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I'm Peter Lyman, I'm a professor here at UC Berkeley, in the School of Information Management and Systems. Well, we're a school that's half computer scientists and half social scientists, and we're trying to figure out how to design computer applications that are much more useful to people. We are about inventing new formats of information and watching how people invent, for themselves, what they think information is going to be.

INVENTING CULTURE

Kids are inventing culture all over again with instant messaging, blogging, e-mail and fan fiction, which is the way kids appropriate culture, recreate it in their own image. It's a fantastic renaissance, really, in the meaning of what information is. Henry Jenkins, at MIT, noticed that kids are not just passive consumers of movies, or television; kids take pieces of it and re-use it. They adapt it to their own stories. They create it on the Internet. They build blogs and multimedia. But, it's all about their stories—appropriating commercial music, commercial TV, commercial movies for themselves, re-using it.

It's a new kind of literacy. They certainly know how to do things that I don't know how to do. They know how to do instant messaging; I haven't a clue. I think they are re-inventing what we mean by literacy with new forms of reading which I don't really know much about. You have to watch kids to learn it. You have to watch how they use cell phones - always on. You have to look at instant messaging. What are they saying to each other? You have to look at blogs. How are they writing? How are they communicating to each other? How do they use language? It's all new.

I think most e-mail are a good example of a new kind of writing. On the one hand, it's written in an alphabet and it's written with familiar words; one the other hand, it has its own lexical and syntactical order. And, it's used for different purposes. Same thing is true of instant messaging. It's a form of writing in the sense of it's an alphabet. It's kind of words, in that they're phonetic words. But, the real point of it is not to send an idea from one person to another; it's to be in contact. So, it's a little bit like speech and it's a little bit like writing. It's a hybrid form of writing. Writing has always been a way of creating a sense of membership in a community.

One thing about kids is that they're always on, they use cell phones to always be in contact with each other and always checking in with each other, so it's a culture of always-on communication, not through face to face relationships but just by being in contact. So it's a new kind of social formation that they experience being a member of a group even when they're alone all the time while they're awake. There's a lot of negative feedback about this kind of social withdrawal, and people are just working out the ethics of what social withdrawal into your cell phone means. What kind of ethics are there about communication? So we're re-inventing the culture around what the proper use of these devices is.

THE COMPUTER REVOLUTION

The computer revolution that makes a difference to me is the shift from a mainframe computer, which was used really for things like inventory and management and for purposes like command and control, to the desktop computer, which is optimized for the individual to give the individual choices. The computer existed at least back into the late 1940's or early 1950's and perhaps centuries before principles of computation existed. But the computer revolution for me was when the computer went onto the desktop of ordinary people and they weren't designed for command and control, they were designed for personal expression, for writing, for creating works of art. That to me is the computer revolution, when it started to serve the individual and not organizations. It's not the technology. It's creating a technology that's in service to individuals and that frees them to create new kinds of information and to communicate it in new ways.

The first part of the revolution was bring the computer to the desktop of the individual and serving the individual. But the second part is connecting the computers through the network so that none of us is isolated. Each of us has access in a sense to every other computer in the world. And all of a sudden the world of information is no longer private and is no longer hidden or protected. It's a democratic resource and all of a sudden the information is something we can search, something that we can read anything that's written and put on a network computer in the world. This really changes the nature of knowledge in a fundamental way.

The universal language of computers has to be computer programs. They create standards like TCP/IP that lets computers talk to each other. Beyond that, we don't know what the common language is because now English is the language of computation on the network but tomorrow it's going to be Chinese. And every country is going to have its own computer culture conducted in a different language. We don't know what the Internet is going to look like in the future when there are more users on the Internet that speak Chinese than who speak English. So we may have a tower of Babylon on the Internet.

The dream of computer science is Unicode - to translate one language into another and in that sense everybody will have a common language. I haven't seen it technically, but it isn't just a technical problem; it's also a cultural issue about what language and what culture is going to become a world culture, a dominant world culture. And I think that's very hard to predict at this point. For today it's English and an Anglo-American culture dominates the world of science and technology. But in a hundred years, I have no way to know.

What's interesting about digital to me is what it allows us to do. I don't so much know what it is from a technical point of view as the capacity to store and distribute all the information, to be able to store all of the information in the world and to distribute it and provide people access to it is why a digital technology is interesting to me. The fact that we can store every year the equivalent of 40,000 Libraries of Congress and search it is significant. The fact that I can publish a paper on the web and people around the world can read it is why digital is significant to me. But I don't really care very much about how it happens...

THE INFORMATION EXPLOSION

Readers always have a choice about what to buy and what not to buy. But it's not always the case that markets determine what is published. Governments can publish things that nobody wants to read. Television can create things that nobody wants to watch. What's happened now is

that people get to edit what they want to read or what they want to watch. On television they have TiVo. On the web, they can search for the information they want and they can print what they want. So no one can force you to consume any information anymore.

It used to be when I wanted to get information on some topic, I had to go to a library and choose from what was provided there, or I had to go to a bookstore or magazine stand and choose from things that other people had selected for me. Now I get to choose from the Internet, and I think of the Internet as a library. I can download anything I want from anywhere around the world. So the library in a sense is infinite now, the bookstore is infinite now. So I feel that it's a much more exciting world of ideas now because there are no limits, no boundaries.

We discovered, in our research on how much information there is, that the amount of information doubles every three years. Anything that is recorded on paper, on a computer, on an optical disk, on a magnetic disk, on wood, on marble, on any media in which information is recorded has been doubling about every three years. And it's increasing. The rate of growth of information is doubling about three years as it's preserved in every medium. And what this means, is there is much more information than anybody can consume, that people now have to select what they pay attention to. So, we are in a world not of publishing now; we are in a world of economy of attention in which we have to make decisions about what we are going to pay attention to and what we are not going to pay attention to.

A lot of the information that's getting recorded now, this immense information explosion, is actually recording things that are always around us, but that we couldn't record. Things like weather patterns, satellite images, information on space to Mars, databases with every time we used a credit card. We're recording things that we treated just as everyday life before, it's all recorded now. So in a sense it's just data; it's not particularly useful until we know how to visualize it, how to use it, how to select it. So the total amount of things being recorded is exploding in size but its usefulness is very problematic, so far.

From what I can tell, the number of books is growing, but the thing that is really growing in the print world is office documents, things that we print from our desktop computer and newspapers. Especially in the third world, we're having an explosion of newspaper communication. But, books and magazines are not increasing. My favorite statistic is that it takes nine-hundred-eighty-seven trees a year to produce enough paper for us, and that the average human being on the face of this planet consumes fifteen-hundred pages of paper a year for writing. But that's very unequal in different societies. In the United States the average person consumes twelve-thousand pages of paper a year; the average European consumes seven-thousand pages of paper a year. So world wide the average is fifteen-hundred, that means most of the people in the world are using very little paper the way we do. What that means is we really are a writing culture still for all of the electronics because we use paper as our medium of record.

All we tried to measure in figuring out how much information is produced was how much storage it would take to hold it all. What we didn't address is what makes information valuable and we're storing a lot more information than we know how to use. We're storing all of the data from satellites, but almost none of us knows how to take images from outer space and use them. There's a real gap between the amount of information we store and the amount of information we know how to use; that's another kind of literacy problem I think. We don't know how to use all of this information. We don't know what makes it useful. So in a sense, most of it is noise.

It's hard to tell if people are reading more or writing more. The one thing we know is that people are printing more, but most of the printing that goes on is made on the desktop by selecting information from the web. So, all of a sudden, the reader is in charge of what's printed rather than publishers or governments or authors. In the history of writing, writing was always tied to somebody's authority. Somebody, up to now, got to choose how information was distributed and how it was preserved, even what the official ways of writing were; good information or bad information. I think that's over now. The reader gets to determine what writing is and I think that's new.

And that's why the search engine is so interesting; the Yahoos and the Googles. All the information that was isolated on computers is being put into a database and made searchable using pretty simple straightforward search techniques. You can use ordinary language to look for knowledge now, you don't have to be a computer scientist. So the search engine is a real change agent in our culture.

There is a vast amount of information on the Internet, and it's growing dramatically quickly. It's the fastest growing new medium for recording writing that's ever been invented. The World Wide Web is growing astonishingly fast, but what's happening is more and more of the Internet is being generated for us on demand, creating a unique look on a computer screen that nobody else will see. When I dial up Amazon or Barnes & Noble online, what I see is not what you see; it's something optimized for me so it'll say "Good morning Peter! We have new rap albums for you..." or whatever else I consume, so it's customized information. Information isn't standard anymore; it's customized for me or for you. The Internet doesn't really consist of standard published information; it's a universe of customized information.

THE NEW LITERACY

We have no choice but to select a subset of information. There's just too much of it for us to read it all. It's way more than you can use or read in a lifetime. So my picture of how we use information now is we filter. Our form of literacy is a series of filters about what I will and will not pay attention to. Which newspapers will I read? Which television shows will I watch? There's way more of everything than I can consume or pay attention to; too many phone calls; too many web pages; too many newspapers. So, literacy now consists of filtering, selecting the right stuff for me, and that's what we call literacy now. It's an economy of attention, it's filtering, choosing, selecting, customizing. We've changed from the world of clay sculpture in which you add knowledge by learning something, to a world in which literacy consists of knowing what to throw away. It's like marble sculpture now; throw away the right bits and you have art. So, it's about selectivity now because we're just overwhelmed. We're overwhelmed with all of these new media and the art of knowledge is knowing how to select, how to customize. If I try to give a lecture in class and state a question of fact, 13 students will raise their hands because they will have looked up my fact on line and they will correct me. That means, as a teacher, I am no longer the authoritative source of all wisdom. I'm kind of the coach or the provocateur, but they're off creating their own knowledge - validating it in their own way. It's not about me; it's about them. It's not a bad thing. There is so much information that what I teach them is really important is how to search for information, how to select the good information, how to throw away the bad information. It's now about how to find information. It's not about how to memorize my version of truth or reality.

I'm a travel guide. I can tell them how to make choices; how to find information on a given topic. But, I can't tell them what the final truth is because they have to invent that for themselves. In a lot of ways, I'm a critic now, more than an authority figure - giving people feedback, making suggestions about how to consume information more thoughtfully, wisely, more carefully, because I know the reality is, they're going to create their own truths. They're going to make their own movies. They're going to make their own audio. They're going to make their own books. They're going to create their own information.

In some ways print is no longer a mass market. We have the technology now to customize publication for smaller and smaller groups. This means we can get better information where it's economically feasible to get information to small groups of people that we couldn't have afforded to publish for before. So it's a new world of publishing too, with micro-markets and customized publication, print-on-demand. And in a certain sense, we don't live in a mass-culture anymore; that that was the twentieth century culture with mass-broadcasting and mass-publication. Now with cable we're seeing very very customized audiences for TV, and the same is true with print: customized publication, customized books, magazines, newsletters. All of a sudden we're living in a much more customized world of information.

On one hand, we're in danger that everybody or groups will create their own truths and we'll have nothing in common, and that was the advantage of having an authoritative canon, Great Books that we all read or certain news shows that we all watched. That did create a sense of community. So on one hand, if everybody's creating their own realities, their own truths, we have a certain isolation; we have certain cult like characteristic of membership and different information cultures. On the other hand, the scale of knowledge has really changed; it's global now. I can have close friends around the world; I get email from people in twenty or thirty countries a week. And, it can't be said that that's a form of isolation since it's openness to the world that never existed. But, it also means that everything has to be negotiated, because my cannon is not their cannon. So we're living in a global information environment in which we have to be able to meet each other half way, to negotiate what we think truth is, what was valuable, what's not valuable.

In the past, knowledge was held in the hands of a few who controlled it, but now everybody can have access to it. The question is what kind of education is going to prepare people to filter the right information; to create their own kinds of knowledge and in many ways, our educational system is optimized to teach a cannon of knowledge that someone thinks is true. But it doesn't address the question of how people are going to create their own knowledge; we need a new educational system for that. I think our educational system is not particularly relevant to the kind of life that our kids are going to have to live. Our educational system was invented for industrial society in which we wanted to teach people how to master a certain body of knowledge and to repeat it accurately. But we don't live in a world of industrial production any more. We live in a world in which people have access to all the information in the world and the problem is going to be how to they select the right information, how do they create new kinds of information? Our educational system isn't designed for that kind of creativity, its designed to create predictability and reliability, not creativity. So the question is, the hard question is, what does literacy look like? Certainly it had to include the classic skills of knowing how to write coherently and how to read accurately and how to speak accurately and coherently. But that isn't

enough anymore, there are other things that have to be a part of literacy. Visual literacy has to be a part of it, the ability to compose in new media. The ability to search a database of knowledge that's almost infinite, and come up with information that's valid as opposed to information that's essentially noise. Those are skills we don't teach. But the literacy of the future has to include those things.

THE FUTURE OF COMMUNICATION

I think there is less writing in the classic genres. But you know they were invented in the century after the printing press was invented and what we're looking at now is what new forms of writing are going to emerge in the first century after the invention of the internet and the cell phone. The distinction between the computer and the cell phone and the Game Boy, none of that makes any difference; the platform is evolving really rapidly, so my phone will take pictures and it'll send it to my computer. It's important not to pay attention to the platform - the computer, the cell phone, or the Game Boy. What you need to pay attention to is the information flow. The digital information flow goes in and out of all of these and the devices are going to change every eighteen months.

What's made this possible is the congruence of the computer chip, which allows for processing signals really rapidly and very cheaply. Devices that can be mass-produced, wireless communication; it's the congruence of several things really in the last ten years. I think this technical process is going to continue. And, remember the analog to the printing press. It took a century after the invention of the printing press to really understand how it could be used, and the same thing's true of the computer. We're really only in the first couple of decades of a century long process of evolution and the devices that we take for granted today are all going to be changing every ten years, maybe every five years for the next century... for sure.

There's no question that the computer is as significant as the printing press and has begun the same kind of social process of change and cultural change that the printing press began. In a way, it's going to be a new renaissance, but an electronic renaissance this time. We are already seeing new kinds of art emerging; we're seeing new forms of social relationships, new ways of creating and distributing news. All of the basic things in life are being changed, the way we communicate is changing, and when you change basic communication patterns you know the whole culture is going to shift in an amazing way.

There is no way to know what the next hundred years is going to look like using these technologies. Some of the histories of the printing press point out that for the first couple of decades the printing press was used to re-create the hand printed manuscript and we're probably still doing that with the computer. We're probably still imitating things from print world and we are just on the verge of breaking on into purely computational and electronic cultural forms and art forms and modes of communication. I think we're seeing that in kids right now. So watching the kids, I think, is the best clue of where it might go. But thirty years from now, nobody will recognize our culture. Everything about it will be different.