UNDERSTANDING THE USABILITY CONSTRUCT:
USER-PERCEIVED USBILITY

Mick McGee, Ph.D.
Oracle Corporation
Redwood Shores, CA, USA

Aaron Rich
Oracle Corporation
Redwood Shores, CA, USA

Joe Dumas, Ph.D.
Oracle Corporation
Burlington, MA, USA

The usability profession has seen success in industry and academia, as well as recognition in the popular press. However, inconsistent measurement, unreliable problem identification, inappropriate high-level goals, and a lack of valid metrics highlight recent usability literature. Rather than support or refute these findings, we offer a research introspection that we hope contributes to all of these issues by improving our basic understanding of the construct of usability. A Usability Concept Survey (UCS) containing 64 potential usability characteristics was created and administered to 46 users who rated how integral each characteristic was to usability. Multivariate analyses of these user perceptions were used to construct: 1) a taxonomy of usability to classify usability characteristics, 2) data-driven general dimensions of usability, 3) a map of usability space showing specific usability characteristics within the general dimensions; and, 4) a definition of usability. We believe this better understanding of the construct of usability can contribute directly to improving usability objectives, measures, and practice.

INTRODUCTION

The usability profession has matured, to a point. We are well publicized (e.g., Oreskovic, 2002), solidly integrated within Fortune 500 companies, and have many vibrant academic programs. However, recent literature suggests there are some weaknesses in our profession that call for at least an evolutionary improvement, if not revolutionary.

Lund (1998), in a call for standardized usability metrics, states that valid and useful usability metrics currently do not exist. Hertzum and Jacobsen (2001) showed that the reliability of problem identification among usability specialists is much less than expected. Wixon (2003) questions the objective of most usability studies (and usability literature) in propagating only problem identification instead of the real need, problem solutions. Frøkjær, Hertzum, and Hornbæk (2000) found in a review of 19 usability-related papers that measures for efficiency, effectiveness, and satisfaction (when two or more were collected) had weak to no correlation.

To us, this collection of questioning literature was evidence that our burgeoning profession was maturing through introspection. To contribute to this increased sense of perspective, we sought through research to more fully understand the construct of usability. An initial review of current definitions (ISO, 1998; Nielsen, 1993) found broad and non data-driven depictions; with little input from users. Thus, the underlying research goal of this project became:

To better understand the construct of usability, from the users' perspective.

With specific objectives:

- Define a taxonomy of usability to classify usability characteristics;

- Define data-driven general dimensions of usability;

- Map specific usability characteristics within the usability space defined by the general dimensions; and,

- Construct a definition of usability, all from the user's perspective.

METHOD

The Usability Concept Survey (UCS) was administered to 46 users at the beginning of five separate usability activities (Business Intelligence (BI) and workplace collaboration browser applications on the desktop and mobile devices -- current BI users and general office computer users). The survey was comprised of potential usability characteristics compiled from existing definitions (ISO, 1998; Nielsen, 1993)], traditional usability literature (Dumas and Redish, 1999), and new theories on usability (Karat, 2003). Users were instructed to rate on a 1-7 scale how integral (using anchors Very Integral and Not Very Integral) each characteristic was to their concept of usability.

RESULTS

We performed a hierarchical cluster analysis to organize the usability characteristics into a classification structure. Figure 1 shows the resultant dendrogram linking all the characteristics, with the distance to 'integrally' link related characteristics across the top and the characteristics themselves along the left. The banded gray boxes are subjective empirical distinctions: linkage distance 1 to 3 forms group one; 4 to 6, group two; 7 to 9, group three; 10 to 14, group four; and, 15 to 25, group five; with corresponding overarching labels of Usability and Not Usability.

We conducted factor analyses to explore relationships among the characteristics and create meaningful dimensions.

Preliminary analysis led to an interpretable varimax rotation with three components. Figure 2 shows a 2-dimensional continuum (the non-impact third factor will not be discussed further) of combined factors mapping the individual characteristics. The gray shapes in Figure 2 represent subjective areas of interest formed by proximity and insight from the cluster analysis.

DISCUSSION

Taxonomy of Usability

The interpretation of the cluster analysis, based on expert knowledge, provides the basis for a taxonomy of usability. Prior to the main division in Figure 1, between groups three and four, most of the characteristics are relatively closely linked (discounting Friendly which had mixed interpretations between 'user' friendly and 'social' friendly). This density and division clearly delineate characteristics that are highly integral to usability, and those that are not -- which we labeled Usability and Not Usability; with corresponding hierarchy names, based on the groupings:

Usability
1. Core Usability (Strategic)
2. Secondary Usability (Tactical)
3. Tertiary Usability (General Qualities)

Not Usability
4. Satisfaction Qualities
5. Style Qualities & Other Constructs

Usability. Core Usability is comprised of the top 12 characteristics of the dendrogram (within 1 to 3 linkage distance). A vertical slice bisect at the 2.5 linkage distance results in three clear subgroups, named (with representative subgroup terms):

Core Usability
o   Consistent and efficient
o   Organized
o   Easy and intuitive

The Core Usability characteristics are the most important qualities associated with usability as perceived by users. Optimizing them should be a primary concern whenever perceived usability is a focus.

Secondary Usability contains all characteristics joining the main cluster within 4 to 6 linkage distance. With a bisect at 4.5, five subgroups can be defined:

Secondary Usability
o   Effective
o   Familiar
o   Controllable
o   Complete and beneficial
o   Useful

The Secondary Usability characteristics seem to be elements related to accomplishing tasks (e.g., Effective, Beneficial for problem solving, Helpful, Useful). Whereas Core Usability is more strategic in nature, accomplishing a task is more tactical. In agreement with other descriptions of usability, accomplishing a task is a key, defining component of a system concerned with usability.

Tertiary Usability contains all items joining the main cluster within 7 to 9 linkage distance. With a bisect at 7.5, there are four subgroups:

Tertiary Usability
o   Expected
o   Natural
o   Worthwhile and flexible
o   (Friendly)

Tertiary Usability characteristics seem generally related to general overall qualities (e.g., Natural, Ideal, Worthwhile, Good). These characteristics are more vague than previous characteristics, providing evidence that explicit association with integral usability components is decreasing at this stage of the cluster analysis.

Not Usability. Satisfaction Qualities begins the Not Usability category, joining the main cluster at the 14th linkage distance. Using a bisect at 8.5, six subgroups are apparent:

Satisfaction Qualities
o   Important
o   Valuable
o   Safe
o   Satisfaction
o   Marketable
o   Adequate

The dominant trait among this group is the large conglomeration of characteristics associated with satisfaction (e.g., Engaging, Satisfying, Appealing, Interesting, Attractive, Enjoyable, Pleasant, Likable, Desirable). These Satisfaction Qualities, by their position in the cluster, are moderately related to usability. However, the degree of separation indicates they are not perceived as integral to usability by users, and thus are not included in the Usability category. Based on these results, we suggest usability specialists take care in over-emphasizing satisfaction-based metrics when evaluating products for usability. Users apparently do not see the two as closely related.

Style Qualities and Other Constructs comprise those characteristics rated furthest from usability, joining at the 25th linkage distance. The bisect at 10.5 appears to still have meaning, despite its distance and linkage of disparate terms, creating five subgroups.

Style Qualities and Other Constructs
o   Style

    o   Different
    o   Well known
    o   Profitable
    o   Beneficial to quality of life

Interpretation becomes more difficult with these characteristics. However, the common thread appears to be elements of what is typically referred to as brand; i.e., a company or product image and philosophy. Brand is a highly sought after business commodity that appears to have little to do with usability to the user.

Quality and Usability Space

The Quality Space created by the "map" of all characteristics, shown in Figure 2, provides more depth to the discussion of usability dimensions. Areas 1 through 6 are comprised of the characteristics classified as Usability, clearly separate from the Not Usability characteristics, primarily in areas 7 and 8.

Overall, there is a polar relationship between the Core Usability characteristics and the Not Usability characteristics. Dimension one is dominated by a difference between several Core Usability characteristics (area 2) and productivity-oriented characteristics (area 4) versus Satisfaction Qualities (area 7). Dimension two shows a contrast between additional Core Usability characteristics (area 1) versus characteristics associated with branding (area 8).

Other apparent distinctions include: 'Strategic' versus 'Tactical' task completion; i.e., planning versus executing tasks (areas 4 and 6 respectively); and, business-oriented terms (e.g., Profitable) versus Core Usability characteristics, suggesting a disconnect between product success and usability (in contrast to a close relationship with brand and satisfaction). The second distinction seems to contradict a typical argument for the importance of usability.

Removing the Not Usability characteristics, resulting in 'Usability Space', slightly shifts the factor analysis dimensions, shown in Figure 3. In this arrangement dimensional relationships between 'Complexity' and 'Familiarity' become apparent. For 'Complexity': Easy to use, Predictable, Easy to learn, and Intuitive appear opposite Useful, Informative, Beneficial for problem solving, and Customizable. For 'Familiarity': Familiar, Understandable, Easy to use, and Natural appear opposite Beneficial for problem solving, Helpful, Complete, and Useful.

IMPLICATIONS

The usability taxonomy and corresponding Quality and Usability Spaces enhance our overall understanding of the construct of usability. Practical implications include: 1) modifying overall goals of usability activities to more closely align with user-perceived usability concerns, 2) developing usability metrics that more accurately and thoroughly capture usability by considering all of the relevant dimensions, but not the unrelated characteristics, 3) creating representative, data-driven definitions of usability, 4) providing a "map" to classify and interrelate usability problems, leading to more informed and specific heuristic evaluations; and, 5) using the taxonomy and maps to judge problem severity. Most of these goals are beyond the scope of this paper; however, the results set the foundation.

Definition of Usability

One impact outcome that is immediately manageable is the development of a generalized, user-perceived definition of usability. First, the essential elements are clearly contained in the Core Usability classification of the taxonomy. A bisect in this group at the 1.5 linkage distance of the dendrogram shows seven subgroups with representative terms from each area of Usability Space. Next, the cluster and factor analyses indicated an underlying influence of task (Strategic and Tactical task completion). Lastly, we specifically designed the UCS to be software domain agnostic; therefore, the definition can be generalized. Thus, the user-defined definition of usability is,

Usability is your perception of how consistent, efficient, productive, organized, easy to use, intuitive, and straightforward it is to accomplish tasks within a system.

FUTURE WORK

Extensions to this work could: 1) expand the UCS terms beyond usability into overall quality and business characteristics, 2) compare user perceptions with user experience (i.e., use the UCS as a measuring tool), 3) map corresponding performance data onto the 'experience' usability space, 4) compare these user-perceived results with usability specialist responses; and, 5) use the data to develop new usability metrics and improve current usability methodologies.

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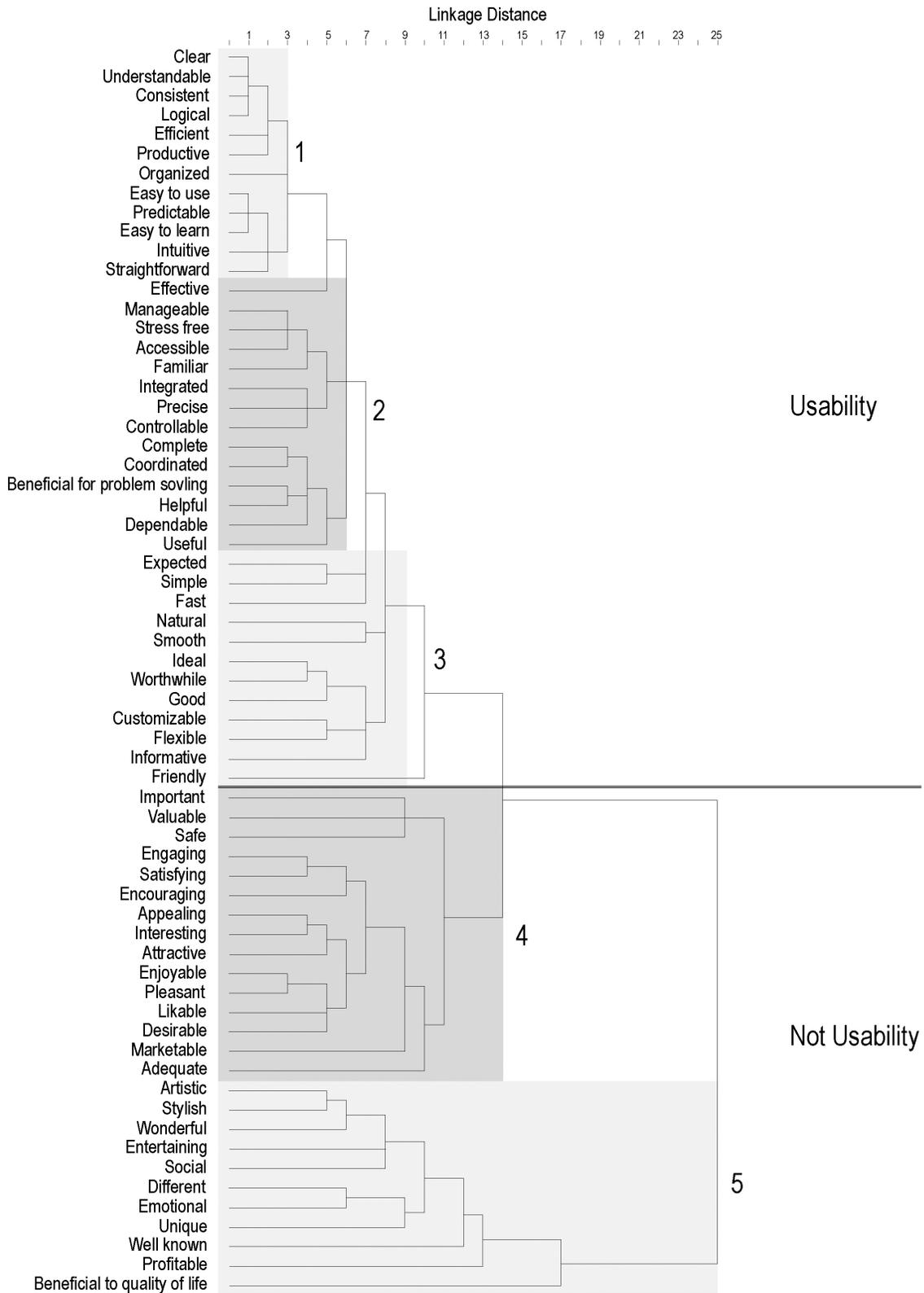
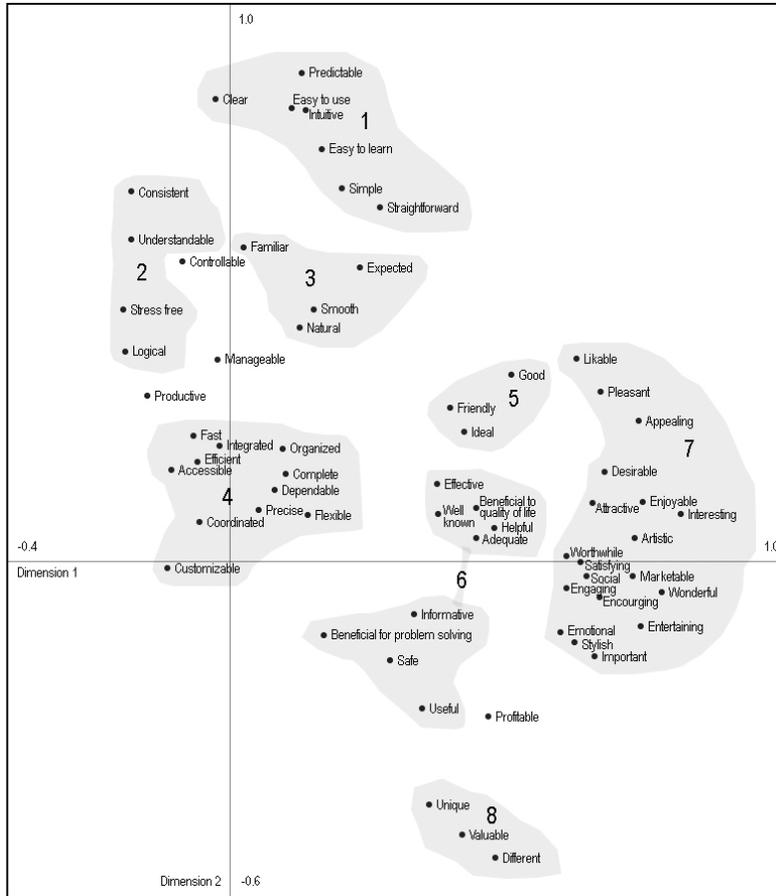Figure 1. Cluster analysis dendrogram.

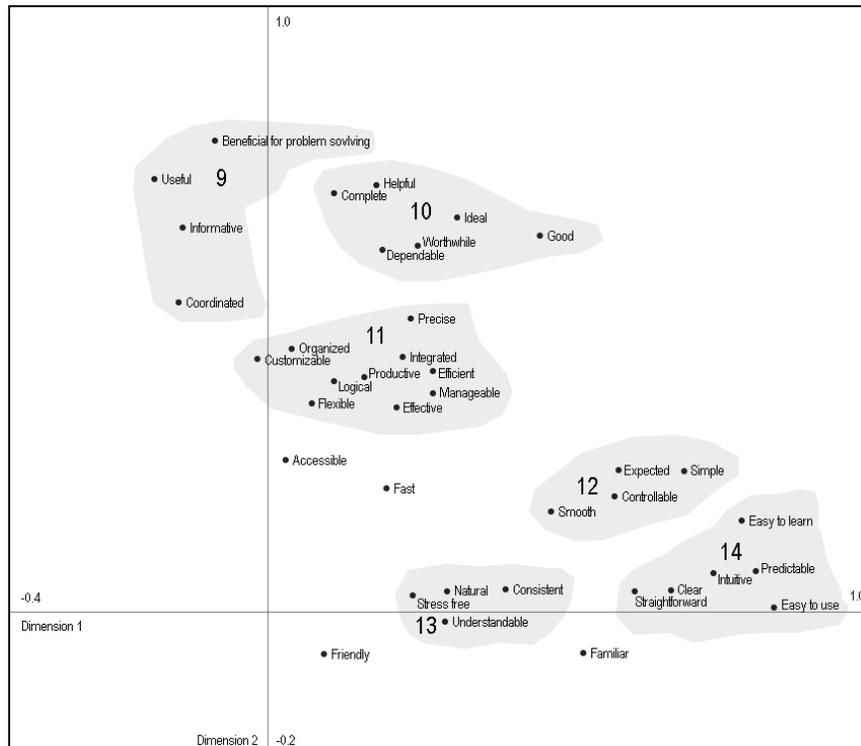Figure 2. Plot of dimensions 1 & 2 from factor analysis on all survey characteristics, defining 'Quality Space'.

Figure 3. Plot of dimensions 1 & 2 from factor analysis limited to Usability classified characteristics, defining 'Usability Space'.