The Two-Way Pager

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1. Abstract

This paper is about the two-way pager: what it is, what people think of it, and how it changes their life. This device has a substantial effect on my communication behavior, and it influences my social life through creating a feeling of comfortably and permanently being connected to my friends and the rest of the world—without being chained[1]. This paper includes the comments of five other two-way pager users. They talk about how they use it and how it shouldn't be misused.

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[1] The distinction between *being connected* and *being chained* is originally introduced by [3].

2. Introduction

When I came to the Media Lab a year ago, several people were carrying small, strange looking devices that caught my interest immediately. Part of it was because I still had the opinion that all people wearing small devices like radios or cellphones must be somehow important, so the high "coolness factor" of these devices whatsoever made the people using them special[2]. On the other hand, the devices with their trapezoid shape reminded me strongly of a small version of a very old fashioned Commodore PET computer of 1977 (e.g., [8]) But, of course, these devices were not old. People told me that these were alphanumeric two-way pagers, and that they were the newest toys they got. I didn't know what this meant, so they explained to me the difference between ordinary paging and this new way of paging[3].

Picture 1: PageWriter 2000 by Motorola

First of all, *alphanumeric* paging. The pagers I knew up to then were numeric, and therefore, they were only good for sending a telephone number that one was supposed to call back. I always felt very uncomfortable with the idea of someone else remotely giving me the order to call back. Like that, anybody would be able to make me run away from what I was just doing, looking for a phone, perhaps spending money on the phone call—and all that without knowing if it was worth the hassle to me! Of course I could just ignore a page, but I was curious enough *not* to be able to do so. Perhaps it was really important this time! Most often, it wasn't. Later on, I heard of another use for numeric paging: secret codes. There was something mystic about it, and it reminded me of secret languages we invented when we were teenagers. But these new codes were mere numbers. I saw a list of them, ranging from "Happy B-Day!" (code 58) to "Get some milk in the grocery store" (code 834572 or something similar) (e.g., [4]).

But who would remember them, since they were pretty much random? Eventually, I found a booklet that contained a long list. But how do I know that the other person has the same booklet, or at least understands my codes? This was very unsatisfying. But now, the new pagers are alphanumeric. What a relief! No more misunderstandings because of short, cryptic pages. Plain English is possible. Together with the fact that six lines, each thirty characters long, can be displayed, it became obvious that "normal" sentences can be transmitted: full-length messages, and therefore, standard email. Although there was originally no relation between "pages" and "email messages," they became the same with alphanumeric pagers. It was also very obvious that an email based communication culture, like the one at MIT and in the Media Lab, would be extremely grateful for a device that enables one to read email even in the bathroom or sitting on a

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[2] Bill, one of the people I interviewed, told me "I'm getting more comfortable using it in public situations. A lot of times I still feel uncomfortable using it, because I think it will attract attention to myself, because these devices are still generally a novelty to most people. They don't understand them, can't afford them, whatever the reason..."

[3] I just arrived from Switzerland, having written a 300-page thesis about how people use modern telecommunication technologies, having interviewed many people about their habits, and no one ever mentioned to me "alphanumeric two-way paging." Therefore, I concluded, it must be *really* cool…

couch watching TV. What an increase of living quality! "Portable email"[4] is probably the most important change the two-way pager made to my life as a student.

The second novelty was the sending of messages. Part of the frustration with simple paging was due to the fact that one can listen, but not speak. What an unnatural way to communicate. It somehow resembles a nightmare of lying on a surgeons bed, being not enough anesthetized so that all the pain is suppressed, but being enough anesthetized so that one is paralyzed and not able to cry! Of course there are one way media, like radio and TV, but these are one-to-many media, not one-to-one. One-way paging degrades a human to follow another person who gives orders. One-way pagers are like very sophisticated remote controls for human beings. The underlying forces are very subtle, but nevertheless very powerful. Like me, most humans are curious enough to follow an order to call back without knowing what it is actually all about. In most of the cases, even after a long period of learning that makes clear that probably none of the orders to call back is as urgent as we assume, we still feel bad if we don't return a call immediately. I always thought that this was very humiliating. And now, this has come to an end! It is not only possible to reply to an email message immediately, but also to originate email messages from the pager. A big concern for the designers of the system[5] was to make the pager technology opaque to people outside. This means, on one hand that every message sent from the pager, be it a newly written email message or a reply, should look like any other email message sent by this specific user. On the other hand, no one should have to worry about multiple email addresses. A user has only one email address, and the system decides autonomously if a message for this user will be forwarded to the pager.

Another novelty was the idea of using a two-way pager not only as a remote email terminal, but also as a means of accessing our desktop computers. The idea is somehow orthogonal to the notion of decentralized computing and information storage. It is based on the assumption that our desktop computers already have a multitude of files and connection possibilities, and that we just have to access the desktop with portable devices. For example, there is a calendar file on UNIX desktop systems, an address book, and a to-do list. If we would have similar files on our portable devices, we would have the problem of how to update and synchronize them with the parent files on the UNIX system. To avoid this, one just caches all information on the portable device. There is no additional calendar or address book in the two-way pager; we just access the relevant files on the UNIX system. The same with other files and information chunks that are accessible locally on the LAN or further away on the Internet, e.g., a thesaurus, weather forecasts, traffic reports, or stock quotes. These things are already accessible on our desktop, so why don't we just use the pager to get access to this desktop? During the last year a system was developed for exactly this purpose [10,21].

And finally, a pager can obviously also have "normal" PDA functionality. One can use it, e.g., as a notebook. Due to the small but complete keyboard and the graphical LCD display, the built

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[4] Nevertheless, people think that the device itself is still too big to carry, which is reason enough just not to use it. As Marco said, "If I can't fit it into my wallet without bloating it, then I pretty much don't use it."

[5] Here I am talking about the *Canard* system [6], as well as the modifications I made to the communication protocol in the context of my *Knothole* project [10,21]. There are commercial systems who are somehow related to these Media Lab projects, like *PocketGenie* by WolfeTech [22] and *Inter@active* by Bellsouth [5] and Research In Motion [2].

in email editor can be used as a simple word processor. However, like with the calendar and the address book, one tends to "store" the text by sending it as an email message to the desktop.

To summarize it, there are three **main functions** of an alphanumeric two-way pager:

- Email handling: receive and send messages.
- Information requests: locally, on the LAN, and on the Internet, e.g., calendar events, translations, weather reports.
- Other PDA functions, e.g., word processor.

So much for how it *should* work. We will look at what actual users say about the system a bit later in section 4.2.

3. Theoretical part

3.1. A Tool To Connect

As we have seen, a two-way pager is a hybrid of a computer and a communication device, with characteristics inherited from uncle *cellphone* and aunt *Nintendo video game*. It is more similar to a cellphone than to a PC because of its form factor. Furthermore, almost all cellphones in Europe already have two-way paging capabilities, so the device that is used at the Media Lab is actually a stepbrother of a GSM cellphone. The size also makes it somehow similar to a Nintendo video game, together with its big graphical display and the big and prominent cursor key. As far as I know, there are also games available to play on the device.

But although it is technically a computer, it is more important as an interface device. Rather than a *Tool To Think With*, I would look at it as a *Tool To Connect,* a gateway to cyberspace. It is "only" an interface, but a very powerful one. It is a magnifying glass, a knothole, allowing a (limited) view to other computational devices. As PalmPilot [1] users sometimes call their brains a cache for their PDA, a two-way pagers adds another layer, since it is a cache for a desktop computer. Therefore, one could call the brain of a two-way pager user a second level cache for cyberspace: the brain as a cache for the pager, and the pager as a cache for cyberspace.

But this is only theory. In my survey, none of the participants mentioned such a one-way directed relationship. Since we do not only access the web passively, but also influence the cyberspace landscape actively by sending out messages, it is indeed an interaction device. As Fuhrer et al. [8] mentions, the internal and the external mind (culture) mutually cultivate or co-develop each other anyway.

I personally think of the pager as an extension of my mind, since certain things are easily accessible through the pager, like my calendar. But my laptop in my bedroom with its

permanent Internet connection is a much more powerful extension of my mind[6]. It is my never-ending source of knowledge. The pager could theoretically have the same function, but practical limitations prevent that. First of all, it is not real time. With the Canard pagers, it takes 70 seconds to get an answer from the desktop. Although other devices are faster, e.g., GSM phones with their SMS service have a response time of less than 20 seconds, it's still far away from the immediacy of a LAN connection or even a cable modem connection. Another problem is that the pager system we use right now can't display graphics or play audio files. Although it is technically possible to transmit such files, it is just too slow to actually surf the Web. I have learned that this is not a limitation, since there indeed are advantages of text-based channels over multimedia channels. There are situations where it is much more effective to have characters and digits than a graphical representation of the same fact. For example, if I want to know the telephone number of a friend, a text message is the most appropriate means[7].

3.2. Two-way paging in classrooms?

Imagine if all students of an elementary school class would have two-way pagers, what would happen to the classroom? One of the characteristics of such a device is permanent and easy access to the web. I think that Internet access in classrooms is very useful as an information resource. But students sitting in front of a computer screen during class all the time is not an option, since the main interaction should happen between them and their teacher. But two-way pagers have a user interface that is much less obtrusive than a normal PC. One can sit in a class and participate normally and, in parallel, look up information on the web. This is possible due to the small size of the device and the still usable keyboard and screen.

Would they be allowed in schools? When I was in elementary school, the first pocket calculators were commercially available. I remember the discussions I had with my classmates about how funny it would be to hide one of these magic machines under the table during classes of mental arithmetic. The teacher could ask very difficult questions, and we would be able to answer them in almost no time. It was like having a James Bond gadget and sitting in a TV talk show as a genius. What a feeling of power! At this time, the concept of the pocket calculator modified my ideas about what was important in learning mathematics. I realized that calculating by hand or mental arithmetic can't be the main thing I have to learn. I realized that understanding the concepts of mathematics is much more useful than dumb number crunching. My teachers and my parents didn't quite agree. They said that calculating arithmetic expressions without "mechanical" help is important, since it shapes the understanding of the concept of numbers. Today, of course, I would agree. Twenty years ago, there was a discussion going on about when a student should be allowed to use a calculator in class or for homework. The same problem will appear with extensive two-way paging in classrooms. Suddenly, the action of accessing information on the Web and on the personal computer of the student is almost not detectable anymore by a teacher, since the use of a two-way pager is unobtrusive. As Fred, one of the

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[6] Actually, I use both of them, pager and laptop, in parallel in my bedroom, and I am not the only one. Fred, another person I interviewed, says: "I frequently wake up and check the a few messages to see if any urgent meetings are scheduled that day."

[7] On the other hand, I am looking forward to having graphical representations for stock quotes, temperature curves, or radar maps.

persons I interviewed, said: "Sometimes I find myself discretely using it under the table—in many cases people don't find out or just ignore my geeky[8] behavior." The device itself is definitively small enough to be hidden behind an open book, or even just behind the table. Although the interface is very unobtrusive, a student using a pager secretly just doesn't pay the same attention to class as others. This leads to the discussion of undivided attention in general, an important issue of two-way paging.

If two-way pagers are allowed in classes, the question will come up very quickly as to whether they are considered as cheating or not. Obviously, students who have these devices available have an advantage over others who haven't. So let's assume that every student has such a device. The nature of tests and finals has to change, since with the external help of the Internet, a test has to focus on the connections between knowledge rather than on the mere knowledge, on the understanding of the material rather than on single formulas and dates. With the help of a two-way pager and the Internet, it becomes very important if one is able to handle this information overflow. But this is not a new problem[9], and elementary school students will eventually learn how to deal with it.

I expect that unlike the controversy about if the use of computers significantly improves teaching and learning [15], two-way pagers will be used by students anyway. Unlike personal computers, pagers will be "real" personal devices, and since they are comparably cheap, students (or their parents) will get them themselves. This technology doesn't have to be introduced to classrooms, like it was the case with PCs and the Internet. It will be much more like cellphones or video games: the technology will find its way from the bottom up, not from the top down.

3.3. Two-way paging in professional environments

In a professional environment, one could argue that laptops have already the same functionality as a two-way pager. This is not correct, since laptops "are awkward and slow to set up, the batteries may not last long enough, and there is a social stigma against typing during meetings." [13] All these things are not true for two-way pagers. Even if the device runs continuously all day and night, the batteries will last for half a week. Once the pager runs, there is no starting up or shutting down procedure. Just open it, and one can start using it immediately. On the other hand, laptops with wireless LAN connections can browse the Web with an acceptable speed, and they are able to display pictures and play sound, which is currently not possible with pagers.

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[8] If elementary school students would call this behavior "geeky" as well is a very interesting issue that I unfortunately can't look at in this context, since I didn't talk to elementary school students. A very interesting collection of subjects for this question would be the young people having attended Junior Summit 1998. They were handed out a two-way pager for the use during their one-week summit at the Media Lab. I thought of interviewing them about their experiences, but although I was a "buddy" of one person, I had to realize that these young people were already very busy in their own activities.

[9] During my finals for my minor in Computer Science in Berne, all written and printed documentation was allowed. I went to these tests with two very big bags of books and all my notes I have ever taken during the classes. But the most important thing was how to organize these 30 kg of paper. During my one-year preparation for the finals, I made a card index with thousands of cards, each of them containing sophisticated entries about what knowledge was to find where in my books and notes. Of course today, it would be obvious to organize these things in a database on a laptop computer. Another option would be to leave the database on a desktop PC and look up the information from the two-way pager!

However, one of the main uses of alphanumeric two-way pagers, email handling, is almost as comfortable as on laptops. Missing on the current pagers are the possibilities to quote certain lines of an email message, the lack of displaying multimedia attachments, as well as the retrieval of older messages[10].

Other very similar devices are PDAs like the PalmPilot by 3Com [1]. However, unless they are connected to a LAN via a wireless network (e.g., Minstrel by Novatel [13]), they are not comparable in their functionality. Being connected makes the big difference. Nevertheless it is obvious that very soon, PDAs will come with a built in wireless connection (e.g., Palm VII [16]).

Picture 2: REX by Franklin

Most probably these devices—PDA's, laptops, palmtops, multi functional cellphones (e.g., Nokia 9110 [15]), and two-way pagers—will eventually converge into a device which combines all their features. However, there are doubts that one device, holding all these functions, is the thing users actually want. Eventually, everything will come down to the form factor. I personally agree with Marco who says, "I would pay *big* money to have a have a deal like that about the size of a credit card and no more than twice as thick." (REX by Franklin [17] is pretty much what he describes.) If someone invented such a device that contained my cellphone, my two-way pager, my PDA, a Web browser, and a nice, readable color display together with some sort of input device, I guess it would be a killer product.

4. Fieldwork

4.1. Methodology

To learn more about how users think of the alphanumeric two-way pager, I decided to make a small survey. It consisted of eight questions, sent out by email to a set of users who I know were actively using the device. Since I knew all of them personally, I mentioned only briefly or not at all that I would ask them to fill out the survey.

The instructions for the survey were included in the email message and were as follows:

> I am currently writing a short paper about 2way pagers for the class Systems and Self (Mitchel Resnik and Sherry Turkle). In this context, I would like to know more about how people use 2way pagers and what they think of them.
>
> So, if you have time, could you please write a few lines to each of these questions? (You can write a s much as you want.) It would be extremely helpful to me! Thanks a lot. Of course all your answers are confidential, and if there are interesting things to quote, I will make sure your anonymity is guaranteed.

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[10] Since all email messages sent to the pager are copies of the messages sent to the desktop, the designers of the pager systems did not intend to make the pager a full email client. Again, the idea behind it is caching the desktop email system.

And these were the eight questions I asked:

1. Since when do you use a two-way pager?
2. What configuration do you use? (Software, hardware) With your settings, which messages are getting forwarded to your pager?
3. What is the advantage of having a two-way pager, for you specifically? Describe how you use it: How often, when, and what you do with it.
4. Did you ever miss it? If yes, when and why?
5. When is it appropriate to use the pager? Do you know situations where you think people misuse it? Give a short "etiquette" for pager users!
6. Did other people ever tell you that your behavior concerning the pager is inappropriate? Did someone ever get upset because of your pager? If yes, why? (See note below *)
7. Has your opinion towards the pager changed? If yes, how, and what caused the change?
8. In short: What do you like about your pager, what do you hate about it?

* Note to question (6): Does it make a difference what you do with your pager, e.g., receive email, send email, use it as a PDA (look up calendar or address book, use it as a translator), request timely information like traffic reports, etc?

Five subjects returned the survey filled out completely, which is 41% of the people I asked. Additionally, several people gave me further feedback on my questions, some of them answering specific questions, some of them giving me unstructured feedback on this issue, both orally and textually.

The five main subjects are 20 to 50 years old; one of them is female[11]. They used two-way pagers for at least two months and up to thirty months, with an average time of approximately eight months.

4.2. Survey results

4.2.1. Email forwarding

The first two questions were about which configuration the subjects use. All of them use the Canard system [6] with a PageWriter 2000 [20]. One subject uses Skytel service [19] as well. All except one use the additional Knothole service [10,21]. However, although the hard- and software settings seem to be similar, there are differences about which messages are being forwarded to the pager. Most of the subjects forward all the email messages they get to their portable device. This can mean that they don't get so many messages that selective filtering is necessary, or it can mean that they filter the messages otherwise, e.g., by just switching off the devices when they don't wish to receive messages[12]. In any case, the fact that the messages are free seems to be an important issue. The SkyTel user restricts the amount of messages sent

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[11] In this paper, name as well as sex of the subjects was changed randomly.
[12] This method works since the Canard system does not buffer the pages. If the pager is not ready to receive a message at the time it is sent, e.g., because the portable device is turned off or out of range, the message is lost. However, Knothole has a feature to compensate for that.

through this commercial service much more than with the Canard system. The same effect with the people using commercial SMS service: since the amount of free messages per month is very low, almost no messages are routed directly to these two-way messaging capable cellphones.

One user, Karen, has installed dynamic filtering, which means that only important messages are sent to the pager. The decision about if a message is important is made by a quite sophisticated system that looks at the users calendar, address book, and prior communication history [11]. It is interesting to see that no one uses the simple static filtering provided by Procmail [10]: with this UNIX program, one can define simple rules about which messages get forwarded. All in all, it looks like to set up the somewhat complicated dynamic and static filtering mechanisms seems not to be worth the hassle! A simple and easy to use routing mechanism might be a useful thing to develop[13].

Bill uses an interesting kind of static filtering. Although all email messages are getting forwarded, he makes the system add specific labels to important messages. Once received by the pager, messages with these labels are automatically put into specific input folders. These specific input folders are configured to make different sounds if a message arrives. Like that, filtering happens on the perceptual side of the system. Specific sounds indicate specific importance levels and origins for a message. However, he also complains about the fact that he has to change these settings constantly: "I hate that I have to change the notification settings all the time. I.e., put it in silent or vibe mode when I go into a class. The same with my cell phone. I have to change to silent/normal/outdoors always depending on the situation I'm in. And it can have very embarrassing consequences if I forget to put it in silent mode during a movie or something similar." I personally never use any sound notification on my portable devices, and it still happens that I get in embarrassing situations. If the vibration mode is on, the device still can make a pretty loud sound depending on the resonance characteristics of the things it touches! If it lies on the table, the whole table starts to vibrate, and even if the pager is in my pocket touching my key ring, the sound can be too loud for quiet seminars or talks.

This leads directly to the issue of unobtrusiveness and annoyance. One of the main questions I wanted to ask the subjects is if a two-way pager is annoying to people interacting with users carrying such devices.

4.2.2. Notification, sixth sense, and "rudeness"

A two-way pager user, like any other one-way pager or cellphone user, is a normal person until she gets a message or a call. Almost everybody agrees that the more directed the notification is, the less obtrusive for the environment. This means, the lower the volume of an audio notification, the better. No audio notification is the best[14]. As Lucy says, "I think it is rude to

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[13] This might be part of my forthcoming Master's thesis.

[14] The fourth rule of CNET.com's Mr. Gadget's 7 simple rules of beeper etiquette says: "Use the Vibrate setting. If a jacket muffles the sound, it's somewhat better, but not much. You'll be less conspicuous and much less annoying if your pager quietly gives you, and only you, a gentle thrill. However, you must learn to control your unsightly beepilepsy when receiving a message. A Tourette's syndrome-like shriek or unsettling physical quiver announces to the world that you are an unstable person, not a mover and shaker with your finger on the pulse of the business world." [7]

have the pager vibrate or beep during a lecture, or movie, etc." And Fred says: "... I find it distracting during a meeting or class, so I turn off all notification." Unfortunately, the "expressive possibilities" of today's portable devices are limited to sound[15] and vibration, and as we have seen, even vibration can be annoying!

Several devices come with built in vibration notification (including the PageWriter 2000). However, the disadvantage is that the user has to be in close contact with the device all the time. A possible solution to this problem is to separate the actual vibration unit from the bigger communication device. Such small, so-called "vibracall" devices were very popular two years ago in Europe. These are tiny (2 1/2 x 1 x 1/2 inch.) stand alone vibration alarm boxes which "listen" to specific radio wave patterns and detect any incoming phone call within a short distance (up to 10 feet). Therefore, a cellphone can be in silent mode, and the user still "feels" a call in his pocket, even if the cellphone itself sits on the table or is hidden in the backpacker. Unfortunately, since these devices don't distinguish between the owners' cellphone and any other cellphone in close range, they vibrate on *any* incoming phone call in their surroundings. As the density of cellphones in commercial environments is growing in Europe, the practical use of these devices is declining. However, I don't know why these very useful devices are not known in the States. Perhaps it is because the cellphone density in the States is not as high as in Europe.

However, my vibracall device is far from being perfect. It registers not only incoming cellphone calls, but gives also a short signal if a message is sent successfully from my pager! Although the manufacturer did definitively not intend it, these two features give me a very interesting **sixth sense**, which I don't want to miss anymore. It enables me to have a "radio wave awareness" of my close environment. The device is small enough to sit in my pocket all the time, the batteries last for months, I don't have to take it out of my pocket to use it, and it talks to me on an almost subconscious level. With the growing amount of wireless communication devices (cellphones, cordless phones, wireless LAN, and pagers), and since a radio transmission means that the device is communicating, it is like having a touchable interface to cyberspace[16]. I am already capable of detecting different patterns of vibration and assigning them to specific devices. Together with the fact that, e.g., email arrives at my pager a few seconds before it gets to my UNIX inbox, and that the audio notification of cellphones is a few seconds after I feel an incoming call, I actually can predict events happening in the near future. The feeling that I get from my vibracall device is somehow related to the power and fascination of infrared or night-vision goggles. I can perceive things that others can't!

Public annoyance stemming from the notification is only the first of several ones. Asked about when it is appropriate to use the pager, Karen says: "The question should be, when is it appropriate to *read* the pager screen." This makes clear that there are at least three different sources of "rudeness" with the use of two-way pagers. The first one is, as we have seen,

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[15] It is perhaps not appropriate to say "limited to sound," since the audio notifications, e.g., on my Nokia 6190 cellphone are extremely sophisticated. There are not only more than 35 different possibilities, but also complete classical pieces, ranging from *Pour Elise* to *Ode to Joy* to Mozart. Even more custom-made notifications are available on the Web, to be transferred via SMS!

[16] The Media Lab's Tangible Media group is doing research on a closely related issue.

obtrusive notification. The second one is **pulling the device out, opening it, and reading the screen**, and the third one is **typing replies or information requests on the keyboard**.

When is it appropriate to pull out the device and read email? Although this action takes only a very short time—I guess my average time to look at a new incoming message is about 3 to 5 seconds—, it still can be inappropriate. Clifford says: "If the class is a seminar type class, besides it being more important to me than any mail, I would also consider it very rude to pull out my pager during the class discussion. On the other hand, if I have a very boring class, which I have to go to, having the pager to receive email is a way to pass the time. (In this case it is a classroom setup, as opposed to all sitting around a table, and I sit at the back.)" Karen has an even more detailed opinion about when it is appropriate to read pages: "[It] depends. During a quick conversation, not appropriate. During a longer conversation where I may have important interruptions, it's OK. In a meeting, it's generally OK. When I am doing the speaking, it's generally not OK." So, the shorter and the more personal the conversation is, the less appropriate it is to read email. Fred has a somehow different opinion. If the relationship is casual, checking email is not such a big issue. "Sometimes I've used it while having dinner with friends—it can be a bit impolite—but if they are really casual friends and you are waiting to hear from someone, it's OK."

When is it appropriate to actually type a message? Clifford: "I find it rude, when talking to a person, for them to pull out their pager, most especially if they start answering the message." Without any doubt, this is the activity that takes the most attention of the user. Interestingly, not many of the subjects type a lot on the keyboard. Clifford says: "In general, I mostly use it as a one-way pager. I receive my mail on it and occasionally send a short answer or request a weather report." And Fred: "I mostly use it to receive messages—I have rarely utilized the two-way feature." The subjects who don't have a permanent Internet connection at home use the device as an email reading mechanism, and then dial up to the mail machine if they want to reply. Lucy: "It is great for checking email fast without having to set up a dialup Internet connection from home." Fred: "It's mostly helpful when I don't want to maintain a long-term connection." However, most subjects like the *possibility* to send a message. Karen: "I use the two-way aspects to answer important messages, to coordinate activity and meeting times/places…" Nevertheless, writing messages from the pager seems to be awkward, and is therefore reserved for important, urgent, or timely events. Clifford: "I must admit that it was very cool once getting a 'good luck' message from my advisor just before a short talk I had to give!" But such things do not happen very often. Clifford again: "The advantage is of course 'being connected.' When I am at work, I am already very connected. The longest period of time in which I don't have access to email is 1.5 hrs if I am in a class. I don't usually take the pager when I go to class and if I do, I don't pay any attention to it. It is a matter of priority! I don't receive any mail about anything which can't wait an hour—so class is more important." And Fred: "Also it is not easy to send messages or use its services. I often forget the commands. I need a simpler interface to send and use remote services, and some more custom replies that may allow me to use the two-way feature more often. It just takes too long to compose messages or request queries." However, it seems like typing messages is seldom enough so that it is not an issue of annoyance.

The reason why people might think that checking email from the pager is rude is actually very simple. One can compare it to other situations, like answering a phone during a conversation. Clifford: "It seems to me that if the phone went off, the person would usually say 'excuse me' or 'just a second' and then attend to it, or maybe just decide to ignore the phone. Basically, they do not attend to both threads of communication at the same time. Pager users often try to simultaneously share their attention between the person they are speaking to and the other person (via the device). This perhaps makes them more efficient although it is questionable if they can actually maintain attention or whether they are jumping back between the two sources." Lucy: "My boyfriend hates the pager though, and I am pretty much forbidden to check it when I'm talking to him ... he hates to think other things demand my attention more than him!" Bill brings it to the point: "I don't think it's appropriate to divide your attention between another person and the pager. Perhaps it's OK when you're in a large lecture situation, but if you are having any sort of conversation with someone, eye contact, etc., then I don't think it's appropriate. […] And more importantly, people still expect to have your undivided attention. Perhaps sometime in the future, people will expect this less, but we're not to that point yet." I have encountered this issue of **undivided attention** several times. In a face-to-face conversation, people expect to get 100% attention from each other. Is this really necessary? Why isn't it enough to get 90% of the partner's attention? I would guess that 10% of my attention would be enough to check email on my pager. But this seems to be a very sensitive issue. I personally think that this will be a less problematic issue for our children. With the advent of wearable computing, especially heads up displays and free hand audio only interfaces[17], they will get used to the fact that anybody might be multitasking during direct conversations. On the question if less than 100% attention is rude, Jesse answers that it would depend on the importance of the topic. If a conversation were about, e.g., a personal relation problem, then she would consider it to be rude. If it were just chatting about weather and random things, it would not. Only Michael mentions that the rudeness of pager use might depend partly on what kind of task is done with it. Reading email would be considered as rude, using it as a thesaurus perhaps not, and taking notes would be OK, but could be rather strange, depending on the subject of the conversation. If a two-way pager would be used by handicapped people, e.g., reminding autistic people of daily events, or even as a translator for non-native listeners, then it would be OK.

Although I personally think that a two-way pager is a very useful thing[18], two of my subjects explained that they were not excited at all about the idea of getting one. Fred says: "Initially, I was not inclined to use it. I had put off getting it for a while. But it became a part of my daily life I've come to accept." Clifford was very negative about getting a two-way pager. Most probably because he felt that the use of two-way pagers can change the social behavior of human beings drastically. In a positive or a negative way? No one can tell right now.

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