



The Adoption and Travel Impacts of Teleworking: Will it be Different This Time?

Patricia L. Mokhtarian

*Susan G. and Christopher D. Pappas Professor
School of Civil and Environmental Engineering*

Georgia Institute of Technology

patmokh@gatech.edu

COMPASS webinar, August 4, 2020

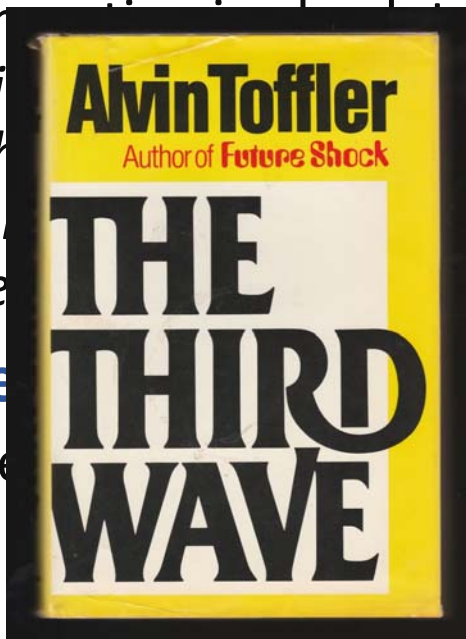
It's déjà-vu all over again!

■ Alvin Toffler (1980)

- “The Electronic Cottage”

■ Peter Drucker (1993)

- Comparison of the future: “It is now infinitely

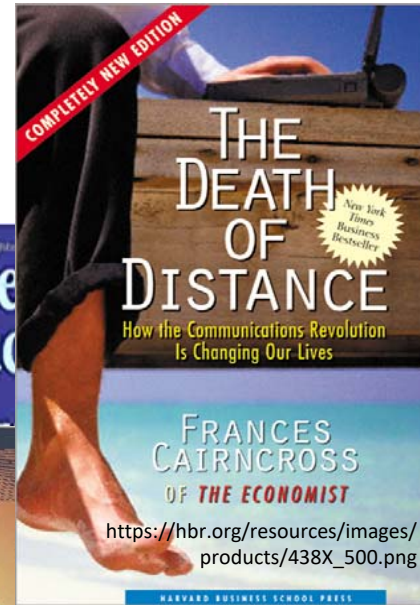
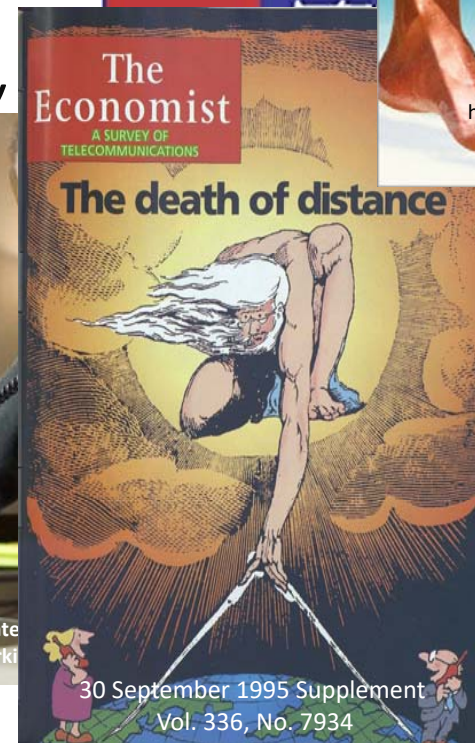


■ Frances Cairncross

- “The Death of Distance”



http://www.slate.com/content/2012/12/121220_FUT_Worki



It's déjà-vu all over again!

(Yogi Berra)

- **Alvin Toffler (1980)**

- “The Electronic Cottage”

- **Peter Drucker (1993)**

- Commuting is obsolete: *“It is now infinitely easier, cheaper and faster to do what the 19th century could not do: move information, and with it office work, to where the people are.”*

- **Frances Cairncross (1995, 1997)**

- “The Death of Distance”

A typology of extreme events for which teleworking has been promoted

Location of event	home, work, other bldg	<i>planned</i>
	either	<i>unplanned</i>
	transport network	<i>planned</i>

A typology of extreme events for which teleworking has been promoted

			<i>What is affected (unsafe, unfit, unavailable)</i>				
			structures		either		humans
			<i>natural</i>		<i>human</i>		<i>natural</i>
root cause →							
Location of event	home, work, other bldg	<i>planned</i>		relocation			
	either	<i>unplanned</i>	fire flood quake tornado blizzard hurricane	asbestos failure accident attack unrest		pandemic	
	transport network	<i>planned</i>		strike construction Olympics			

Examples...

- 1984 Los Angeles Olympics
- 1989 Loma Prieta (SF) quake
- 1992 Los Angeles riots
- 1992 flood in Chicago Loop
- 1993 NYC World Trade Center bombing
- 1994 Northridge (LA) quake
- 1995 Kobe (Japan) quake
- 1996 Atlanta Olympics
- 2002... NY... transit strike
- 2003 SARS pandemic
- 2004... blizzard (DC...)
- 2005 Hurricane Katrina
- 2007 MacArthur Maze fwy collapse, East Bay (SF)
- 2007 I-35W bridge collapse, Twin Cities
- 2008 Fix I-5 (Sacramento, CA)
- 2009 DC Metro crash
- 2011 Christchurch, NZ quakes
- 2011 Great East Japan earthquake
- 2012 London Olympics
- 2012 Hurricane Sandy
- 2016 Chilean earthquakes
- 2017 Atlanta I-85 bridge collapse
- 2020 Coronavirus pandemic

2012

SHRM

Telecommuting May Ease Chaos of a Transit Strike

Threat of Strike in New York City Puts Spotlight on Remote Access for Workers

By Stephanie Miles *The Wall Street Journal Online*

Updated Dec. 13, 2002 4:10 pm ET

<https://www.wsj.com/articles/SB1039204370405654513>

2002

Hurricane Sandy Forces Companies to Reconsider Telework

<https://blog.shrm.org/workplace/hurricane-sandy-forces-companies-to-reconsider-telework>

By Greg Wright | On November 26, 2012 | News Updates

Los Angeles Times

Earthquake: The Long Road Back : Telecommuting Takes Off After Quake : Business: Building owners are converting unused spaces into work stations to meet the demand. Most employees welcome the change.

<https://www.latimes.com/archives/la-xpm-1994-02-05-me-19465-story.html>

1994

of an earthquake to shake loose some interest

Move to telecommute may be an Olympic legacy

By Jeffrey Kagan - Oct 7, 1996, 12:00am EDT Updated Oct 7, 1996, 12:00am EDT

Now that Atlanta's great Olympic telecommuting experiment has concluded, what have we learned? Many Atlanta businesses braced for Olympics-related gridlock by setting up telecommuting programs and business continuity plans to

1996

<https://www.bizjournals.com/atlanta/stories/1996/10/07/smallb7.html>

So (even pre-COVID-19) teleworking must be through the roof by now?

▪ A lot depends on how you define it! “Working from home” includes

- Moonlighting (second jobs)
- Self-employment (blue-collar as well as white and pink)
- Farmers and live-in domestics
- Long-distance teleworkers
- Overtime (evenings/weekends)

as well as

- Salaried employees not commuting

Transportation impacts differ markedly

“telework” more broadly

reduce

- salaried employees
- live-in domestics

ambiguous

- self-employment
- moonlighting
- long-distance telework

neutral

- overtime WAH

increase

- fieldwork
- working while traveling

How much (pre-COVID-19) working from home is there?

- Statistics like “43% of employees work remotely” (2016) include all of those forms, plus just “away from their team members”

<https://cloc.umd.edu/library/research/State%20of%20the%20American%20Workplace%202017.pdf>

- Census/American Community Survey (ACS) journey-to-work numbers give us the most consistent count for the US

- “How did [you] usually get to work last week?”

- “Worked from home”

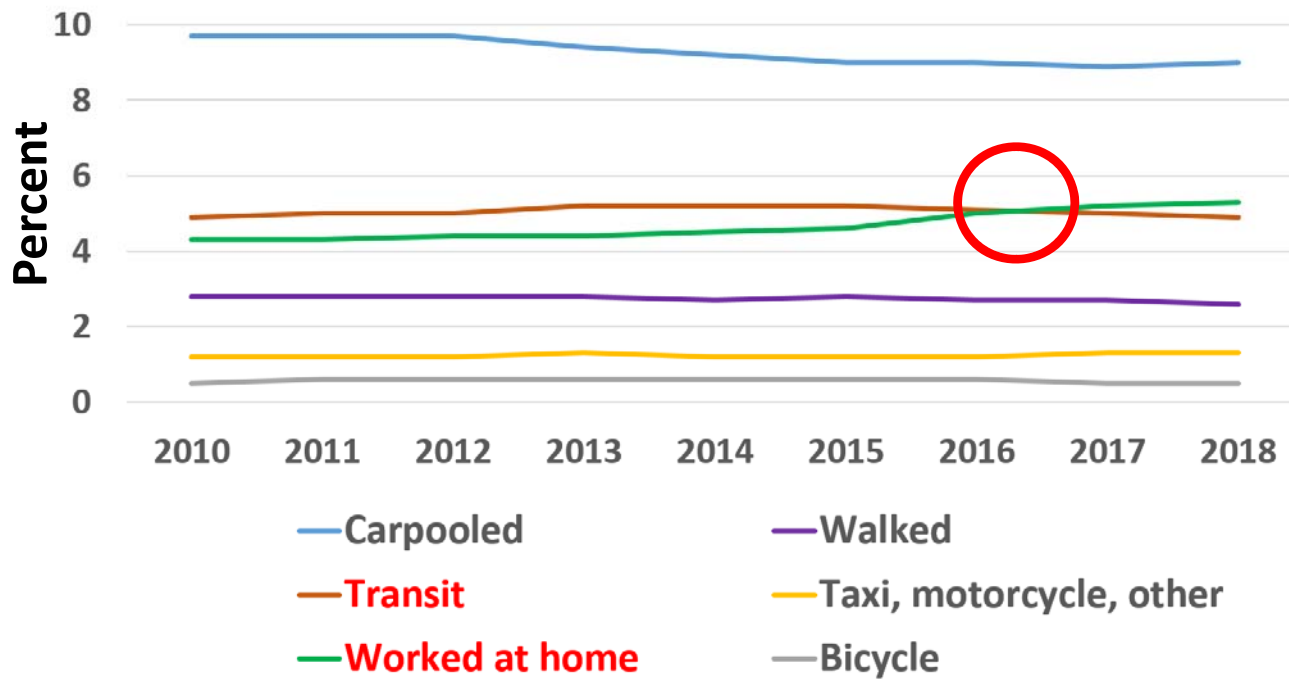
- **Includes** self-employed

- **Excludes** less frequent teleworkers

<https://www2.census.gov/programs-surveys/acs/methodology/questionnaires/2020/quest20.pdf>

What do the US Census numbers show?

"Usual commute mode" shares



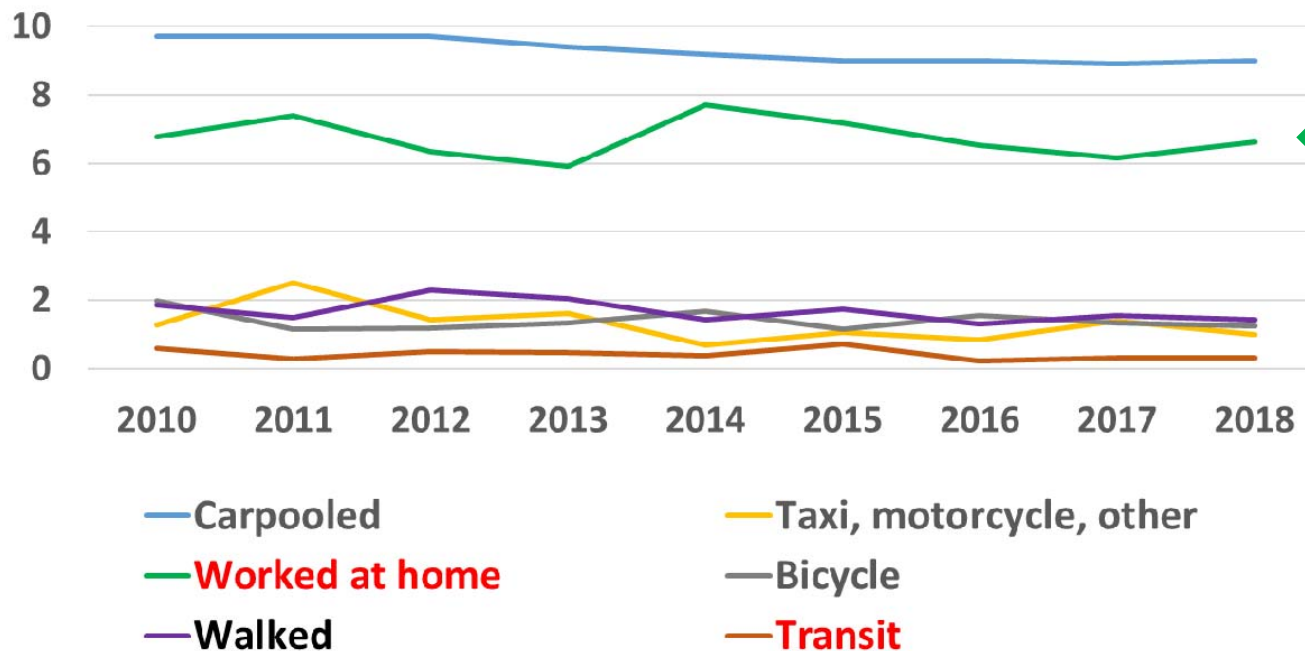
- Work-at-home commute share has increased from **2.3%** in **1980** to **5.3%** in **2018**
- It now **exceeds the share of transit** (4.9% in 2018)

~77% drive-alone share omitted

Mokhtarian et al. 2005; <https://data.census.gov/cedsci/table?q=S08&d=ACS%201-Year%20Estimates%20Subject%20Tables&tid=ACSST1Y2018.S0801>

What do the US Census numbers show?

"Usual commute mode" shares in SW Idaho



• **Work-at-home** share has fluctuated between **6 and 8%**

• Its share is **10-30 x** that of **transit**

~80% drive-alone share omitted

<https://data.census.gov/cedsci/table?q=S08&d=ACS%201-Year%20Estimates%20Subject%20Tables&tid=ACSST1Y2018.S0801>

Why aren't the numbers higher?

- Not everyone's **job is suitable**
- Not everyone whose job is suitable **wants to**
- Not everyone whose job is suitable and wants to **is allowed to**
- Not everyone who ... is allowed to **does so on any given day**
- People often don't **do it for very long**

How many *can* work from home?

▪ Based on job

- **56%** (non-self-employed, could partially, Global Analytics), <https://globalworkplaceanalytics.com/work-at-home-after-covid-19-our-forecast>
- **40%** (Pew), <https://www.pewresearch.org/fact-tank/2020/05/06/telework-may-save-u-s-jobs-in-covid-19-downturn-especially-among-college-graduates/>
- **37%** (could entirely), Dingel & Neiman 2020

▪ Allowed to, available, eligible

- **29%** (non-self-employed, BLS), <https://www.bls.gov/news.release/pdf/flex2.pdf>
- **18%** (2017 National Household Travel Survey), https://nhts.ornl.gov/assets/FHWA_NHTS_Report_3B_Final_021119.pdf
- **7%** (civilian, BLS), “flexible workplace”, <https://www.bls.gov/ncs/ebs/benefits/2019/ownership/civilian/table39a.pdf>

How many *did* work from home (pre-COVID-19)?

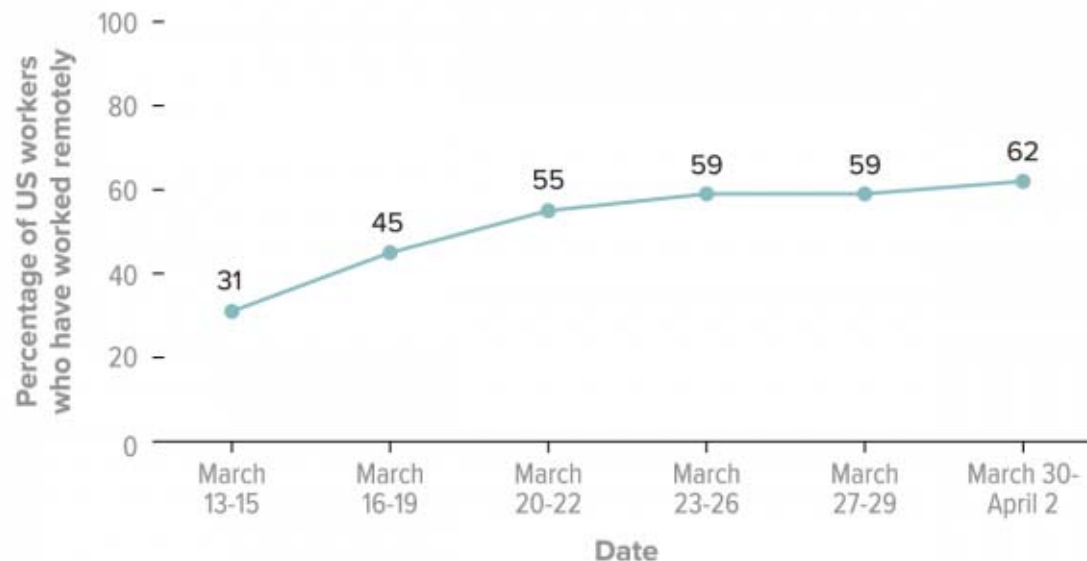
- **5.3%** “usually” (2018 American Community Survey)
(<https://data.census.gov/cedsci/table?q=S08&d=ACS%201-Year%20Estimates%20Subject%20Tables&tid=ACSST1Y2018.S0801>)
- non-self-employed: **8%** at least once/wk (could be weekends!),
2% full-time (2017-18 American Time Use Survey)
(<https://www.bls.gov/news.release/flex2.t03.htm>)
- **12%** “usually” (2017 NHTS) (<https://nhts.ornl.gov/assets/NHTSBriefTelecommuting041719.pdf>)

How many *do/have now* (during COVID-19)?

- **40%** (late March 2020, Pew) (<https://www.pewsocialtrends.org/2020/03/30/most-americans-say-coronavirus-outbreak-has-impacted-their-lives/>)
- **50%** (Apr/May 2020, MIT) (Brynjolfsson et al., 2020, N = 50,000)
- **62%** (Gallup) (<https://news.gallup.com/poll/306695/workers-discovering-affinity-remote-work.aspx>)

More recently, Gallup research revealed that the percentage of American workers who had worked from home [during the crisis, per <https://news.gallup.com/poll/306695/workers-discovering-affinity-remote-work.aspx>] doubled in the weeks between mid-March and early April 2020, to more than 60 percent. Three-fifths of people working from home said they'd like to keep doing so once the crisis is over. https://theweek.com/articles/915611/new-era-working-from-home?utm_campaign=newsletter&utm_source=afternoon&utm_medium=05_30_20-article_8-915611

A steep rise in remote working during Covid-19



SOURCE: GALLUP PANEL 2020

KNOWABLE MAGAZINE

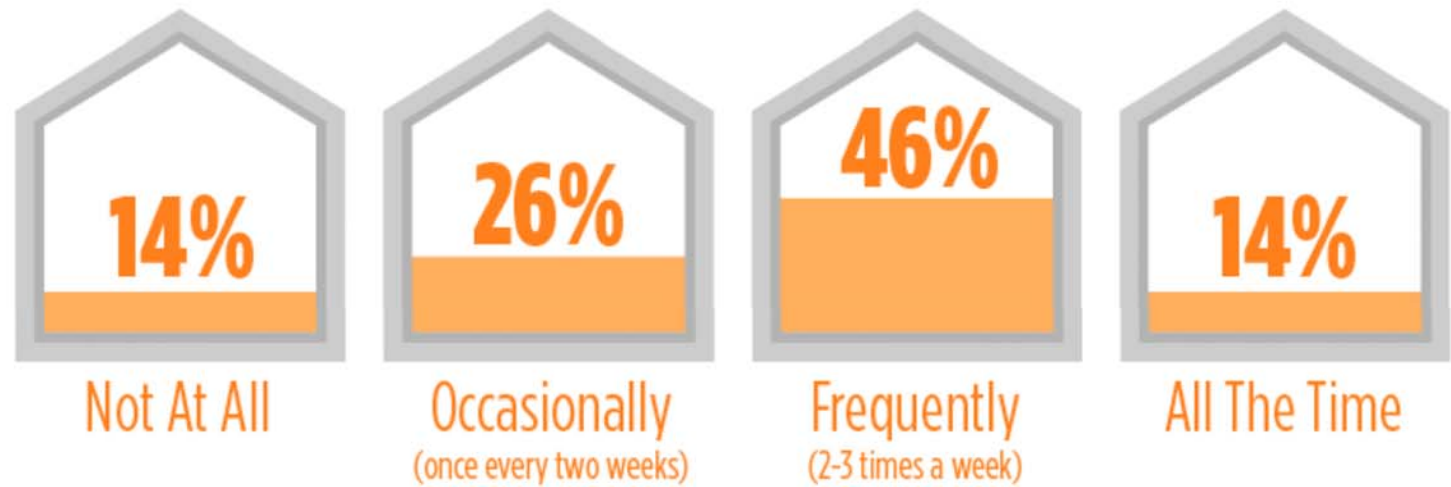
How many (say they) want to? (1)

- **59%** of those who WAH during COVID-19, “as much as possible” (<https://news.gallup.com/poll/306695/workers-discovering-affinity-remote-work.aspx>)
- Of FT office wrkrs (co’s of ≥ 100 emps) who WAH during COVID-19:
 - **56%** some of the time
 - **30%** most of the time
 - **12%** all the time (<https://www.gensler.com/uploads/document/695/file/Gensler-US-Work-From-Home-Survey-2020-Briefing-1.pdf>)

DO YOU PREFER TO GO BACK TO THE OFFICE OR CONTINUE TO WORK FROM HOME?



here's how often our respondents would like to work from home moving forward.



N=1,000; "not representative of all commuters in the United States"

<https://www.kittelson.com/ideas/will-covid-19-permanently-alter-teleworking-and-commuting-patterns-heres-what-1000-commuters-told-us/>

How many (say they) *want to*? (2)

- Of those who WAH during COVID-19, **54% primarily, 75% occasionally**
 - But **< 40%** “feel strongly that their employer should provide employee opt-in remote work options when returning to normal operations”???

<https://newsroom.ibm.com/2020-05-01-IBM-Study-COVID-19-Is-Significantly-Altering-U-S-Consumer-Behavior-and-Plans-Post-Crisis>
- **Maybe I “want to, but know I really can’t, or shouldn’t”?**
 - Only **37%** of those who **could** and **wanted to** actually **did**

(Mokhtarian & Salomon 1996)

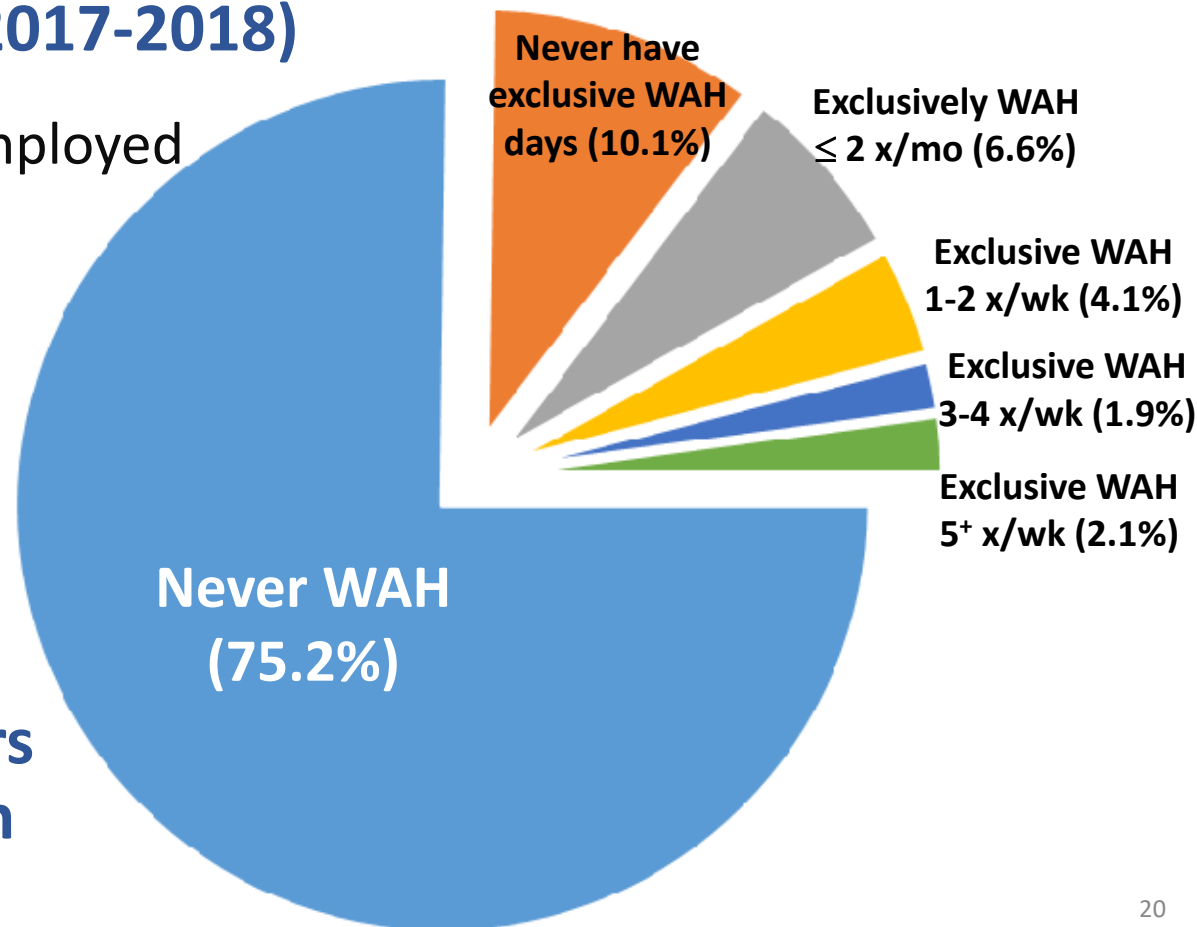
How often did they telework (pre-COVID-19)?

■ American Time Use Survey (2017-2018)

(<https://www.bls.gov/news.release/flex2.t03.htm>)

- Main job only, excludes self-employed
- “Worked at home”
 - **Excludes** telework center
 - **Includes** evenings
- “Worked exclusively at home”
 - **Excludes** home+coffee shop
 - **Includes** weekends

- Ave. frequency ~1.7 days/wk
→ ~5% non-self-empl workers exclusively WAH on any given weekday



There's an optimum level of teleworking

- The optimum level will differ from person to person, and over time for the same person
- On average, *job satisfaction* plateaued at around 15 hours / week of teleworking – i.e. at about *2 days/week*
- The optimum level differed by job and person characteristics

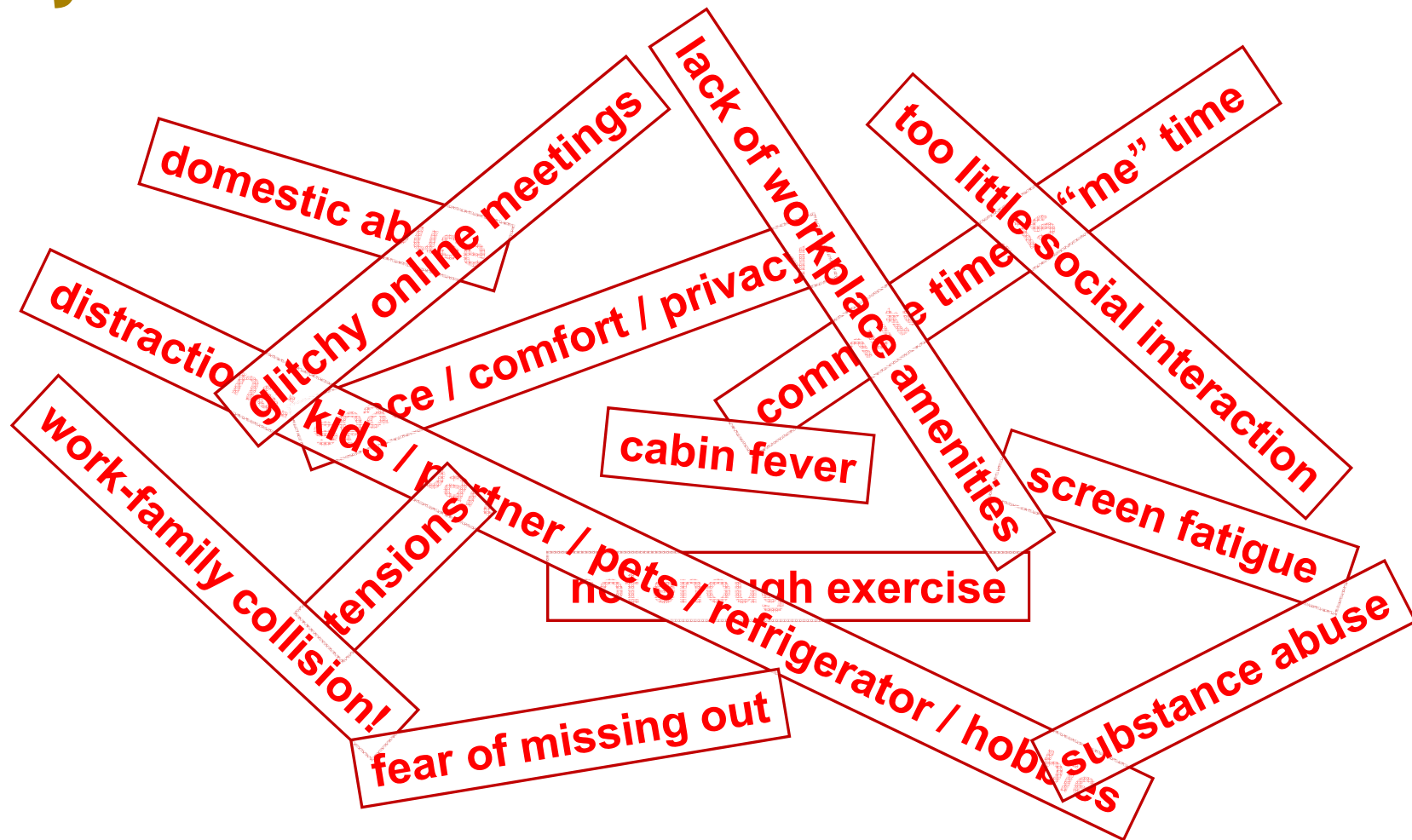
How long did they telework (pre-COVID-19)?

- **An under-researched question!**
- **After the 1989 Loma Prieta (SF) quake** (Pratt 1991):
 - Only half the teleworkers (N = 32) were still doing so 2-6 mos later
- **Across three 2-year pilot projects** (Varma et al. 1998):
 - 60-70% (N=773) were still doing so at the end
- **In one study of telecenter users** (Varma et al. 1998):
 - 50% (N=274) had stopped teleworking within 9 months
- **Constraints more important than preferences**

Why *wouldn't* we want to work from home?

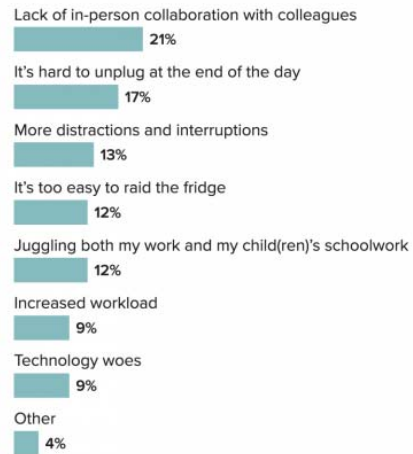
- Saves time (commuting, getting dressed?)
- Saves money (commuting, grooming?)
- Better work-family balance
- Higher productivity
- Less stress
- Safer neighborhoods (eyes on the street)
- Job retention, access
- Good for the environment
- **Less contagion!!!!**

Why would we want to work from home?

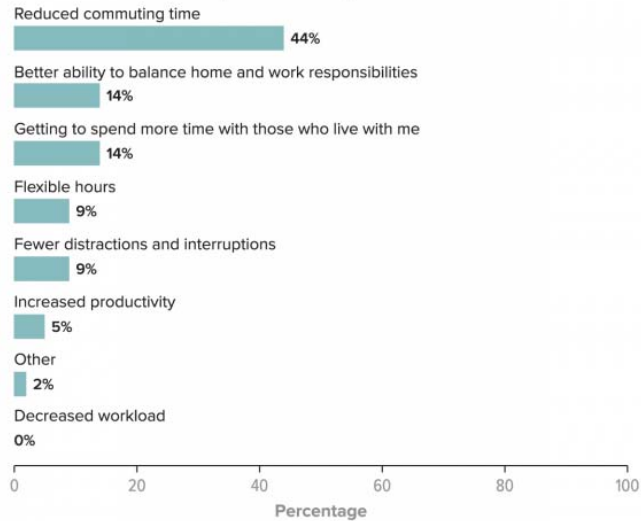


Pluses and minuses of remote work during Covid-19

What has been your biggest challenge while working from home?



What has been the best part of working from home?



SOURCE: © 2020 SOCIETY FOR HUMAN RESOURCE MANAGEMENT

KNOWABLE MAGAZINE

https://theweek.com/articles/915611/new-era-working-from-home?utm_campaign=newsletter&utm_source=afternoon&utm_medium=05_30_20-article_8-915611

Why *wouldn't* managers want their staff to work from home?

■ Saves a ton of money

- On *real estate* (if eliminating assigned offices)
- Potentially on *wages* (hiring from lower cost-of-living areas)

■ Improves recruitment

■ Improves retention

■ Reduces absenteeism

■ Increases productivity

■ Virtue signaling (care about environment, employees)

Why *don't* managers want their staff to work from home? (if they don't have to)

- **Management resistance is still perhaps the strongest barrier, often for good reasons...**
 - Value of in-person communication
 - Greater “overhead” of remote management
- **... and often for weaker ones**
 - “How will I know they’re really working?”
 - “I don’t want to let Susie do it but not Joe”

Why don't managers want their staff to work from home? (if they don't have to)

- **Management resistance is still perhaps the strongest barrier, often for good reasons...**
 - Value of in-person communication
 - Greater “overhead” of remote management
- **... and often for weaker ones**
 - “How will I know they’re really working?” (How do you know now?)
 - “I don’t want to let Susie do it but not Joe” (should be able to defend those decisions, but it takes time and can be a hassle)

Won't it be different this time?

- Well, we've heard that before ...
- But technology's so much better now...
 - And it will get even better!
 - But technology is not the main barrier
 - Considering that tech-based companies such as **Yahoo** (2013), **Reddit** (2014), and **IBM** (2017) had previously cut back or withdrawn teleworking programs...
- Some key reasons for the slow adoption of working from home have not gone away
 - Value of in-person communication
 - Weak employee preferences
 - Home, internal constraints

The boring (likely) truth

- We will neither snap back to the status quo ante
- Nor will “everything” be different now
- We will be somewhere in between

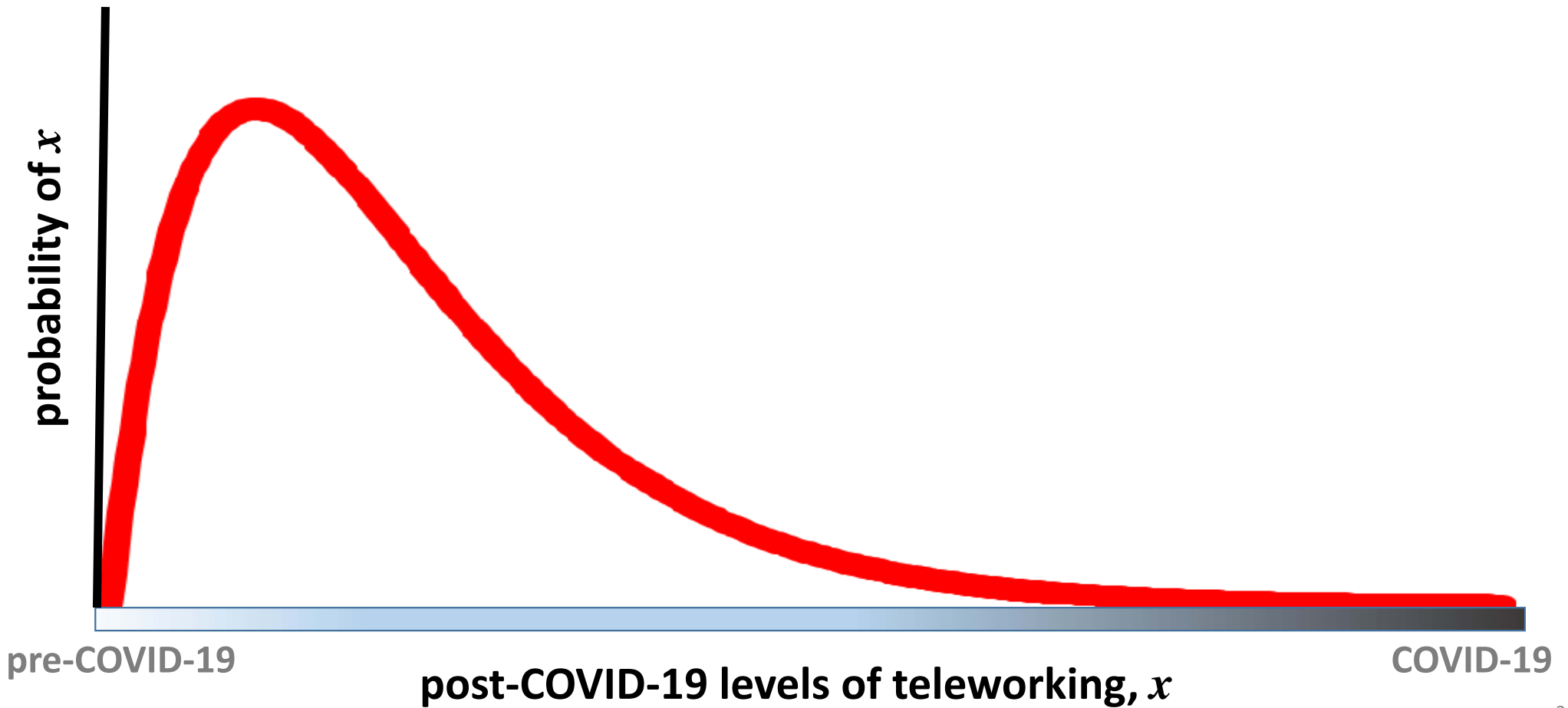


<https://images7.alphacoders.com/438/thumb-1920-438352.jpg>

pre-COVID-19 levels

COVID-19 levels

Pat's probabilistic prediction



Closing thoughts ⁽¹⁾

- **We used to ask how to increase the adoption of teleworking**
- **A pandemic has taken care of that for us**
 - Arguably under less than ideal circumstances
 - But with lots of time to adjust...
- **So organizations and employees alike should have an adequate idea of its pros and cons**
- **Let's see what happens!**

Closing thoughts ⁽²⁾

■ Some research needs...

- Measurement of amounts of various types of telework, with careful and consistent definitions!
- Frequency, duration, reasons for starting, quitting, re-entry
- Impacts on residential location
- Carbon footprint of long-distance teleworkers
- Impact differences between opt-in and involuntary programs

■ Don't forget the ~40% who cannot telework

Selected references: Adoption, frequency (1)

- "The Impact of the Residential Built Environment on Work at Home Adoption and Frequency: An Example from Northern California", by Wei Tang, Patricia L. Mokhtarian, and Susan L. Handy. *Journal of Transportation and Land Use* **4(3)**(Fall), 2011, 3-22. doi: 10.5198/jtlu.v4i3.76, available at <https://www.jtlu.org/index.php/jtlu/article/download/76/186>.
- "Modeling the Joint Labor-Commute Engagement Decisions of San Francisco Bay Area Residents", by David T. Ory and Patricia L. Mokhtarian. Chapter 25 in Hani S. Mahmassani, ed., *Transportation and Traffic Theory: Flow, Dynamics, and Human Interaction*. Oxford, UK: Elsevier Ltd., 2005, pp. 487-506.
- "Measuring the Measurable: Why Can't We Agree on the Number of Telecommuters in the US?", by Patricia L. Mokhtarian, Ilan Salomon, and Sangho Choo. *Quality and Quantity* **39**, 2005, 423-452. Authors' postprint available at <http://repositories.cdlib.org/postprints/821/>.
- "Patterns of Telecommuting Engagement and Frequency: A Cluster Analysis of Telecenter Users", by Patricia L. Mokhtarian and Ravikumar Meenakshisundaram. *Prometheus* **20(1)**, 2002, 21-37.
- "Worker Telecommunication and Mobility in Transition: Consequences for Planning", by Amy Helling and Patricia L. Mokhtarian. *Journal of Planning Literature* **15(4)** (May), 2001, 511-525.
- "Modeling Employees' Perceptions and Proportional Preference of Work Locations: The Regular Workplace and Telecommuting Alternatives", by Patricia L. Mokhtarian and Michael N. Bagley. *Transportation Research A* **34(4)**, 2000, 223-242.
- "Duration and Frequency of Telecenter Use: Once a Telecommuter, Always a Telecommuter?", by Krishna V. Varma, Chang-luan Ho, David M. Stanek, and Patricia L. Mokhtarian. *Transportation Research C* **6(1/2)**, 1998, 47-68.
- "Analyzing the Preference for Non-exclusive Forms of Telecommuting: Modeling and Policy Implications", by Michael N. Bagley and Patricia L. Mokhtarian. *Transportation* **24(3)**, 1997, 203-226.
- "Developing Models of Preference for Home-Based and Center-Based Telecommuting: Findings and Forecasts", by David M. Stanek and Patricia L. Mokhtarian. *Technological Forecasting and Social Change* **57(1/2)**, 1998, 53-74.

Selected references: Adoption, frequency (2)

- "The Impact of Gender, Occupation, and Presence of Children on Telecommuting Motivations and Constraints", by Patricia L. Mokhtarian, Michael N. Bagley, and Ilan Salomon. *Journal of the American Society for Information Science* 49(12), Special Issue on Social Informatics, 1998, 1115-1134.
- "The Future of Telecommuting", by Susan L. Handy and Patricia L. Mokhtarian. *Futures* **28(3)**, 1996, 227-240.
- "Forecasting Telecommuting: An Exploration of Methodologies and Research Needs", by Susan L. Handy and Patricia L. Mokhtarian. *Transportation* **23**, 1996, 163-190.
- "Modeling the Choice of Telecommuting 3: Identifying the Choice Set and Estimating Binary Choice Models for Technology-Based Alternatives", by Patricia L. Mokhtarian and Ilan Salomon. *Environment and Planning A* **28**, 1996b, 1877-1894. Postprint available at <http://ideas.repec.org/p/wpa/wuwpla/0505010.html>.
- "Modeling the Desire to Telecommute: The Importance of Attitudinal Factors in Behavioral Models", by Patricia L. Mokhtarian and Ilan Salomon. *Transportation Research A* **31(1)**, 1997, 35-50.
- "Modeling the Choice of Telecommuting 2: A Case of the Preferred Impossible Alternative", by Patricia L. Mokhtarian and Ilan Salomon. *Environment and Planning A* **28**, 1996a, 1859-1876. Postprint available at <http://ideas.repec.org/p/wpa/wuwpla/0505009.html>.
- "Modeling the Choice of Telecommuting Frequency in California: An Exploratory Analysis", by Jill S. Mannering and Patricia L. Mokhtarian. *Technological Forecasting and Social Change* **49(1)**, 1995, 49-73.
- "Planning for Telecommuting: Measurement and Policy Issues", by Susan L. Handy and Patricia L. Mokhtarian. *Journal of the American Planning Association* **61(1)** (Winter), 1995, 99-111.
- "A Comparison of the Policy, Social, and Cultural Contexts for Telecommuting in Japan and the United States", by Patricia L. Mokhtarian and Koji Sato. *Social Science Computer Review* **12(4)** (Fall), 1994, 641-658.
- "Modeling the Choice of Telecommuting: Setting the Context", by Patricia L. Mokhtarian and Ilan Salomon. *Environment and Planning A* **26(5)**, 1994, 749-766.
- "Telecommuting Frequency and Impacts for the State of California Pilot Project Participants", by Piotr Olszewski and Patricia L. Mokhtarian. *Technological Forecasting and Social Change* **45(2)**, 1994, 275-286.
- "Defining Telecommuting", by Patricia Lyon Mokhtarian, *Transportation Research Record* **1305**, 1991, 273-281.

Selected references: Transportation and air quality impacts ⁽¹⁾

- Mishra GS (2017) *Estimating the Travel Behavior Effects of Technological Innovations from Cross-Sectional Observed Data: Applications to Carsharing and Telecommuting*. Institute of Transportation Studies, University of California, Davis, Research Report UCD-ITS-RR-17-08. <https://its.ucdavis.edu/research/publications/>
- “Impacts of Information and Communication Technology”, by Giovanni Circella and Patricia L. Mokhtarian. Chapter 4 in Susan Hanson and Genevieve Giuliano (eds.), *The Geography of Urban Transportation*. Guilford Press, NY, 2017, pp. 86-109.
- “Home-based Telecommuting and Intra-household Interactions in Work and Non-work Travel: A Seemingly Unrelated Censored Regression Approach”, by Seung-Nam Kim, Sangho Choo, and Patricia L. Mokhtarian. *Transportation Research Part A* 80, 2015, 197-214.
- “Impacts of ICT on Travel Behavior: A Tapestry of Relationships”, by Patricia L. Mokhtarian and Gil Tal. Chapter 14 in *The Sage Handbook of Transport Studies*, Jean-Paul Rodrigue, Jon Shaw, and Theo Notteboom, eds., London: Sage Publications, 2013, 241-260.
- “Does Telecommuting Reduce Vehicle-miles Traveled? An Aggregate Time Series Analysis for the U.S.”, by Sangho Choo, Patricia L. Mokhtarian, and Ilan Salomon. *Transportation* 32(1), 2005, 37-64. Postprint available at <http://econwpa.wustl.edu/eprints/em/papers/0505/0505001.abs> or repositories.cdlib.org/postprints/547/.
- "A Space-Time Network for Telecommuting versus Commuting Decision-Making", by Anna Nagurney, June Dong, and Patricia L. Mokhtarian. *Papers in Regional Science* 82, 2003, 451-473.
- "A Synthetic Approach to Estimating the Impacts of Telecommuting on Travel", by Patricia L. Mokhtarian. *Urban Studies* 35(2), 1998, 215-241.
- "Analyzing the Travel Behavior of Home-Based Workers in the 1991 Caltrans Statewide Travel Survey", by Patricia L. Mokhtarian and Dennis K. Henderson. *Journal of Transportation and Statistics* 1(3), 1998, 25-41. Available at http://www.bts.gov/publications/journal_of_transportation_and_statistics/volume_01_number_03/.

Selected references: Transportation and air quality impacts (2)

- "The Transportation Impacts of Center-Based Telecommuting: Interim Findings from the Neighborhood Telecenters Project", by Prashant N. Balepur, Krishna V. Varma, and Patricia L. Mokhtarian. *Transportation* 25(3), 1998, 287-306.
- "The Tradeoff between Trips and Distance Traveled in Analyzing the Emissions Impacts of Center-Based Telecommuting", by Patricia L. Mokhtarian and Krishna V. Varma. *Transportation Research D* 3(6), 1998, 419-428.
- "The Impact of Telecommuting on the Activity Spaces of Participants and their Households", by Somitra Saxena and Patricia L. Mokhtarian. *Geographical Analysis* 29(2) (April), 1997, 124-144.
- "The Transportation Impacts of Telecommuting: Recent Empirical Findings", by Patricia L. Mokhtarian. *Understanding Travel Behaviour in an Era of Change*, P. R. Stopher and M. Lee-Gosselin, eds., Pergamon (Elsevier Science Ltd.), Oxford, Great Britain, 1997, 91-106.
- "Impacts of Center-Based Telecommuting on Travel and Emissions: Analysis of the Puget Sound Demonstration Project", by Dennis K. Henderson and Patricia L. Mokhtarian. *Transportation Research D* 1(1), 1996, 29-45.
- "The Travel and Emissions Impacts of Telecommuting for the State of California Telecommuting Pilot Project", by Brett E. Koenig, Dennis K. Henderson, and Patricia L. Mokhtarian. *Transportation Research C* 4(1), 1996, 13-32.
- "Using Travel Diary Data to Estimate the Emissions Impacts of Transportation Strategies: The Puget Sound Telecommuting Demonstration Project", by Dennis K. Henderson, Brett E. Koenig, and Patricia L. Mokhtarian. *Journal of the Air and Waste Management Association* 46(1), 1996, 47-57.
- "Methodological Issues in the Estimation of Travel, Energy, and Air Quality Impacts of Telecommuting", by Patricia L. Mokhtarian, Susan L. Handy, and Ilan Salomon. *Transportation Research A* 29A(4), 1995, 283-302.
- "The Effectiveness of Telecommuting as a Transportation Control Measure", by S. Sampath, S. Saxena, and P. L. Mokhtarian. *Proceedings of the ASCE Urban Transportation Division National Conference on Transportation Planning and Air Quality*, Santa Barbara, CA, July 28-31, 1991 (© 1992), 347-362.
- "Telecommuting and Travel: State of the Practice, State of the Art", by Patricia L. Mokhtarian. *Transportation* 18(4), 1991, 319-342.

Selected references: Residential/location impacts, cost-benefit analysis

Residential Location Impacts of Telecommuting

- “The Seoul of Alonso: New Perspectives on Telecommuting and Residential Location from South Korea”, by Seung-Nam Kim, Patricia L. Mokhtarian, and Kun-Hyuck Ahn. *Urban Geography* 33(8), 2012, 1163-1191.
- “Does Telecommuting Really Save Commute Time? Time, Distance, and Speed Evidence from State of California Workers”, by David T. Ory and Patricia L. Mokhtarian. Chapter 15 in Tanja van der Lippe and Pascale Peters, eds., *Competing Claims in Work and Family Life*. Cheltenham, UK: Edward Elgar, 2007, 249-267.
- “Which Came First, the Telecommuting or the Residential Relocation? An Empirical Analysis of Causality”, by David T. Ory and Patricia L. Mokhtarian. *Urban Geography* 27(7), 2006, 590-609.
- “Telecommuting, Residential Location, and Commute Distance Traveled: Evidence from State of California Employees”, by Patricia L. Mokhtarian, Gustavo O. Collantes, and Carsten Gertz. *Environment and Planning A* 36, 2004, 1877-1897.
- "Telecommuting and Residential Location: Theory and Implications for Commute Travel in the Monocentric Metropolis", by Jay R. Lund and Patricia L. Mokhtarian. *Transportation Research Record* 1463, 1994, 10-14.

Cost-Benefit Analysis of Telecommuting

- “Costs and Benefits of Home-Based Telecommuting: A Monte Carlo Simulation Model Incorporating Telecommuter, Employer, and Public Sector Perspectives”, by Kevan Shafizadeh, Debbie A. Niemeier, Patricia L. Mokhtarian, and Ilan Salomon. *ASCE Journal of Infrastructure Systems* 13(1) (March), 2007, 12-25.

Selected references: Responses to congestion/system disruption (1)

- “Calculation of Changes in Vehicle Miles Traveled for Drive-Along Commuting during a Temporary Freeway Closure: The Fix I-5 Project in Sacramento, California”, by David van Herick, Patricia L. Mokhtarian, and Xi He. *Transportation Research Record* 2319, 2012, 67-76.
- “Commuter Impacts and Behavior Changes during a Temporary Freeway Closure: The Fix I-5 Project in Sacramento, California”, by Liang Ye, Patricia L. Mokhtarian, and Giovanni Circella. *Transportation Planning and Technology* 35(3), 2012, 341-371. Editor’s Choice, 2012.
- “Individual Responses to Congestion Policies: Modeling the Consideration of Factor-Based Travel-Related Strategy Bundles”, by Sangho Choo and Patricia L. Mokhtarian. *KSCE Journal of Civil Engineering* 16(5), 2012, 822-834.
- “Non-work Travel Behavior Changes during a Temporary Freeway Closure: The Fix I-5 Project in Sacramento, California”, by Meiping Yun, David van Herick, and Patricia L. Mokhtarian. *Transportation Research Record* 2231, 2011, 1-9.
- “Effects of Gender on Commuter Behavior Changes in the Context of a Major Freeway Reconstruction”, by Patricia L. Mokhtarian, Liang Ye, and Meiping Yun. *Conference Proceedings 46, Women’s Issues in Transportation: Summary of the Fourth International Conference*. Volume 2: Technical Papers, pp. 143-153. Transportation Research Board, Washington DC, in press. Available at http://pubs.its.ucdavis.edu/publication_detail.php?id=1408.
- “How do People Respond to Congestion Mitigation Policies? A Multivariate Probit Model of the Individual Consideration of Three Travel-Related Strategy Bundles”, by Sangho Choo and Patricia L. Mokhtarian. *Transportation* 35(2), 2008, 145-163. Authors’ postprint available at <http://repositories.cdlib.org/postprints/2861>.

Selected references: Responses to congestion/system disruption (2)

- “How do Individuals Adapt their Personal Travel? A Conceptual Exploration of the Consideration of Travel-related Strategies”, by Xinyu Cao and Patricia L. Mokhtarian. *Transport Policy* 12(3), 2005, 199-206.
- “How do Individuals Adapt their Personal Travel? Objective and Subjective Influences on the Consideration of Travel-related Strategies for San Francisco Bay Area Commuters”, by Xinyu Cao and Patricia L. Mokhtarian. *Transport Policy* 12(4), 2005, 291-302.
- “Personal Travel Management: The Adoption and Consideration of Travel-Related Strategies” by Michael J. Clay and Patricia L. Mokhtarian. *Transportation Planning and Technology* 27(3) (June), 2004, 181-209.
- “Reducing Road Congestion: A Reality Check – A Comment”, by Patricia L. Mokhtarian. *Transport Policy* 11(2), 2004, 183-184.
- "Modeling Individuals' Consideration of Strategies to Cope with Congestion", by Elizabeth A. Raney, Patricia L. Mokhtarian, and Ilan Salomon. *Transportation Research F* 3, 2000, 141-165.
- "Behavioral Responses to Congestion: Identifying Patterns and Socio-Economic Differences in Adoption", by Patricia L. Mokhtarian, Elizabeth A. Raney, and Ilan Salomon. *Transport Policy* 4(3), 1997, 147-160.
- "Coping with Congestion: Understanding the Gap between Policy Assumptions and Behavior", by Ilan Salomon and Patricia L. Mokhtarian. *Transportation Research D* 2(2) (May), 1997, 107-123.

TCing as a response to extreme events (1)

- Pratt, J.H. (1991) Travel behavior impact of telecommuting following the **San Francisco earthquake**: a case study. *Transp. Research Record* **1305**, 282-290.
- Pratt, J.H. (1991) Incorporating portable offices into a contingency plan. *Contingency Journal*, **Sept./Oct.**, 21-23.
- Bates, V.L. (1992) Working at home [after the 4/13 **flood of the Chicago Loop** (downtown)]. *IEEE Communications Magazine* (Aug.), 14-15.
- 2/5/1994: **Northridge earthquake**, Los Angeles region, <https://www.latimes.com/archives/la-xpm-1994-02-05-me-19465-story.html>
- Weseman, L., T. Hamilton, & S. Tabaie (1996) Traveler response to damaged freeways and transportation system changes following Northridge Earthquake. *Transportation Research Record* **1556**, 96-108.
- 10/7/1996: Legacy of **Atlanta Olympics**, <https://www.bizjournals.com/atlanta/stories/1996/10/07/smallb7.html>
- 12/8/1998: Post-**Atlanta Olympics**, “This telecommuting stuff simply will never work”, <https://www.baltimoresun.com/news/bs-xpm-1998-12-08-1998342004-story.html>

TCing as a response to extreme events (2)

- Sato, K. & W.A. Spinks (1998) Telework and crisis management in Japan. In *Teleworking: International Perspectives – From Telecommuting to the Virtual Organization*, eds. P. J. Jackson & J. M. van der Wielen. Routledge, London. [**Great Hanshin (Kobe) Earthquake, 1/17/1995**]
- Joice, W.H. (2000) The evolving workplace: Avoiding costly work stoppages through telework solutions. *The Public Manager* **29(2)**. <https://www.questia.com/library/journal/1G1-66498047/the-evolving-workplace-avoiding-costly-work-stoppages>
- 12/13/2002: “Telecommuting may ease chaos of a **transit strike**”, <https://www.wsj.com/articles/SB1039204370405654513>
- 4/28/2003: <https://www.bloomberg.com/news/articles/2003-04-27/coping-with-sars-telecommuting-and-herbal-tea>, **severe acute respiratory syndrome (SARS)**
- 1/27/2004: <https://www.baltimoresun.com/news/bs-xpm-2004-01-27-0401270124-story.html>, **Washington DC-area blizzard**
- Gill, T. (2006) Countering the economic effects of **bird flu** through teleworking. *J. of Business Continuity & Emergency Planning* **1(1)**, 27-36.

TCing as a response to extreme events (3)

- Roitz, J. & E. Jackson (2006) AT&T adds business continuity [around **Hurricane Katrina**] to the long list of telework's advantages. *J. of Organizational Excellence* **25(2)**, 3-12. <https://doi.org/10.1002/joe.20085>
- 5/2006: <https://www.gao.gov/products/GAO-06-713>, USGAO report on teleworking for **continuity of operations**
- 5/1/2007: <https://www.eastbaytimes.com/2007/05/01/maze-meltdown-offers-telecommuting-test-case/> [**MacArthur Maze freeway collapse**]
- 2009: Zhu, S., et al., Traffic and behavioral effects of **I-35W Mississippi River Bridge collapse**. Paper number 09-2164 presented at the Transportation Research Board 88th Annual Meeting, 11-15 January, Washington, DC.
- 6/2009: http://voices.washingtonpost.com/federal-eye/2009/06/opm_grants_workplace_flexibili.html, **DC Metro crash**
- 2/13/2010: <https://www.zdnet.com/article/blizzard-shuts-down-feds-due-to-telework-cluelessness/>

TCing as a response to extreme events (4)

- 07/2011: <https://www.gao.gov/assets/330/321637.pdf>, USGAO report on incorporating telework into **emergency and continuity planning**
- 9/30/2012: <https://www.japantimes.co.jp/life/2012/09/30/general/teleworking-home-sweet-office> [**Great East Japan Earthquake**, 3/13/2011]
- 11/26/2012: <https://blog.shrm.org/workplace/hurricane-sandy-forces-companies-to-reconsider-telework>
- Donnelly, N. & S. B. Proctor-Thomson (2015) Disrupted work: home-based teleworking (HbTW) in the aftermath of a natural disaster [the **2011 Christchurch, NZ earthquake**]. *New Technology, Work & Employment* **30(1)**, 47-61. <https://doi.org/10.1111/ntwe.12040>
- 12/2016: <https://ischool.uw.edu/news/2016/12/disaster-response-chile-critical-role-libraries-and-telecenters> [8.8 **earthquake in Chile**, 2/2010]
- Brynjolfsson, E., J.J. Horton, A. Ozimek, D. Rock, G. Sharma, & H-Y T Ye (2020) **COVID-19** and Remote Work: An Early Look at US Data. NBER Working Paper # 27344, <https://www.nber.org/papers/w27344>

Recent-ish (pre-COVID-19) setbacks for TCing (1)

- 11/15/2019: Social Security ends its telecommuting program;
https://thechiefleader.com/news/news_of_the_week/social-security-ends-its-telecommuting-program/article_0546dd5a-0bd5-11ea-8630-b314deb168d9.html
- 9/30/2019: Co-workspace company WeWork pulls its IPO; CEO steps down;
<https://www.vanityfair.com/news/2019/11/inside-the-fall-of-wework>
- 2/20/2019: Virginia's Telework Expenses Tax Credit program eliminated after it was found to return only 4 cents per dollar invested
(<http://jlarc.virginia.gov/pdfs/reports/Rpt506.pdf>; pp. 49ff):
<https://blog.arlingtontransportationpartners.com/the-virginia-telework-tax-credit-expired>
- 11/2017: IBM pulls back its TCing program;
<https://www.theatlantic.com/magazine/archive/2017/11/when-working-from-home-doesnt-work/540660/>

Recent-ish (pre-COVID-19) setbacks for TCing (2)

- Aetna, Bank of America, Best Buy terminate TCing programs;
<https://www.nbcnews.com/business/business-news/why-are-big-companies-calling-their-remote-workers-back-office-n787101> (7/27/2017)
- 7/2016: “management resistance remains the most frequently reported barrier to telework [in the US Federal Government], according to OPM”;
<https://www.gao.gov/assets/680/678465.pdf>, p. 16.
- 10/3/2014: Reddit “dismantl[es] its remote-work policy”;
<https://www.fastcompany.com/3036660/reddit-gives-remote-employees-until-end-of-year-to-relocate-to-san-francisco>
- 2013: Yahoo terminates its TCing program

Other useful sources ⁽¹⁾

- <https://www.gensler.com/uploads/document/695/file/Gensler-US-Work-From-Home-Survey-2020-Briefing-1.pdf>
- <https://www.forbes.com/sites/jackkelly/2020/05/13/twitter-ceo-jack-dorsey-tells-employees-they-can-work-from-home-forever-before-you-celebrate-theres-a-catch/#39a4ddbb2e91>
- <https://www.brookings.edu/blog/up-front/2020/04/06/telecommuting-will-likely-continue-long-after-the-pandemic/>
- <https://www.forbes.com/sites/ezequielminaya/2020/04/03/cfos-plan-to-permanently-shift-significant-numbers-of-employees-to-work-remotely---survey/#1e12e137575b>
- <https://bfi.uchicago.edu/working-paper/how-many-jobs-can-be-done-at-home/>
- <https://www.newyorker.com/culture/annals-of-inquiry/can-remote-work-be-fixed?>

Other useful sources (2)

- <https://news.gallup.com/poll/306695/workers-discovering-affinity-remote-work.aspx>
- <https://www.nytimes.com/2020/03/10/technology/working-from-home.html?action=click&module=RelatedLinks&pgtype=Article>
- <https://www.bls.gov/opub/mlr/2012/06/art3full.pdf>
- <https://inrix.com/blog/2020/05/covid19-us-traffic-volume-synopsis-10/>
- <https://globalworkplaceanalytics.com/work-at-home-after-covid-19-our-forecast>
- <https://clark.com/employment-military/companies-long-term-remote-work/>
- Allen TD, TD Golden, and KM Shockley (2015) How effective is telecommuting? Assessing the status of our scientific findings. *Psychological Science in the Public Interest* **16(2)**, 40-68.