

Assessing Conceptualizations of User Friendliness for Consumer Products

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This study examines the conceptualizations of the user-friendliness of technology-based consumer products. Participants (n=205) were asked to evaluate 25 statements related to the topic of user-friendliness. Participants' ratings indicated that statements concerning positive productivity levels and reliable displays (e.g. "I quickly learned how to use this product" or "I can find information quickly within the display") received the highest ratings of user friendliness. Low user-friendliness was associated with systems deemed as complex or with longer durations of product adaptation and learning (e.g. "This product prevents me from choosing what I would like to do" or "I really have to concentrate to use this product"). A factor analysis of the data suggested four dimensions of user-friendliness: *ease-of-use*, *delight*, *reliability* and *feedback*. Design implications and possible human factors' interventions for consumer products are discussed.

INTRODUCTION

The relationship between perceived usability and technology acceptance by the end user has been an interest to researchers in design, engineering, psychology and marketing. However, interface designers may have different perceptions of usability than end-users. Despite a large body of existing literature in the general area of usability, reasons why end-users perceive technology as user-friendly is not well-researched. Perceived usability is difficult to study because it is a psychological construct (Cronbach & Meehl, 1955); it cannot be measured directly, but rather by indirect indications through multiple types of measures (e.g., speed and accuracy among many others such as learning and fatigue). Thus, psychological constructs are typically measured indirectly through an aggregation of multiple measures of related phenomenon. Technology variables that are important for acceptance are typically measured in terms of how they are perceived by potential users (Caine et al. 2006). For example, usability may be efficiency and satisfaction to one person but may be aesthetics and effectiveness to another. Kuniavsky (2003) defines a consumer product as "usable" if it is functional, efficient and desirable. These differing conceptualizations may be influenced by numerous variables such as performance, durability, fit and finish, and reliability (Maeyer & Estelami, 2011). To assess the meaning of the construct, different beliefs about it can be measured and if they are highly related could be combined. Moreover, different or distinctive beliefs about the construct can also be potentially distinguished.

The importance of examining product technology acceptance could determine what aspects of a product result in emotional attraction as well as positive and negative connotations of a product (Rouse & Morris,

1986). For example, Norman (2002) noted that designers should look for aspects of products that could cause users to feel threatened, overwhelmed or high levels of anxiety (Norman, 2002). Additionally, evaluations can also include determining which aspects of a product promote the desire for continued use.

To date, considerable research has been conducted examining factors that influence product usability, using tests and measures of usability (e.g., Lund, 1998; McGee, Rich & Dumas, 2004). Studies have included performance and subjective ratings of consumer products performed by people of different demographic backgrounds (e.g., novices versus experts) on intention-based acceptance relating to technology-based product usage. Caine et al. (2006) describes a heuristic tool for evaluating acceptance variables of high-technology products using guidelines derived from published research literature. Variables such as perceived usefulness, ease of use, complexity, consistency of product experience, and relative advantage were identified (Caine et al., 2006). Babutsidze (2011) found two underlying skill-acquisition characteristics for every product; quality and user-friendliness. Babutsidze (2011) concluded that user-friendliness controls the speed of skill acquisition through learning. Using a questionnaire evaluation, Rushinek and Rushinek (1986) noted that quicker response time and shorter learning duration were important to user satisfaction. Moreover, McGee et al., (2004) suggest that qualities of satisfaction may be moderately related to "traits" of usability.

In studies examining usability factors influencing system friendliness and technology adoption for older adults, variables dealing with familiarity and simplicity of use appear to be important. Older adults tend to adopt a technology if they find it useful and if they perceive the end experience as valuable and beneficial (also see

Hawthorne, 2011). In comparison to older adults, younger users showed lower levels of anxiety and positive attitudes towards technology-based devices (Czaja & Sharit, 1998; Chou & Hsiao, 2011). Despite the large and growing literature on usability, McGee et al. (2004) points out that research on the topic have used varied measurement techniques. Despite this difficulty, the findings are largely consistent.

These and other research studies suggest that it would be useful to investigate the potential characteristics of the user friendliness concept held in the minds of consumer product users. The purposes of the present research are three-fold. One is to identify characteristics that comprise user friendliness by having participants rate a set of descriptive statements using a scale assessing how well the statements represent the concept of user-friendliness with respect to consumer products. The second purpose was to determine if there was a difference in user-friendliness beliefs depending on whether they were younger (mostly college students) or somewhat older non-student adults. A third purpose was to determine if user-friendliness is a unitary dimension or a multidimensional concept according to analyses of participants' ratings of statements.

METHOD

Participants

For this study a total of 205 individuals ranging from age 18 to 73 years participated; 102 male and 103 female with a mean age of 23.4 years (*S.D.* = 9.08 years). This sample included North Carolina State University undergraduate students and a group of non-students. Of the 170 (83%) student participants, 85 were male, 85 were female and the mean age was 20.7 years (*S.D.* = 5.14 years). Thirty-five (17%) non-student adults from the surrounding Raleigh, North Carolina area participated. Seventeen were male and 18 were female; their mean age was 36.6 years (*S.D.* = 12.8).

Materials and Procedure

Participants were asked to complete a questionnaire with three sections: demographics (e.g., gender and age), the extent of their computer usage, and ratings about user friendliness with respect to a set of statements.

Following completion of the demographic section of the questionnaire, participants were asked to provide a self-assessment of weekly hours spent using technology-based consumer products. Participants were then presented with 25 statements describing potential reasons why they might determine whether a technology-based consumer product may be perceived as user-friendly. In considering the user-friendliness concept they were asked to think of a variety of products

and tasks they might perform with them, including a clock radio, email account, oven or stove, cellular phone, computer programs, laptop computer, vacuum cleaner and a coffee pot. The statements were derived from previous research and input from members of a human factors laboratory at North Carolina State University.

Statements were randomized to comprise two forms of the questionnaire. Approximately half of the participants had one random order and the other half of participants had the reverse order. These statements are listed in **Table 1** (ordered according to mean ratings). Participants were asked to evaluate each statement relating to consumer technology-based products and rate the level to which each statement may or may not represent user-friendliness. A 9-point unipolar scale from 0 to 8 was provided with the even-numbered anchors labeled as: (0) not at all represents user-friendliness; (2) somewhat represents user-friendliness; (4) represents user-friendliness; (6) represents user-friendliness very well; and (8) represent user-friendliness extremely well.

After completing this questionnaire, participants were thanked for their assistance in this study.

RESULTS

Data Analysis

On average, participants rated all of the items as falling between the rating anchors of (4) represents user-friendliness and (6) represents user-friendliness very well (*M* = 5.18, *S.D.* = 0.3). **Table 1** shows mean ratings with standard deviation listed in descending mean order. The specific statements used are provided in the table while the text refers to both the corresponding letter label in the table. A somewhat shortened version of the statements is given in the text.

It is instructive to note that 9 of the 25 items were found to have high mean ratings that fell between ratings 6 and 8 (i.e., representing user-friendliness very well or extremely well on the rating scale). These were: (a) quickly learned; (b) can find information quickly; (c) easy to remember; (d) product offers help; (e) get out of my mistake (without further error); (f) can get things done quickly; (g) can quickly tell mode; (h) reliably responds as expected; and (i) works consistently).

It is also instructive to note which statements were rated low on the rating scale. For example, two statements had means that fell between 0 and 2 (i.e., representing user-friendliness somewhat or not at all on the rating scale). These statements were: (y) product prevents desired use (*M* = 1.24) and (x) product requires much concentration (*M* = 1.81).

Table 1
Average (Mean and Standard Deviation) Ratings of Statements Concerning User-Friendliness of Consumer Products in Descending Order

	Statement	M (SD)
(a)	I quickly learned how to use the product.	6.69 (1.6)
(b)	I can find information quickly within the display.	6.60 (1.4)
(c)	It is easy to remember how to operate this product.	6.51 (1.6)
(d)	The product offers me help (either through written manuals or electronic help menus) if I do not know how to use something.	6.48 (1.6)
(e)	If I mistakenly choose the wrong option, then the product will allow me to get out of my mistake (without further error).	6.36 (1.7)
(f)	I can get things done quickly when I use the product.	6.22 (1.7)
(g)	If the product has a display, I can quickly tell what mode I am in.	6.23 (1.5)
(h)	If I push a button, it reliably responds as expected every time.	6.10 (1.5)
(i)	Every time I turn the product on, it works fine.	6.04 (2.2)
(j)	The product does not break or shut down unexpectedly.	5.94 (2.2)
(k)	I make less mistakes when using this product compared to other similar products.	5.88 (1.9)
(l)	I can achieve excellent performance using the product.	5.85 (2.2)
(m)	The product is well designed.	5.79 (2.0)
(n)	If I accidentally choose the wrong option, then it will warn me about it.	5.61 (1.8)
(o)	It is safe to use	5.43 (2.3)
(p)	I know how to use the product's display most of the time.	5.40 (1.8)
(q)	I really enjoy using the product.	5.19 (2.2)
(r)	The product behaves in a similar manner to other products I have used in the past.	4.57 (2.2)
(s)	The product controls what I can do next and most of the time it does what I expected it to do.	4.51 (2.1)
(t)	I get a sense of accomplishment when I use this product.	4.18 (2.3)
(u)	When I use the product, I am really engaged with the product. I am not aware of my surroundings and time passes very quickly while using the product.	3.77 (2.3)
(v)	The product is attractive.	3.49 (2.4)
(w)	There are more features available than the ones I use consistently.	3.47 (2.0)
(x)	I really have to concentrate a lot when I use the product.	1.81 (1.9)
(y)	The product prevents me from choosing what I would like to do.	1.24 (1.9)

Younger vs. Older Adults

For analysis of age group, a median split at 20.5 years was used to divide the sample roughly in half into younger and older age groups. Most participants of the younger age group were college students. Five statements showed significant difference as a function of age group ($p < .05$). In all cases the younger group rated

the statements higher than the older group. The younger age group ($M = 6.149, S.D. = 1.5$) rated statement (k) "less mistakes" significantly higher than the older age group ($M = 5.63, S.D. = 2.1$). The younger group ($M = 4.04, S.D. = 1.9$) rated statement (w) "more features than used" significantly higher than the older age group ($M = 2.91, S.D. = 2$). The younger group ($M = 4.05, S.D. = 2.3$) rated statement (v) "product is attractive" significantly higher than the older group ($M = 2.94, S.D. = 2.3$). The younger group ($M = 4.34, S.D. = 2.1$) rated statement (u) "product is engaging" significantly higher than the older group ($M = 3.22, S.D. = 2.3$). Lastly, the younger group ($M = 5.5, S.D. = 2$) rated statement (q) "enjoy using this product" significantly higher than the older group ($M = 4.89, S.D. = 2.4$).

Correlations

In order to examine the interrelatedness among the 25 statements, simple Pearson's Product-Moment Correlations were used. Most correlation coefficients were positive and falling within the range of small to medium size correlations (Cohen, 1988). Of these, five pairs of statements had a correlation between $r = .5$ and $r = 1.0$. The pair (g) "can quickly tell what mode I am in" and (b) "can find information quickly" had a correlation of $r = .50, p < .0001$. Statements (i) "works consistently" and (j) "product does not break or shut down" had a correlation of $r = .74, p = .0008$. Statements (g) "can quickly tell what mode I am in" and (h) "reliably responds as expected" had a correlation of $r = .50, p = .0004$. Statements (e) "get out of my mistake" and (b) "can find information quickly" had a correlation of $r = .59, p = .04$. Statements (c) "easy to remember" and (a) "quickly learned" had a correlation of $r = .54, p = .045$.

Factor Analysis

An exploratory principal components factor analysis was conducted on the data. Four dimensions resulted from an exploratory principle component factor analysis. Dimensions were derived from aggregating common characteristics of high loading statements under each factor in an orthogonal transformation solution matrix. These dimensions appeared to be best named as (1) *ease-of-use*, (2) *delight or satisfaction*, (3) *reliability*, and (4) *feedback and help provided*.

Statements that loaded high and positive for the 'ease-of-use' dimension were (a) quickly learned; and (c) easy to remember. Statements that loaded negatively for the 'ease-of-use' dimension were: (y) product prevents desired use; (x) product requires much concentration; and (w) has more features available than used.

Under the dimension 'delight' (or satisfaction), statements that loaded high and positive were: (t) sense

of accomplishment during use; (q) enjoy using this product; (u) product is engaging; (v) product is attractive; (l) achieve excellent performance; (w) more features available than used; and (r) product behaves in a similar manner.

Statements that loaded high and positive under the dimension of '*reliability*' were: (i) works consistently; (j) product does not break or shut down; (b) can use the display; (g) can quickly tell mode; (h) reliably responds as expected every time; and (f) can get things done quickly.

Lastly, the dimension of '*feedback and help provided*,' had high and positive loadings for the statements (s) controls what I can do and gives expected result; (d) product offers help; (b) can find information quickly; (n) warns of errors; and (e) get out of my mistakes (without further error).

DISCUSSION

The current data shows that user-friendliness of technology-based consumer products that relate to the characteristics of reliability, quickness of functionality, rapidity of learning, intuitiveness, and helpful feedback. Many of these characteristics fell between the scale values of "represents user-friendliness very well" and "represents user-friendliness extremely well." Notably, the highest rated statements concerning user-friendliness were: (a) "quickly learned," (b) "can find information quickly," and (c) "easy to remember."

On the other end of the scale, statements such as: (y) "product prevents desired use" and (x) "product requires much concentration" received very low mean ratings of user friendliness. These low rated statements suggest that some kinds of automation and lengthened duration of product adaptation are not desirable aspects in technology-based consumer products. Lack of acceptance of technology has been noted as a factor of device abandonment or poor consumer ratings and reviews (Maeyer & Estelami, 2011).

Other notable results concerned feelings about product aesthetics and engagement. Maeyer and Estelami comment that fit and finish may contribute to the perceptual construct of product quality. The rather low mean ratings of statements (v) "product is attractive" and (u) "product is engaging" suggest that while visual attractiveness and high levels of engagement of a product may contribute to marketability of consumer products, they are not synonymous with user-friendliness. Likewise, other marketability aspects were also found to not be characteristics that are highly

representative of user-friendliness. One notable example is indicated in the low mean ratings for the statement (w) "has more features available than used." This suggests user-friendliness is different than what marketing departments have often associated (albeit erroneously) with the user-friendliness concept.

The factor analysis revealed that the concept of user-friendliness is not one-dimensional. This is not surprising since it is a complex concept that is not easily measured by a single response measure. However it is interesting to note that the dimensions are not simply speed and accuracy or conceptualized by simple subjective preference. In this research, four dimensions were revealed by a factor analysis. These dimensions appeared to be best named as (1) ease-of-use, (2) delight or satisfaction, (3) reliability, and (4) feedback and help provided. Ease-of-use is probably the best common correlation to many peoples' conceptions of user-friendliness. A second dimension of delight and satisfaction is an affective factor. This suggests that it is not just the cognitive or performance aspects of the operation of consumer products that are important but also how it makes the consumers feel. This is an interesting finding and would need to be replicated to verify its reliability. User friendliness does not necessarily require positive affective reactions, such as delight, since usually it is often considered to be a lack of negative qualities. The dimension of reliability is a sensible dimension since a product that does not operate consistently is not going to accomplish the goals of the product and therefore would not be user friendly. The dimension of providing feedback and help is particularly important for human factors professionals because this dimension has been problematic in the design of consumer products and systems and is important in reducing errors by users (Woods, Decker, Cook, Johannesen, & Sarter, 2010).

The purpose of this study was to examine the perceptions of user-friendliness based on ratings of statements associated with consumer products. While a relatively large number of statements were used, they are not inclusive of potential statements that could be used. A potential limitation is the positive manner in which each of the statements was phrased. Future research might further manipulate the statements to be both positive and negative. Few differences were found between the two age groups. However, further investigations could specifically examine whether there are demographic differences in conceptualizations as a function of personal characteristics.

Design Implications

Results of this study identified several important factors to be considered when assessing the usability or

perceived user-friendliness of a technology-based consumer product. Such results highlight the importance of conducting user-centered usability or acceptance testing as opposed to relying solely on designer perceived quality of this subset of products. Many of the statements evaluated and rated in questionnaire responses are valuable considerations in user-friendliness. This knowledge can provide information to consider in the product design process. The present study suggests that several factors of perceived usability for end-users should be considered when developing these consumer products. This research is still in preliminary stages, but further research in this area may offer a more solid core of information regarding the factors comprising people's conceptualizations of product usability and perceived user-friendliness.

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