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A portable, unobtrusive device for videorecording clinical interactions

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Recording and analyzing real-time interactions in clinical settings is important for basic and applied research in psychology and other disciplines. Investigators frequently have used simple audiotaping procedures to record these encounters (e.g., Roter, Geller, Bernhardt, Larson, & Doksum, 1999), but videorecording is increasingly viewed as more reliable and valid, because it captures the full range of complex and interdependent verbal and nonverbal behaviors that occur in an interaction. This article describes a system designed to videotape clinical interactions in a manner that can be moved in and out of different clinical rooms to preserve flexibility in its use. Data are presented to demonstrate that the system is unobtrusive during the interaction, yet fully compatible with institutional review board guidelines to protect human participants' privacy and freedom to control the recording process.

Recording and analyzing real-time interactions in clinical settings (e.g., doctor–patient visits, therapy sessions) is of substantial value to both basic and applied researchers in fields such as clinical psychology, health psychology, communication, and behavioral medicine. Investigators frequently have used simple audiotaping procedures to record these interactions (e.g., Roter, Geller, Bernhardt, Larson, & Doksum, 1999). However, videorecording is increasingly seen as a more reliable and valid technique because it captures a fuller representation of the complex

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verbal and nonverbal behaviors involved in such encounters (Ford, Hall, Ratcliffe, & Fallowfield, 2000; Jones & LeBaron, 2002; Riddle et al., 2002). For example, videorecording enables tracking of specific displays of nonverbal cues and gestures that convey important relational information (such as level of mutual congruence and compatibility/responsiveness) occurring between providers and patients in a medical setting (Bavelas, 1994; Bavelas, Chovil, Coates, & Roe, 1995; Burgoon, 1994). It allows for a more holistic and contextual presentation of the encounter, including most physical arrangements and movements, objects that attract attention, gesticulations, and so on.

Despite this, videorecording procedures present some substantial challenges for researchers, particularly when the data involve gaining access to sensitive clinical settings, such as interactions regarding diagnosis and treatment of a life-threatening illness. Some researchers found early video technology to be cumbersome and the recording process to be awkward and inflexible. More worrisome has been the persistent belief (despite evidence to the contrary, e.g., Ickes, 1994; Ickes & Tooke, 1988) that videorecording is too intrusive and reactive, thereby yielding behavioral data that are artifactual or biased.

An additional problem has been that designs and prototypes for fully integrated digital videorecording and analysis systems are not readily available to behavioral scientists interested in studying clinical interaction. This problem is especially acute for behavioral and social scientists who are relatively unfamiliar with advanced media technology. Systematic evaluations of the efficacy of the few disparate systems that are in use are also generally unavailable.

The following is a nontechnical description of a fully integrated digital video system that can be used for recording sensitive clinical interactions. Although this system was specifically developed for recording interactions among oncologists, their patients, and their patients' family members/companions, it could be easily used in a variety of nonmedical clinics and other settings where real-time recordings of sensitive interactions are desired. This system was designed to meet three important criteria for scientific and practical utility: *protection of human subjects, portability, and unobtrusiveness.*

First, almost all research with human participants requires formal and informal adherence to procedures that protect the rights of the research participants. As noted above, participants must be aware of how and when they are being observed and give informed consent to such observations (Belmont Report, 1979). Participants in behavioral research also need to be able to freely withdraw without fear of recrimination (Nuremberg Code, 1949) at any point. Participants thus have the right to exercise control over their participation in the study such that if they choose at any time to withdraw or do not want certain portions of the interaction recorded, the recording process can be terminated immediately and the tapes destroyed. Participants' privacy rights must also be protected during the encounter (as in the case of a physician conducting a physical examination of a patient within the timeframe of the clinic visit).

Second, many of the rooms where clinical examinations and interviews take place are wired specifically for videotaping. However, the cameras are usually mounted and stationary, meaning that all data collection can only occur in those rooms. Aside from the obvious identification of those rooms as "taping" rooms and possible biases in the assignment of people to them, the situation may produce a conflict between the needs of the researcher and those of the clinical setting where the research is occurring. Cameras and microphones that can be moved from room to room provide a more economical, situationally adaptive, and empirically authentic means of recording, enabling the researcher to obtain a more representative cross section of the interactions that occur in a particular setting or across settings. The cameras also need to have the lens capability and flexibility to follow the participants in the interaction around the room and simultaneously record their facial expressions.

Finally, although study participants must be fully aware of the presence and location of the video- and audio-recording devices (see below), at the same time, these devices should be inconspicuous, so as to minimize potential impact on the participants' behavior. And the process of setting up and operating the equipment must be sufficiently unobtrusive so as not to interfere with the schedule of a busy clinic or the flow of the patients and their families into and out of the clinic's rooms.

The Videorecording Process

The on-site system includes mobile digital video-recording units, composed of two mobile high-resolution digital cameras (with wide-angle lenses) shielded by a cylinder housing, with remote monitoring and recording capabilities and an external microphone. Figure 1 shows the cylinder, made of shaded acrylic, that encloses the video cameras (stacked atop one another) as they capture the discussion between the physician and the patient and family member(s). The prototype was developed at the H. Lee Moffitt Cancer Center and Research Institute in Tampa, Florida.

During the interactions, one camera is directed toward the physician and one on the patient and his/her family member(s). The shaded acrylic hides the cameras from external view but permits high-resolution recording of the people in the room (the optical quality is high, thus enabling a distortion-free image). An external laminate coating on the outside of the cylinder matches the clinic room decor and counters. An important attribute of the camera operation in the exam room is the nearly silent motorized movement undetectable by the doctor, patient, or family member.

The physicians sign one-time blanket consents to videotape all their patient interactions (though they always have the option to request that a particular meeting not be recorded or that a particular taped recording be

Figure 1. Camera cylinder recording a patient–physician–family member interaction.

terminated early or destroyed). Research assistants obtain consent to videotape the interaction from the patients and their family members/companions before they enter the examination room. (Only one patient has rescinded his informed consent after seeing the equipment.) Patients usually observe the placing of the cylinder on the table.

After plugging the camera cylinder into the wall port, the study investigators move to a small, private room elsewhere in the clinic for the monitoring process of the video capture (Figure 2). The cylinder is connected via twisted pair cabling to units that remotely control the cameras. The researchers are located in a separate, secured space where they view and control the camera views in real time, using the touch panel/LCD video screen (Crestron TPS 6000) that displays the audio/video images sent from the cameras. The touch panel enables the researcher to remotely control (pan, tilt, focus, and zoom) each camera in order to track movement of participants in the room. This feature is also used when the doctor conducts the physical exam of the patient; the cameras are simply turned away to protect the patient's privacy and then readjusted once the patient is dressed.

Additional units include synchronous time-code generators, an audio mixing component, and separate DV recording decks for capturing each camera image onto independent mini-digital videocassettes. Researchers have the added capability of making real-time audio data annotation.

Audio, composite video, and control signals from both cameras are sent over the connections installed in each exam room (CAT-5 cabling; see Figure 3). Specialized transceivers (Extron TPRAV and TPTAV), designed specifically to combine the audio and video signals into a single signal, are used. The control signals that enable manipulation of the cameras are also transmitted over these links.

The combined audio, video, and control signals sent over the connection provide separate views of the physician and the patients/family members and are simultaneously recorded on tapes inserted into two separate digital videorecorders. Because two views of the interaction are recorded with separate cameras, a time-code generator and time-code reader automatically insert synchronized running time codes on both tapes for later side-by-side viewing of the session on a computer monitor. The time code provides a continuous display of

Figure 2. Crestron LCD panel for monitoring interaction and controlling cameras.

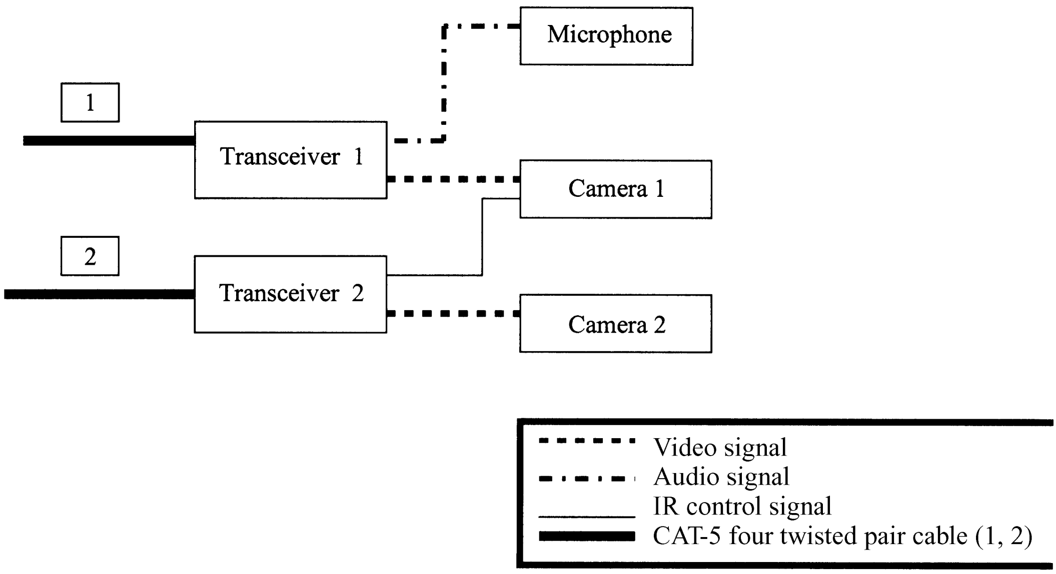

Figure 3. Diagram of CAT-5 four twisted pair cabling. Each cable consists of four pairs of wire, for a total of eight wires per cable. Sending video and audio requires all four pairs of cable. Because there is one microphone, audio is sent through Cable 1. By not sending audio from Camera 2, the two available wire pairs are used to send IR control signals to each camera. Each IR control requires one pair.

hours, minutes, seconds, and frames (1 sec of video consists of 30 individual, sequential frames). The time code inserted into the video signal allows the researcher to properly synchronize the separate tapes during the post-production/editing phase of the process, to generate side-by-side video display, and to create an accurate way to time specific events that occurred during the session. Each of the exam rooms has cables wired to a rack in the observation area. Twisted pair cabling was chosen as the transmission medium due to its low cost, ease of installation, and availability of components that are able to use it to transmit signals. To select a given room to monitor (18 rooms were wired for potential use), the operator simply "patches" two cables from the control unit to a patch panel, which is wired to all of the exam rooms.

In the postproduction phase, the tapes are captured and then edited using an IBM Intelli-station/Adobe Premiere-based editing suite (located in a laboratory office), which allows the separate views to be combined into a single video file. This file is then transcoded to an MPEG2 format for subsequent video-based analysis coding. Final production media capabilities currently include DVDs with multiple views and menu functions.

The MPEG2 files are compatible with the Noldus Observer 5.0 Behavior Analysis software program for digital on-screen playback and user-defined coding. (Of note, although Apple Macintosh G4 computers are also powerful video capturing and editing machines, they are not used in our system because they are not readily compatible with the Noldus Observer software, which is our principal data-analysis tool.) Coded data are then automatically transferred to a database (e.g., EXCEL) for statistical analysis including behavioral frequency and duration, reliability analysis, and lag sequential analysis (conducted within the software). Data are also exported for use in other statistical packages (such as SPSS or SAS) for further analyses. All workstations are networked to facilitate data management.

Assessment

Portability. The cylinder and power supply pack can be quickly set up in any of the 18 exam rooms in the clinic; minimal training is needed to set up and operate the recording units. The single cylinder creates a limited range for the camera angles (even with wide-angle lenses), so we designed and are using a dual-unit device whereby each camera is enclosed in a single, smaller cylinder. The portability of the system has been extended to the ease with which it can be adapted to a new clinical context. The system hardware and software have been successfully installed in the multidisciplinary oncology clinic exam rooms at the Karmanos Cancer Institute with data collection underway.

Unobtrusiveness. Analyses of the system suggest that the cylinders are not reactive stimuli in the exam rooms and do not produce artifactual or biased records of the doctor–patient interactions. To date, about 70 doctor–patient interactions have been recorded using this system.

As part of a followup telephone interview, patients were asked the extent to which they had noticed the cameras. Seventy-two percent reported not noticing "at all," 22% responded "not much," and 5% said they noticed them "somewhat." In response to whether the cameras affected their behavior, 94% said not at all," and 5% said "not much." Patients were asked, if the cameras did not affect them, why not? The most frequent response: they "forgot about the cameras" once the physician entered the room, because their focus was on the medical discussion about their disease and treatment.

Furthermore, we assessed the extent to which the patients, family members, and physicians were aware of the cameras and therefore altered their verbal and nonverbal behavior. Ten recordings were selected at random. On the basis of a pilot study with a separate set of tapes and prior research, we identified five verbal or nonverbal behaviors that were assumed to reflect awareness or reaction to the cameras. These include: a passing glance at the camera for a few seconds, staring into the camera for more than a few seconds, talking about the camera to another person in the room (e.g., "I wonder what they are looking at"), hiding from the camera (e.g., whispering or covering one's mouth when speaking to another individual in the room), and "self-reflexive behavior" suggesting that the person was aware that he or she was being observed (e.g., fixing one's hair, adjusting or straightening one's clothes).

Two trained raters independently coded the 10 tapes. The coding form was divided into 6-min segments; each behavior was presented within a segment with separate spaces within each behavior for the patient, the family member, and the physician. When a rater observed one of the behaviors listed above, she (both raters were female) wrote the time that the behavior occurred and which party to the interaction displayed it. Thus, the code sheets contained information on the exact time at which each party to the interaction displayed any one of the five behaviors listed above. The agreement between the two independent raters exceeded 90%.

Among patients, behaviors reflecting awareness of, or reactions to, the cameras were observed in 7% of the 6-min segments. The most common behavior was the patient talking about the camera, occurring just under 3% of the time. In about 2% of the segments, patients displayed two behaviors in response to the camera; no patient displayed more than two behaviors in any segment. Among family members, the behaviors were observed in 5% of the segments. Again, the most common behavior (about 2% of the time) was talking about the camera. Family members displayed more than one behavior in 1% of the segments; no family member displayed more than two behaviors in any segment. Finally, among physicians, the behaviors were observed in less than 1% of the segments. Specifically, there was one segment in which one of the raters observed a physician talking about the camera.

Summary

This article presents a model for a digitally based system that enables flexible, real-time monitoring, tracking, and capturing of observable behavior and interaction. An initial evaluation shows that the system is unobtrusive in the naturalistic setting. The recording system provides human participants full protection by enabling them to have knowledge of the process and to retain maximum control over the videorecording as it occurs.

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