1

Title: The Expert and the Machine: Competition or Convergence?

Author information:

Eric T. Meyer

Oxford Internet Institute, University of Oxford, United Kingdom

1 St Giles, Oxford, OX1 3JS, UK

Email: eric.meyer@oii.ox.ac.uk

Author bio:

Eric T. Meyer is a Senior Research Fellow and Associate Professor at the Oxford
Internet Institute, University of Oxford, UK. His work in the area of social informatics
focuses on how work and knowledge practices are transformed as people adopt digital
technologies. For more, see http://www.oii.ox.ac.uk/people/meyer/

Abstract

In this essay, the role of human expertise in the face of technological advance is discussed. There are many examples of technology that has become sufficiently advanced that the previous need to develop expert-level skills before being able to perform at a high level is either vastly reduced or eliminated. For instance, digital cameras can create sharp, beautiful photos with essentially zero technical skill, and high-definition video recordings are available on smartphones and iPads. The question is not just whether these technologies eliminate the need for expertise (thus substituting engineering for expertise), but also if in doing so they foster the development of new types of creative expertise (such as an ability to use photography as part of a social media strategy, for instance). The paper concludes by arguing that machines contribute to an increasingly capable constellation of people and machines, which together allow more people to develop their talents into expressions of creative expertise.

Introduction

There has been much talk in recent years about the growth in the power of the amateur that has been powered by the Internet (Shirky, 2008), in terms of amateur contributions to Wikipedia (Benkler, 2006), the growth of amateur photography (Gómez Cruz and Meyer, 2012), citizen journalism (Outing, 2005), citizen science (Raddick et al., 2010), and any number of other realms. One element that has been less frequently mentioned in this rush toward building a world of crowd contributions is the role of the expert[1] and the role of acquired expertise.

Technical expertise, as opposed to innate skill, must be developed in humans in order to reach higher levels of performance, which in turn can be thought of as the expression of creative expertise (Ericsson, 1999). Ericsson et al. (1993) were among the first to examine the role of deliberate practice, often subsequently called the 10,000 hour rule, referring to the number of hours of practice needed to develop expert-level skills.[2] In the case of a musician, there are many hours of practice that go into developing the technical expertise and skills required to produce the desired sounds and to play particular pieces of music, and many more that go into developing the creative expertise, or virtuosity, required to perform at a maximal level. Whether it takes 10,000 hours or not to become an expert, one question that has been largely ignored in recent years is the extent to which technologically sophisticated devices which provide the appearance of expertise can replace the need for individually acquired expertise.

Or to put it in a somewhat flippant way, to what extent can 10 million lines of algorithmic code

replace 10 thousand hours of human experience?

Of course, the process of human expertise being replaced by the actions of machines and

processes of automation (which of course are themselves the products of human expertise) is

not new, and has often generated anxieties about the loss of previous human expertise-based

systems. The industrial revolution saw a shift from craft- and guild-based production to large

industrial automation, for instance replacing the expertise of weavers working in cottage

industries with huge machines that replicated and even in many cases improved upon skilled

hand-work.[3] Likewise, the rise of the networked information society of the last 30-50 years has

seen the steady shift from individual labour to automation (Castells, 2011). The first

"computers" after all were people (Grier, 2013), but are now, of course, automated pieces of

machinery ranging from the smartphones in our pockets with Google Now and Siri predicting

our next moves to massive supercomputers put to tasks such as drug discovery and the

detection of international security threats. In a recent article discussing these trends in detail,

Frey and Osborne have examined the computerization of occupations, and predict that about

47% of Americans are currently working in occupations at risk of being replaced by computers

in the relatively near future, although the exact timeframe cannot be predicted (Frey and

Osborne, 2013).

I would like to take a different view on this however, which is slightly different than the fears

raised at the prospect that human expertise will be increasingly replaced by that enacted by

machines. Instead, the question is to what extent can sufficiently sophisticated machines allow us to replace *each other*, to supplant experts with non-experts who are armed with technology, to revolutionize (or undermine, depending on your view) the production of knowledge and creative expression? In this essay, I would like to discuss the relationship between expertise as enacted by human experts and the activities of inexpert humans armed with technologies which are sufficiently advanced so as to produce outputs of sufficient quality that they replicate or even improve upon previous expert-quality outputs.

Photography

I have previously written about the difference between amateurs and professionals in the context of photography: one can think about a two by two grid in which one axis distinguishes between amateurs and professionals, and the other axis differentiates between those who consider themselves photographers and those who use photographs for a variety of purposes but do not consider themselves to be photographers[4] (Meyer, 2008). These boundaries are not rigid, but are increasingly blurred in this technological era when cameras are not only highly capable but also ubiquitous in the form of smartphones. In this conceptualization, the importance for what we are discussing here is somewhat surprisingly not the professional versus amateur dimension, since both categories include people who traditionally spent many hours perfecting their technical expertise, be it in the ability to record the "decisive moment" (Cartier-Bresson, 1952) or to excel at the skills required to process and print photographs in a darkroom. Instead, we are interested in the dimension that more closely maps onto acquired

expertise: people who self-identify as "photographers" (and thus internalize this role as part of their identity, in the symbolic interactionist sense) versus those who use photography as a means toward other ends. Traditionally, the highest expressions of creative photographic expertise were performed by those who had also acquired the necessary technical expertise and frequently also a significant quantity of expensive technical gear.

In recent years, however, the technical barriers to taking high quality photographs have dropped dramatically, as have the material requirements for creating, processing, and sharing an image. The difference between a professional grade SLR and mass-market cameras designed for holiday snapshots used to be a wide gulf, with the difference in technical quality obvious to the naked eye. With the shift away from film toward digital cameras that began in the 1990s and was essentially complete within 20 years, digital devices capable of creating technically high-quality images are in everyone's backpack or pocket in the form of small cameras, inexpensive SLRs, and smartphones. Image processing and manipulation is likewise easy: while advanced processing with Photoshop still has a learning curve, anyone can apply Instagram filters and post their images for the world to see.

This begs the question of whether expertise in film photography is fundamentally different than expertise in digital photography because of the affordances and demands of the technology of each, or whether there is something fundamental to both that goes beyond creating expert-quality *images* using technological means (technical expertise) and gets to the

question of the ability to engage in expert-level *photography* as a practice and process (creative expertise).

One version of this story is that photography has become a domain in which little to no technical expertise is required, allowing everyone to become an expert (or at least create outputs which are indistinguishable technically from those created by experts) with little effort by leveraging the built-in "expertise" encoded in the algorithms that run our photographic devices. Of course, cameras themselves were seen by some as a technological means by which painting expertise was being devalued in the 19th century:

> As the photographic industry became the refuge of all failed painters with too little talent, or too lazy to complete their studies...I am convinced that the badly applied advances of photography, like all purely material progress for that matter, have greatly contributed to the impoverishment of French artistic genius. (Baudelaire, 1980 [orig. 1855]: 87)

Baudelaire's dismissal of "purely material progress" starts to get at the tension[5] that can arise as technological improvements offer us as human actors the ability to do things which we would be unable to do proficiently using manual methods. In Baudelaire's worldview, the expression of a scene as rendered by an artistic genius is taken as a laudable goal, but one that is somehow debased if too many people have the ability to create an image of a scene without expending the effort required to become an expert. I think it is far too simple to say that

substituting technological power and prowess for hard-won human skill and knowledge is a debasement of "artistic genius". On the other side of the coin, however, it is also too simple to argue that technology has simply democratized endeavours such as photography, opening up the path of artistic expression to all. Instead, I think something else explains how machines reconfigure expertise: the machines we build have taken away some degree of demand for expertise in performing functional work (again, technical expertise), but at the same time, have opened up possibilities for expanded opportunities for people to engage in higher order expression (creative expertise) and also for new forms of expertise to emerge.

Using our example of photography, what are examples of these new forms of expertise? One is clearly the ability to effectively use social media to create an online message using photography in conjunction with writing, design, presentation, and other sets of skills and abilities. Many of the parts of this social media skill set rely on automated tools to work together, but simply having access to all these tools does not make everyone an expert in social media. A limited number of people are able to acquire the expertise (operating in conjunction with their natural abilities) to become social media influencers, because these technologies allow them to leverage their innate talents in ways that are suited to success in an online environment. Many others, however, make a single blog post, YouTube video, or post a few photographs on Instagram, Flickr, or Twitter, and then disappear from view, lacking the ability, knowledge, expertise, and possibly the prior cultural capital or even the inclination required to make their work more visible.

These successful social media influencers are a good example of our professionals who use photography, but do not call themselves photographers. Photographs may play an important role in the messages they broadcast, but they would in many cases not view themselves as photographers. Also important is that these new social media experts are not necessarily the same people who would have achieved expertise or prominence related to photography in another time because the types of expertise required for success are different: combining various types of media into packages that appeal to social media consumers is wholly different to working with cameras, lenses, and darkroom chemicals. The digital camera's embedded technical capabilities and algorithms allow the social media expert to appear expert precisely because many of the elements of being a prominent social media influencer have had the expertise formerly required to excel packaged into machines, but it is still up to this new type of expert to tie them together in creative ways. The benefits accrue more widely than this, however: many others (including many amateurs who use photography but don't call themselves photographers) neither have nor want these social media skills, but can still enjoy the benefits of digital cameras, relying on the same packaging of technical expertise into the digital camera to better record their personal and family life and share it with friends on Facebook, to give just one example.

Filmmaking

Making a film that the average layperson would perceive to be filmic, in that it is sufficiently high quality in terms of images, lighting, sound, editing, and presentation format, has for most

of the history of filmmaking been out of reach of the average user. Certainly, home movies

could be made using handheld movie cameras since the 1930s, VHS camcorders in the 1980s,

and digital camcorders in the 1990s. However, all of these produced resolutions that were less

than professional equipment, and largely did not enable the sophisticated editing and post-

production that marks the professional films produced by experts. However, this dynamic has

changed dramatically in recent years. First, digital SLR cameras capable of shooting high-

resolution video were introduced, and now small hand-held devices such as mobile phones

and iPads can shoot high-quality video. One only needs to go to YouTube to see that people

with little or no training (the traditional source of expertise) are able to produce films that at

least look professional: they are shot at high resolutions, have good quality sound, and are

edited into a coherent package often with titles and end credits.

In a recent project, some filmmaker colleagues and I worked with several schools to test the

proposition that it was possible to teach students with either limited or no previous training

how to plan, shoot, edit, and produce a high quality film using nothing but a basic iPad (Meyer

et al., 2014). One of the team members (Phillips) involved in the project is an experienced

filmmaker. He worked directly with the students at each school to create a bespoke film using

the iPad as the main platform for all aspects of the production.[6]

What we found was that the iPad running the right software can replace many other pieces of

technology (large cameras on tripods, editing suites, and so forth) to make the filmmaking

experience much less onerous (partly because of the compact design of the technology but

also because of the affordances that embed technical expertise into the software and hardware) and as a unexpected benefit, potentially more collaborative as well. The relatively large screen of the iPad, for instance, allowed many more off-camera students to see exactly what the iPad operator was seeing and shooting, which contributed to their ability to learn even when playing a relatively passive role for the time being. Also, editing collaboratively on a large projected screen immediately after shooting enabled the students to get immediate feedback on whether their shots worked or might need reshooting, a sharp contrast to most filmmaking when rough cuts are only available days or weeks after the initial shoot.

So, some of the expert skills normally needed to make a film have been reduced or eliminated when making a film with an iPad. One element of teaching filmmaking that was not replicated by the iPad, however, was the professional expertise of the filmmaker with regard to how one tells a dramatic and compelling story with film. In speaking with teachers, this was a key area where they felt their lack of expertise held them back from making short narrative films with their students. As a result, film projects in many schools appeared to fall back on genres that are less demanding in terms of narrative structure, such as reshooting a professional music video or movie trailer.

The replacement by digital technology of difficult-to-learn technical expertise opens up new (practical) possibilities for filmmaking expertise to be taught. The expertise being taught is no longer necessarily in the technical areas of manipulating filming equipment and editing suites, but in the area of storytelling and teaching students collaborative and creative working

techniques. These are arguably higher-order skills demonstrating creative expertise,

potentially well-suited to success in the modern economy. A relatively small handful of people

will ever need the expertise in how to operate highly technical film equipment to make feature

films, but many people can benefit by gaining expertise in how to create a compelling narrative

that influences those who see, hear or read it. So we return to authorship: in this area of

digital photography and iPad filmmaking, we see not the diminishing of the author and creator,

but a central role for creative experts to emerge who have different skills, abilities, and

interests than the experts of a previous time whose place they are taking.

Conclusion

We have considered just a few technologies here that have contributed to the declining need

for individual human expertise in some areas while enabling other forms of expertise to

emerge, although there are many more we could have addressed (e.g. crowd-sourced

Wikipedia replacing edited encyclopedias, Google search replacing consulting a librarian, or

even word processing making us all into typists and typesetters). The question we have been

considering is whether these technologies eliminate the need for expertise, or if they

substitute engineering for expertise, or if they foster the creation of new types of expertise

and the expansion of alternative forms of expertise.

I think it is clear that I am arguing for the latter. The first too options are too simple, almost

straw figures. Yes, technology replaces certain jobs, as it has always done and will continue to

do as long as humans are able to innovate. If it were not so, we would still be living on the savannah or in caves without a weapon, farming implement, or cooking tool to our names, yet expert in the ability to hunt and gather food to be eaten raw. Also, yes, technologies do frequently substitute engineering for elements of expertise, because the engineering has been designed to replicate the lessons learned by previous experts and to embed those lessons into the algorithms and operations the technology is able to replicate. As we have seen, there is a point at which technology becomes sufficiently advanced that the previous need to develop lots of skills before being perceived as an expert is either eliminated or vastly reduced. So the answer to our earlier question (Can 10 million lines of algorithmic code replace 10 thousand hours of human experience?) is a qualified yes: we are clearly able to encode and reliably reproduce some types of expertise previously limited to humans. We should be clear here, however, that this applies unevenly, as some types of expertise are less amenable to an algorithmic approach than others.

However, even as some forms of expertise are enacted by technology, new forms of expertise will inevitably emerge. Perhaps this is part of human nature, in that we as humans seem to seek out ways to challenge ourselves and others (White, 1959). Or perhaps it is due to the limits of any technology: no matter how many challenges the technology solves, new challenges inevitably arise as its limits become visible.

To return to the title of the paper, are we seeing competition or convergence between the expert and the machine? I argue for the latter: we as humans are part of an increasingly

complex but also increasingly capable constellation of people and machines (made up of physical hardware and software). We can create beautiful images with the push of a button, typeset a page without ever touching a printing press, and film something we see as it happens. However, the most beautiful photographs will be created by those who gain expertise in composition, layout, lighting, and choice of subject. The most compelling writing will be done by those who learn how to communicate their ideas effectively onto the typeset page. And the best films will be made by those who have the ability to visually tell a story that is able to generate an emotional reaction from those who see it. What the machines do for us is open up the possibility of developing these types of expertise to more people, and also allow more people such as students additional ways to explore how they might develop their talents into true expressions of creative expertise.

Acknowledgements

References Cited

Baudelaire C (1980 [orig. 1855]) The Modern Public and Photography. In: Trachtenberg A (ed) *Classic Essays on Photography.* Stony Creek, CT: Leete's Island Books, 83-89.

Benkler Y (2006) *The wealth of networks.* New Haven, CT: Yale University Press.

Cartier-Bresson H (1952) *The Decisive Moment.* New York: Simon and Schuster.

Castells M (2011) *The Rise of the Network Society: The Information Age: Economy, Society, and Culture (Volume 1).* Malden, MA: Wiley-Blackwell Publishers.

Collins HM and Evans R (2002) The Third Wave of Science Studies: Studies of Expertise and Experience. *Social Studies of Science* 32(2): 235-296.

Epstein SR (1998) Craft Guilds, Apprenticeship, and Technological Change in Preindustrial Europe. *The Journal of Economic History* 58(03): 684-713.

Ericsson KA (1999) Creative expertise as superior reproducible performance: Innovative and flexible aspects of expert performance. *Psychological Inquiry* 10(4): 329-333.

Ericsson KA (2012) *The Danger of Delegating Education to Journalists: Why the APS Observer Needs Peer Review When Summarizing New Scientific Developments*. Florida State University. Available at: http://www.psy.fsu.edu/faculty/ericsson/2012%20Ericssons%20reply%20to%20APS%20Observer%20article%20Oct%2028%20on%20web.doc (accessed 14 August 2014).

Ericsson KA, Krampe RT and Tesch-Romer C (1993) The Role of Deliberate Practice in the Acquisition of Expert Performance. *Psychological Review* 100(3): 363-406.

Frey CB and Osborne MA (2013) *The Future of Employment: How susceptible are jobs to computerisation?* Oxford: Oxford Martin School. Available at: http://www.oxfordmartin.ox.ac.uk/publications/view/1314 (accessed 22 August 2014).

Gladwell M (2008) *Outliers: The Story of Success.* New York: Little, Brown and Company.

Gómez Cruz E and Meyer ET (2012) Creation and control in the photographic process: iPhones and the emerging fifth moment of photography. *Photographies* 5(2): 203-221.

Grier DA (2013) *When computers were human.* Princeton: Princeton University Press.

Jones J (2014) The $6.5m canyon: it's the most expensive photograph ever – but it's like a hackneyed poster in a posh hotel. In: Jonathan Jones on Art (Guardian Blogs). Available at: http://www.theguardian.com/artanddesign/jonathanjonesblog/2014/dec/10/most-expensive-photograph-ever-hackneyed-tasteless (accessed 10 December 2014).

Meyer ET (2008) Digital photography. In: Kelsey S and St. Amant K (eds) *Handbook of Research on Computer Mediated Communication, Volume I.* New York: Information Science Reference, 791-803.

Meyer ET, Carroll J and Phillips K (2014) Bottling Inspiration: Shoot Smart Swindon Final Project Report. London: Into Film.

Nowotny H (2003) Democratising expertise and socially robust knowledge. *Science and Public Policy* 30(3): 151-156.

O'Hagan S (2014) Photography is art and always will be. In: Sean O'Hagan on Photography (Guardian Blogs). Available at: http://www.theguardian.com/artanddesign/2014/dec/11/photography-is-art-sean-ohagan-jonathan-jones (accessed 11 December 2014).

Outing S (2005) *The 11 Layers of Citizen Journalism.* Available at: http://www.poynter.org/content/content_view.asp?id=83126 (accessed 25 May 2006).

Raddick MJ, Bracey G, Gay PL, et al. (2010) Galaxy Zoo: exploring the motivations of citizen science volunteers. *Astronomy Education Review* 9.

Shirky C (2008) *Here comes everybody : the power of organizing without organizations.* New York: Penguin Press.

White RW (1959) Motivation reconsidered: the concept of competence. *Psychological Review* 66(5): 297-333.

End Notes

[1] The use of the word expert in this paper is in line with Ericsson's ideas about understanding expertise which is used to create or perform something. There are clearly other ways to think about experts, including the role of certified experts (Nowotny, 2003), such as in expert testimony, or the role of experts in decision-making (Collins and Evans, 2002).

[2] The 10,000 hour rule terminology arose after Malcolm Gladwell's (2008) popularization of the Ericsson et al. work, which has since been argued to be a mischaracterization of the original data and argument (Ericsson, 2012). The actual amount of time required is not a magical number like 10,000 hours, but varies by type of expertise and levels of innate skill.

[3] See Epstein (1998) for a discussion of the role of guilds in technological change. Epstein argues that guilds were not, as some other authors have argued, simply resistant to new

technologies, but were part of a technical and political environment that pursued

technological innovation that "privileged skill-enhancing, capital-saving factors" (p. 696).

[4] Example of professionals who use photography but do not consider themselves to be

photographers per se include members of many scientific disciplines such as biology, medicine,

archaeology, and ecology, as well as professional examples such as police who take

photographs of crime scenes as part of their other duties. Amateur examples include people

taking snapshots of holidays or sharing smartphone images on Facebook or Snapchat.

[5] This tension expressed by Baudelaire is not completely resolved over 150 years later: in

December 2014, an exchange between Guardian newspaper blog writers revisited a debate on

photography as art, with Jones (2014) claiming that "Photography is not an art. It is a

technology." O'Hagan (2014) responds that Jones "still thinks painting is in some sort of

competition with photography. How quaint. He also seems to think that all photography is

derivative of painting. This is plainly not so."

[6] One sign that the project was successful at creating a film that displayed creative expertise is

that one of the films (*The Other Girl*, available at http://vimeo.com/idealfilms/theothergirl)

was selected for the competition section of an international film festival, the 14th European

Meeting of Young Peoples' Audiovisual Creation - Camera Zizanio.