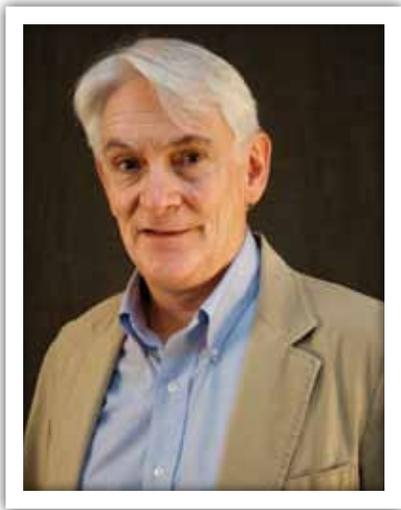


Minimalism Revisited:



An Interview with John Carroll

BY NICKY BLEIEL | *STC Vice President and Senior Member*

It has been 23 years since John Carroll's landmark book *The Nurnberg Funnel: Designing Minimalist Instruction for Practical Computer Skill* was published. The title of the book refers to the legend of the Nurnberg Funnel, which was said to make people wise very quickly after the right knowledge was poured in. The year 1998 brought *Minimalism Beyond the Nurnberg Funnel*, a collection of essays exploring the evolution of minimalism by Professor Carroll, Hans van der Meij, JoAnn Hackos, Ginny Redish, David Farkas, and other luminaries. In this Q&A, Nicky Bleiel discusses these groundbreaking works with John Carroll, who is currently the Edward M. Frymoyer Professor of Information Sciences and Technology at Penn State's College of Information Sciences and Technology.

Nicky Bleiel: Let's start at the beginning, Professor Carroll. Why did you embark on your original research in the '80s? At that time, you weren't in academia. You were an "IBMer."

John Carroll: Yeah. That's actually probably why I was inclined to do that. This, in the early '80s at IBM, was a time when the company was trying to expand into new markets. The IBM PC was in development. They had just brought out the Displaywriter, which was a micro-computing-based document-processing system, reaching out to much broader user groups. Users, usability, the whole HCI transformation was loose at IBM. I've often thought the decade of the '80s was the decade of the new user, because there was such a vast expansion. Not that it really has slowed down [laughs] with respect to computing, but it wasn't like that in the '70s. It was a professional area, and the issue was supporting computing and information professionals.

These problems of new users—problems of learning, problems of getting started—were "the" problems, because if you don't get started, all bets are off. There really isn't anything more to worry about. You haven't become a user.

I don't like the term "user" anymore, but that was the term we used then.

NB: [laughs] The '80s, when you were working on all of this, was the time that everything transitioned from everyone who was involved in software being a developer, a high expert, into bringing it out to the people, so to speak.

JC: Right. Yeah. And there were waves of it. The first wave was computer hobbyists and clerical people, secretaries. Administrative assistants in today's parlance. And then office principals, that was the next wave. It was basically the computerization of the entire office, everyone, all the staff. That was a big wave after wave of new users and learners, and that's what drew us into this work. It was strategically critical for IBM. And as a young psychologist working at IBM, it was fascinating, because [laughs] it was actually a way to apply things I knew and had studied and was curious about to real needs of the business.

NB: That does sound like it would be fun. How do you describe Nurnberg Funnel minimalism, in a nutshell?

JC: Well, I think the metaphor of minimalism and, of course, the Nurnberg Funnel is this medieval legend—it's German—about The Funnel of Nurnberg, which made learning very easy. Basically you insert the funnel into somebody's head and pour knowledge in. It's an interesting metaphor. In some sense it's something we all would desperately like. Certainly somebody who is struggling with a computer system or application would like to be able to just pour the knowledge in and not have to struggle.

On the other hand, it's ironic in that our studies of learning, and other people's studies of learning, led us to a concept of the active learner, the active user. Meaning that people need to act, they need to be engaged, and that they need to struggle. That's not a bad thing. That's the way people learn.

Of course, just because you're struggling, that's not a good thing, but the right kind of struggle could lead to

the right kind of outcome. The minimalist idea, the way I think of it, is to minimize the extent to which the system and the information get in the way of what the user's really interested in.

I think this is very consistent with the notion of minimalist design from the Bauhaus tradition. To try to bring function to the fore, chairs for sitting in fundamentally. It's not something to look at or contemplate. It's functional.

Similarly, a computer application is to do stuff with. Not to read the information, puzzle over the interface, get confused, and frustrated. That's not what it's about. That's what should be minimized. People should be on the course that they want to be on and relating to computer products the way they want to.

NB: I think that's an interesting way of putting it. More Bauhaus and less Louis XIV in design.

JC: Yes. Of course, the impulse to end up with Louis XIV, with decoration, and extras, and so forth, is something you always have to struggle against. You know, the old term "featuritis." Those of us who produce software, produce information. We're producing both the vehicle to make everything work right but also the obstacles. And we have to exert a certain amount of self-control, empathy, and of course, user testing [laughs] and other things like that, to make sure we don't lapse into decoration and obstacles.

NB: That's very true. Jumping back to something you touched on when we first started talking, there's been a bit of an argument in the tech-comm community about what we should call the people who consume our content. Everybody in software has always said "users," and some have suggested we say "customers." But in the book, you generally refer to them as "learners." Do you think that term is more appropriate and keeps us, as technical communicators, more on task?

JC: I do like the term "learner." "User" is passive, to me—you've been handed something, use it—whereas I think what people are doing is much more actively a matter of ownership and appropriation and coming to control a new tool in a new environment. And it is a matter of learning. It's a matter of problem-solving. Besides being cumbersome long—you could call them "problem-solvers...."

I think that's accurate, too, but it's awkward. But also, it focuses on the performance, where "learners" focuses on the human development and appropriating new knowledge and skill, which I think is really more the essence of what's going on. But I think it's worth struggling a little bit with the terminology. [laughs] For years, I used "users" unquestioningly, and I finally realized I wasn't really comfortable with it, so I tend not to use it. In your question, you also suggested the term "customer," and I understand, in a commercial context, where that could be relevant, because there is a transaction going on in the background. There's a purchase. But again, as with "user," I think that's something I wouldn't want to overemphasize, because a customer can't buy skill and a customer can't buy a good user experience. They have to be a partner in that.

Ten Misconceptions About Minimalism

1. Minimalism means brevity.
2. Minimalism means incomplete instructional analyses.
3. Minimalism means trial-and-error learning.
4. Minimalism does not support people who learn by reading.
5. Minimalism over-emphasizes errors.
6. Minimalism is just another word for job aids.
7. Minimalism only works for simple domains.
8. Minimalism merely reflects the preconceptions of users.
9. Minimalism offers a complete documentation solution.
10. Minimalism has no theoretical foundation.

From Minimalism Beyond the Nurnberg Funnel, 1998

Actually, we have the same terminology thing in the university, in contemporary times, where some of our administrators urge us to think of our students as customers [laughs], which I think is just terrible. It's a terrible idea because, again, they can't buy an education, and calling them a customer conveys to them that they can, which, really, just technically, it's wrong. It's also the wrong attitude to take when you're a student or a person learning new skills and information in a professional context.

NB: It's true. What you call someone, how you label something, does matter, bottom line.

JC: Yes.

NB: Now, *The Nurnberg Funnel*, it pioneered so many of the best practices that technical communicators adhere to today. You could start with the concept that software documentation should be designed and it shouldn't simply be a list of menu items and dialog boxes. The concept that documentation should be modular, and support both sequential use and random access. That docs should be user-centered. Even the concept that "less is more." What do you think is the most important takeaway of *The Nurnberg Funnel*?

JC: Well, it's a fair question. I may end up wriggling out of it. I wanted to insert here just an acknowledgement. It fills me with delight that people still can find utility in this book after all the years that have passed. I never anticipated this, so it's just pure pleasure. It's fun to revisit the ideas and try to reconstruct things we were thinking of then and how they might be relevant now.

I think that the idea that documents must be designed is one part of minimalism in *The Nurnberg Funnel* that's very relevant today.

I do think that techniques like crowdsourcing and search have caused, what I think, is a radical position that there is no need to design information anymore because it's so abundant. We can rely on the crowd and search, and between the two we're going to be able to generate such wondrous amounts of information.

I'm drawn back to a very old statement by Herbert Simon that I think comes from the '60s where he said that in our age we have an abundance of information—that's true—but we have a poverty of attention. This, I think, was much in our minds, even in our early work, and I think it's a bigger problem now.

Online information is a huge resource and we do need to curate it. We do need to cultivate it, use it, and understand how people appropriate it, but we need to understand that people are overwhelmed by the amount of information.

Saying that the age of design is passed and now we can just rely on the Web and it will take care of things, I think, is just way more optimistic than I am. I think that information does need to be designed. Of course, we have to realize also we can't design all the information on the Web. That's loose and that is the new paradigm, so we do need to understand search. We need to integrate that into information strategies, but I don't think a way to get started

is to point people to a Web browser and say, "You're on your own. There's plenty of information there." That's true and that's the problem.

NB: That's very, very true and it's something the profession has been struggling with and working on for many years. As you noted, that question started a lot earlier than a lot of us thought.

Speaking of learning, in *The Nurnberg Funnel* you note that

people learn by doing. This was an important concept. They learn by doing, not reading. For software, kinesthetic learning trumps visual and audio learning. This piece of minimalism is often overlooked. How does the research you and your colleagues did support this?

JC: I would say that the way our research supported it is through the studies we were doing, which were largely these rather intensive thinking-aloud studies of new users getting started with various IBM—mostly IBM—systems. We saw people resort to learning by doing almost immediately. Of course, the most vivid examples were people who would declare that they were systematic thinkers. They really liked to puzzle through things and they wouldn't be going off half-cocked and trying this and trying that. They were very systematic people.

Of course they weren't because learning by doing, I think, is really just a fundamental truth about learning. People need to act. We are, after all, talking about skill learning. We're not talking about pondering abstract concepts or definitions or conceptual information, declarative information. It's mostly skill learning and you learn skills by doing.

In terms of where the idea came from, I was talking about how we experienced it and observed it in our research, but it's an older idea that in my education and further reading you can trace back to various sources. I've gotten a lot of inspiration from reading John Dewey on this, but there are many other sources.

For example, Jean Piaget, the great developmental psychologist, talked about how people had to interact with things, see them, handle them, manipulate them, in order to develop their intellect. He had a series of stages in his model of intelligence.

I think it's a very widespread idea. In fact, I think this general idea of active learning is so pervasive there really aren't voices against it anymore.



The Nurnberg Funnel circa 1910

http://en.wikipedia.org/wiki/Nuremberg_Funnel

I regard this as pretty much a settled issue. It was maybe just mildly controversial even in the '80s, but it's certainly not now.

NB: We know that this is how people learn. We know that we need to optimize for it. On the other hand, there's a greater and greater level of impatience when people need to learn software.

JC: Of course, that impatience is because they want to do things. What we tried to do in our work was work with that impatience. A lot of times a risk can be seen as a resource from a different perspective. If people are impatient that's energy. It's a goal. It's a desire, a direction. If you can guide that, if you can work with it, if you can direct it in a lightweight way and put more initiative, allow more initiative to the learner, you might get a better result. That's really what we were trying to do. And I think it's more possible to do today. In the 1980s, the idea of digital memory, integration of printers, even what printing was, these were all new concepts, and I find it hard to believe these same concepts are problematic in the least for anybody now.

So we're in an industry, we're in a region of human endeavor, where what's problematic is moving ahead so now there are concepts about the way that smartphone apps update, some of these are not concepts everybody shares, but those problems were not even ... we couldn't even conceive of them.

And I think this pattern is likely to continue so that the problems that are vexing us today someday will be in the background, and there will be new ones.

NB: That's the good thing about problems, right? [laughs]

JC: Yeah.

NB: *The Nurnberg Funnel* was published in 1990, and you followed up in 1998 with *Beyond the Nurnberg Funnel*. How did you come to revisit minimalism eight years later?

JC: Well, in the intervening time—and, of course, when a book comes out in 1990 in those days it means you finished it in 1988. So in that intervening decade, I got to meet a lot of people, got to read more stuff, find out what other people were doing, and realized that what I was doing was just part of a larger zeitgeist of changing ways of thinking about information design, documentation, learning, various user interface designs, and so forth. And I was, with the help of the Society for Technical Communication, able to arrange a workshop at Virginia Tech—I can't remember exactly what year that was, maybe 1996—and invite a bunch of these people I had met in that decade, and they were all going in different directions, emphasizing different aspects.

I remember people were talking about using hypermedia to layer information to achieve minimalist designs where you could hide information unless people requested it. Get it out of their way unless they actually chose to look at it, made that their path for looking at different kinds of applications. As I mentioned, I was working heavily on office information systems, and people were working on other things with similar approaches and so forth.

So that was how *Beyond the Nurnberg Funnel* came to be, and that book included the article on misconceptions about minimalism, because any idea that you try to develop, people are going to creatively interpret it, and that's an opportunity to refine the way it's presented.

NB: First of all, I'd like to say it's very cool that STC was involved with all of this. We're very proud of that, and I was going to ask you about the essay that you and Hans van der Meij wrote for that book. Minimalism is a hot topic right now—for lack of a better term—in tech comm, because it's considered essential for mobile outputs and documentation in general. But Nurnberg Funnel minimalism, to expand on your paper a little bit, it doesn't mean concise, necessarily, though I'm sure that you wouldn't dispute that conciseness and good editing is important. So if minimalism does not exactly mean brevity, how would you explain it?

JC: Well, I would say that brevity is more a consequence of minimalism than a principle of minimalism. If you go back to what I was saying earlier about trying to facilitate the learner's initiative and goals and aspirations and impede them less, you will most likely end up with a briefer design, or it might be layered. I was alluding earlier to David Farkas's contribution to minimalism in the book *Beyond the Nurnberg Funnel* which had to do with layered designs. This was a way in his work of getting the information design out of the learner's way, making the information layered so that it was available on demand, but not necessarily an impediment if the learner didn't choose to look at it at that time.

NB: Wow. That's a great explanation of that. That makes perfect sense.

In *Beyond the Nurnberg Funnel*, you note that minimalism is a combination of documentation and user interface improvements. Do you believe that technical communicators should get involved in user interface design and software usability, and if you do, how do you think they could work alongside user experience professionals without actually changing their profession and becoming user experience professionals?

JC: The second part of that is probably the more difficult part, but the first part is easy. I've always believed this, and I think the design of information and the design of the user interface started to really... Again, if we rewind history here, when we started out books were the primary vehicle for information design, for technical communication, designing libraries, actual books. And that's just much less true now. Information started to move online, started to become integrated with user interfaces.

I think that the two interests were always very aligned and subject to a lot of the same processes. The way usability's articulated, the way we think about usability testing applies just the same to developing a book as it does to developing an interface. The interface is more interactive, and so it's more complex.

But once the information starts to go online, it's exactly the same. And not only that, it's embedded in the user interface, so I don't see how the two professions can really be separate. They're codependent, and the better and the more closely they're integrated would lead to a better process in which usability would be optimized generally throughout the design.

The other question you asked is how these two professional concerns—and they're often people who come from different professional preparations and maybe affiliate with different groups—how they can maintain their identity. That's a tricky question.

And I think it's valid, because these are different perspectives. The information and the user interface has been integrated to a considerable extent. The two perspectives are valid perspectives on that boundary object, that single thing that they're looking at from two different points of view.

But I think that is just problematic. Probably some information designers will over time become user interface designers, and maybe the converse, too. So there might be movement across that boundary. That probably wouldn't be a bad thing, either. I think that's an interesting dynamic in the whole system development process.

Of course, you could make similar arguments, or raise similar issues with respect to people who design functionality and people who design user interfaces and online information, right?

NB: True.

JC: There's been a long tradition of trying to separate architecturally the user interface from the functionality, but in general I wouldn't say this has been a howling success. I mean in very simple user interfaces it's doable. The Web, the early Web, was able to do it, but then as Web 2.0 is articulated, it's probably less true today than it used to be. I don't know. I think that all these professions end up interacting quite intimately, and people cross boundaries, and maybe that's just the way it's going to be.

NB: I like the term you use, "codependent." So we should all realize our codependency, because at the end of the day there's going to be better software and that's what we're interested in developing. That's what everybody on the team wants to do.

JC: The tensions, the perspective of an information designer, the perspective of a user-interface designer, the perspective of the software engineer, looking at the same thing from different ways, I think that could be a beneficial tension. Again, all conflict, all difference is not necessarily a problem. Sometimes it's a resource. [laughs]

NB: That's very true.

JC: If we could only collaborate with people who are exactly like us and have our values and our skills and our knowledge, it'd be a boring world.

NB: [laughs] Absolutely. We talked earlier about all the different options we have for online user assistance today. Of course, we still create manuals, but there are so many

The Nurnberg Funnel Approach to Minimalism

- ▶ Allow learners to start immediately on meaningfully realistic tasks.
- ▶ Reduce the amount of reading and other passive activity in training.
- ▶ Help to make errors and error recovery less traumatic and more pedagogically productive.

From The Nurnberg Funnel, 1990

more options. We have embedded help. We have dynamic help. We have tool tips. We have videos. We have wizards.

We have all kinds of things going on to help the user and guide them along on their path. But minimalism strives to keep the documentation itself from obstructing the user. Do you think these options distract the user, or do you think they're just valid steps on the path to minimalism?

JC: I think they're both. I think that we have a much richer design palette today than we did in 1980, and that's got to be a good thing. On the other hand, to use your analogy earlier about the Louis XIV tendency, it raises that risk, because now the concept of what is a document set now is just totally open-ended. I mean, it could be a ton of information. It could require a dump truck. And that's probably not where we want to go. We certainly don't want to make that a prerequisite to doing anything. That would be exactly the wrong thing to do.

On the other hand, having a rich design palette makes the professional practices much more interesting, much more demanding. There's lots to know. There are lots of techniques to deploy, maybe a lot of more need for a kind of multimedia analog of layering, so that not everything is on the critical path, but it might be in the information space as an option.

But I think the goals of minimalism are still valid. I think people use tools to get things done, and one way we have to measure ourselves is the extent to which we facilitate that and make it make a very short and stimulating and effective path available to the person wanting to use the tool.

That said, we know that people often do not attain the level of expertise that would be good—even for their own goals—and so we need to think about ways to stimulate people to learn more and get better. Again, these challenges aren't new ones. They were there in 1982 also, and they're still here today. And as systems are more complex, more integrated, and more interesting, I think these challenges also get more complex and more interesting.

NB: Right. We want to support discovery learning, but we've given them a lot more to discover. [laughs]

JC: Right. That's not a bad thing, I mentioned at the beginning that I think maybe it's just a fact that

learning involves some struggle, but I think that this can be very rewarding. I think people intrinsically want to be stimulated and learn things, and so if we do it right, really, we're not just doing our job, we're really enriching [laughs] the human experience, I think. I think people in computing and information technology have a great opportunity to contribute to that.

NB: I agree. It's a very noble goal, too. We talked about how all these options have increased and disciplines—we talk a lot about content strategy in tech comm now. So technical communicators, understandably, we're more technologically savvy and we're more process-oriented. But *The Nurnberg Funnel* focused quite a bit—and we've talked about this a lot today—on the psychology of learning.

Do you think that *The Nurnberg Funnel's* emphasis on learning theory is still valid? [laughs] I think you do. Technology and systems always change, but humans essentially don't change much at all, do they?

JC: Well, no. I guess my simplest answer is learning theory is still valid and, I think, provides a stimulating and a forceful and a useful perspective, and that's a continuing thing. Technology and systems are ever-changing. Let's call it "the human architecture" is unchanging, and that's the sense in which learning theory is a continuing resource for us, to us. But what is changing is prior knowledge and culture. What the humans bring to the kinds of situations we are designing for—that is changing—and that will continue to change.

So earlier I was alluding to our concerns back in the day with people trying to understand what it meant when a document was queued for printing. Well, that was really a fascinating challenge in 1980 but not so challenging today. Kids that are three or four understand that. [laughs] So that's simply not something we need to worry too much about.

On the other hand, there are many other problems that have come to take those problems' place. And so that's the sense in which the humans also are ever changing. Again, winding the clock back, one thing that really impressed me in 1980 was the IBM materials we were reviewing at that time did not treat the learners as ... well, they didn't really treat them with respect. I mean they didn't treat them as people that had a goal or that knew anything.

And when we worked with these people, we realized these people did have goals and they were experts, but they weren't experts with the Displaywriter or the IBM PC. They were experts in office work, and they knew a lot about work practices, and processes, and objectives, and quality standards, and they knew more than we did.

And we came to see that prior knowledge as an important resource that needed to be leveraged in the design of information, the design of training materials, and the design of user interfaces. And that basic strategy, I think, should be the operative one, but all of the specifics are different.

So the people today, just the people who walk off the street that are like your user, they know a lot about the Web, they

know a lot about mobile phones. They use computers every day. They know about Facebook. I mean, there is lots of prior knowledge that we have to respect and that we have to use and leverage in our designs today, but it's all different knowledge.

So this, again, is the challenge of information design, and the fundamental problem that was addressed in, *The Nurnberg Funnel*, and why this profession is not going away. It can't go away. But it will always be changing.

NB: Right. So the tech-comm mantra of "know your user" is important in all phases of software design, in designing the information, in designing the interface, in designing the interaction, all of those things.

JC: Yes. I think a lot of times when people read that mantra, which has been around a long time—that must go back to the '70s, if not the '60s—but when you read that I think a lot of people say, "Ah, we're all human beings. What's the news there?" But we shouldn't take it at that high a level. It's true. We're all human beings, and our minds essentially work the same as people several thousand years ago, but our users are completely different than the users of 10 years ago. That's a thing we have to focus on when we say, "Know the user."

And that's changing ... it's changing faster and faster, in fact, so that challenge is not just a "so what?" kind of challenge. It's really a very serious challenge, and it gets more demanding, I think, with time.

NB: You said in *Beyond the Nurnberg Funnel* that many challenges remain ahead—not just the one we just discussed about knowing users—and that you believe there can never be an end to the project of reconstructing minimalism; that it's constantly evolving. We have talked about the fact that software is ubiquitous, it's everywhere, and it's much more user-friendly than it used to be. Is there anything you could think of that you would tweak in your original description of minimalism?

JC: I think if I was going to write the book again I could write it better. [laughs] I think I'm a better writer now than I was 25 years ago. Aside from that, I think I'm going to stand pat with the basic ideas. Essentially, in what you're alluding to, I was predicting that things would change—of course that's an easy prediction, and I'd make it today too.

We've talked about some of that change. You rattled off the design palette for information designers today. That is a much richer design palette than what we were talking about, not just in 1980 but in the mid-'90s when we did *Beyond the Nurnberg Funnel*.

That's the sense in which the project of reconstructing minimalism is constantly evolving. Tools are all different. The point I was making a minute ago about the cultural context, the prior knowledge that we can assume and must leverage—and respect—in our users or learners, that's changing.

Of course, the applications. The most obvious thing would be mobility. In the mid-'90s there really wasn't any mobility to speak of. Not like today. The prospect now—with a billion smartphones already in use—the prospect

today is that everybody is going to have a fairly advanced computer in their pocket all the time.

That's the world we're designing for right now. I think that's going to require minimalism in every sense, but it's a different kind of requirement than we were ever worrying about when we were thinking about desktop computing.

NB: Very true! You are a professor in the information sciences and technology college at Penn State, and I'd be remiss if I didn't ask what you're working on now, even if it isn't tech-comm specific.

JC: My work ... of course. I don't think I work specifically on information design. These different professions and perspectives all converge—I think I encounter these issues every day in my work. Just to mention two things I'm doing. One thing I work on is educational technology. In terms of learners, if you're interested in learning and supporting learners with technology, becoming a professor is a good way to make sure you'll stay active.

Students both are able to benefit from and really expect technologically sophisticated tools, and I've been working with that in my teaching pretty much all the time I've been a professor, which is the last 20 years.

One thing I'm working on I call "collaborative information analysis." This is the scenario of law enforcement or intelligence professionals trying to make a theory of the crime, which may not have been committed yet, by analyzing a very large information space. I've been doing this for about seven years, mostly with U.S. Navy support.

The interest in it is, of course, we realize we live in a world full of threats and those threats are hard to identify. There are large information spaces we need to analyze to try to identify hypotheses that would be theories of the crime or crimes. The way that you support that is by allowing people to abstract the information, but also by being able to get back to the original source and ground their hypotheses in the real data.

This involves visualizations and online sketching tools, social network analysis tools, lots of different kinds of tools that need to be integrated. Minimalism is a big issue here because it's easy to get overwhelmed. The model problem that I'm working on consists of 222 propositions. If you think about it, it's really easy to get lost in an information space that complex.

That's one thing I'm doing. It involves development of an integrated tool for information analysis and also studying team process where people try to work together to collaboratively analyze a complex information space.

The other project I'm working on is community technology. I've been interested for a number of years, really, in how information technology can strengthen community as an experience that people have.

Specifically, I'm interested in placed community, so I've worked with nonprofits, local government, schools, and so

forth in a geographical area. Because I'm lazy, I guess, or because it's more fun to work where you live, I'm working now in the State College community with my own neighbors, in effect. There's just a huge number of interesting projects.

I think this work has a larger relevance because the idea of community, I think, is fundamentally important to being human. You can see from the explosion of online community and community-like experiences that people are striving for community. They want to participate in community. I think that technology can and does support that. That's the other focus of my work.

NB: Wow. That's really interesting and also a way that minimalism is coming full circle for you. It's coming back around. Cool.

JC: In these areas and other areas I've worked in, these ideas are still operative. They're very important. If information technology's going to be effective—across the whole host of things that people use it for—these orientations, I think, are critical to our success in the future.

NB: Thank you for that, and thank you for having this conversation with me today, Dr. Carroll. It was a privilege and an honor, and I learned a lot.

JC: Well, it's been fun for me, too. It's always fun to go down memory lane. I believe that the past is important to succeed in the future and it's fun for me to revisit that. ■

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