Mobile Lexicography: Let's Do it Right This Time!

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Abstract

Mobile phones are ubiquitous and have completely transformed the way we live, work, learn and conduct our everyday activities. Mobile phones have also changed the way users access lexicographic data. In fact, it can be argued that mobile phones and lexicography are not yet compatible. Modern users are already mobile – but lexicography is not yet fully ready for the mobile challenge, mobile users and mobile user situations.

The article is based on empirical data from two surveys comprising 10 medical doctors, who were asked to look up five medical substances with the medical dictionary app *Medicin.dk* and five students, who were asked to look up five terms with the dictionary app *Gyldendal Engelsk-Dansk*. The empirical data comprise approximately 15 hours of recordings of user behavior, think-aloud data and interview data.

The data indicate that there is still much to be done in this area and that lexicographic innovation is needed. A new type of users, new user situations and new access methods call for new lexicographic solutions, and this article proposes a six-pointed hexagram model, which can be used during dictionary app design to lexicographically calibrate the six dimensions in mobile lexicography.

Keywords: mobile lexicography; mobile user situation; mobile data access

1. Introduction and Problem

Lexicography has gone mobile. Mobile phones are ubiquitous (cf. Google, 2013: 2) and are used by virtually everybody everywhere. Also publishing houses have caught the mobile wave and developed and marketed a host of dictionary apps. People are already mobile – but is lexicography as a discipline ready for the mobile challenge? Are lexicography and mobile devices compatible at all, and what characterises the mobile user situation? Questions like these can only be answered by means of user surveys with real users in real-life contexts. User research is serious business, but unfortunately is often unrightfully criticized by researchers, who prefer theory over practice (cf. for example Tarp, 2008: 44), who refers to user research of specific lexicographic situations as "…trying to fill the leaking jar of the Danaids…". However, purely deductive procedures are not enough.

Like dictionaries, dictionary apps are utility tools designed and developed to be used (cf. Wiegand, 1988) and they should be designed and developed based on reliable user survey data. This argument is supported by Müller-Spitzer (2013), who argues that it is important to collect empirical data relating to dictionary users and Lew (2015), who offers an interesting discussion of the opportunities and limitations of user

surveys in lexicography. Collecting real-life empirical data is difficult and hard work, but like Müller-Spitzer (2013), it is argued that obtaining empirical data "with all the restrictions that go with it" is important.

Furthermore, as pointed out by Lew (2015: 8–9), the number of participants tends to be low in tests under the naturalistic paradigm, and this is in fact also the case in the two empirical surveys discussed in this paper. In fact, the answer to the question of how many users you should test in usability research was already given in 1989, when Nielsen argued that user testing with five participants was a cheap, fast and satisfactory evaluation (cf. Nielsen, 2000). Today, the answer is still the same as "this lets you find almost as many usability problems as you'd find using many more test participants" (cf. Nielsen, 2012).

First, the methodology and the empirical basis of this article will be outlined and next a number of important theoretical considerations on what characterizes mobile lexicography will be briefly discussed. Third, this article offers a discussion of six dimensions of paramount importance in mobile lexicography, and finally the article proposes a six-pointed hexagram model, which can be used during dictionary app design to lexicographically calibrate the six determining factors in mobile lexicography.

2. Methodology and Empirical Basis

As already briefly described, this article is based on data from two empirical analyses, and both surveys belong to the naturalistic paradigm (cf. Lew, 2015).

First, the article draws on the insights and conclusions from an intra-consultation survey of the consultation behaviour of 10 medical doctors. The data and the insights from this survey are discussed in (Simonsen, 2013: 416–429) and (Simonsen, 2014: 259–260). The 10 medical doctors were asked to look up medical terms by means of the app *Medicin.dk* on an iPhone 4S, which was wirelessly connected to a PC by means of Reflector, cf. http://www.airsquirrels.com/reflector/. The 10 medical doctors were asked to participate in two tests. In Test A the test persons were asked to look up five medical terms while sitting down at a desk. In Test B the 10 test subjects were asked to look up the same five terms while slowly walking around a hospital bed. The survey of the mobile user situation focussed on a number of concrete task-dependent situations. Both tests were recorded while the tasks were performed both from the "inside" by means of Reflector, and at the same time the user activities were recorded from the "outside" by means of a digital camera. In addition to the recordings from the "inside" and the "outside", the empirical basis also includes think-aloud data, as the test persons were asked to think aloud and verbalize what they did and saw, etc. To deduce additional qualitative comments, the empirical basis also includes interview data as the test persons were interviewed before and after the tests (cf. also Simonsen, 2014: 259–260 for a detailed discussion).

Tests A and B were designed to imitate two typical user situations for many doctors: knowledge acquisition and knowledge checking prior to patient consultation and knowledge checking during a patient consultation. During the two tests, the doctors were asked to solve five tasks. The five tasks included looking up the five product names Terbasmin (asthma), Tamoxifen (breast cancer), Antepsin (ulcer), Tredaptive (cholesterol) and Fludara (leukaemia) and can be summarized as follows:

Task 1: Look up "Terbasmin" – to find information
Task 2: Look up "Tamoxifen" – to extract information about side effects to inform patient
Task 3: Look up "Antepsin" – to extract information about dosage to check prescription
Task 4: Look up "Tredaptive" – to extract information about dosage to inform patient
Task 5: Look up "Fludara" – to find and check spelling of term to be able to write a text.

In other words, the first survey tests how the 10 doctors act in cognitive situations (Task 1), in operative situations (Tasks 2–4) and in communicative situations (Task 5), cf. also Tarp (2011). Furthermore, Fuertes-Olivera & Tarp (2014: 87) argue that the lexicographical process seen from the user's perspective can be divided into three fundamental phases:

1. extra-lexicographical pre-consultation phase
2. intra-lexicographical consultation phase
3. extra-lexicographical post-consultation phase

The first survey thus primarily covers the intra-lexicographical consultation phase and the extra-lexicographical post-consultation phase.

Second, the article draws on the insights and conclusions from another intra-consultation survey of the consultation behaviour of five 13-year-olds. The five teenagers were asked to look up five terms from an official text used for testing the English proficiency levels of Danish students by means of an iPhone 4S with the dictionary app *Gyldendal Engelsk-Dansk*. In this survey, the iPhone was also wirelessly connected to a PC by means of Reflector, cf. http://www.airsquirrels.com/reflector/. The five students were asked to participate in two tests. Test A investigated how the five 13-year-olds accessed bilingual dictionary data while sitting down at a desk. Test B looked at how the five 13-year-olds accessed the same bilingual dictionary data while walking around a table, thus alluding to a mobile user situation. Both tests were recorded while the tasks were performed both from the "inside" by means of Reflector, and at the same time the user activities were recorded from the "outside" by means of a digital camera.

The five teenagers were asked to look up the following five terms.

Task 1: Look up "wildlife programmes" – to translate into Danish
Task 2: Look up "cheetahs" – to translate into Danish
Task 3: Look up "fancy it" – to translate into Danish
Task 4: Look up "auntie" – to translate into Danish
Task 5: Look up "disappointed" – to translate into Danish

In other words, the second survey tests how the five teenagers act in communicative situations (Tasks 1–5) during primarily the intra-lexicographical consultation phase and the extra-lexicographical post-consultation phase.

The two surveys thus included a total of 10 medical doctors and five teenagers. The empirical data of the first survey comprises 20 internal recordings, 20 external recordings, 20 think-aloud data recordings and 10 interview data recordings. The empirical data of the second survey comprises 10 internal recordings, 10 external recordings and 10 think-aloud data recordings.

3. The DNA of mobile lexicography

Before discussing the mobile user situation and the challenges and opportunities of mobile lexicography on the basis of the insights and conclusions from the two surveys, we first need to outline six dimensions, which dictate and constitute the basic framework of mobile lexicography. The six dimensions are the mobile device as a lexicographic medium, the mobile lexicographic data, the mobile user, the mobile user situation, the mobile lexicographic task and the mobile access method (cf. also Simonsen, 2014: 249–262).

First, what characterizes a mobile device? According to Budiu (2015) and Simonsen (2014), the small screen and the size of the mobile device make it hard for users to access, understand, process and remember information on mobile devices. Furthermore, the size and the portability of the mobile phone make it hard for users to stay focused. According to Budiu (2015), the portability of mobile phones also means that attention is fragmented and sessions very often short and punctual. Furthermore, it is also twice as hard to understand mobile content compared to online content (cf. Budiu, 2015), so therefore mobile content should leave out any filler content and unnecessary information. Budiu (2015) also argues that there is an inherent problem with the size of the touchscreen keyboard, because it is hard to type proficiently on a mobile phone. This argument is supported by Simonsen (2014), who also found that medical doctors often experienced problems when typing during search operations on a medical dictionary app. In fact, one medical doctor specifically referred to the fact that the touchscreen was too small and his fingers were too large. All these characteristics of the mobile device contribute to the cognitive load of the user; and we have not yet even considered the DNA of the lexicographic data.

Second, what characterizes lexicographic data? The information density of lexicography is high and very often lexicographic articles are quite long and comprehensive. It is in the DNA of lexicography to give the user precise, but often also long definitions, examples, synonyms, idioms, etc. The complexity is even higher in bilingual dictionary apps. Furthermore, many dictionary apps are unfortunately merely abridged app versions of the paper version. This argument is also made by Tarp (2015: 17), who argues that "However, in spite of the existence of a number of relevant techniques to improve the lexicographical product, the overwhelming majority of e-dictionaries still present themselves as paper or paper-like dictionaries with traditional, static articles, which have been placed on digital platforms without taking the necessary steps towards a completely new generation of dictionaries much more adapted to the users' real needs in each situation". Many dictionary apps do feature Google-like search-as-you-type search functions, but the user still interacts with the mobile device by means of a very small touchscreen keyboard. The small screen also means that content is not easily accessed and processed. Lexicographic content thus needs to be revised and abridged for dictionary app purposes; otherwise the mobile user will suffer from information overload.

Third, the characteristics and backgrounds of the users play a paramount role. The test persons involved in the two surveys discussed below comprise both digital immigrants and digital natives (see Prensky, 2001 for an outline of the terms digital natives and digital immigrants). As outlined above, the test persons can also be divided into professionals (medical doctors) and non-professionals (teenagers) and – as will become apparent from the discussion below – the backgrounds, competence sets and experience levels of the users almost dictate the way they access data and process information. The 10 medical doctors could be described as digital immigrants and they still prefer accessing medical data on a computer screen. However, the five 13-year-olds are digital natives and have all grown up in a hyper-connected world, and they prefer accessing virtually everything on mobile devices. The surveys seem to indicate that digital natives in comparison to digital immigrants are impatient and surprisingly illiterate when it comes to basic reference and dictionary skills, i.e. they have never really learned how to use a dictionary. In conclusion, the characteristics and backgrounds of the users are important to keep in mind when designing dictionary apps.

Fourth, the actual user situation is crucial. Dictionary apps are utility tools designed and developed to be used (cf. also Wiegand, 1988), and they must be designed and developed to suit the different user situations in which the users operate. Clearly, the user situation has an important impact on the selection of lexicographic data to be shown and the type of access method by means of which the user should access lexicographic data.

Fifth, the type of task that the user is solving also plays an important role in mobile lexicography. Dictionary apps are utility tools, and utility tools are used to solve

specific tasks. The empirical data, which will be discussed below, also show that different tasks call for different data sets and different access methods are required when using a dictionary app, for example, to translate a word or to save a person's life in an ambulance or in an emergency. In other words, the task dictates a number of factors in mobile lexicography.

Finally, the way users access lexicographic data in dictionary apps is also important to keep in mind when discussing mobile lexicography and designing dictionary apps. The two dictionary apps tested in the two surveys differ considerably. The *Gyldendal Engelsk-Dansk* app is a standard bilingual dictionary app based on the well-proven Gyldendal dictionary concept used by almost all students in Danish schools. The *Medicin.dk* app is a medical dictionary app designed and developed for health care persons. The *Gyldendal Engelsk-Dansk* app does not have a search-as-you-type search function. The *Medicin.dk* app does, and it even allows the user to tailor-make which data categories to show. This feature is very useful for users, because they can tailor-make the amount and type of data that they need. Another feature offered to the users of the *Medicin.dk* app is the scan feature utilizing the camera of the mobile device. In fact, paramedics or emergency doctors use the scan feature of the *Medicin.dk* app to determine the type of medicine digested in situations where patients are suffering from poisoning and where doctors need to make quick decisions. In conclusion, different access methods are needed in different situations to solve different tasks.

4. Results and Discussion

First, a brief description of the two surveys and the tests performed is relevant. Figures 1 and 2 below show a 62-year old medical doctor (TP5) being tested during Test A (while sitting down at a desk) and during Test B (while walking around a hospital bed).

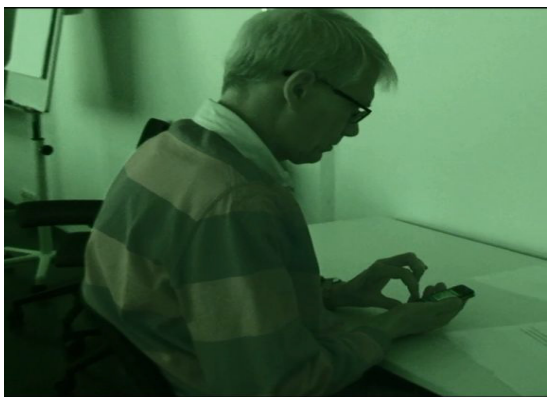

Figure 1: Survey 1 - Test A: Stationary Test

Figure 2: Survey 1 - Test B: Mobile Test

Figure 3 below shows a user situation with the same 62-year old medical doctor. Figure 3 shows the user situation seen from both the inside and the outside and is an edited figure of two video recordings. Figure 3 shows how TP5 sits at the table in the

left hand side of the picture interacting with the mobile device, and in the right hand side of the picture TP5's search behaviour on the iPhone is recorded and shown from the inside.

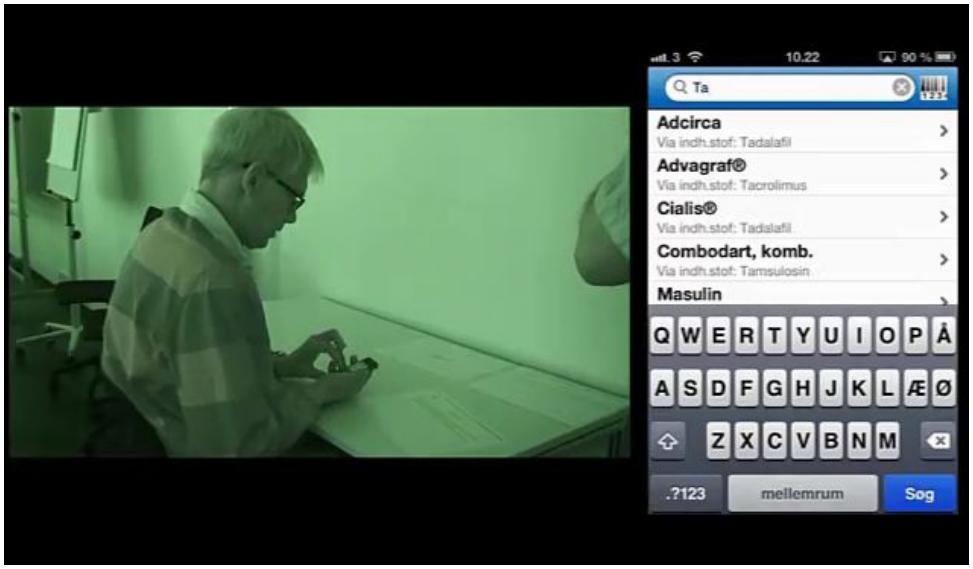

Figure 3: Survey 1 - Test A: Outside vs. Inside

Figures 4 and 5 below show a 13-year-old test person (TP15) being tested during Test A (while sitting down at a desk) and during Test B (while walking around).

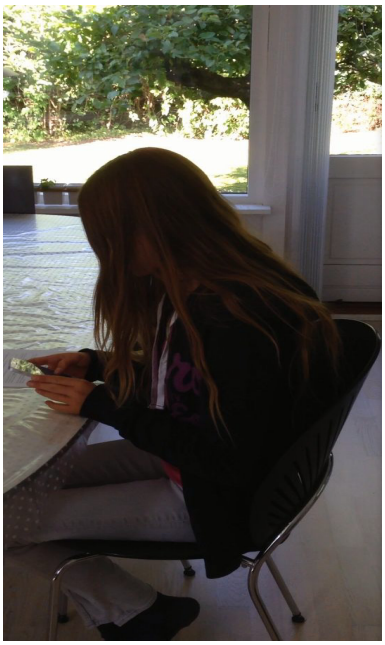

Figure 4: Survey 1 - Test A: Stationary Test

Figure 5: Survey 2 - Test B: Mobile Test

Figure 6 shows TP15's user situation seen from both the inside and the outside. Figure 6 shows how TP15 sits at the table in the right hand side of the picture

interacting with the mobile device, and in the left hand side of the picture TP15's search behaviour on the iPhone is recorded and shown from the inside.

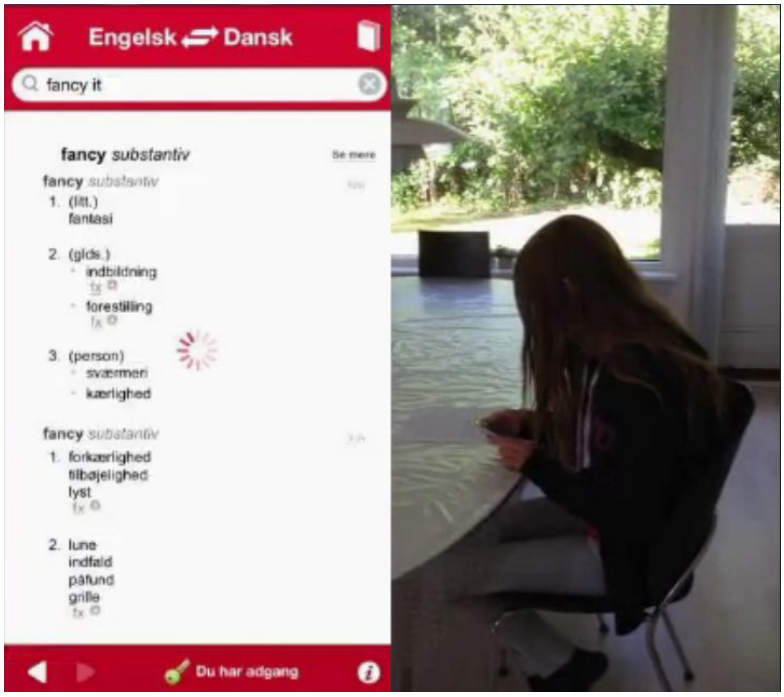

Figure 6: Survey 2 - Test A - Outside vs. Inside

A general observation on the basis of the data is that search speed, search quality, and ability to focus and interact with the mobile device was higher during the stationary user situation than during the mobile user situation. The digital natives were marginally quicker interacting with the device than were the digital immigrants, but they also seemed to have poorer reference skills.

The discussion of the data and the results will be based on data relevant to the six characteristics of mobile lexicography: the mobile device, the lexicographic data, the mobile user, the mobile user situation, the mobile task and the mobile access method.

4.1 The Mobile Device as a Lexicographic Medium

For decades the limitations and opportunities of both paper and online dictionaries have been discussed (e.g. Almind, 2005). Now, a new lexicographic medium is used and theoretical considerations on the characteristics of the mobile phone as a lexicographic medium are needed. No doubt the limitations and opportunities of the mobile device are relevant when discussing mobile lexicography. The trend in mobile telephones is that touchscreens are getting bigger, but the trade-off between portability and size still means that size is limited. A number of relevant considerations on mobile user surveys, mobile devices and interaction with a mobile device during movement can be found in Budiu & Nielsen (2013); Budiu (2015); Cerejo (2012); Church (2009); and Google (2013).

However, in the field of lexicography, only a few contributions have been published (including, in particular Curcio, 2014; Marello, 2014; Simonsen, 2013; Simonsen, 2014), which each offer a number of theoretical considerations on how mobile users consult and use different dictionary apps.

The two surveys upon which this discussion is based do however seem to indicate that interacting with a mobile phone such as the iPhone 4S is difficult. Both surveys show that interacting with a mobile phone during movement is possible, but difficult, because the user both has to navigate in the search functions on the touchscreen and in the physical world at the same time.

Survey 1 tested 10 medical doctors in two user situations, and when I asked TP5 "Do you use your mobile device while moving?" he said "No – not really. I mostly use my mobile phone when I am sitting down because I think the screen is too small and my fingers are too big for the touchscreen". TP5 can be seen in Figures 1–3 above, and at the time of the test he was a 62-year old medical doctor. He was the oldest test person among the 15 people tested, which seems to indicate that age plays a role in mobile information access behaviour. This in fact corresponds with the discussion of digital natives vs. digital immigrants (cf. Prensky, 2001). The 5-inch screen on a standard smartphone such as the iPhone 4S is simply not enough. Size does matter when it comes to successful data access and information processing. The design of dictionaries has always been relevant for lexicography (e.g. Almind, 2005), but when it comes to mobile lexicography there is still much to be done.

The input device (the finger) and the small letters displayed on a 5-inch screen are not a perfect match as one of the test persons surveyed actually pointed out. The data from TP7 and TP8, who chose to hold the mobile device horizontally, show that they in fact were quicker and better at locating information. A similar conclusion can be made on the basis of Survey 2, which included five teenagers. The digital natives (the teenagers) were no doubt quicker than the digital immigrants (the doctors); however, they also used the backspace button all the time, indicating that they might be quick at interacting with the device, but that they made a large number of typos. All five teenagers held the mobile device with both hands during movement while they typed with their thumbs. Observations from the outside during both surveys indicate that the majority of users hold the mobile device in a vertical position allowing them to use both thumbs while either sitting or walking. Observations from the inside during both surveys indicate that the majority of users make a large number of typos and that they use the backspace button to delete and retype. Other observations indicate that the autofill function of the iPhone 4S is not a help but more a source of frustration. Only TP14 and TP15 use the pinch and pan gesture and the magnifying glass to make it easier to select the type of information they want and both TP14 and TP15 are digital natives.

In conclusion, the physical characteristics of a mobile phone must be taken into consideration when designing dictionary apps. The size and the user situation make it

impossible to access information the same way we do in electronic dictionaries, for example. Consequently, we need to carefully select the type and amount of dictionary data to show and even leave out data. This will be discussed in detail below.

4.2 Lexicographic Data on Mobile Devices

The type and amount of lexicographic data to be included in dictionary apps is a new discussion. In fact, it is argued that this discussion is of paramount importance, because users may otherwise suffer from information overload; see also Tarp (2015: 17) who eloquently argues that "One of the major problems in past and present dictionaries is information overload…". The fact that data overload may obstruct and even hinder both access to the relevant data and retrieval of the required information from these data, (cf. also Bergenholtz & Gouws, 2010) has been empirically demonstrated in these surveys. In fact, the discussion was started by Simonsen (2014), who proposes four principles of mobile lexicography. One of the principles is called "Mobile Data Principle". Simonsen (2014: 260) argues that "The mobile user situation also dictates the type and complexity of the mobile data. The size of the user interface and the punctuality of the user situation mean that complex data and long text segments are not an optimum way of displaying mobile data".

The data from the surveys support the argument that data overload may obstruct and even hinder both access to the relevant data and retrieval of the information required from these data (cf. Bergenholtz & Gouws, 2010). Nielsen (2011) argues that "if in doubt – leave it out" and empirically proves that "writing for mobile readers requires even harsher editing than writing for the web". The two dictionary apps tested in this article clearly contain way too much information in a number of situations, and it can be argued on the basis of my own empirical data that some information overload does in fact take place, especially in *Gyldendal Engelsk-Dansk*. Sometimes you get the impression that publishing houses publish dictionary apps simply because everybody else does and that include as much lexicographic data as possible. The question of information overload is discussed by Tarp (2015: 17) who uses the following terms to describe information overload:

"absolute overload", which takes place if there are more data than required to meet the users' needs

"relative overload", which takes place if there are more data than can be visualised without scrolling down or than the predicted user can be expected to overview

"functional overload", which is a case of absolute data overload when it relates to the needs of a specific user in a specific type of situation

"concrete overload", which is a case of absolute data overload when it relates to the needs that a concrete, individual user may have in a concrete situation.

In fact, I argue that all four types of information overload can be demonstrated using empirical data. Less is in fact more sometimes, and it is argued that the characteristics of the mobile device, the characteristics of the mobile user, the size of the user interface and the complexity of the mobile user situation may sometimes have been sacrificed on the altar of lexicographic and technical perfectionism.

The dictionary app tested in Survey 1 was a medical dictionary app developed for health care professionals (HCPs). Figure 7 below shows three screen dumps from the app.

As will appear from the circled spot in the screen dump to the left, the dictionary app features a very useful "search-as-you-type" feature similar to that used by Google. The centre screen dump shows a standard display of the search result, but as will appear from the circled spots the user can tailor-make what and how much lexicographic data he wants when he clicks "Min visning" (My profile). The circled spots in the screen dump at the right show how the user may select the type of lexicographic data he needs the next time he uses the dictionary app. This sort of situational adaptation is a step forward in mobile lexicography and resembles principles 1, 2 and 6 described by Fuertes-Olivera & Tarp (2014: 64), because the customization allows the user to avoid information overload, to access the data required in each consultation and finally ensures that the article contains no more than needed.

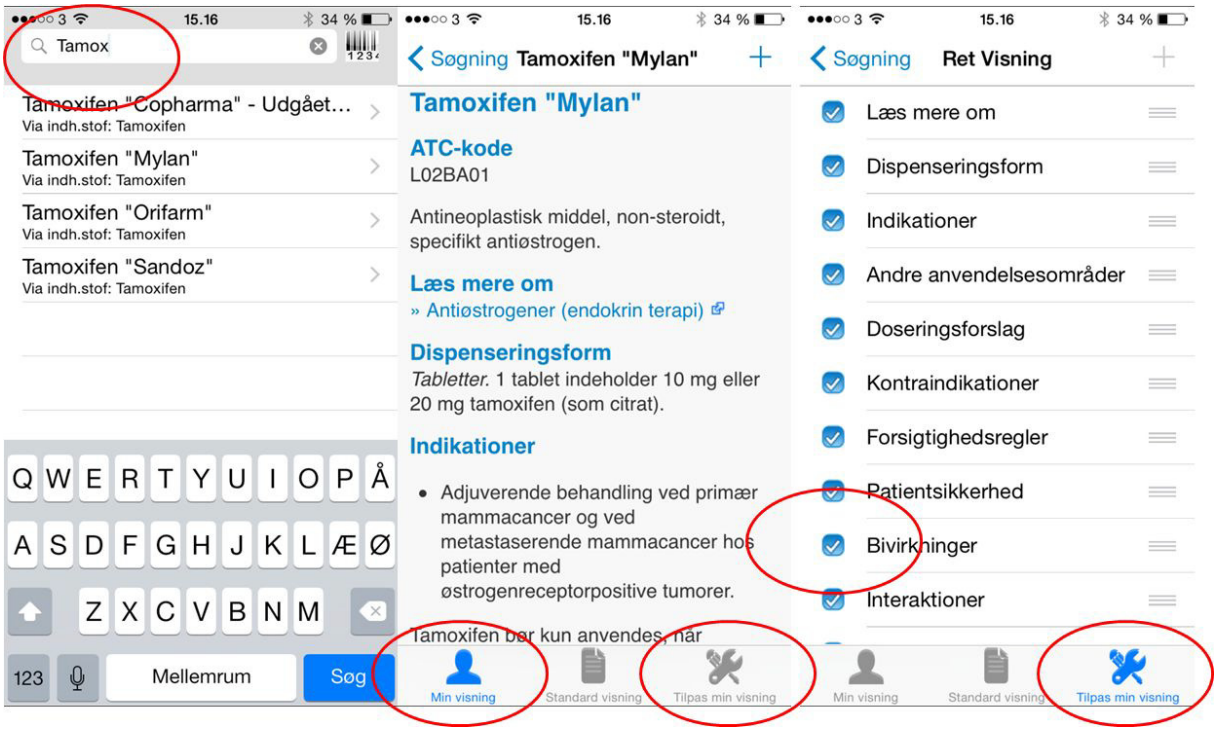

Figure 7: Medicin.dk

Observations from the inside reveal that the 10 doctors quickly find and access the article they need, primarily because of the powerful search-as-you-type feature. When

they look for a specific type of information, for example information on side effects (Bivirkninger), they quickly scroll down to the lexicographic data type needed by navigating on the basis of the bold, blue headlines. The user situation and the actual task also affect the type of data needed. As will be discussed below, the mobile user situation is characterized by being volatile and punctual. The mobile user typically checks knowledge and performs simple searches. The mobile user situation primarily supports simple, punctual, communicative lexicographic functions, but is not suited to support complex, cognitive lexicographic and bilingual communicative functions.

Recordings from the inside of the consultation behaviour of the five teenagers indicate that information overload does take place and that this information overload in fact hinders both access to the right type of data and the extraction of the required information. Figure 8 below shows a number of screen dumps from the dictionary app *Gyldendal Engelsk-Dansk*.

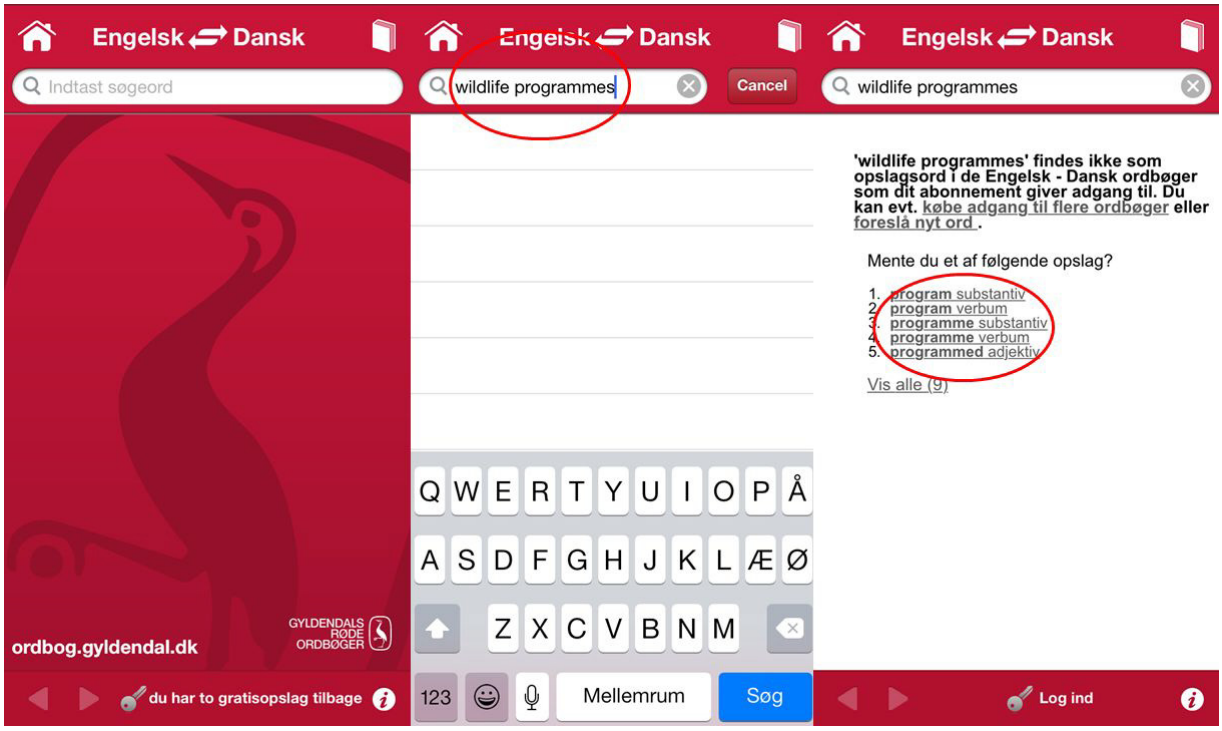

Figure 8: *Gyldendal Engelsk-Dansk*

This dictionary app does not offer a search-as-you-type feature, which is unsatisfactory if the primary user group (students) is borne in mind. A search-as-you-type feature seems to be a standard solution in mobile lexicography, cf. for example *Merriam-Webster Dictionary App (MW), Den Danske Ordbog (DDO), Advanced English Dictionary and Thesaurus (AEDT)* and *Ordbogen.com (OC),* etc. The recordings from the inside clearly show that users make a lot of typos, and that the consultation process is negatively affected because users have to use the backspace button all the time. The recordings also show that the *Gyldendal Engelsk-Dansk* app, in some situations, seems to display way too much data and that some data should be

offered earlier in the consultation process.

Obviously, this may have to do with the argument that the five teenagers tested seem to lack basic reference skills, but the empirical data also show that the five digital natives search as they would on Google and it seems as if they expect a search-as-you-type feature. TP11, TP12, TP13 and TP14 all typed "wildlife programmes", that is, they entered a multiword item in the search field and clicked search to find the translation. Only TP15 performed a search for "wildlife" and then "programmes". So it seems that the digital natives expect a search-as-you-type feature.

Furthermore, the recordings from the inside show that the teenagers do not explore the possibilities of the *Gyldendal Engelsk-Dansk* app. Even though the app suggests a number of possible meanings, none of the five digital teenagers used this feature. Not even when the app actively asked "Do you mean one of the following terms", did they explore further possibilities. TP11, for example, entered "wildlife programmes" in the search field and even though the app suggested a number of options, she did not click any of them. Instead she deleted what she wrote in the search field and entered the word "wild" and subsequently the word "wildlife". In conclusion, the empirical data support the argument made above that too much information may both hinder access to the right data and extraction of the information required, because none of the teenagers except TP15 came up with the right Danish translation of "wildlife programmes". The next step in this discussion is to look at the characteristics of the mobile user.

4.3 The Mobile User

Wiegand once called the user the "Bekannten Unbekannten" (Wiegand, 1988), but it is argued that we now have much more knowledge of who the user actually is. A number of relevant theoretical contributions have discussed how mobile dictionary users use different dictionary apps (for example Curcio, 2014; Marello, 2014; Simonsen, 2013; Simonsen, 2014). Simonsen (2014) describes the mobile user as follows: "The mobile user is on the move and needs and accesses information while on the go. This makes the mobile user punctual, impatient, imprecise and preoccupied with other things". Background, education, age and experience level of the user play a paramount role in all types of information access discussions. The test persons involved in the two surveys can be divided into professionals (medical doctors) and non-professionals (teenagers); into digital immigrants (medical doctors) and digital natives (teenagers); into educated and experienced (medical doctors) and uneducated and inexperienced (teenagers); and into old (medical doctors) and young (teenagers). Obviously, the user's background, competence set and experience level almost dictate the way they access data and process information. This is also evident from the empirical data. As already discussed above, the digital natives seem to be really impatient and lacking reference skills. Only TP15 chose to explore the additional suggestions offered by the app while the other four test persons ignored the full

potential of the app. Another general observation is that mobile users *per se* are mobile and able to move around. This very fact makes them sporadic and impatient multi-taskers, which means that accessing data on a mobile device is not the same as accessing data on a 17-inch computer screen. The empirical data produced in the two surveys also indicate that consultation behaviour is naturally individual and dependent upon the task. The emergency doctor prefers the mobile device and loves accessing medical data on the mobile device because she uses the app at emergency sites or in the ambulance. The characteristics of the mobile user situation will be the topic of the next section of this article.

4.4 The Mobile User Situation

As already argued the mobile user situation affects a number of dimensions. The data show that there is a significant difference between the two user situations, sitting (Test A) and moving (Test B), when it comes to access speed; that is, from the moment the test person started the data access operation to the moment he ended the search operation. A dictionary app is no doubt a utility tool designed and developed to be used in specific situations and, according to Tarp (2011), online dictionaries should be developed to help users perform activities in four situations:

1. In communicative situations, to listen to – and to read, write or translate oral and written texts in specific professional situations
2. In cognitive situations, to store information and learn about the profession (theories, methods, etc.) and about carrying out professional activities
3. In operative situations, to perform specific activities and solve problems in specific situations
4. In interpretive situations, to interpret and extract information from opaque, non-verbal signs such as figures, graphs, visual illustrations etc. that are used as information units in texts in specific professional situations, or as independent items.

The two surveys in this paper cover the first three situations and show that it does make a difference whether a dictionary app is used professionally or in school, or when sitting down or walking and that the user situation does affect which data are accessed, how data are accessed and how information is extracted from the data and used. Simonsen (2014) argues that "the mobile user situation is characterized by being volatile, punctual and by often taking place while the user does other things. The mobile user typically checks knowledge and performs simple searches. The mobile user situation primarily supports simple, punctual, communicative lexicographic functions, and is not suited to support complex, cognitive lexicographic functions".

The data clearly substantiate this argument. The data seem to indicate that the mobile user situation primarily supports simple, punctual, communicative lexicographic functions, but that mobile devices and dictionary apps are also suitable

in operative situations, for example when an emergency doctor needs to find a medical product and decide what does to dispense to the patient.

The data also show that mobile lexicography is not a perfect match when it comes to heavy cognitive situations, where users are researching a specific complex question. In Survey 1, it was found that the information access success of the 10 medical doctors was reduced in cognitive user situations, especially Tasks 2, 3 and 4, which were all about locating complex information with a view to making decisions as to side effects, dosage and how to take the medicine, etc. In fact, TP7 stated during the follow-up interview that "If I have to look a little bit deeper into a question then I clearly prefer the computer. I would definitely use the computer if I were to prescribe medicine that I have never used before". In other words, the mobile user situation and cognitive lexicographic functions does not make a perfect match.

In conclusion, the user situation has an important impact on the selection of lexicographic data to be shown and the type of access method by which the user should access lexicographic data. This question will be addressed in the next section of this article.

4.5 The Mobile Lexicographic Task

The mobile lexicographic task that the user is solving constitutes perhaps the most important dimension. Apps are utility tools and are designed so that the user can solve specific tasks. And different tasks call for different tools, etc. Unfortunately, the importance of the task has so far received little attention in lexicography, but it is argued that the task which the user is solving is of paramount importance for a number of aspects.

The data harvested during the two surveys also suggest that there is a clear connection between the user's competence set, the task that the user is solving, the way the user prefers to access the data and last, but not least, the type of data the user needs. One example from Survey 1 reveals that a paramedic doctor uses the *Medicin.dk* app differently than do, for example, the hospital doctors. When asked "Which platform and user situation do you prefer?", one of the hospital doctors said "I prefer the website version of Medicin.dk, if my problem is complex. The app and the iPhone are handy, if I suddenly have a problem that I know can be solved by using the app. However, if I need more in-depth knowledge I would rather use the website". On the other hand, the test person working as an emergency doctor stated that "I prefer the app and I noticed that using it comes naturally for me, because I use it all the time. As an emergency doctor the app is much better. It is quicker and I do not have the time to use the website version".

Such choices are in fact only natural. When you want to hammer a nail into wood

you use a hammer. The task dictates that you use a hammer. The task comes first – not the tool, which in fact is also the essence of the popular expression "If all you have is a hammer, everything looks like a nail". In other words, if the tool you have is limited, simple-minded people (users?) apply the tool inappropriately. It is argued that this is what sometimes happens in mobile lexicography.

As will be evident from Figure 7 above, the user searched for a medicinal product called Tamoxifen. The autofill search function also works in the app as shown in the left-hand screen dump. If the user wants to tailor-make the data structuring of the app he can open the actual article as shown in the middle screen dump and click the option "Min visning" (My profile). Then a customization window appears as shown in the right-hand screen dump, and the user can select the data he wants. In other words, an oncologist for example may first of all select the groups of medicinal products that he often prescribes, and which is recommended in the treatment guides. Second, he can select the exact types of data that he needs when solving different tasks. If, for example, the doctor is going to inform a breast cancer patient about possible side effects, he may choose to enable "Bivirkninger" (side effects) and disable all other data types. In other words, you use the tool required to solve a specific task. Tarp (2014: 17) argues for the use of mono-functional dictionaries to avoid functional overload and for the development of personalised dictionary tools to avoid concrete overload and, as shown in Figure 7, this is in fact possible in the medical dictionary app *Medicin.dk*.

4.6 The Mobile Access Method

The way users access data is yet another important dimension when discussing mobile lexicography. According to Simonsen (2014: 260) "the mobile user navigates in both the physical world and in the user interface of the mobile device at the same time. This calls for a very simple and easy-to-use data access method, for example a very intelligent search engine or even better a voice-activated search engine like Siri in an iPhone".

The data seem to suggest that simple search-as-you-type search engines with a large search field are preferred by most users: Budiu (2015) argues that content and prioritization are extremely important issues to take into account on mobile devices. Scrolling through large text blocks reduces the information access success of users and as data from Survey 2 indicates, users do not explore the many possibilities of standard dictionary apps.

During the two surveys the 10 medical doctors and five teenagers exclusively used a semasiological data access method of typing letters in the search field. All test persons used this access method, probably because it is the most natural access method for most users, even though other ones are possible. Figure 9 below shows a section of the search fields in the two apps tested *Medicin.dk* and *Gyldendal Engelsk-Dansk.*

Both apps feature a standard search field of 4 cm x 0.5 cm, and as data from the two surveys show it is in fact quite difficult for both digital immigrants and digital natives to type the right letters by means of the touchscreen and at the same time monitor the correct spelling. That is why a search-as-you-type search feature is so important in mobile lexicography.

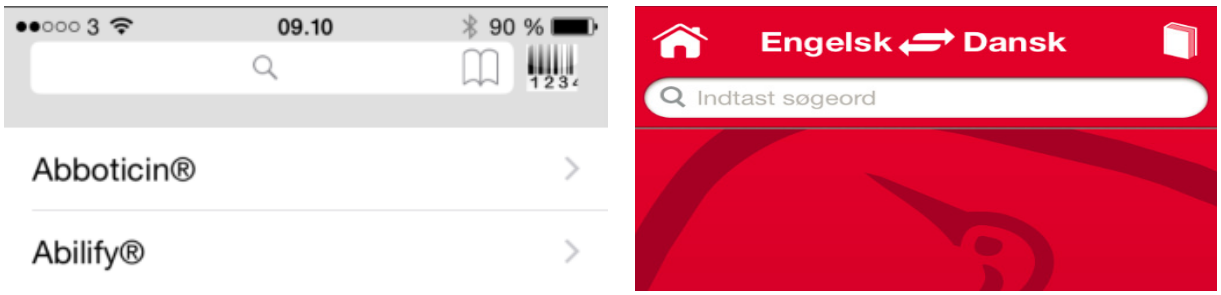

Figure 9: Search fields in *Medicin.dk* and *Gyldendal Engelsk-Dansk*

None of the 15 test persons used an onomasiological access method for looking up on the basis of concepts, etc. The medical dictionary app *Medicin.dk* does in fact offer a bookmark feature, where users can store frequently-used look-ups, just as the app allows users to access information on reimbursement, dispensation of medicine, etc. Finally, the app *Medicin.dk* also features an optical character recognition feature whereby health care persons can use the inbuilt camera of the mobile device to scan the bar code of medicinal products and this way check the type of medicine being administered to a patient.

The method by which users access lexicographic data on mobile devices is no doubt an area where more research is needed. As demonstrated above, users find it relatively hard to type correctly simply because the touchscreen is too small compared to the size of the index finger and thumb. At the same time users are often mobile when using mobile devices, thus rendering it even harder to type on the touchscreen and simultaneously navigate in the physical world. Consequently, new access methods and technologies are needed and one of the most promising solutions might be a voice-activated access method like Siri in most iPhones.

Too much focus on a single aspect in a complex situation very often results in failure. Other researchers have discussed this dilemma (e.g. Verlinde et al., 2010; Simonsen, 2011; Simonsen, 2013; Simonsen, 2014; Tarp, 2015 to mention just a few). Verlinde et al. (2010: 5) make a case for a "Lexicographic Triangle", Simonsen (2011) proposes the "Information Scientific Star Model", and Tarp (2015) argues for a back to basics approach where a mono-functional solution is recommended.

The above discussion can be illustrated in the hexagon model for mobile lexicography given in Figure 10.

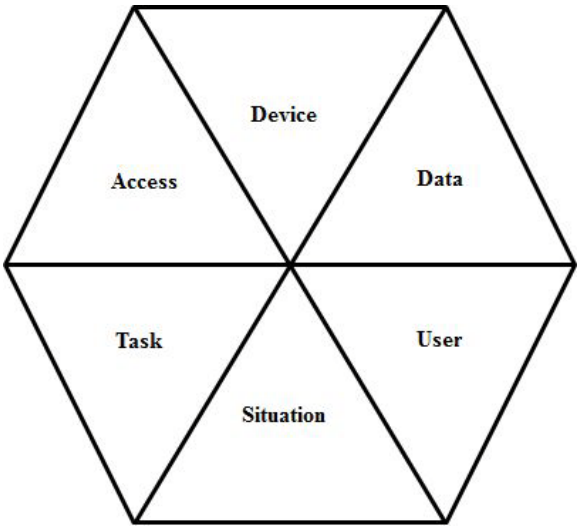

Figure 10: Mobile Lexicography Model

5. Conclusion

In this article the DNA of mobile lexicography has been discussed and a model for mobile lexicography proposed. Users have already gone mobile and to avoid the different types of information overload discussed by Tarp (2015), new more balanced solutions are required. All six dimensions discussed above should be taken into account. So no more lexicographic data dictatorship! No more user dictatorship!

What mobile lexicography needs is a balanced distribution of power whereby all six dimensions are calibrated vis-à-vis each other. The hexagon model proposed above illustrates that all six dimensions are interconnected, and it is argued that the hexagon model may enable lexicographers to design better dictionary apps.

This article has demonstrated how doctors and students use two different dictionary apps and has proposed a number of theoretical considerations regarding mobile lexicography.

Lexicographic innovation is required. Now is the time to do it right, otherwise lexicography as a discipline may die from a fatal *"identity crisis"*, as Tarp (2015: 16) argues. Therefore, much more research in mobile lexicography is needed and timely; because users have already gone mobile.

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Pro.medicin.dk app at App Store [21/04/2015]