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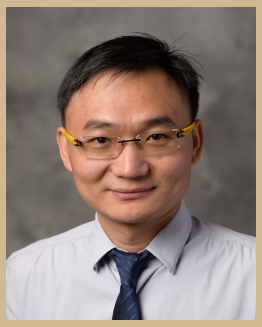

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Driving Data: The cost and benefits of usage-based auto insurance

by Eric Nelson

Having a technological device collect data on your every turn, stop and driving maneuver may be annoying, but new research from Krannert School of Management's Professor Ting Zhu and colleagues at the University of British Columbia (UBC) shows that people's driving techniques may actually improve when they know their insurance company is watching. Companies across a broad spectrum of industries are increasingly using new technologies based on real-time consumer data to increase their business productivity," Zhu explains. "In the highly competitive auto insurance industry, for example, insurers are trying to more precisely predict risks, sharpen pricing strategies and provide better value to their customers.

"Sensor Data and Behavioral Tracking: Does Usage-Based Auto Insurance Benefit Drivers?" is available at https://doi.org/10.1287/mksc.2018.1126.

Source: Ting Zhu

As the price of sensors and communication devices continues to fall, and as the value of sensor-based information is more evident, usage-based insurance is becoming a popular alternative to traditional automobile insurance. With usage-based insurance, or UBI, a telematics device is installed in your car that records such details as how far you drive every day, where you drive, and how quickly you accelerate, brake or make turns. Insurance companies use this information to adapt their rates accordingly, offering lower premiums to better drivers. The research examines if and how people change their driving behavior after adopting this new form of insurance.

Using data from a major U.S. auto insurance company collected on new customers in 15 states, the researchers observed UBI subscribers' driving behavior over varying periods and found that those who use telematics reduced the number of hard brakes and improved their overall UBI score. "Women in particular seem more likely to respond to the knowledge that their insurance rates will increase as a result of their bad habits and change their behavior accordingly," the researchers say. "Young drivers also benefited from the device."

According to Strategy Meets Action, a strategic advisory services firm in the insurance industry, more than one in three auto insurance carriers are expected to use telematics UBI by 2020. Given the ongoing data breaches in companies representing nearly industry, however, some consumers might be wary of trading their privacy for an insurance discount. Because it is typically a voluntary option on most policies, however, drivers with privacy concerns won't be likely to install a telematics device. Ultimately, the tradeoff for those who rely on UBI includes the benefits of being encouraged to drive more safely, which ultimately results in fewer accidents.

"We find evidence that negative feedback and economic incentives correlate with greater improvement in driving behavior," Zhu says. "This suggests that by sharing private consumer information with the insurer, UBI can benefit consumers who become better drivers, as well as society from improved road safety." Still, she cautions, showing a direct personal benefit of revealing private information in a large-scale setting is novel at best. "The data is so rich," Zhu says. "Further examination of the impact of privacy concerns on participation in such monitoring programs is clearly needed."

How can we make sure that algorithms are fair?

THE CONVERSATION
by Karthik Kannan

Using machines to augment human activity is nothing new. Egyptian hieroglyphs show the use of horse-drawn carriages even before 300 B.C. Ancient Indian literature such as "Silapadikaram" has described animals being used for farming. And one glance outside shows that today people use motorized vehicles to get around. Where in the past human beings have augmented ourselves in physical ways, now the nature of augmentation also is more intelligent. Again, all one needs to do is look to cars – engineers are seemingly on the cusp of self-driving cars guided by artificial intelligence. Other devices are in various stages of becoming more intelligent. Along the way, interactions between people and machines are changing.

Source: https://theconversation.com/how-can-we-make-sure-that-algorithms-are-fair-122994

Machine and human intelligences bring different strengths to the table. Researchers like me are working to understand how algorithms can complement human skills while at the same time minimizing the liabilities of relying on machine intelligence. As a machine learning expert, I predict there will soon be a new balance between human and machine intelligence, a shift that humanity hasn't encountered before. Such changes often elicit fear of the unknown, and in this case, one of the unknowns is how machines make decisions. This is especially so when it comes to fairness. Can machines be fair in a way that people understand?

When people are illogical

To humans, fairness is often at the heart of a good decision. Decision-making tends to rely on both the emotional and rational centers of our brains, what Nobel laureate Daniel Kahneman calls System 1 and System 2 thinking. Decision theorists believe that the emotional centers of the brain have been quite well developed across the ages, while brain areas involved in rational or logical thinking evolved more recently. The rational and logical part of the brain, what Kahneman calls System 2, has given humans an advantage over other species. However, because System 2 was more recently developed, human decision-making is often buggy. This is why many decisions are illogical, inconsistent and suboptimal.

For example, preference reversal is a well-known yet illogical phenomenon that people exhibit: In it, a person who prefers choice A over B and B over C does not necessarily prefer A over C. Or consider that researchers have found that criminal court judges tend to be more lenient with parole decisions right after lunch breaks than at the close of the day. Part of the problem is that our brains have trouble precisely computing probabilities without appropriate training. We often use irrelevant information or are influenced by extraneous factors. This is where machine intelligence can be helpful.

Machines are logical…to a fault

Well-designed machine intelligence can be consistent and useful in making optimal decisions. By their nature, they can be logical in the mathematical sense – they simply don't stray from the program's instruction.

In a well-designed machine-learning algorithm, one would not encounter the illogical preference reversals that people frequently exhibit, for example. Within margins of statistical errors, the decisions from machine intelligence are consistent. The problem is that machine intelligence is not always well designed. As algorithms become more powerful and are incorporated into more parts of life, scientists like me expect this new world, one with a different balance between machine and human intelligence, to be the norm of the future.

Judges' rulings about parole can come down to what the computer program advises. In the criminal justice system, judges use algorithms during parole decisions to calculate recidivism risks. In theory, this practice could overcome any bias introduced by lunch breaks or exhaustion at the end of the day. Yet when journalists from ProPublica conducted an investigation, they found these algorithms were unfair: white men with prior armed robbery convictions were rated as lower risk than African American females who were convicted of misdemeanors. There are many more such examples of machine learning algorithms later found to be unfair, including Amazon and its recruiting and Google's image labeling.

Researchers have been aware of these problems and have worked to impose restrictions that ensure fairness from the outset. For example, an algorithm called CB (color blind) imposes the restriction that any discriminating variables, such as race or gender, should not be used in predicting the outcomes. Another, called DP (demographic parity), ensures that groups are proportionally fair. In other words, the proportion of the group receiving a positive outcome is equal or fair across both the discriminating and nondiscriminating groups.

Researchers and policymakers are starting to take up the mantle. IBM has open-sourced many of their algorithms and released them under the "AI Fairness 360" banner. And the National Science Foundation recently accepted proposals from scientists who want to bolster the research foundation that underpins fairness in AI.

Improving the fairness of machines' decisions

I believe that existing fair machine algorithms are weak in many ways. This weakness often stems from the criteria used to ensure fairness. Most algorithms that impose "fairness restriction" such as demographic parity (DP) and color blindness (CB) are focused on ensuring fairness at the outcome level. If there are two people from different subpopulations, the imposed restrictions ensure that the outcome of their decisions is consistent across the groups. Beyond just the inputs and the outputs, algorithm designers need to take into account how groups will change their behavior to adapt to the algorithm.

While this is a good first step, researchers need to look beyond the outcomes alone and focus on the process as well. For instance, when an algorithm is used, the subpopulations that are affected will naturally change their efforts in response. Those changes need to be taken into account, too. Because they have not been taken into account, my colleagues and I focus on what we call "best response fairness."

If the subpopulations are inherently similar, their effort level to achieve the same outcome should also be the same even after the algorithm is implemented. This simple definition of best response fairness is not met by DP- and CB-based algorithms. For example, DP requires the positive rates to be equal even if one of the subpopulations does not put in effort. In other words, people in one subpopulation would have to work significantly harder to achieve the same outcome. While a DP-based algorithm would consider it fair – after all, both subpopulations achieved the same outcome – most humans would not.

There is another fairness restriction known as equalized odds (EO) which satisfies the notion of best response fairness – it ensures fairness even if you take into account the response of the subpopulations. However, to impose the restriction, the algorithm needs to know the discriminating variables (say, black/white), and it will end up setting explicitly different thresholds for subpopulations – so, the thresholds will be explicitly different for white and black parole candidates.

While that would help increase fairness of outcomes, such a procedure may violate the notion of equal treatment required by the Civil Rights Act of 1964. For this reason, a California Law Review article has urged policymakers to amend the legislation so that fair algorithms that utilize this approach can be used without potential legal repercussion.

These constraints motivate my colleagues and me to develop an algorithm that is not only “best response fair” but also does not explicitly use discriminating variables. We demonstrate the performance of our algorithms theoretically using simulated data sets and real sample data sets from the web. When we tested our algorithms with the widely used sample data sets, we were surprised at how well they performed relative to open-source algorithms assembled by IBM.

Our work suggests that, despite the challenges, machines and algorithms will continue to be useful to humans – for physical jobs as well as knowledge jobs. We must remain vigilant that any decisions made by algorithms are fair, and it is imperative that everyone understands their limitations. If we can do that, then it’s possible that human and machine intelligence will complement each other in valuable ways.

E-Waste Recycling Through a Business Lens:

The Ethics and Economics of Recycling Standards

by August Lynne Reed

A game theoretic model shows how recyclers choose to process their recycling when in competition with other recyclers and used-product markets and how their choices affect the quantity and profitability of e-waste recycling.

The year is 2022, and I have finally fulfilled my perennial resolution to do something with the old cell phones and laptop packed tightly into a corner of my closet—in the end, I drive them to a local electronics-waste collector. In two months, my donated laptop is regularly used by schoolchildren hurriedly shuffling into a computer center in the urban Mexican neighborhood,

Source:
Gokce Esenduran

Gökçe Esenduran, Minyue Jin, Wenli Xiao, and Yen-Ting Lin,. "Choice of E-Waste Recycling Standard Under Recovery Channel Competition," SSRN (2018): 1–32.

Nezahualcoyotl, to do their homework. In another Mexican neighborhood, children playing in a schoolyard run, stand, and sit on ground contaminated by lead from a nearby e-waste plant where my cell phones were exported for recycling.

According to Assistant Professor of Purdue's Krannert School of Management, Gökçe Esenduran, many American electronic-waste (e-waste) products--such as cell phones, laptops, and computers--go on to provide technological access as second-hand goods to populations who, otherwise, would be unable to afford them. Unfortunately, when exported e-waste products are not resold, they are often recycled in a growing number of unregulated recycling facilities. Esenduran explains that people in developing countries try to burn these electronics to extract their valuable metals such as silver, gold, and lanthanum. In the process, community residents are exposed to dangerous materials such as lead, mercury, arsenic, and cadmium through direct contact and through soil and water pollution resulting from their improper storage. The above hypothetical is often a reality in many Mexican, Indian, and Chinese neighborhoods where American electronics are exported and often deconstructed in dangerous conditions.

Where and Why Recycle

While many individuals and households prioritize responsible recycling because of environmental concerns, they have little knowledge about where their donated recyclables go after dropping them off. The recycler's choice of standard certification is a key determining factor in who handles e-waste, how it is handled, and where it ends up. A certification from one of the two American standards, E-Stewards and Responsible Recycling, verifies that recycling facilities are operating according to responsible recycling practices. Uniquely, E-Stewards is the single American e-waste standard that forbids openly shredding, incinerating, and exporting hazardous materials. In this way, E-Stewards ensures that non-functioning and hazardous materials are not exported to developing countries where regulations do not guarantee proper treatment and safe working conditions.

Although recent studies have tracked the final destinations of e-waste (locating it in places such as China, Ghana, and Africa) and analyzed the profitability of e-waste exportation and resale, little information was known about how competition affects which standard (or recycling practices) a recycler will adopt--inevitably influencing whether e-waste is recycled or resold in domestic

or foreign markets (e.g. Craigslist and Ebay) and facilities. In their research, Dr. Esenduran and her coauthors explore, not where e-waste products end up, but why they end up where they do. Specifically, their research offers insights into why and when recycling facilities process their waste responsibly and how market variables affect the e-waste industry. Moreover, her research analyzes the overall environmental benefit of each standard choice.

A Global Game of Economics

At first, the decision between these two standards may appear to be a question of ethics. Dr. Esenduran and her coauthors, Yen-Ting Lin, Wenli Xiao, Minyue Jin, explain in their article, "Choice of E-Waste Recycling Standard Under Recovery Channel Competition," that the E-Stewards standard is supported by many environmentalists, NGOs, governmental agencies, environmentally-conscious donors, and corporations (such as Boeing, Nestle, Samsung, and Wells Fargo), because of its more rigorous requirements and the potential benefit to their image gained from demonstrating environmental concern. However, in communicating with recyclers, Esenduran and her coauthors discovered that most base their decisions, not on environmental impact, but on cost and market analyses.

Recyclers who choose E-Stewards' suffer an increase in operating costs (due to the more rigorous regulations) but draw more e-waste from eco-conscious collectors and donors, thereby increasing their revenues. Recyclers weigh the gain in revenue against the increase in cost. In doing so, recyclers must also account for market variables such as e-waste supply, number of eco-conscious donors, demand for used products in the secondary market, and--most notably--competition. Esenduran and her coauthors' game theoretic model shows that a recyclers choice of standard can be predicted based on the type of competition they face.

Most recyclers obtain their e-waste from collectors (those who run e-waste pick-up and drop-off services, acting as middlemen between donors and recyclers) rather than collecting themselves. There are two types of competition that arise from this. If there are multiple collectors in one market, collectors may need to compete with other collectors to buy and sell their e-waste. If there is a secondary market (such as Craigslist) available to the collector, the collector may resell some of their e-waste as refurbished products rather than selling it all to the recycler. Because of this, some recyclers must compete with secondary markets. This is common as many electronics gain a higher price as used products than as recycling materials.

Responsible Recycling: Profits Made

This connection between competition and standard choice raised new questions for Esenduran and her coauthors. Under what type of competition is E-Stewards certification profitable for recyclers? And how do collectors allocate electronics between secondary markets and recyclers to maximize their profits? By posing the dynamic between collectors and recyclers as a Stackelberg game, they were able to develop a model that predicts how collectors allocate their e-waste and how recyclers select a standard under various market conditions.

Esenduran's model is based on data collected on recyclers' choices of standards in these various market conditions. It further explores the variables affecting this choice. For example, when there is only one recycler in the market, donors will give all of the unwanted, used items to the single recycler--out of necessity--regardless of standard choice. Because the recycler will not gain an economic advantage by adopting E-Stewards in this context, they always choose the cheaper standard (Responsible Recycling).

In another scenario outlined by Esenduran, recyclers compete against each other, but there is no secondary market drawing away any of the collectors' e-waste. Whenever a recycler is competing with another, there are two factors which determine its standard choice: the standard choice of the competing recycler and the cost advantage or disadvantage of selecting the same or opposite standard. Facilities can maximize their profits--in this scenario--by both selecting the cheaper standard, Responsible Recycling, when it is significantly cheaper than the alternative standard, E-Stewards.

Opposing Sides: How to Adopt or Argue Against E-Waste Recycling Regulations

Most surprising are the strategic, and sometimes counterintuitive, decisions recyclers make when competing with other recyclers and secondary markets for collectors' e-waste. These choices provide valuable insights for policymakers attempting to steer recyclers toward a certain standard. Alternatively, Esenduran and her coauthors' research also provides evidence for recyclers arguing against regulations which are economically--and sometimes environmentally--harmful.

For example, their analysis reveals that competing recyclers will choose E-Stewards in the presence of secondary market competition when two things

happen: E-Stewards greatly increases their unit cost (the cost to process an individual recyclable unit), but this cost increase is partially offset by the recyclers' abilities to cheaply process volumes of e-waste. This is because, if one of them were to adopt Responsible Recycling, they would receive less e-waste from eco-conscious collectors. This decrease in e-waste is not worth it when they can cheaply process large quantities of electronics. Alternatively, recyclers that are not able to offer collectors higher wholesale prices (perhapsbecause they do not have advanced technology which lowers their operating costs), choose E-Stewards when it does not greatly increase operating costs. Esenduran finds that in the second scenario, policymakers could encourage recyclers to adopt E-Stewards by paying for the increase in cost. However, this would not be beneficial if they are already able to offset this cost increase themselves.

Esenduran and her coauthors also detail other policies would be economically and/or environmentally beneficial. In their research, they also explain the implications of operation and certification costs on the profits of and prices set by collectors and recyclers.

The Bottom Line

In Esenduran's research, she examines the decisions made by recyclers and collectors to maximize their profits. These pricing and allocation choices are largely dependent upon competition. So far, it has seemed that the competition is won through economic-mindedness. However, successful recyclers must increasingly appeal to the public's desire for responsible handling as the public becomes more attentive to how and where their electronics are recycled. Contrastingly, in the early 2000s, e-waste remanufacturing and recycling had not yet reached the public sphere of concern. Moreover, these fields of research were still in their early stages; and it was at this time that Esenduran first began her study of them.

She was pursuing her MS in Industrial Engineering in Istanbul when she happened upon the research of Professor Jayashankar Swaminathan, a University of North Carolina professor in the Kenan-Flagler School of Business and a pioneer in the field of remanufacturing. He was one of the first researchers to publish on the topic of remanufacturing; and Esenduran, who had long since found, "the idea of maximizing profits alone, without thinking about the greater impact of the businesses, inadequate," was inspired to join him at UNC. Pursuing her PhD under his and Professor Eda Kemahlioglu-Ziya's

coadvisorship gave her the opportunity to continue her research of best practices for maximizing profits while also studying the environmental and societal impacts of these practices. She has since used her expertise in professorships at The Ohio State University and (currently) Purdue University and in the publication of over a dozen peer-reviewed articles in operations, supply chain management, and engineering journals. Her focus is often on business and the environmental impacts of related legislation.

While policymakers attempt to regulate the growing e-waste industry, the potential effects of policies upon recyclers practices sometimes remain obscure. Esenduran's research shows that recyclers and policymakers both need to be concerned about the unanticipated impacts of these policies when aiming for economic and environmental welfare. For example, her research shows that policymakers can increase E-Stewards adoption by increasing competition between recyclers. She writes that this could be accomplished through legislation making it easier for new recyclers to enter the market or legislation subsidizing the extra costs of E-Stewards certification. However, her findings on standard certification, reveal policies like this will have opposite effects depending on whether recyclers do or do not have the recycling machinery and methods necessary to cheaply process their e-waste. These policy results are also inverted in the presence and absence of secondary markets. Even more importantly, her research shows (through a modelling of life-cycle analysis) that pushing recyclers to adopt E-Stewards may actually be, overall, less environmentally beneficial.

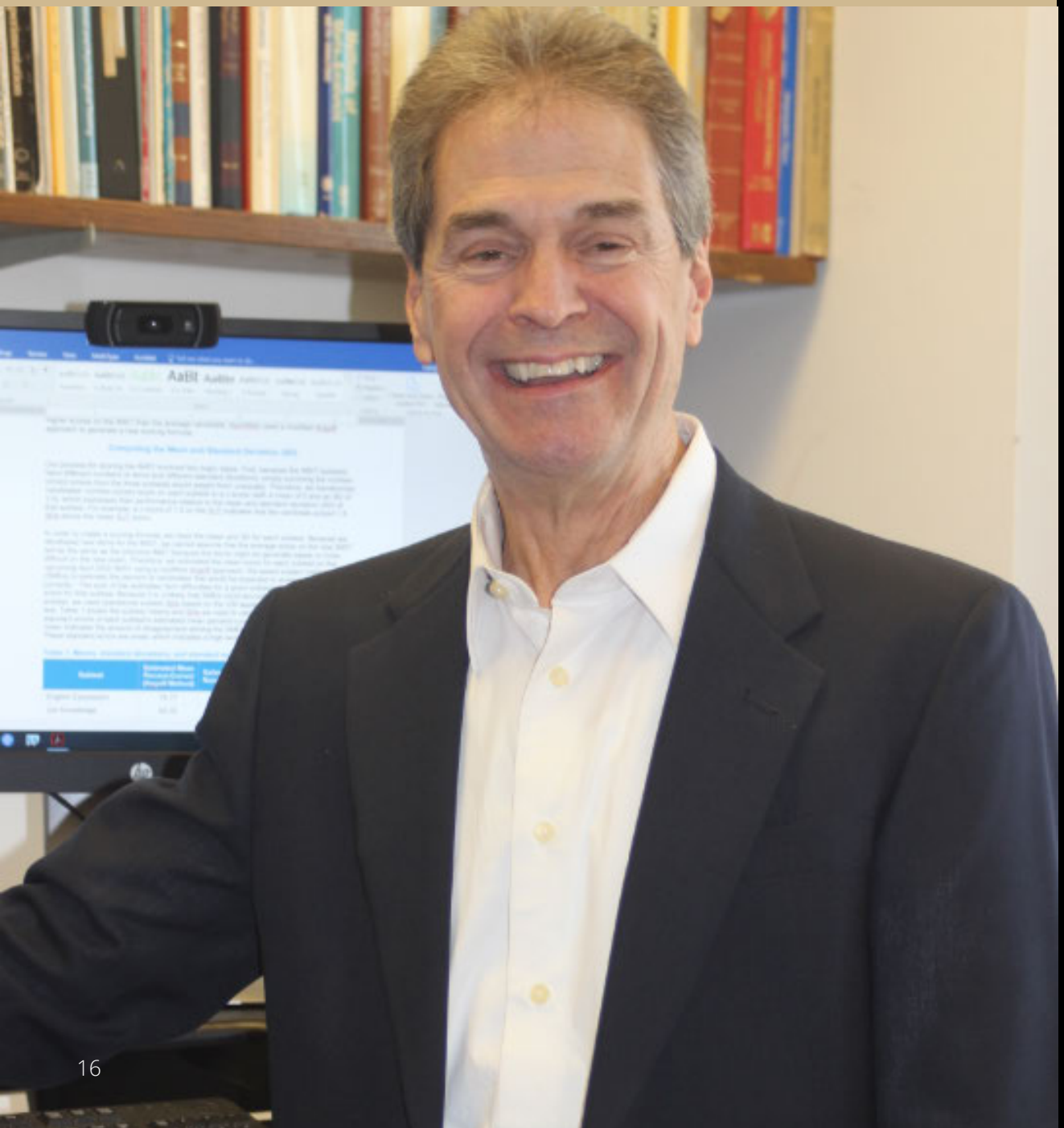
As the e-waste recycling industry continues to increase--at an expected rate of 20% annually--the potential dangers of unsafe recycling processes are becoming even more pressing. It remains a large concern as reports surface in growing numbers about the harmful effects of e-waste on the environment and the laborers and families who live and work beside it. Thankfully, these dangers are more readily understood and made public than in previous decades. Esenduran continues the progress toward understanding the e-waste industry by analyzing collectors' and recyclers' business decisions, their choice of standard and recycling practices, and the effects of these practices on the environment and public welfare. While debates continue over the best methods for protecting our environment--and simultaneously, the public's economic welfare--it is notable that one person's concern about larger environmental and human impacts lead to this collaboration, understanding, and advancement.

When Employees Make Changes to Their Jobs, it Often Benefits Employers

by Eric Nelson

An employee of an animal nutrition company sets personal deadlines a week ahead of actual deadlines to reduce stress. A credit union employee deals with stress by telling jokes and laughing with other employees. An information technology worker takes a walk and listens to music when problems arise.

These are some of the many ways that employees make changes to their jobs, as revealed in interviews conducted for a Purdue University study. The practice is known as job crafting, adjustments employees make to help them cope with work demands and improve their performance and well-being. "More



Source:
Mike Campion

Bruning, P.F. & Campion, M.A. (2018). A role-resource approach--avoidance model of job crafting: A multi-method integration and extension of Job Crafting Theory. *Academy of Management Journal*, 61.

often than not, it's good for the company, but sometimes it's not," said Michael A. Campion, professor of management at Purdue's Krannert School of Management.

Campion and his co-researcher, Patrick F. Bruning of University of New Brunswick at Fredericton, have developed a taxonomy of job crafting that includes seven types of crafting and is based on whether employees approach (are motivated toward) roles and resources or avoid them. "One of the interesting things is people craft to both improve their productivity and also to reduce their personal cost of working, their stress of working, and they do that in a range of different ways," Campion said. "Sometimes they try to reduce the workload themselves, or they try to get others to do work, or they don't participate, or they avoid certain people."

Bruning and Campion shared their findings on job crafting in a paper titled "A Role-Resource Approach-Avoidance Model of Job Crafting: A Multimethod Integration and Extension of Job Crafting Theory." Published in the April 2018 issue of the Academy of Management Journal, the paper was based on the dissertation research Bruning completed while earning his doctoral degree at Purdue. As part of the research, Bruning interviewed 196 employees and 50 supervisors in six industries, collecting 433 descriptions of job crafting activities. For a second study, he analyzed data from a nationwide survey of working adults.

The two studies helped the researchers identify the seven types of crafting in their taxonomy: work role expansion, social expansion, work role reduction, work organization, adoption, metacognition and withdrawal. "One way of crafting your job is mind control," Campion said, explaining the concept of metacognition. "You adjust your mind that your job has constraints that you must cope with, so you just understand what it is and adjust your attitude." Employees may tell themselves, for example, that "the organization is run by people who are not very capable," Campion said. "If I were the boss, I could do things differently, but I'm not. It's a good job anyway. I like what I do."

The researchers found that approach crafting generally produced more positive outcomes than avoidance crafting. But employees who expand their roles or adopt new resources aren't always doing so for the benefit of employers. "Many people get involved in a wide range of activities that they think are helping, but they're not," Campion said. "You as a manager really

would prefer someone to be focused totally on their own job and not be involved in other things." He cited the example of an employee who speaks up too often. "You don't need to have an opinion on everything. You might think you're adding value, but you're not. You're actually causing disharmony in the group." Likewise, avoiding roles and resources isn't always a detriment to employers. "People understand their limitations," Campion said. "Maybe adjusting your job scope to match what you can do well may not be such a bad idea."

It's important for employers to realize that job crafting occurs and to use it to benefit the organization as a whole, he said. One way to do this is to bring employees together – even from multiple locations of a company – to share best practices with each other. "People craft their jobs and they often find better ways of doing things," Campion said. "We should recognize that and try to use that for our mutual benefit." Employees should also realize that they can make changes to their jobs. "It's almost partially incumbent on them to do so," Campion said. "To be the most effective doesn't mean necessarily doing the work exactly as you were instructed."

Investor Protection and Asset Prices

by Melvin Durai

Buying stock in a company involves a certain amount of risk, but the risk can be considerably greater in countries with limited corporate governance and investor protection. In such countries, companies may have trouble attracting investors, and stock markets may languish.

Investor protection has been observed to affect the ownership stake of controlling shareholders, as well as stock prices and returns, said M. Deniz Yavuz, associate professor in Purdue's Krannert School of Management. Yavuz has conducted research that helps explain how this happens, using a dynamic asset pricing model that he developed with his collaborators, Suleyman Basak of London Business School and CEPR, and Georgy Chabakauri of London School of Economics.

Source:
Deniz Yavuz

Basak, S., Chabakauri, G., Yavuz, M.D., The Review of Financial Studies, Volume 32, Issue 12, December 2019, Pages 4905–4946, https://doi.org/10.1093/rfs/hhz038

In their research paper "Investor Protection and Asset Prices," which is forthcoming in The Review of Financial Studies, the researchers find that imperfect investor protection implies higher stock holdings by controlling shareholders, lower stock returns, higher stock return volatilities and lower interest rates. Investor protection discourages corporate theft, Yavuz said. He offers an example of how stealing can occur: If a shareholder owns controlling shares in two companies and if the companies do business with each other, the shareholder can get one company (the one in which he has a smaller ownership interest) to sell goods to the other company at a below market price. The controlling shareholder has thus transferred wealth to a company in which he has larger cash flow rights, which is called transfer pricing. Regulations that limit transfer pricing can protect minority shareholders and put a constraint on how much a controlling shareholder can steal.

The researchers' model not only incorporates such constraints, but also configures a shareholder's ability to steal as a function of the amount of control the shareholder exercises over the company. Previous theories have assumed that shareholders either have full control or no control, but Yavuz and his co-authors have considered the impact of varying degrees of control that are endogenously determined by the controlling shareholder’s shares. "If you have higher control rights than you can have more power over the firm," Yavuz said. "For example, you can assign a board member and force the CEO to do transactions you want.” The assumption is that having more power allows a shareholder to use more creative stealing mechanisms, Yavuz said. "So in some sense, it basically relaxes this constraint that's put on controlling shareholders by investor protection regulations."

However, two competing forces are at play. On one hand, a higher stock holding relaxes the investor protection constraint and allows the controlling shareholder to divert more, but on the other hand decreases his incentive to divert. That is because if the controlling shareholder’s cash flow rights are high, he would be stealing from himself, Yavuz said. If a controlling shareholder does not have absolute control over a firm, the shareholder will be motivated to acquire more shares when investor protection constraint binds. This allows the shareholder to collect not only the regular dividend that minority shareholders get, but also a second dividend in the form of stolen wealth.

"One prediction is that the control premium is going to be larger in countries with weaker investor protection and that's one of the main empirical findings,"

Yavuz said. As a result of higher incentive to exercise control over a firm, a controlling shareholder will even be willing to borrow money to invest in the company's stock and acquire a greater ownership stake. This higher demand by the controlling shareholder will cause the stock price to rise in equilibrium. If stock prices are higher and cash flows remain constant, expected returns will be lower, Yavuz said. "So we can explain why firms with better governance will provide higher returns – because they don't have this price appreciation due to demand from controlling shareholders." The authors can also explain that the equilibrium stock return volatility is higher with imperfect protection and exceeds the volatility of the fundamentals. Intuitively, leverage finances the acquisition of shares by the controlling shareholder when investor protection is low, and hence increases the sensitivity of the controlling shareholder's wealth to economic shocks, which translates into higher stock return volatility.

In addition, Yavuz and co-authors find that the risk-free interest rates decrease with lower protection due to two effects in equilibrium. First, because of low equity returns and high volatility, the minority shareholder turns to bond markets and is more willing to provide cheap credit. Second, the acquisition of shares by the controlling shareholder is partially covered by the diverted output, which moderates his demand for credit.The authors also find that most of the effects that they find interact with the consumption share of the minority shareholders. "This variable can be viewed as a proxy for income inequality and it is useful to explain why the effects of investor protection may be different across different countries," Yavuz said.

The authors also analyze how social norms in a society that promote fairness, honesty and morality could affect controlling shareholders incentive to steal and equilibrium outcomes. In contrast to the effect of investor protection, the effect of non-monetary cost on asset price dynamics is higher when minority investors' consumption share is low, namely when the controlling shareholder has a high stake in the firm and the investor protection constraint does not bind.

In summary, the dynamic accumulation of control and the ability of controlling shareholders to trade and rebalance their portfolios are new aspects of the authors' work which play a key role in determining the effects of investor protection on asset holdings and returns.

Researchers Develop New Network Model to Study Brain Development in Youth

by Melvin Durai

In social networking sites such as Facebook and Twitter, connections are made among people in a variety of ways. These connections, often seen as comments, 'likes' and other reactions to posts, are not static, but can change considerably over time. Many similar networks exist in social, physical and biological systems, giving researchers the challenge of modeling these networks to reflect their complexity. These models have progressed from showing static networks, where a single snapshot of each network is observed and modeled, to showing dynamic networks, which incorporate a sequence of snapshots of each network that evolves over time.

Source:
Wei Sun

Jingfei Zhang, Will Wei Sun & Lexin Li (2019), Mixed-Effect Time-Varying Network Model and Application in Brain Connectivity Analysis, *Journal of the American Statistical Association*, DOI: 10.1080/01621459.2019.1677242

A Purdue University statistician and his two co-authors have taken this modeling a step further, developing a new time-varying network model that allowed them to study brain development in youth and investigate how functional connectivity within the brain varies with age. "The functional connectivity over the brain regions will change when you grow up," said Will Wei Sun, assistant professor at the Krannert School of Management. "Some will become more active, some will become less active. So that's the motivation of the study."

Sun and his collaborators, Jingfei Zhang of Miami Herbert Business School at University of Miami and Lexin Li of UC Berkeley's School of Public Health, have developed a model that's able to handle multiple subjects in a continuous time setting. As a mixed-effect model, it can characterize not just the time-varying behavior of the network at the population level, but also individual subject variability. In a paper entitled "Mixed-Effect Time-Varying Network Model and Application in Brain Connectivity Analysis," published recently in the Journal of the American Statistical Association, the researchers described how they used their stochastic block model to study brain development in youth based on functional magnetic resonance imaging (fMRI).

Their data came from resting-state fMRI scans of 491 healthy subjects ranging in age from 7 to 20. Each image was preprocessed and summarized in the form of a network, with each node of the network corresponding to one of 264 seed regions of the brain. Links between pairs of nodes represented functional connectivity. The 264 regions were partitioned into 10 functional modules corresponding to the major resting-state networks, as previous research had defined. These modules (or communities of regions), including medial visual, cerebellum, sensorimotor and auditory, inspired the researchers' choice of a block model, as each module could be treated as a block. Using their model, the researchers were able to make a number of observations on functional connectivity as the brain develops from childhood to adolescence and then to early adulthood.

"We indeed found some interesting stories about brain connectivity patterns," Sun said. Looking at overall patterns of connectivity as a function of age, they found that connectivity within each community is greater than connectivity between communities, but the between-community connectivity grows stronger with age.Examining between-community connectivity patterns, they found that connectivity between the fourth community (default mode) and other communities increases with age. They also observed increased connectivity between the fifth community (cerebellum) and other communities; and low connectivity between the sixth community (sensorimeter) and other communities.

Also notable is that three communities involved with visual function (medial visual, occipital pole visual and lateral visual) show high between-community connectivity, even at young ages, and this connectivity gets stronger with age. This observation had not been reported before in scientific literature. Another new finding is that the ninth and tenth communities (frontoparietal right and left) show increased connectivity with the eighth community (executive control) with age.

Examining within-community connectivity patterns, they found that the fifth community (cerebellum) exhibits high within-community connectivity that does not change with time. In contrast, all other communities tend to increase within-community connectivity with age. Changes in within-community connectivity are particularly notable around age 9 and 10, and tend to stabilize around age 13. "In their late childhood and early adolescence, we see some sharp changes in the within-community connectivity," Sun said. "After age 13, the change is very mild. They are very stable after 13 years old. That captures the functional behavior growing over time." Though the researchers were motivated to develop their model to conduct the brain development study, the model can be applied to a range of network problems, including gene regulatory networks.

When Firms Do Business with Each Other: How They Protect Themselves Depends Partly on National Culture

by Melvin Durai

If a friend wants to stay in your home for a month while you're on vacation, you probably won't put anything down in writing. But if a stranger is staying in your home for a month, you may ask them to sign a document accepting responsibility for any damage that occurs while you're gone. It's not that you're exempting your friend from any obligation to pay for damages – it's just that you trust your friend to be honorable and do the right thing.

Source:
Fabrice Lumineau

Cao, Z., Li, Y., Jayaram, J. et al. A meta-analysis of the exchange hazards–interfirm governance relationship: An informal institutions perspective. J Int Bus Stud 49, 303–323 (2018). https://doi.org/10.1057/s41267-017-0144-2

Companies make similar considerations when doing business with each other. They can protect themselves through written contracts that define each company's obligations and rights, and include detailed clauses that address any uncertainties. They can also rely on mutual trust, values and norms."When a high level of mutual trust is present, cooperative firms have high expectations of each other," said Fabrice Lumineau, associate professor of strategic management at Purdue University's Krannert School of Management. "They are more likely to work towards mutual interests, rather than private interests."

Whether firms protect themselves through formal contracts (contractual governance) or mutual trust (relational governance) depends partly on national culture, according to a study by Lumineau and four co-researchers: Zhi Cao of University of Wisconsin-Madison; Yuan Li of Tongji University in Shanghai, China; Jayanth Jayaram of University of South Carolina; and Yi Liu of Shanghai Jiao Tong University. The researchers analyzed 167 articles involving 38,183 interfirm relationships in 35 countries and found evidence that three facets of national culture – collectivism, power distance, and uncertainty avoidance – influence the ways that companies protect themselves. Their research paper, entitled "A Meta-Analysis of the Exchange Hazards-Interfirm Governance Relationship: An Informal Institutions Perspective," was published in the April 2018 issue of the Journal of International Business Studies.

Companies have three main concerns when dealing with other companies: safeguarding investments specific to the relationship, adapting pre-specified agreements to environmental changes, and evaluating partners' performance. While many studies have shown that firms use detailed contracts to address these concerns – known as exchange hazards – other studies have shown a negative relationship between exchange hazards and contractual governance. The relationship between exchange hazards and relational governance is also inconsistent, leading Lumineau and his co-researchers to explore the context of the relationship and the moderating effect of national culture.

Through their analysis of the 38,183 interfirm relationships, the researchers found a positive but relatively small association between exchange hazards and both contractual and relational governance. "To our knowledge, this is the first study to conduct a meta-analysis of the relationship between exchange hazards and interfirm governance," Lumineau said. "Our findings highlight the

differences among different types of exchange hazards in their associations with interfirm governance." They found that a company's need to safeguard investments has a strong connection to contractual and relational governance, whereas environmental and behavioral uncertainty have little (or even negative) association with such governance. The three facets of national culture – collectivism, power distance, and uncertainty avoidance – moderate the exchange hazards-interfirm governance relationship in different ways, their research shows.

Contractual governance is less likely to be used to address exchange hazards in high collectivist countries such as China, where group cohesiveness and group goals are emphasized, as well as in countries with high levels of power distance such as Malaysia, where people are more willing to accept unequal distributions of power.

The study shows that national culture can have conflicting roles in influencing whether contractual and relational governance are used and how effective they are in reducing opportunism and improving performance. For example, while a previous study found that relational governance is more effective in reducing opportunism in higher uncertainty avoidance cultures, Lumineau and his co-researchers found that, in such cultures, firms are less likely to use relational governance to address exchange hazards. The study has important implications for managers who collaborate with other firms. The researchers encourage them to carefully consider the varying effects of the three facets of national culture." Based on those three, you can understand how you can develop governance mechanisms, depending on specific types of risk," Lumineau said.

Subjectivity in Financial Reporting: Does it Cause Auditors to Trust Managers More?

by Melvin Durai

Financial reports often contain estimates that rely partly on the judgement of managers. These subjective estimates can potentially be manipulated. A manager can inflate the value of a transaction to attract investors.

That's why the Public Company Accounting Oversight Board (PCAOB) has cautioned auditors to pay special attention to accounting estimates. It has criticized them for putting too much weight on managers' numbers and not relying enough on independent valuation specialists.

Source:
Rahul Menon

Kyungha (Kari) Lee and Rahul Menon (2019). The Effects of Subjectivity on Manager and Auditor Reporting. The Accounting Review: September 2019, Vol. 94, No. 5, pp. 273-295.

But is this criticism always valid? Not according to a study by Rahul Menon, assistant professor of accounting in Purdue University's Krannert School of Management, and Kyungha (Kari) Lee, assistant professor of accounting in Rutgers Business School. The study shows that, contrary to popular belief, it is optimal for an auditor to rely more on a manager's report when estimates are more subjective. In such circumstances, the auditor isn't necessarily choosing a lower audit quality. "Although they are relying more on management's estimates, that does not necessarily mean that they're slacking off," Menon said.

An economic model developed by Menon and Lee produced another notable finding: when subjectivity increases and an auditor relies more on a manager's report, the manager manipulates the report less. The researchers shared their findings in a paper titled "The Effects of Subjectivity on Manager and Auditor Reporting," published in the September 2019 issue of The Accounting Review. They note that fair value estimates have become increasingly common in financial reports, giving rise to two potential sources of uncertainty: inherent uncertainty about future events and uncertainty about the accuracy of the judgement used in determining estimates.

The researchers focus their study on the latter uncertainty, namely subjectivity, which increases significantly for certain types of estimates, such as fair values of mortgage-backed securities and other Level 3 assets. "That’s where auditors tend to have a lot of difficulties," Menon said. "When they're auditing big banks or financial institutions that have all these complex securities, auditors often have difficulty figuring out what should be the right model to estimate the value of a particular security." But even for such estimates, when auditors rely too heavily on managers' estimates, they open themselves to criticism from the PCOAB and others. Menon and Lee sought to determine if this criticism was fair.

"Perhaps when the PCAOB criticizes auditors for deficiencies in auditing fair values, maybe they're creating unreasonable demands on what can be expected from auditors," Menon said. "That was the underlying motivation." The researchers developed a model that examines the choices an auditor makes when verifying a subjective estimate and how these choices affect the manager's reporting decisions. In their model, the manager makes an investment and reports an estimate of the resulting cash flows, based on a private signal — information that can be used to make a prediction. The auditor obtains a separate report from a valuation specialist, who receives a different signal, but also views the manager's report. The auditor, who can

adjust the precision of the specialist's signal, aggregates the two reports to produce a final report that is released to investors, who react to the report.

Built into the model is the assumption that managers have better information about transactions that they generated. But managers may also have incentive to manipulate the estimate. "They might want to portray an optimistic picture of the securities they hold onto," Menon said. "The way to deter that is to have a verification of the management's estimate. That's why the auditor uses a valuation specialist." The model assumes that the auditor will rationally place some weight on the manager's numbers and some weight on the specialist's estimate. The auditor will also decide how precise an estimate to get from the specialist.

"One of the key things that we find is that as the estimate becomes more subjective the auditor will rationally respond by putting more weight on the management's numbers," Menon said. But that doesn't mean that the auditor is making less effort to get additional evidence from an independent specialist. "Both of these could be happening simultaneously: the auditor might be seeking a more precise estimate from the specialist while at the same time relying more on the management's numbers," Menon said.

So why doesn't the auditor put more weight on the specialist's numbers? Because subjectivity also affects the specialist's numbers. The specialist is supposed to consider the manager's numbers as well as the signal that the specialist receives, but as subjectivity increases, the specialist relies on the signal more. This affects the tradeoff that the auditor makes in determining how much weight to place on each report. "The auditor, by putting more weight on the management's estimate, is in some sense trying to unwind some of that overreliance that the specialist has on their own estimate," Menon said.

Although the manager anticipates that the auditor will rely more on the manager's numbers as subjectivity increases, the model shows that the manager is less inclined to manipulate the estimate. This is partly because the manager is concerned about the market's reaction to the audited report. When estimates are more subjective, investors are more skeptical and this curtails a manager's inclination to bias an estimate. "Biasing, we've assumed, is costly to the management," Menon said. "When you bias estimates, you are incurring risks. It's not for free. Given that you anticipate rationally that investors are going to be skeptical of whatever you say, you don't want to spend too much effort and cost in biasing these numbers."

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