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Research Spotlights

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Research Spotlights

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Motion Sensor–Based Fall Prevention for Senior Care: A Hidden Markov Model with Generative Adversarial Network Approach (p. 1)
Shuo Yu, Yidong Chai, Sagar Samtani, Hongyan Liu, Hsinchun Chen

Whereas modern medicine has enabled humans to live longer and more robust lives, recent years have seen a significant increase in chronic care costs. The prevention of threats to mobility is critical for chronic disease management. Researchers and physicians often analyze data from wearable motion sensor–based information systems (IS) to prevent falls. However, prior studies on fall prevention often achieve suboptimal performance because of their limited capacities in modeling data distributions. In this study, we adopt the computational design science paradigm to develop a novel fall prevention framework, which includes the hidden Markov model with generative adversarial network (HMM-GAN) that extracts temporal and sequential patterns from sensor signals and recognizes snippet states and a logistic regression that utilizes the snippet states and determines whether and when to trigger protective devices to prevent fall injuries. We evaluate the proposed framework against prevailing fall-prevention models and the HMM-GAN component against state-of-the-art sensor analytics models on large-scale data sets. Through an in-depth case study, we demonstrate how the proposed framework can lead to significantly reduced potentially catastrophic falls. Besides practical health information technology contributions, HMM-GAN offers methodological contributions to the IS knowledge base for scholars designing novel IT artifacts for healthcare applications.

Improving Convenience or Saving Face? An Empirical Analysis of the Use of Facial Recognition Payment Technology in Retail (p. 16)
Jia Gao, Ying Rong, Xin Tian, Yuliang Yao

Facial recognition (FR) payment technology has the potential to disrupt the offline retailing industry by automating the payment process. However, some firms that adopted FR payment technology have experienced only moderate success, and many customers have expressed frustration using FR payment technology. By utilizing data sets from three retail chains, we find that customers are less likely to use FR payment technology during self-checkouts when more customers are in line behind them, waiting and watching (the social presence effect), and when more preceding customers use the other payment technology (the herding effect). These findings imply that (1) the design of FR technology can be improved to alleviate the social presence effect (such as adding a privacy screen filter or beautify the appearance of the consumer's image), and (2) monetary incentives may be used to attract more users by leveraging the herding effect.

Business Value of Information Technology Capabilities: An Institutional Governance Perspective (p. 28)
Jessica Pye, Arun Rai, John Qi Dong

Situated in the U.S. electric utility industry in a period of significant market restructuring, our study investigates how market valuations of a firm's investments to develop intrafirm and interfirm information technology (IT) capabilities are conditional on regulatory context. We find that firms are rewarded by investing in intrafirm IT capabilities in a more deregulated context, and by investing in interfirm IT capabilities in a more uncertain regulatory context. When deregulation expands customer choice, intrafirm IT capabilities create value by enabling greater efficiency and service reliability through coordination of a firm's internal activities. When regulatory uncertainty increases for key aspects such as price control, value chain configuration, and information control, interfirm IT capabilities create value by enabling greater flexibility through reduction of external transaction costs with customers and suppliers. When allocating resources to develop IT capabilities, executives need to consider that market valuation of IT capabilities development is not static, but dynamic with changes in market structure and regulatory uncertainty. Regulators also need to consider that the regulatory context that they shape through their deliberations and decisions has a substantial impact on the market valuation of investments by firms to develop different types of IT capabilities.

Impact of Telehealth and Process Virtualization on Healthcare Utilization (p. 45)
Sezgin Ayabakan, Indranil R. Bardhan, Zhiqiang (Eric) Zheng

Telehealth has emerged as a tool to improve patient access by virtualizing healthcare services, particularly during the COVID-19 pandemic. However, concerns have been raised that telehealth may actually increase healthcare spending by leading to new types of utilization. Our research provides empirical evidence that this concern is unfounded based on a state-wide study of patient visit-level data of telehealth use in 58 hospitals in Maryland from 2012 to 2021. On average, telehealth use can reduce future outpatient visits by 13.6% within 30 days after a telehealth visit, leading to a cost reduction of $239. The benefits of telehealth are most apparent for diseases with high potential for process virtualization, such as mental health, skin disorders, metabolic, and musculoskeletal diseases. Although telehealth has a substitution effect on future healthcare utilization, this effect is not observed among rural patients who use telehealth as a gateway to utilize more primary care and specialist services. Our findings suggest that policymakers should promote the use of telehealth in a value-based healthcare environment by providing monetary incentives to expand telehealth use among patients and providers, and expand the scope of telehealth services to include consultation with specialists especially among rural patients.

Atrophy in Aging Systems: Evidence, Dynamics, and Antidote (p. 66)
Amrit Tiwana, Hani Safadi

Information systems age ungracefully. Once-modern systems aging into unmaintainable, buggy, meltdown-prone albatrosses is a widespread phenomenon that has received limited research attention. The received wisdom is that degenerative deterioration can be combated with refactoring or architectural improvements to their existing code. We conceptualize this phenomenon as *system atrophy*, and corroborate its existence by analyzing the code of over 1,300 systems as they underwent 19 million changes over 25 years. Such atrophy in systems has bread-and-butter consequences for organizations that rely on them. We show that it stunts the evolution of systems, makes them more bug-prone, and disengages developers. Atrophy in existing systems also makes it for organizations to implement other new systems because there are harder to integrate with them and cannibalize resources left over after their costlier upkeep. We then develop the idea that little increments in the modularity of their underlying code as a system evolves provide a powerful antidote to such atrophy. However, this antidote gradually loses its potency as a system ages further. Contrary to the popular belief, architectural improvements slow down atrophy but do not stop it. Our findings suggest that organizations must plan to eventually phase out these information systems, rather than just hoping to maintain them. For practice, we offer new insights on managing the tradeoff between evolution and atrophy; and how organizations can extract more useful life from aging systems.

The Effect of Gender Expectations and Physical Attractiveness on Discussion of Weakness in Online Professional Recommendations (p. 87)
Rohit Aggarwal, Vishal Midha, Nicholas Sullivan

Companies are using online professional networks at an increasing rate to find qualified candidates to interview for job openings. Although recommendations published on these sites can provide valuable information and influence hiring decisions, the information may suffer from credibility issues due to the medium by which it is shared. In this study, we investigate whether including a discussion of a candidate's weakness in a recommendation may be an effective way to increase the perceived credibility of the recommender and thereby improve the candidate's chance of receiving an interview. We surveyed hiring managers and recruiters to collect data to measure the impact different recommendations have on their decisions. Our findings show that including a discussion of weakness in a recommendation increases the perceived credibility of the recommender, which has a positive effect on the candidate's likelihood of being interviewed. However, when the discussion of weakness counters common gender-based expectations, it is harmful. When the discussion of weakness is consistent, it is helpful. Furthermore, we find that the physically attractive candidates (as shown in their profile picture) are harmed regardless of the weakness discussed. We investigate this further and find that additional discussion of the candidate's strengths can reduce the negative impact of the discussion of weakness, but only if the strengths are consistent with common gender-based expectations.

Effect of Online Professional Network Recommendations on the Likelihood of an Interview: A Field Study (p. 104)
Rohit Aggarwal, Vishal Midha, Nicholas Sullivan

Online professional networks (OPNs) are an increasingly common tool used by recruiters to find and vet qualified job candidates for open positions. These sites allow users to publish recommendations given by other users to supplement their profile information and add credibility to the information provided. OPN recommendations offer a rich source of information to recruiters. Unlike recommendations shared in other ways (non-OPN recommendations), OPN recommendations are publicly accessible, and candidates have complete control over which recommendations they

show to others. In this study, we investigate how recommendations may have a different effect when presented as an OPN recommendation versus a non-OPN recommendation. Furthermore, we explore how to improve the effectiveness of recommendations. We conducted a field study where we leveraged the candidate tracking system of a large recruitment firm to measure the varying impact recommendations have on recruiters' decisions. Our findings show that OPN and non-OPN recommendations that discuss an expected weakness positively affect a candidate's likelihood of being interviewed. In contrast, recommendations that discuss an unexpected weakness have a negative effect. Furthermore, we find that non-OPN recommendations with no discussion of weakness are significantly more effective than OPN recommendations with no discussion of weakness. We then show that the potential benefits of discussing an expected weakness are more pronounced for OPN recommendations, whereas the potential harm of discussing an unexpected weakness is more severe for non-OPN recommendations.

Smart Testing with Vaccination: A Bandit Algorithm for Active Sampling for Managing COVID-19 (p. 120)
Yingfei Wang, Inbal Yahav, Balaji Padmanabhan

This paper presents methods to proactively choose individuals to test for infection during a pandemic such as COVID-19, characterized by high contagion and presence of asymptomatic carriers. We show that by a smart integration of exploration/exploitation balancing, contact tracing, and location-based sampling, one can effectively mitigate the disease spread and significantly reduce the infection rates and death rates. Under different vaccination policies and under different compliance levels to quarantine order and/or testing requests, our smart testing algorithm can bring down the death rate significantly by 20% to 30%, as well as the percentage of infected drops by approximately 30%. The load on hospitals at peak times, a crucial aspect of managing COVID-19, drops, by 50% when implementing smart testing. We also show how procedural fairness can be incorporated into our method and present results that show that this can be done without hurting the effectiveness of the mitigation that can be achieved.

Shedding Light on the Dark: The Impact of Legal Enforcement on Darknet Transactions (p. 145)
Jason Chan, Shu He, Dandan Qiao, Andrew Whinston

Law enforcement bodies have largely responded to the increase in darknet activities through site shutdowns, which involve significant investment of policing resources. Despite these efforts, new darknet sites continue to show up after the site takedowns. We offer a new look at this issue by assessing the viability of selectively targeting large drug vendors operating on darknet sites. We find that the arrest of a major drug vendor reduced subsequent transaction levels by 39% and the number of remaining vendors by 56% on Silk Road 2.0. This deterrent effect also spilled over to drug vendors located in countries beyond the prosecutorial jurisdiction of the arrested vendor. We further find that small darknet drug vendors were most deterred by the arrest and vendors selling dangerous drugs were relatively more deterred. Our study findings hold policy-relevant implications to government agencies and law enforcement. Whereas site shutdowns can disrupt these markets momentarily, the selective targeting of large-scale drug vendors should be given serious consideration and used to a broader extent. The design of future enforcement strategies should also account for the finding that darknet markets are made up of both small-scale drug dealers new to the drug trade and large-scale drug syndicates.

The Influence of Media Capabilities on Knowledge Contribution in Online Communities (p. 165)
Gen-Yih Liao, Tzu-Ling Huang, Alan R. Dennis, Ching-I Teng

Online communities (OCs) have historically focused on building knowledge repositories, but as OCs add more synchronous communication, it is important to understand how different communication capabilities influence user commitment, individual growth, and knowledge contribution. We studied 452 members of a popular OC in Taiwan and found that both connectivity (direct user-to-user interaction) and communality (knowledge repositories) influence member commitment, but connectivity has a stronger influence than communality on knowledge contribution and individual growth. We also found that four media capabilities (transmission velocity, parallelism, symbol sets, and reprocessability) have strong influence on both connectivity and communality. These findings suggest that managers of OCs should add software capabilities that help OC members find like-minded members, enable instant messaging among members, and provide richer communication beyond simple text messages.

Interorganizational Systems and Supply Chain Agility in Uncertain Environments: The Mediation Role of Supply Chain Collaboration (p. 184)
Jingmei Zhou, Ting Xu, Yuchi Chiao, Yulin Fang

The economy is recovering in today's postpandemic phase, but uncertainties such as supply chain disruptions remain a top risk. Environmental uncertainty creates the need for swift supply chain adjustments in response to these external changes. Supply chain agility (SCA) has been recognized as a key capability for firms working to achieve superior performance in uncertain business environments. SCA is challenging to achieve, however, because it requires the firm and its supply

chain partners to collaborate closely yet flexibly across organizational boundaries. Considering interorganizational systems (IOS) have been widely deployed to establish digital connections across organizational boundaries, this study aims to explore to what extent and how IOS as boundary objects, characterized by standardization and adaptability, affect SCA under different levels of environmental uncertainty. This study provides guidance for information technology (IT) and business directors on how to achieve SCA through the design or implementation of IOS, provides guidance for business directors on how to invest more effectively to capture opportunities and deal with risks, and advises business and IT directors on how to respond appropriately to different levels of environmental uncertainty (e.g., IT directors should design adaptive IOS and business directors should invest in supply chain collaboration when environmental uncertainty is high).

Ontology-Based Information Extraction for Labeling Radical Online Content Using Distant Supervision (p. 203)
Ugochukwu Etudo, Victoria Y. Yoon

Social media companies dedicate significant resources to create machine-learning models to label harmful content on their platforms, including content promoting violent, extremist beliefs. These models have to evolve over time to keep up with a dynamic threat landscape. Over time, as new violent ideologies emerge, existing models will fail to detect them. Training fresh models for the task is risky (there are new model biases to understand), time consuming (you will need to see many examples to predict new examples), and cost-ineffective. We propose an approach that prioritizes the evolution and representation of radical ideas by creating a computer program to explicitly keep track of ideologies. We show how this program uses state-of-the art deep-learning models to create human and machine-readable representations of radical ideologies by automatically consuming content symbolic of those ideologies. Our approach validates the notion that violent ideologies differ in content but are homogenous in structure. With just a few examples of content, the program creates powerful representations that can be used to automatically detect additional content with surprising accuracy. This process greatly reduces the time and resources necessary to adapt existing content-labeling models to the changing ideological and rhetorical landscape.

Mirror, Mirror on the Wall: Algorithmic Assessments, Transparency, and Self-Fulfilling Prophecies (p. 226)
Kevin Bauer, Andrej Gill

Predictive algorithmic scores can significantly impact the lives of assessed individuals by shaping decisions of organizations and institutions that affect them, for example, influencing the hiring prospects of job applicants or the release of defendants on bail. To better protect people and provide them the opportunity to appeal their algorithmic assessments, data privacy advocates and regulators increasingly push for disclosing the scores and their use in decision-making processes to scored individuals. Although inherently important, the response of scored individuals to such algorithmic transparency is understudied. Inspired by psychological and economic theories of information processing, we aim to fill this gap. We conducted a comprehensive empirical study to explore how and why disclosing the use of algorithmic scoring processes to (involuntarily) scored individuals affects their behaviors. Our results provide strong evidence that the disclosure of fundamentally erroneous algorithmic scores evokes self-fulfilling prophecies that endogenously steer the behavior of scored individuals toward their assessment, enabling algorithms to help produce the world they predict. Our results emphasize that isolated transparency measures can have considerable side effects with noticeable implications for the development of automation bias, the occurrence of feedback loops, and the design of transparency regulations.

Personalized Privacy Preservation in Consumer Mobile Trajectories (p. 249)
Meghanath Macha, Natasha Zhang Foutz, Beibei Li, Anindya Ghose

The use of mobile technologies to collect and analyze consumer location data has created a multi-billion-dollar ecosystem with various stakeholders. However, this ecosystem also presents privacy risks to consumers. To address this issue, data aggregators can implement a privacy preserving framework that balances privacy risks to consumers with data utilities for advertisers. The proposed framework is personalized and flexible, allowing for quantification of personalized privacy risks and data obfuscation to reduce these risks. It can accommodate a variety of risks, utilities, and trade-offs between the two. The framework was validated on one million consumer location trajectories, revealing potential privacy risks in the absence of data obfuscation. Machine learning methods are used to demonstrate the effectiveness of the proposed framework which outperformed ten baselines from the latest literature, significantly reducing each consumer's privacy risk while preserving advertiser utility. As the use of location big data continues to grow, this research offers a necessary framework to balance privacy risks and data utilities, sustain a secure and self-governing ecosystem, and ensure the protection of consumers' personal data.

Better to Give Than to Receive: Impact of Adding a Donation Scheme to Reward-Based Crowdfunding Campaigns (p. 272)
Jason Chan, Zihong Huang, De Liu, Zhigang Cai

The choice funding scheme is an important design dimension in crowdfunding for which platforms should not assume that they are restricted to the use of one funding scheme. In particular, we find that the addition of a donation scheme can increase the success rate of reward campaigns substantially, especially those with prosocial causes. In addition, the donation received is found to have a crowd-in effect on subsequent contributions. To get the most out of donation schemes, crowdfunding sites should provide features that help backers locate reward campaigns for prosocial causes, for example, by providing tags or search filters related to prosocial causes. Second, campaign owners should take steps to highlight the prosocial aspects of their crowdfunding campaign, for example, by revising campaign descriptions to include prosocial keywords/tags. Third, campaign owners should play a more active role in encouraging early donations to enjoy the crowd-in effect that could help their campaigns reach the targeted funding amount. Specifically, the owner's direct social network is a potentially good source for soliciting these early donations. Relatedly, the campaign owners could benefit by spreading the word about the early donations they receive so as to generate a greater crowd-in effect at later phases of the crowdfunding process.

When Is More Merrier? A Cloud-Based Architecture to Procure Impressions from Multiple Ad Exchanges (p. 294)
Leila Hosseini, Shaojie Tang, Vijay Mookerjee

This study proposes a method to reduce the cost for acquiring impressions for location-based, mobile advertising firms. Such firms act on behalf of advertisers to execute mobile, in-app, ad campaigns. Ad space is sold on ad exchanges that auction impressions one-at-a-time, on a real-time basis. In this paper, we examine whether ad firms should work with one or multiple ad exchanges to minimize the total procurement cost (equal to the cost incurred to acquire impressions plus the computing cost). By working with more ad exchanges, the ad delivery firm can bid lower on each exchange and potentially save on the total procurement cost. However, ad exchanges typically require ad firms to spend a minimum amount on the exchange. Hence, it is not smart to work with an exchange but acquire very few impressions from this exchange. Working with multiple exchanges also incurs a higher computing cost, corresponding to the computing capacity needed to support the bidding architecture. We solve an optimization problem to determine the optimal number of ad exchanges to use to acquire impressions and the optimal bidding policy on each of these exchanges. We also propose a novel, selective bidding strategy where some bid requests are returned with a zero bid. That is, the ad firm deliberately passes on some opportunities to win impressions. Doing so reduces the computing cost (because returning a zero bid expends minimal computing resources). However, the firm needs to bid higher on other opportunities to meet its demand. We find the optimal selective bidding strategy in addition to the optimal number of ad exchanges and the optimal bidding strategy when non-zero bids are returned. Finally, we demonstrate our solution for a real ad firm (Cidewalk) where the firm is shown to reduce its total cost by 33% by working with multiple ad exchanges (instead of working with a single ad exchange) and the use of selective bidding (instead of returning a nonzero bid for every bid request).

Long-Range Social Influence in Phone Communication Networks on Offline Adoption Decisions (p. 318)
Yan Leng, Xiaowen Dong, Esteban Moro, Alex Pentland

We use high-resolution mobile phone data with geolocation information and propose a novel technical framework to study how social influence propagates within a phone communication network and affects the offline decision to attend a performance event. Our fine-grained data are based on the universe of phone calls made in a European country between January and July 2016. We isolate social influence from observed and latent homophily by taking advantage of the rich spatial-temporal information and the social interactions available from the longitudinal behavioral data. We find that influence stemming from phone communication is significant and persists up to four degrees of separation in the communication network. Building on this finding, we introduce a new "influence" centrality measure that captures the empirical pattern of influence decay over successive connections. A validation test shows that the average influence centrality of the adopters at the beginning of each observational period can strongly predict the number of eventual adopters and has a stronger predictive power than other prevailing centrality measures. Our centrality measure can be used to improve optimal seeding strategies in contexts with influence over phone calls, such as targeted or viral marketing campaigns.

Consumer Acquisition for Recommender Systems: A Theoretical Framework and Empirical Evaluations (p. 339)
Xuan Bi, Mochen Yang, Gediminas Adomavicius

How to acquire the most valuable consumers to grow your recommender system? We propose a dynamic consumer acquisition model to enable value-driven acquisition decisions. We build a model of consumer acquisition that takes into account the value that a

consumer contributes to the recommender system, the cost of their participation (e.g., privacy loss), and the value of their participation to other consumers (via network externality). We also propose data-driven procedures to estimate this model to enable informed, value-driven acquisition decisions. On three different data sets, we perform comprehensive simulation-based evaluations to demonstrate the performance of this dynamic consumer acquisition model. We find nuanced relationships between the firm's choice of incentive strategies and acquisition outcomes. Neither a constant pricing strategy nor a greedy pricing strategy may be optimal. Instead, under a moderately greedy strategy, where the firm only partially extracts the network externality from consumers, the dynamic acquisition sequence can outperform random acquisition sequences on firm utility, recommender system performance, and consumer surplus simultaneously. Our work contributes a novel theoretical framework, practical insights, and design artifacts to facilitate effective consumer acquisition in recommender systems.

Coordination in a Digital Platform Organization (p. 363)
Carmen Leong, Silvia Lin, Felix Tan, Jie Yu

The value of a digital platform (DP) can only be achieved through the coordinated actions of participating sides. Therefore, the question of how platform owners can coordinate multiple side actions is central. By positioning platform sides as part of the DP organization rather than viewing DP as a market or technological architecture, we highlight the differences in platform sides and how these differences must be acknowledged and managed as they are a source of misalignment among platform sides. Given that DP owners do not possess formal power over the sides (they are free to join other DPs simultaneously), our study demonstrates how a DP owner, in addition to putting in place structures to *enable* or *constrain* certain actions of platform sides, must also influence their narrowing of possibilities of action toward achieving coordinated actions. To the best of our knowledge, this study is the first to offer a process model of digital platform coordination that explains digital platform coordination in terms of the contextual conditions (when platform sides could enact their agency), the mechanisms of the platform sides' agency enactment and digital orienting (an expanded repertoire of actions in coordinating platform sides through technology), and the resultant outcome.

An Examination of the Dynamics of Crowdsourcing Contests: Role of Feedback Type (p. 394)
Pallab Sanyal, Shun Ye

As more businesses are turning to crowdsourcing platforms for solutions to business problems, determining how to manage the sourcing contests based on their objectives has become critically important. Aside from static design parameters, such as the reward, a lever organizations can use to dynamically steer contests toward desirable goals is the feedback offered to contestants during the contest. In this study, first, using the psychology literature on the theory of feedback intervention, we classify feedback into two types: outcome and process. Second, using data from almost 12,000 design contests, we empirically examine the effects of the two types of feedback on the convergence and diversity of submissions following feedback interventions. We find that process feedback, providing goal-oriented information to contestants, fosters convergent thinking, leading to submissions that are similar. Outcome feedback, on the other hand, encourages divergent thinking, producing a greater variety of solutions to a problem. Furthermore, the effects are strengthened when the feedback is provided earlier in the contest rather than later. Based on our findings, we offer insights on how practitioners can strategically use an appropriate form of feedback to either generate greater diversity of solutions or efficient convergence to an acceptable solution.

Task Characteristics and Incentives in Collaborative Problem Solving: Evidence from Three Field Experiments (p. 414)
Jayarajan Samuel, Zhiqiang (Eric) Zheng, Vijay Mookerjee

Effective teamwork is crucial in modern-day business, especially in knowledge work. However, building and maintaining effective teams is a challenging task for firms. Whereas previous literature emphasizes the significance of team composition, dynamics, and senior management's role, the role of task characteristics and incentive alignment in effective collaboration is largely ignored. Our study addresses this gap by identifying the importance of task characteristics and incentive alignment in successful collaboration. Through three large-scale field experiments, we find that tasks with high difficulty and urgency are suitable for collaboration, whereas collaboration can be detrimental to tasks that don't require urgent completion. We also find that aligning individual incentives with organizational goals is critical to successful collaboration. Our research offers practical guidance to organizations implementing information systems for collaborative problem solving. We suggest using task characteristics to determine the workflow that will benefit from a collaborative approach. Furthermore, we emphasize the importance of management's active involvement in aligning incentives between team members and the project or company's goals.