Aalen University
INSTITUTE FOR CONVERSATIONAL BUSINESS

Smart Speaker Study 2022

Google Assistant

amazon alexa

Cortana

Siri

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AGENDA

1. PURPOSE
2. RESEARCH OBJECTIVE
3. FINDINGS
4. INTERNATIONAL BENCHMARKING
5. FUTURE PROSPECTS

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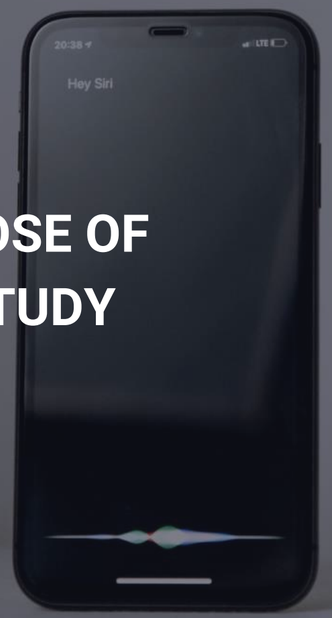

PURPOSE OF THE STUDY

AI has been on the rise for many years. Voice-based (chat)bots are one application of AI. They are a further development of text-based (chat)bots, which enjoy great popularity.

The best-known use of voice-based (chat)bots is in so-called intelligent personal assistants. The aim of voice-based (chat)bots is to enable the user to carry out a wide range of functions by means of a simple verbal request, in order to make this considerably easier through intuitive operation. For example, they can be used to operate smart-home devices or to order things on the Internet.

The aim of the work is to find out how well the four most common bots - namely Amazon Alexa, Apple Siri, Google Assistant, and Microsoft Cortana - currently work, and to compare their functionality with each other. Following an evaluation of the found results, future uses will also be discussed.

ALEXA

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Amazon Alexa is a voice assistant developed by Amazon in 2013, mainly for the Amazon Echo series of smart speakers. Alexa provides all the functions that are common for voice assistants, however, it is also possible to install so-called "skills" for Alexa, which were developed by third-party providers.

Amazon's goal with Alexa is to better integrate their online shop into people's lives, making it significantly easier for customers to order from Amazon. Nowadays, many people just order things through Amazon instead of driving to a local store, which in the future will even shift as one's won't even have to use a computer to order online. It's just a matter of telling Alexa what to buy.

SIRI

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Siri

Siri is Apple's voice assistant released in 2011. It was developed exclusively for the Apple ecosystem and is therefore only available for Apple devices such as the iPhone, iPad, iMac and Apple HomePod. Siri's additional features had been developed by third parties, however, compared to other voice assistants, the offering in this field is rather limited.

Apple's goal with Siri is to take as much work off the hands of users as possible and to make using their devices as pleasant as possible, as many functions can now be done much more easily via voice assistants, such as setting an alarm clock. Therefore, it is also important for Siri to be cloud-based in order to connect all devices in the Apple ecosystem and to establish Siri as the interface for this interaction.

GOOGLE ASSISTANT

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Google Assistant is a voice assistant developed by Google. Assistant is the successor to Google Now, which it replaced in 2016. It provides all the usual functions of a voice assistant and is available on all Google devices as well as on devices that offer Google integration. Furthermore, Google Assistant offers the possibility of integrating apps and thus obtaining new functions.

Google's goal with the voice assistant is to enable a personalized Google for every user. It is also intended to bring Google's core product range to the next level in order to remain relevant.

CORTANA

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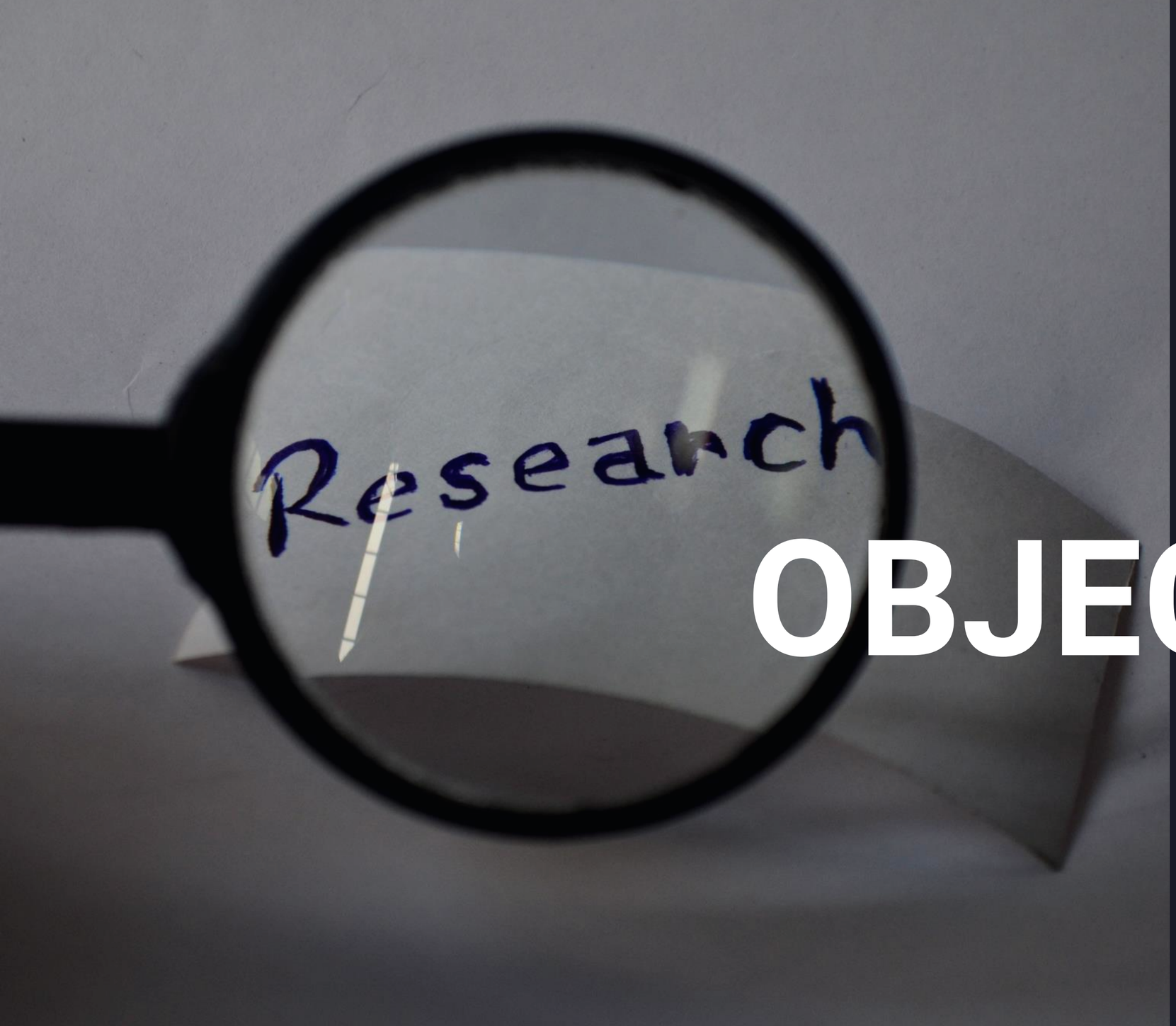
Cortana

Cortana was developed by Microsoft and appeared in 2014 for all Windows devices. In the meantime, Cortana was also available for Android and iOS, although this was terminated after a while. Compared to other voice assistants, Cortana includes relatively few third-party functions, which is not necessarily Microsoft's goal for the voice assistant, as Cortana is used in a different environment.

Initially Cortana was intended to be a voice assistant similar to its competitors Google, Amazon and Apple, however Microsoft has since shifted its focus. On the basis of user numbers, Microsoft realised that they could no longer keep up in this field.The Cortana apps for mobile devices were terminated and subsequently the best possible integration of Cortana in Windows and Office 365 were defined as the new goal. Therefore, Cortana was also adapted to more text-based input, as there are many computer users who do not want to talk to their PC or who need additional hardware to do so. Microsoft Cortana is now intended to be a productivity assistant in the Microsoft environment rather than a general personal assistant on multiple platforms.



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OBJECTIVE

RELEVANCE & MODEL

The study aims to determine the current state of voice-based (chat)bot technology and to identify any differences between them. In order to achieve this, qualitative and quantitative criteria will be used to examine whether the voice assistants can correctly recognise the intentions of the questions from the consumer's point of view and provide appropriate answers. For this, the voice assistants must be evaluated according to their conversational ability. Therefore, a catalogue with 71 questions from 4 categories was created:

- **Personal questions**
- **Knowledge/technical questions**
- **Questions about functions**
- **Conversational questions**

The answers are first checked to see whether the intention of the question was understood at all and then evaluated according to the following criteria:

- **Relevance and accuracy of answers**
- **Speed of answer**
- **Comprehensiveness and informative character of the answers**
- **Reliability of the answers (must the question be repeated)**
- **Accessibility and user-friendliness**
- **Entertaining nature of the answers**


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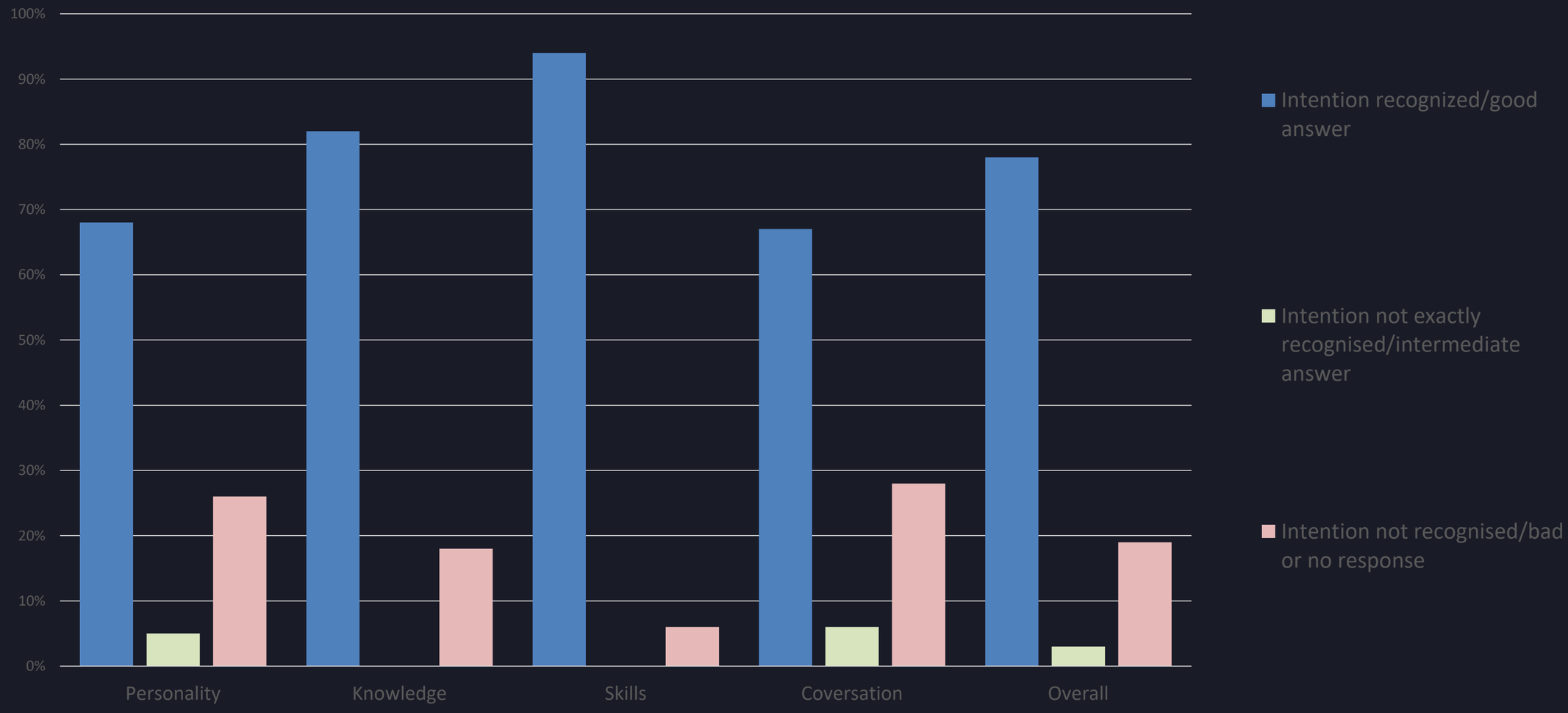
FINDINGS

ALEXA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Personality
Knowledge
Skills
Coversation
Overall
Intention recognized/good answer
Intention not exactly recognised/intermediate answer
Intention not recognised/bad or no response

ALEXA

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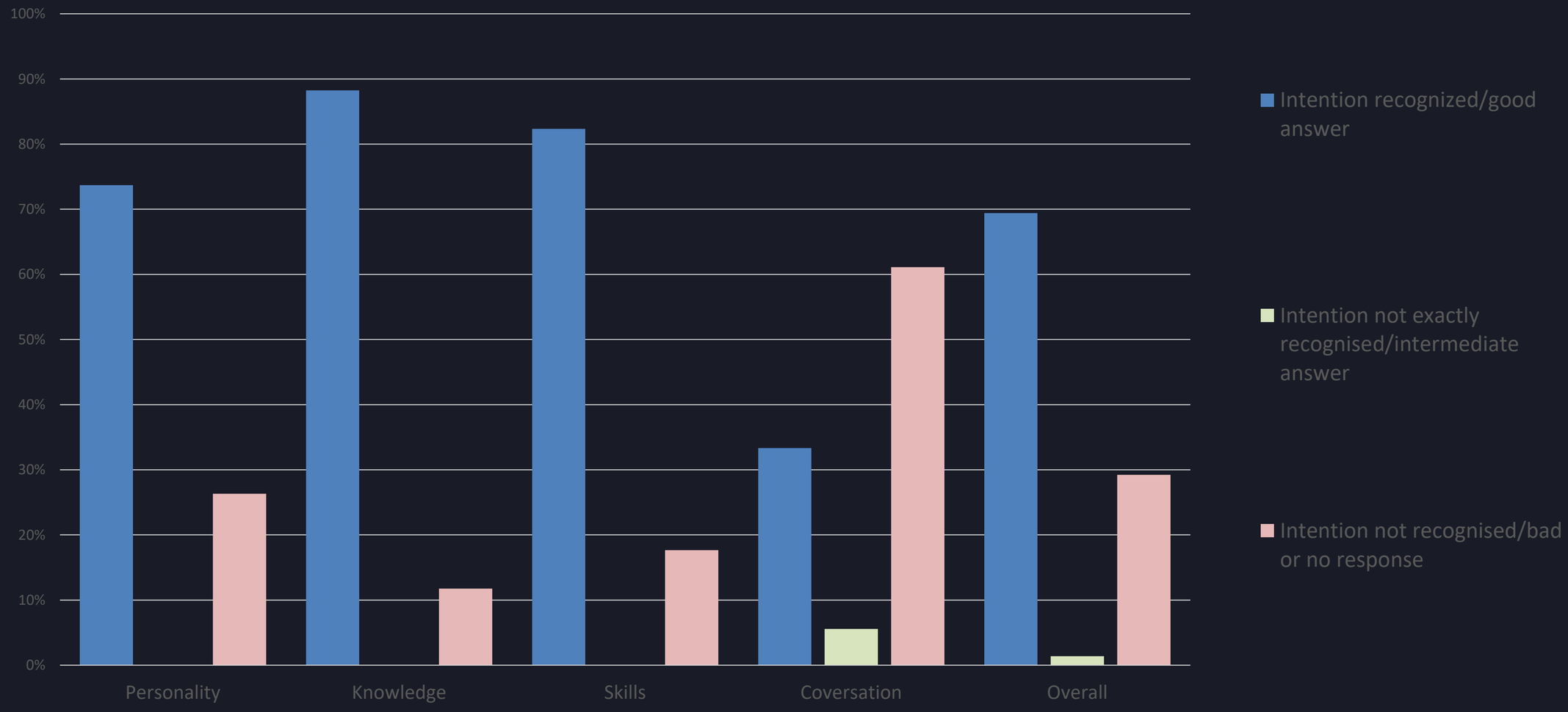
Alexa was able to **recognize the intention** and give a **good answer to 55 out of 71** questions and thus has an overall rate of **77%** of correctly answered questions in the study.

Alexa shone especially in the categories Skills and Conversation, which can be explained by the integration of the Amazon online store and the numerous third-party skills for Alexa. Alexa's answers were always very fast, good and often very detailed, which is another advantage. A reformulation was rarely necessary overall.

When asked "Wie heißt du?“ Alexa answers with a rap song introducing herself, or when asked "Magst du Sport?" she answers that she loves brain jogging and is very good at it. There was one question where Alexa didn't exactly realize the intention and gave a somewhat confusing answer. When asked "Magst du es mit mir zu sprechen?“ she initially answered in the affirmative. After that, however, a function of hers was presented that had nothing to do with the original question.
As another example, when asked about the current Corona rules in Baden-Württemberg, the complete regulations currently in force were read out and where they apply quite precisely. This is a big plus compared to the other voice assistants. Alexa was the only voice assistant in the test that could execute the request for the purchase of a toothbrush, which can be attributed to the link to the Amazon store. Also the question "Wann fährt der nächste Zug nach Frankfurt vom Stuttgarter Hauptbahnhof aus?" could not be recognized by Alexa.

SIRI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SIRI

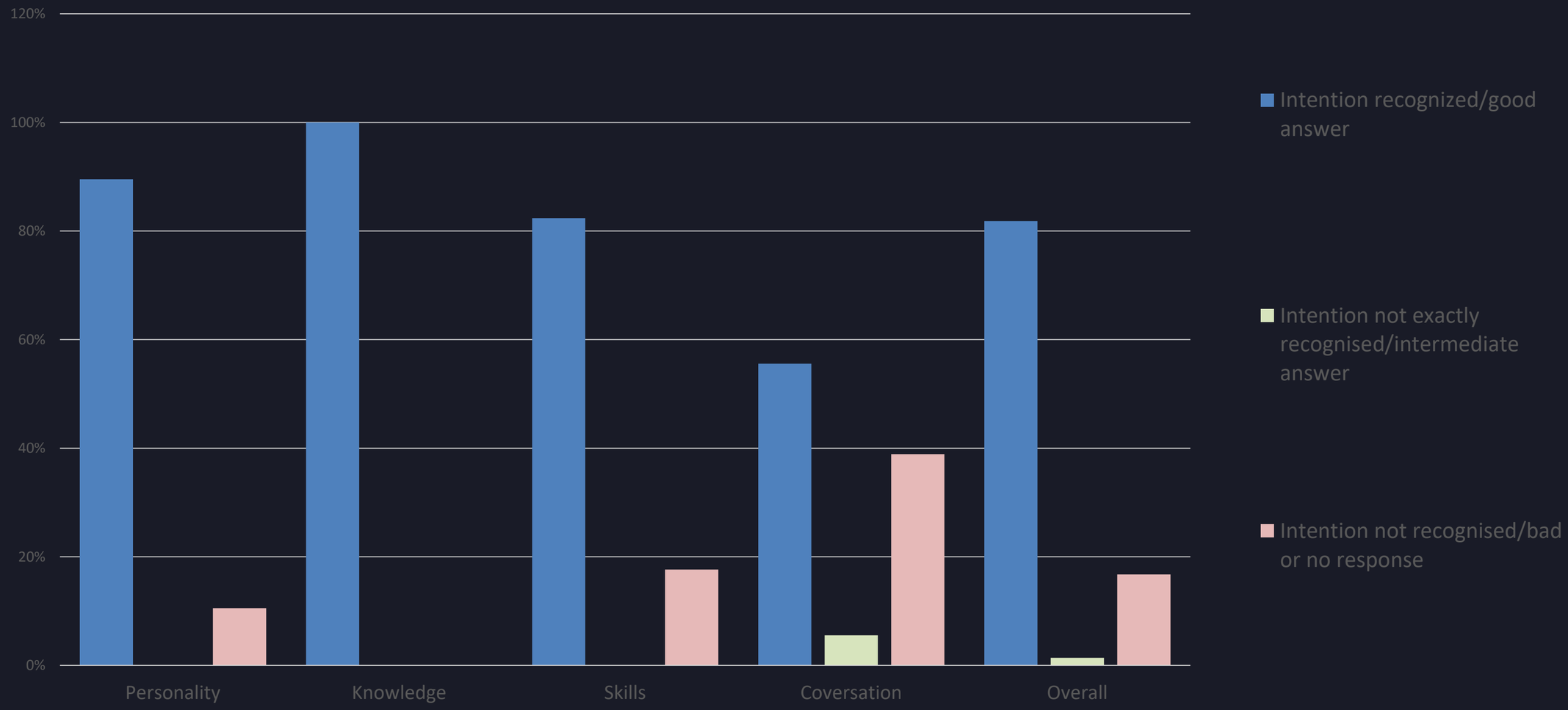
Siri

Siri was able to **recognize the intention in 49 of 71 questions** and give a good answer. Thus, Siri was able to answer about **69%** of the questions. Only in the conversation category could Siri not convince at all and took last place.

Thus, Siri is more of an all-rounder and does not really stand out in any category. This could be due to the fact that Apple develops its voice assistant with the intention of complementing their operating systems and not for the one specific reason like Amazon, for example, to expand their range. Siri's responses were always accurate and good. However, the speed was noticeably slower compared to the two better placed voice assistants.

Some questions Siri could not answer. However, these questions tended to be the more difficult ones in the personality category, such as "Was findest du lustig?“ or "Wie viele Gespräche führst du am Tag?“. In addition, some questions had to be rephrased so that Siri recognized the intent. For example, the question "Hast du eine Lieblingsfarbe?“ was not understood correctly and the answer did not match the question, whereas the rephrasing "Was ist deine Lieblingsfarbe ?" was recognized and answered. In the question "Wer ist der aktuelle Außenminister von Portugal?“ Siri searched for the Prime Minister of Portugal and in the question about the size of Brazil in comparison to Germany she also did not know.

GOOGLE ASSISTANT



GOOGLE ASSISTANT

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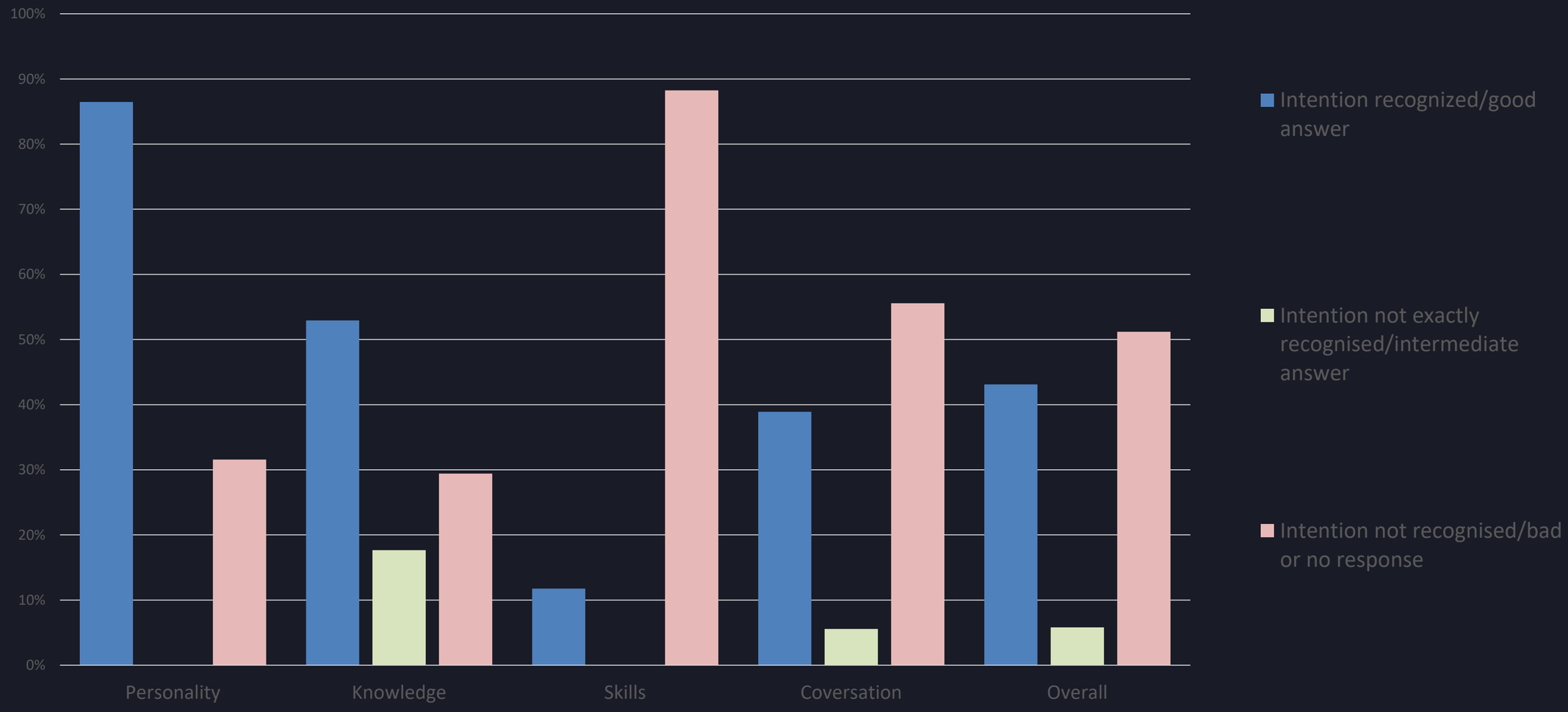
The voice assistant was able to **recognize the intention in 58 of 71 questions** and give a good answer. This means that it was able to answer around **82%** of the questions asked. Assistant's result in the knowledge category should be emphasized, where **100% of the questions were answered**.

This is probably due to Google's know-how in the field of search engines, which is why this category probably suits the voice assistant best. The speed of the answer was also very fast. Once the question is asked, the answer comes directly without delay. Another positive aspect is that Google Assistant was able to answer the questions reliably without having to rephrase them several times.

Overall, Assistant's answers were very good and entertaining. Emojis were often added to the answers in the log and, for example, Assistant told a joke and accompanied it with a sound effect when asked "Was findest du lustig?“. It should also be noted that Assistant was the only voice assistant that could correctly answer the questions about the foreign minister of Portugal and the size of Brazil in comparison to Germany. The total area and length of the coast were listed and it was stated that this was about 23.8 times the size of Germany.

CORTANA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CORTANA

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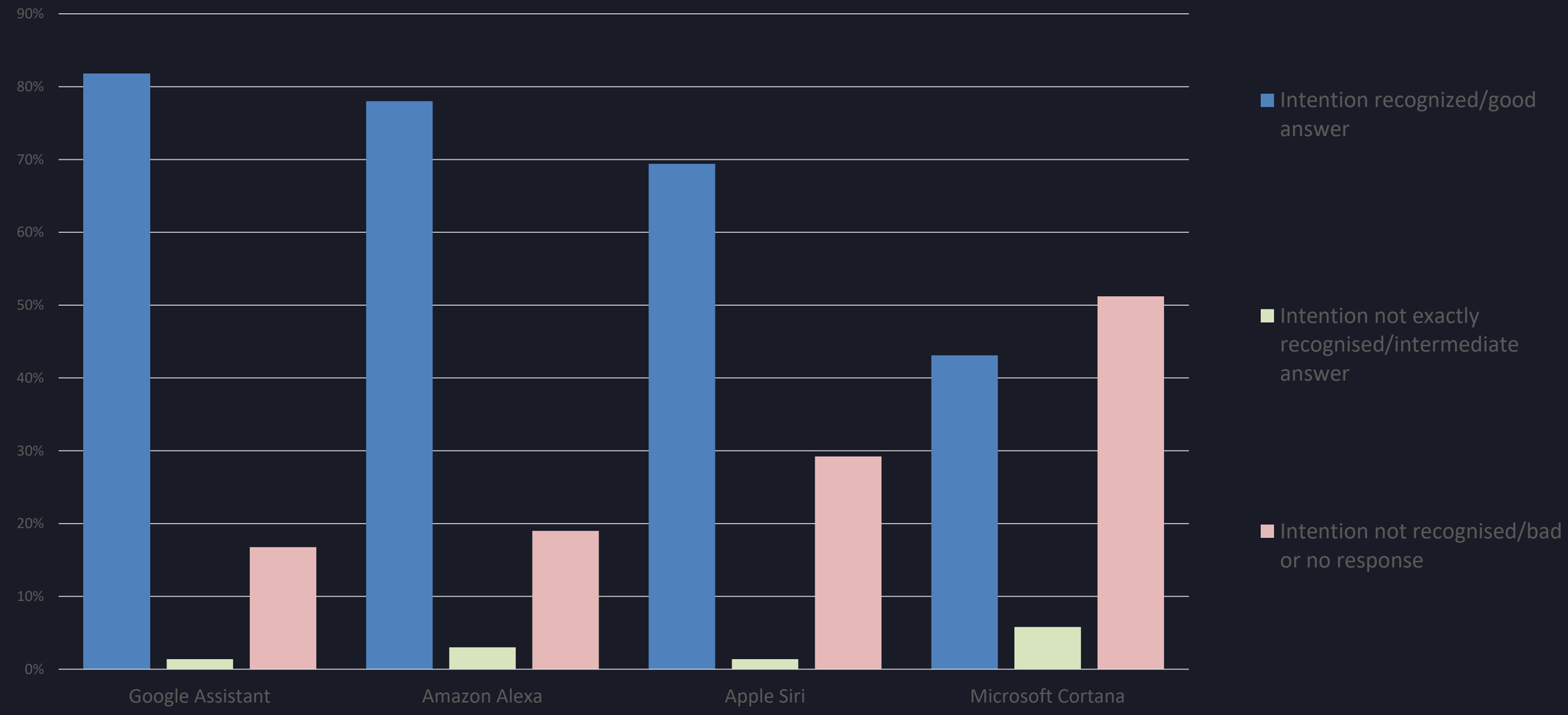
Cortana

Cortana was able to **recognize the intention of 31 of 71 questions** and give a good answer, which corresponds to a rate of about **44%**. Thus, Cortana is the only tested voice assistant that could answer **less than 50%** of the questions asked.

This result can be explained by the fact that Microsoft has a different objective for Cortana and concentrates on Windows desktop devices. The answers given were always precise and good and were even very detailed in some cases. However, just like Siri, the speed was noticeably slower than in the first two places. In addition, the questions had to be rephrased more often so that the intention could be recognized.

Some answers are also entertaining, such as when asked "Magst du Sport?" Cortana answers that she sometimes spins in circles, which is enough to burn excess kilobytes. For example, when asked "Wer ist der aktuelle Außenminister von Portugal?“, Cortana shows as an answer an article about the Covid-19 aid of Germany, in the course of which the name of the foreign minister is mentioned, or when asked about the size of Brazil compared to Germany, Cortana answers with a source that mentions the size of Brazil, but only says that Germany is very small in comparison. It was noticeable that Cortana also had problems with simpler questions. For example, she was the only voice assistant that could not answer the question “Was ergibt 256/0?“ which was very surprising. The question "Wann öffnet das Porsche Museum in Stuttgart ?" could not be answered either, although this actually only requires a simple search query.

OVERALL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Google Assistant
Amazon Alexa
Apple Siri
Microsoft Cortana
Intention recognized/good answer
Intention not exactly recognised/intermediate answer
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OVERALL

Google Assistant took first place overall. The voice assistant was able to recognize the intention in **58 of 71 questions** and give a good answer. This means that it was able to **answer in total around 82%** of the questions asked. Assistant's result in the knowledge/technical category, where **100%** of the questions were answered, deserves special mention. None of the other voice assistants managed to achieve such a result in a category. This is probably due to Google's know-how in the area of search engines, which is why this category is probably best for the voice assistant.

Amazon Alexa comes in second place in the study. Alexa was able to recognize the intention in **55 of 71 questions** and give a good answer. This gives it a rate of **about 77% of correctly answered questions** in the study. Alexa was able to shine especially in the categories functions and conversation, where it took first place. This can mainly be explained by the integration of the Amazon online store and the numerous third-party skills for Alexa.

OVERALL

Third place in the overall ranking was taken by Apple Siri. Siri was able to recognize the intention in **49 of 71 questions** and give a good answer. Thus, Siri was able to answer about 69% of the questions asked. In the three question categories of personality, knowledge/technical and functions, Siri was in second place, sharing second place in the functions category with Google Assistant. Only in the Conversation category could Siri not convince at all and took fourth place. This could be because Apple develops their voice assistant with the intention of complementing their operating systems and not for a specifically conceived reason like Amazon, for example.

The fourth and last place in the survey was taken by Microsoft Cortana. Cortana was able to recognize the intention **in 31 of 71 questions** asked and give a good answer, which corresponds to a rate of about **44%**. Thus, Cortana is the only tested voice assistant that could answer **less than 50%** of the questions asked. Only in the conversation category was it better than Siri and reached third place. This result can be explained by the fact that Microsoft has a different objective for Cortana and focuses on Windows desktop devices.

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INTERNATIONAL BENCHMARKING

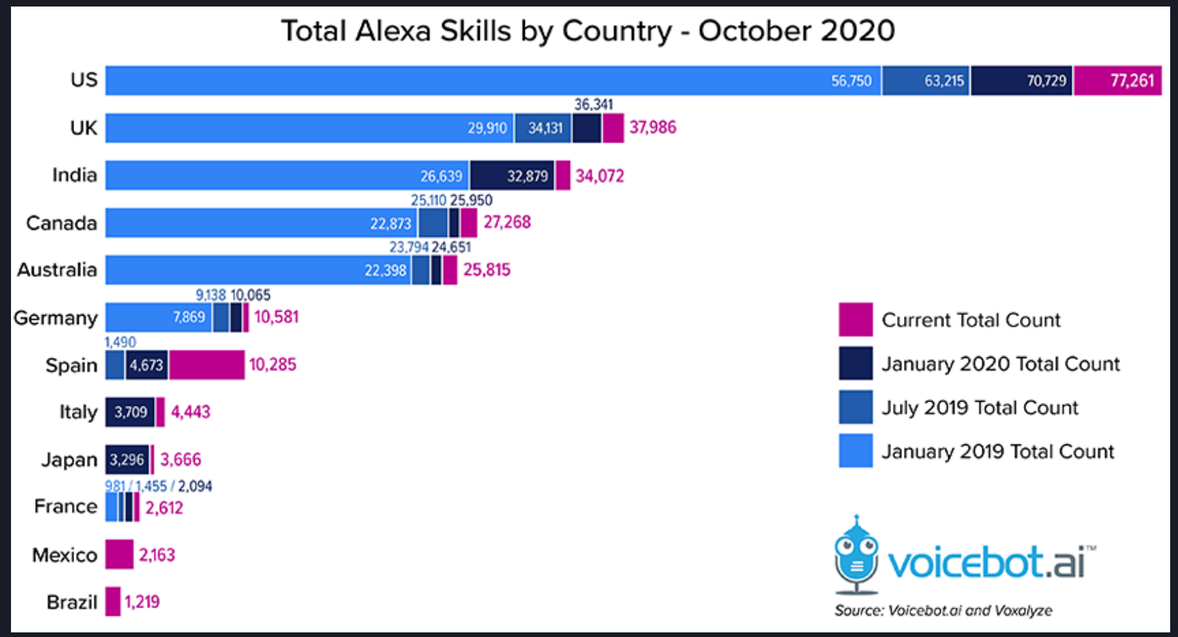
INTERNATIONAL BENCHMARKING

In a global comparison, Germany is not among the biggest players in the AI market.

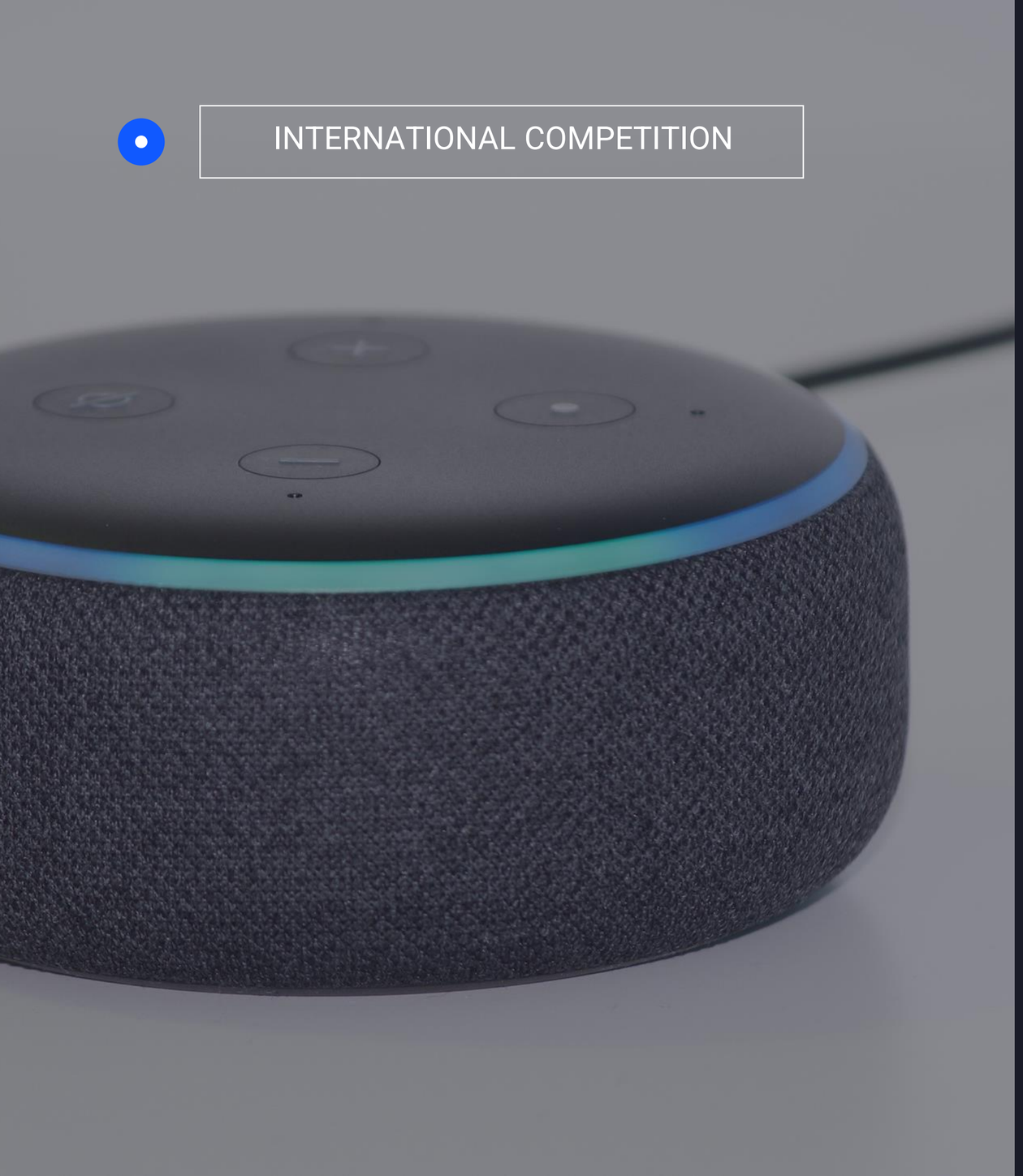
Internationally, there are significantly more functions for voice-based (chat) bots, which is primarily due to the language. In the English-speaking world, there are significantly more functions and integrations for voice assistants, as the best-known and most advanced are developed there and thus primarily for the domestic market.

In the international ranking, Germany lands in 6th place, which shows that a lot of development is being done in Germany in the field of AI and that there is corresponding interest on the part of customers.

Overall, this shows that Germany is a relatively important market in an international comparison, which should definitely not be underestimated, even if some development is still needed.



INTERNATIONAL COMPETITION



The most common international competitors mainly come from Asian countries. Especially Samsung's Bixby from South Korea, which is mainly developed for Samsung's mobile devices, is a big competitor.

Further competition comes from the Chinese company Huawei with its Celia. The voice assistant is currently only available in a few languages, namely German, English, French and Spanish, since it is still relatively new on the market. Nevertheless, Huawei wants to further expand its market share in the future.

Another competitor is the Alibaba Group, which also originates from China. The Chinese counterpart to Amazon provides similar functions to Alexa with AliGenie.

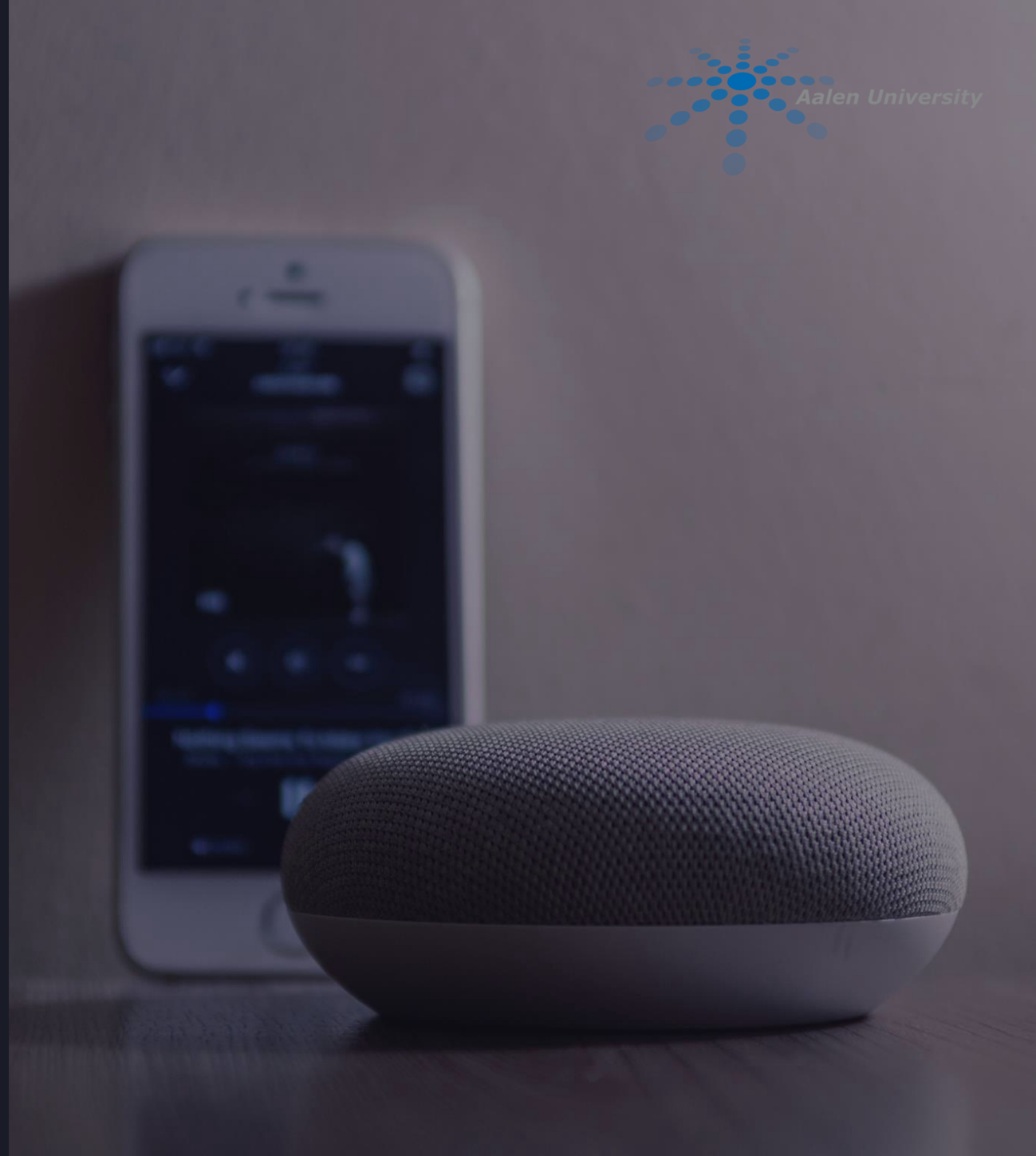
FUTURE PROSPECTS

Voice-based (chat)bots are becoming increasingly important in today's world. The market for voice assistants alone is estimated to be worth around 15 billion US dollars in 2021, with an upward trend for the next few years.

In the future, voicebots will also gain in importance for companies to sell their products, e.g. via online shopping using a voice command. At present, this is often already the case for standard products such as detergents.

However, there is still a great deal of potential for development, since, for example, many conversations that require more than just simple responses from a voice assistant are currently not possible in most cases. But the more these are used, the more data can be collected and processed, which will allow manufacturers to significantly improve their applications in the future. It is foreseeable that this will mainly take place in the USA and China or Asia.

The large market in Asian countries, especially China, provides an enormous basis for data collection. In particular, the data protection regulations in force there, which are very relaxed in comparison with Western countries, will mean that developments in these countries will form a strong competitor to the current peak in the USA.



Institute for Conversational Business

CONTACT:

Hochschule Aalen - Technik und Wirtschaft
Institut für Conversational Business
Prof. Dr. Peter Gentsch
Beethovenstraße 1
73430 Aalen
peter.gentsch@hs-aalen.de
https://conversationalbusiness.de/

PROF. DR. PETER GENTSCH

FLORIAN WALL

SELECTED QUESTIONS

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Personality

1. *Hast du eine Lieblingsfarbe?*
2. *Magst du deinen Job?*
3. *Magst du es mit mir zu sprechen?*
4. *Magst du Sport?*
5. *Was findest du lustig?*
6. *Was hältst du von mir?*
7. *Was ist dein Geschlecht?*
8. *Was sind deine Arbeitszeiten?*
9. *Welche ist deine Lieblingsmusik?*
10. *Wer bist du?*

Knowledge

1. *Erkläre mir den Satz des Pythagoras?*
2. *Ich habe Kopfschmerzen, was kann ich dagegen tun?*
3. *Wann öffnet das Porsche Museum in Stuttgart?*
4. *Was ergibt 256/0?*
5. *Was ergibt 4714/3*597?*
6. *Was ist ein Algorithmus?*
7. *Was ist künstliche Intelligenz?*
8. *Was kannst du mir über Chatbots erzählen?*
9. *Was kannst du mir über die Corona Impfung erzählen?*
10. *Wer ist das aktuelle Staatsoberhaupt von Griechenland?*

Skills

1. *Kannst du das Licht im Zimmer anschalten?*
2. *Kannst du mein Lieblingslied abspielen?*
3. *Kannst du mich morgen 7:30 daran erinnern, meinen Laptop mitzunehmen?*
4. *Kannst du mich morgen um 7 Uhr wecken?*
5. *Kannst du mir ein Buch vorlesen?*
6. *Kannst du mir eine Fahrt mit öffentlichen Verkehrsmitteln buchen?*
7. *Kannst du mir eine Zahnbürste bestellen?*
8. *Kannst du mir Lebensmittel/Essen bestellen?*
9. *Kannst du Netflix auf dem Fernseher öffnen?*
10. *Kannst du Rock Musik abspielen?*

Conversation

1. *Denkst du, ich sollte heute einen Regenschirm mitnehmen?*
2. *Gehst du in den Urlaub?*
3. *Hast du eine Geschenkidee für meine Eltern?*
4. *Hast du Ideen was ich heute kochen kann?*
5. *Hattest du Corona?*
6. *Kannst du mich gut verstehen?*
7. *Kannst du mir ein gutes Restaurant in der Umgebung empfehlen?*
8. *Kannst du mir einen Witz erzählen?*
9. *Kennst du unnütze Fakten?*
10. *Warum ist die Banane krumm?*