

SHORT TAKES

What Can Digital Audio Data Do for You?

R. SHAWN MALONEY
MICHAEL PAOLISSO
University of Maryland

In the age of computer-generated music and digital cameras and camcorders, have you wondered whether it was possible to turn your tape-recorded interviewing into a digital process? Existing hardware and software are now available that will allow you to record, transcribe (via keyboard and remote foot pedal), and analyze digital interview data. Where appropriate, digitally recorded interview data can be used to enhance the power of your PowerPoint, GIS, Internet, and film-based multimedia presentations by actually allowing the interviewees' voices to be heard.

Have you been exploring alternative ways to express your tape-recorded interview data? Would you like to enhance your text analysis capabilities via a personal computer (PC)? Looking for a long-term storage solution for your tape-recorded interviews? How about transcribing your interviews using a PC? If you answered "yes" to any of these questions, you may be interested in making your taped interview data digital. Affordable hardware and software are now available to make digital interview recordings, transcribe audio recordings using a PC via keyboard and remote foot pedal, code and analyze audio data, and integrate audio and text data through presentation media.

DIGITAL AUDIO RECORDINGS

In making successful digital audio recordings, there are several equipment and hardware and software issues, as well as procedural matters, that must be considered. First, an appropriate recording device should be selected. Fortunately, you can use a standard audio cassette recorder or opt for a digital recorder such as the Voice-It™ mobile digital recorder, VTR series, at approximately \$200 (see the appendix for a complete list of recommended equipment and software and their cost).



Field Methods, Vol. 13, No. 1, February 2001 88–96
© 2001 Sage Publications, Inc.

We'll discuss the audio cassette recorder option first. Almost any cassette recorder device that allows you to record ninety minutes of tape will work, although the recorder does have to have jacks for an external microphone and earphone. In most cases, a professional-grade external microphone is necessary to ensure that the sound quality of the recorded interview is clearly audible, both for ease of listening and for transcription. More on microphones later.

Earphones are important because they allow you to monitor the sound quality of what is being recorded. Periodic checks of your earphones let you determine whether your recorder and microphone are working properly and whether the sound being produced is audible. More expensive recorders have voice-recording meters for this function. The big distinction between audio cassette and digital recorders is that you need software to convert recorded cassette tapes to a digital format. Digital recorders, as the name indicates, are specifically designed to make digital recordings that are PC compatible.

With regard to microphones, we suggest that you consult with a sound or music professional who sells and/or installs different types of audio equipment to determine what type of microphone best meets your needs. Some things to keep in mind are the environment you will be recording in (i.e., outdoors vs. indoors, room acoustics, level of background noise, access to a tabletop, etc.), recording distance (i.e., two to three feet, five to ten feet, etc.), and the location of those you wish to record in relation to your microphone (i.e., are the interviewees and interviewer positioned in front, to the side, and/or in back of the microphone?). Omnidirectional microphones pick up sound in all directions but don't reject any sound and may include undesirable background noise.

If you are recording sound primarily from one direction, a unidirectional microphone may be your best bet. In this instance, the more degrees off axis, the less sensitive the microphone is. Microphones, in general, convert sound waves into electric signals and only respond to those waves traveling in their direction (they don't seek out sound). In dynamic microphones, these waves create vibrations in a magnetic field that generates an output voltage to the recording device, whereas electret microphones have a permanently charged capacitor, powered by an alternating current or direct current source, that generates a stronger output voltage. In recording voices more than two or three feet away, an electret microphone may produce a fuller sound.

Boundary microphones are great for interviews or meetings where a table is available. This type of microphone uses the flat surface on which it sits to boost its recording range. These microphones are typically electret. Where flat surfaces are not available and the interviewer needs to be more mobile, a hand-held microphone is desirable. Small lavalier microphones that attach to

the speaker's lapel may also be appropriate and greatly reduce the distance between mike and speaker. Keep in mind, though, that this setup may require several microphones, separate power supply, transmitter, and a recording device that is compatible with the additional external items mentioned.

For our work, we chose Shure-BG4.1 electret unidirectional hand-held microphones (at approximately \$160 each). We believe this option provides us with the versatility necessary to record in many different settings.

Several software products are available to convert audio cassette recordings to digital format. They can be found on the Internet or at stores that carry music and audio equipment and computer software. We chose two programs that were bundled together called "Clean!" (Schmidt 1999) and "WaveLab Lite" (Goutier 1998), both by Steinberg. The cost of this package is \$100. Clean! allows you to record, compile, and professionally restore audio data; WaveLab Lite is designed for audio editing and processing. Both allow you to convert cassette recordings into audio WAV files. A WAV file is a format for storing digital sound, developed jointly by Microsoft and IBM, and has become the standard audio format for sound files.

Our preferred software is WaveLab Lite because of its user-friendly interface and ability to edit audio recordings. We also recommend that you use a 300–400 MHz Pentium II or compatible PC with at least 64 MB of RAM, 4–6 GB of hard disk, CD-ROM drive, 16-bit multimedia sound card, and Windows 95 or later operating system. Processing large audio files with a less powerful PC will be time consuming.

Finally, you'll need a quality cable (\$15) (like those manufactured by Monster Cable) and adapters (two for \$6) that run from your recorder's ear jack to your PC's microphone jack. Gold-plated adapters and banana plugs (cable ends) make better conductors. This setup allows the sound signal to be transferred from your recorder to your PC.

WaveLab Lite has a couple of recording settings that you should adjust so that the audio file you are creating has a quality sound but uses as little hard disk space as possible. One preferred setting uses mono channel, 16-bit resolution, and 22 kHz sample rate. This configuration requires approximately 2.5 MB for every minute of tape. A CD-quality recording has different settings—stereo channel, 16-bit resolution, and 44.1 kHz sample rate—which require about 10.5 MB of hard disk for every minute of recording. You can also try the 11 kHz sample rate, which uses about 1.3 MB for every minute of tape, and see whether the sound quality suits your needs.

Now comes the fun part. When you hit the software record button and the cassette recorder play button to begin the audio-recording process, you get to monitor and adjust the software's and Microsoft Window's volume mixing boards as a sound professional would. Make sure throughout the recording

process that peak signal levels never or rarely exceed 0 dB. Colored indicator lights help you keep the signal in the optimal yellow range, which is below red- and above green-lit areas where distortions may occur. Once you have made your audio file, the WaveLab Lite's editing features come in handy. Through block, cut, copy, paste, and delete functions such as those found on word-processing programs, you can edit out portions of the file that are not needed (saving disk space) and create new audio files by copying selected audio passages from the original file into new ones and saving under a different file name.

The second recording option is to use a digital recorder such as Voice-It. We recommend a \$30, 8 MB SmartMedia (memory) card that will boost your memory to 12 MB and recording time at an 11 kHz sampling frequency to two hours instead of forty minutes. The digital recorders operate on a file system much like your PC's Windows Explorer. You record into a file or several files in WAV format until you have reached the memory capacity of your recorder.

When you want to transfer audio files from your recorder to your PC, simply link the recorder to a PC (serial port with a DB-9 connection) with the cable and software provided, and your digital audio files are made available on your PC. As indicated earlier, these audio files do not need to be further processed before use, unlike cassette tapes. Most digital recorders come with microphone and earphone jacks, which are essential to making a quality recording. The previous discussion on microphones also applies to digital recorders.

CD recorders and writers have become very popular. Not only can you store up to 650 MB of data on a CD, but you can record up to seventy-four minutes of digital sound. Some PCs are sold with this device as a standard feature. An internal CD recorder/writer may cost \$200 (HP 8210i) and an external one around \$300 (HP 8210e). We chose the Hewlett Packard CD-Writer Plus 8210e (USB port connection) primarily because it was one of the most affordable and available external CD recorders/writers on the market.

Recordable CDs for this hardware can be purchased in packs of ten for \$13. If you are planning to play WAV files directly from the CD you created, recordable CDs must be used, not rewritable ones.

There are several reasons why you may want to consider copying your audio files to CD. First, putting your audio data on CDs will free up your hard drive. At the 22 kHz sampling rate mentioned earlier, a sixty-minute audio file can use 150 MB of hard disk space. In less than ten interviews, you can easily use up a gigabyte of your hard drive. By using CDs, you can choose to either access your audio files from your CD player or temporarily copy the

ones you want to work with from the CD to your hard drive. Second, CDs make good archival media. Audio files never lose their sound quality and, once placed on a CD, can easily be stored. Third, due to the large size of audio files, it is not easy to distribute them to transcribers or other researchers through customary practices. The files are typically too large to be sent as e-mail attachments, and even 100 MB Zipdrive disks may be too small as well. CDs have sufficient memory capabilities to handle large files and can be easily sent by mail. We recommend that you place each audio file on two separate CDs, one for archiving and the other for distribution.

PC TRANSCRIPTION

But how can transcripts be made from an audio file? Most people are familiar with pedal-driven transcription machines (ranging from \$300 to \$500) for transcribing cassette tapes, and others may have had the misfortune of using a cassette recorder as the playback mechanism for creating transcripts. Few people have knowledge of digital transcription equipment.

HTH Engineering, Inc. developed a digital transcription product called Start-Stop Universal Transcription System (Winner 2000) that turns your PC into a high-quality transcription machine. At \$199, this product provides all the features that accompany a standard cassette transcription machine, but in a windows format. A small Start-Stop Transcription Interface box attaches to your PC's serial port (DB-9 connection) and is also connected to a pedal assembly that activates all playback features commonly found in standard transcription equipment. Audio files can be opened from the file menu, accessing any drive, and a word-processing program can operate simultaneously with the small Start-Stop window, effectively sharing the same screen.

During transcription, we recommend that on the top of every new page, or on every other one, an audio "time marker" be inserted (e.g., [Time: 00:15:23] for zero hours, fifteen minutes, and twenty-three seconds). Later, this will let you more quickly find the audio component to the transcribed text. The next section on coding audio data will further elaborate on this point.

Note that the Start-Stop Universal Transcription System does not use voice-recognition software to transcribe your audio files for you but instead requires someone to physically transcribe the audio data. One reviewer, however, brought to our attention that voice-recognition software could be used to help transcribe audio files through a different approach. The transcriber

could listen to the audio file using headphones and repeat what she hears into a microphone that is linked to a PC running voice-recognition software.

Voice-recognition software can be trained to identify the transcriber's voice, and with some software an accuracy rate of 95% or more can be achieved. Truly verbatim transcripts, though, can be a problem. Voice-recognition software may not be able to consistently differentiate slang, abbreviated words, and/or colloquialisms from other similar-sounding words that one has trained the software to recognize. And while 95% recognition is a time saver, going back to correct 5 words out of 100 does mean real work.

CODING DIGITAL AUDIO DATA

Many people today use packages such as The Ethnograph, NUD*IST, Code-A-Text, ATLAS.ti, and so on to organize, code, and analyze text. The latest versions of some packages let you code audio files like you would text. We use ATLAS.ti (Muhr 1998) to do this. We recommend coding the transcribed text and then duplicating the coding process with the audio file using a printout of the coded text.

We suggest placing a time marker at the top of every page of transcribed text, particularly if you want to locate selected passages to code. Once both text and audio files have been similarly coded, search mechanisms can group text and audio quotes by code. This lets you read and listen to like quotes during analysis. ATLAS.ti lets you create a hypertext link between a specific coded audio segment and a coded text quotation, providing access to both the audio segment and text quote in the same window and file (T. Muhr, personal communication, 19 April 2000).

Other software packages such as InterClipper let you mark salient audio clips (via remote control) while the interview is in progress. After the audio segments have been marked, you can scan through and play the previously marked clips without having to listen to the entire audio file to find the segments that interest you. For those who need a more comprehensive multimedia qualitative analysis tool, programs such as ATLAS.ti may be better.

By listening to audio quotes, we are able to reflect on how intonation, tone (style of expression), mood, and so on help shape meaning. In other words, by using both text and audio quotes, we can look at what is said, and how it is said, to come up with an overall understanding of what is communicated. If you are both interviewer and data analyst, audio quotes bring you back, mentally, to the interview, helping you to recall previous observations such as nonverbal gestures and interview surroundings.

Be aware that in ATLAS.ti, audio and text coding and searches may be different in some cases. In text-based coding and searches, many text files can be stored in one path and easily scanned in one procedure to pull out quotes with specific codes. Audio files, however, may be too large to store in any one drive, limiting your ability to pull out coded audio quotes from several audio files at once. We recommend working off a CD and only coding and conducting searches with audio files found on each, one CD at a time.

PRESENTATION OF DIGITAL AUDIO DATA

Beside strengthening discourse analysis, digital audio data can be used in work to enhance the presentation of interview data. When appropriate, audio quotes can be used along with, or in place of, text quotes to provide context to research findings. What better way to give a study community a voice than to use its own voices to highlight specific issues to select audiences?

Digital audio is appropriate where participant anonymity is not a concern. In these situations, digital audio files can be used to enrich Power Point presentations, Internet web pages, word-processing documents, electronic journals, GIS projects, and film production.

CONCLUSION

Social scientists are well positioned to incorporate the use of digital audio data into their work. Cassettes from tape-recorded interviews no longer have to collect dust on a shelf after they have been transcribed. Their audio message can now be analyzed like text and used to communicate research findings.

Digital audio data is not for everyone. There are additional costs and time associated with their use. Fortunately, digital audio technology will become more sophisticated, easier to use, and less costly in the near future. New advances will decrease the size of audio files and allow for simultaneous coding of text and audio files. There will be more user-friendly presentation tools and, eventually, computer-generated transcription of recorded interviews. But digital audio data can enrich our analysis today. And it is a mechanism through which communities can express themselves in their own voice.

APPENDIX

<i>Product</i>	<i>Cost</i>
Ten 650 megabyte recordable CDs	\$13
URL: http://www.bestbuy.com/default.asp	
ATLAS.ti, single copy, educational	\$395
URL: http://www.scolari.com/	
Format: PC, Windows 95, 98, and NT	
Clean! and WaveLab Lite, bundled software	\$100
URL: http://www.steinberg.net/index2.phtml?sid=07232135	
Format: PC	
Note: If Clean! and WaveLab Lite are not bundled, WaveLab 3.0 may be the better purchase.	
Code-A-Text, single copy, educational	\$315
URL: http://www.scolari.com/	
Format: PC, Windows 95 and NT	
Ethnograph, single copy, educational	\$295
URL: http://www.scolari.com/	
Format: PC, Windows 3.1, 95, 98, and NT	
Two gold-plated adaptors, RadioShack	\$6
URL: http://www.radioshack.com/	
Hewlett Packard CD-Writer Plus 8210e	\$300
URL: http://www.hp.com/	
Format: PC	
InterClipper	\$495
URL: http://www.interclipper.com/	
Format: PC, Windows 95, 98, and NT	
Monster Cable with gold-plated banana plugs, RadioShack	\$15
URL: http://www.radioshack.com/	
NUD*IST, single copy, educational	\$325
URL: http://www.scolari.com/index1.asp?id=Software.asp?id=13051	
Format: PC, Windows 95, 98, and NT; Mac NUD*IST 4.0 only	
Shure-BG4.1 electret unidirectional microphone, cardinal sound	\$160
URL: http://www.cardinalproaudio.com/	
8 MB SmartMedia card	\$30
URL: http://www.bestbuy.com/default.asp	
Start-Stop Universal Transcription System by HTH Engineering, Inc.	\$199
URL: http://www.startstop.com/transcribe/	
Format: PC, Windows 95, 98, 2000, and NT	
Voice-It™ mobile digital recorder, VTR series	\$200
URL: http://www.voiceit.com/	
Format: PC, file transfers	

REFERENCES

- Goutier, P. 1998. WaveLab Lite version 1.3 [Software]. Hamburg, Germany: Steinberg Soft-und Hardware GmbH.
- Muhr, T. 1998. ATLAS.ti version 4.2, build 057 [Software]. Berlin: Scientific Software Development.
- Schmidt, M. 1999. Clean! version 1.02 [Software]. Hamburg, Germany: Steinberg Soft-und Hardware GmbH.
- Winner, J. 2000. Start-Stop Universal Transcription System version 7.6 [Hardware and software]. Clearwater, FL: HTH Engineering, Inc.

R. SHAWN MALONEY is an associate researcher in the Department of Anthropology at the University of Maryland. He is a 1996 graduate of the department's M.A.A. program and is currently one of the lead researchers on a three-year NSF/EPA-funded project studying issues of environment and pollution among stakeholder groups in the Chesapeake Bay. His interests include cognitive anthropology, discourse analysis, and sustainable development.

MICHAEL PAOLISSO is an assistant professor in the Department of Anthropology at the University of Maryland. His research interests include environmental anthropology, methods, gender and development, and cultural models. He is currently the principal investigator of an NSF/EPA-funded project on environment and pollution in the Chesapeake Bay.