System Use and Interpersonal Communication in the General Practice Consultation: Preliminary Observations

David Greatbatch

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Rank Xerox Research Centre
Cambridge Laboratory
61 Regent Street
Cambridge CB2 1AB

Tel:+44 1223 341500
Fax:+44 1223 341510

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Introduction

Computing technologies are commonly employed as their users discuss either the task at hand or unrelated matters with co-present colleagues, clients, customers or other individuals. As yet, however, there is relatively little research concerning the relationship between system use and interpersonal communication in such environments. Research in HCI has largely been confined to a single user carrying out tasks on a personal workstation. Moreover, those studies which have focussed on the use of systems within socio-interactional environments have been primarily concerned with using the conversations of the participants as a resource for analyzing human-computer interaction (e.g. Suchman 1977; Thomas and Norman 1990). As such, they have shed little light of the ways in which system use and communicative conduct may be coordinated and shaped by reference to each other.

As part of a programme of research concerning this issue, we are conducting a study of the use of new technologies in consultations between doctors and patients in an inner city medical practice. In examining the relationship between human-computer interaction and interpersonal communication, the study is addressing two interrelated questions: (1) the extent to which the technology shapes and mediates communication between doctor and patient; and (2) the extent to which use of the system is embedded in and coordinated with the doctors interaction with the patient.

The observations that follow concern the first of these topics, focusing on the communicative conduct of patients while the system is being used by the doctor to issue a prescription. The project has revealed that patient's recurrently coordinate their actions with visible and audible features of the use and operation of the system. In this paper, I illustrate this by considering cases in which patients produce unsolicited turns at talk[1] while a prescription is being issued, either to raise issues concerning the prescription *per se* or to introduce unrelated topics (concerning, for example, other complaints, social issues, or problems encountered by members of their family). Subsequently, I discuss some of the potential design implications of the findings and suggest that the linkage between human-computer interaction and face-to-face interpersonal communication raises important issues for the field of HCI.

Data consist of video recordings of consultations conducted by five practitioners before and after the introduction of the technology. At present, the data corpus comprises recordings of approximately 100 consultations before the introduction of the computer and 100 since. The latter have been made at regular intervals in order to reveal any changes in the use and effect of the technology as the doctors become more familiar with its operation, constraints and potential. These recordings have been transcribed and analysed using a methodological framework based on recent developments in the social sciences concerning the situated character of human action, namely ethnomethodology and conversation analysis. Field observation and interviews with the doctors have also been conducted but data derived from these sources are not utilised in this paper.

The System

The system used within the practice is IGP VAMP, which can be accessed through consulting room terminals consisting of a standard visual display unit (VDU) and keyboard. [2] Although VAMP is designed to document and retrieve medical biographical information, the doctors as yet make limited use of this facility while consulting with their patients. Thus, although the doctors use the system to store details of the medical biographies of patients, they have nonetheless continued to maintain paper records of this information and normally refer to these rather than their computerized records while consulting with their patients (Greatbatch forthcoming). Within the consultation, the system is used primarily to issue prescriptions.

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1 That is, utterances which are not solicted by the doctor.

2 One doctor has the monitor directly in front of him, two have it between themselves and the patient, and the other two have the monitor placed at the other end of the desk to the patients (who sit to the doctors left). The implications of the positioning of the screen vis-a-vis the patient are discussed in Greatbatch (forthcoming).

In order to issue a prescription, the doctor must first enter the relevant file by pressing two alphanumeric <AN> keys followed by the carriage return <CR> key. The VDU subsequently displays details of past prescriptions and a series of prompts for details of the new prescription.

The prompt line requires such details as the name, form, strength, dosage, and quantity of the item(s) being prescribed. In each field the doctor normally uses the <AN> keys to type in abbreviations of the relevant information: for example, to enter a pharmaceutical name the doctor types the first three or four letters of the name if it is a drug that is being prescribed, or the first three or four letters of each word if prescribing appliances or dressings. Alternatively, the doctor may summon a list (e.g. of drugs) by pressing a character key (and in some cases <CR>) and choosing an item from this.[3]

In working through the sequence of prompts, the doctor presses <CR> to move to a subsequent field or <Control B> to return to a previous field. In some cases pressing <CR> in this context results in a simple movement of the cursor; in others more substantial changes in the image on the screen occur, including the inclusion of additional prompt lines. Having pressed <CR> to leave the final field in the sequence, the doctor presses this key once again to print the prescription. As each prescription is issued the system displays and updates the patient's prescription history and a paper record of this is no longer maintained.

In order to issue a prescription, then, the doctors have to perform a series of discrete tasks via the keyboard, each normally being completed by a <CR> keystroke and each resulting (unless there is an error) in a change in the image on the VDU. The number of keystrokes required to accomplish each task ranges from a single key entry, as when a doctor presses <CR> to by-pass a field into which he does not wish to enter information, to a sequence of several keystrokes, as when a doctor types in information via the <AN> keys and then presses <CR> to move to the next field.

The Initiation and Extension of Unsolicited Turns at Talk

In the data to hand, both the initiation and extension of patients' unsolicited turns at talk frequently follow keystrokes which either accomplish or complete one of the tasks involved in the generation of a prescription. This suggests that patients may be attempting to synchronise their utterances with the doctors' use of the keyboard so as to avoid interrupting an activity in progress. In considering this possibility, we begin by examining a number of cases in which the initiation/extension of a patient's turn at talk occurs immediately after the completion of a task involving a series of <AN> keystrokes followed by <CR>.[4]

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3 The system's drug dictionary is updated approximately six times a year.

4 In the transcripts an individual's visual conduct is mapped out above the line allocated for his or her talk. Gazing at a co-participant is indicated by a continuous line "____"; gaze towards keyboard (k) and monitor (m) by a broken line "-----";

The Initiation of Unsolicited Turns at Talk

In extracts (1) and (2), patients initiate a turn at talk immediately following the sound(s) of the final keystroke in a <AN>-<CR> sequence:

(1a) [CN:2:3: Transcript One]

```
1    Dr:  is all connected (0.2) with u:hm (0.7)
2         with ┌ all this this: this worry (and) stress.=
                │
3    P:       └(             )
4    Dr:  =.hhhhhhh U:hm
5         (3.1)
6    P:   (You see if I could)- I'd be all right if I could
7         just- you know slee:p,
```

(1b) [CN:2:3:Transcript Two]

```
P:                                          (You see)
                        R R   +           R       +
           *  *         * *       *   *   *
                        ¯ ¯               ¯

Dr:  ----------, ----------, ----------, -
```

In extract (1) the doctor turns to the computer keyboard and, using his right hand, strikes a series of keys. He begins by pressing two character keys on the left of the keyboard and then strikes <CR> twice with considerable force. After the subsequent change on the monitor, he initiates a new <AN>-<CR> sequence of keystrokes, moving his hand to the left and pressing a central key. Upon releasing this key, he moves his hand further to the left, presses a second key, and then sweeps back across the keyboard and strikes <CR> hard. Following the sound(s) emitted by this keystroke, the patient initiates a turn at talk (line 6).

(2a) [CN:2:3:Transcript One]

```
1    Dr:  And in fact if you find that they help you sleep
2         you can (1.6) sort of leave them off after a bit.
3         (.)
4    P:   Yeah.
5    Dr:  .hhh U:hm
6         (0.6)
7    P:   Doctor (     ) used to give me u:hm:  ((Continues))
```

---

turning towards the co-participant, keyboard or monitor is captured by a row of dots ".....", turning away by commas ",,,,,".

In the transcripts each keystroke is denoted by as asterisk. It is important to note, however, that the sounded emitted by a keystroke actually involves the merging of two sounds: a 'click' as the key is pressed, a 'click' as it is released. While this is not represented in the current transcripts, it will be referred to in discussing the data extracts. <CR> keystrokes are signified by an 'R' over the asterisk. The underlining of an asterisk means the key was struck with greater force than normal. A cross (+) signifies a significant change in the image on the screen .

(2b) [CN:2:3:Transcript Two]

```
                        Printer starts
                              ↓
P:                          Doctor (      ) used to give me u:hm:
                          R      +
          *     *     *
                        —
Dr:   .hhh U:hm ------
```

As the patient acknowledges his initial utterance (line 4), the doctor moves his right hand across to the <CR> key, holds it there for a moment, and then, taking an inbreath (line 5), moves it to the left as he looks down from the screen to the keyboard. In overlap with his "U:hm", he then initiates an <AN>-<CR> keystroke sequence, striking a character key positioned just right of centre on the keypad. Subsequently, he strikes a key situated a little further to the left, before moving his hand back to the right of the keypad and striking the <CR> key with greater intensity than the preceding two keystrokes. Immediately following the sound emitted by the release of the key, the patient initiates an unsolicited utterance (line 7).

The Extension of Unsolicited Turns at Talk

In the following cases, the doctors produce acknowledgement tokens at the possible completion of a patient's utterance. Previous research has demonstrated that, by producing such tokens at the possible completions of turns at talk, recipients display that they are passing the opportunity to take the full turns at talk that they might otherwise properly initiate, and thereby exhibit their understanding that a yet to be completed extended unit of talk is currently in progress and leave the current speaker free to continue (Jefferson 1984; Schegloff 1982). Ordinarily, if current speakers do in fact extend their turns, vocalisations of this sort are either overlapped or immediately followed by the start of a new turn-constructional unit. Here, however, this is not the case: the patients delay the extension of their turns until the doctor has completed an <AN>-<CR> sequence of keystrokes:

(3a) [HY:2:1:Transcript One]

```
1    P:   The only thing other problem I do have u::hm I
2         sleep quite fitfully.
3    Dr:  Uh huh
4         (0.6)
5    P:   a:u::hm: With my previous doctor I did occasionally
6         go to him for: sleeping tablets.
```

(3b) [HY:2:1:Transcript Two]

```
P:   I sleep quite fitfully.      ------ a:u::hm: With
                                       R     +++
                    *   *    *       *    *
                                            —
Dr:                           Uh huh
```

The doctor initiates a new sequence of keystrokes as the patient begins the final word of his utterance ("fitfully") at lines 1-2. The first key in the sequence is pressed by his left hand, the second his right. He then strikes two further keys with his left hand, the first as he produces the

acknowledgement token "Uh huh" (line 3). On the second beat of the token, he starts to move his right hand over towards the <CR> key, which he subsequently strikes, with characteristic force, to complete the sequence. It is following this keystroke - rather than immediately following his initial utterance, or in the midst of or after the doctor's acknowledgement token - that the patient initiates a new turn-constructional unit (line 5).

(4a) [CN:2:4:Transcript One:Simplified]

```
1    P:   You name it.=
2    Dr:  =Yeah.
3         (0.7)
4    P:   But as I sa:y (0.2) we were very lucky when he was-
5         he's forty-six li:ke.
```

(4b) [C:2:4:Transcript Two]

```
P:   name it.=      ------- But as I sa:y
                          R
                    *  *  *
                          —
Dr:          =Yeah.
```

As the doctor responds to the patient's initial utterance (line 2), he prepares to initiate a sequence of keystrokes. Following his acknowledgement token ("Yeah") he immediately presses two character keys, the first with his left hand, the second with his right. As he releases the second key, he moves his hand to the right and strikes <CR>, again with greater force than the preceding two keystrokes. It is only then that the patient initiates a new unit of talk (line 4).

The fact that patients so regularly initiate units of talk immediately after the completion of <AN>-<CR> keystroke sequences suggests that they must be in a position to anticipate such points in advance of their occurrence. If this were not the case, one would expect to find more frequent pauses between the sound of the <CR> keystroke and the onset of the patients' talk. Since such projections are unlikely to be based on detailed knowledge of system operation, they must presumably be informed by the visible (and audible) features of the doctors use of the computer. In the remainder of this paper, we identify several aspects of the doctors' conduct as they interact with the system that appear to be involved in this process.

Projections of Keystroke Sequence Completion

One possibility is that projections of the completion of <AN>-<CR> sequences may be based upon the manner in which doctors strike the <CR> key (as compared to preceding <AN> keys). Three points concerning the examples considered above may be noted in this regard. First, the <CR> key is situated to the right of the main block of keys. Accordingly, since the doctors' have used their right hand to press at least one of the <AN> keys, they have to make a pronounced movement of this hand in order to prepare to strike the <CR> key.

Second, the doctors strike the <CR> key with greater force than the preceding keys. Consequently, as they prepare to press this key, they (i) lift

their fingers/hands more than is the case with the preceding <AN> keys and (ii) bring them down with a more pronounced thrust.

Third, because the key is struck with greater intensity, the sound of the <CR> keystroke is obviously louder than that of the preceding <AN> keystrokes. And this is available to the patients before the sound of the keystroke is complete; that is, it is hearable following the first of the two 'clicks' which combine to form the sound of a keystroke.

Taken together these features might provide a basis for the boundary projections in cases such as (1)-(4) above. The movement of the doctor's hand across the keyboard, the raising of the fingers/hand, the (comparatively) pronounced jab downwards to strike the key, the louder volume as the key is pressed, could be taken as evidence of an upcoming boundary. But while these features are certainly implicated in the cases seen thus far (and are likely to constitute resources used by patients in making projections), they do not appear to adequately account for the frequency with which patients initiate their utterances immediately on the completion of <AN>-<CR> keystroke sequences. For instances can be found in which a doctor's conduct exhibits all of these features and yet a patient delays the subsequent initiation of an utterance-unit. A case in point is the following.

(5a) [OB:2:1:Transcript One]

```
1    P:   You can just use your loaf can't you.
2    Dr:  Yeah.
3         (.)
4    Dr:  .hh
5    P:   And those paracetomol are very good.
```

(5b) [OB:2:1:Transcript Two]

```
P:   can't you.            And those paracetomol
                                    ++++++++++
                       R    bb
                  * *  *
                       _
Dr:            Yea:h. - .hh
```

Here typing with his right hand, the doctor strikes two centrally positioned keys before traversing across to the right and striking the <CR> key with greater force. Subsequently, the patient initiates an utterance. As in the previous cases, it is noticeable that he does not do so in overlap with the <AN>-<CR> sequence. But here neither does he furnish his utterance upon the completion of the sound of the <CR> keystroke. Rather he delays the utterance for a further 0.3 second during which the doctor takes an inbreath. In cases such as this, then, it appears that the resources discussed thus far may not have been sufficient to enable a patient to gear up to speak immediately following the <CR> keystroke.

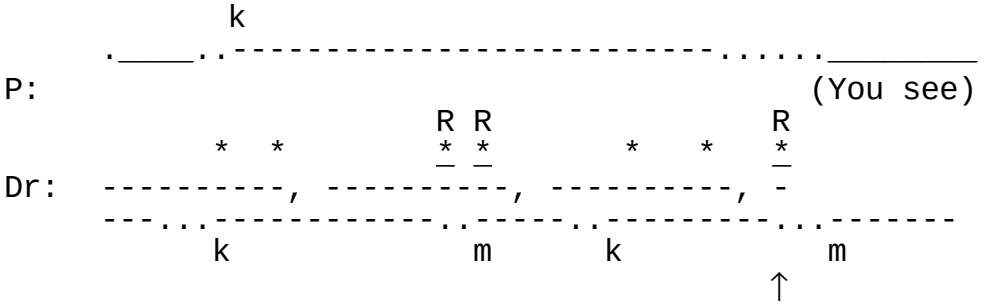
Closer inspection of cases in which utterance initiations are produced without delay following the completion of an <AN>-<CR> sequence reveals the presence of a number of features, none of which are observable in extract (5) above, which may provide patients with additional bases for anticipating a possible boundary in keyboard use. First, as the doctors strike and release the <CR> key with their right hands, their left hands are not positioned so as to give any obvious indication that they will be used

to press a further key immediately after the <CR> keystroke. Moreover, the movement(s) of the doctors' right hands upon releasing the <CR> key are also normally consistent with at least temporary disengagement from use of the keyboard. Simultaneous with the sound resulting from the release of the key, then, the doctors' conduct may provide further evidence of a possible boundary.

Second, in a number of cases, while the doctors are looking at the keyboard as they press the <AN> keys, they start to shift their gaze towards the monitor in conjunction with the <CR> keystroke: that is, as the <CR> key is either pressed or released. These gaze shifts may provide further evidence of a potential boundary in a doctor's use of the keyboard.

We can illustrate the occurrence of these features by looking in more detail at the cases considered above.

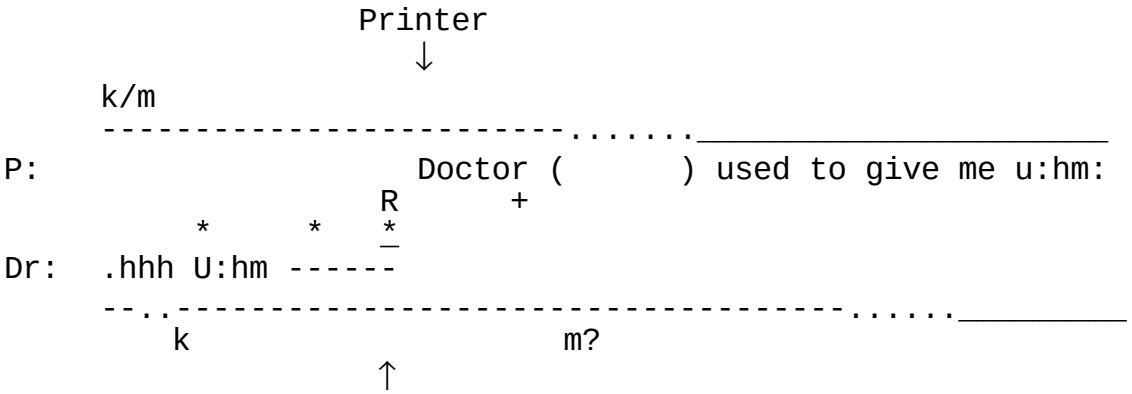
(1c) [CN:2:3:Transcript Three]



Dr starts to shift gaze to monitor

As noted, in this case the doctor is typing with his right hand. His left hand is in fact placed on his lap throughout. As the doctor strikes the <CR> key, his left hand is thus "out of play" in so far as the keyboard is concerned. As for the right hand, as the doctor releases the <CR> key, and the second click of the keystroke sounds, he lifts this hand quite sharply away from the key, folding the fingers in towards the palm slightly. At the same time, he begins to shift his gaze away from the keyboard, towards the monitor. The inactivity of the left hand, the inception of a gaze shift away from the keyboard, the positioning and comportment of the right hand may all serve to provide grounds for the projection of a potential boundary over and above those concerning the doctors striking of the <CR> key.

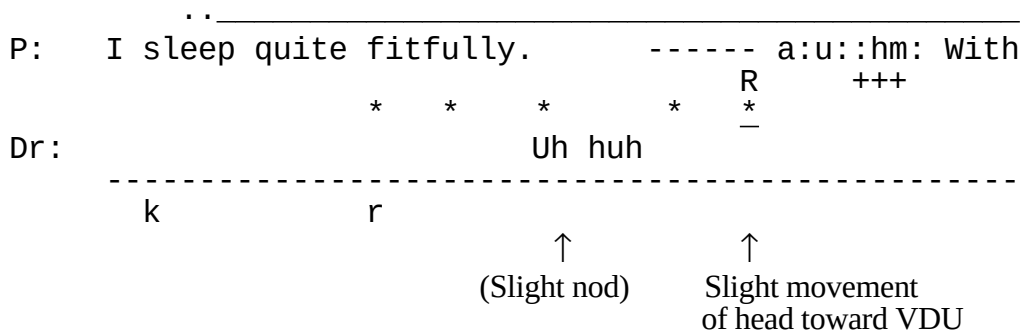
(2c) [CN:2:3:Transcript Three]



Very slight shift of head towards monitor

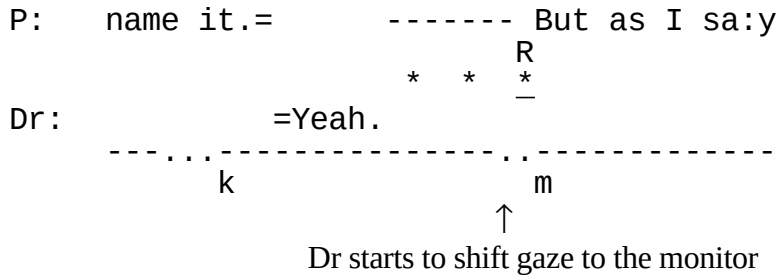
As in (1), the doctor's left hand is on his lap throughout this instance. Again there is a pronounced (upward) movement of the right hand away from the <CR> key as it is released; and again the fingers, most notably the one used to press the key, are bent in slightly towards the palm. Moreover, in the course of striking/releasing the <CR> key, the doctor moves his head up slightly in the direction of the monitor.

(3c) [HY:2:1:Transcript Three]



Having pressed the penultimate key in the <AN>-<CR> sequence, the doctor holds his left hand, fingers relaxed, over the keyboard, as he uses his right hand to strike the <CR> key. As the <CR> key is pressed/released there is a slight, but clearly discernible movement of the head towards the monitor. On the release of the key, there is no pronounced upward movement of the hand/fingers. However, the hand and fingers <u>are</u> motionless as they are held above the keypad upon completion of the second 'click' of the keystroke. As such, neither hand has been, or is currently being, moved (or held) in a manner which suggests that the doctor is preparing to strike a further key immediately after the <CR> keystroke.

(4c) [CN:2:4:Transcript Three]



Having used the left hand to strike the penultimate keystroke in the sequence, the doctor lifts it clear of the keys as he positions his right hand over the <CR> key.[5] As he strikes the <CR> key, he continues to move his left hand away from the keyboard. This movement continues as, on releasing the <CR> key, the doctor with a pronounced movement, pulls his right hand upward and a little towards the left, tucking the fingers in

5 The movement of the right hand begins as the doctor presses the penultimate key with his left hand.

slightly toward the palm.[6] Finally, once again, the doctor starts to look away from the keyboard, towards the monitor as he strikes/releases the <CR> key.

The features highlighted in these cases appear to be central resources upon which patients rely in synchronising their utterances with the completion of <AN>-<CR> keystrokes sequences. While preparing to press the <CR> key and striking it with greater intensity may indicate a possible boundary in keyboard use, these features provide stronger evidence of such a boundary in that they all signify the possibility of at least brief disengagement from typing (and hence completion of the activity in which the doctor is currently engaged).

The import of these (and related) features as resources for boundary projection is strongly evidenced by (i) cases, such as extract (5) above, in which the initiation of a turn is delayed after the completion of an <AN>-<CR> keystroke sequence; (ii) cases in which patients initiate utterances in the midst of, rather than at the completion of, this form of keystroke sequence; and (iii) cases in which alternatives to this sequence are employed.

Delayed Initiation

As should already be apparent, although a doctor may complete an <AN>-<CR> sequence of keystrokes by striking the <CR> key hard, the absence of hand movements and/or the onset of gaze shifts/head movements which prospectively indicate the possibility of at least brief disengagement from the use of the keyboard may result in delayed utterance initiation by a patient. The interest of these cases does not end here, however. For the question arises as to whether the initiation of utterances in these positions is systematically related to the conduct of the doctor. In other words, after the <CR> key has been pressed do the doctors conduct themselves in ways which may <u>retrospectively</u> indicate or confirm that a boundary has been reached?

In fact, delayed initiations do appear to be associated with the occurrence of such conduct. The way in which patients may withhold utterance initiation until such evidence is available can be illustrated by reference to extract (5). As the doctor uses the keyboard, the patient is standing to his left, dressing.

6 The hand movements described here end with the doctor having removed both hands from the keyboard. Subsequently, he moves a sheet of paper on his desk, before returning to the keyboard and initiating a new keystroke sequence.

(5c) [OB:2:1:Transcript Three]

```
P:   can't you.            And those paracetomol
                      R                ++++++++++
                  * *  *    bb
Dr:            Yea:h. - .hh
     --------------------..    ..------. _______
     k                         m
                        ↑  ↑
                        1  2
```

1 Slight head shift toward monitor
2 Dr ceases head movement, before subsequently resuming gaze shift

Here the doctor continues to gaze at the keyboard as the <CR> key is released. Moreover, while his left hand is tucked under his chin, upon releasing the <CR> key, his right hand remains over the keys. The precise positioning of the hand is impossible to determine as it is shielded by the doctor due to the position of the camera. However, the patient, who is in the process of dressing, is not looking directly at the keyboard and as such the general location of the hand over the keys, together with the direction of the doctor's gaze (at the keyboard), may be taken as problematic in so far as inferring a boundary in keyboard use is concerned.

Following the keystroke the doctor takes a brief inbreath, while simultaneously shifting his head slightly in the direction of the monitor. Immediately following this, the patient initiates his utterance. Thus while the intensity of the <CR> keystroke could possibly have alerted the patient to the occurrence of a potential boundary, he does not initiate his utterance until conduct (the gaze shift) consistent with disengagement from keyboard use is forthcoming.

Utterance Initiation Following <AN> Keystrokes

In a number of cases, patients utterances are produced following <AN> rather than <CR> keystrokes in <AN>-<CR> sequences. Here, then, the patients start to speak at points which do not appear to constitute the completion of a discrete keyboard activity (when viewed from the perspective of the system). In these cases, however, it is not unusual to find that the doctors have comported themselves in ways similar to those found in the cases considered above. For example:

(6a) [HY:1:1:Transcript One]

```
1    Dr:  Okay? That's great.
2         (2.0)
3    P:   The only thing other problem I do have u::hm I
4         sleep quite fitfully.
```

(6b) [HY:2:1:Transcript Two]

```
     ____________________________________________________,,
P:                                                The only other
                                  *    *   *                  *
Dr:  That's great. ----------, ----------,
                     ..-----------------------------------
                       m-k


P:   problem I do have u::hm I
                       R   ++
     *             *   *
Dr:
     -------------------------
                r  k     r
```

Having completed his utterance at line (1), the doctor initiates a <AN>-<CR> sequence of keystrokes. He strikes three character keys, the first two with the left hand, the third, centrally positioned key, with the right. Immediately following the latter, the patient initiates a turn at talk. While this keystroke does not represent the completion of a discrete keyboard task, the doctor's conduct does suggest the possibility of activity completion. Thus, as he strikes the third key slightly harder than the preceding two, his left hand is held motionless above the keyboard. Upon the releasing the key, his left hand is held still, as he raises his right hand with a pronounced movement (in preparation, it turns out, for a subsequent shift back across to the right of the keyboard). By the end of the sound(s) emitted by the keystroke, the fingers of the doctor's right hand are out of range of the keys; his left hand is motionless. His activities are thus consistent with the completion of a sequence of keystrokes and at least momentary disengagement from use of the keypad.

Successive <CR> Keystrokes

As noted, a range of alternatives to the <AN>-<CR> sequence may be used by doctors. A common occurrence, for example, is for the doctor to press two or more <CR> keys consecutively, frequently with pronounced jabs. As noted earlier, this will normally involve the doctors by-passing prompts. Here, then, from the perspective of the system, we find two or more discrete activities being completed after successive keystrokes.

It is noticeable that when utterances are initiated in the context of consecutive <CR> keystrokes, patients do not necessarily coordinate their talk with the first <CR> keystroke/boundary. Rather they routinely speak after the first of the keystrokes that is produced in conjunction with gaze shifts and/or hand movements which project possible completion or suspension of keyboard use. This is the case, for example, in extract (7).

(7a) [HY:2:1:Transcript One]

```
1    Dr:  with your Parkinson's (.) .hhh er: treatment.
2         (2.2)
3    P:   I do find it very (.) difficult to get comfortable
4         in bed.
```

(7b) [HY:2:1:Transcript Two]

```
                                                    
P:                                          I do find it
                                          R + R +
                 * * *   **     *        *   *   *     *
Dr:  treatment. ----------, ----------, --
     ------------------------------...--------------
                                     m
                                     ↑
```

Dr lifts head to look at monitor

The doctor begins to use the keyboard following the completion of his utterance at line 1. He begins by striking a central key with his right hand and two keys to the left of the keyboard with his other hand. Then having pressed two more central keys with his right hand, he strikes a further key with his left hand and moves his right hand across the board to subsequently strike the <CR> key twice in quick succession. Immediately following the second <CR> keystroke, the patient initiates his utterance.

We may begin by noting that while the doctor shifts his gaze to the monitor just as he is about to make the first of the two <CR> keystrokes, and while his left hand is motionless above the keys at the far left of the keyboard, upon releasing the key he immediately thrusts his finger back down towards the key to make the next <CR> keystroke. Thus before the second beat of the sound of the initial <CR> keystroke is complete, it is already apparent that he intends to strike the key again. However upon releasing the second keystroke, he starts to lift the hand up and across (slightly) to the left, opening out the fingers from their previously 'cocked' position. As such, given that he continues to hold his left hand still, his actions may now suggest activity completion; a boundary in his use of the keyboard. And it is here, immediately after the sound of the second <CR> keystroke, that the patient starts to speak.

As it happens the doctor subsequently proceeds to initiate a new <AN>-<CR> sequence, pressing a key with his left hand. However, he only moves his hand to strike this key <u>after</u> the sound of the preceding <CR> keystroke. As the <CR> key is pressed and released the positioning of both his gaze and his hands are consistent with a lull in keyboard use.

Possibly anomalous case

We conclude by considering a case which may initially appear anomalous. The case, involves the initiation of a turn following a keystroke produced in conjunction with conduct which, in the light of the preceding analysis, might be expected to be associated with the withholding of speech by the patient:

(8a) [P:2:3:Transcript One]

```
1    Dr:  It may not help at all we'll have to see. (.) I'll
2         just give you twenty for now.
3         (0.6)
4    P:   So they won't clash with one another.
```

(8b) [P:2:3:Transcript Two]

```
     ________________,,,        ...______________
P:                          So they won't clash
                      R  R R
        * * *         *  * *
Dr:   twenty for now. ------
     ----------------------------------------
     k
```

Using both hands, the doctor strikes three character keys and then shifts his right hand over to the <CR> key as he completes his utterance at line (2). Immediately following his utterance, he makes three rapid and pronounced <CR> key strokes. Following the third of these the patient initiates an utterance.

What is interesting about this case is that on first inspection the doctors conduct might appear to be counter to that associated with the initiations considered above. Thus there is no discernible movement of his head or eyes towards the monitor as he makes the third <CR> keystroke. Moreover, as he releases the key, he leaves his finger poised just above, an action clearly implicating the possibility of an imminent keystroke. However, on closer inspection, the doctor's hand movements do appear to be consistent with possible activity completion.

The important point is the rapidity with which the keystrokes are made, one after the other. In order to achieve this rapidity, the doctor's thrusts his finger back down towards the key immediately following both the first and second keystrokes. On the third keystroke, by contrast, he lifts his finger and holds it just above the key. Given the character of the preceding two keystrokes, then, this aspect of the doctors conduct, combined with the left hand being held still, gives a clear sense of a boundary; a brief lapse in the use of the keyboard: the sudden stilling of the finger above the key, as opposed to the immediate thrust downward, serving to mark out a potential boundary. This case demonstrates the danger of assuming that given bodily movements, or lack of them, will automatically be taken as signifying (or not) a boundary in keyboard use. Quite clearly, the interpretation of such movements is shaped by the context in which they occur, and this should be borne in mind in interpreting the preliminary findings reported in this paper.

The Coordination of Patients' Talk With the Operation and Use of the Computer

In the data to hand, patients recurrently synchronise the initiation of their unsolicited talk with visible features of the doctors' use of the computer system. Specifically, they monitor the doctors' conduct for evidence of boundaries in their use of the keyboard. In so doing, they appear to be attempting to avoid interrupting an activity in progress.

It may be that the patients are alerted to the possibility of such boundaries by, for example, the intensity with which a key is struck (by comparison with the preceding keys). But often they do not treat this as sufficient to warrant utterance initiation. Rather they appear to monitor

the doctors' conduct for evidence of at least temporary disengagement from the the task of typing.

This analysis is preliminary and a number of important factors have not been considered. Thus one issue that is currently under investigation concerns the way in which a process of *in situ* socialisation may underpin some boundary projections. For example, there is evidence to suggest that if a keystroke or sequence of keystrokes is followed by a pause in the doctors use of the keyboard, then patients may treat subsequent instances of that keystroke or keystroke sequence as adumbrating a boundary even though some or all of the features which indicate possible activity completion are absent. This process appears to underpin a number of instances in which patients begin to speak simultaneously with a keystroke, as well as some in which they start to speak immediately after one. In the former, patients seem to be prospectively orienting to the possibility of an upcoming juncture in the doctors' use of the system by initiating their talk as the doctors make a keystroke that has previously been followed by such a juncture.[7]

The talk of patients may also be coordinated by reference to changes on the screen. For example in the following case a doctor completes an AN>-<CR> sequence and then gazes at the screen, his hands poised just above the keyboard, suggesting that further keystrokes are imminent. After several tenths of a second it becomes evident that the system is in the process of wiping away all but the top two items of a long screen-based list. It is at this point that the patient begins to speak. Cases such as this illustrate how patients may take aspects of system operation as indicating that further keyboard use is not imminent, even though displays of disengagement are absent.[8]

7 In a number of other cases in which patients initiate talk in overlap with <CR> (and sometimes <AN>) keystrokes they appear to be anticipating a juncture in system use on the basis of the doctors having started to shift their gaze towards the monitor before making the keystrokes.

8 This is only one of a range of ways in which patients synchronise their talk with screen changes. For example, in a number of instances they seem to be aiming to initiate their talk after a screen-change is completed but before a new keystroke sequence commences.

(9a) [OB:3:7:Transcript One]

```
P:   he's- he's- he's going down the dumps .hhh
Dr:  Yeah
     (1.5)
P:   Because I have some of the homemade stuff you know.
Dr:  Yeah.
```

(9b) [OB:3:7:Transcript Two]

```
                                          ....
P:   he's- he's- he's going down the dumps .hhh
                                       R + +
     *          *     *      *       *
                                       —
Dr:                                             Yea:h.

     ---------------...------------------------..---
     k                  m                         k


     Dr/m
     ------------------------------------
P:                     Because I have some
          R + +  b + + + + + + + + + + + +
     *    *
          —
Dr:  ----------, -----
     -----...-------------------------------
     k       m       ↑
```

Transformation of list begins

Patients may also closely monitor the sounds emitted by the system, such as beeps or the the operation of the printer. In a number of cases, for example, patients appear to withhold talk concerning non-medical topics until there is evidence that the doctor has completed the prescription. This may be deemed an appropriate moment to introduce such topics since the production of a prescription often completes the main business of the consultation and thereby provides an environment for "small talk" (as well as medical topics which are marginal to the main agenda) (ten Have 1991).

As they press and release the final <CR> keystroke to complete the sequence of prompts in the prescription file, it is not unusual for doctors to begin to withdraw their hands from the keyboard. But, while this may be strongly indicative of completion of system use, such actions may also be found at other locations during the generation of a prescription, since on occasion doctors withdraw their hands in order to consult and/or rearrange their paper records. In such cases, however, patients may attend to this possibility by withholding their talk until the printer starts up and thus gives a clear indication that system use (at least in so far as the prescription is concerned) is at an end. This occurs in the following extract, in which the patient departs from a medical agenda by inquiring about the well-being of the doctor's wife who has recently given birth.

(10a) [HY:2:6:Transcript One]

```
Dr:  throw those awa:y and I'll give you some new ones
     then.
     (2.2)
P:   And is the wife keeping all right (a[fter her)
Dr:                                      [She's very well
```

(10b) [HY:2:6:Transcript Two]

```
                m/k
     ___________,,-----------------------------------
P:
     R + +                                    R +++
     *                                        *
Dr:  throw those awa:y and I'll give you some new ones
     -----------------------------------------------
     k/m



     m/k
     ------------------------------------...___________
P:                                       And is the wife
     +++++++             RR    +++++
                        ***
Dr:  then. ----------, ----------, --
     ------------------------------------------------
     k/m                     ↑         ↑
                            1          2
```

1 Dr starts to withdraw hands from the keyboard
2 Printer starts

In sum, although patients do sometimes initiate and extend unsolicted utterances without any obvious attention to the current state of the doctors' interaction with the computer, they recurrently endeavour to synchronise their conduct with boundaries in system use. In doing this they rely upon a variety of the visible and audible features of the use and operation of the system. This raises a number of issues concerning both the design and analysis of human-computer interactions.

Implications for the Analysis and Design of Human-Computer Interactions

A considerable body of research within HCI has been concerned with the notion of consistent interfaces and interactions. Although it may turn out that design of VAMP does not adhere to various guide-lines for human-computer interaction, it does appear to provide for consistent patterns of system use. For example, as the doctor prepares a prescription, input is entered after successive prompts along the bottom of the screen; there is little variation in the sequences of keystrokes that are required to

enter information; and movement from one prompt to the next is always brought about by the same keystroke (as is movement to prior prompts).

The findings reported in this paper reveal that in seeking to synchronise their talk with the doctors' use of the computer keyboard patients make use of this consistency. However, the analysis also indicates that the process of coordination does not rest solely on consistent and predictable patterns of keystrokes, since patients frequently coordinate their talk with boundaries that are accompanied by displays of potential disengagement from use of the keyboard. This clearly raise issues concerned with the design of consistent interfaces and the structuring of human-computer interaction which are not encompassed by current notions of consistency in HCI. It may be useful to examine some of these issues in more detail in terms of their implications for the design of human-computer interactions.

In examining the relationship between system design and displays of disengagement, the first point to note is that the response time of VAMP varies considerably. In some cases, for example, the movement of the cursor from one prompt to another takes a fraction of a second. In others, the time taken can range up to ten seconds or more. It is commonly suggested that systems, like VAMP, which are used in real-time should have quick response times so as to minimise the time required to execute screen-based tasks (e.g., Card, Moran and Newell 1980). However, in the case of VAMP many of the doctors' displays of disengagement result from delays in keyboard activity that are due to the system's slow response. As a result, it is possible that a reduction in response times might affect the practices that have been discussed above. However, it does not follow from this that slow response times should be built into systems, since displays of disengagement also occur at points at which response times are relatively short. In these cases, doctors appear to be orienting to a prospective juncture in their use of the system; as, for example, when a system's response has to be checked, an item in a list needs to be located and chosen, and/or it is necessary for the doctor to consult a paper document.

In the case of VAMP, then, patients orient to displays of disengagement which result both from slow response times and junctures in system use. If such boundaries can be identified in human-computer interaction, it may be possible to design systems that make it easier for others to locate and orient to them. For example, Paul Luff (personal communication) has suggested that it may be possible to make boundaries in the doctor's use of the system more accessible to the patient by carefully augmenting the user interface with sounds, or 'auditory icons' (c.f Gaver 1986, 1991). Thus one possibility might be to use different (patterns of) sounds for sequences of keystrokes which are likely to be followed by junctures in the doctors' use of the system than for those which are not. This would provide patients with additional resources for discriminating between those sequences which are likely to be followed by pauses in keyboard activity and those which, although involving similar or even identical patterns, are likely to be followed by an immediate continuation of keyboard activity.

It might also be possible to configure systems so as to simplify the process of locating displays of disengagement. For example, as noted above, such displays frequently involve doctors positioning their hands in ways which suggest that another keystroke is not imminent. One possibility might be to design sequences of keystrokes so that the final two keystrokes of each sequence involve the use of same hand as does the first key of the following sequence. This might lead to the other hand being held still around the boundary between the sequences, with the result that`the patient would only need to monitor the movement of one of the doctors' hands in order to determine whether they are likely to move directly to another keystroke sequence.

These observations are only tentative, and to fully explore the issues raised it would be necessary to build and test systems. However, they do point to the possibility of designing systems which are sensitive to the orientations, expectations and actions of parties other than users. This obviously involves a new set of considerations for designers aiming to build consistent interfaces. If systems are to be specifically designed for use within a socio-interactional environment, then it is necessary to consider not only how features affect individual users , but also how they are likely to affect other parties.

In developing patterns of human-computer interaction which facilitate rather than undermine social interaction it will, of course, be necessary to consider the communicative conduct of the user as well as other individuals. In this connection, the present research is beginning to reveal how doctors, as well as patients, structure their conduct around the use and operation of the system. For example, in attending to the operation of the system and the demands it places upon them, doctors may engage in a variety of practices which undermine and disrupt their communication with the patients as a prescription is issued. Thus we find doctors confining themselves to minimal responses to patients utterances; delaying responses until they have completed a sequence of keystrokes; producing talk with extended perturbations as they await screen changes, complete sequences of keystrokes, or try to figure out what the system is doing or requires of them; glancing at patients while a screen change takes effect, but then immediately returning their gaze to the monitor as the screen-change is completed; and abruptly shifting topic in order to elicit information that is required by the system. In general it appears that, unless doctors put the prescription on hold for an extended period in order to attend exclusively to the patient, the interactional conduct of both the doctor and patient will be structured around the use and operation of the system.

In the light of these observations, it is interesting to consider the situation prior to the introduction of the computer system. When producing a prescription with pen and paper, the doctors are often able to delicately interleave their participation in the interaction and the activity of writing. Thus when prescriptions are written by hand we often find the activity of writing the prescription being adapted to (structured around) the demands of social interaction. Moreover, patients do not recurrently attempt to coordinate their talk with boundaries in the writing of the

prescription. Their utterances are not systematically synchronised with, for example, the completions of a line of text or the movement of the pen from one line to another. As such, the activity of producing the prescription tends to be much less prominent than when the computer is used.[9]

These observations point to the need for the development of tools, technologies, and systems which are configured so as to minimise the extent to which their use is likely to impede or disrupt interpersonal communication. They also suggest that some of the requirements for such systems could be established through analyses of the ways in which paper-based activities are managed within socio-interactional contexts.[10] But the aim should not be simply to replicate characteristics associated with paper, since it may be possible to develop technologies which are still less intrusive. Innovations in the integration of paper and screen-based documention currently being developed at EuroPARC suggest that such technologies may soon be to hand (e.g Newman and Wellner 1992).

In conclusion, studies of human computer interaction have largely been confined to an individual seated before a personal computer. Even radical reconceptualisations of HCI, those that take into account the situated nature of human-computer interaction, either maintain a focus on the single user (e.g. Young et al. 1990) or introduce additional users or helpers to the setting in order to use their conversations as a resource for analyzing and modelling human-computer interactions (Suchman 1977; Thomas and Norman 1990). However, if systems are to be designed for use within socio-interactional environments, an alternative approach will be necessary: one which encompasses issues concerning the relationship between human-computer interaction and interpersonal communication.

9 At present, the doctors sometimes attempt to reduce the intrusiveness of their use of the computer by, for example, lowering the intensity of their keystrokes. We are currently examining how different styles of system use effect the interaction between doctor and patient.

10 For considerations of the use of paper and screen-based documentation in the medical consultation, see Greatbatch (forthcomimg) . See Luff et al. (forthcoming) for a related discussion of the use of paper documents and screen-based systems in three real-world settings: medical consultations, an architectual practice and the London Underground control rooms.

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