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Can artificial intelligence arrange a perfect marriage of technology and human judgment?

By Cynthia Harrington, CFA



We usually think of the term “technology” in very modern, even futuristic contexts. Yet the word has a long history, deriving from the Greek *tekhnologia*, meaning “science of craft” or “systematic treatment” of actions. These traits have been with us since humans first discovered tools. In fact, the investment-analyst profession emerged from ad hoc investment approaches, using systematic processes to analyze and evaluate the health and value of companies.

Increasingly, those processes are being undertaken by what we usually mean when we say “technology”: computer hardware and software. Methods of investment analysis and selection, as well as portfolio management, have been heavily influenced by “quants” for decades. Is the next frontier automating all human actions in investment firms, or will both humans and

computers need technology to prompt good investment—and business—performance?

Former hedge fund manager Clare Flynn Levy, founder and CEO of Essentia Analytics in London, is plowing this new ground. She moved from finance to tech in Silicon Valley fashion. As a long-only tech fund manager during the internet bubble, she used to wish for the decision analysis and nudges toward effective behaviors that her firm now provides. “I wanted someone to tell me to focus on the one thing the data says is most important,” says Levy. “Nobody could ever tell me that in the moment; then, the data only reported what happened last quarter or last year.”

The dozen years between wanting and providing the solution saw the development of computing power necessary to perform complex analysis on “big data” quickly enough for investment practitioners to use in the moment. For example,

Illustration by Bob Scott

Essentia Analytics' products use digital investment journals to analyze transaction data and find insights to improve the decision process. The company also offers coaching and consulting when requested. "We have data and analytics aimed at some sort of behavioral change," explains Levy. "Our clients take that knowledge and do something different."

The changes in habits range from such investment decisions as holding losers too long to such daily concerns as the optimal number of meetings each day. Reminders to practice optimal habits come through the software in the form of "nudges."

"Even when we start out a new habit with perfect practice, we need reminding to make decisions," says Levy. "We are not programmed to do the most rational thing."

REPETITIVE PROCESSES

Even at pure quant firms that outsource distribution of their new accounts to a custodian and use robo-advisers, people remain involved. Cambria Investments in Los Angeles, a quant firm currently managing eight ETFs, launched Cambria Digital Advisor accounts last fall. According to an August 2016 blog post by Cambria co-founder and CIO Mebane Faber, "This is not a passive, buy-and-hold robo-service. Far from it. Rather, we're a people-powered digital investment advisory. And we're always here to discuss your portfolio if you ever want to chat on the phone or in person in our office."

"The human element will always be impossible to outsource," Faber continues. "Even using the computer for portfolio management, investors need someone to talk to. I don't think in my lifetime that will be disrupted."

That being said, since Faber started Cambria in 2006, administrative functions in the firm have been replaced by computer and internet-enabled processes. Cambria still manages separate accounts, as it has from the beginning, but now the company outsources onboarding accounts, using Betterment as its custodian. Seven people, all executives, work at Cambria (a CEO, CIO, COO, vice president of portfolio operations, vice president of operations, director of business development, and director of communications), managing \$400 million in assets. Faber and his co-founder, Eric Richardson, spend their days tweaking the investment philosophy and constructing new ETFs. "Traditional custodians lacked online account opening, online account funding, and automated portfolio management and tax harvesting," says Faber. "Since we launched the Digital Advisor accounts, we've accomplished a feat impossible with traditional firm onboarding: We're opening 50 accounts a month, with \$25 million in assets in the first five months."

Some newer investment firms outsource everything except the technology. Numer.ai and Kaggle run competitions for data scientists, crowdsourcing predictions based on datasets the companies provide. Kaggle offers up a wide range of datasets covering everything from financials to public health to product usage, whereas the Numer.ai contests all rely on past price movements in stocks and markets. Founded in 2015, Numer.ai uses machine learning to allocate funds to models that are doing better in the moment. The company innovates by using not only computers and software

but also the payment technology of Bitcoin to compensate the anonymous submitters.

QUANTIFYING THE UNQUANTIFIABLE

Quantifying investment decisions started with the ability of computers to run algorithms on massive amounts of economic and market data, allowing them to spit out analysis or orders. Providers have taken different approaches. Consider the example of Numer.ai and Kaggle. Numer.ai data gives quants the "clean" data generated from transparent stock trades and economic activity calculated from consistent sources and methods. Datasets from Kaggle are broader reaching, collected from various sources with good to poor methods, and express conditions of human behavior and demographics that are harder to quantify. The data scientists working with both Numer.ai and Kaggle comment on this difference. Is it possible to get data as clean as stock prices to measure and predict broader human behavior in investment firms?

Efforts are underway in many sectors seeking to "quantify the unquantifiable" in human investment behavior. Consider recent research undertaken by CFA Institute in collaboration with the Center for Applied Research, the independent think tank of State Street. After surveying 7,000 professional and individual investors about what it means to win in the investment business, the study's authors came to a surprising conclusion. The results, published in "Discovering Phi: Motivation as the Hidden Variable of Performance," determined that phi, derived from the "motivational forces of purpose, habits, and incentives that govern our behaviors and actions," is what leads to investment success. The research shows that a one-point increase in phi is associated with a 28% greater probability of excellent organizational performance, a 55% greater likelihood of excellent client satisfaction, and a 57% greater probability of excellent employee engagement.

According to the study, increasing phi requires managers to "form a new habit of decision making such that ... cognitive and emotional behavioral biases [are] kept in check." Though reforming our habits seems straightforward, however, "it can be extremely difficult ... because habits by definition are largely within our unconscious. The habit process begins with a cue, then there is a routine, and finally a reward is received based on this habit." Perhaps most pertinently, "In our industry, we need to break the habit of having fear trigger action."

Interest in the behavioral aspects of investment management has been slowly gaining momentum. The desire by professionals to hone their investment or time-management skills is not new, but CFA Society-sponsored education events on meditation or mindfulness are certainly a new phenomenon. Also new is the growing number of coaches, many with professional psychology and coaching credentials coupled with investment experience. Despite these trends, though, Levy reports that coaching in the investment industry is not widespread. "Maybe a third [of my clients] are working with coaches, but a lot of people in finance are just not comfortable with the concept," she says. "They might be comfortable with working with their behavioral data, but something about having a coach is scary to them."

The phi research also illustrates that investment performance relies on an alignment of all human behaviors away from the focus on short-term performance and asset gathering to the mutual interests of the investment professional, the investment firm, and the client. This includes customer service functions as well as managing processes across portfolios and investment. Could computers take over these processes in addition to choosing and managing investments? The demand for such solutions could be high. “We’re constantly asked for an application of our products to general business decisions,” says Levy.

One major hedge fund recently made headlines for its plan to develop an artificial intelligence (AI) system that will encompass (but not replace) all staff decisions. With 42 years of history, Bridgewater Associates in Westport, Connecticut, is one of the longest-running hedge funds and has made its reputation leveraging technology for investment decisions. In addition to good performance, the firm effectively leveraged human talent with computers. The firm employs 1,500 people to manage \$160 billion in assets.

The “radical transparency” that Bridgewater claims is behind its success describes a culture similar to what Levy says is common among her clients. Firms that use Essentia have “cultures of safety and a willingness of employees to stick their necks out and look deeper.” This is especially true for those clients who use the Essentia tools to improve team performance. The team leader, usually the portfolio manager, sees data on all decisions made by team members. “In conventional companies, if a program like Essentia Analytics [were] put in, the employee might be judged on—but would likely never see—data,” Levy contends. “Essentia users are not afraid to look in the mirror to see what’s working and what’s not. Team members share a growth mindset. They tell us they’re interested in bettering themselves.”

Bridgewater describes a practice of quantifying human processes that is inherent in its hiring practices. The company is measuring people for a fit to a function and to the Bridgewater culture. According to Chairman and CIO Ray Dalio, “By collecting data on people, we can learn what they are like, what jobs they are best suited for, and how they would most effectively work together.” A video on Bridgewater’s website expresses the process visually, illustrating potential hires as configurations of Legos that fit into perfectly shaped holes in the company’s wall.

Corporate America has relied on collecting data about people to quantify hiring decisions since the 1960s (for example, to diminish interviewer bias). But the problems with such hiring tests are legion. Like most research in social and biological sciences, findings are rarely replicated. In addition to the statistical challenges, the tests must be administered consistently to allow comparability of results, which would mean a room with the same furniture, temperature, computer interface, and sound level for each test taker. The tests should be administered at the same time of day, and the test takers should have eaten similar meals within similar time frames beforehand. If the test is conducted offsite, the test taker’s identity must be established, and then firms must acknowledge that potential hires may have taken the

advice of a popular recruiting site and learned how to “beat” investment banks’ psychometric tests. If these conditions are not met or accounted for, the inputs cannot be trusted 100%.

For Essentia, getting the data to do their work is not an easy task. This is not a math problem; it’s a big-data problem. Essentia has a disciplined but involved process for onboarding a customer. Although the basics can be captured through telephone or in-person meetings, new users must be trusted to express their thoughts clearly. “There’s no data footprint before someone makes a decision,” says Levy. “We have to ask them and look at a lot of different factors to understand the context from which the person is making the decisions. After we understand the context, we can define the behavior change and nudge for that change. That’s the problem we’re solving, really.”

MORE HUMAN THAN HUMANS?

Big data is heralded as a solution to gaps left by traditional research methods. In a recent article published in the journal *Perspectives on Psychological Science*, author Tal Yarkoni sets out a prescription for solving the replicability problem. His co-authored paper, aptly named “Choosing Prediction over Explanation in Psychology: Lessons from Machine Learning,” challenges the profession to acknowledge that studies done with small sample sizes using “best fit” models can only explain but not predict behavior. In addition, Yarkoni contends, only big data and machine learning can reasonably be used in making predictions.

Small sample sizes and best-fit analysis might be blamed for the difficulty in applying behavioral finance and neuroeconomics findings. The sample sizes are miniscule compared with the data available. Consider the example of G.E. Wimmer’s 2012 article “Preference by Association: How Memory Mechanisms in the Hippocampus Bias Decisions.” Published in the journal *Science*, the article included data from brain imaging as well as behavioral data from controlled laboratory settings. Researchers looked at a lot of data from both the fMRI measures and behavior experiments and concluded that people choose things with which they have some familiarity instead of things that are totally new—a key insight for investment managers and marketers alike. But these conclusions were drawn from the participation of only 28 subjects. Or consider the Nobel Prize-winning behavioral finance paper “Prospect Theory: An Analysis of Decision under Risk” by Daniel Kahneman and Amos Tversky, which forms the basis for many practitioner applications and includes several studies with startling and conclusive proof that the assumptions behind classical economics are false. The sample sizes for those studies range from 50 to 100 people.

What Yarkoni proposes about using big data is now possible with cognitive computing and enormous, ever-replenishing, and often publicly available datasets. With business or marketing analytics as the usual outcome, cognitive computing enables machines to learn from data based on how humans think and detect patterns. From millions of subjects and millions of posts on Facebook or Twitter feeds or other online writings, research models can determine gender, income, political leanings, and emotional states.

One source for research and business applications is the result of collaboration between Stanford University and the University of Cambridge called “Apply Magic Sauce,” featuring a process by which their “Trait Prediction Engine” learns from multiple data sources to identify personality traits and psychographics.

“Cognitive computing” is an IBM term, and users can access psychometric analysis through the IBM Watson Personality Insights service. Using your online writings (which you must give the company permission to access) or any 3,000 words you supply, you can gain a better understanding of yourself or others. IBM’s models are constructed from ground-truth data—information gleaned from direct observation rather than inference—supplied by standard psychometric surveys of large numbers of people, along with writing the subjects have posted online. The software scores using the Big Five personality model (based on agreeableness, conscientiousness, extraversion, emotional range, and openness), which is the most-used measurement for academic researchers, as well as other sets of values and needs.

IN AN INVESTMENT SETTING, COMPUTERS THAT WERE SET FREE TO ACT BASED ON LEARNING FROM THE ACTIONS OF OTHERS—EVEN THE BEST PEOPLE ON STAFF—COULD HAVE NOTORIOUS ERRORS OF OMISSION AS WELL AS COMMISSION.

Machine learning solves the best-fit problem and small sample sizes but brings its own challenges. One is finding comparable datasets. Self-driving cars are improving because researchers are now using urban environments rather than the suburbs, parking lots, and contained environments of the early models. In an investment setting, computers that were set free to act based on learning from the actions of others—even the best people on staff—could have notorious errors of omission as well as commission. “If one just models current staff and learns from that, the repetition could run to mediocrity with no new inputs,” says Levy. “However, if someone is going to do it, [Bridgewater] certainly has the right people to start with.”

Indeed, in 2013, Bridgewater hired David Ferrucci away from IBM, where he led teams for semantic analysis and integration for the Watson project. This move might provide some clues as to what Bridgewater has planned next for its use of big-data measurements beyond hiring for a good fit.

An even bigger concern than finding the right datasets is that machines can’t move beyond the biases built into the decision criteria of the program. Applications of AI notoriously reflect the biases of subject groups. Even emotional or cognitive biases detected in the ground-truth data could undermine all processes. According to

Dan Ariely, professor of psychology and behavioral economics at Duke University and author of the seminal book *Predictably Irrational*, technology is often applied to take advantage of some of our biggest weaknesses—such as the addictive, feel-good stimulus of having “likes” or fulfilled friend requests on social media.

PARENTAL GUIDANCE SUGGESTED

Could a system be created for all business decisions, one with behavior more mature than the drunken and disorderly actions of investment algorithms? Computers, left to their own devices, have made the public credit and stock markets look like a wild weekend at a casino resort. We’ve seen algorithms go wild and create havoc many times: the Crash of ’87 index futures, high-frequency-trading flash crashes, and collateralized debt obligations. Can AI actually be intelligent?

This concern is held by many scientists and technology leaders, including Stephen Hawking, Elon Musk, and Bill Gates, and is being addressed by companies in the business of AI. For one, DeepMind, the London-based AI lab, is renowned for its work in the field. When Google purchased the firm in 2014, the news at the time alternated between the price paid for the company and fears about what the deep-learning technology could do to the world in the hands of Google. Reportedly, DeepMind is also concerned and “has made a number of hires as part of an effort to mitigate the chance of its artificial intelligence developing into something dangerous,” according to *Business Insider* and other sources.

In machine learning, the terminology bespeaks a sort of parental role. Models that search massive datasets for predetermined relationships are called supervised models, whereas those looking for patterns in human mental and emotional processes are called unsupervised models.

Maybe a next step in the “computer versus human” saga is for the fintech industry and the experts to create a list much like Faber’s “Million-Dollar Fintech Opportunities” series. Of his original list (public alts newsletter, quant back-tester, tax harvesting, investment research boutique focused on private crowdfund companies, and investment newsletter focused on best ideas), three of the five have been addressed by multiple providers. The new list might be called “\$78 Trillion Fintech Opportunities” and might list ideas that can generate massive wealth without threatening the entire worldwide GDP at the same time.

As in other industries, when it comes to computers versus humans in finance, computers are winning out for many jobs, and the humans being replaced will have to retool their skillsets to be employable. But the behavioral side of the equation can’t be neglected and will still be critical to

success. Firm leaders who figure out how to combine phi with new technology will presumably be the winners of the game.

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KEEP GOING

“Why Phi?” *CFA Institute Magazine* (March 2017) [www.cfapubs.org]

“The Decision Code,” *CFA Institute Magazine* (May/June 2013) [www.cfapubs.org]