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▶ **To cite this version:**

Nicole Ke Cheng Pong. Understanding and Increasing Users' Interaction Vocabulary. 29ème conférence francophone sur l'Interaction Homme-Machine, AFIHM, Aug 2017, Poitiers, France. 4 p. hal-01577901

HAL Id: hal-01577901
https://hal.science/hal-01577901

Submitted on 28 Aug 2017

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Understanding and Increasing Users' Interaction Vocabulary

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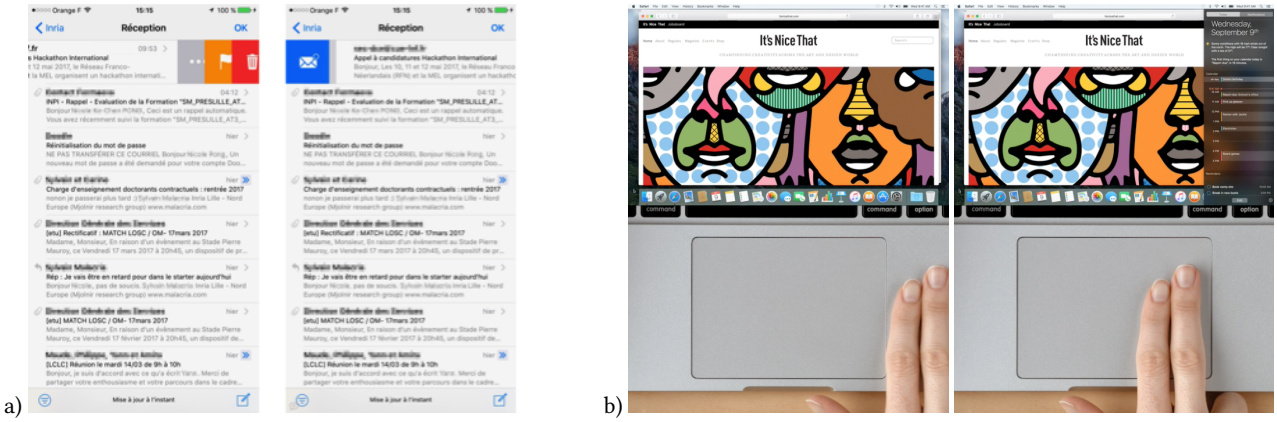

Figure 1: Hidden controls. a) Performing an horizontal swipe gesture from the edge of the display in iOS Mail reveals hidden buttons. b) Under macOS X, a two-finger leftward swipe gesture from the right edge of the touchpad reveals the "Notification center", a hidden information panel disclosed from the right side of the screen.

ABSTRACT

This paper describes my PhD topic which is focused on the design of tools, environments and interaction techniques that help users increasing their interaction vocabulary. I define users' vocabulary as the degree of knowledge of all the possible functions and modalities a user can use to interact with a computing system. I introduce my first project which is about *hidden buttons*. This project aims at identifying the benefits and drawbacks of hidden buttons, defining a design space, and proposing different design ideas to implicitly and explicitly incite users to discover hidden controls.

CCS CONCEPTS

• **Human-centered computing** → **Human computer interaction (HCI)**; **Graphical user interfaces**;

KEYWORDS

Interaction vocabulary, awareness, user expertise, hidden buttons

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IHM '17 , August 28–September 1, 2017, Poitiers, France

RÉSUMÉ

Ma thèse concerne la conception d'outils, d'environnements et de techniques d'interaction aidant les utilisateurs à développer leur *vocabulaire d'interaction*, défini comme le niveau de connaissance de l'ensemble des fonctions et modalités qu'une personne peut utiliser pour interagir avec un système informatique. Je présente également un premier projet concernant les *boutons cachés*, dont le but est d'identifier les avantages et inconvénients de ces boutons, de définir un espace de conception, et de proposer différentes idées visant à permettre aux utilisateurs de découvrir les boutons cachés de manière implicite ou explicite.

MOTS-CLEFS

Vocabulaire interactionnel, expertise utilisateur, boutons cachés

1 INTRODUCTION : INTERACTION VOCABULARY AND AWARENESS

The design of user interfaces has once suffered from the idea that to make users more powerful, one just had to put more features in the system. It is known however that users only know and use a small subset of the system functionalities and interaction modalities [8] – subset that we call the user's *interaction vocabulary*. Interaction Design thus now aims at empowering users by allowing them to better exploit their own limited skills [9]. My PhD is about one aspect of this concern that has become an important topic of study in HCI : the design of tools, environments and interaction techniques that help users increasing their interaction vocabulary.

While most studies on this topic have approached the problem as a learning/teaching problem [7], my background in videogame design suggest a different perspective to me, which is a guidance problem : how can we put users on the path that will lead them to new discoveries ?

I first address one aspect of this question, which is the increase of users' awareness of the system's features. Low levels of awareness to system's features is often understood as a lack of affordance or feed-forward [19], although I would argue that there are other means to create awareness.

The lack of such awareness is a problem affecting all platforms. A well-known manifestation of this problem is the need to explore the user interface when system functionality is not directly exposed : desktop computers hide plenty of commands in hierarchical menus [4, 8, 10] and mobile devices hide settings in hierarchical organizations that users do not know unless they browsed it[13]. Another aspect of this problem is the lack of discoverability of some input mechanisms : desktop computers provide multiple input modalities to trigger the same command [7, 10, 11], and mobile devices may rely on force- or gesture-based inputs that users need first to discover in other tu use afterwards.

The problem is particularly sensible on handheld devices with limited screen real estate, as they do not reuse solutions designed for the desktop such as drop-down menus. As a consequence, mobile devices introduced new types of interactions to the customers – such as "simple" gestures – and benefited from the development of new interaction techniques like bezel slides, for instance to display the Control Center on iOS [2]. And the desktop interface which has been relying for decades on hierarchical menus is now also adopting some of these new techniques (see Figure 1, right).

These new techniques often increase users' performance (e.g., [1]), assuming that users are aware of and know how to use them. I therefore postulate that these techniques still provide a net benefit if we consider the awareness-performance trade-off. Existing systems, and especially mobile ones, have thus many efficient features that might not be used because users are simply not aware of their existence. During my PhD, I investigate means to rise the level of awareness of these techniques while preserving their high level of performance.

2 BACKGROUND AND RELATED WORK

Interaction vocabulary is usually defined as the degree of knowledge and use of the range of functions available in an interface [7, 11] functions implicitly referring to available commands. While focused on functions, Cockburn et al. acknowledge in [7] that the conceptual deterrents and barriers to vocabulary extension are similar to those described for intermodal improvement in the fact that users need to be aware of them before to use them. For this reason, we extend the definition of vocabulary extension by combining Cockburn et al.'s definition with the awareness of alternative modalities available to the user to perform a single action. In short, in the context of this PhD, users' vocabulary refers to user's degree of knowledge of all the possible functions and modalities he or she can use with an interactive system.

Previous research on interaction vocabularies has first described issues with interaction vocabularies and the difficulties of extending one. These works often build on Norman's concepts of mental models, gulf of evaluation, and gulf of execution – as with Rasmussen's focus on skills, rules, and knowledge [18]. These cognitive models allow discussing users' expertise level in the use of some tool, but often ignore the situated nature of interaction : users apply different interaction patterns according to the context of use, and different users work differently. As a result, no single interaction technique works best in all contexts, and interaction vocabularies should be studied as coherent wholes rather than as isolated interactions [6].

Cockburn et al. studied the factors affecting users' transition from novice to expert, including awareness of system's features [7]. Despite being restricted to *awareness mechanisms* that designers can use to help or force users into learning new interaction modalities, their study expose a variety of approaches from forcing techniques use, to the display of more subtle hints.

Historically, several methods have been explored in computing systems in order to increases users' awareness of the other existing functions. The most common method is probably the use of a *Tip-of-the-day* window that pops up when the application launch or while it is busy loading assets (the later being very common in video games). These methods, however, often suffer from being used at inappropriate times : when the user's attention is not available, or when the user lack some knowledge to interpret the tip.

Researchers have also explored social-based methods in an attempt to increase users' awareness of existing modalities [11] or functions [12, 13]. These methods capitalize on the fact that users' reflexion on his own activity can be fostered by showing the activity of other users.

The approach I follow in this PhD is to non-intrusively lead users to experience situations where they get a chance to discover new interface features and to update their expectations about the interface. To do so, I draw connections between interaction design and game design, from getting inspiration from the practice of level design to the direct use of game mechanics in non-ludic applications.

3 RESEARCH SITUATION

I am currently in my first year of PhD at Inria-Nord-Europe. My personal background is however not in computer science as I have professional experience in screen writing, video game design (including teaching [15]), and gamification. The later bring me to HCI via the experimental design and evaluation of an instant messaging system aiming at rising chatters' awareness of the emotional ambiance of the conversation, with visualization techniques and game-inspired mechanisms [16, 17].

This background made me value the importance of observing how users (or players) acquire their knowledge and the way they progress and improve their skills from novice to expert level. As a first step in this direction, I address the problem introduced by a recent trend on mobile phones, tablets, and laptops, which consists in the spread of a category of widgets that I call *hidden buttons*.

4 TREASURE HUNTING THE HIDDEN BUTTONS

The first project of my PhD is focused on the problem of hidden buttons on touch based interfaces. Smartphones and tablets

have limited screen real estate and as a result, more and more commands are provided via command panels that users can query by performing a specific gesture. A similar gesture can sometime be performed on a domain object, revealing some buttons that can be used to trigger commands on this domain object. However, these panels and buttons are barely suggested to the user.

As an example, the hidden buttons in iOS Mail application (Figure 1, left) provide a fast way to do the most common mail manipulations. The non-hidden widgets in Mail require more steps than the hidden buttons for the same task : they either require to enter a mail selection mode, select the relevant mails, choose an operation, and eventually an argument to the operation such as a destination folder ; or users can enter the single mail view for each mail, and use the menu revealed by hard-pressing an icon.

There is thus a clear benefit for users to be aware of these hidden controls. Unfortunately, these controls are hidden "under the bezels" and provide no visual cue to teach users about these features. To be aware of the existence of these controls, users need to be preliminarily introduced to them by external sources such as friends, the help application or the media.

The goal of this project is to better understand when and how hidden buttons are used, what are their drawbacks and benefits, and how they could be improved. I therefore adopt a methodology based on three mutually informing components : a study of hidden buttons usage, a design space, and a set of alternative designs.

4.1 Investigating the Use of Hidden Buttons

A study of hidden buttons usage is under development, which will investigate users' awareness of and expectations about hidden buttons, as well as what hidden buttons are used for and in what situations. The methodology will be based on semi-structured interviews with iOS and Android users, with light tasks to complete during the interview (e.g. asking what time they received an SMS sent to them before).

4.2 Design Space of Hidden Buttons

To use hidden buttons, one need to know about them. But since this knowledge is not provided in the use context where it is needed, it has to be communicated to the users by other means. I thus investigate four dimensions characterizing this communication of knowledge.

1. Distance between the source of knowledge and its use. Distance is a continuum between two extremes, which are epitomized by classical widgets providing affordances and feed-forward for the smallest distances, and hidden buttons for the greatest distances — although knowledge about both types of widgets can also be communicated with intermediary distances. A simple categorization of distances consider whether the source of information is the widget or domain object itself, the application, the operating system, or the outside world (mass media or word of mouth). But it is also important to consider temporal aspects, as the source can provide explicit knowledge permanently, suggest hints close to the time knowledge is needed, provide knowledge on demand with or without interrupting the users' task, or can even only provide the knowledge during random encounters.

2. Completeness of the information provided : there is a continuum between no information provided and a complete knowledge of the hidden buttons : where and when they are present ; the number, type, or identity of the commands they provide ; how to reveal the set of commands or trigger each command, etc.

3. Steps in the communication of the knowledge. The design of hidden buttons can combine multiple types of interactions, with some requiring the prior knowledge of others. For instance, the expert mode of hidden buttons un Mail.app builds on knowledge of the novice mode.

4. Semiotics. The information provided can stand by itself or require further external knowledge to be interpreted. In Peircean semiotics, symbols require prior external knowledge, but icons (in which I include metaphors) rely on similarity with what they stand for, hopefully already known. Indexes only require to understand the contextual contiguity between them and what they represent, which often only requires general knowledge like naive physics.

In addition to the means of conveying knowledge to the users, I also consider **dimensions describing the interaction** with the hidden buttons. For instance, Pillias et al. discuss how exploration of the interface is affected by how the system interprets user actions as commands — what they call the *interaction style* [14].

4.3 Alternative Designs

Figures 2 and 3 illustrate several alternative designs of hidden buttons inspired by the iOS Mail application. Designs 1 to 4 add small graphical details to the original design of hidden buttons, to get a much smaller **knowledge distance**. They differ in the **completeness of information** they provide : Design 1 only informs with generic **icons** that there are hidden buttons on the item, while designs 2, 3 and 4 additionally suggest what action will reveal them, using **physical metaphors** (2 : sliding plate with semi-elliptical cut-outs, 3 : origami-style folded paper, 4 : paper flap). Design 2 also shows the number of commands on each side of the item, using digits (which are symbols).

Designs 5 and 6 rely on an external source of knowledge but focus on facilitating the **transition from novice to expert** by replacing buttons with **gestures**, which are identical in both modes. Design 5 is inspired by OctoPocus [5] : a long touch on the screen's edge triggers the display of horizontal lines ending with command

Figure 2: Alternative designs 1-4 (top-bottom) and 6 (right).

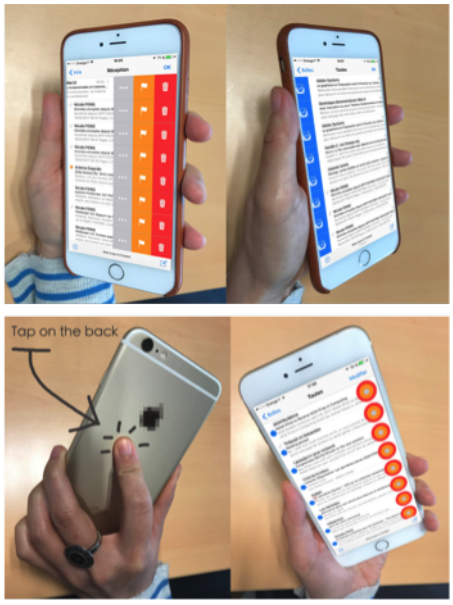

Figure 3: Alternative designs 7 (top) and 8 (bottom).

icons. The line lengths are iconic representations of the amplitude of the swipe gestures that users should perform to trigger the corresponding command. Design 6 was inspired by Flower Menus [3] and is triggered like design 5 but uses more differentiated, non-horizontal gestures.

Designs 7 and 8 (Figure 3) explore the possibility offered by intermediate **knowledge distances**. Design 7 exploits the fact that users often tilt unconsciously the smartphone, to give them a chance to learn about the hidden buttons. A gravity-based **physical metaphor** makes domain objects behave as plates that slide to the left or right when users tilt the device, which reveals commands hidden under them. Design 8 is inspired by a daily life behavior : when we tap nervously with our fingers on the table or on the object held, our brain trying to catch up with some idea. This behavior is turned into a system-defined **gesture** so that taping on the back of the smartphone pops up round figures that reveal the hidden options. Because of the nature of this gesture, it can be either triggered by chance or voluntarily.

5 PERSPECTIVES

My immediate perspective is to implement and evaluate the alternative designs in controlled experiments.

The alternative design 7 builds on an idea inspired by game design practice, which I then plan to explore as a short term perspective : the idea that widgets not only react directly to the user's input, but also have their own behavior induced by the environment in which they are embedded (here, a physical behavior). Because this behavior is observable by the user, it can inform her about how to use the widget and what to use it for.

On longer term, I would like to address other aspects of interaction vocabulary extension than awareness. For instance, the problem of the "performance dip" [7] also exists in video game design, where a few solutions have been devised. Adapting these solutions to the design of widgets and interaction techniques is a research direction that I plan to investigate.

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