



Automotive Voice UI Usability Study User Survey

Attitude, Experience, Motivation and Key Issues

Aachen, Germany, February, 6th 2009



1. Introduction

The purpose of this research project was to investigate the usage of in-car voice user interface (VUI) systems. Key focus areas of the survey were usage, acceptance of systems, motivation for using in-car voice interfaces and the main challenges that arise while using these systems. This study offers a better understanding of current usage while pointing to desired improvements for the next generation of in-car voice user interfaces. Therefore, questions were included that help developers determine additional areas where natural language voice control can be used.

The study was conducted among both users and non-users of in-car voice user interfaces in the USA and in the UK. There was a strict screening process to determine the desired target group for this study. Respondents had to drive a car that is equipped with voice enabled functions and was registered in 2007 or 2008, so that only state-of-the-art voice user-interfaces were surveyed. At least one voice enabled function, out of a list of 11, had to be used frequently in order to qualify for the study. If none of the voice-enabled functions was used frequently by a respondent, he or she was counted as a non-user.

Because in-car voice control provides the greatest benefits with navigation, the focus of the survey was on car drivers with a car that includes voice controlled navigation. In addition, the survey included a group of users with an in-car infotainment system controlled by voice (Ford SYNC[®]), but not necessarily with speech-enabled navigation.

473 respondents completed the questionnaires; among them, 108 were non-users and 365 were users. Non-users from USA and UK are consolidated into one group to ensure a representative size of this group. The groups of active users consisted of 133 drivers from the UK, 179 users of speech-enabled in-car navigation from the USA and 53 users of Ford SYNC[®].

Interviews were conducted between November 30th and December 22nd 2008.

2. Management Summary

2.1 General Usage of Voice User Interfaces (VUI)

If voice enabled functions are built-in, most drivers use this functionality. Only 1 in 9 drivers is a non-user, resulting in a share of 11%. Taking into account that about a third of all non-users use occasionally voice control, there is only a small portion of about 7% who never use voice control even though it is available to them. Of all non-users in this study, two thirds are female.

Figure 1 shows that users of in-car VUI systems very frequently place and accept phone calls by voice while driving. Adding together the users who always and frequently control a certain function by voice, 83% place and 80% accept a phone call by voice command while driving. Entering an address by voice or selecting a point of interest by voice is done by 76% and 69% of all users respectively. 70% of the users with a Ford SYNC® systems always or frequently control their media player by voice. This demonstrates that usage of voice control is not limited to a single function.

Comparing users in the USA and the UK shows that there is a slightly higher usage rate in the UK than the USA, but in most cases there is no significant difference. Only 'selecting a point of interest' by voice is more frequently conducted in the USA compared to in the UK.

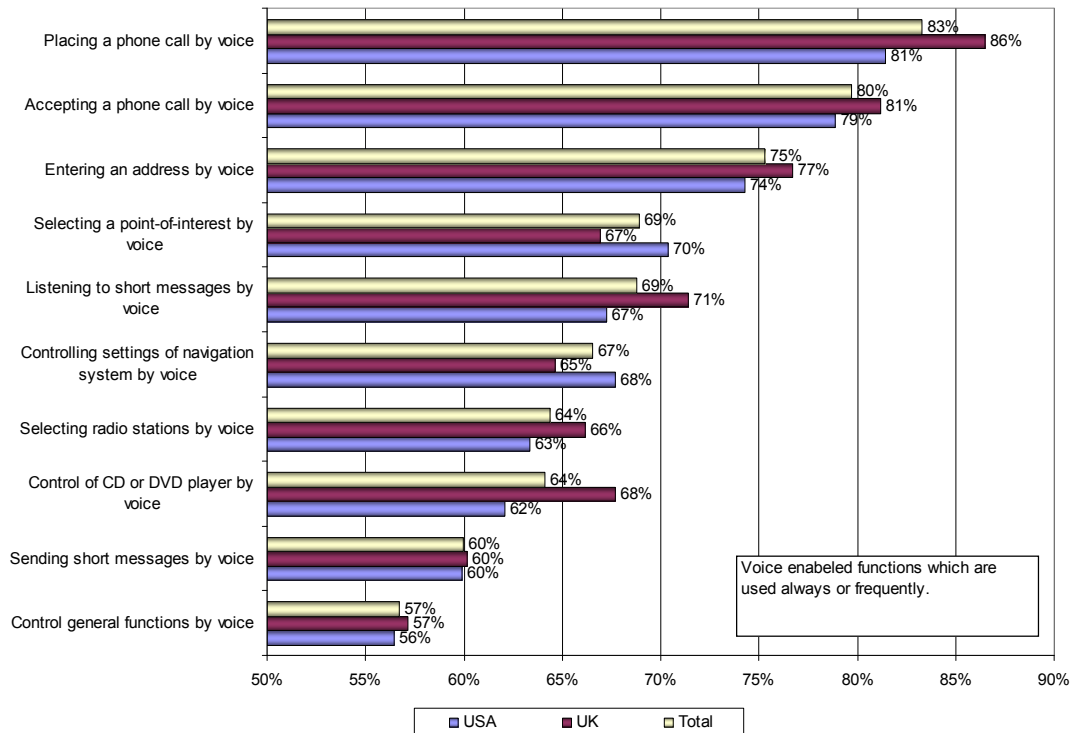


Figure 1: Which of these functions do you use while driving?

In order to measure agreement or disagreement with statements, general satisfaction or likelihood, we used a 10 point scale where 1 represents the lowest score and 10 the highest score. Therefore values for satisfaction, recommendation and likelihood to repurchase are rated on a 10-point scale (figure 2).

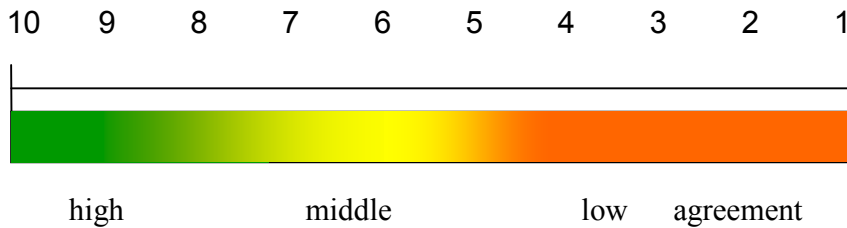


Figure 2: 10-point scale

Figure 3 shows, that if drivers have experienced voice recognition in their car, there is a high likelihood to purchase a car with speech enabled functions again. Additionally, satisfaction with voice controlled functions and likelihood to recommend voice recognition are generally high. Findings suggest an expectation that consumers will increase their demand for cars with speech recognition.

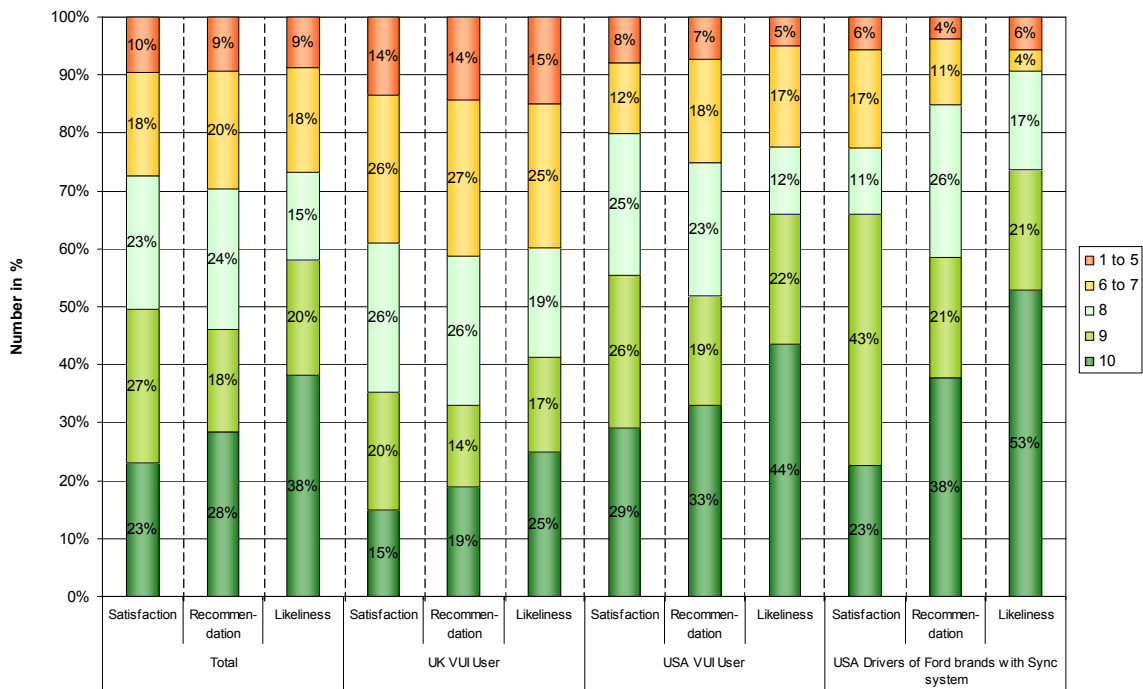


Figure 3: Satisfaction with voice controlled features, Likelihood of recommendation of an speech controlled system and likelihood to repurchase a car with speech controlled functions

USA users with a Ford SYNC® system yield the highest scores in satisfaction, recommendation and likelihood to repurchase, while drivers in the UK yield the lowest values on these (figure 3, top 2 scores (rating 9 + 10)).

There are some striking differences between the USA and the UK. In the UK, the level of satisfaction, recommendation and likelihood to repurchase decreases with increasing age of respondents. In the USA, the level of satisfaction, recommendation and likelihood to repurchase is almost not affected by age.

2.2 Situational Preferences for Voice Interfaces

Users of in-car voice recognition were asked to name circumstances out of a predefined list where they prefer voice control over manual control. As shown in Figure 4, it appears that in almost all the driving scenarios listed, users prefer voice to manual control. Only when the car is idle or when accompanied by passengers is there no clear preference. Results demonstrate that voice control is widely accepted by users.

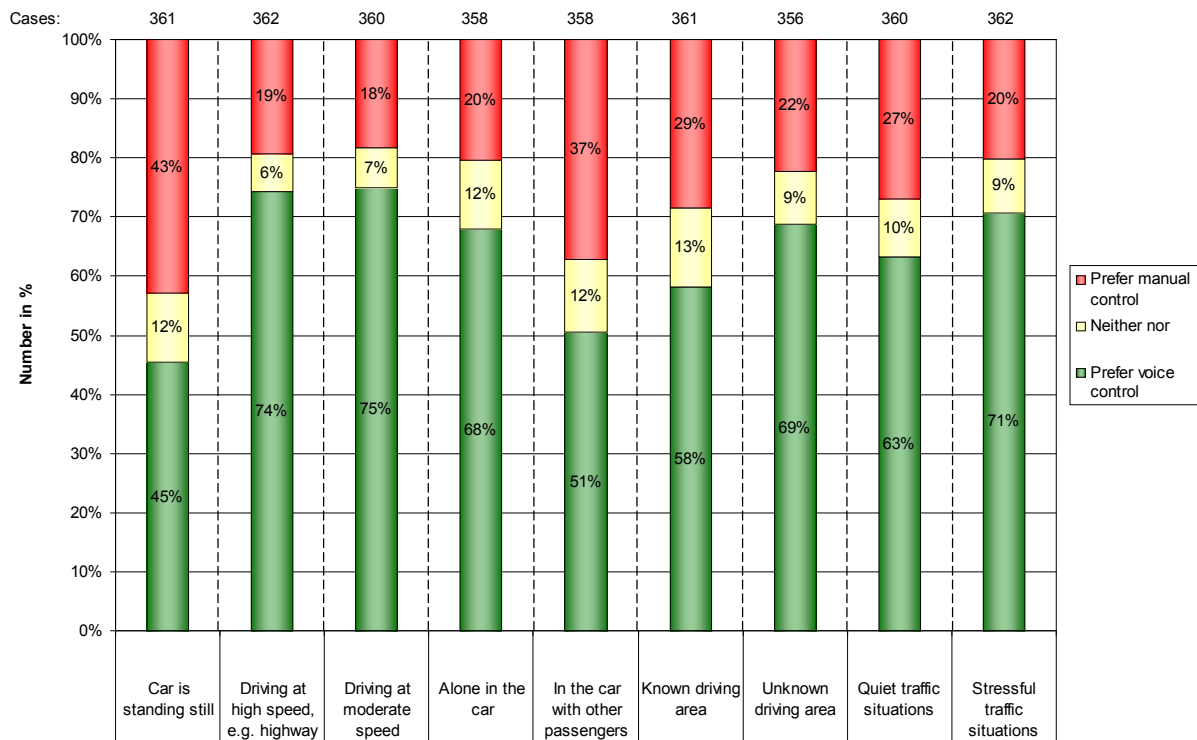


Figure 4: Please describe the circumstances when you prefer voice control over manual control!

Younger drivers and drivers from the USA tend to use voice control more than other subgroups in this study, even when the car is idle. The preference for using voice control is higher for older drivers when driving at moderate or high speed where they value it most. Being alone in the car, in unknown driving areas or in stressful traffic situations, older drivers again have a higher preference for voice control in comparison to younger drivers.

2.3 Key Drivers for Using Voice Interface

When asked in an open question what they liked most about the voice controlled functions, most users mentioned the fact that voice is hands-free, safe and easy to use (Figure 5). Surprisingly, legal requirements do not seem to be a key motivation for using voice control, or it is not top of mind when users are asked unaided.

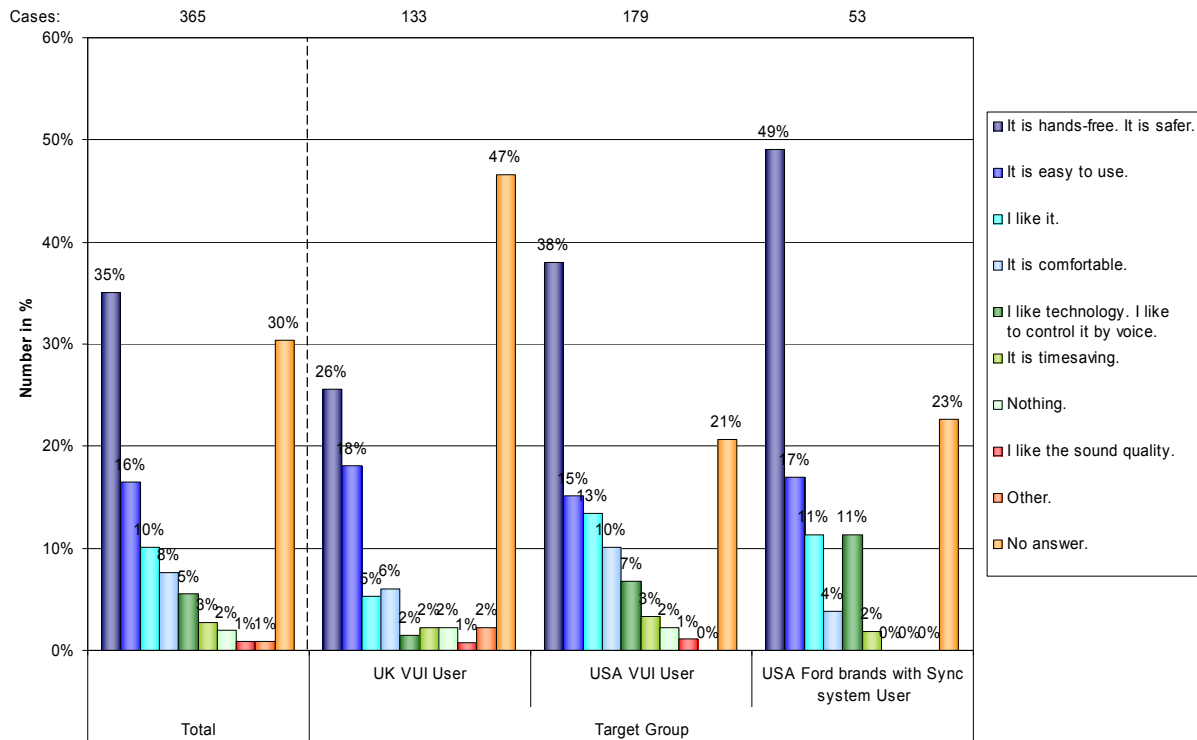


Figure 5: Open question: What do you specifically like about the voice controlled functions in your car?

This finding is again supported by measurement of motivation on a 10-point scale, where legal requirements yield the lowest motivation for using speech recognition (Figure 6). Ease of use, less distractions and simply 'liking it better' are the main reasons for using voice user-interfaces. Users of Ford SYNC® systems showed the highest motivation to use voice controlled functions in the car.

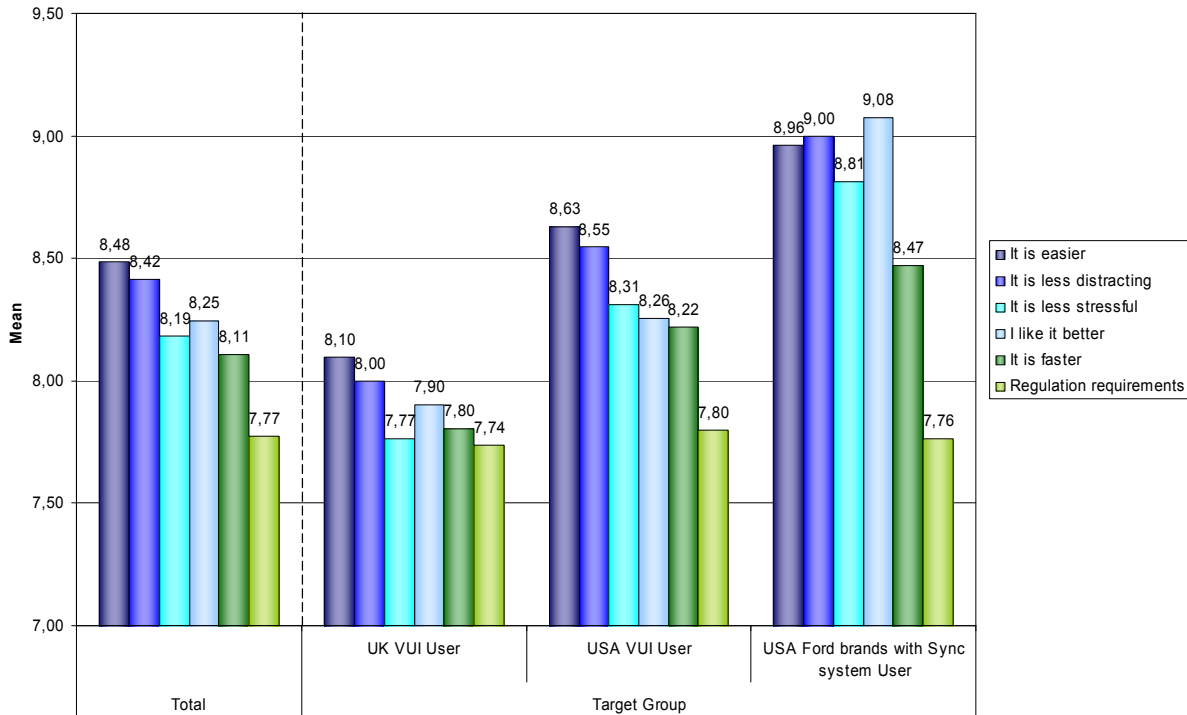


Figure 6: Why do you prefer voice control over manual control in your car?

2.4 Navigation Related User Preferences

The majority of recent navigation systems are equipped with the ability to enter a point-of-interest (POI) as destination (91% of the navigation systems in this survey). On average, car drivers enter a destination as frequently by selecting a POI as they do by entering a specific address. Therefore, optimizing the ability to enter POIs by voice is considered an important task. When asking about the challenges that arise while entering a point-of-interest (in general, not only by voice) 'too many subcategories' and 'categories that don't contain the desired information' are the most common answers (Figure 7).

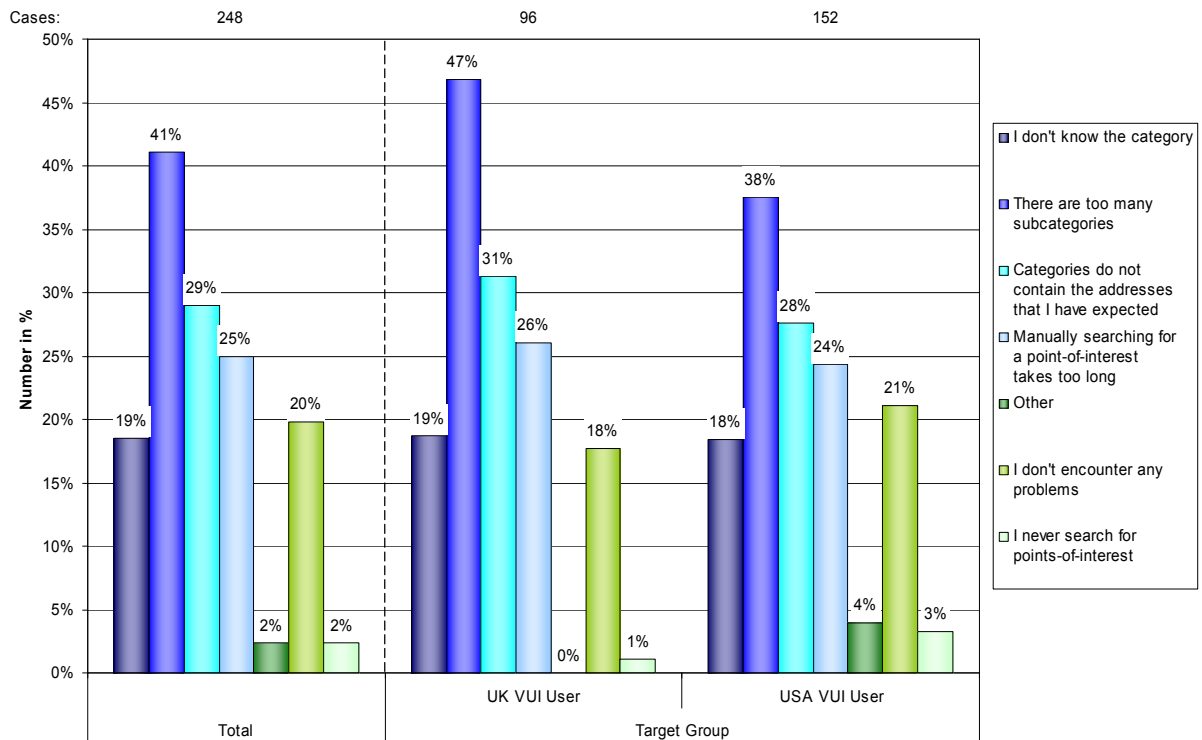


Figure 7: Which problems do you generally encounter when searching for a point-of-interest?

2.5 Areas of Improvement

A key aspect of the survey is to determine the areas where today's voice controlled systems can be improved. Below are 13 recommendations for improving existing built-in speech controlled functions, and recommendations for new functions. Results demonstrate the individual importance of the recommendations, helping to prioritize future in-car speech recognition development initiatives.

In order to identify the relative importance of features for the respondents, the so-called Maximum Difference Scaling (MaxDiff) methodology was chosen. When asked how important a certain function is, respondents tend to give high scores for all proposed functions. This "ceiling-effect" in turn defeats the goal to discriminate between functions as most receive a similar rating. The MaxDiff methodology circumvents this problem.



Please consider what is **truly important** to you when looking for new or improved built-in speech controlled functions in a car.

Which one of these speech controlled functions make you **most** want to have and which one make you **least** want to have.

| Most Important | | Least Important |
|----------------------------------|--|----------------------------------|
| <input checked="" type="radio"/> | Access of up-to-date traffic information / weather information | <input type="radio"/> |
| <input type="radio"/> | Read out short messages / e-mails | <input type="radio"/> |
| <input type="radio"/> | Better recognition of regional accents | <input type="radio"/> |
| <input type="radio"/> | Select destination by Postal Code | <input checked="" type="radio"/> |

Next



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Figure 8: Example for a MaxDiff question

The output of the MaxDiff analysis can be scaled so that the importance of all items adds up to 100%. The most desired improvements are ‘better recognition in general’, ‘access to connected services’ like weather or traffic information, and ‘selecting points-of-interest by voice’.

New natural language understanding (NLU) features such as ‘more flexible phrasing’ and ‘entering destination in one utterance instead of step by step dialogue’ are the fourth and fifth most desired functions. The following chart (Figure 9) displays the priority and importance of all 13 items under investigation for all respondents.

Cases: 365

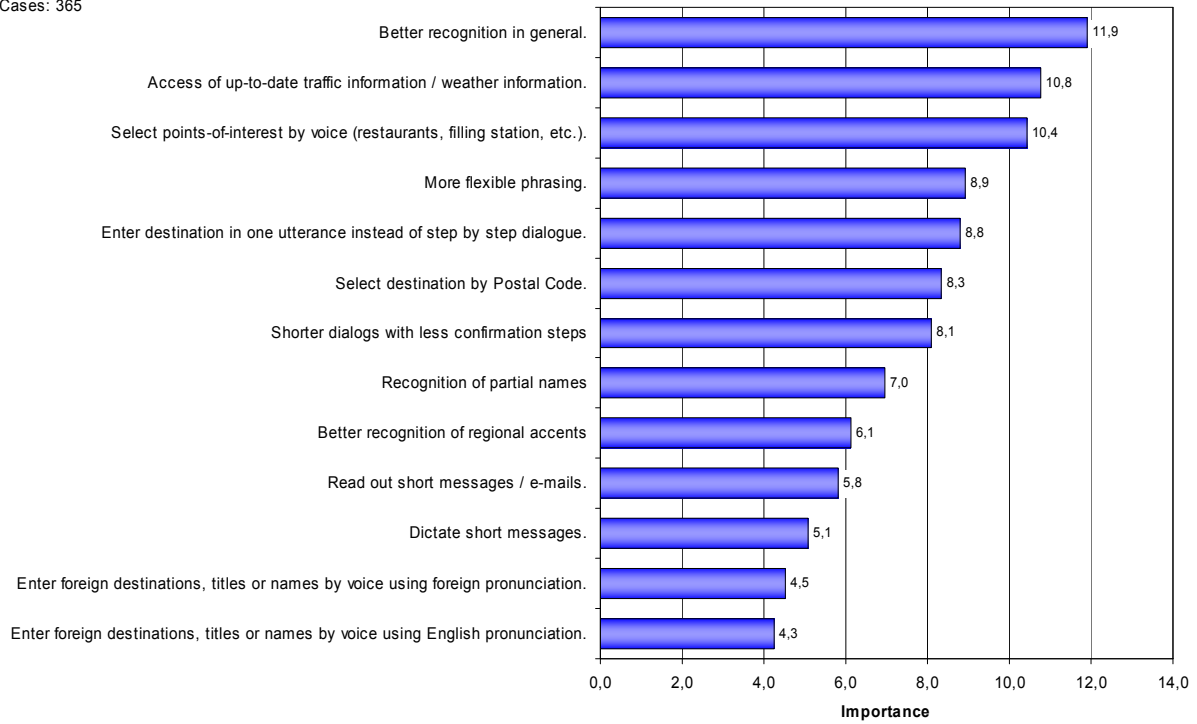


Figure 9: Priority of desired system improvements (UK and USA)

While preferences among the top five items are similar in the USA compared to the results of all respondents there are some differences for UK-users (Figure 10). 'Selecting destinations by Postal Code' is the second most desired function whereas this function is in the lower half for USA drivers. Also NLU-functions in the UK are more in the middle of all items compared to the USA where these functions are among the top five items. The following chart shows the results for UK-drivers.

Cases: 133

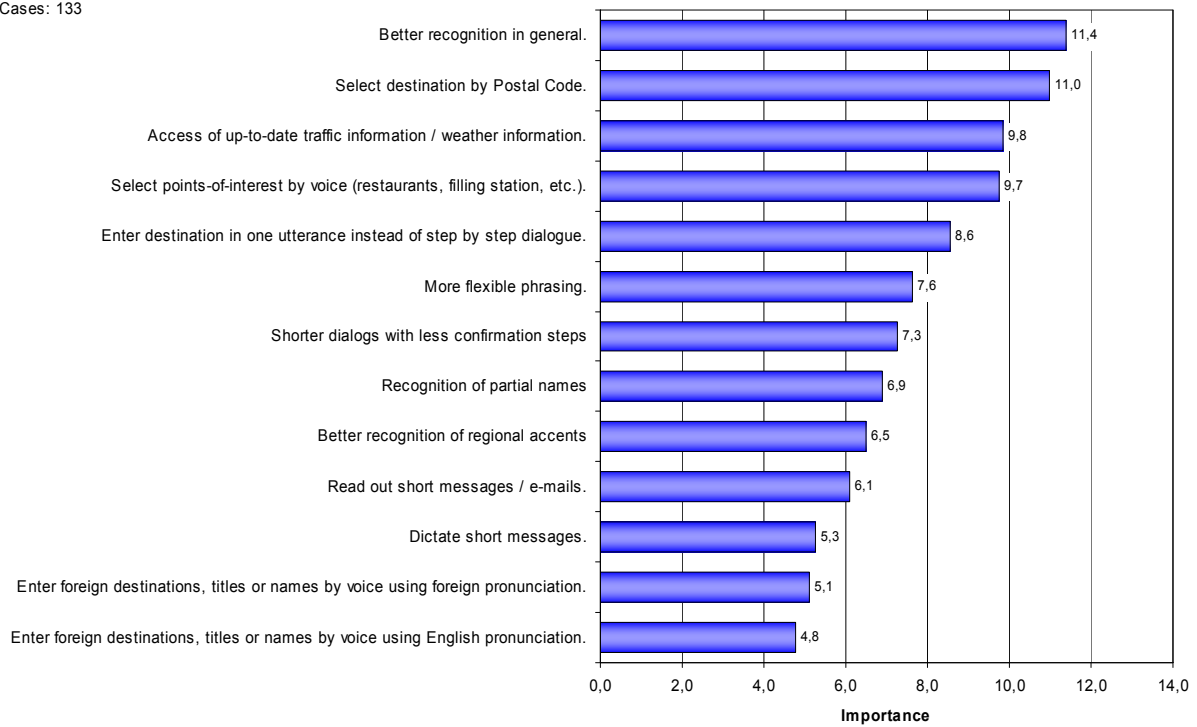


Figure 10: Priority of desired system improvements (UK)

Drivers of Ford vehicles with SYNC® (Figure 11) differentiate the most between the proposed features. If one adds up the importance of the top six items for users of Ford brands with Sync ('Better recognition in general', 'Access of up-to-date traffic or weather information', 'Select points-of-interest by voice', 'Shorter dialogs with less confirmation steps' and 'Enter destination in one utterance instead of step by step dialogue'), they yield a significantly higher combined value compared to the top six items for UK-drivers or for other US-drivers. Connected services also seem to be of more importance to user group.

Cases: 53

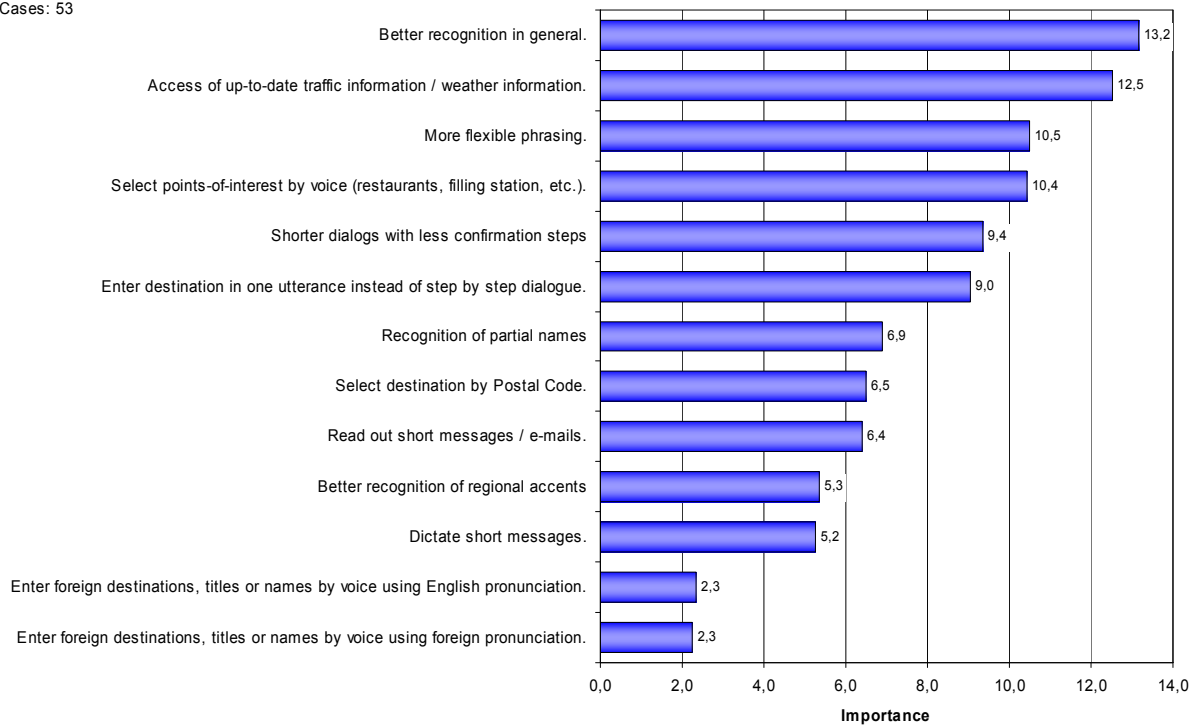


Figure 11: Priority of desired system improvements (USA Drivers of Ford brands with SYNC® system)

2.6 Problems Encountered

In the final section of the survey, users and non-users of voice recognition are asked about challenges they encounter while using voice control and their reasons for not using voice control at all. Surprisingly, more than 50% of the non-users stated that they have simply never tried using them. Only 23% of the non-users stated that they started using command and gave up over time.

About two-thirds of all non-users are older than 40 years and are female.

When asked about the length of time users and non-users needed to get used to the speech controlled system, younger drivers become acquainted to the systems faster than older drivers and UK users seem to take longer to become familiar with the voice control functions. Roughly 20% of all respondents still feel as though they are not familiar with the basic voice commands (Figure 12).

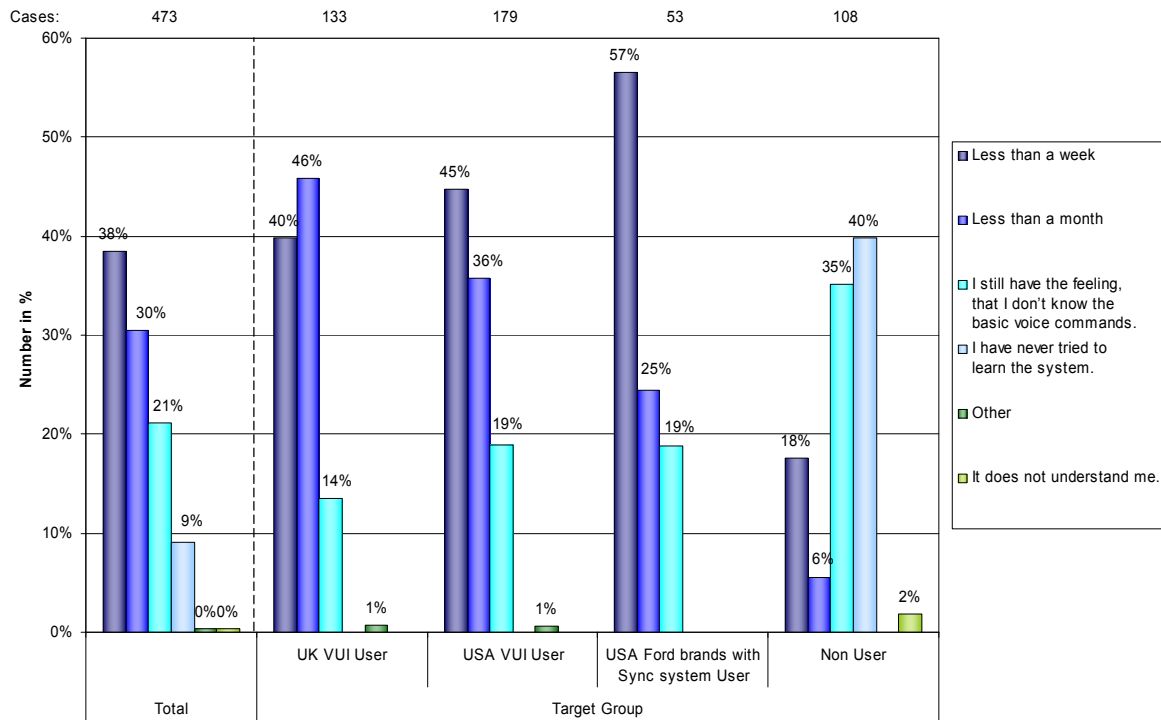


Figure 12: How long did it take you to get used to the speech controlled system in your car?

Several challenges are reported by users and non-users in using voice recognition. One out of five respondents has not encountered any issues. For users of SYNC®, this is 1 out of 4 respondents. The most common challenges cited were commands that cannot be remembered or car manuals that are too complicated to reference (Figure 13). Interestingly, only 15 % of all users held car dealers responsible for not explaining the systems sufficiently.

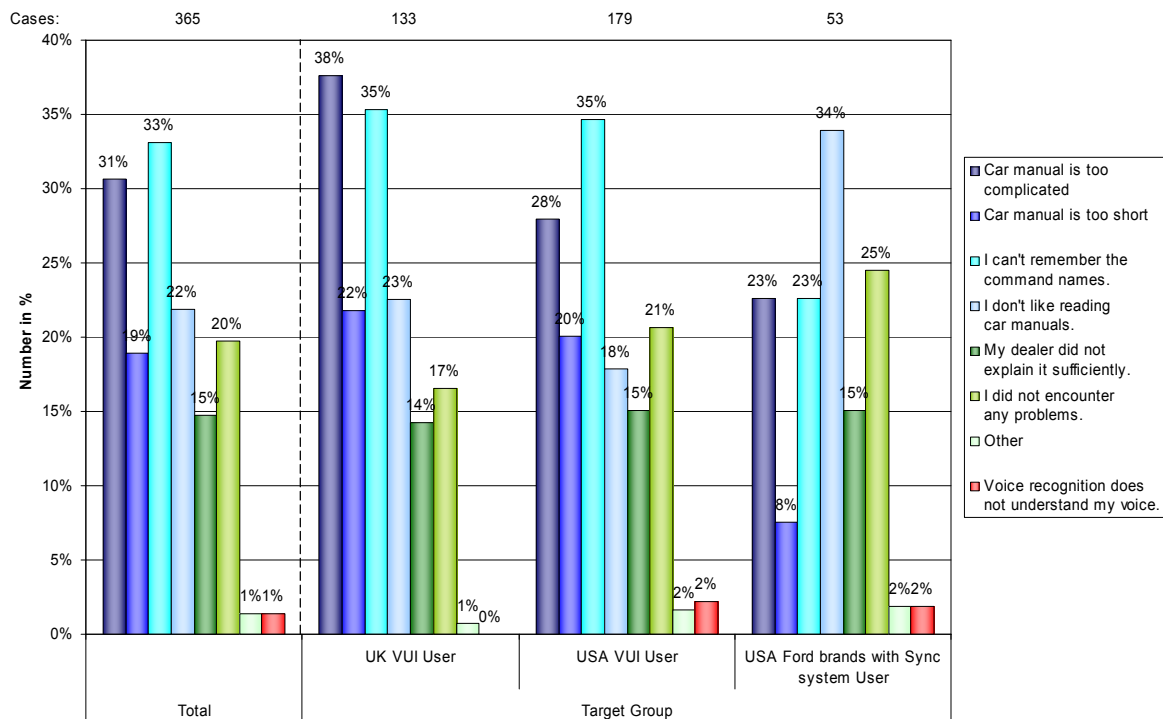


Figure 13: What kind of problems did you encounter when you tried to get used to the speech controlled system in your car?

Overall, all users felt that they could use more assistance in getting acquainted to the voice control systems. Non-users often consider manual control faster than voice commands. When asked about the things that they disliked users rated features related to the dialog flow rather high. (Figure 14). The dialogues are often perceived as being too long with too many confirmations needed. This indicates that shorter, more natural dialogues with the system may help to improve acceptance also amongst non-users. Recognition performance for different tasks was also mentioned as another frequent challenge by users and non-users. The mean value on a 10-point scale of agreement is shown in the following chart for 17 possible problems.

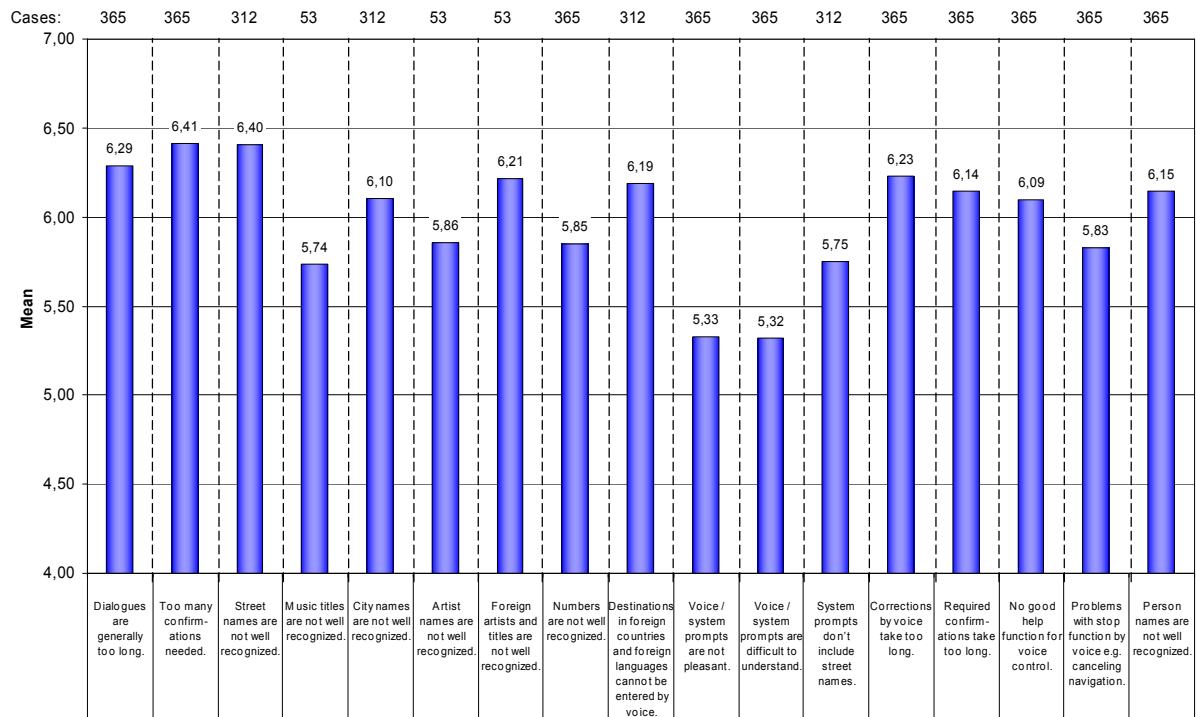


Figure 14: What do you specifically dislike about speech controlled functions in your car?

3 Outlook

The objective of this survey was to assess car drivers' usage and acceptance of existing in-car voice interfaces, to learn more about their expectations, and to understand the key problems of non-users. The survey is one important element of a larger initiative to gain deeper knowledge of car drivers' behavior and to identify voice user interfaces that meet drivers' needs, are easy to use, and reduce driver distraction.

Recent studies, including the 2008 'In-car distraction study' by Mark Vollrath, et. al., from University of Braunschweig, Germany, demonstrate that well-designed voice user interfaces significantly reduce driver distraction compared to manual operation of navigation, telematics and entertainment systems in cars.

This survey shows that the vast majority of car drivers that have speech-enabled in-car systems use them on a regular basis and prefer voice commands to manual operation in almost all traffic situations. The main motivations for utilizing voice user interfaces are hands-free control, safety, ease-of-use and reduced distraction. The survey also identifies the main areas of desired improvements from car drivers' perspective in order to further increase acceptance and usage of in-car voice controlled functions. Next to better recognition performance in general, improvements are expected both by current users and non-users in the area of shorter and more intuitive dialog flows and more natural phrasing.

The survey will be followed by further research steps including scenario-based design techniques and focus group methodologies to develop and validate dialogue techniques that address these areas of improvement with regards to usability and driver distraction. Overall, the goal is to identify and prioritize the implications for technology roadmaps, new feature development and dialog design, thus creating voice user interfaces for in-car systems that truly meet car drivers.