# Measuring attitudes towards mobile information services: an empirical validation of the HED/UT scale

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Abstract

The psychometrical properties are studied of a scale that measures attitudes towards mobile information services. Starting point is an attitude measure from the consumer behaviour literature, the HED/UT scale, which consists of 12 items measuring hedonic value, and 12 items measuring utilitarian value of a service.

Data was collected alongside an experiment on the use of a mobile shopping service. 86 students participated in the experiment and were subject to two treatments: task complexity and presence of mobile decision aid as part of the service. Results indicate that the original HED/UT scale should be reduced to a short-form version to meet standard reliability and validity tests. We present a modified version of the scale for use in further empirical research.

It is generally agreed by market analysts and technology watchers that mobile information services (services accessible via mobile devices) will increasingly become more personal and more context-aware. This prediction is based on two converging technological developments: the increased sophistication of mobile phones and handheld devices, and the increased availability of short- and long-range mobile networks. Advanced mobile information services that make use of these technologies are put forward under umbrella terms such as ambient intelligence (ISTAG, 2001), pervasive computing, and ubiquitous computing (Weiser, 1993). Examples include the display of film listings when a user walks past a cinema, or the display of room availability when a user walks past a hotel. For an overview and more examples, see Dey, Abowd, & Salber (2001).

Providers of advanced mobile information services are facing a number of questions, not the least of which will be how users will react to personal, context-aware services in the first place. To provide theoretically informed answers to these questions, researchers will require a measurement instrument that captures user attitudes towards mobile information services. Such an instrument could then be used in empirical research to validate hypotheses in this area. In the present study, we examine the methodological suitability of one candidate instrument: the HED/UT scale reported in Spangenberg, Voss, & Crowley (1997). We conducted an experiment in which participants used a mobile information service, and administered the HED/UT scale after participants had completed their task. In this paper we demonstrate that statistically, this instrument *as is* did not perform as expected. To address this issue, we present a modified version of the scale to be used in further empirical research.

In accordance with current conceptualisations of attitude in recent psychological research (for an overview, see Ajzen, 2001), we define user attitude as the user's *summary evaluation* of a mobile information service. We focus on dispositions towards specific services, not on dispositions towards using mobile services in general. A user may respond negatively to a room availability service, but positively to a film listing service.

Theories on user attitude have central stage in information system (IS) research. In particular, the field has paid much attention to understanding user satisfaction with an information system. User satisfaction is pivotal in the relationship

between system characteristics and individual and organisational performance (Goodhue, 1988). This is illustrated by the influential IS success model (DeLone & McLean, 1992). The model depicts user satisfaction as a central construct, having system-related constructs as its antecedents, and performance-related constructs as its consequences.

It is possible to measure attitudes with a single item, but to battle measurement error, multi-item measures should be used (DeVellis, 1991). One of the first available multi-item measures of user satisfaction was developed by Bailey & Pearson (1983). A number of researchers have since developed similar user satisfaction scales (see Doll & Torkzadeh, 1988; Ives, Olson, & Baroudi, 1983 for examples). In line with calls for validation of instruments in quantitative, positivist IS research (Boudreau, Gefen, & Straub, 2001; Straub, 1989), these satisfaction measures have been subject to rigorous methodological tests (Baroudi & Orlikowski, 1988; Doll, Xia, & Torkzadeh, 1994). As a result of this work, a set of reliable and valid scales is currently available to measure satisfaction with information systems, and these scales can in principle be used to measure attitude towards mobile information services.

Another body of research also provides candidate scales for measuring attitudes towards mobile information services. This research is grounded in the consumer behaviour literature, or more specifically, the literature that deals with consumer's attitudes towards products and services. Central in this literature is the recognition that consumer attitudes can be decomposed into a cognitive and an affective component (Hirschman & Holbrook, 1982; Holbrook & Hirschman, 1982; Simonson, Carmon, Dhar, Drolet, & Nowlis, 2001). The cognitive component refers to the utilitarian value that a person associates with the product or service. The affective component refers to the hedonic value that a person associates with the product or service. For example, attitudes towards artistic events are typically dominated by hedonic value, whereas attitudes towards instruments and tools are typically dominated by utilitarian value. It is useful to distinguish between cognitive and affective evaluation because research has shown that perceptions regarding utilitarian and hedonic value do not necessarily come with equal vigour to the brain (Shiv & Fedorikhin, 1999).

Due to the utilitarian purpose of many office information systems, the hedonic measurement of user attitudes has been less developed in the IS literature. There is, however, growing recognition that hedonic value is an important part of user attitudes

(Venkatesh, 1999; Webster & Martocchio, 1992), and that affective evaluation can severely impact user acceptance of an information system (Heijden, Forthcoming). This is particularly so for information systems that are voluntary in their use and for systems that aim to serve a hedonic purpose (Heijden, 2002; Kempf, 1999). Mobile information services may serve both utilitarian and hedonic purposes, and consequently, it is relevant to measure both the cognitive and the affective part of attitude. For example, researchers may find the measurement of affective evaluation relevant for hedonic information services such as human interest stories. Cognitive evaluation may be relevant for utilitarian services such as route map support.

In this study, we measured user attitudes towards a mobile information service with the HED/UT scale, developed by Spangenberg et al. (1997). The scale is influential because it is included in the *Handbook of Marketing Scales* (Bearden & Netemeyer, 1999), a resource frequently used by marketing researchers to design academic questionnaires. It is also an appropriate scale, because it addresses the utilitarian and the hedonic components of attitude, and, according to its developers, it is generally applicable to all products and services. It was therefore assumed that the scale could be applied to mobile information services *as is*, without any modification from our part. Our driving hypothesis was that the scale would uphold against standard reliability and validity tests.

## Method

### *Participants*

86 undergraduate students of a Danish business school (48 male, 38 female, mean age = 22.1 years, *SD* = 2.95) participated in the experiment as part of a course requirement. 15 students had English as their native tongue, 42 had Danish as their native tongue, and 29 had neither English nor Danish as their native tongue. All students followed an international curriculum which was entirely taught in English, so it was natural for the experiment to be conducted in English as well. To encourage involvement, we awarded one digital camera to a random participant at the end of the experiment. Participants signed an informed consent form in which they agreed to participate seriously and to the best of their ability.

*Context, device, and information service*

A mobile service that provides information about products in a retail store was developed. Furthermore, we constructed an artificial camera store with digital camera pictures on stands. The stands were placed in a circle with equal distance between each stand, so as not to introduce shelf space bias. Each picture was accompanied by a barcode. The mobile information service retrieves data about the digital camera from the barcode, and displays this data to the user on his mobile device. This way, the user can inform himself about the cameras and then select the one that best meets his needs.

We developed two versions of the mobile service. One version produced data about five attributes of the scanned digital camera. The other version contained a decision aid that produced a colour-coded indication of the camera's attractiveness to the user. This attractiveness was computed according to preferences that could be input into the device. Shades of a single colour (blue) were used to display this attractiveness to the user. Darker shades indicated better fit with revealed preferences. There was neither a comparison function, nor an archive function: the device could display information about only one camera at a time.

The mobile device that we used was an iPaq H3850 (Hewlett Packard) with an SPS 3000 barcode jacket (Symbol). Together, the device weighed 262g. We built the software using Microsoft Windows Platform SDK for PocketPC 2002, Symbol Windows CE SDK, and Embedded Visual Basic 3.0 (Microsoft). Figure 1 displays screenshots of the two versions of the mobile information service, the first version without the decision aid, and second version with the decision aid.

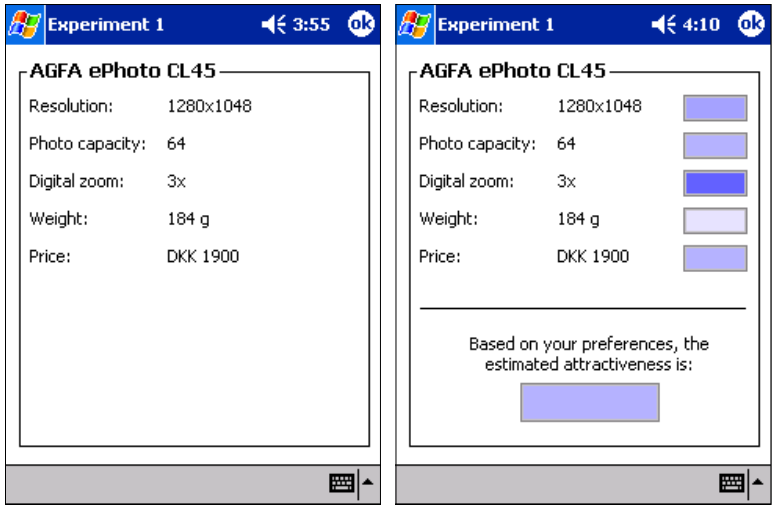


**Figure 1 Screenshots of the mobile information service. The first is without decision aid, the second with decision aid. The darker the colour blue, the better the fit with the user's revealed preferences**

*Procedure*

Using a 2 x 2 factorial design, we worked with two treatments: 1) task complexity and 2) absence / presence of the decision aid. Task complexity was reflected in the number of digital cameras that participants could choose from (10 and 20). Note that this is only one way to improve task complexity (Campbell, 1988). The 86 participants were randomly assigned to each of the four cells.

After entering the artificial store, the participant was given written instructions about the experiment. The participant then signed the informed consent form, and filled out a pre-experiment survey. This survey included demographic questions, control questions, and a scheme where participants could fill in their personal preferences on the five camera attributes.

Before beginning the actual task of selecting a camera, the participant was shown how to work with the mobile device. After the participant had successfully tried the service and expressed readiness to proceed, the actual purchase selection task started. The participants were told that there were no constraints on how much time they could spend on the task or how many times they could scan a camera. The whole procedure took approximately between 20 and 40 minutes, a few took less and a few took longer.

After completing the task, the participant administered a post-experiment survey which contained, among other questions, a verbatim copy of the HED/UT scale.

## Results

Desirable properties of any measurement instrument are reliability and validity. In the case of multi-item measurement instruments, items should be eliminated from the instrument if they fail to contribute to these properties. In the subsequent analysis, we examine the reliability first and the validity second.

To examine the reliability of the instrument, we computed Cronbach's alpha for both dimensions. The utilitarian dimension had an alpha of .87 and the hedonic dimension had an alpha of .82. This is acceptable (Nunally, 1967). We then looked at the inter-item correlations and item-to-total correlations of each item, and discovered that some of them performed inadequately. Conforming to the generally agreed rules-of-thumb that inter-item correlations should exceed .50 and that inter-item correlations should exceed .30 (Hair, Anderson, Tatham, & Black, 1998), a substantial number of items presented themselves as candidates for deletion. For the utilitarian dimension, the adjective pairs that did not meet the standards were *sensible/not sensible*, *handy/not handy*, and *problem solving/not problem solving*. After deleting these items, the remaining instrument had 9 adjective pairs, acceptable inter-item and item-to-total correlations, and a Cronbach alpha of .87. The purification of the hedonic dimension was more dramatic. Strictly adhering to the rules-of-thumb, we dropped the adjective pairs *not sensuous/sensuous*, *unpleasant/pleasant*, *not funny/funny, not happy/happy*, *enjoyable/unenjoyable*, *cheerful/not cheerful*, and *amusing/not amusing* in the first run of reliability analysis, and *not thrilling/thrilling* and *not playful/playful* in the second run. The remaining instrument had 3 adjective pairs left. These pairs had acceptable inter-item and item-to-total correlations, and the alpha was .83. The alpha of the whole instrument (now 12 items) is .87.

The HED/UT scale posits a two-dimensional structure, with hedonic value and utilitarian value being the two latent factors. Also, the scale posits that 12 items load predominantly on utilitarian value, and 12 items load predominantly on hedonic value. The next step in our analysis is to see if this two-dimensional structure could be reproduced by an exploratory factor analysis (EFA). It should be noted that our sample size is only barely adequate to perform an exploratory factor analysis on the

instrument as a whole. With 86 observations and 12 variables, the observation-to-variable ratio is 7.1. This is just about sufficient according to generally accepted norms (Hair et al., 1998).

We ran a factor analysis on the 12 remaining adjective pairs using principal components analysis with varimax rotation. The dataset met the necessary threshold of sampling adequacy (KMO = .85 and Bartlett's test of sphericity = 446.58, $p <$ .001). The total variance explained is 58 %. Table 1 provides the factor loadings and the communalities.

**Table 1 Summary of Items and Factor Loadings for Varimax Orthogonal Two-Factor Solution for the reduced HED/UT scale (*N = 86*)**

| | | Factor loading | | Communality |
|---|---|---|---|---|
| | Item | 1 | 2 | |
| 1 | Useless/useful | .77 | | .61 |
| 2 | Impractical/practical | .75 | | .62 |
| 3 | Unnecessary/necessary | .59 | | .40 |
| 4 | Not functional/functional | .66 | | .48 |
| 5 | Unhelpful/helpful | .77 | | .59 |
| 6 | Inefficient/efficient | .75 | | .56 |
| 7 | Ineffective/effective | .68 | | .50 |
| 8 | Harmful/beneficial | .63 | | .45 |
| 9 | Unproductive/productive | .59 | | .47 |
| 10 | Dull/exciting | | .78 | .72 |
| 11 | Not delightful/delightful | | .87 | .75 |
| 12 | Not fun/fun | | .88 | .79 |

*Note:* Items 1-8 were reverse scored in the questionnaire. Factor loadings below 0.40 are not shown.

Each item loaded high on the factor it originally belonged to, and low on the factor it originally did not belong too. This is evidence of convergent and discriminant validity of the resulting instrument, reflecting the two dimensions utilitarian and hedonic value. It should be noted that some of the items have communalities slightly lower than .50, indicating that more than half of their variance is unique.

Task complexity and the availability of the purchasing decision aid were manipulated before administering the survey. The differences in means and standard deviations of the summated scale are displayed in Table 2 and 3 respectively.

**Table 2 Differences in utilitarian value and hedonic value between individuals whose device featured a decision aid and those whose device did not feature a decision aid**

| | No decision aid | | Decision aid | | | |
|---|---|---|---|---|---|---|
| | *M* | *SD* | *M* | *SD* | *df* | *t* |
| Utilitarian value | 5.02 | .91 | 5.29 | .80 | 83 | -1.46 |
| Hedonic value | 5.00 | 1.09 | 5.10 | .98 | 84 | -4.30 |

**Table 3 Differences in utilitarian value and hedonic value between individuals who faced a low complexity task and those who faced a high complexity task**

| | Low complexity | | High complexity | | | |
|---|---|---|---|---|---|---|
| | *M* | *SD* | *M* | *SD* | *df* | *t* |
| Utilitarian value | 5.21 | .88 | 5.11 | .85 | 83 | .53 |
| Hedonic value | 5.29 | .76 | 4.81 | 1.21 | 84 | 2.21* |

*$p < .05$

As can be seen from the tables, the availability of the decision aid did not result in a significant change in utilitarian or hedonic appreciation of the service. Task complexity did not significantly change the utilitarian value, but significantly decreased its hedonic value of the service. Because the aim of this paper is not to develop a theory on the impact of task complexity and decision support on the attitude towards mobile services, a discussion of these relationships is outside the scope of this paper. Nevertheless, the tables show how manipulations can be assessed in utilitarian and hedonic terms, and how theoretical propositions in the area of mobile information services can be empirically evaluated.

## Discussion

The original 24-item HED/UT scale did not perform as expected in our research. Its reliability in particular was problematic. After pruning those items that were psychometrically unsound, we obtained a reduced form of the scale that meets commonly accepted reliability and validity criteria. This shorter version of the instrument contains 12 items and can be used to measure the attitudes of users towards mobile information services.

The reader may question our ruthless elimination of suspect items for the following reasons. First, the research design has a potential weakness in that it used a convenience sample. Second, our results may have been biased by artefacts of the questionnaire design. Third, the resulting number of hedonic items is too low for rigorous statistical analysis. We will discuss these limitations turn.

In theory, a convenience sample impacts the credibility of the data because the sample may not be representative of the larger population that is being studied. Also, participation was required to successfully complete the course, and this typically affects involvement in the study. We acknowledge these limitations. It should be noted that the majority of the participants had contemplated the purchase of a digital camera before they were confronted with the experimental task. 37 out of 86 reported that they had been shopping for a digital camera in the past, 19 owned a digital camera already, and 29 of them intended to purchase a digital camera within 12 months. This experience may have increased their involvement with the experimental task.

A second caveat is related to the format of the questionnaire, in that it generated some confusion among the respondents. The first source of confusion was the reverse structure in which some of the adjective pairs were presented to them. For example, the last three pairs in the hedonic scale were reversely scaled, and they performed the worst in the reliability analysis. So, their exclusion may actually be an artefact of horizontal order bias (Dillman, 1999). At least three participants first overlooked the reverse structure, and treated the anchors the other way around. These persons recognised their mistakes during the completion of the survey, and voiced their confusion to us. It is conceivable that other participants underwent the same experience but didn't notice their mistakes. Although mixing of the anchors is sometimes recommended to mask the nature of the instrument and to avoid

unsensitive response sets (Heise, 1970), this should perhaps be offset against the likelihood that participants get confused or make mistakes.

Another source of confusion is that many of the adjectives have negations as their opposite anchor. Examples include *playful/not playful*, *happy/not happy*, etc. The problem is that a negation may actually be conceived as a neutral, rather than a negative attitude. For example, *not good* does not necessarily mean *bad*. Similarly, if a participant evaluates a mobile service as *not fun*, it could mean that he does not associate the use of the service with being fun (neutral stance), but it could also mean that he associates the use of the service with being boring (negative stance). Participants may have attributed different interpretations to these adjective pairs, and it may have caused confusion because not all adjective pairs have negations as opposite anchors. Both implications discourage the use of negations in adjective pairs.

Finally, the hedonic subscale has been reduced to three items in the short-form version of the instrument. This is below the limit of four items which some psychologists argue is the minimum to get a reliable attitude measure (e.g. Heise, 1970). We therefore recommend that the hedonic scale be supplemented with more items. The overrepresentation of utilitarian items may also evoke the wrong impression that utilitarian value is superior to hedonic value.

Taking all these limitations into account, we propose a new version of the measurement instrument to be used in future research on mobile information services. This version is included in the appendix. First, we propose that the adverbial quantifiers *Extremely, Quite, Slightly*, *Neutral* be included in the measurement instrument, following the recommendations set forward by Heise (1970). These adverbs decrease the participant's potential confusion in the interpretation of the rating, and thereby help to reduce the differentiation in the ratings. Second, we propose to include the altered hedonic items: *Unenjoyable/Enjoyable*, *Uncheerful/Cheerful*, and *Unamusing/Amusing* into the scale again. In their original form, these pairs were reversely scaled and subject to confusion. Also, the items *Not playful/playful* and *Not thrilling/thrilling* should be added to the scale in a new version: *Serious/Playful* and *Unthrilling/Thrilling*. In their original version these items just didn't make it in the reliability analysis, but they may well fare better in a subsequent empirical study of greater and more varied sample size. For the remaining adjective pairs containing negations, the negations were likewise converted into opposites instead.

We offer the resulting 17-item measurement scale (9 items for utilitarian and 8 items for hedonic value) to the academic community, hoping that the availability of the improved scale will stimulate empirical research in this area.

## Appendix: A revised version of the HED/UT scale for the measurement of attitudes towards mobile information services

Question: In the context of this experiment, I evaluate the usage of the mobile information service as:

| | Extre-mely | Quite | Slightly | Neutral | Slightly | Quite | Extre-mely | |
|---|---|---|---|---|---|---|---|---|
| Useless | ○ | ○ | ○ | ○ | ○ | ○ | ○ | Useful |
| Impractical | ○ | ○ | ○ | ○ | ○ | ○ | ○ | Practical |
| Unneces-sary | ○ | ○ | ○ | ○ | ○ | ○ | ○ | Necessary |
| Un-functional | ○ | ○ | ○ | ○ | ○ | ○ | ○ | Functional |
| Unhelpful | ○ | ○ | ○ | ○ | ○ | ○ | ○ | Helpful |
| Inefficient | ○ | ○ | ○ | ○ | ○ | ○ | ○ | Efficient |
| Ineffective | ○ | ○ | ○ | ○ | ○ | ○ | ○ | Effective |
| Harmful | ○ | ○ | ○ | ○ | ○ | ○ | ○ | Beneficial |
| Un-productive | ○ | ○ | ○ | ○ | ○ | ○ | ○ | Productive |
| Dull | ○ | ○ | ○ | ○ | ○ | ○ | ○ | Exciting |
| Disgusting | ○ | ○ | ○ | ○ | ○ | ○ | ○ | Delightful |
| Boring | ○ | ○ | ○ | ○ | ○ | ○ | ○ | Fun |
| Serious | ○ | ○ | ○ | ○ | ○ | ○ | ○ | Playful |
| Unthrilling | ○ | ○ | ○ | ○ | ○ | ○ | ○ | Thrilling |
| Un-enjoyable | ○ | ○ | ○ | ○ | ○ | ○ | ○ | Enjoyable |
| Unamusing | ○ | ○ | ○ | ○ | ○ | ○ | ○ | Amusing |
| Uncheerful | ○ | ○ | ○ | ○ | ○ | ○ | ○ | Cheerful |

Author note

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The experiment was conducted when the first author was a visiting associate professor of Information Systems at the Department of Informatics, Copenhagen Business School.

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