is not on his mobile device, are to be expected.

For this, the setup of an online study does limit the generality of the results, but it is uncommon to use an 'artificial' context as a preliminary source of insights.

7. CONCLUSIONS AND OUTLOOK

Whether an overall pragmatic compromise can be seen for a short textual hint, which does not disturb on task continuity and task completion (Type C) is to be doubted: It does not fit critical situations. Users expect the system to interrupt their current activities if a usage problem may end in serious consequences. Ideally users do not run into such situations, since help types ideally should be presented on demand for on task situations (which are not critical), or the user should get information about the relevance / criticality of the occurring problem.

As a result for the investigated target group neither specific needs are not relevant for the design nor a 'one fits all' solution exists – the only factor that has to be considered is the perceived criticality (Chi square (4, 139)=311.4, $p<0.01$).

Future investigation is motivated by the result that criticality is so fundamental for the users' acceptance of help designs:

- on factors contributing to criticality complex – and criticality classes,
- on design approaches to visualize the factor criticality and its relevance,
- on qualitative and unique categorizations of errors (e.g. cost, data loss, etc.) to allow more generic approaches for interaction design.

Consequently, the long term goal is not only to understand the user preferences on help types, but to develop methods that enable a system to detect the perceived criticality of usage problems taking account users goals.

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