Article

Social Science Computer Review
2018, Vol. 36(2) 139-156

DOI: 10.1177/0894439317698637
journals.sagepub.com/home/ssc

"You're Fired," Says the Robot: The Rise of Automation in the Workplace, Technophobes, and Fears of Unemployment

Paul K. McClure[1]

Abstract

The rapid adoption of new technologies in the workplace, especially robotics and artificial intelligence (AI), has motivated some researchers to determine what effects such technologies may have. Few scholars, however, have examined the possibility that a large segment of the population is apprehensive about the quick pace of technological change and encroachment into modern life. Drawing from economic projections about the future of the digital economy and from literature in the sociology of technology and emotions, this article explores whether certain fears of technology exacerbate fears of unemployment and financial insecurity. Using data from Wave 2 of the Chapman Survey of American Fears ($N = 1{,}541$), I find that there exists a sizable population of "technophobes" or those who fear robots, AI, and technology they do not understand. Technophobes are also more likely than nontechnophobes to report having anxiety-related mental health issues and to fear unemployment and financial insecurity. With advances in robotics and AI, the threat of technological unemployment is discussed as a real concern among a substantial portion of the American population.

Keywords

artificial intelligence, robotics, technology, unemployment, sociology of emotions, fear, mental health, technophobia, culture

> We are being afflicted with a new disease of which some readers may not yet have heard the name, but of which they will hear a great deal in the years to come—namely, technological unemployment.
>
> —John Maynard Keynes (1930/1932, p. 364)

Fears about technologically induced unemployment ebb and flow. Surfacing at various points historically, such fears occasionally reach a fever pitch, as they did during the Luddite rebellion in England in the early 1800s (Thomis, 1970) or during the Great Depression when the renowned

[1] Baylor University, Waco, TX, USA

Corresponding Author:
Paul K. McClure, Baylor University, One Bear Place #97326, Waco, TX 76798, USA.
Email: paul_mcclure@baylor.edu

economist John Maynard Keynes first introduced the term "technological unemployment." Since then, economists have been mostly optimistic about the positive relationship between employment and technological advances (Abernathy & Townsend, 1975; Evangelista & Vezzani, 2012). Recently, however, this optimism has come under scrutiny. As Oxford researchers Frey and Osborne (2013) estimate in their study of more than 700 different U.S. occupations, within two decades, 47% of today's jobs will be susceptible to automation by computerization and may become obsolete. These jobs span the blue- and white-collar divide, from truck drivers and warehouse workers to accountants, loan officers, health-care managers, and paralegals. MIT economists Brynjolfsson and McAfee (2014), while optimistic about the effects of technology in other respects, hypothesize that recent changes in automation, robotics, and artificial intelligence (AI) may create the structural conditions for widespread unemployment.

Some may speculate, of course, that such predictions are unnecessarily alarmist, especially considering the current unemployment rate is only about 5% in the United States (Bureau of Labor Statistics, 2016). But these figures do not take into consideration those who have quit looking for work, and as Ford (2015) argues, economists also need to recognize that the labor force participation rate has been declining since 2000 and that the "jobless recovery" since the 2008 recession has translated into extended seasons of unemployment for millions of workers.

With projected changes in the automation of the workplace, this article explores who fears these anticipated workplace technologies the most and whether these "technophobes" also report fearing unemployment and financial insecurity as a result. Currently, a greater percentage of the workforce has already begun to recognize that becoming technologically literate is an essential skillset in an increasingly digital workplace (Smith, 2015). However, greater technological access and reduction in what scholars have dubbed the "digital divide" (Nie & Erbring, 2001; P. Norris, 2001; Robinson, DiMaggio, & Hargittai, 2003; Warschauer, 2003) has not eliminated concerns regarding workplace technology for several reasons. First, a number of Americans have left the workforce in recent years and have no intentions to reenter. Analyzing data from the Bureau of Labor Statistics, the Pew Research Center reports that over 92 million Americans (37% of the population aged 16 year and over) are not in the labor force and are not looking for work either. While this figure includes retirees, as many as two thirds of Americans expect that "robots and computers will be able to do most of the work currently done by humans within 50 years" (Smith, 2016).

Further, a growing source of frustration for many is that work prospects have already diminished because of increases in automation and AI. MIT economist Acemoglu (2003) argues that a "skills bias" has resulted from technological improvements that advantage the highly educated: "the major driving force behind the changes in the U.S. wage structure is technology" because "technical change favors more skilled (educated) workers, replaces tasks previously performed by the unskilled, and increases the demand for skills" (also see Acemoglu & Autor, 2010). While this skills bias began as early the 1970s, it has accelerated with the progression of Internet technology and improved workforce automation (Autor, Levy, & Murnane, 2003).

As a result, while there is a higher demand for college-educated workers, less educated workers face threatening job prospects as the price of computer technology falls and simultaneously improves in its capabilities (Autor & Dorn, 2009; Autor, Katz, & Krueger, 1998). Further, the prospect of maintaining employment becomes less likely in a digital economy because programming software can do the work of human employees more cheaply. Even so, though evidence for growing income inequality can be partially attributed to the skill biases present in industries that demand college-educated workers, the "rate of skill-upgrading has been greater in more computer-intensive industries" (Autor et al., 1998, p. 1169).

The complex labor market circumstances brought forth by automation and AI motivate this study examining fears of technology, unemployment, and the consequences such fears elicit. Although many researchers have discussed the social consequences of unemployment (Reichert &

Tauchmann, 2011; Wilson, 1997, 2012), no research exists on the fear of unemployment as it relates to workplace automation and improved technology. Equally importantly, too, are the narratives and discourses that guide both technological adoption and apprehension. On the one hand, the trajectory of postindustrial countries seems unequivocally to favor using technology to boost economic productivity, enhance gross domestic product, and create more business opportunities for underprivileged and working-class people. On the other hand, many suspect that technology will not deliver widespread financial security nor will it be a panacea for the world's underprivileged. iPhones may be more affordable today, but college tuition, health care, and housing are less so.

Thus, the main questions that guide this research are these: What are the consequences that result from a heightened fear of technology and job loss? And how do fears of AI or other technologies fuel fears of unemployment and financial insecurity? To answer these questions, I first draw from prior studies that connect unemployment to technological progress, and I examine some of the underlying technological assumptions and how these carry over into the general psyche of American culture. Second, I look at more specific research studies that have explored the causes and consequences of technophobia. Ultimately, I argue that fears of robots, AI, and new workplace technologies that are not well understood signal a cultural apprehension to the narrative of progress embedded in technological advances. This argument suggests that, far from wholesale acceptance, many Americans fear technologies they do not understand because they may realistically threaten their livelihoods.

Literature Review

Technology and Unemployment

Working at the outset of the industrial revolution, early sociologists recognized that improvements in technology would disrupt and perhaps permanently alter economic relations. Seeing an early antagonism between the worker and the machine, Marx, for example, observed that technology could be used to extract low-paid work from wage laborers and exploit them in the process (Marx & Engels, 1978). In economics, Keynes (1930/1932) also worried that advances in technology would make possible widespread technological unemployment, and today his concerns are being reappreciated by scholars across disciplines. For example, Wilson's (1997) *When Work Disappears* documents the rise of limited job opportunities in Chicago's inner-city neighborhoods and shows that unemployment hurts individuals and ruins communities. While there are many factors that lead to the deterioration of inner-city neighborhoods, Wilson partially attributes increases in income inequality and rising unemployment to the technological changes that have taken place. As he explains,

> The workplace has been revolutionized by technological changes that range from robotics to information highways. While educated workers are benefiting from the pace of technological change, involving the increased use of computer-based technologies and microcomputers, more routine workers face the growing threat of job displacement in certain industries. (1997, pp. 28–29)

Wilson's observations reflect the concern that technological changes can eliminate blue-collar jobs. Although recognizing that advances in computer technology require new operating skills that may in some cases lead to the creation of new jobs, Wilson (1997, p. 29) also shows that the new demands of the workplace "eliminate jobs for those trained only for manual, assembly-line work."

As primarily a race scholar, Wilson's concerns focus mostly on the effects of technological improvements on the African American community. However, the digital horizons projected by other economists and technologists may transcend racial and ethnic boundaries. Brynjolfsson and McAfee (2014) caution that the digital revolution will exacerbate income inequality and eliminate low-wage earning jobs. As they predict,

> Rapid and accelerating digitization is likely to bring economic rather than environmental disruption, stemming from the fact that as computers get more powerful, companies have less need for some kinds of workers. Technological progress is going to leave behind some people, perhaps even a lot of people, as it races ahead. (2014, pp. 10–11)

Echoing these projections are R. Susskind and D. Susskind (2016) who find that there will be a gradual increase in technological unemployment over the course of the next few decades. "[I]t will become ever more difficult," they write, "as time passes and machines become increasingly capable, to ensure that there is enough reasonably-paid employment for professionals" (Susskind & Susskind, 2016, p. 290). Therefore, in recognizing trends in income inequality, new technological skillsets may either disproportionately affect particular racial groups, as Wilson projects, or as Brynjolfsson and McAfee argue, indiscriminately transcend racial categories.

The flip side to these arguments is that improvements in technology will yield greater opportunities for all. Indeed, narratives of progress and prosperity animate much of the thinking among technological enthusiasts. Perhaps the greatest apologist for Internet technology, Bill Gates outlines a vision of the future guided by computers that is almost wholly positive. As he explains in *The Road Ahead* (1996, p. 284), because of the Internet, "Whole new markets will emerge, and a myriad of new opportunities for employment will be created." Highlighting many of these sentiments are Google pioneers Eric Schmidt and Jared Cohen, who argue that developing countries will see immense economic productivity by adopting new technologies. As Schmidt and Cohen (2014, p. 14) elaborate,

> As digital connectivity reaches the far corners of the globe, new users will employ it to improve a wide range of inefficient markets, systems and behaviors, in both the most and least advanced societies. The resulting gains in efficiency and productivity will be profound, particularly in developing countries where technological isolation and bad policies have stymied growth and progress for years . . . .

Such optimistic assessments suggest that many of the guiding assumptions behind technology emphasize progress and potential. Technology, some believe, will rid markets of inefficiency and propel humanity toward its fullest potential. Song (2003) finds that this narrative of progress characterizes much of the thinking of technological enthusiasts such as Gates (1996), Kurzweil (2006), and Negroponte (1996). However, citing a study of various businesses where one third of the respondents reported being motivated to adopt new technology out of the "fear of being left behind," Song shows that technology is as much a push factor as a pull factor. Song explains,

> While technological adoption may have been characterized by excitement in the early stages, as it has become increasingly integrated and institutionalized into our everyday lives, the excitement has taken on a new dimension . . . the impetus behind technological adoption is not only the pull of utopian dreams of Progress, . . . but also *the push of fear*—specifically the fear of being left behind. (2003, p. 1; emphasis added)

Thus, in the minds of many, there exist competing narratives regarding the hopes and fears that technology may bring.

Fear and Technophobia, Causes and Consequences

Although fear is widely understood to be a fundamental human emotion, little research has attempted to explain what fear is or why it matters. In *The Sociology of Emotions*, Turner and Stets (2005, p. 1) frankly express their surprise that emotions have received such scant scholarly attention, for as they write, "emotions pervade virtually every aspect of human experience and all social relations. How could sociologists have turned a blind eye to emotions?"

Despite its relative infancy, the sociology of emotions has made significant theoretical strides. For example, dramaturgical and social constructionist theories hold that emotions should be primarily understood as culturally accepted responses to external stimuli (Goffman, 1959). Drawing from Goffman's legacy, Hochschild (1979, 2012) argues that "emotional cultures" and "feeling rules" influence how humans experience and display their emotions including fear. Other scholars emphasize the primacy of frightening situations and "interaction ritual chains" in producing fight-or-flight responses (Collins, 2014). Fear may be contagious, in other words, and may work itself into entire populations when certain contexts arise. Broadly speaking, studies on fear generally point to its multifaceted nature. Fear may be properly understood as a *cultural* phenomenon (Glassner, 2000), a product of *institutional* arrangements (Wuthnow, 2010), or a *biological* response to perceived or real danger (Turner & Stets, 2005).

While acknowledging the comparative paucity of research in the sociology of emotions, there are actually a substantial number of studies related to computer anxiety and technophobia. As early as 1963, a nationwide study of American perceptions of technology showed that some people believed computers were a helpful tool to accomplish a variety of tasks, whereas others viewed them with apprehension, "a sense of inferiority," and were worried about its potential to lead to unemployment (Lee, 1970, p. 53). More recently, psychologists Larry Rosen and Michelle Weil have published numerous studies on technophobia. These range from cross-cultural comparisons that measure university students' technological fears and sophistication to studies that examine computer receptivity and use among public school teachers (Rosen & Weil, 1995a, 1995b; Weil & Rosen, 1995). Although these studies suffer from a lack of diversity and randomness in their samples, some persisting patterns emerge. For example, some countries are more averse to technology than others, computer experience and technological education have inverse relationships with technophobia, males and White respondents often report greater self-efficacy (or confidence) in using technology than females and non-White minorities, and relatedly, females and minorities generally exhibit higher levels of technophobia when compared to their White, male counterparts.

Other studies find that technophobia correlates strongly with specific, recurring demographic traits and personality types. For instance, building off Rosen and Weil's research, a study of South African university students discovered that as much as 33% of their sample population exhibited moderate to high levels of technophobia and that technophobia was positively correlated with neuroticism (Anthony, Clarke, & Anderson, 2000). These results often transcend national boundaries too, as one study of Romanian university students found when females were shown to have more computer anxiety than males (Durndell & Haag, 2002). Although gender effects are not significant in all studies, many researchers believe that educational differences may help explain why some groups fear computer technology more than others. For example, Korukonda (2005) shows that in addition to stable and enduring personality correlates, students with better math and logic skills have lower levels of technophobia. Additionally, Beckers and Schmidt (2001) demonstrate that computer literacy and self-efficacy (or lack thereof) often trigger specific emotions, which in turn affect one's beliefs about technology. Echoing these findings in a meta-analysis of computer anxiety studies, researchers in Singapore showed that female undergraduates generally (but not conclusively) exhibit greater computer anxiety than males and that regular computer use is inversely correlated with computer anxiety (Chua, Chen, & Wong, 1999).

Perhaps the most comprehensive treatment of technophobia is Brosnan's (1998) *Technophobia: The Psychological Impact of Information Technology.* Consolidating much of the research on these topics, Brosnan offers a compelling picture of the multilayered nature of technophobia and its causes. Although impossible to summarize here, some important conclusions may be drawn. First, given that surveys have found technophobia to be present in up to 50% of several sample populations (Brosnan, 1998, p. 33), fear of technology cannot be written off as either trivial or merely symptomatic of some other disorder. Second, of the variables often related to technophobia, the most

common are gender, self-efficacy, and cognitive style. Although Brosnan finds that females, computer novices, and nonanalytical cognitive styles are more likely to report being technophobic, he argues these trends are probably due to how parents and teachers introduce technology to children and how children are taught to associate certain (masculine) values with computers. In other words, any gender effects are more likely the result of differences in socialization rather than inherent biological distinctions. Third, Brosnan argues that technophobes are increasingly found not just in the classroom but also in the workplace, where market pressures compel employers to introduce new technologies for the sake of profit, improved efficiency, and greater productivity. Forcing workers to incorporate new technology into their work routines may therefore induce technophobia or, worse, place their employment at risk if they are unable to keep pace with the rapid clip of technological change. As Brosnan (1998, p. 33) explains, "As computers to continue to proliferate throughout the workplace with the increasing application of IT, the job security of the technophobe will become increasingly compromised."

Finally, though few studies mention technophobia alongside job security, numerous health researchers have conducted studies on the consequences of fearing unemployment. For example, Reichert and Tauchmann (2011) investigate levels of psychological distress for those whose job security is in question and find that employees with little job security suffer from poorer psychological health and that the effects of job insecurity are exacerbated for those who already suffer from higher levels of mental health problems. Other research has contested the notion that negative economic situations and financial strain necessarily translate into poorer health. Ruhm (1996) and Laporte (2004) independently observe that the connections between personal financial strain and adverse health outcomes are surprisingly weak, and with the exception of suicide, which does increase during economic recessions, some health behaviors such as physical activity and exercise actually improve during periods of unemployment.

Despite such findings, several studies document negative health effects stemming from sudden changes in the economy. Unemployment and job insecurity are often linked to negative health outcomes such as mental health, heart disease, and mortality rates (Martikainen, Mäki, & Jäntti, 2007; Murphy & Athanasou, 1999; Sundquist et al., 2006). Rodriguez, Allen, Frongillo, and Chandra (1999) show that while African Americans are more than twice as likely to suffer from unemployment as Caucasians, health differences between the employed and unemployed are less drastic for African Americans. Tefft (2011), using data from Google web searches, finds that individuals are more likely to search for health-related information on "anxiety" and "depression" at times when weekly unemployment insurance claims climb and monthly unemployment rates increase. More recently, research on the 2008 recession has confirmed that economic changes and personal financial strain worsen anxiety and depressive symptoms (Wilkinson, 2016). What the tenor of this literature suggests, then, is that fear of technology and unemployment, actual job loss, and economic recessions generally have adverse health outcomes.

Hypotheses

With this literature in view, this study aims to explore (1) new dimensions of technophobia related to robots, AI, and other technology that is not well understood; (2) possible mental health consequences of technophobia; and (3) fears of unemployment and financial insecurity as a potential byproduct of technophobia.

Given that previous studies have linked gender, education, and race to computer anxiety and self-efficacy (Brosnan, 1998; Rosen & Weil, 1995b), this study similarly proposes to understand whether certain demographic trends affect individual fears of newer technologies involving robots and AI. Accordingly,

Hypothesis 1: Technophobia will be more prominent among (a) those with the least amount of education, (b) non-White minorities, and (c) females.

Earlier studies have also found relationships between technophobia and psychological constructs such as emotional stability and neuroticism. Notably, Anthony, Clarke, and Anderson (2000) and Korukonda (2005) discovered that personality characteristics such as insecurity, anxiety, and nervousness were characteristic of negative attitudes toward computers. Applied to the newer technologies under discussion, I hypothesize:

Hypothesis 2: Technophobes will be more likely than nontechnophobes to report having anxiety-related mental health issues.

Lastly, the trajectories of the increasingly digital economy suggest that workers without the necessary technological skillsets will face worse job prospects in the coming years (Brosnan, 1998; Brynjolfsson & McAfee, 2014; Ford, 2015; Frey & Osborne, 2013). While fears of unemployment and job insecurity are often linked to negative health outcomes, no study to my knowledge has sought to connect fears of unemployment and financial insecurity with fears of AI and robotics in the workforce. As such,

Hypothesis 3: Technophobes will be more likely than nontechnophobes to fear (a) unemployment and (b) not having enough money in the future.

Data and Method

Data for this study come from the Chapman Survey of American Fears, Wave 2 (CSAF). The initial wave of this annual survey project was made possible through grants from the John Templeton Foundation and by the Institute for the Study of Religion, Economics, and Society at Chapman University. Wave 2 of the national, random survey ($N = 1{,}541$) asked respondents questions about their fears and worries regarding certain life events such as governmental policies, crime and victimization, natural and man-made disasters, technological changes, and a variety of other possible occurrences. Relevant to this study, the survey asks respondents about their fears of unemployment and being displaced in the workplace because of AI and robots. Housed and internally funded by the Earl Babbie Research Center at Chapman University, the CSAF Wave 2 is unique insofar as it is a broadly representative national sample containing questions related to fear, technology, mental health, and unemployment.

In collecting data for this study, researchers used the consumer research company Gesellschaft für Konsumforschung (GfK) and their service Knowledge Networks. GfK organizes and maintains a probability-based web panel broadly representative of the general population of the United States. The initial panel was recruited through the use of random digit dialing and also employed the U.S. Postal Service's delivery sequence file that includes households without home landlines. Selected households were invited to participate in a web-based panel study, and GfK provided any potential respondents who lacked computer access or an Internet connection with the necessary equipment to complete the survey. Once recruited for the panel study, participants received unique log-in information where they could access and answer the survey questions. Wave 2 of the CSAF was fielded to an English-speaking sample in two stages. First, a pretest of 39 respondents assessed the feasibility and duration of the survey to ensure that the questions were clearly understood and answered in a reasonable amount of time. Since the pretest did not elicit concerns, GfK then recruited 2,660 panelists to take the survey through e-mail. The survey was fielded from May 15, 2015, to May 26, 2015. Of the initial 2,660 recruits, 1,541 completed the survey for a completion rate of 58%. The

final sample consists of 1,541 noninstitutionalized adults, 18 years or older, who reside in the United States.

Dependent Variables

Several pertinent questions ask about personal fears, unemployment, and technology which form the basis for this study. Related to technology, these key questions include:

> How afraid are you of robots replacing people in the workforce? How afraid are you of robots that can make their own decisions and take their own actions? How afraid are you of AI? How afraid are you of people trusting AI to do work? And How afraid are you of technology that you don't understand?

Answers for these questions range in the following way: *not afraid* (1), *slightly afraid* (2), *afraid* (3), and *very afraid* (4).

Other questions on the CSAF tap into general mental health issues and are adapted from the *Diagnostic and Statistical Manual of Mental Disorders*, fifth edition (hereafter, *DSM-5*). Respondents were asked,

> During the past 2 weeks, how often have you experienced the following? Feeling nervous, anxious, or on edge; not being able to stop or control worrying; worrying too much about different things; trouble sleeping; being so restless that it is hard to relax; becoming easily annoyed or irritable; feeling afraid as if something awful might happen?

For each of these items, respondents rated themselves in one of the following ways: *not at all* (1), *sometimes* (2), *more than half the days* (3), *nearly every day* (4).

Finally, two questions on the survey ask about fears of unemployment and not having enough money for the future. For these questions as well, respondents were asked to assess their fears on a scale from *not afraid* (1) to *very afraid* (4).

Independent Variables

A main objective of this article is to shed light on how Americans understand and relate to new technologies relevant to work. I constructed a binary variable that distinguishes between *technophobes* (1) and "*nontechnophobes*" (0). For the purposes of this study, I define a "technophobe" as any respondent who reports being either *afraid* or *very afraid* of the following: robots replacing people in the workforce, robots that can make their own decisions and take their own actions, AI, people trusting AI to do work, and technology that they don't understand. A factor analysis of these variables shows that respondents answer these survey questions similarly (standardized Cronbach's $\alpha = .90$).

A number of essential demographic variables are also used in this study. The first of these variables includes age measured continuously from age 18 and older. For the respondent's gender, a binary variable labeled *female* has the response values of 1 = *female* and 0 = *male*. With over 70% of the sample identifying as White, a race variable was constructed along binary lines where 1 = *White* and 0 = *non-White.* A third standard control variable asks respondents whether they live in a *metropolitan* area, and respondents who answered affirmatively = 1 whereas *nonmetro* residents = 0. Another essential control variable in these analyses involves education. With research by Autor, Levy, and Murnane (2003) suggesting that workers with nonroutine, manual work have greater job security than those involved in routine cognitive/manual work, greater levels of education may not necessarily protect against loss of employment. In fact, workers in well-educated fields and with higher incomes may have greater reasons to fear emerging workplace technology. However, given

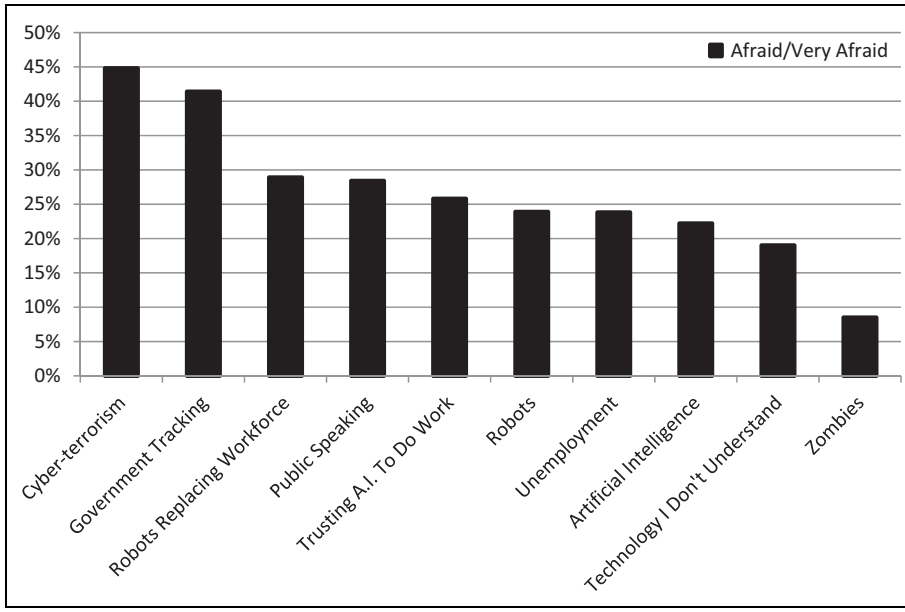

Figure 1. Select fears of the American population. Chapman Survey of American Fears (2015).

previous literature on technophobia and in keeping with the common adage—we fear what we don't understand—education may also buffer against various fears. Generally, more education translates into more knowledge and resources for people to guard and protect themselves against loss of employment. Whatever the case may be, in this article, education is measured as a continuous variable ranging from *no formal education* (1) to a *professional or doctorate degree* (14).

For similar reasons, income is considered a possible predictor of fear in that higher income may provide the means for physical or emotional security against various threats. The survey asked respondents to report their annual household income, and response categories ranged from *less than US$5,000* (1) to *US$175,000 or more* (19) with increments ranging from US$2,499 on the lower end to US$24,999 on the higher end. Marital status is also taken into consideration where being *married* = 1 and *unmarried* = 0. Political party also provides an important measure of one's self-identified political affiliation. The question on the CSAF asks, "Do you think of yourself as Republican, Democrat, or Independent?" Answer choices included *strong Republican* (1), *moderate Republican* (2), *leaning Republican* (3), *Independent* (4), *leaning Democrat* (5), *moderate Democrat* (6), and *strong Democrat* (7).

Analytic Approach

To understand the contours of American fears and how fears of technology and unemployment fit into this landscape, some visual comparisons of what Americans fear most may prove useful. The CSAF targets several domains of fear and shows that various technological concerns prove to be some of the greatest fears Americans have (Figure 1).

A second analytical objective is to evaluate the demographic composition of technophobes. Summary statistics show a comparison of means for technophobes and nontechnophobes and illustrate differences between these populations (Table 1).

Third, an initial concern in trying to understand who fears technology the most is that it may be difficult to differentiate between technophobes and phobic people in general. The extensive research

Table 1. Descriptive Statistics of Technophobes and Nontechnophobes.[a]

	Technophobes[b] (37% of Sample)				Nontechnophobes (63%)			
	N	*M*	*SD*	Range	*N*	*M*	*SD*	Range
Independent variables								
Age	575	51.663	17.172	18–90	966	49.175	17.519	18–88
Female	575	0.569	0.496	0–1	966	0.482	0.500	0–1
White	575	0.670	0.471	0–1	966	0.746	0.435	0–1
Education	575	10.050	1.989	2–14	966	10.572	2.048	1–14
Income	575	11.635	4.427	1–19	966	12.602	4.352	1–19
Married	575	0.548	0.498	0–1	966	0.578	0.494	0–1
Metro	575	0.837	0.370	0–1	966	0.856	0.351	0–1
Political party	564	4.271	1.755	1–7	941	4.045	1.755	1–7
Dependent variables								
Fear of decision-making robots	573	0.616	0.487	0–1	925	—	—	—
Fear of robots in the workforce	573	0.729	0.445	0–1	925	—	—	—
Fear of AI	569	0.555	0.497	0–1	921	—	—	—
Fear of people trusting AI to do work	574	0.639	0.481	0–1	920	—	—	—
Fear of technology you don't understand	570	0.465	0.499	0–1	922	—	—	—
DSM-5 mental health								
Nervous, anxious, or on edge	572	0.152	0.359	0–1	943	0.109	0.312	0–1
Can't stop worrying	570	0.163	0.370	0–1	942	0.086	0.280	0–1
Worrying too much about different things	570	0.177	0.382	0–1	942	0.106	0.308	0–1
Trouble sleeping	572	0.219	0.414	0–1	941	0.152	0.359	0–1
Restless/hard to relax	568	0.144	0.352	0–1	942	0.088	0.284	0–1
Annoyed or irritated	571	0.156	0.363	0–1	941	0.106	0.308	0–1
Afraid something awful might happen	571	0.100	0.300	0–1	940	0.061	0.239	0–1
Job and money								
Unemployment	572	0.309	0.463	0–1	922	0.152	0.359	0–1
Not having enough money	573	0.492	0.500	0–1	929	0.260	0.439	0–1

Note. *M* = mean; *SD* = standard deviation; *DSM-5* = *Diagnostic and Statistical Manual of Mental Disorders*, fifth edition; AI = artificial intelligence.

[a]Chapman Survey of American Fears (2015). [b]Defined as those who report being either afraid or very afraid of one of the following: robots that can make decisions and take actions on their own, robots replacing people in the workforce, AI, people trusting AI to do work, and technology they don't understand. Standardized Cronbach's $\alpha = .90$.

that exists on computer anxiety and technophobes partially mitigates this concern (Brosnan, 1998; Durndell & Haag, 2002; Korukonda, 2005; Rosen & Weil, 1995b; Weil & Rosen, 1995). However, because this study investigates new dimensions of technophobia, particularly robots and AI, it is important to make sure technophobes are not just a subset of a larger group of generally fearful people. To make this distinction, I first illustrate that technophobes reserve their greatest fears for technological concerns, even though they may fear other things as well (Figure 2). If it is the case that technophobes are just as fearful about things as disparate as romantic rejection, global warming, and police brutality as they are about technology, then any effects technophobia may have in later regression analyses are statistical artifacts.

After providing descriptive statistics, I then run a series of binary logistic regressions that attempt to see what variables may significantly affect fears of technology. In Table 2, I regress five binary variables related to fears of technology against standard demographic controls (*not or slightly afraid* = 0, *afraid or very afraid* = 1). In Table 3, I run a series of binary logistic regressions that predict the effects of being a technophobe on assorted mental health outcomes taken from the *DSM-5*. Respondents who experienced anxiety-related health issues *more than half the days* or *nearly every day* in

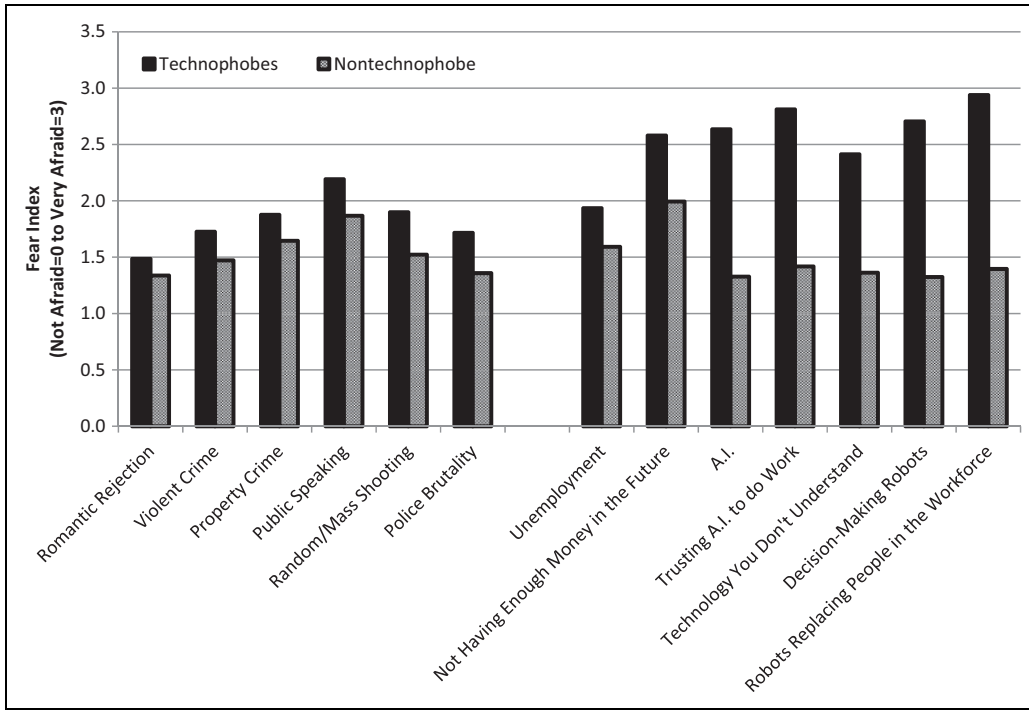

Figure 2. Select fears of technophobes and nontechnophobes. Chapman Survey of American Fears (2015).

Table 2. Binary Logistic Regressions With Odds Ratios Predicting Fears of Robots, Artificial Intelligence (AI), and Technology.[a]

Variables	Decision-Making Robots	Robots in the Workforce	AI	People Trusting AI to Do Work	Technology They Don't Understand
Age	1.012**	1.009*	1.008	1.004	1.011**
Female	1.278	1.511***	1.318*	1.308*	1.657***
White	0.667**	0.660**	0.621**	0.808	0.639**
Education	0.923*	0.901**	0.878***	0.880***	0.851***
Income	0.988	0.967*	0.976	0.986	0.974
Married	1.058	1.134	1.211	1.133	1.288
Metro	1.045	0.808	0.801	0.768	1.058
Political party	1.035	1.033	1.030	1.017	1.072
N	1,474	1,474	1,466	1,470	1,468
Rescaled R^2	.04	.06	.05	.04	.08

[a]Chapman Survey of American Fears (2015).
*$p < .05$. **$p < .01$. ***$p < .001$.

the past 2 weeks from which they answered the survey = 1 whereas *other respondents* = 0. In Table 4, I run four models of binary logistic regressions that predict fear of unemployment and fear of financial insecurity (again, *not or slightly afraid* = 0, *afraid or very afraid* = 1). Models 1 and 2 have fear of unemployment as the outcome variable, while technophobes are stepped into the second model to see whether there are significant effects that help explain more variation. A similar procedure pertains to Models 3 and 4, and technophobes are considered a key predictor in explaining

Table 3. Binary Logistic Regressions With Odds Ratios Predicting Anxiety-Related Mental Health Concerns.[a]

Variables	1	2	3	4	5	6	7
Age	0.970***	0.976***	0.972***	0.993	0.977***	0.964***	0.966***
Female	1.440*	1.960***	1.593**	1.402*	1.347	1.318	1.489
White	1.480*	1.142	1.348	1.498*	1.157	1.262	1.037
Education	1.059	0.976	1.022	0.963	0.987	0.992	1.021
Income	0.907***	0.920***	0.916***	0.931***	0.902***	0.934***	0.901***
Married	0.838	0.725	0.749	0.727*	0.816	1.13	0.561*
Metro	1.153	1.690*	1.556	0.969	1.631	1.825*	1.521
Political party	1.013	0.986	0.965	1.025	0.933	0.986	0.923
Technophobes[b]	1.505*	1.947***	1.785***	1.426*	1.653**	1.633**	1.763**
N	1,488	1,486	1,485	1,486	1,483	1,485	1,484
Rescaled R^2	.11	.13	.12	.07	.10	.10	.15

Note. Model 1 = feeling nervous, anxious, or on edge; Model 2 = not being able to stop or control worrying; Model 3 = worrying too much about different things; Model 4 = trouble sleeping; Model 5 = becoming so restless that it is hard to relax; Model 6 = becoming easily annoyed or irritable; Model 7 = feeling afraid as if something awful might happen.
[a]Chapman Survey of American Fears (2015). [b]Defined as those who report being either afraid or very afraid of robots that can make decisions and take actions on their own, robots replacing people in the workforce, AI, people trusting AI to do work, and technology they don't understand. Standardized Cronbach's $\alpha = .90$.
*$p < .05$. **$p < .01$. ***$p < .001$.

Table 4. Binary Logistic Regressions With Odds Ratios Predicting Fears of Unemployment and Not Having Enough Money.[a]

	Fear of Unemployment		Fear of Not Having Enough Money	
Variables	Model 1	Model 2	Model 3	Model 4
Age	0.962***	0.957***	0.975***	0.971***
Female	1.111	1.020	1.248	1.167
White	0.817	0.883	0.947	1.022
Education	1.009	1.040	0.968	0.993
Income	0.926***	0.926***	0.928***	0.930***
Married	1.136	1.140	1.114	1.119
Metro	1.422	1.524*	1.318	1.382
Political party	1.008	0.996	1.042	1.031
Technophobes	—	3.011***	—	2.868***
N	1,469	1,469	1,476	1,476
Rescaled R^2	.14	.19	.10	.16

[a]Chapman Survey of American Fears (2015).
*$p < .05$. **$p < .01$. ***$p < .0001$.

fears of not having enough money in the future. For these and previous regression models, in cases where there are missing data constituting less than 5% of the overall sample size, I have omitted responses using list-wise deletion.

Results

The findings from the descriptive statistics in Table 1 show that, on average, technophobes are around 52 years old, female, and have less than a college degree. Over half the technophobes in this sample are married, live in a metropolitan area, and identify as politically conservative. Although

this is true of other fears in general, if technology is the democratizing panacea that some believe it to be, we would expect that minority groups would feel less afraid of technology than they do for other items on the CSAF. However, despite the tenor of many technological enthusiasts who believe that technology creates (job) opportunities and eliminates inequalities, it is those in historically marginalized groups—women, non-Whites, and the less educated—who report being most fearful of technology.

A second finding worth highlighting is that technophobes are disproportionately afraid of technology. While this observation may appear redundant, what Figure 2 illustrates is that technophobes are not equally afraid of other potentially threatening or dangerous life circumstances. Although they are still more afraid of other things like romantic rejection, public speaking, and police brutality when compared to others, technophobes nevertheless direct their phobias significantly toward technology. This means that, despite whatever else technophobes may fear, their unique and disproportionate propensity to fear technology may have other significant outcomes.

To understand further the demographic composition of technophobes, I ran five binary logistic regressions with odds ratios predicting various technophobic measures. In Table 2, the most significant predictive effects of fearing robots, AI, or technology that the respondent does not understand are being non-White, female, and having less education, though in some models, age and income are also statistically significant. Overall, however, the results confirm Hypothesis 1a for Models 2–5 (education effects) and all five models for Hypotheses 1b (racial effects) and 1c (gender effects) in Table 2. Specifically, for each additional unit increase in education, there is an 8–15% decrease in fearing the listed technophobic items. Thus, the projections made by Autor et al. (2003), which hold that white-collar workers are more susceptible to having their jobs automated than blue-collar employees in manual labor, is potentially unrealized by those with higher levels of education. Further, Whites have 33–38% lower odds of fearing technology whereas females have 31–66% higher odds of fearing technology when compared to males. Thus, in confirmation of Hypothesis 1, the results suggest those with the least amount of education, non-White minorities, and females express greater fear and apprehension to robots, AI, and technology they do not understand.

In Table 3, I included technophobes as a predictor variable for anxiety-related mental health concerns. The dependent variables here are adapted from the *DSM-5* and asked respondents questions about their anxieties, worries, sleep patterns, restlessness, inability to relax, susceptibility to irritation, and foreboding feelings. As the results show, increases in age and income generally predict lower levels of anxiety and restlessness. However, those who report being afraid or very afraid of technology are predicted to have much greater odds of anxiety-related mental health concerns. For instance, technophobes have 95% greater odds of *not being able to stop or control worrying* when compared to others (Model 2) and 76% greater odds of *feeling afraid as if something awful might happen* (Model 7). These findings suggest that technophobia and general anxiety are highly correlated, and while technophobia may be symptomatic of a broader anxious temperament among some individuals, causality between the two is possible.

Finally, in Table 4, I examine the odds ratios that predict fears of unemployment and financial insecurity. Given the projections of the economists and technology forecasters discussed in this article, these outcome variables tap into an important sociological question—namely, what effects will fears of technology have on other fears such as unemployment and financial insecurity? These outcome variables have also been shown to be important predictors of other negative life outcomes. Reichert and Tauchmann (2011) have found that psychological distress levels increase for those who sense they lack job security, and the negative health effects of unemployment and/or financial strain are well documented (Martikainen et al., 2007; Tefft, 2011; Wilkinson, 2016). With these observations in mind, Table 4 shows that technophobes are 3 times more likely to fear unemployment when compared to others (Model 2) and 2.87 times more likely to fear not having enough money in the future (Model 4). Further, the statistical procedure of stepping technophobes into the second and

fourth models in Table 4 helps explain 5–6% more of the variation. While the effects are modest, it is likely that exhibiting a fear or aversion to technology exacerbates other fears related to employment and financial insecurity.

Discussion and Conclusion

The aim of this article is to gauge American receptivity to technologies that may threaten to make certain occupations obsolete. The results suggest a few things about how new workplace technologies—specifically, robots, AI, and technology that is not well understood—affect some people more than others and impact anxiety levels and prospects about employment and financial insecurity. Far from being unanimously welcomed by all segments of society, there exists a distinct population of technophobes who express disproportionate fears regarding its continual encroachment into modern life. Statistically, females, non-White minorities and those with the least amount of education are more likely to fear these developing technologies (in support of Hypothesis 1a, 1b, and 1c). This further suggests that despite the utopian promises of technological visionaries (Gates, 1996; Kurzweil, 2006; Schmidt & Cohen, 2014), some Americans discernibly fear technological advances, particularly in the area of workforce robotics and trusting AI to do the work of humans. Although this apprehension may exist because of a basic lack of information or access to educational technology, it is equally possible that the technophobes sampled here feel threatened by technology that may replace them in the workforce.

A second implication of this study is that the population of technophobes exhibit higher than average anxiety-related mental health issues. The dependent measures used in this article, adapted from the *DSM-5*, are all significantly affected by including technophobes into the binary logistic regression models (in support of Hypothesis 2). Given that technophobes exhibit disproportionate fears of technology and are not simply a subgroup of generally fearful people (Figure 2), fears of technology may be understood as either correlational or having the additive effect of sustaining anxiety-related health problems, but further and preferably longitudinal studies would help to examine these connections.

Third, it is possible that these concerns spur on other fears, thus leading to a cyclical or feedback problem whereby various fears compound and create new obstacles for individuals. As I have shown, the inclusion of technophobes into the binary logistic regression models in Table 4 explains more variation than other models and shows that technophobes are more likely to fear unemployment and financial insecurity (in support of Hypothesis 3a and 3b).

With these observations in mind, some limitations to this study deserve mention and raise further questions. One of the most striking results is that women consistently report being fearful when compared to men. But are women more fearful or is there a gendered response bias that inhibits men from admitting their fears? If the former, why is it that women are more fearful than men when it comes to technology? Some feminist scholars argue that the computer industry and online gaming culture are largely male-oriented fields that frequently marginalize and harass women (Cherny, 1996; Natale, 2002; K. O. Norris, 2004; Turkle, 1997), but further research could explore the extent to which technology has masculine values embedded in its architecture and various interfaces.

Other limitations to this study pertain to the survey itself. First, though the CSAF intends to capture the individual and social effects of various human fears, it is impossible to know whether those who are most afraid are represented in this sample population. If one is truly fearful, will that respondent answer the telephone from an unknown number and agree to take a survey about fear? If they are truly technophobic, will they agree to use a computer to answer the survey questions? While the CSAF contains a larger and more diverse sample than previous studies on technophobia, there could still be a selection bias that problematizes the CSAF sample and creates obstacles for the researchers using this data. Second, personality traits are also not measured in the survey instrument,

but previous studies on technophobia have found important personality correlates. Lastly, some work may need to go into distinguishing between conscious and unconscious fears since unconscious or visceral reactions to emotionally upsetting stimuli are often the most common types of fears. However, these reactions may not bubble up to the level of conscious recognition or be captured in survey data.

Two areas of research that explore the rise of automation in the workplace and technophobia have heavily informed this article. The first of these is found in the projections of economists such as Acemoglu (2003), Frey and Osborne (2013), Brynjolffson and McAfee (2014), and Ford (2015) who speculate that changes in digital technology may induce widespread unemployment, especially for those with routine job responsibilities. Individuals in these professions, rather than manual laborers or workers in creative fields, are perhaps most at risk for losing their jobs to AI and machine-learning software. Even so, if the seeds for structural unemployment have already been planted, people in certain occupations may legitimately fear technological unemployment and financial insecurity in the coming years, and the possibility of major social unrest or a neo-Luddite movement could increase among those whose jobs are automated. If, however, these fears are misplaced, then more work needs to be done to dispel technophobia as a legitimate social concern.

Other literature that informs this article comes from studies in fear from the sociology of emotions and research on the causes and consequences of technophobia. Turner and Stets's (2005) work in *The Sociology of Emotions* as well Wuthnow's (2010) and Glassner's (2000) analyses of fear are pivotal in elucidating what fear is and why it matters. These researchers show that fear has *biological*, *institutional*, and *cultural* dimensions that must be taken seriously. Song's (2003) analysis of technological discourses also provides a much needed platform from which to understand the ironic implications of this article. That is, the promises of prosperity and progress, though made by many techno-elites, have in actuality been realized mainly by those very people who are titans in the industry. For those whose jobs are threatened, on the other hand, technology looks much different. According to this study, 37% of the sample population are either afraid or very afraid of the specific types of technology considered here, and such fears may have negative effects on mental health and potentially aggravate fears of unemployment and financial insecurity.

In the end, the trajectory of the digital economy may mean that an unprecedented number of citizens could lose their jobs to robots and software that can work for cheaper and for longer hours than any human. If such a transformation occurs, it will most likely be gradual (Susskind & Susskind, 2016), but even so, anticipating the individual and social outcomes is a matter worth pursuing. Hopefully, by recognizing the potential dangers of unemployment and by assessing both the trajectories and discourses associated with newer technologies, social scientists will be more equipped to discuss the implications of robotics, AI, and other technologies that are not well understood. At this moment, however, the relative inattention that has been given to this area of study should lead to new questions; catalyze more studies at the intersection of technology, culture, and the economy; and provoke new criticisms of present research, this one included.

Declaration of Conflicting Interests

The author declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Funding

The author received no financial support for the research, authorship, and/or publication of this article.

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Author Biography

Paul K. McClure is a PhD candidate in the department of sociology at Baylor University whose research interests include technology, religion, and culture. His most recent publications include "Faith and Facebook in a Pluralistic Age," which is featured in *Sociological Perspectives*, and "Tinkering With Technology and Religion in the Digital Age," which is forthcoming in the *Journal for the Scientific Study of Religion*. E-mail: paul_mcclure@baylor.edu