"Oh, Now I have to Speak"

Older Adults' First Encounters with Voice-based Applications in Smartphone Courses

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Abstract *This chapter deals with the question of what we can learn from interaction in institutional settings about the usability and learnability of everyday technologies such as voice-based Intelligent Personal Assistants (IPAs), especially for older adults or, more generally, less-expert technology users. Based on an analysis of video recordings made during smartphone courses in adult education centers in Germany, this contribution provides a qualitative and micro-analytical perspective on non-expert adult users' processes of discovering and exploring voice-based technologies. Using the framework of multimodal conversation analysis, both linguistic formats and embodied actions are examined, revealing the participants' situated and dynamic understandings of how one type of IPA (as a smartphone app or widget) works and operates. The analysis of these either guided or accidental discoveries of a new technology can provide new insights regarding the specific challenges associated with handling IPAs and instructing new users how to do so. Based on these observations, this chapter also provides some general thoughts on teaching digital skills to less-expert users.*

1. Introduction

Voice interfaces such as Intelligent Personal Assistants (IPAs), integrated into personal smartphones or as external devices, have been marketed as a particularly accessible technology that can be easily incorporated into our everyday lives (Reeves et al. 2018). However, despite the intuitive ease of use propagated, users with low technical affinity do not seem to adopt these technologies particularly well. Apart from – perhaps false – assumptions regarding idealized user types and interface design, one possible reason for this

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is the lack of opportunities to *discover* voice-based technologies, especially for older adults. One situation that can provide such a chance is in introductory smartphone courses for older adults: as well as explaining how to use basic applications such as messaging programs, emails, or the camera, some courses also introduce smartphones' voice assistant function (in our data, typically the "Google Assistant"). Although this type of institutionalized learning setting cannot show how participants adopt new technologies over longer periods of time, nor how practices and routines emerge in regular use in everyday life, observing this educational context can offer a unique opportunity to examine how initial contact is made with a previously unknown application.

The question of how children and young adults learn to use new technologies and media has attracted widespread interest in research. How people in later life phases get in touch with and use new technologies has received much less attention, however, and studies have tended to be based on questionnaires or interviews (section 2.1). Regarding IPAs more specifically, interactional research has illustrated how domestication processes manifest themselves in the details of talk with and around IPAs in mundane, private settings (section 2.2). With reference to video recordings made during introductory smartphone courses, this chapter is based upon data from a non-experimental setting in which older adults engage with everyday technologies (section 3). Deploying multimodal conversation analysis, I then illustrate how course participants discover and try to use an IPA for the first time (section 4). Both instructed and accidental as well as individual and joint 'discovery processes' are considered, showing which types of obstacles non-expert users encounter and how they respond to the discovery of this new application. Finally, the potential of this type of data and analysis to further our understanding of how non-experts approach mundane technologies, and how digital skills teaching might be improved, is briefly assessed in section 5.

2. Background

Both IPAs in general and the communication routines and technology use of older adults have been studied from a wide range of perspectives and fields, including, among others, computer science, media and communication studies, human–computer interaction (HCI), social psychology, and applied linguistics. As this contribution focuses on situated technology use in non-experimental social settings, the most relevant prior research comprises qualitative

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studies of older adults' interactional practices (with technologies, Section 2.1) or involving the use of IPAs in general (Section 2.1).

2.1 Older adults in social interaction (and interacting with technology)

"Communication and aging" was coined as a topic in the early 1990s to emphasize that despite the decrement in health and skills associated with aging (Coupland et al. 1991, Mollenhauer and Meier zu Verl 2023, 8–12), age should be understood as essentially contributing to an individual's identity and as a development process that unfolds in and through communication (Nussbaum and-Coupland 2004). However, just as ageism and ascriptions of age are part and parcel of our daily personal and institutional communication routines (Fiehler and Thimm 2003, Thimm 2000), a bias can also be observed in researchers' choice of settings and phenomena for studies focusing on older participants. Within interactional studies, for instance, most research seems to investigate speech-related pathologies (and how participants successfully communicate despite certain constraints, Goodwin 2003, Wilkinson 2019), on communication in private or institutional care settings (investigating issues of autonomy or entitlement, Backhaus 2013, Lindström 2005), or on practices of remembering and self-reflection (Boden and Bielby 1983, Boxer 2018).

When it comes to technology and the internet/media use of senior citizens, a plethora of studies have typically deployed surveys and interviews to investigate the question of how this population adjusts to the increasingly pervasive integration of digital tools into everyday life. Within the last two decades, a shift can be observed from an attitude towards technology characterized by anxiety and resistance (Czaja et al. 2006, Selwyn et al. 2003) toward more creative and customized practices whereby technology supports the maintenance of social connectedness (Quan-Haase et al. 2016, Wang et al. 2018), as "… longtime users of digital media have grown up into older age …" (Quan-Haase et al. 2018, 1207). Nonetheless, older adults remain a heterogeneous population in terms of their digital practices and experiences, as they dynamically encounter various technologies at different stages of their lives (Domínguez-Rué and Nierling 2016, Vincent 2018).

But while asking elderly participants to report on and assess their own level of connectedness and technology acceptance is important, such studies offer little to further understanding of how older adults develop skills in handling hard- and software, and how situated processes of domestication and taming (Waldecker and Hector 2023) of new technologies actually unfold (see

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also section 2.2). Within interactional approaches, there have been studies on first contact among older participants and assistive technologies, such as social robots (Habscheid et al. 2020) or virtual assistants (Opfermann/Pitsch 2017), but other technologies remain understudied from this perspective (see Hrncal andHofius 2023, 125–127). The settings investigated have tended to be semi-experimental, testing participants' reactions in trials designed to assess a specific technology's acceptability and user design (see, e.g., Hrncal andHofius 2023, Pino et al. 2015). In their case study on the use of social robots in care facilities, Carros et al. (2020) describe the elderly as being "more restrained and insecure" (ibid., 5) when first meeting a robot, and then engaging more actively with it from the second time on. While focusing on assistive technologies is clearly justified from a demographic and socio-economic perspective (Carros et al. 2020), this emphasis tends to render uses of more mundane technologies invisible. First, older adults can and do inhabit this world not exclusively as participants in need of assistance, but also as fully capable, i.e., typical (cf. Antaki andWilkinson 2012 for the notion of (a)typicality), participants, who also use technology for non-medical purposes and in non-institutional settings; uses that do not differ fundamentally from those of younger adults. Second, research with older citizens tends to take what could be called an exoticizing approach, in the sense that the technologies under investigation tend to be highly specialized, pricey, and often still in development or in a test phase (see, for example, Carros et al. 2020, Opfermann anditsch 2017, Pino et al. 2015). While this is linked to the applied dimension and with aims to develop and improve specific designs and user interfaces, especially in HCI-related research, one result is that mundane and fully domesticated technologies such as smartphones, tablets, and laptops in their standard uses tend to be overlooked, possibly due to being perceived as less interesting or valuable research topics (Oloff 2021a, 197ff.).

Indeed, there seems to be a greater societal interest in the techno-socialization of toddlers and children (e.g., Lahikainen et al. 2017, Wiesemann et al. 2020), thereby further marginalizing attention to the acquisition of digital skills in older populations. This is compounded by the difficulty of identifying precise places and times in which such learning processes could take place, as older adults, unlike children and young adults, do not generally encounter technologies within compulsory institutional contexts (kindergarten, school, university), but ad hoc and at different moments in their professional and private lives. One such setting, however, is provided by digital skills courses within adult education. Indeed, micro-analytical studies conducted in these

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settings can reveal precisely the challenges older adults face when learning how to use mobile and smartphones, tablets, or computers (Oloff 2023, Råman 2022, Weilenmann 2010). Drawing conclusions from video recordings made during instructional and learning activities in situ, a multimodal interactional approach can expand upon the findings of more design-oriented research by contributing new perspectives and topics that offer detailed insights into the potential benefits and complex obstacles that mundane technologies present to less-expert users, singling out specific physical and digital *learnables* (cf. Råman 2022). It is this approach that is followed in the study presented in this chapter.

2.2 IPAs in social interaction

One of the advantages of taking an interactional approach to study the role of technology in our lives is that it enables us to examine technology use outside controlled laboratory conditions, i.e., 'in the wild' of everyday life. Compared to log data or protocols that only provide snippets of talk with and around IPAs, video recordings of social interaction offer a more comprehensive perspective on how IPAs are embedded in conversational and other mundane activities (Habscheid et al. 2021, Porcheron et al. 2017). In multi-party interactions, users have been shown to mutually adjust by selecting a query performer or by producing silence (Porcheron et al. 2017, 2018), thereby collaboratively finding ways to use IPAs in co-presence with others, despite them having been initially designed for single users (Albert et al. 2023). Indeed, interactionally-oriented research has criticized the focus in much of HCI research on IPAs as being driven by false assumptions about ideal users and conversational models that the device should supposedly be designed for (Reeves and Porcheron 2023). Research based on interactional data concludes that it would be better to design IPAs not in accordance with an idealized model of "conversation" that the device output is optimized to correspond to, but rather to aim to maximize the progressivity of the request–response chain (Fischer et al. 2019, Reeves et al. 2018, Reeves and Porcheron 2023).

When users try out and explore a new IPA, they usually proceed by taking a trial-and-error approach (Habscheid et al. 2023, Velkovska et al. 2020). This first exploration phase ends when users' practices involving the IPA stabilize, indicating that the technology has been "tamed" by its new users (Waldecker/Hector 2023, note, however, that the domestication/taming of new technologies does not always follow a unilinear trajectory, as new functions or updates

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can instigate new appropriation processes, see Peil/Röser 2023). IPA users have been shown to repeat or refine their formulations of queries (Porcheron et al. 2017) and to try out different syntactic formats, with a decreasing number of unsuccessful commands over time, which might indicate a learning process leading to more successful and therefore routine query types (Barthel et al. 2023, Porcheron et al. 2018). More experienced users have been shown to later flexibly ascribe or restrict the IPA's agency according to their technical needs and interactional purposes (Habscheid et al. 2023).

According to the literature review by Stigall et al. (2019), studies addressing older adults and voice assistants were overall very few and predominantly interested in the participants' *perceptions* of IPAs (with respect to their usability, accessibility, or trustworthiness) or in their preferences (e.g., regarding the hardware, or the gendered voice output). IPAs are thought to be possibly more user-friendly for older or disabled users than other interfaces, as the voice interface does not require potentially challenging physical or visual input methods (Stigall et al. 2019). With their study on the use of IPAs in a private homecare environment, however, Albert et al. (2023) show that IPAs do not represent a technological panacea – even if they can augment the independence of those in need of care – because they always end up being used in complex socio-material settings that cannot be modelled in advance. Moreover, even if problems with tactile user interfaces seem to be rather prevalent among less experienced technology users (see, e.g., Råman 2022, Weilenmann 2010), IPAs seem to figure among the least-used mundane technologies among the elderly.[1] While one possible reason for this might be the lower frustration threshold of older users than their younger counterparts when interacting with IPAs (Desai/Chin 2023), detailed research on older participants interacting with IPAs in everyday settings could shed more light on why voice interfaces are less popular with this user group. This chapter therefore proposes looking closely at situations in which older adults make first contact with IPAs, in order to better understand both the challenges and the opportunities IPAs present for less experienced users.

1 In a survey of media use among participants of 60+ years of age in Germany, only 14% of the respondents reported having an IPA at their disposal, compared to 100% for TVs and 72% for smartphones (SIM-Studie 2021, 6). "As this figure is significantly lower than the ownership rate of smartphones, which usually include a voice assistant, it can be assumed that many people are not aware of these functions, or thought that they were only available on [external] devices." (translation of SIM 2021, 7).

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3. Data and Method

The video data analyzed for this contribution were collected within the research projects "Smart Communication" and "DigiLife". Both projects set out to investigate the use of mundane technologies in naturally occurring (i.e., non-elicited) face-to-face encounters, with the project DigiLife focusing more specifically on older adults' routines and challenges when handling technological devices such as smartphones or tablets. Although the currently available data set involving older adults was collected in both institutional (currently approximately 38 hours of recorded video) and private settings (currently 12 hours), it is only the institutional data set that is referenced in this contribution. This is because, for one, participants did not spontaneously use IPAs during the recorded sessions in private settings; secondly, my focus in this chapter is on first encounters with IPAs and their initial exploration, which can be observed as an activity in smartphone courses designed for non-expert users, but are much more difficult to record "in the wild" of private homes (Hector/Hrncal 2020). Courses offered by public adult education centers may be attended by adults of any age; however, in our data, it was typically older adults who seemed interested in acquiring basic smartphone skills. Among the seven smartphone courses that were recorded in adult education centers in different regions in Germany (most of which offered an introduction to Android phones), the presentation and introduction of voice-controlled applications such as Google Assistant was rather peripheral. This relates to the courses' introductory scope, emphasizing the most basic functions of the hardware and the operating system (including, for instance, control buttons for volume, different connection modes such as WIFI or mobile data, writing emails, or taking pictures), and to the limited time frame of the courses: usually ranging from two to twelve hours. Indeed, the only detailed introduction to IPAs observed during the courses took place in one of the longer ones (which comprised three three-hour sessions). In the other courses, the existence of IPAs was mentioned, but they were not introduced as a separate topic. However, course participants can potentially discover voice-controlled applications themselves at any time by intentionally or accidentally activating the app, as happened during one of the observed courses. In this chapter, I focus on moments of both instructed and accidental discoveries of IPAs during these courses.

The framework used for analyzing these first encounters with IPAs is ethnomethodological conversation analysis: a qualitative approach to social

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interaction with the primary aim to reveal the underlying orderliness of conversational and other mundane activities, i.e., the participants' methods (Bergmann 1981, Garfinkel 1967) for achieving social order and mutual understanding. Based on audio and video recordings of naturally occurring social interactions (Sacks 1984), the main tools of ethnomethodological conversation analysis are detailed transcripts and sequential analysis (Schegloff 2007), focusing on the precise temporality and coordination of audible and visible action (Mondada 2016, 2018). The data were transcribed using transcription conventions following Jefferson (2004) for the verbal transcript, and Mondada for the multimodal annotations (Mondada 2018[2]). The original talk in German was translated into English endeavoring to provide an idiomatic translation. All the participants consented to the recording and to their data being used in scientific publications, and all names have been pseudonymized in the transcripts.

4. Analysis

In this section, I focus on three excerpts from video recordings made during smartphone courses for adults in which participants explore IPAs, firstly, as part of an instructed activity (section 4.1), and secondly, following their accidental discovery (section 4.2). The analyses take into account how the participants orient to this discovery process through talk and embodied actions, and what the participants' conduct reveals about their expertise and stance toward the 'new' technology.

4.1 Instructing the Use and Exploring IPAs for the First Time

I now take a closer look at a smartphone course in which part of a session is devoted to the Google Assistant (as a widget[3] on Android smartphones, see Figure 1 as an example). This slot of approximately 20 minutes takes place at the beginning of the second of the course's three meetings. The seven participants

2 https://www.lorenzamondada.net/multimodal-transcription (accessed on 10/08/2024).

3 A widget is a simplified interface that can be positioned on the home screen of a mobile device (in this case a "mobile widget") so as to make a specific and usually data-rich application more quickly accessible to the user.

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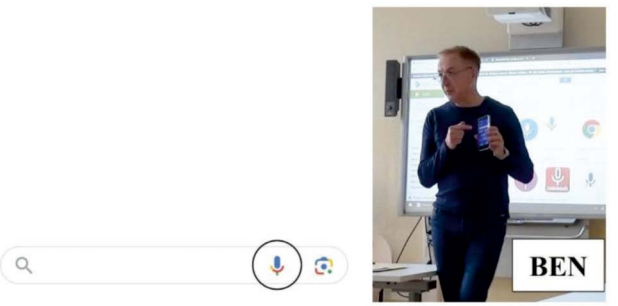
are seated at tables arranged in a horseshoe formation, and course leader BEN uses a smartboard and his own phone during the course (see Figures 2–3)[4]. Prior to the excerpt, BEN had already shown (via smartboard) how to carry out a browser-based web search and a search in the Google Play Store. He then announced that he would now present a "completely different way of searching" and began by pointing to the Google widget and the microphone icon in the search bar on his own phone (see Figure 2). The participants were supposed to then find the widget and the icon on their own device; a task that, due to the design of the microphone icon (circled in black in Figure 1), caused some difficulties (for a more detailed analysis, see Oloff 2021b). After ensuring that each participant had identified the microphone icon on their own phone (by moving around and checking on all the participants), BEN now explains how to make the IPA work (note that in the multimodal annotation, the abbreviation SP stands for smartphone):

Excerpt 1 (190925_VHSB_001521_okgoogle)

Figure 1: Widget with microphone icon. Figure 2: #2, l. 1



4 BEN uses the smartboard to project a browser window (e.g., the Play store) from the desktop computer in the room and for writing down basic keywords and instructions, or for drawing diagrams of the smartphone screen. He rarely uses his own smartphone, except, for instance, to show and comment on specific functions, or to demonstrate how to use it, such as when introducing the IPA (see Excerpt 1). The phone screen, however, is not projected and therefore the course leader's manipulation of the device is largely unseen by the course participants and can only be followed on the basis of his spoken commentary. This might contribute to the participants' difficulties in executing tasks on their own phones afterwards.

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```
1    BEN  +SO; wenn ich das #2mikrofo:n antippe; (.) dann kann ich das
          NOW  if   I  tap  on the microphone   (.) then I can ask
          +...right index points to SP/widget------------------->
     kle  >>looks down at her SP and notes--->>
2         was ich suche, (1.2)+als   FRA:ge stellen.     (0.9)
          a question     (1.2) about what I am searching (0.9)
          >pppp to SP/widget--+,,,
3         also; (.) und die [frage?]
          so    (.) and the [question
4    KLE                    [ °ach:]so:; (jetzt)     [sprechen;°]#3
                            [  oh: ]right (now) with [speaking  ]
5    BEN                                             [die läu:t,]   äh:
                                                     [(this) ring-] e:r
6         die:;           (.) beginn ich, mit;  (.) 'okay: google.' (0.5)
          this (question) (.) I'll  begin  with (.) 'okay: google'  (0.5)
7         dieses 'okay google:' (.) ist da[für da, .h: dass    er[:,
          this   'okay google'  (.) is the[re      .h: so that he[:
8    SPth                                 [((beep1))
9    THI                                                          [°ah:°
                                                                  [°oh°
10        °sch(h)o(n) muss ich spr(h)echen.°
          (already)  I  have  to  speak
```

Figure 3: #3, l. 4

Figure 4: #4, l. 16

```
11        (0.3)
12   BEN  dass er, (0.5) [sich:-
          that he  (0.5) [can
13   THI                 [°schon muss [ich  sprech[en.°
                         [(already) I [have to spe[ak
14   SPth                             [((beep2))
15   BEN                                          [auf ihre sprache
                                                  [prepare for your
16        einrichten +kann. (0.5)    +also mikro#4fon   an, und dann;
          speech             (0.5)      so (turn) on the mic and then
     ben            +rHand t/display+activates microphone
```

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```
17          (.) die frage stellen,(.) und das ganze 'okay google;
            (.) ask  a   question (.) and then this 'okay google
18          [zeige [mir;' 'okay google; was ist,' et cetera.
            [show  [me'   'okay google what is'   et cetera
19     SPBe [((beep1))
20     SPx         [((beep1))
21          (0.5)
22     BEN  jetzt hat er bei mir natürlich [reagiert hier,]
            now   in my case  of course    [(he) reacted  ]
23     SPbe                                [von     wikipe]dia; (.) der
                                           [from    wikipe]dia  (.) the
24          [lateinische ausdruck et cetera, wird zur abkürzung einer&
            [Latin    expression et ecetera is (used) to abbreviate an&
25     SPx  [((beep2))
26     SPbe &aufzählung verwendet, und bedeutet wörtlich,
            &enumeration           and literally   means
27          und die üb[rigen dinge.
            and the   [other things
28     ZAN             [th: °ich glaubs nich;°
                       [th: I can't believe it
```

BEN's demonstration of the IPA provides a variation of the different steps required to operate it: activating the mic, saying the wake words *okay google*, and then formulating the query. Notably, however, he inverts the order of the two latter steps: while stating how to activate the microphone by tapping on the symbol (l.1), he points to the widget on his phone (Figure 2). As the second step of the demonstration, he then mentions the formulation of the query *als Frage* "as a question" (l.2), only afterwards mentioning the wake word as the way to start the request (l.3, 5–6) so that the device (*er* "he", l.7) can "prepare for your speech" (l.7, 12, 15–16), thus providing a lay explanation of the wake word's technical significance. Indeed, BEN then condenses the procedure of using the IPA with the summary: "So turn on the mic and then ask a question" (l.16-17), mentioning the wake word only indirectly in the following two generalized and incomplete example queries "and then this 'okay google show me' 'okay google what is' et cetera" (l.17-18). Thus, he does not emphasize the required precise order of the steps to be taken nor the technical importance of the wake word (or of the activation in general) and of the timing, nor that the IPA can be activated by either voice or touch (but does not actually need both), all of which missing details might make it difficult to understand how to successfully use the IPA. Moreover, BEN's initial demonstration is interspersed with some responses from the group, leading to suspensions and breaks in the production of this multi-unit turn.

The first participant to respond is KLE, who constantly looks down at her device and notes during BEN's demonstration (see Figure 3), a posture she

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maintains throughout and beyond the duration of the excerpt. Her possibly distracted reception of BEN's demonstration of the IPA is thus limited to the audible. Perhaps unsurprisingly, then, her early response to BEN's turn (l.4), indicates that her initial understanding of the IPA's function is somewhat over-simplified (see the change-of-state token *achso*, Heritage 1984, Golato and Betz 2008): searching by simply speaking. Proceeding with his example query, BEN unintentionally activates the IPA on THI's smartphone. The fact that her device respond only to the wake word (which publicly shows that the touch activation is an alternative, not a compulsory first step) is not commented on by BEN. This prompts THI's phone to produce the on/off sound (l.8, 14), which THI comments on, thus incidentally displaying the knowledge she already has about IPAs ("Oh I already have to speak", l.9-10, 13). These overlapping audible actions lead to major perturbations in BEN's turn production, but he nevertheless proceeds with his condensed explanation[5]. Finally, by tapping on the mic (l.16, Figure 4), uttering the wake word and a (double) question, BEN then accidentally triggers the IPA on his own phone (l.19, see his comment l.22), leading to an audio output from the phone concerning the definition of the word "etcetera" (l.23-24, 26–27), which had only been used in order to mark the end of the list (Jefferson 1990) of possible queries BEN provided as part of his initial explanation. Participant ZAN assesses this demonstration as "unbelievable" (l.28), which, similar to KLE, displays her status as someone with no prior knowledge about IPAs. This clearly contrasts with THI's previous display of knowledge (also implied by her pre-emptive completion of BEN's turn in Excerpt 2, l.67; see Lerner 1996). The participants' speaking turns therefore reflect whether they are encountering the technology for the first time or already have some degree of familiarity with it. Indeed, in what follows, it is both KLE and ZAN who attempt to use Google Assistant on their own devices, whereas THI only does so to assist them in their initial, unsuccessful attempts.

5 Indeed, none of the other participants' devices are automatically triggered at this moment. As BEN does not formulate any guidelines regarding the timing for individually trying out the IPAs, he does not seem to expect major problems due to multiple overlapping queries. But his ensuing round to check up on each participant will show that the participants' IPAs have either been set to inappropriate settings (e.g., not yet set to enable voice input, or the correct language), or that the participants have not yet understood how to correctly activate and use them.

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In the following 28 seconds (not presented here), BEN provides two fully-formulated examples of IPA-assisted searches: first, a search for pictures ("OK Google, show me pictures of elephants"), and second, asking for the opening times of a sightseeing attraction, which leads to an audio output. He then goes on to provide another summary of how the IPA functions (Excerpt 2A). During all this time, KLE continues to look down at her phone, an orientation she maintains when she requests assistance (l.69):

Excerpt 2A (190925_VHSB_001633_okgoogle)

```
65   BEN  also ich brauch das dann nicht (0.4) mehr; (.)
          so I no longer have            (0.4) (to)  (.)
     kle  >>-looks down at her SP--------------------->>
66        [reinzuschrei:]ben, (.) sondern (.) ich; (.)&
          [write it     ] in  (.) but     (.)  I   (.)&
67   THI  [reintippen:, ]
          [type it in   ]
68   BEN  &sp:r:eche es rein; (0.5)
          &say        it       (0.5)
69   KLE  und [wo find ick det 'okay'?   ]
          and [where do I find the 'okay']
70   BEN      [.h und   kriege  genau so ] die ergebnisse
              [.h and   (I) get the same ] results
71        wie bei  der normalen;
          as  with the normal
72   KLE  jetzt +sprechen?
          speak   now
     ben        +..looks to KLE->
73        (0.2)
74   BEN  suche; (.) 'okay, google;'+ und dann einfach lossprechen;
          search (.) 'okay  google'   and then just start talking
     ben  >gaze KLE----------------+,,,
75        (.)
76   KLE  ich hab hier +keen-  find   keen   'okay:'
          I  don't have a-    can't find any 'okay'
     ben               +..gaze KLE->
77   THI  .H:
78        +(0.4)
     ben  +..walks twd KLE, stands next to THI/ZAN->
79   KLE  °det  [is-°
          that  [is-
80   THI        [nee einfach- (.) einfach [reinsprechen.      ]
                [no  just-    (.) just    [talk into (the mic)]
81   BEN                                  [NEIN. wenn sie auf ]
                                          [no    when you     ]
82        das  [mikrofo:n *gedrückt [haben; sagen sie-     ]
          have [pressed  the   micro[phone   you say-      ]
83   KLE       [achso:,             [ja: und jetzt soll ick] +sprechen.
                [oh okay             [yes and now  I have to]  speak
     ben  >gaze KLE-----------------------------------------+t/ZAN->
     zan  >gaze t/KLE-----*...gaze twd SP display-->>
     zan                  *..bends body closer twd her SP->l.89
```

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```
84          (.)
85    BEN   [+°genau.°
            [  exactly
86    KLE   [su-  (.) °°su-°°
            [sea- (.)  sea-
      ben    +..gaze KLE-->
87          (0.2)
88    ZAN   °einfach+*%reinsprechen;°#5a/b[xxx kosten]los installieren;°&
             just talk into (the mic)     [xxx   down]load      for free&
89    KLE                                [suche elefant. ]
                                         [search elephant]
      ben   >--KLE--+..gaze t/ZAN----------------------->
      zan           *..bends down, closer to SP display->l.112
      thi           %..gaze & bends t/SP&ZAN----------->>
90    ZAN   &°mh° (.) au weia; das is ja der reinste [wahnsinn;
            & mh  (.) oh dear  that's really         [insane
```

Figure 5a: #5a, l. 88

Figure 5b: #5b, l. 88

BEN concludes his introduction of the IPA by comparing it to a standard, text-based search: the query is not made by writing, but by speaking (l.65-66, 68) to obtain "the same results as with the normal search" (l.70-71, 74). This summary is again repeatedly suspended by KLE's requests for assistance to find the "Okay" (l.69), and asking whether she needs to "speak now" (l.72), which seems to display a more generalized trouble relating to the correct order of steps required to activate the IPA. While KLE's first request does not receive a response, BEN does shift his gaze to her (l.72) and replies to her second turn by providing yet another version of the summarized procedure: "'Okay Google' and then just start talking" (l.74). This is not sufficient for KLE, who then reformulates her first question in the form of a declarative, stating the absence of an "Okay" in the widget (l.76). With her gaze steadily fixed on the screen and her posture bent over her smartphone, this declarative aims at mobilizing the course leader's assistance, and is apparently successful – BEN moves from the

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front desk toward KLE (Oloff 2023). He does not, however, go to KLE and inspect her device, but remains standing in front of the table where THI and ZAN are seated (l. 78, cf. Fig. 5a). THI, after an initial hesitation (l.77) and possibly waiting for BEN to respond, now self-selects with another instruction for KLE ("just talk into (the mic)", l.80). In overlap, BEN provides his own response, finally mentioning the need to tap the mic symbol first (l.81-82), which is a way of triggering the IPA if it has not yet been activated or set to operate via voice activation[6]. Interestingly, KLE's initial misconception (that "Okay" corresponds to some kind of button to press) is not explicitly corrected, but only disconfirmed as non-relevant (see the initial negative response tokens in l.80-81). Nevertheless, KLE publicly displays understanding with *achso*, and, sequentially well placed as a second step following the first part of BEN's response, reformulates her prior request for confirmation (l.72) as an instruction directed to herself ("yes: and now I have to speak", l.83). Simultaneously with BEN's confirmative closing third (l.85), KLE now tries to initiate a query on her device by imitating one of BEN's prior demo queries, albeit in a simplified form ("sea- sea- search elephant", l.86, 89). Despite having previously displayed possible understanding through the change-of-state token *achso*, she neither activates the mic nor verbalizes the wake word, so her IPA is not activated and this attempt will fail.

BEN, who has monitored KLE beyond the sequence closing (l.86-88), now refocuses his attention on ZAN, most likely prompted by her self-selection (Fig. 5a/b, l.88). Her embodied display of trouble (bending down and looking at her smartphone lying in front of her, Kendrick and Drew 2016), the muttered repeat of THI's previous instruction to KLE (l.80), reading aloud a message from the screen, the trouble alert (ibid., *auweia* "oh dear", l.90) and the final assessment ("that's really insane", l.90) clearly display that she is struggling to use the IPA on her own. This way, ZAN successfully mobilizes both BEN's and THI's assistance, who will now guide her in her first attempt to operate the Google Assistant:

6 See the instructions provided here (accessed on 10/08/2024): https://support.google.com/assistant/answer/7172657?sjid=17825161593263064971-EU&hl=en.

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Excerpt 2B (190925_VHSB_001633_okgoogle, continuation of Excerpt 2A)

```
90   ZAN  &°mh° (.) auweia; das is ja der reinste [wahnsinn;
          & mh  (.) oh dear  that's really        [insane
91   KLE                                          [°gibt nur keenen
                                                  [ but there's no
92        (0.2)+gibt keenen ele[fant°
          (0.2) there's no  ele[phant
93   THI                        [einfach-
                                [just
     ben       +..puts on glasses & comes to ZAN's place->
94        (0.3)
95   BEN  .h::
96   ZAN  hier;
          here
97   KLE  °°da kommt keen elefant.°°
            there is no elephant
98        (0.8)
99   BEN  +°so;° (und) das #6 antip[pen, (.)+&
           alright (and)      tap  [here (.) &
100  ZAN                           [ja,
                                   [yes
     ben  +right index ppp to SP ZAN--------+,,,
101  BEN  &*sagen; 'okay, google?' und dann: die [frage.+
          &   say  'okay google'   and then the  [question
102  SPza                                        [((beep1))
     zan   *activates microphone on SP by tap
     ben  >stands & leans to ZAN-----------------------+,,,
103       (0.2)
104  ZAN  okay:,
105       (0.6)
106  THI  google;
107       (0.4)
108  ZAN  google.
109       (0.5)
110  BEN  #7und die frage,
            and the question
111       (0.3)
112  ZAN  .h[:: äh::; [wie +komme ich-       *ach]so:;&
          .h[:: uhm:: [how  do I get          oh ] okay&
113  KLE    [°ach ick muss sa:gen; 'okay google'°]
            [ oh  I have   to say  'okay google' ]
114  SPza             [((beep2))
     zan  >bent over SP display--------------*,,,straigthens up->
     ben  >in front of ZAN-+,,, starts turning & walks back t/desk->>
115  KLE   [okay, google; (.) ich suche den elefant;      ]
           [okay  google  (.) I'm looking for the elephant]
116  ZAN  &[(0.4) °ja° *(.)   welche  öff: (.) nungszeiten] hat äh::::;
          &[(0.4)  yes  (.)  what are the o(.)pening hours](of) uh:::m
     zan  >straight----*...bends back to SP display->
117  THI  °nee sie- sie-° die frage müssen sie schon vorher wissen;
           no  you  you   have to know the question beforehand
118       des: [.h der-  .h:] und dann fangen sie einfach&
          that [.h the-  .h:] and then     you just start&
119  ZAN       [*he, he, he;]
     zan  >-----*..leans back, away from SP->>
     zan  >gaze SP*,,,,
120  THI  &noch mal von vorne an;
          &again from the beginning;
```

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Figure 6: #6, l. 99

Figure 7: #7, l. 110

BEN visibly prepares to help ZAN by putting on his glasses and moving closer to her (l.92-93). While both THI and BEN project (longer) turns (l.93, 95), they wait for ZAN to initiate the trial on her own, which she does by hovering with her index finger over the widget on her smartphone screen (l.96, cf. Figure 6). As she does not then tap the mic icon, BEN bends closer to her smartphone, points to the correct area of the screen (Figure 6) and reissues an instruction, this time in the correct order (l.99, 101). At the same time, ZAN activates the mic by tapping, which is registered by the device's activation sound (l.102). ZAN then proceeds by saying *Okay*, but does not continue (l.104-105). THI, seated next to ZAN, prompts her by saying the missing part of the wake formula (*Google*), which ZAN hesitantly repeats before stopping again (l.106-109)[7]. BEN, who has meanwhile re-straightened his posture (Figure 7), thereby treating ZAN's problem as a *learnable* (and not something he will solve by manipulating her device, Råman 2022), now urges her to provide a question (l.110). ZAN initiates a possible request for directions ("how do I get-", l.112), interrupts herself and attempts a different query ("what are the opening hours of-", l.116), echoing one of BEN's initial demo queries. She then abandons this syntactic construction as well, apparently realizing that she has not yet prepared an appropriate query. By now, her IPA is no longer activated (l.114). THI offers a suggestion (i.e., that the question should be known in advance, l.117) and

7 Indeed, both BEN and THI seem to orient to a redundant activation practice (tapping the mic and saying the wake formula), which seems probably easier than to immediately instruct two different ways (either touch or voice activation), and less time-consuming than to check the settings on all the participants' devices.

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encourages ZAN, who has momentarily disengaged from her smartphone, to start again (l.118-120).

This assistance sequence is overheard by KLE, who had previously realized that her first attempt had failed, as "there's no elephant" (i.e., pictures thereof) to be seen on her phone (l.91-92, 97). Concurrently with ZAN's first attempt, KLE displays understanding of how to proceed, affirming that she now understands that *Okay Google* has to be voiced as well (l.113). This leads her to produce a formally correct query (l.115) which nonetheless fails as the language of her IPA seems to be set to English – a problem that will later be resolved by BEN.

The excerpts in this section have illustrated that even detailed demonstrations of how to use a new application do not always lead to its immediately successful implementation by course participants. This could be partly due to a certain variation in the explanation: the order and exact effects of the three steps (activating the mic by tapping, uttering the wake formula, and verbalizing a query) were not consistently presented in exactly the same way, or to the heterogeneity of types of queries demonstrated (both syntactically, i.e., including both directives or WH-interrogatives; and in terms of output, i.e., voice, images, or text/display output). Here, the ways the participants respond to and comment on BEN's introduction reveal different levels of (non-)expertise regarding IPAs. While those (such as THI in this case) who already have a degree of familiarity with a specific app or technology can even assist their peers, the 'newcomers' mobilize assistance through various audible and visible displays of trouble. This leads to customized instructional sequences and extended monitoring of the participants' (here, KLE and ZAN) trials. While the non-expert participants audibly display some understanding about how the IPA functions from very early on in the demonstration, the lack of success of their initial attempts to use it indicates that first-time users of IPAs might benefit from supplementary basic technical information, such as the necessity of the wake word (or, more generally, of the need to *activate* the IPA), the timing of the query formulation, and the significance of the on/off sounds. Beginning the demonstration by outlining some of the benefits of using an IPA might also contribute to faster success in using it, or, at least, increase participants' motivation to try out the IPA on their own. In the next section, I discuss the role of discovering individual benefits to be gained by adopting and accepting a new technology.

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4.2 Discovering IPAs and assessing their value for non-expert users

The analysis in this section will offer a reflection on chance encounters with new applications or functions, and examine the process of discovering a 'new technology'. In the example I draw upon here, the IPA is not introduced as part of the course, but discovered when a participant inadvertently activates it on her own device. The excerpt is taken from the second meeting of a two-part course (2 x 1.5 hours); the eight participants, who are seated in a row opposite the course instructor, have previously been instructed how to use Google Maps. They are now supposed to type the name of a place or location into the search bar to explore the app. Instructor JUN's final example as part of this instructional sequence is the Eiffel tower in Paris (Excerpt 3A, l.1-2). During this turn, participant MEF, seated to the left end of the row, unintentionally activates the IPA integrated in the Google Maps app of her phone. Because the excerpt included numerous turns by other participants and the course leader's interaction with them, especially at the beginning, the transcript presented here has been simplified to focus on the exchange between MEF and FIS, who is seated next to her.

Excerpt 3A (190919_NOS_010910)

Figure 8: #8

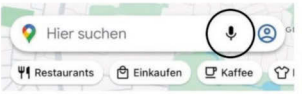

Figure 9: #9, l. 4

Figure 10: #10, l. 6

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```
1    JUN  >genau so können sie jetzt auch sagen< (0.3) ich h(h)ab ja
          exactly and so you could also say     (0.3) I have
2         schon immer mal von de:m; (0.5) pari:ser eiffelturm gehört;
          always  heard about the   (0.5)     Eiffel tower in Paris
3         (0.25)*(0.6)
     mef        *..rHand to SP, changes position of SP->
4    JUN  *aber noch *#9nie *gesehen.
          but  I've  never seen it
     mef  *...gaze t/watch--*...gaze t/left------>
     mef             *right thumb pushes border SP
     SPmf >>google maps on screen->
5         (0.1)%(0.3)
     SPmf  >---%...pop-up voice assistant on screen->
6    SPMf ((beep1))*#10
     mef            *..gaze SP->
7         (1.0)
8    MEF  hUch
          oh dear
9         (0.7)
10   MEF  'sAg etwas'
          'say something'
11        (0.9)
12   SPmf £((beep2))
     fis  £..gaze t/SP MEF->
```

Figure 11: #11, l. 14

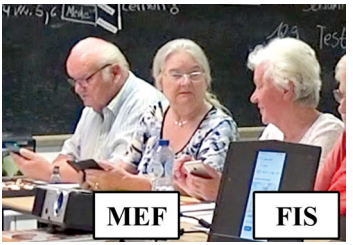

Figure 12: #12, l. 18

```
13        (0.75--)*(0.1)%(0.5)
     mef  >gaze SP*...gaze FIS->
     SPmf                %screen changes
14   FIS  hem,#11
15        (0.5)
16   MEF  .H; *.he,
     mef  >FIS*,,,gaze SP->
17        (0.9)
18   FIS  der spricht ja auch mit £ihnen; (0.3) wenn sie_s-#12
                he also talks to you; (0.3) if   you s-
     fis  >SP MEF----------------£..gaze MEF->
19   MEF  %ja:,:;=
           yeah=
     SPmf %,,,blue pop-up beam on display disappears
```

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```
20   FIS  =wenn sie zum +beispiel *ins +internet gehen,&
          =if       for example you go on the internet &
     mef  >gaze SP----------------*...gaze FIS->
     jun                 +...walks back t/center of room->
     jun                                +..gaze t/FIS&MEF>
21   FIS  &und wollen nich eintippen     (0.3) was sie wissen wollen,
          &and you don't want to type in (0.3) what you want to know
22        (0.5)+können sie den *fragen (0.2) und dann kommt&
          (0.5) you can ask him        (0.2) and then you get&
     mef  >gaze FIS------------*,,,gaze SP->
     jun  >----+stands in front of board, gaze t/FIS&MEF->
23        &die antwort auch °über-° (0.6) per stimme;+#13
          &the answer (also) over-  (0.6) by   voice
     jun                                              +nods
24        (0.8)
25   MEF  ha,ha,ha,ha;
26   JUN  da geb ich ihnen recht.
          I do agree with you
```

Figure 13: #13, l. 23

As he formulates his final example of a list of several possible places to look up with the Maps app, course leader JUN is standing behind the desk in the center of the classroom. When one of the participants self-selects in overlap and formulates a complaint (not shown in the transcript), JUN moves to the right end of the row to assist that person, a position he will remain in until line 20. This might explain why he is so late to comment on MEF's discovery of the IPA (l.26 and further). Before and in the beginning of the excerpt, MEF is looking at her smartphone, viewing the app interface in order to follow JUN's instruction (to insert the name of a location in the search bar, cf. Figure 8). During JUN's turn suspension (l.3), she slightly adjusts the position of her smartphone (that, due to a protective double case, can be held like a book) more towards her right

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hand, and then looks at her watch on her left wrist (l.4, fig. 9). With this movement, her right thumb apparently briefly touches the microphone icon in the Google Maps search bar (see the black circle in Figure 8), triggering a pop-up message on the screen (l.5, cf. Figure 10) and the IPA's activation sound (l.6). MEF, who had looked up to the left in the meantime, shifts her gaze back to her smartphone display and perceives the modified interface, to which she responds with the high-pitched response cry *huch* (l.8, Goffman 1981), a formulaic interjection expressing "surprise" that works as a possible public trouble alert (Kendrick and Drew 2016). She then reads aloud the IPA's initial message on her screen *sag etwas* (l.10), but does not seem to understand it as a prompt to actually "say something" to the IPA at this moment. Shortly thereafter, the "off" sound indicates the IPA's deactivation (l.12), apparently accompanied by a visible notification on the screen (l.13). FIS, who is sitting next to MEF and probably overheard the surprise discovery, now turns her gaze to MEF's smartphone (l.12) and produces a laughter particle (l.14). MEF minimally responds to this by shifting her gaze to FIS and reciprocating the laughter (l.13, 16, Figure 11). She does not take this opportunity to initiate topical talk or to formulate an assessment, possibly because she does not know the exact meaning of the visual and audio notifications presented by her device, which is also suggested by her gaze returning to the screen immediately afterwards (l.16, cf. Figure 12). MEF's lack of understanding seems to have been anticipated by FIS, who then provides a basic explanation of the IPA, shifting her gaze from MEF's smartphone to MEF's face (l.18, fig. 12). Notably, FIS does not offer instructions on how to make the IPA work, but instead describes the general functioning and advantages of the app, i.e., that queries don't have to be typed and that answers are provided via audio output (l.18, 20–23). MEF initially responds in a possibly disengaged way (her stretched "yeah", l.19, suggests acknowledgement of having heard more than it displays comprehension), but she then gazes back at FIS (l.20) before returning to her device (l.22). She then produces more laughter particles and finally formulates an assessment that evaluates the IPA's functioning as something "nice" (l.27, Excerpt 3B):

Excerpt 3B (190919_NOS_010910, continuation of Excerpt 3A)

```
25   MEF  ha,ha,ha,ha;
26   JUN  da geb ich ihnen recht.
          I do agree with you
```

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```
27   MEF  £das ist gu:t.
            that's nice
     fis  £..gaze JUN->
28        (0.2)
29   MEF  'nein [danke,' 'aktivieren;'(nun muss-) achso,]+ dann muss&
          'no   [thank you' 'activate'(now I have-) oh okay] then I have&
30   JUN        [für die SCHREIBfaulen mal ganz gut; ehe,he,he,he,]
                [for the ones too lazy to write that's good ehe,he,he,he,]
     jun  >monitors FIS/MEF-----------------------------+.back t/desk>
31   MEF  &ich das aktivieren und dann, .h [*xx-
          &to activate it     and then  .h [ xx-
32   JUN                                   [+>dann kann man auch-<&
                                           [  then you  can also  &
     mef  >gaze SP--------------------------*...gaze JUN->
     jun  >gaze downwards / desk------------+...gaze MEF->
33        &(0.2)#14 t- +REIN[sprechen=also heut-= hier heute abend]&
          &(0.2)    t- speak[ into(the mic)=but today=here tonight]&
34   MEF                    [dann brauch ich nicht schreiben.     ]
                            [then I don't have to write           ]
     jun                +..walks twd MEF-------->
35   JUN  &empfehl ichs nich unbedingt=
          &I would not really recommend it=
36        =[weil wenn wir alle acht     REIN]sprechen (0.4) eH: (0.3)&
          =[because if the eight of us speak] into(the mic)(0.4)eH(0.3)&
37   MEF   [dann ist doch einfacher;       ]
           [then it is easier               ]
38   JUN  &[aber- (.) gerne auch üben.           ]
          &[but   (.) you are welcome to practice]
39   MEF   [dann brauch ich nicht schreiben,     ] dann kann ich
           [then I don't have to write           ] then I can
40        einfach sprech[en;  ] ne,
          just       spe[ak   ] right
41   JUN                [+ja; ]
                        [ yes ]
     jun                 +..steps back from MEF
42        (1.0)*(0.2)
     mef  >JUN-*,,,gaze SP->>
```

MEF then reads again from her phone's screen ("activate", l.29), and, after having produced the change-of-state token *achso*, concludes: "then I don't have to write", l.34, "then it's easier", l.37, "then I don't have to write then I can just speak, right", l.39-40). She thereby formulates in her own words what FIS has just told her and draws her own conclusions about the IPA's usefulness. JUN, who had been walking back to the center of the room a bit earlier, first overhears (see his gaze orientation and nod, l.20, 22–23 cf. Figure 13) and then joins the conversation between FIS and MEF (l.26). He then proceeds to somewhat diminish the attractiveness of the IPA by jokingly saying that it is for people who are "too lazy to write" (l.30). Instead of simply confirming MEF's tentative understanding, i.e., that she can "speak into the device" after activating it (l.29, 31), JUN remarks that trying out the IPA during the ongoing course could lead to problems due to the size of the group (l.33, 35–36), which is why he recom-

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mends MEF should try it at a different time (l.38)[8]. Interestingly, most of MEF's reasoning seems to be formulated independently of the course leader's argumentation, although JUN and MEF have meanwhile engaged in mutual orientation and gaze (l.32, cf. Figure 14). As course leader, JUN orients to the institutional tasks of limiting possible digressions from the course content and of arranging adequate learning conditions (i.e., without overlapping noise), which he also continues beyond the excerpt shown here. He thus also addresses the other course participants, not only MEF. MEF, as a course participant, does not respond to JUN's objections, but instead elaborates on her assessment of the usefulness of the IPA, which her husband, sitting to her right, finally acknowledges as well by announcing that they will use the IPA in the future (not shown here).

Figure 14: #14, l. 33

Although we do not know for sure whether, prior to this excerpt, MEF knew anything about how IPAs function, the way she responds to this chance en-

8 While the other course leader, BEN, did not treat the possible concurrent use of several IPAs in one room as a problem, JUN claims that it is a reason not to do so. This might be less related to an actual (and so far unencountered) problem of concurrent acoustic signals, but rather that this might distract from the current course agenda, namely exploring the Maps app.

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counter with the Google Assistant integrated in the Maps app strongly suggests that she did not. Her careful inspection of the screen, reading the text aloud, and her minimal answers to the IPA's prompts indicate that this might very well be her first encounter with this type of IPA, or even with any IPA at all. Furthermore, FIS' explanation is not met by MEF with an already-knowing stance, but instead responded to with an assessment, and then, when requesting feedback from course instructor BEN, by an independent public appraisal of the IPA's potential usefulness. The data collected does not reveal whether MEF and/or her husband subsequently used the IPA again or attempted to do so. However, within the excerpt they are quick to assess the IPA as a potentially useful application to learn to use (e.g., l.34, 39–40), even though it had not been explicitly introduced in the course.

5. Conclusion

As the analyses of the instructed and the chance encounter with a smartphone-based IPA have shown, overall, participants in the present data set reacted with interest to the discovery of the hitherto unknown application. Within these two basic IT skills courses, neither the course leaders nor the participants mentioned the potential risks associated with IPAs relating to data collection and privacy that are frequently discussed in the media. On the contrary, participants' occasional assessments such as "this is spooky" rather expressed a general fascination regarding the functionalities and "omniscience" of the IPA. For the course leaders, avoiding the topic of data security might have been primarily a pragmatic decision because of insufficient time to address a complex and potentially controversial topic; for the participants, this absent critical perspective might be due to a lack of knowledge and/or display a sense of trust in the course leader and the specific institutional framework.

When encountering the IPA, the course participants' first speaking turns reveal their (un)knowing stance: first-time encounters are met, for example, with expressions of surprise, response cries, and assessments, whereas participants who already know the IPA instead display their expertise, for example, by pre-emptively completing the course leader's turns or by self-initiating offers of advice to their peers. Excerpts 1 and 2 illustrate that newcomers to the application display certain difficulties when they immediately try to use the IPA on their own following instruction, despite or perhaps exacerbated by the quite elaborate information from the course leader and his three different

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demonstration queries. More specifically, the IPA newcomers display difficulty in immediately recognizing the significance of the wake formula, what it triggers (or, more generally, why and how an IPA has to be activated), and the overall importance of the temporal order and formulation of the query. A particular challenge seems to be the production of a specific way of speaking *for* and *to* the machine, both with respect to action formation (e.g., what and how does the IPA process what its user is saying, cf. Reeves 2017) and with respect to the need to verbalize in a planned, appropriately timed, and orderly way (unlike spontaneous and emergent conversational requests). While it might intuitively be a sensible choice to skip more technical explanations when introducing a new application to non-experts, relating the technical constraints of the application more explicitly to its use could possibly lead to a faster successful implementation of the task. Indeed, the participants' incremental formulations not only publicly display the process of their appropriation of the IPA (which can then be assisted), but also show their reasoning as they break down the handling of the IPA into a machine-like step-by-step procedure, but tend not to take into account the required timing and planning – a frequent reason for unsuccessful first queries. Rather than presenting newcomers with a black-box technology, a more technically-oriented instruction could support them to try out the IPA with more autonomy.

Another (unplanned) approach was illustrated in Excerpt 3, in which a peer described to her fellow participant how the IPA functions and how it differs from script-based searches in potentially useful ways. While the course setting, with the app not featured as a topic, prevented the newcomer from exploring the app immediately, her independent appraisal of the IPA illustrated her intuitive grasp of its hitherto unknown affordances, which she evidently deemed to be useful. When introducing a new technology to non-experts, it might thus be advantageous to initially underline why it might be of interest and what specific benefits it could offer for the participants addressed. Complemented by more technically-oriented cause–effect instructions, this could present the use of the IPA as being fundamentally a matter of personal choice, and therefore foster the non-experts' agency from the start. As first-time encounters with a new technology can be formative in encouraging participants' acceptance and later engagement with it, the way its use and functioning are presented in educational contexts should be critically assessed in further empirical and qualitative studies. Future research could, for instance, explore how, within an institutional setting, participants can be guided to use a previously unknown device or application such as an IPA

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by directly relating instructions regarding practical handling to its technical constraints and characteristics, and by actively encouraging and structuring individual processes of discovery to identify its advantages and disadvantages, for example, by working in peer dyads.

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