

A STUDY TO ASSESS USERS' PREFERENCES FOR INTELLIGENT PERSONAL ASSISTANCE AND IMPROVE THEIR MASS ADOPTION

Research in Progress

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Despite the dissemination and wide availability of Intelligent Personal Assistants (IPA), such systems have not reached the popularity expected. One reason for this is the users' lack of trust in IPA and their providers. Another reason is the IPA's limited performance and skill set, which in turn is due to the intentional segregation of IPAs in proprietary ecosystems. Enabling IPAs to communicate and exchange data with each other could help IPAs improve performance and thus their acceptance among users. Further, certifications and suitable marketing strategies can also contribute towards their mass adoption, by fostering user's trust in IPA and their providers. To better understand the incentives necessary to instigate mass adoption of interoperable IPAs, this paper presents a survey which captures the potential users' attitude towards interoperable IPAs and their attitude towards different marketing strategies which could increase users' trust in IPAs. The ultimate purpose of this ongoing research is to develop design recommendations and an efficient incentive system that can foster the mass adoption of IPAs.

Keywords: Adoption of Intelligent Personal Assistants, User Preferences for Interoperable Assistance Systems; Incentive Systems for Adoption.

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1 Introduction

Advancements in technology and artificial intelligence abet the development of a plethora of sophisticated, intelligent personal assistants (IPA) aimed at supporting their user in everyday life. Apple's Siri, Samsung's Bixby, Google's OK Google, Microsoft's Cortana and Amazon's Alexa are the most popular IPA's. These IPAs are mobile in use, voice-controlled and their capabilities include searches for things on the web, reading the weather forecast, setting alarms, calling people or creating reminders and calendar entries. Besides some exceptions (e.g. Amazon's Alexa), most IPA's come for free on smartphone devices but are also increasingly available in smart homes and cars (Cowan et al. 2017). However, despite being available to anyone owning a smartphone with an Internet connection, people do not use IPAs on a regular basis (Cowan et al. 2017). As research on user interaction and experience with IPAs shows, only 30% of iPhone owners use Siri, and 38% of Android owners use OK Google regularly (Milanesi, 2016). The rest of smartphone users either have not used Siri or OK Google at all (i.e. 2% and 4% respectively), or use it only too rarely (i.e. 70% and 62% respectively) (Milanesi, 2016).

Recent studies exploring the users' experience with IPAs (e.g. Cowan et al. 2017) reveal that IPA users often undergo suboptimal performance and support quality of IPAs, as well as a lack of trust in such systems (i.e. concerns about the data privacy, monetization, data permanency, and transparency). Indeed, though the IPAs' current capabilities are continuously extended, IPAs remain far from being proactive, omniscient and context-sensitive companions. Research studies testing the knowledgeability of IPAs, show the limitations of such systems. Siri, for instance, answers on average only 21.7%, and Alexa only 20.7% out of 5000 general knowledge questions they might get asked, whereby the number of correct answers given is even lower (Enge, 2017). Google and Cortana, on the other hand, can answer up to 68.1% and 56.5% of the questions asked. This difference illustrates how IPA performance depends on the amount of data and the quality of available data sources. The more and better data sources IPAs have at their disposal, the more versatile and qualitative their support.

To date, existing IPAs are limited to a large extent to the proprietary platforms of their vendors or operators. This segregation hinders the IPAs' ability to combine data and services across vendors and data sources, and thus the achievement of the IPAs full potential. To solve this problem enabling IPA's to talk to each other enables the provision of ubiquitous assistance, which can again foster the mass adoption of IPAs. On the other hand, enabling IPAs to communicate with each other might give rise to data privacy, data security and data ownership issues, which in turn represent another impediment to the IPAs market success. As users are increasingly data security and privacy aware (Statista 2015a; Statista 2015b), trust in IPAs systems is decisive for their mass adoption (PWC, 2017).

In general, IPAs have enjoyed extensive interest from both business and academia. Thus it is surprising that studies exploring possibilities and incentive systems to promote their mass adoption are scarce. This research in progress addresses this void in research and seeks to formulate and test a suitable incentive system for mass adoption of intelligent assistant systems. The basis for the development of a suitable incentive system for mass adoption builds on empirically backed insights about the users' general attitude towards enabling IPAs to communicate with each other, as well as users' attitude towards different strategies that could increase users' trust in IPAs (e.g. certification, selected business models, various marketing strategies).

Formally, this paper is structured as follows: after presenting related studies and theories, the paper presents the survey used for the data collection. Subsequently, after presenting the results of the survey, this paper discusses the main findings and concludes by presenting the next steps planned, to advance this research in progress.

2 Related Work

2.1 Intelligent Personal Assistants

The idea of intelligent agents has been around for decades (Foner 1993), but only recent advancements in technology facilitated a boom in intelligent assistance. Per se, IPAs are computer systems featuring anthropomorphic interfaces (i.e. they are personified and can, for instance, interact with the user in natural language) and artificial intelligence, which allows them to be aware of the user's location, and gather and evaluate contextual information (Jennings, 2000; Hauswald et al. 2015) with the purpose of making suitable recommendations or performing actions on their user's behalf.

Prevailing business and academic interest in the area of IPA motivated various research efforts on this topic so that the existent body of literature presents a plethora of studies on technical topics (e.g. advanced toolsets and methodologies (e.g. Brézillion 2014; Kim et al. 2014) new use cases and even new types of IPAs (e.g. Hauswald et al.2016; Büyüközkan and Ergün2011), and research efforts on trust, acceptance and user experience when using existing IPAs. Moorthy and Vu (2014) for instance test the individuals' attitude to use IPAs in public; Strayer and colleagues (2017) explore the users' experience and cognitive workload while using IPAs in cars; Kiseleva and colleagues (2016) evaluate Cortana's effectiveness in supporting their user; while Cowan et al. (2017) assess infrequent users' experience with Siri and identify six key issues disturbing users' experience when using Siri. They argue that the main cause of user frustration is the limited integration of IPA with other platforms, services or other apps. Further, they also find that other factors that cause inconvenience when dealing with IPAs are data privacy, confidentiality, and monetization issues. Combined, these insights suggest that enabling IPAs to interact with other IPAs, platforms or services while gaining the users' trust concerning data security and privacy can foster the mass adoption of IPAs significantly.

2.2 Trust and Diffusion of Innovative Technology Products

As in the case of any new technology product, its adoption and thus market success depends on a variety of factors influencing peoples' decision to adopt or reject the new technology. So, the reasons for adopting new information systems was studied in several contexts and great depth. Accordingly, there exist several studies assessing the key elements driving the adoption of new technology products. Agarwal and colleagues work (1998), for instance, draws on Rogers' theory of diffusion of innovations (1995) to explain the adoption of new technology products. According to Rogers' theory, users' decision to adopt a new technology product is the outcome of a process which starts with the users' search for product and product vendor related information. Once users know about the product in question, its features, as well as the consequences using that product, they form beliefs that will help them decide when to adopt a product. According to this theory, based on the timing of the decision to adopt, users can be classified into five groups of adopters. One of the critical groups promoting mass adoption is the group of "early adopters" – i.e. opinion leaders who can persuade others to adopt by providing evaluative information. Also noteworthy is that in a previous academic effort, Agarwal and colleagues (1997) show evidence from a field study that innovation characteristics explain acceptance behavior so that innovative products should enjoy a broader acceptance and adoption than less innovative products.

In addition, the existent literature suggests that trust is another decisive factor for the market success of IS related artifacts and services (e.g. Bélanger and Carter 2008; Chen and Barnes, S. 2007; Benbasat and Wang 2005; Featherman and Pavlou 2003; Pavlou 2003).

In fact, trust is, in particular, relevant for the adoption of new technology products where uncertainty and risk concerns related to using the new product make users hesitant towards trying such products (McKnight et al. 2002a; McKnight et al. 2002b). Accordingly, several scholars worked on identifying the key drivers of building trust. For instance, McKnight and colleagues (2002b) developed and tested a model for building trust in the context of e-commerce. In their contribution, these scholars propose three factors for building trust in e-commerce vendors: structural assurance (that is, consumer perceptions of the safety of the web environment), perceived web vendor reputation, and perceived web site

quality. In another contribution, McKnight and colleagues (2002a), also show that the disposition to trust is positively related to the potential users' innovativeness. Also, more recent studies on trust in the context of e-commerce provide empirical evidence that third-party certification, reputation, and the vendors' return policy are significant trust building mechanisms (e.g. Chang et al. 2013; Kim and Peterson 2017). Kim and Peterson (2017) for example, performed a meta-analysis of online trust relationships in e-commerce. Based on the existent literature, they selected and studied several mechanisms for trust building. Their results confirm that factors such as perceived privacy, perceived reputation, perceived usefulness, attitude, and purchase intention indeed impact the trust-building process in online commerce in a statistically significant manner. Nevertheless, these findings stem from the realm of e-commerce and do not necessarily apply to the context of IPAs. On the one hand, in order to provide their user with holistic and useful support, IPAs gather and combine a variety of personal and context relevant information. Because the collection, processing and storage of such data by a central entity such as the IPA raises several data privacy and security related concerns, users might display higher mistrust levels towards IPAs than towards any other e-commerce applications. On the other hand, if taking into consideration that the IPAs main goal is to support the user in their everyday life, they might view IPAs (especially such with anthropomorphic traits) as human interlocutors, or teammates (Nass et al. 1996), and thus display a higher willingness to trust such IPAs. In the case of e-commerce however, where users know that recommender systems' primary goal is linked to a companies' increases in sales, users might be inclined to trust recommender systems less than IPAs. Based on this ambivalence, we highlight the necessity to validate the insights presented by the e-commerce literature within the special context of IPAs. Accordingly, the survey in this paper explores the transferability of the previously stated constructs and trust building mechanisms to the research context of interoperable IPAs.

3 User Study

As mentioned previously, this study explores the potential users' general attitude towards enabling IPAs to communicate with each other, and their view on the issues arising from this endeavor. In addition, it also studies the users' attitude towards strategies and mechanisms which could increase users' trust in IPAs via a computer-administered survey. For this purpose, a market research institute was hired to provide a suitable sample for our survey. From the originally 450 participants who took the survey, a total of 229 individuals completed the questionnaire by providing us with all the information needed for this analysis. The final sample features an almost equal gender split, with 53% of the participants being male and 47% female. All participants in the survey were between 18 and 69 years old, whereby the majority of participants were between 40 and 59 years old (52%). 18% of participants were between 18 and 29 years old, and 12% were between 30-39 years old. The remainder (18%) of participants were over 60. 51% of the participants are married, and 56% have one or more kids. Regarding education, only two participants were still attending school, one had no school degree, but most of the participants (51%) hold either a high school degree or a university diploma.

3.1 Survey Design

This survey is based on an exemplary case study which visualizes the amenities of interconnecting several IPAs with each other. At the beginning of the survey, users were shown a use case in which a connected car IPA can exchange information with a smart home and a public transportation IPA in order to assist their users in tackling multiple challenges. In the use case presented, the user is on his way home, where he expects a few hours of guests to a private event. Due to an accident, the user's plans and preparations for the event must be changed or rescheduled. However, the IPAs help him to come home in time and to prepare his smart home for the private event without stress.

Based on the use case shown, participants were asked to rate several statements on Likert scales. The statements prompted in the survey originate from the existent body of literature and capture the participants' attitude towards connecting IPAs, elicits their preferences for trust building mechanisms. Below, an overview of the constructs addressed in the survey.

Construct	Reference
Perceived usefulness	Vijayarathy (2004); Pavlou (2003); Davis (1989)
Attitude towards the product (i.e. interoperable IPAs)	Cowan et al. (2017); Vijayarathy (2004); Davis (1989)
Intention to use	Davis (1989)
Purchase intention	Kim et al. (2009)
Interoperability of IPAs with other IPAs, apps, and services	Cowan et al. (2017); Vijayarathy (2004)
Innovativeness (product and participant)	Agarwal and Prasad (1997);
Trust and trust building mechanisms: e.g. third-party certification, reputation, return policy	Chang et al. (2013); Komiak and Benbasat (2006); Benbasat and Wang (2005); McKnight et al. (2002a); McKnight et al. (2002b)
Trust and risk perception of monetary loss	Pavlou (2003)
Trust and risk perception of loss of privacy	Pavlou (2003); Vijayarathy (2004)
Trust and country of origin	Jiménez and Martín (2010)
Trust and business models (i.e. data monetization, advertisement based revenue)	Cowan et al. (2017)
Information sources and marketing channels (e.g. WOM)	Parry et al. (2012); Molitor et al. (2011); Agarwal et al. (1998); Mahajan et al (1990); Rogers (1995)

Table 1. Overview of the constructs address in the survey.

3.2 Results

3.2.1 Participants' attitude towards interconnected IPAs and related services

The usage pattern of IPAs discovered by previous literature is also visible in our sample. Accordingly, the majority of participants (59%) do not use the smartphone installed IPAs ever, 2% (i.e. 5 participants) did not know what IPAs are at all, 31% use it only sometimes, and only 7% use the IPAs on their phone more often (see Table A1 in Appendix). Regardless the participants' current usage of IPAs, the majority of participants (i.e. 58%) display a positive attitude towards the assistance scenario presented in the survey. Only 10% have a negative attitude towards enabling IPAs to communicate with each other, and the remaining 30% are still undecided regarding their attitude towards such IPAs. The vast majority of participants, however (71%) rate the idea of interconnecting IPAs as innovative, meanwhile only 7% disagree. Even so, 71% of the participants think that it is desirable to connect more than one area of assistance and perceive this undertaking as useful (70%). In contrast, only 27% do not think that such an endeavor is desirable, as they do not regard it as useful at all (18%). Meanwhile, the remainder of the participants is unsure if interconnecting IPAs to provide more ubiquitous assistance is useful (10%) or desirable for them (27%) (see Table A1 in Appendix). Related to the participants' needs for assistance, it is noteworthy that public transportation, smart city, connected car, e-government and smart home are the areas where the majority of participants would like to use IPAs. In contrast, health, job, and education related assistance are not among the participants' top priorities (see Table A2 in Appendix).

Regarding the IPA and related services, it is noteworthy that the majority of participants consider data security and privacy compliance (74%); an intuitive and user friendly control logic (74%); the support services offered by IPAs providers (71%); a low system error rate (70%); and certifications according to German standards, as essential factors influencing the decision to use or not to use IPAs. In contrast, characteristics such as image and reputation of the IPA provider, as well as the number of ancillary products are important but only to half of the participants (see Table A3 in Appendix). Surprisingly, despite the participants' awareness related to data security and privacy, the origin of the IPA provider or the origin where the data of the IPA is hosted (i.e. EU hosted, USA designed) does not matter in this

context (see Table A4 in Appendix). As the survey data shows, the participants in this study value the feature set and price-performance ratio of technological products more than their origin.

Finally, it is surprising that despite the broad positive perception of the usefulness brought by interconnected IPAs, only 28% can seriously imagine using interoperable IPAs, about half (51%) of the participants are still unsure if they would use the interconnected IPAs indeed more IPAs. One potential reason, therefore, is the participants' lack of trust in IPAs and their service providers, as well as the participants' concerns for data security, privacy, and transparency.

3.2.2 Participants Trust in IPAs and attitude towards certifications

With regard to the participants' fears about IPAs, it is surprising that 43% (i.e. 99) participants fear that IPAs will limit their freedom of choice and freedom of action, while 14% (i.e. 31) participants are still uncertain regarding this topic, and 43% of them do not share this fear at all (see Table A4 in Appendix). To provide personalized support, IPAs need to know and store the preferences of their user. However, 63% of the participants feel uncomfortable if the IPAs know their personal preferences. In contrast, only 23% of the participants have no problem with the IPAs holding vast personal information about them. In addition, 79% are afraid that their personal information could be misused. Moreover, 42% of participants are actually fearful that IPAs can bring them into uncontrollable and dangerous situations (see Table A5 in Appendix). These findings show that many participants mistrust IPAs and their providers, and corroborate the insights provided by the insights provided by the e-commerce literature. Another example of the participants' lack of trust in IPAs is the fact that 55% of participants would let the IPA perform transactions on their behalf only if they can keep control over each transaction. On the contrary, 12% would not approve for IPAs to perform any transactions on their behalf, even if they had suitable control mechanisms available. In case of automatic transactions without previous control by the IPA's user, most participants' (37%) limit is 10€. In other words, 37% of the participants would allow their IPAs to perform only transactions automatically, only if these do not exceed €10 (see Table A6 in Appendix).

A conventional mechanism for building trust in products and providers, in general, are certifications. Related to certifications, the evaluation of the survey data reveals that at large, participants tend to trust well-established certifications, even though they do not know exactly and in detail what these certifications entail and confirm. Amongst the prompted certification seals, the majority of participants know the established third party seals issued by the TUEV and ISO organizations. In addition, the majority of participants also recognize the BSI data security certification seal issued by a German governmental agency but are less familiar with the ePrivacy seal or the GDD seal, which are both certifications issued by other third-party companies.

Given the increasing number of certifications available on the market, participants and users, in general, are facing high uncertainty about the real meaning and importance of such certifications. Subsequently, 30% of the participants trust unknown certifications only if federal organizations award them. Meanwhile, the majority of participants (i.e. 41%) are unsure if they should or should not trust new certification seals at all (see Table A7 in Appendix). Regarding the IPAs attributes for which participants expect or wish a particular certification (see Table A8 in Appendix), it is not surprising that the majority of participants expect their IPAs to hold certifications for data security and privacy compliance and user-friendliness. In addition, participants would like to have a certification attesting the vendor independence of the IPA and support service quality offered by the IPA provider. In fact, it is noteworthy that participants display a strong wish for support service and would like to receive any kind of support, be it in the form of an online forum or chat (67%), a knowledge database for self-fixes (73%), or via a hotline (79%) (see Table A9 in Appendix).

3.2.3 Preferred marketing and information channels

Given the high number of participants who have not yet made up their mind regarding the trustworthiness and usefulness of IPAs, suitable marketing strategies might be helpful tools to tilt their beliefs in a positive direction.

Concerning the testing habits of our participants (see Table B1 in Appendix), it is worth mentioning that a high expectation of usefulness of a product motivates 70% of the participants to test a product. Further, participants like to test new products which are on everyone's lips (61%). However, 53% of the participants wish to inform themselves about the characteristics of a product before testing it. As the results of the survey suggest (see Table B2 in Appendix), in the context of new technology products WOM is the most effective channel for information and marketing, as 69% of the participants report that when deciding to purchase new technological products, they orientate themselves on the recommendations made by friends and family. In addition to WOM, participants consider recommendations in articles in technology-related media (37%), recommendations issued by influencer on social media (38%) and recommendations made by established technology testing or certification agencies (43%).

Regarding promotion channels (see Table B3 in Appendix), again WOM is the most effective, followed by TV, Internet advertising, advertising in technology magazines. Accordingly, 67% learn about new technology products when talking to their friends and family; 51% and 48% notice such products via TV or Internet ads; 34% learn about new technology products from technology magazines. In contrast, only 30% of the participants learn about new technological products from social media sites like Youtube, and only 24% through mobile advertising. Surprisingly, 26% of the participants learned about new technology because they were preinstalled on their device.

3.2.4 Participants' willingness to purchase interoperable IPAs

From the 183 participants who did not exclude the use of interoperable IPAs, 36% (66 participants) would be willing to pay for interoperable IPAs, 27% (i.e. 49 participants) would not be willing to pay for such assistance, while 37% (i.e. 68 participants) have not yet made up their mind on this topic. However, when asked if participants would use interoperable IPAs if they were for free, 63% (115 participants) answered in the affirmative. 86 participants (47%) are even willing to accept advertising and product placement measures in their assistance, just to be able to use interoperable IPAs free of charge. Interestingly, what the majority of participants (62%) are not willing to accept is the monetization of their personal data in exchange for free assistance. Also noteworthy is that amongst participants willing to purchase IPA assistance, the majority (55%) would prefer a pay per use business model over other business models.

4 Discussion and further research steps

At large, the findings of this survey indicate that the participants have a positive predisposition regarding interoperable IPAs. In particular, enabling IPAs from the areas of public transportation, smart city, connected car, e-government and smart home to talk to each other could increase usage of IPAs if IPA providers simultaneously can raise the potential users' trust in them. Lack of trust in the IPAs actions, their data privacy, and security compliance, as well as lack of trust in IPAs providers, are also visible in this study's sample. Accordingly, although many of the participants in this study acknowledge the amenities, usefulness, and innovativeness of interoperable IPAs, they still hold important reservations holding them back from wanting to use such IPAs on a regular basis. The participants' reservations can potentially be alleviated by employing the right marketing strategies, business models or certifications. As the results of the survey indicate, participants trust certifications issued by well-established governmental and non-governmental institutions. Especially certifications concerning the IPAs' data security and privacy, user-friendliness and vendor independence could improve potential users' trust in such systems. Also, the provision of user support services could also be advantageous, as participants display a strong wish for support service.

Furthermore, the adoption of IPAs could be promoted by employing the right marketing strategies. Based on the results of the survey, WOM is the most effective channel for promoting interoperable IPAs. Other effective channels for marketing are TV ads, Internet advertising, advertising in technology magazines, or in some cases also influencer marketing on social media. Finally, IPA providers could insti-

gate IPAs adoption by keeping the IPAs assistance services free of charge, while simultaneously considering advertising-based revenue models over monetization strategies. Along these lines, increasing the transparency about data processing and data ownership will also benefit IPAs mass adoption.

I seek the discourse of this workshop to jointly discuss not only the results presented in in this paper, but also any ideas and suggestions for designing and performing a suitable experiment, which (1) can help us better understand trust building mechanisms in the context of IPA, and (2) captures the impact and effectiveness of several trust building mechanisms. The ultimate goal of this research in progress is to develop an effective incentive system to foster IPAs mass adoption.

5 Appendix: Constructs to be rated in the survey (detailed view)

5.1 Constructs assessed in this study- detailed view.

1. General attitude towards IPA interoperability: Participants' attitude towards enabling IPA's to exchange information with each other.
2. Interoperability domains: Which of the following areas do people value intelligent personal assistance the most? Areas of support include:
 - health assistance: e.g. IPA supports a healthier lifestyle
 - public transport: e.g. IPA helps its user to use the public transport in a more efficient way
 - connected car: e.g. IPA supports a more comfortable and entertaining driver experience
 - smart city: e.g. IPA supports their user in finding parking, paying for parking automatically
 - e-government: e.g. IPA helps you to fulfill administrative duties, such as in tax redemption, social benefits claims
 - smart home: e.g. IPA allows high living comfort and reduced costs by regulating the heating and the energy consumption of the household
 - education: e.g. IPA allows for more efficient and entertaining education by providing support which adapts to their users' learning habits
 - job-related assistance: e.g. IPA supports their user to perform their jobs in a less stressful manner by reminding their user about appointments, or automatically prioritizing tasks
3. Perceived usefulness: do participants consider interoperable IPAs as useful?
4. Perceived innovativeness: do participants consider enabling IPAs to communicate with each other as innovative?
5. Intention to use: can participants imagine to use IPAs if they were interoperable, as in the use case presented at the beginning of the survey?
6. Trust: do participants feel vulnerable if IPAs know and interconnect their data? Are participants concerned that their data will be misused? Are participants afraid that IPAs will bring them into a dangerous situation and they cannot do anything about it?
7. Preference for product origin: do participants have any preferences about the origin of IPAs? Would they prefer IPAs hosted in Europe over those hosted in other parts of the world?
8. Willingness to test new technologies and products: When do participants usually test new products? Regularly or always; only if there is a hype around the product; only if participants did prior research on the product and expect high utility from that product; only if well-known companies develop those products; never before purchasing
9. Preferences for support services: potential support services include: online support via chat or forum; online FAQ and fixes database; call center; no support
10. Preferred marketing channels: TV; Radio; Print; Online; Mobile advertising; Influencer marketing; Word-of-mouth (WOM)
11. Information search: Print, WOM; Social Media (e.g. Youtube); online communities experts;
12. Certifications and trust: participants indicate which European and German certification seals they are familiar with. The selection of seals include the most common certification seals in Germany: BSI; TUEV; ISO; Software made in Germany; Software hosted in Germany; EU Privacy Seal
 - Do participants tend to trust in general?
 - Do participants trust seals even if they do not know the details and goal of the certification process?
 - Do participants trust seals only if governmental entities issued them?
 - Do participants trust seals from third-party organizations?
13. IPA attributes certification: which attributes and related IPA services must or should be certified? The promoted attributes were: data security and privacy; data transparency; interoperability with other products, platforms, and apps; user-friendly operation; support services

In addition to these constructs that have been shown to all users, there are three more that are directed only to those who did not exclude the use of interoperable IPAs. The choice for this approach is based on the logic that participants who cannot imagine using interoperable IPAs should not rate statements about constructs such as purchase intent. These constructs are:

14. Purchase intention: would participants want to purchase interoperable IPAs?
15. Importance of IPA attributes and related services and potential business models: participants rate the importance of several IPA attributes for themselves. The attributes addressed were: IPA support features; complementary services; seamless interoperability with other third-party artifacts; user-friendly and intuitive control logic of IPAs (ease of use); support services offered by the IPAs providers; IPA provider reputation; certifications of the IPAs; data security certification
16. IPAs and money transactions: would participants allow IPAs to perform payments and purchases on behalf of their user?

5.2 Table A1: Users' attitude towards IPA in general

Are you currently using Siri, Google Now, Cortana, Alexa Samsung or another intelligent personal assistant?	Scale Items / Chosen by % of participants (n=229)						
	<i>Yes, often (1)</i>	<i>Yes, seldom (2)</i>	<i>No, never (3)</i>	<i>I am not familiar with these (4)</i>			
	7%	31%	59%	2%			
<hr/>							
Do you think it is desirable that different IPAs can communicate with each other?	<i>Yes, surely (1)</i>	<i>Rather Yes (2)</i>	<i>Unsure (3)</i>	<i>Rather No (4)</i>	<i>No (5)</i>		
	21%	36%	21%	13%	8%		
<hr/>							
How innovative is the IPA presented?	<i>Not innovative at all (1)</i>	<i>Only slightly (2)</i>	<i>Little innovative (3)</i>	<i>Unsure (4)</i>	<i>Rather innovative (5)</i>	<i>Innovative (6)</i>	<i>Very innovative (new product) (7)</i>
	0%	2%	4%	20%	24%	36%	14%
<hr/>							
I think the IPA is...	<i>Not useful at all (1)</i>	<i>Not useful (2)</i>	<i>Rather not useful (3)</i>	<i>Unsure (4)</i>	<i>Rather useful (5)</i>	<i>Useful (6)</i>	<i>Very useful (7)</i>
	0%	3%	7%	18%	37%	23%	11%

5.3 Table A1: User preferences for support - most important areas of support

Areas of Support	Scale Items							MEAN	SD
	1	2	3	4	5	6	7		
	Not helpful at all	Not helpful	Rather not	Unsure	Rather helpful	Helpful	Very helpful		
Health	4%	7%	10%	17%	36%	14%	12%	4.646	1.531
Public Transport	2%	3%	3%	10%	29%	26%	28%	5.504	1.359
Connected Car	4%	3%	7%	17%	28%	21%	20%	5.039	1.563
Smart City	3%	2%	5%	13%	25%	28%	24%	5.367	1.444
E-Government	3%	4%	5%	20%	27%	23%	18%	5.048	1.490
Smart Home	3%	3%	7%	20%	22%	28%	17%	5.026	1.516
Education	5%	7%	9%	27%	25%	18%	9%	4.489	1.538
Job related	7%	9%	7%	24%	21%	19%	14%	4.568	1.709

5.4 Table A3: User preferences for IPA attributes and related services

IPA Attributes and related services	Scale Items							MEAN	SD
	1	2	3	4	5	6	7		
	Not im- portant at all	Not im- portant	Rather not im- portant	Unsure	Rather important	Important	Very im- portant		
Functionality and support fea- tures	1%	2%	3%	23%	36%	23%	12%	5.109	1.143
Number of add-on products and services	1%	1%	11%	28%	32%	20%	7%	4.765	1.160
Interoperability with products from other manufacturers	1%	2%	6%	31%	18%	30%	12%	5.005	1.307
Low error rate	0%	0%	2%	11%	18%	30%	39%	5.934	1.087
Intuitiveness and ease of use	0%	0%	0%	8%	16%	34%	42%	6.098	0.938
Comprehensive documentation of features	1%	1%	5%	20%	26%	26%	21%	5.328	1.263
User-friendly support service	1%	0%	1%	9%	26%	35%	28%	5.770	1.049
Image and reputation of the ser- vice provider	2%	2%	8%	27%	22%	27%	11%	4.923	1.332
Certification of the IPA	1%	1%	3%	18%	27%	31%	21%	5.448	1.170
Data privacy certification in line with German standards	1%	1%	2%	10%	11%	24%	52%	6.120	1.180
High data security standards	0%	0%	1%	7%	7%	17%	68%	6.454	0.942

5.5 Table A4: User preferences for product origin and users' trust in IPA

Product Origin	Scale Items							MEAN	SD
	1	2	3	4	5	6	7		
	Not true at all	Not true	Rather not true	Unsure	Rather true	True	Very true		
I prefer high-tech products and services of German companies.	5.24%	6.99%	12.66%	32.31%	22.71%	11.35%	8.73%	4.293	1.506
I prefer high-tech products and services of European companies.	4.80%	6.11%	13.97%	44.10%	18.34%	12.23%	0.44%	4.035	1.238
I prefer high-tech products and services of US companies.	10.48%	10.48%	21.83%	41.92%	8.30%	5.24%	1.75%	3.498	1.336
The origin of the product is not important to me because the functionality is the most important to me.	1.31%	4.37%	8.30%	19.21%	27.51%	24.02%	15.28%	5.004	1.410
The origin of the product is not important to me because the price / performance ratio is most important to me.	0.87%	3.93%	4.37%	17.03%	33.19%	23.14%	17.47%	5.170	1.322

5.6 Table A5: User preferences for product origin and users' trust in IPA

Trust in IPA									
I am afraid that the intelligent assistant will restrict my freedom of decision and action.	11%	10%	21%	14%	21%	21%	10%	3.991	1.809
In general I do not feel comfortable if the assistant knows my preferences.	5%	8%	10%	14%	16%	23%	24%	4.930	1.790
I am afraid that my data will be abused and that I cannot do anything about it.	1%	4%	6%	10%	19%	22%	38%	5.576	1.790
I am afraid that the assistant puts me in a dangerous situation and I can do nothing about it.	8%	10%	19%	21%	19%	14%	10%	4.135	1.710

5.7 Table A6: User preferences for money transactions made by IPAs

<p>In case that the IPA must perform and manage money transactions (e.g. book train tickets, parking lots, etc.), would you allow it?</p>	Scale Items							MEAN	SD
	1	2	3	4	5	6	7		
	Not true at all	Not true	Rather not true	Unsure	Rather true	True	Very true		
No, I would never allow it.	10%	7%	11%	35%	10%	14%	13%	4.213	1.755
I am not sure yet.	11%	7%	11%	32%	17%	11%	10%	4.120	1.712
Yes, I would allow it, but only if I can review and approve all transactions individually before execution.	10%	3%	2%	16%	26%	25%	18%	4.934	1.747
Yes, I would allow it, but only for small purchases worth less than 10 euros. All other transactions should be explicitly confirmed by me.	16%	7%	6%	26%	14%	21%	11%	4.224	1.921
Yes, I would allow it, but only for small purchases worth less than 25 euros. All other transactions should be explicitly confirmed by me.	18%	9%	13%	28%	13%	11%	8%	3.749	1.825
Yes, I would allow it, but only for small purchases worth less than 50 euros. All other transactions should be explicitly confirmed by me.	23%	11%	10%	30%	11%	8%	6%	3.443	1.820

5.8 Table A7: Users' trust in certifications

Trust in certifications	Scale Items							MEAN	SD
	1	2	3	4	5	6	7		
	Not true at all	Not true	Rather not true	Un-sure	Rather true	True	Very true		
Because I know exactly what the displayed certification seals mean, I trust them.	6%	10%	18%	31%	25%	8%	2%	3.943	1.364
Although I know exactly what the displayed certification seals mean, I still do not trust them.	8%	16%	24%	33%	12%	6%	1%	3.476	1.326
Although I do not know exactly what the displayed certification seals mean I would tend to trust them.	3%	7%	17%	28%	35%	9%	2%	4.201	1.244
Because I do not know exactly what the displayed certification seals mean I cannot trust them.	8%	12%	25%	31%	14%	7%	3%	3.651	1.411
If I do not know exactly what a certification seal means, I trust it only if it comes from a federal association or from a federal organization.	4%	9%	16%	41%	22%	7%	1%	3.939	1.223
I generally do not care which certification a product carries, as long as data security and privacy compliance has been confirmed by a state organization or a federal association.	6%	7%	16%	39%	22%	8%	2%	3.948	1.290
I generally do not care which certification a product carries, as long as data security and privacy compliance has been confirmed by a third neutral organization.	10%	8%	21%	39%	14%	7%	2%	3.664	1.362

5.9 Table A8: User preference for certification

In which areas would you wish or expect a certification?	Scale Items					MEAN	SD
	1	2	3	4	5		
	Not important	Rather not important	Unsure	Important	Expected		
Data security	0	4	8	40	177	4.703	0.621
Transparency about what happens with my data	1	2	12	45	169	4.655	0.661
Interoperability with products from other companies	0	14	26	118	71	4.074	0.816
User friendliness	0	8	9	80	132	4.467	0.735
Service and support quality	0	4	22	105	98	4.297	0.713

5.10 Table A9: User preference for support

User preferences for support	Scale Items							MEAN	SD
	1	2	3	4	5	6	7		
	Not true at all	Not true	Rather not true	Unsure	Rather true	True	Very true		
I would like to have an online support (for example in the form of a chat or forum).	2%	4%	7%	20%	34%	21%	13%	4.926	1.373
I would like to have an extensive Knowledge Database so I can solve my problems and mistakes myself.	2%	3%	6%	16%	31%	28%	14%	5.131	1.325
I would like to have a call center type of support.	2%	2%	3%	14%	24%	34%	20%	5.397	1.342
I do not necessarily wish for any support at all. I can handle everything alone, with the information available on the Internet.	24%	20%	19%	22%	10%	3%	2%	2.904	1.542

5.11 Table B1: User preferences – When do users like to test new technology products

	Scale Items							MEAN	SD
	1	2	3	4	5	6	7		
	Not true at all	Not true	Rather not true	Unsure	Rather true	True	Very true		
When new technology products come on the market, I am usually one of the first to test these products.	35%	22%	15%	11%	10%	3%	3%	2.616	1.676
Whenever the test of new technology products and services is free and does not entail further obligations, I do test such products.	7%	8%	10%	22%	30%	13%	10%	4.371	1.627
I get curious when the product / service is on everyone's lips.	3%	7%	11%	18%	38%	17%	6%	4.576	1.373
I only test if I really expect a great benefit. Otherwise it is lost time.	2%	5%	6%	17%	31%	24%	16%	5.044	1.423
I mostly only test the products and services of companies that I know.	7%	9%	21%	25%	28%	7%	3%	3.939	1.419
I only test when I have carefully researched the product and its functionality and have studied detailed product information and tests.	3%	5%	16%	24%	29%	16%	8%	4.511	1.401
Usually, I do not test products. I buy them directly.	19%	24%	20%	15%	14%	5%	3%	3.070	1.634

5.12 Table B2: User preferences for product recommendations

How do you inform yourself when buying high-tech products and Services?	Scale Items							MEAN	SD
	1	2	3	4	5	6	7		
	Not true at all	Not true	Rather not true	Unsure	Rather true	True	Very true		
I buy products that are recommended by magazines and other online media.	12%	12%	15%	24%	26%	10%	2%	3.764	1.561
I buy based on experiences / recommendations from friends or family members.	5%	3%	7%	16%	40%	22%	7%	4.777	1.401
I buy based on reviews and recommendations from the internet and social media (for example Youtube).	10%	9%	16%	27%	26%	9%	3%	3.891	1.534
I buy products based on reviews and recommendations issued by specialized communities.	13%	13%	24%	24%	22%	3%	2%	3.467	1.470
I am not guided by recommendations, but by the existence of various certifications and certificates (for example, TUV certified, ISO certified, etc.).	7%	6%	18%	26%	30%	11%	3%	4.083	1.423
I am not looking into others' opinions. I make decisions based on my own experiences, research and tests.	2%	5%	15%	25%	31%	16%	5%	4.489	1.310
I am not looking into certifications. I make my decisions based on my own experiences, information and tests.	3%	10%	17%	27%	25%	12%	6%	4.201	1.446

5.13 Table B3: User preferences for marketing channels

Thinking about high-tech products that you already own: Which channels draw your attention towards them? Please rate following statements:	Scale Items							MEAN	SD
	1	2	3	4	5	6	7		
	Not true at all	Not true	Rather not true	Unsure	Rather true	True	Very true		
I learned about them mostly through Radio ads.	21%	20%	21%	15%	16%	5%	2%	3.070	1.618
I learned about them mostly through TV ads.	10%	11%	15%	13%	30%	14%	8%	4.131	1.742
I learned about them mostly through ads in tech journals.	18%	12%	18%	16%	23%	9%	4%	3.594	1.761
I learned about them when surfing in the Internet on my notebook.	7%	14%	14%	17%	30%	14%	5%	4.092	1.632
I learned about them through ads on my mobile phone.	22%	18%	22%	14%	14%	7%	3%	3.140	1.709
I learned about them through technology podcasts	24%	17%	19%	15%	16%	8%	1%	3.105	1.683
I learned about them through technology related radio shows	38%	23%	15%	13%	7%	2%	2%	2.419	1.507
I learned about them from Magazines.	22%	16%	14%	14%	21%	8%	6%	3.424	1.866
I learned about them when surfing in YouTube, Facebook or other social media sites.	21%	18%	13%	17%	18%	7%	5%	3.345	1.801
I learned about them through recommendations of family and friends.	8%	5%	7%	14%	38%	21%	9%	4.642	1.601
I became aware of them because they were preinstalled on my device.	18%	15%	17%	24%	17%	6%	3%	3.362	1.634

References

- Agarwal, R., & Prasad, J. (1997). The role of innovation characteristics and perceived voluntariness in the acceptance of information technologies. *Decision sciences*, 28(3), 557-582.
- Bauchet, J., D. Vergnes, S. Giroux, and H. Pigot (2006). "A pervasive cognitive assistant for smart homes." In *Proceedings of the International Conference on Aging, Disability and Independence*, Vol. 228.
- Bélanger, F., & Carter, L. (2008). Trust and risk in e-government adoption. *The Journal of Strategic Information Systems*, 17(2), 165-176.
- Benbasat, I., & Wang, W. (2005). Trust in and adoption of online recommendation agents. *Journal of the association for information systems*, 6(3), 4.
- Brusilovsky P. & C. Peylo (2003). "Adaptive and Intelligent Web-based Educational Systems." *International Journal of Artificial Intelligence in Education* 13, 159-172.
- Büyüközkan, G. & B. Ergün (2011). "Intelligent system applications in electronic tourism." *Expert systems with applications*, 38(6), 6586-6598.
- Chang, M. K., Cheung, W., & Tang, M. (2013). Building trust online: Interactions among trust building mechanisms. *Information & Management*, 50(7), 439-445.
- Chen, Y. H., & Barnes, S. (2007). Initial trust and online buyer behaviour. *Industrial management & data systems*, 107(1), 21-36.
- Cowan, B. R., Pantidi, N., Coyle, D., Morrissey, K., Clarke, P., Al-Shehri, S., Earley, D. & Bandeira, N. (2017, September). What can i help you with?: infrequent users' experiences of intelligent personal assistants. In *Proceedings of the 19th International Conference on Human-Computer Interaction with Mobile Devices and Services* (p. 43).
- Coyle, D., G. Doherty, M. Matthews, & J. Sharry (2007). "Computers in talk-based mental health interventions." *Interacting with computers* 19(4), 545-562.
- Enge, E. (2017, April 27). *Rating the Smarts of the Digital Personal Assistants*. Retrieved from Stone Temple: <https://www.stonetemple.com/digital-personal-assistants-test>.
- Featherman, M. S., & Pavlou, P. A. (2003). Predicting e-services adoption: a perceived risk facets perspective. *International journal of human-computer studies*, 59(4), 451-474.
- Foner, L. (1993). "What's an agent, anyway? A sociological case study" *Agents Memo* 93.
- Giroux, S., Pigot, H., & Mayers, A. (2004, July). Indoors pervasive computing and outdoors mobile computing for cognitive assistance and telemonitoring. In *International Conference on Computers for Handicapped Persons* (pp. 953-960). Springer Berlin Heidelberg.
- Jiménez, N. H., & San Martín, S. (2010). The role of country-of-origin, ethnocentrism and animosity in promoting consumer trust. The moderating role of familiarity. *International Business Review*, 19(1), 34-45.
- Kim, D. J., Ferrin, D. L., & Rao, H. R. (2009). Trust and satisfaction, two stepping stones for successful e-commerce relationships: A longitudinal exploration. *Information systems research*, 20(2), 237-257.
- Kiseleva, J., Williams, K., Jiang, J., Hassan Awadallah, A., Crook, A. C., Zitouni, I., & Anastasakos, T. (2016, March). Understanding user satisfaction with intelligent assistants. In *Proceedings of the 2016 ACM on Conference on Human Information Interaction and Retrieval* (pp. 121-130). ACM.
- Komiak, S. Y., & Benbasat, I. (2006). The effects of personalization and familiarity on trust and adoption of recommendation agents. *MIS quarterly*, 941-960.
- Lovato, S., & Piper, A. M. (2015, June). Siri, is this you?: Understanding young children's interactions with voice input systems. In *Proceedings of the 14th International Conference on Interaction Design and Children* (pp. 335-338).
- Mahajan, V., Muller, E., & Bass, F. M. (1991). New product diffusion models in marketing: A review and directions for research. In *Diffusion of technologies and social behaviour* (pp. 125-177). Springer, Berlin, Heidelberg.
- McKnight, D. H., Choudhury, V., & Kacmar, C. (2002a). Developing and validating trust measures for e-commerce: An integrative typology. *Information systems research*, 13(3), 334-359.

- McKnight, D. H., Choudhury, V., & Kacmar, C. (2002b). The impact of initial consumer trust on intentions to transact with a web site: a trust building model. *The journal of strategic information systems*, 11(3-4), 297-323.
- Milanesi, C. (2016, June 3). *Voice Assistant Anyone? Yes please, but not in public!* Retrieved from Creative Strategies: <http://creativestrategies.com/voice-assistant-anyone-yes-please-but-not-in-public/>.
- Mitchell, T. M., Caruana, R., Freitag, D., McDermott, J., & Zabowski, D. (1994). Experience with a learning personal assistant. *Communications of the ACM*, 37(7), 80-91.
- Molina, M. (2005). "An Intelligent Assistant for Public Transport Management." *International Conference on Intelligent Computing*, 199-208, Berlin Heidelberg: Springer.
- Molitor, D., Hinz, O., & Wegmann, S. (2011). The interplay between psychometric and sociometric data and the willingness to adopt innovations. *Zeitschrift für Betriebswirtschaft*, 81(1), 29-59.
- Moorthy, A. E. & K. P. L. Vu (2014). "Voice activated personal assistant: Acceptability of use in the public space." *International Conference on Human Interface and the Management of Information*, 324-334 Springer International Publishing.
- Myers, K., P. Berry, J. Blythe, K. Conley, M. Gervasio, D. McGuinness, D. Morley, A. Pfeffer, M. Pollack & M. Tambe (2007). "An intelligent personal assistant for task and time management." *AI Magazine* 28(2), 47.
- Nass, C., Fogg, B. J., & Moon, Y. (1996). Can computers be teammates?. *International Journal of Human-Computer Studies*, 45(6), 669-678.
- Padgham, L., & Winikoff, M. (2005). *Developing intelligent agent systems: A practical guide* (Vol. 13). John Wiley & Sons.
- Parry, M. E., Kawakami, T., & Kishiya, K. (2012). The effect of personal and virtual word-of-mouth on technology acceptance. *Journal of Product Innovation Management*, 29(6), 952-966.
- Pavlou, P. A. (2003). Consumer acceptance of electronic commerce: Integrating trust and risk with the technology acceptance model. *International journal of electronic commerce*, 7(3), 101-134.
- PWC. (2017, Juni 2017). *Digitale Assistenten Bevölkerungsbefragung*. Retrieved March 23, 2018, from PWC: <https://www.pwc.de/de/consulting/management-consulting/pwc-befragung-digitale-assistenten-2017.pdf>.
- Rhiu, I., Kwon, S., Bahn, S., Yun, M. H., & Yu, W. (2015). Research issues in smart vehicles and elderly drivers: a literature review. *International Journal of Human-Computer Interaction*, 31(10), pp. 635-666.
- Rogers, E.M., *The Diffusion of Innovations*, 4th Edition, Free Press, New York, NY, 1995.
- Soliman, M. & C. Guetl (2010). "Intelligent pedagogical agents in immersive virtual learning environments: A review." In: *MIPRO, 2010 proceedings of the 33rd international convention*, 827-832.
- Stanford, V. (2002). "Using pervasive computing to deliver elder care." *IEEE Pervasive computing* 1(1), 10-13.
- Statista (2015a). "Consumer confidence about personal online data security 2015". URL: <https://www.statista.com/statistics/296700/personal-data-security-perception-online> (visited on 23/03/2018).
- Statista (2015b). "Actions to protect devices and online usage privacy according to internet users worldwide as of June 2015". URL: <https://www.statista.com/statistics/463380/protection-of-devices-and-internet-privacy-worldwide/> (visited on 23/03/2018).
- Strayer, D. L., Cooper, J. M., Turrill, J., Coleman, J. R., & Hopman, R. J. (2017). The smartphone and the driver's cognitive workload: A comparison of Apple, Google, and Microsoft's intelligent personal assistants. *Canadian Journal of Experimental Psychology/Revue canadienne de psychologie expérimentale*, 71(2), p. 93.
- Vieira, V., L. R. Caldas & A. C. Salgado (2011). "Towards an ubiquitous and context sensitive public transportation system." *Ubi-Media Computing (U-Media) 4th International Conference*, 174-179.
- Vijayarathy, L. R. (2004). Predicting consumer intentions to use on-line shopping: the case for an augmented technology acceptance model. *Information & management*, 41(6), 747-762.