



Marketing Science

Publication details, including instructions for authors and subscription information:
<http://pubsonline.informs.org>

Frontiers: Machines vs. Humans: The Impact of Artificial Intelligence Chatbot Disclosure on Customer Purchases

Xueming Luo, Siliang Tong, Zheng Fang, Zhe Qu

To cite this article:

Xueming Luo, Siliang Tong, Zheng Fang, Zhe Qu (2019) Frontiers: Machines vs. Humans: The Impact of Artificial Intelligence Chatbot Disclosure on Customer Purchases. Marketing Science 38(6):937-947. <https://doi.org/10.1287/mksc.2019.1192>

Full terms and conditions of use: <https://pubsonline.informs.org/Publications/Librarians-Portal/PubsOnLine-Terms-and-Conditions>

This article may be used only for the purposes of research, teaching, and/or private study. Commercial use or systematic downloading (by robots or other automatic processes) is prohibited without explicit Publisher approval, unless otherwise noted. For more information, contact permissions@informs.org.

The Publisher does not warrant or guarantee the article's accuracy, completeness, merchantability, fitness for a particular purpose, or non-infringement. Descriptions of, or references to, products or publications, or inclusion of an advertisement in this article, neither constitutes nor implies a guarantee, endorsement, or support of claims made of that product, publication, or service.

Copyright © 2019, INFORMS

Please scroll down for article—it is on subsequent pages



With 12,500 members from nearly 90 countries, INFORMS is the largest international association of operations research (O.R.) and analytics professionals and students. INFORMS provides unique networking and learning opportunities for individual professionals, and organizations of all types and sizes, to better understand and use O.R. and analytics tools and methods to transform strategic visions and achieve better outcomes.


For more information on INFORMS, its publications, membership, or meetings visit <http://www.informs.org>

Frontiers: Machines vs. Humans: The Impact of Artificial Intelligence Chatbot Disclosure on Customer Purchases

Xueming Luo,^a Siliang Tong,^a Zheng Fang,^b Zhe Qu^c

^aFox School of Business, Temple University, Philadelphia, Pennsylvania 19122; ^bSichuan University, 610017 Chengdu, Sichuan, China;

^cFudan University, 20043 Shanghai, China

Contact: luoxm@temple.edu,  <http://orcid.org/0000-0002-5009-7854> (XL); tug76173@temple.edu (ST); 149281891@qq.com (ZF); quz@fudan.edu.cn (ZQ)

Received: March 1, 2019

Revised: May 12, 2019; June 8, 2019

Accepted: June 10, 2019

Published Online in Articles in Advance:
September 20, 2019

<https://doi.org/10.1287/mksc.2019.1192>

Copyright: © 2019 INFORMS

未揭露身份的聊天机器人在引导顾客购买方面和熟练的工人一样有效，比没有经验的工人效率高4倍；但在机器人和人对话之前揭露聊天机器人的身份会降低超过79.7%的购买率。

Abstract. Empowered by artificial intelligence (AI), chatbots are surging as new technologies with both **business potential** and **customer pushback**. This study exploits field experiment data on more than 6,200 customers who are randomized to receive highly structured **outbound sales** calls from chatbots or human workers. Results suggest that **undisclosed chatbots are as effective as proficient workers and four times more effective than inexperienced workers in engendering customer purchases**. However, a disclosure of chatbot identity before the machine–customer conversation reduces purchase rates by **more than 79.7%**. Additional analyses find that these results are robust to nonresponse bias and hang-ups, and the chatbot disclosure substantially decreases call length. Exploration of the mechanisms reveals that when customers know the conversational partner is not a human, they are **curt** and purchase less because they perceive the disclosed bot as less knowledgeable and less empathetic. The negative disclosure effect seems to be driven by a subjective human perception against machines, despite the objective competence of AI chatbots. Fortunately, such negative impact can be mitigated by a late disclosure timing strategy and customer prior AI experience. These findings offer useful implications for chatbot applications, customer targeting, and advertising in conversational commerce.

History: K. Sudhir served as the editor-in-chief and Puneet Manchanda served as associate editor for this article. This paper was accepted through the *Marketing Science*: Frontiers review process.

Funding: Z. Fang acknowledges the support from the National Natural Science Foundation of China [Grants 71172030, 71202138, 71472130, and 71522010], the Youth Foundation for Humanities and Social Sciences of the Ministry of Education of China [Grants 12YJC630045, 14YJA630024, and 14YJC630166], and Sichuan University [Grants skqy201423 and skqy201502]. Z. Qu acknowledges the Shanghai Philosophy and Social Science Plan [Grant 2017BGL019] and the National Science Foundation of China [91746302].

Supplemental Material: Data and the online appendix are available at <https://doi.org/10.1287/mksc.2019.1192>.

Keywords: artificial intelligence • chatbot • conversational commerce • new technology • disclosure

Introduction

Chatbots are a popular new technology with unprecedented business potential, **galvanized** by artificial intelligence (AI) and machine learning. Essentially, **AI chatbots are computer programs that simulate human conversations through voice commands or text chats and serve as virtual assistants to users**. Google Duplex, a groundbreaking application of AI chatbots, can make restaurant and haircut reservations over the phone, wherein people answering the call may not know they are engaging conversations with bots (Leviathan and Matias 2018).

The market size of chatbots is expanding quickly, from \$250 million in 2017 to more than \$1.34 billion in 2024 (Pise 2018). More than 21% of U.S. adults and more than 80% of Generation Z use voice/text bots for information search and shopping (Del Valle 2018). Many brands, such as American Eagle Outfitters and

Domino's Pizza, have rolled out chatbots to take orders or recommend products, and major platforms, such as Amazon, eBay, Facebook, and WeChat, have adopted chatbots for conversational commerce (Thompson 2018).

AI chatbots can provide several **unique business benefits**. First, they **automate customer services and facilitate firm-initiated communications**. Chatbots are equipped with sophisticated speech recognition and natural language-processing tools that enable them to understand complex and subtle dialogs and address consumer requests with depth, compassion, and even humor (Wilson et al. 2017). Moreover, **chatbots can converse in a friendly way with customers** because they don't have bad days and never get frustrated or tired like humans. **In addition, they can easily scale up to handle a large volume of customer communications for call center businesses**.

Despite such potential benefits for the supply side, a key challenge for AI chatbot applications is **customer pushback from the demand side** (Froehlich 2018). Customers may feel uncomfortable in talking with computer programs for personal needs or letting chatbots assist in purchase decisions. That is, humans may prejudice that chatbots lack personal feeling and empathy, perceiving bots as less trustworthy with payment information and product recommendations (i.e., the uncanny valley feelings and algorithm aversion in Dietvorst et al. (2018) and Kestenbaum (2018)).

Therefore, firms face a dilemma in disclosing the usage of AI chatbot technology to customers. On the one hand, if firms disclose the machine identity, they might not gain the full business value of AI chatbots because of customer pushback. On the other hand, customers have the right to know whether it is a bot or a human that handles their communications because of business ethics (Wise 2018). Moreover, regulators are increasingly concerned about customer privacy protection and have encouraged companies to be transparent on chatbot applications during customer communications (Federal Trade Commission 2017).

Against this backdrop, we collaborate with a large financial service company to conduct a randomized field experiment on chatbot disclosure. The company randomly assigned 6,255 customers to receive highly structured outbound sales calls from chatbots or human workers. A novel part of our experiment design is to vary the disclosure of chatbots (no disclosure, disclosure before conversation, disclosure after conversation, or disclosure after decision) as well as human expertise (proficient or inexperienced workers).¹ This allows us to test the causal impact of chatbot disclosure on customer purchases and compare the performance of chatbots and human workers in the six-condition experiment.

Our data suggest that undisclosed chatbots are as effective as proficient workers and four times more effective than inexperienced workers in engendering customer purchases. However, the disclosure of chatbot machine identity before conversation reduces purchase rates by more than 79.7%. Our results are robust to various falsification checks and additional analyses with nonresponse bias and hang-ups. Also, compared with the condition of no disclosure, disclosure before conversation substantially reduces the call length.

Next, we test the behavioral mechanisms by augmenting the field experiment with survey data and voice-mining of conversation records. The survey data support that, when customers know the conversational partner is not a human, they are brusque and purchase less because they perceive the disclosed bot as less knowledgeable and less empathetic. However, voice-mining of the objective conversation records suggests that the undisclosed chatbot is competent in

terms of knowledge and empathy. Thus, the negative chatbot disclosure effect seems to be driven by a subjective human perception against machines despite the objective competence of AI chatbots.

Moreover, we explore various ways to mitigate the negative effect of chatbot disclosure on customer purchases. We find that such negative impact can be allayed by a late disclosure timing strategy and customer prior AI experience.

Our research makes several contributions. It provides the first field experiment evidence for the business value of emerging AI technology and challenges of chatbot applications. Our field data and voice-mining approaches not only reveal the negative impact of chatbot disclosure on customer purchases, but they also shed light on the underlying mechanism. Our findings of the mitigated effects are nontrivial because they empower marketers to target certain customer segments for more optimal value of AI chatbot services. Also, brands can advertise the role of experiential learning so as to cultivate consumer trust in chatbots, that is, from aversion to appreciation of bots.

More broadly speaking, we extend the discussion about machines versus humans. Our data suggest that undisclosed chatbots that incur almost zero marginal costs can outperform the paid underdogs by five times in purchase rates. These findings imply that the potential replacement of underperforming human workers by AI chatbots and other new automation technologies is an inevitable trend. However, our results of the negative disclosure effect also imply that chatbots may not perfectly substitute human labors in the near future because of a subjective human perception against bots. These findings have useful implications for chatbot applications in conversational commerce. Indeed, motivated by our findings, the financial service company has taken actions to implement a human-AI assemblage strategy. AI chatbots assist call center workers, especially the underdogs, by analyzing customer queries and emotional stress with voice-mining and by displaying best answers from the depository of company knowledge bank as possible solutions to customer needs.

Related Literature on AI Applications and Text-Based Bots

Prior research has recognized the benefits of AI technologies across various fields. In finance, trading bots and robo-advisors can facilitate investors for stock analytics (Trippi and Turban 1993). AI applications can improve banks' operation efficiency, fraud detection, and asset management (Fethi and Pasiouras 2010). Studies in healthcare have explored how AI-powered algorithms can help doctors diagnose cancers (Esteva et al. 2017, Leachman and Merlino 2017). AI applications can reduce medical errors

本研究的贡献有3: 1. 为新兴AI技术的商业价值和聊天机器人的应用提供了实验证据。2. 不仅揭示了聊天机器人的身份会降低客户购买率还揭露了潜在的机制。

and improve hospital efficiency (Patel et al. 2009, Bennett and Hauser 2013). In marketing, Huang and Rust (2018) note that the future trend of AI applications hinges upon empathetic tasks that require computers to understand people's emotional status and respond appropriately with care and feeling. Leung et al. (2018) find that AI automation may be undesirable to consumers when the identity motives are important drivers of consumption. However, Logg et al. (2019) document that nonexperts appreciate algorithmic advice based on laboratory experiments. Prior research also discusses how AI and robots will replace the labor and work force (Brynjolfsson and Mitchell 2017, Lu et al. 2018). We extend this literature by providing real-world field experiment evidence for the negative impact of AI chatbot disclosure on customer purchases. We demonstrate the challenges of and harsh reactions to disclosed chatbots in outbound sales calls although the bots can simulate human conversations in an intelligent and empathetic manner.

Our work on voice-based chatbots is related to and extends the literature on text-based chatbots (e.g., Sivaramakrishnan et al. 2007, Köhler et al. 2011, Saad and Abida 2016, Mimoun et al. 2017). Compared with text-based bots, voice-based bots offer more **anthropomorphism** in the humanized computer representations and richer interaction data, such as voice pitch and tone beyond the narratives. Importantly, narratives only capture what is said but miss how it is said (e.g., do the conversation participants raise their voices suddenly, or is there a frustration tone?). Extending prior literature on text-based chatbots, our research involves voice-mining analytics that can provide **auditory cues** of the sentiment and intent of the conversation participants. Also, extending prior research with surveys or laboratory studies measuring soft outcomes, such as perceived fun and social presence, we conduct a field experiment addressing the **hard metrics** in terms of customer purchases. We further leverage deep learning methods of voice-mining and survey data to identify behavioral mechanisms that might account for the negative impact of disclosed bots on customer purchases.

Company Background and Experiment Settings

The randomized field experiment was conducted by a **major internet-based financial service company** in Asia (that wishes to be anonymous). In terms of types of business, this company offers various financial services, such as personal loans, **refinance**, and **equity investments**, to individual customers through its mobile app. Ranked among the top 20 in the Fin-tech internet loan industry, this multibillion-dollar company has more than 23 million registered customers.

Its customers are from all major provinces in the country (see Online Appendix C). In our experiment, the customers are borrowers who keep a high credit score and have successfully repaid their loans to the company in the past 11 months for the 12 monthly installments. Because only one repayment is left, there is a sales opportunity of loan renewal. Most loans are in the amount between USD \$800 to \$2,500 for the purposes of purchasing electronic products, such as smartphones, computers, and TVs. The company can assign chatbots or human workers in its call center to make the outbound sales calls. In order to boost responses, the service agents inform customers about a special promotional offer for renewing the loan. The promotion is a 24-hour limited-time offer to waive the regular loan application processing fees if the customer decides to renew the loan with the same terms (loan amount, interest, and installments). All the outbound sales calls occur on a Tuesday afternoon from 2 p.m. to 4 p.m. during working hours of the day, and most customers would be at their workplace rather than home.

The company implements a sophisticated voice AI chatbot in its call center to provide timely customer services and improve the operational efficiency with lower labor costs. Unlike traditional rule-based systems that only handle simple inquiries with pre-recorded messages, the voice chatbot can conduct live and natural conversations with customers. The AI chatbot here is trained with the company's call center voice data to emulate the best-performing human workers in terms of understanding financial loan product features and deploying adaptive selling strategies (Churchill et al. 1985) in serving customers over the phone. The chatbot is applied to make highly structured outbound sales calls because outbound calls have relatively standard conversation content for computers to handle. In the setting of structured outbound calls, without disclosure, customers would not realize the machine identity of the AI chatbot over the phone.² The chatbot in our experiment has an **optimized female voice**, that is, with the most appealing pitch, tone, speed, and intonation to capture customer attention. The company uses a female voice because there is no significant difference between optimized female and male voices in call performance during pilot tests. Indeed, most chatbots (e.g., Alexa) in the industry adopt a female voice. Next, we present the field experiment design.

Field Experiment Design

In the field experiment, the company randomly assigned customers to receive a sales call from either human agents or AI chatbots. Each customer receives only one call and is randomized into one of the six experimental conditions in a between-subject design.

Figure 1 (the top panel) presents the six conditions and sample sizes.

The first condition is *underdogs* in the call center, that is, *unseasoned human workers* whose past six-month call report performance is among the bottom 20th percentile. The second condition is *proficient workers*, that is, experienced human agents whose past performance is among the top 20th percentile. The third condition is *AI chatbot without disclosure*. In this group, the chatbot initiates the sales call without revealing its machine identity. For these three conditions, the agent starts the call with a greeting statement: “Dear customer, I am the service agent of the company XYZ” prior to communicating the promotional deal to the customers.

The fourth condition is *AI chatbot with disclosure before conversation*. Here, the chatbot reveals its machine identity at the beginning of the conversation with the customer. The disclosure of chatbot identity is a simple statement: “Dear customer, I am the AI voice chatbot of the company XYZ” prior to communicating the same promotional deal. The fifth condition is *AI chatbot with disclosure after conversation*. In this group, the chatbot does not reveal its machine identity (with the same statement as in the fourth condition) until after communicating the promotional deal to customers but right before they decide whether to purchase. The sixth and final condition is *AI chatbot with disclosure after decision*, wherein the chatbot reveals its machine identity (also with the same statement as in the fourth condition) right after customers decide whether to purchase.³

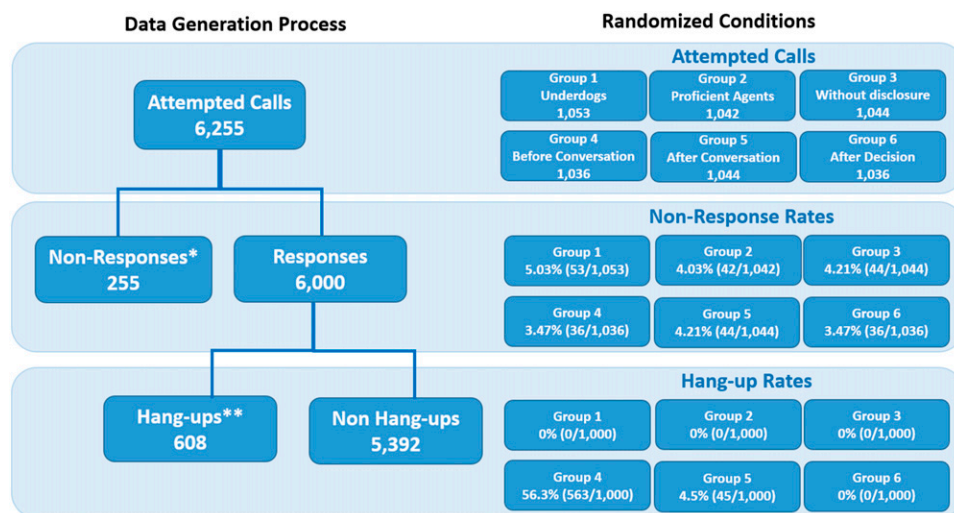
All service agents across the six conditions follow the same sales call procedure as shown in Online

Appendix A. Service agents first greet customers and appreciate their good repayment history before offering the special promotion deal over the phone. If customers are not interested, the agent tries to remedy the sales call by elaborating that the deal is designed for high-value customers and expires in 24 hours and by encouraging customers to review the promotion details on the mobile app.⁴ However, if customers are interested in the promotion, the agent asks follow-up questions about their changes in job as well as credit card balance. Customers are then asked to confirm whether to renew the loan. If customers agree to renew the loan, they need to log on to the mobile app to sign the documents (99% of the people who agreed to do so indeed followed through ultimately according to the company records). Examples of the call transcripts of the six experimental conditions can be found in Online Appendix B, and audio examples of the AI chatbot used in our experiment are available online. In the data, making a purchase means that customers agree to renew their loans during the promotion period with the financial service company.

Data and Randomization Check

Figure 1 shows that there are a total of 6,255 attempted customers who are called by service agents. Out of these, 255 are nonresponses (customers who may be too busy or have changed their contact numbers), and each condition has 1,000 responses to achieve the promotion goal with an automated replacement technique. Our *proprietary* data set includes rich information about the customers. Table 1 summarizes the descriptive statistics. According to

Figure 1. (Color online) Experiment Design and Data Generation Process.



*“Nonresponses” refer to the calls that were not answered by customers.

**“Hang-ups” refer to the calls that were answered by customers, but the customers were terse and terminated the calls within five seconds right after chatbot identity disclosure.

Table 1. Descriptive Statistics

Variables	Data type	Explanations	Min	Max	Mean	25th percentile	50th percentile	75th percentile	90th percentile
Gender	Binary	1 = male, 0 = female	0	1	0.774	1	1	1	1
Age	Integer	The actual age calculated based on ID card information	19	55	30.86	26	30	34	40
Education	Category	1 = middle school and below, 2 = high school, 3 = junior college or community college, 4 = undergraduate	1	5	2.671	2	3	3	4
Number of credit cards	Count	Number of eligible credit cards owned by the customer	1	8	1.26	1	1	1	2
Online loan inquiries	Count	Number of personal loan inquiries by the customer in the past 30 days	0	64	10	4	8	15	22
Loan amount	Integer	The loan amount repaid by the customer to the company (US\$)	142.857	2,857.143	2,017.049	1,285.714	2,142.857	2,857.143	2,857.143
Credit card spending	Continuous	Amount of credit card spending in the past 30 days (US\$)	0	82,855	1,843	122.509	611.363	1,906.558	4,522.721
Online spending	Continuous	Amount of online spending in the past 30 days (US\$)	0	7,415.617	107.337	11.938	36.206	92.347	227.716

our data, 77.4% of the customers are males with an average age of 30.86, and most of them have a high school or higher degree. The statistics also indicate that targeted customers tend to be young working professionals who frequently use credit cards and engage in online shopping. They have, on average, 1.26 credit cards, US\$1,843 credit card spending, and US\$107 online spending in the past 30 days as well as 10 online personal loan inquiries in the past 30 days. Their personal loan amount with the company is around US\$2,017. We conducted randomization checks with these background variables. The results in Table 2 suggest that there is no significant difference among these variables across the six experimental conditions according to *F*-test statistics. Thus, the data passed the randomization check.

Effects of Chatbot Disclosure on Customer Purchases

The model-free results based on the raw data across the six treatments in Table 3 suggest that the condition of disclosure before conversation tends to have

lower purchase rates, higher hang-up rates, and shorter call length.

Next, we apply econometric models to test the effects. Because we have randomized field experiment data to identify causal effects, our modeling analyses of purchase rates are straightforward. We develop a logit model, in which the unobserved purchase likelihood is a logit function of the randomized conditions:

$$\text{Purchase Likelihood}_i = \frac{\text{Exp}(U_i)}{\text{Exp}(U_i) + 1}$$

$$U_i = \alpha + \alpha_1 * \text{Underdogs}_i + \alpha_2 * \text{Without Disclosure}_i + \alpha_3 * \text{Before Conversation}_i + \alpha_4 * \text{After Conversation}_i + \alpha_5 * \text{After Decision}_i + \Gamma \text{Controls}_i + \varepsilon_i, \quad (1)$$

where U_i denotes the latent utility of making a purchase, and the dependent variable of purchase is whether the customer has decided to renew the loan. The key independent variables are the six groups in our experiment, that is, the five dummy variables with the proficient human agent group as the

Table 2. Randomization Check

Group	N	Gender	Age	Education	Number of credit cards	Online loan inquiries	Loan amount	Credit card spending	Online spending	Nonresponse rate, %
Underdogs	1,053	0.759	30.854	2.696	1.247	10.877	2,035.502	1,867.649	115.176	5.03
Proficient workers	1,042	0.788	30.750	2.663	1.287	10.242	2,040.951	1,863.102	97.539	4.03
Without disclosure	1,044	0.778	30.921	2.677	1.295	10.139	1,984.907	1,993.738	115.803	4.21
Before conversation	1,036	0.777	30.918	2.679	1.230	9.990	1,995.905	1,663.772	97.901	3.47
After conversation	1,044	0.786	30.789	2.670	1.247	10.404	2,023.249	1,778.202	97.249	4.21
After decision	1,036	0.769	30.911	2.667	1.236	10.433	2,036.715	2,070.709	117.982	3.47
F-value		0.717	0.1332	0.2174	2.081	1.253	0.724	1.421	1.273	
P-value		0.610	0.985	0.955	0.065	0.281	0.605	0.213	0.272	

Table 3. Model-Free Results

Condition	N	Call response rate, %	Hang-up rate, %	Call length	Purchase rate
Underdogs	1,053	94.96	0.00	39.888	0.049
Proficient workers	1,042	95.97	0.00	63.888	0.251
Without disclosure	1,044	95.79	0.00	64.152	0.237
Before conversation	1,036	96.52	56.30	10.325	0.048
After conversation	1,044	95.78	4.50	63.873	0.110
After decision	1,036	96.52	0.00	63.731	0.232

comparison baseline. *Controls_i* is a vector of control variables with individual customer profiles, including gender, age, education, and location dummies (see Online Appendix C for a frequency distribution of the 33 provinces); number of credit cards; online loan inquiries; loan amount; credit card spending; and online spending as well as customer voice pitch (which are derived from speech-to-text, Word2Vec, and Hierarchical Softmax Python tools; see Online Appendix D for details). Note that, in the natural holdout case, without any sales call, the organic purchase rate is zero during the promotion period because customers would not know the loan renewal opportunity without the sales calls. Thus, all effects on purchases here are incremental.

Table 4, columns (1)–(3), reports the results for all attempted calls. Across three models (logit, probit,

and ordinary least squares (OLS)), the results consistently suggest that, relative to proficient human workers, disclosing the chatbot machine identity before the conversation statistically significantly reduces customer purchase rates ($p < 0.01$).

Besides the statistical significance, we present the magnitude of the effects in Figure 2. Compared with the without disclosure condition, disclosure before conversation decreases customer purchase rates dramatically by 79.7% (from 0.237 to 0.048).

Robustness Checks with Falsification Tests

Our results are robust to various falsification checks. First, because the AI chatbot is trained by the calling records of the company's proficient workers, performance should be similar. Results in Table 4 indeed

Table 4. The Negative Disclosure Impact on Customer Purchases

DV: Purchase rate	Attempted calls			Excluding nonresponses			Excluding hang-ups		
	Logit	Probit	OLS	Logit	Probit	OLS	Logit	Probit	OLS
Underdogs (a)	−1.886*** (0.164)	−0.991*** (0.080)	−0.194*** (0.015)	−1.683*** (0.217)	−0.879*** (0.113)	−0.176*** (0.023)	−1.769*** (0.219)	−0.932*** (0.114)	−0.185*** (0.025)
Without disclosure (b)	−0.082 (0.104)	−0.050 (0.061)	−0.014 (0.015)	−0.085 (0.105)	−0.051 (0.062)	−0.015 (0.016)	−0.085 (0.105)	−0.052 (0.062)	−0.015 (0.016)
Before conversation (c)	−2.228*** (0.187)	−1.146*** (0.087)	−0.208*** (0.015)	−1.792*** (0.366)	−0.899*** (0.195)	−0.159*** (0.041)	−1.675*** (0.379)	−0.883*** (0.201)	−0.169*** (0.044)
After conversation (d)	−1.056*** (0.127)	−0.585*** (0.068)	−0.141*** (0.015)	−1.065*** (0.128)	−0.595*** (0.069)	−0.146*** (0.016)	−1.017*** (0.128)	−0.570*** (0.070)	−0.142*** (0.016)
After decision (e)	−0.107 (0.105)	−0.064 (0.061)	−0.018 (0.015)	−0.112 (0.106)	−0.068 (0.062)	−0.020 (0.016)	−0.113 (0.106)	−0.067 (0.062)	−0.020 (0.016)
Control variables	Y	Y	Y	Y	Y	Y	Y	Y	Y
Excluding nonresponses	N	N	N	Y	Y	Y	Y	Y	Y
Excluding hang-ups	N	N	N	N	N	N	Y	Y	Y
Constant	−0.741 (0.547)	−0.463 (0.314)	0.295*** (0.072)	−1.126 (34.884)	−1.601 (19.429)	−0.020 (4.173)	2.050 (35.249)	0.856 (19.830)	0.561 (4.605)
N	6,255	6,255	6,255	6,000	6,000	6,000	5,392	5,392	5,392
Log likelihood	−2,354.020	−2,352.805	N/A	−2,310.453	−2,309.193	N/A	−2,238.702	−2,237.754	N/A
(Pseudo) R ²	0.092	0.093	0.063	0.095	0.095	0.066	0.076	0.077	0.053
F-value									
d–c	33.902***	36.546***	20.104***	3.787**	2.357	0.089	2.847*	2.320	0.363
e–d	54.784***	57.051***	66.179***	54.625***	56.996***	65.841***	48.965***	51.064***	54.744***

Notes. This table tests the effect of chatbot identity disclosure on purchase rates for three different samples. Results from columns (1)–(3) are based on the full sample of 6,255 attempted calls. Results from columns (4)–(6) are based on the responded calls of 6,000 (excluding the 255 nonresponses). Results from columns (7)–(9) are based on the sample of 5,392 non-hang-ups (further excluding the 608 hang-ups).

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$.

support that the purchase rate of *no disclosure* is not significantly different from that of *proficient workers* ($p > 0.10$). This also rules out an alternative explanation that it might be the bad service quality of the chatbot itself rather than the act of disclosure that drives the negative effects. Also, the *underdogs* generate a significantly low purchase rate of 0.05 ($p < 0.01$). This makes sense because they are inexperienced rookies and unseasoned call center employees in the company. Still, they get some purchase results because of the exerted sales efforts. Moreover, we expect that the condition of *after decision* will not differ from the condition of *proficient workers* because it is after the fact (customers have already made the decision of purchasing or not). This is confirmed by the insignificant coefficient of *after decision* in Table 4, thus passing another sanity or falsification check.

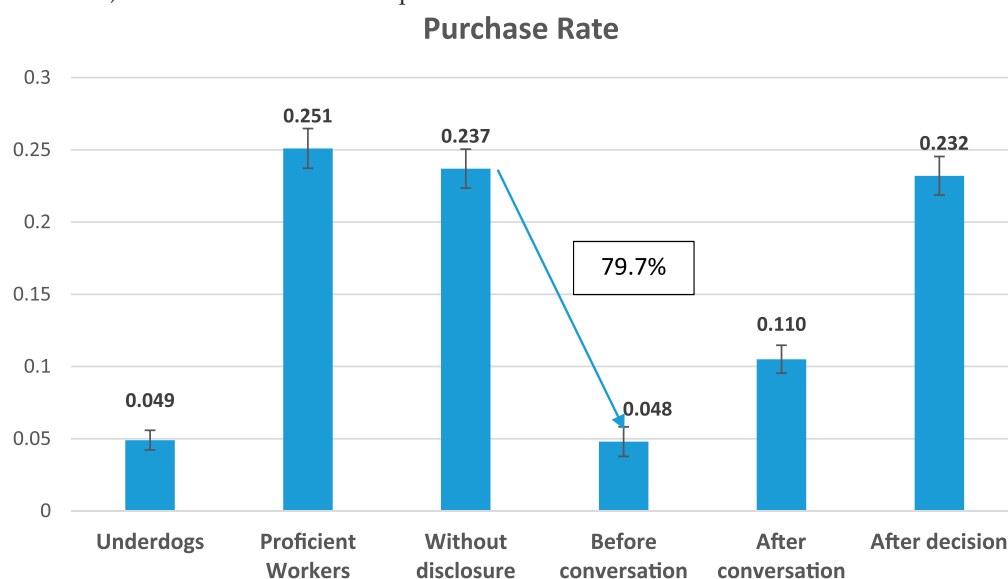
More Robustness Checks with Nonresponses and Hang-ups

First, we conducted additional analyses with possible nonresponse bias. Customers are randomized to receive the call but not answer it. Thus, one possible concern is that customers may self-select to ignore the call and not purchase. That is, not all attempted calls are answered by customers because some customers cannot answer the phone (as this study was done during work hours), and others might have changed their contact numbers. As presented in Figure 1, the middle panel, our data have a total of 255 nonresponses with a response rate of 96% from attempted customers. This high response rate is not surprising because the targeted loan borrowers may fear missing out on important loan-update information from the

lending company. More importantly, our data suggest that the nonresponse rates are almost evenly distributed among the six experiment groups, ranging from 3.5% to 5% as shown in Figure 1 and Table 2, last column. We also run the models after excluding the nonresponses. Results in Table 4, columns (4)–(6), confirm that all our main results are robust. Thus, possible selection effects resulting from nonresponses cannot explain our results.

Moreover, we check our data regarding hang-ups (defined as the cases in which customers terminate the call within five seconds right after knowing the bot machine identity). If customers terminate the call or hang up too early, they might not have indicated their purchase decisions. As reported in Figure 1, bottom panel, there are a total of 608 hang-ups. The condition of *disclosure before conversation* had 563 cases (hang-ups without much interaction with the AI chatbot), and the condition of *disclosure after conversation* had 45 cases (hang-ups after the initial interaction with the AI chatbot). The remaining four groups had zero hang-up cases. We rerun the models after further excluding the hang-ups so as to scale the purchase rate (= number of “yes” purchase decisions / (number of “yes” purchase decisions + number of “no” purchase decisions)). Again, Table 4, columns (7)–(9), confirm that all our main results are robust after accounting for hang-ups. We also check the robustness by measuring hang-ups within four, three, two, and one seconds after the bot machine identity disclosure, and again, all results are robust across these different measures of hang-ups. These analyses of hang-ups resulting from chatbot disclosure motivated us to dive deeper by examining call length.

Figure 2. (Color online) Purchase Rates Across Experimental Conditions



排除掉接通电话无回应和挂断电话的情况，并做稳健性检验

Additional Analyses with Call Length

One plausible explanation for our results is that, when customers know the conversational partner is not a human, they tend to be curt (i.e., hang up abruptly or terminate early) and purchase less. **If so, the call length in the disclosed chatbot condition should be significantly shorter than that of the undisclosed chatbot condition.** This is confirmed by the Online Appendix D histograms of call length. Among the six experimental conditions, the case of chatbot identity disclosure before conversation has the shortest call length. We also run the models with call length as the dependent variable. Results in Table 5 with both OLS and tobit models consistently support the negative and significant effect of *before conversation* on call length for the samples of attempted calls, excluding nonresponses and hang-ups. **However, these results cannot reveal the underlying psychological mechanisms, which are explored next.**

Behavioral Mechanisms for the Negative Effects of Chatbot Disclosure

To understand the behavioral mechanism, we augment the field experiment with subjective data from postcall surveys as well as objective voice data from audio analytics of the conversation records. The surveys poll all customers who have completed or

hung up the calls and ask their satisfaction with the service agent’s knowledge level and sentimental empathy (see Online Appendix E). Figure 3 reports the results of a formal mediation test with 5,000 replications in bootstrapping (Preacher and Hayes 2004). The results confirm that, relative to no disclosure, chatbot disclosure before conversation significantly reduces the *perceived* knowledge and empathy of chatbots and, through these two mediational routes, decreases call length and purchase rates (all path $p < 0.01$; see Online Appendix E for more details). In other words, when customers know the conversational partner is not a human, they are brusque and purchase less because they perceive the disclosed bot as less knowledgeable and less empathetic. However, voice-mining of the objective conversation records suggests that the undisclosed chatbot is indeed as competent as proficient workers in terms of knowledge and empathy (see Online Appendix F). **Thus, the negative impact of chatbot disclosure may be driven by a subjective human perception against machines despite the objective competence of AI chatbots.**

Additional Checks on Deception Feeling and Order Cancellation

Another alternative explanation is a customer feeling of deception. However, in the condition of disclosure

Table 5. The Negative Disclosure Impact on Call Length

DV: Call length	Attempted calls		Excluding nonresponses		Excluding hang-ups	
	OLS	Tobit	OLS	Tobit	OLS	Tobit
Underdogs (a)	−23.456*** (0.546)	−23.547*** (0.567)	−24.030*** (0.283)	−24.030*** (0.282)	−23.999*** (0.283)	−23.999*** (0.282)
Without disclosure (b)	0.129 (0.547)	0.117 (0.568)	0.263 (0.283)	0.263 (0.282)	0.274 (0.283)	0.274 (0.282)
Before conversation (c)	−51.373*** (0.548)	−51.543*** (0.569)	−53.566*** (0.282)	−53.566*** (0.282)	−49.447*** (0.362)	−49.447*** (0.362)
After conversation (d)	−0.134 (0.548)	−0.143 (0.568)	−0.015 (0.283)	−0.015 (0.282)	0.603** (0.286)	0.603** (0.285)
After decision (e)	0.238 (0.548)	0.255 (0.568)	−0.153 (0.283)	−0.153 (0.282)	−0.144 (0.283)	−0.144 (0.282)
Control variables	Y	Y	Y	Y	Y	Y
Excluding non	N	N	Y	Y	Y	Y
Excluding hang-ups	N	N	N	N	Y	Y
Constant	60.698*** (2.644)	60.406*** (2.756)	177.832** (75.946)	177.832** (75.660)	154.162* (79.948)	154.162* (79.837)
N	6,255	6,255	6,000	6,000	5,392	5,392
Log likelihood	N/A	−24,328.355	N/A	−19,545.183	N/A	−17,578.171
(Pseudo) R ²	0.707	0.129	0.911	0.271	0.855	0.229
F-value						
d−c	8,743.801***	8,153.974***	35,765.645***	36,035.915***	18,834.990***	18,887.533***
e−c	8,831.520***	8,243.613***	35,591.725***	35,860.680***	18,528.711	18,580.399***

Notes. This table tests the effect of chatbot identity disclosure on call length for three different samples. Results from columns (1)–(3) are based on the full sample of 6,255 attempted calls. Results from columns (4)–(6) are based on the responded calls of 6,000 (excluding the 255 nonresponses). Results from columns (7)–(9) are based on the sample of 5,392 non-hang-ups (further excluding the 608 hang-ups).
*** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$.

在排除不回应的情况，在对话前揭露机器人身份的情况时最短。

人类对聊天机器人的主观感知驱使了揭露聊天机器人带来的消极影响。

before conversation, the customers are informed up front about the chatbot machine identity; that is, the disclosure is done immediately. Thus, it is more likely that customers' subjective perception against the chatbot rather than their feeling of deception drives the negative disclosure effect. Also, voice-mining of the conversation records failed to find words with strongly negative feelings across all experimental conditions, more evidence of no serious deception feeling. Moreover, according to company records, there are no order cancellation or overt consumer complaints against the company in the conditions of chatbot identity disclosure after the experiment.

Strategies to Mitigate the Negative Effects of Chatbot Disclosure

Mitigation Strategy One

Results in Table 4 on the coefficient comparisons indicate that customer purchase rates significantly improve when the disclosure is delayed from before to after the conversation and to after the decision (all p s < 0.01). Thus, more interactions with and experiential learning of chatbots may help allay the negative chatbot disclosure effect. In other words, as long as the chatbot identity is disclosed, regardless of before or after the conversation, customer purchase rates are negatively affected. However, disclosing the bot identity after the conversation helps mitigate such negative impact. This is reasonable because the customer might form a good impression in the first one-minute interaction with the AI chatbot, which can help reduce the distrust of the chatbot.

Mitigation Strategy Two

We also explore how customers' prior AI experience can affect the negative effects of chatbot disclosure. The data set provided by the company includes a binary variable that indicates whether a customer downloaded and used other AI apps on the smartphone (1 = has at least one AI app with smart digital agents similar to Google Allo, ELSA Speak, Cortana, FaceApp, Edison Assistant and 0 = otherwise).

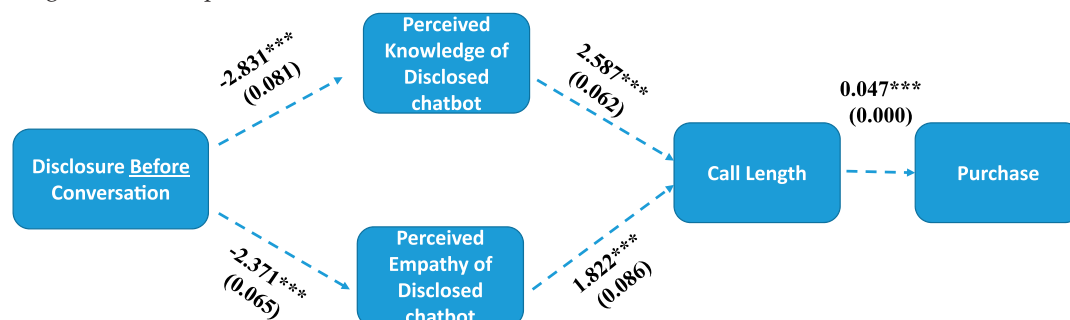
As shown in Table 6, prior experience with AI induces more customer purchases. More importantly, the coefficient of the interaction term *Prior AI Experience_i * Before Conversation_i* is positive and significant ($p < 0.01$), suggesting that prior AI experience is helpful in reducing the negative disclosure effect.

Conclusion and Future Research

This research examines AI chatbots, a timely and managerially relevant topic. On the basis of a six-condition field experiment, it finds that the disclosure of chatbot machine identity reduces purchase rates substantially. Further analyses reveal that customers tend to purchase less and even terminate the calls early because they perceive the disclosed chatbot as less knowledgeable and empathetic.

Our setting of structured outbound calls is limited because the chatbot only engages in a restricted two-way information exchange rather than a highly interactive two-way conversation. This restrictive nature is an important limitation here, which may help open up new research. For example, it would be fruitful for future research to investigate dynamic differences of the two-way conversation between chatbot–customer dyads versus worker–customer dyads. Another direction for future research is to test the generalizability of our results in other settings, such as the more dynamic inbound calls. Moreover, we address the first-order disclosure effects (with or without disclosure). Future research may test the second-order effects with different framings in the introduction of disclosed bots. For instance, the AI chatbots may self-introduce to customers with the framing of enhanced technological benefits (big data computing and fast quantitative learning of AI chatbots), reduced customer hassle costs (less waiting time to get answers from AI chatbots), or even surprising consumer welfare (offering the product at a lower price because bots help save labor costs). Indeed, bots may help make life less prickly in certain interactions that are inherently bleak (e.g., call customer service support to fix computers or replenish a product). Paradoxically, in these interactions, humans are trained

Figure 3. (Color online) Customers Are Curt and Purchase Less from the Disclosed Chatbot Because They Perceive the Bot as Less Knowledgeable and Empathetic



未来可以研究人机对话和人人双向对话之间的动态差异

Table 6. The Negative Disclosure Impact on Customer Purchases Is Mitigated by Prior AI Experience

Purchase rate	Attempted calls	Excluding nonresponses	Excluding hang-ups
Underdogs	<u>−1.718***</u> (0.196)	<u>−1.552***</u> (0.245)	<u>−1.635***</u> (0.247)
Without disclosure	−0.053 (0.129)	−0.058 (0.130)	−0.058 (0.130)
Before conversation	<u>−2.539***</u> (0.270)	<u>−2.165***</u> (0.428)	<u>−2.340***</u> (0.505)
After conversation	<u>−0.912***</u> (0.154)	<u>−0.915***</u> (0.154)	<u>−0.871***</u> (0.154)
After decision	−0.003 (0.128)	−0.004 (0.128)	−0.004 (0.128)
Prior AI experience	<u>1.816***</u> (0.177)	<u>1.817***</u> (0.177)	<u>1.817***</u> (0.177)
Underdogs × prior AI experience	−0.247 (0.386)	−0.237 (0.386)	−0.244 (0.386)
Without disclosure × prior AI experience	0.183 (0.262)	0.188 (0.262)	0.183 (0.262)
Before conversation × prior AI experience	<u>0.916**</u> (0.405)	<u>0.900**</u> (0.405)	<u>1.257**</u> (0.533)
After conversation × prior AI experience	−0.311 (0.301)	−0.310 (0.302)	−0.264 (0.304)
After decision × prior AI experience	−0.154 (0.260)	−0.146 (0.260)	−0.147 (0.260)
Control variables	Y	Y	Y
Excluding nonresponses	N	Y	Y
Excluding hang-ups	N	N	Y
Constant	−0.991* (0.580)	−34.405 (36.974)	−29.953 (37.361)
N	6,255	6,000	5,392
Log likelihood	−2,116.459	−2,115.005	−2,048.078
Pseudo R ²	0.171	0.171	0.155

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$.

to behave like a bot. Also, customers have different innate preferences of talking to bots as some can be cordial and don't feel judged, but others tend to be rude and brusque (Thompson 2018). Thus, depending on the degree of task complexity and customer preference heterogeneity, future endeavors may let customers self-select who (bots or humans) to serve them over the phone in order to boost purchases in conversational commerce. As millions tell Alexa, Siri, or Google Assistant to play music, reorder products, and make appointments, the impact of AI new frontiers on our daily life will be ubiquitous in the long run.

In conclusion, more scholarly works are strongly encouraged to address this pivotal area of **AI chatbot applications for marketing promotions and customer services**.

Acknowledgments

The authors gratefully acknowledge the anonymous Fintech company for sponsoring the field experiment. The corresponding authors of this paper are Zhe Qu and Zheng Fang.

Endnotes

¹ Based on past six-month sales call performance in the company, proficient workers are among the top 20% (seasoned), and inexperienced workers or underdogs are among the bottom 20% (rookies).

² The AI platform that invents this chatbot conducted and passed the Turing test during chatbot developments. On the basis of a pilot test of 283 customers, the corporate partner company confirmed that, without disclosure, 97% of its customers did not recognize the bot machine identity over the phone because our setting here is a structured straightforward task—outbound sales calls in less than two minutes (the mean call length is less than 70 seconds).

³ Customers can reverse their purchase decisions and cancel the order after they know the bot machine identity. However, we do not find such cases in our data. In addition, all agents and customers speak Mandarin rather than local dialects in our data.

⁴ Customers who are not interested in the promotion would say “no” and terminate the call, thus leaving little opportunity for agents to remedy. Nevertheless, all experimental conditions follow this same protocol.

Reference

- Bennett CC, Hauser K (2013) Artificial intelligence framework for simulating clinical decision-making: A Markov decision process approach. *Artificial Intelligence Medicine* 57(1):9–19.
- Brynjolfsson E, Mitchell T (2017) What can machine learning do? Workforce implications. *Science* 358(6370):1530–1534.
- Churchill GA, Ford NM, Hartley SW, Walker OC (1985) The determinants of salesperson performance: A meta-analysis. *J. Marketing Res.* 22(2):103–118.
- Del Valle K (2018) Conversational commerce: A new opportunity for card payments. MasterCard (January 25), <https://newsroom.mastercard.com/documents/conversational-commerce-a-new-opportunity-for-card-payments/>.
- Dietvorst BJ, Simmons JP, Massey C (2018) Overcoming algorithm aversion: People will use imperfect algorithms if they can (even slightly) modify them. *Management Sci.* 64(3):1155–1170.
- Esteva A, Kuprel B, Novoa RA, Ko J, Swetter SM, Blau HM, Thrun S (2017) Dermatologist-level classification of skin cancer with deep neural networks. *Nature* 546(7639):115–118.
- Federal Trade Commission (2017) Privacy & data security update (2016). Federal Trade Commission, ftc.gov. Accessed September 7, 2018, <https://www.ftc.gov/reports/privacy-data-security-update-2016>.
- Fethi MD, Pasiouras F (2010) Assessing bank efficiency and performance with operational research and artificial intelligence techniques: A survey. *Eur. J. Oper. Res.* 204(2):189–198.
- Fröhlich A (2018) Pros and cons of chatbots in the IT helpdesk. Informationweek.com. Accessed October 18, 2018, <https://www.informationweek.com/strategic-cio/it-strategy/pros-and-cons-of-chatbots-in-the-it-helpdesk/a/d-id/1332942>.
- Huang M-H, Rust RT (2018) Artificial intelligence in service. *J. Service Res.* 21(2):155–172.
- Kestenbaum R (2018) Conversational commerce is where online shopping was 15 years ago—Can it also become ubiquitous? *Forbes* (June 27), <https://www.forbes.com/sites/richardkestenbaum/2018/06/27/shopping-by-voice-is-small-now-but-it-has-huge-potential/#1d140fc37ac8>.
- Köhler CF, Rohm AJ, de Ruyter K, Wetzels M (2011) Return on interactivity: The impact of online agents on newcomer adjustment. *J. Marketing* 75(2):93–108.
- Leachman SA, Merlino G (2017) The final frontier in cancer diagnosis. *Nature* 542(7639):36–38.
- Leung E, Paolacci G, Puntoni S (2018) Man versus machine: Resisting automation in identity-based consumer behavior. *J. Marketing Res.* 55(6):818–831.
- Leviathan Y, Matias Y (2018) Google Duplex: An AI system for accomplishing real-world tasks over the phone. *Google AI Blog* (May 8), <https://ai.googleblog.com/2018/05/duplex-ai-system-for-natural-conversation.html>.
- Logg JM, Minson JA, Moore DA (2019) Algorithm appreciation: People prefer algorithmic to human judgment. *Organ. Behav. Human Decision Processes* 151(2019):90–103.
- Lu SF, Rui H, Seidmann A (2018) Does technology substitute for nurses? Staffing decisions in nursing homes. *Management Sci.* 64(4):1842–1859.
- Mimoun B, Slim M, Poncin I, Garnier M (2017) Animated conversational agents and e-consumer productivity: The roles of agents and individual characteristics. *Inform. Management* 54(5):545–559.
- Patel VL, Shortliffe EH, Stefanelli M, Szolovits P, Berthold MR, Abu-Hanna A (2009) The coming of age of artificial intelligence in medicine. *Artificial Intelligence Medicine* 46(1):5–17.
- Pise R (2018) Chatbot market size is set to exceed USD 1.34 billion by 2024. ClickZ (July 6), <https://www.clickz.com/chatbot-market-size-is-set-to-exceed-usd-1-34-billion-by-2024/215518/>.
- Preacher KJ, Hayes AF (2004) SPSS and SAS procedures for estimating indirect effects in simple mediation models. *Behav. Res. Methods Instruments Comput.* 36(4):717–731.
- Saad BS, Abida FC (2016) Social interactivity and its impact on a user's approach behavior in commercial web sites: A study case of virtual agent presence. *J. Marketing Management* 4(2): 2333–6099.
- Sivaramakrishnan S, Wan F, Tang Z (2007) Giving an 'e-human touch' to e-tailing: The moderating roles of static information quantity and consumption motive in the effectiveness of an anthropomorphic information agent. *J. Interactive Marketing* 21(1):60–75.
- Thompson C (2018) May A.I. help you? *New York Times* (November 18), <https://www.nytimes.com/interactive/2018/11/14/magazine/tech-design-ai-chatbot.html>.
- Trippi RR, Turban E (1993) Neural networks in finance and investing: Using artificial intelligence to improve real-world performance (McGraw-Hill Inc., New York).
- Wilson HJ, Daugherty PR, Morini-Bianzino N (2017) The jobs that artificial intelligence will create. *MIT Sloan Management Rev.* 58(4).
- Wise L (2018) New media doesn't mean new rules: The challenges of chatbots. *Social Media Week* (June 20), <https://socialmediaweek.org/blog/2018/06/new-media-doesnt-mean-new-rules-the-challenges-of-chatbots/>.