Service Robotics: Trends in Acceptance and Factors behind Willingness to Adopt

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Study Objectives

- Determine consumer interest in service robots and trends (2015 to 2018)

- Identify the correlates of interest in this technology

- Explain changes in interest in the technology

- Evaluate an assessment tool based on the Technology Readiness Index (TRI) framework
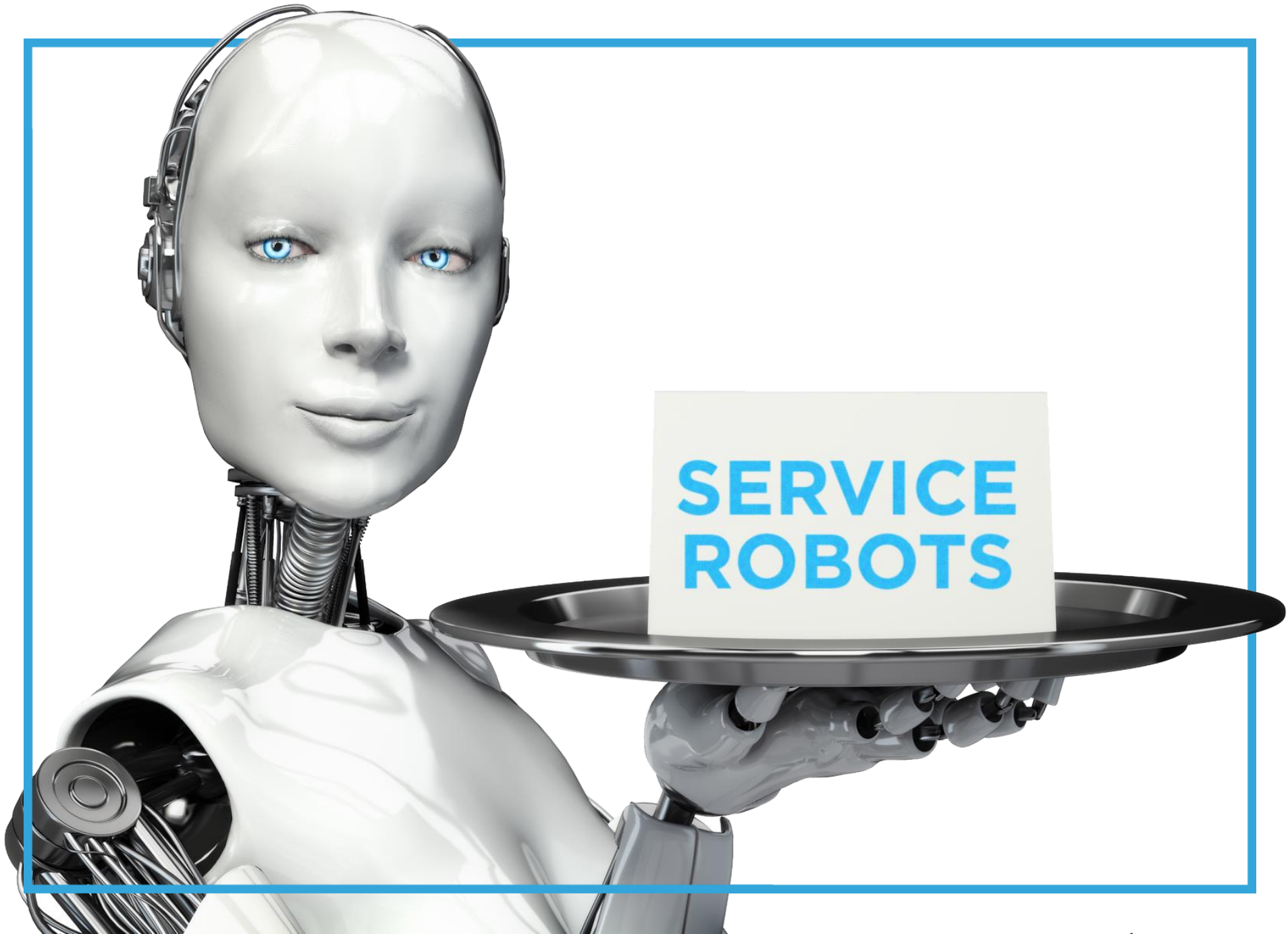
SERVICE ROBOTS

Definitions

- Robot – introduced by playwright Karal Capek (1920). Based on the Czech word "robata" which means servant or obedient worker.

- Robotics – introduced by science fiction writer Isaac Asimov (1945). Asimov subsequently created the 3 "laws of robotics" including "a robot may not injure a human being … or allow a human to come to harm."

- Definitions of a Service Robot:

  - "A robot which operates semi- or fully autonomously to perform services useful to the well being of humans and equipment, excluding manufacturing operations." (International Federation of Robotics).

  - "System-based autonomous and adaptable interfaces that interact, communicate and deliver service to an organization's customers." (Wirtz, Patterson, Kunz, Gruber, Lu, Paluch and Martins, 2018).

Research

- [Service Robots] promise advantages in efficiency, reliability and quality. However, the downsides regarding loss in flexibility and fear of dehumanization might outweigh the benefits in situations where the human touch is priceless." (Sprengler and Mettler, 2015)

- Wirtz et al propose a Service Robot Acceptance Model (sRAM) (2018) that melds the functional elements of the TAM model with social-emotional elements with relational elements. These should collectively predict usage of service robots.

- Van Doorn, Mende, Noble, Hulland, Ostrom, Grewal, and Petersen (2017) propose a framework that considers the interplay between Automated Social Presence (ASP) and human social presence in frontline service transactions. They posit that successful service outcomes are influenced by the social cognition and psychological ownership of the ASP, and consumer characteristics including Relation Orientation, Anthropomorphization of the ASP and Technology Readiness.

- Jörling, Böhm and Paluch (2019) examined through online experiments the role of attribution of responsibility and ability to control a technology on service outcomes.

- Čaić, Odekerken-Schröder and Mahr (2018) used an in-depth interview technique to identify six roles for socially assistive robots and linked them to health supporting robot functions: safeguarding, social contact and cognitive support.

Survey Definition of a Service Robot
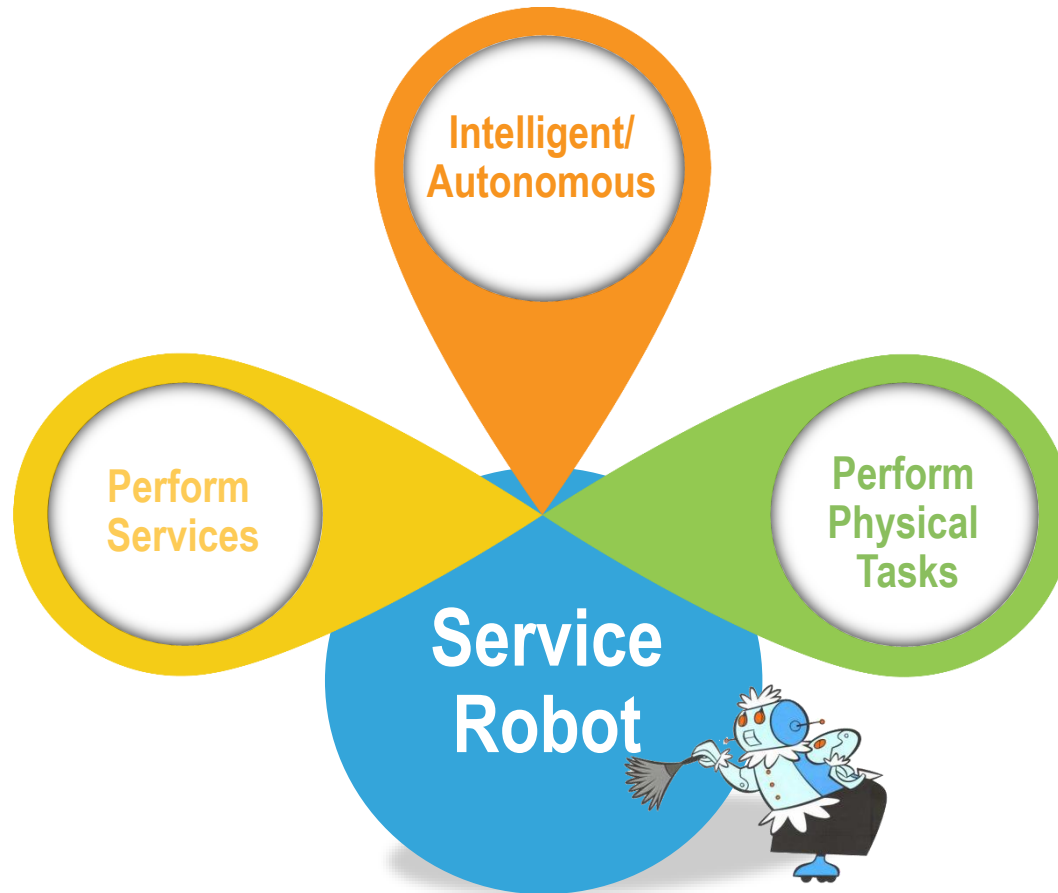
- "For this study, robots are defined as follows: they are technology that can perform physical tasks (e.g., driving, housework, serving in a restaurant), operate autonomously without needing instruction, and are directed by computers without help from people."

Examples of Service Robots

Our Study: Data Collection

- The National Technology Readiness Survey has tracked technology trends since 1999*. It is based on a representative sample of U.S. adults in the U.S. and is weighted to match the U.S. Census. Data are collected online using a consumer research panel.

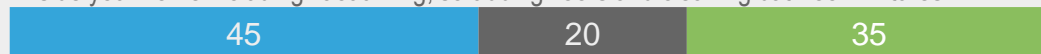| Survey Year	Sample Size	Margin of Error
2015	933	+/- 3.0%
2016	1032	+/- 2.9%
2018	544	+/- 4.0%

Our Study: Metrics

- Desirability of 7 technologies (5 tracked over 3 years)

- Technology Readiness Index 2.0

- 10 Beliefs about Robots (4 tracked over 3 years, 6 tracked over 2 years)

A minority finds service robots desirable

Perceived Desirability of Service Robots
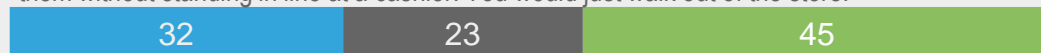
	Net Desirability
Robotic Home Assistant: the robot would autonomously handle physical labor tasks inside your home including vacuuming, scrubbing floors and cleaning bathroom fixtures	
Desirable 45 / Neutral 20 / Undesirable 35	+10
Cashier-less store: a convenience store where you can pick up items and then pay for them without standing in line at a cashier. You would just walk out of the store.	
Desirable 32 / Neutral 23 / Undesirable 45	-13
Receive a package from an automated pilotless drone: the aircraft would find its way to you aided by computers	
Desirable 30 / Neutral 26 / Undesirable 44	-14
Social Robot: the robot would make recommendations on recipes, take pictures, play music, learn and adapt to your needs by voice recognition.	
Desirable 25 / Neutral 23 / Undesirable 52	-27
Robotic Server: when you go to a restaurant or coffee shop, you would be waited on by a robot that would take your order, bring to you, collect payments, and help with requests	
Desirable 26 / Neutral 20 / Undesirable 54	-28
Purchase or lease a driverless vehicle: the vehicle would transport you to where you request, but would drive itself aided by computers	
Desirable 22 / Neutral 17 / Undesirable 61	-39
Ride in a driverless taxi: the taxi would transport you to where you request, but would drive itself aided by computers	
Desirable 21 / Neutral 18 / Undesirable 61	-40

■ Desirable (5-7) ■ Neutral (4) ■ Undesirable (1-3)

- Consumers are highly interested in robots that free them from household toil.

- Consumers are less interested in autonomous retail stores and robotic deliveries.

- The majority find "social robots" to be undesirable.

- The least appealing is self-driving transportation where control is ceded to the technology.

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Innovativeness drives desirability of service robots

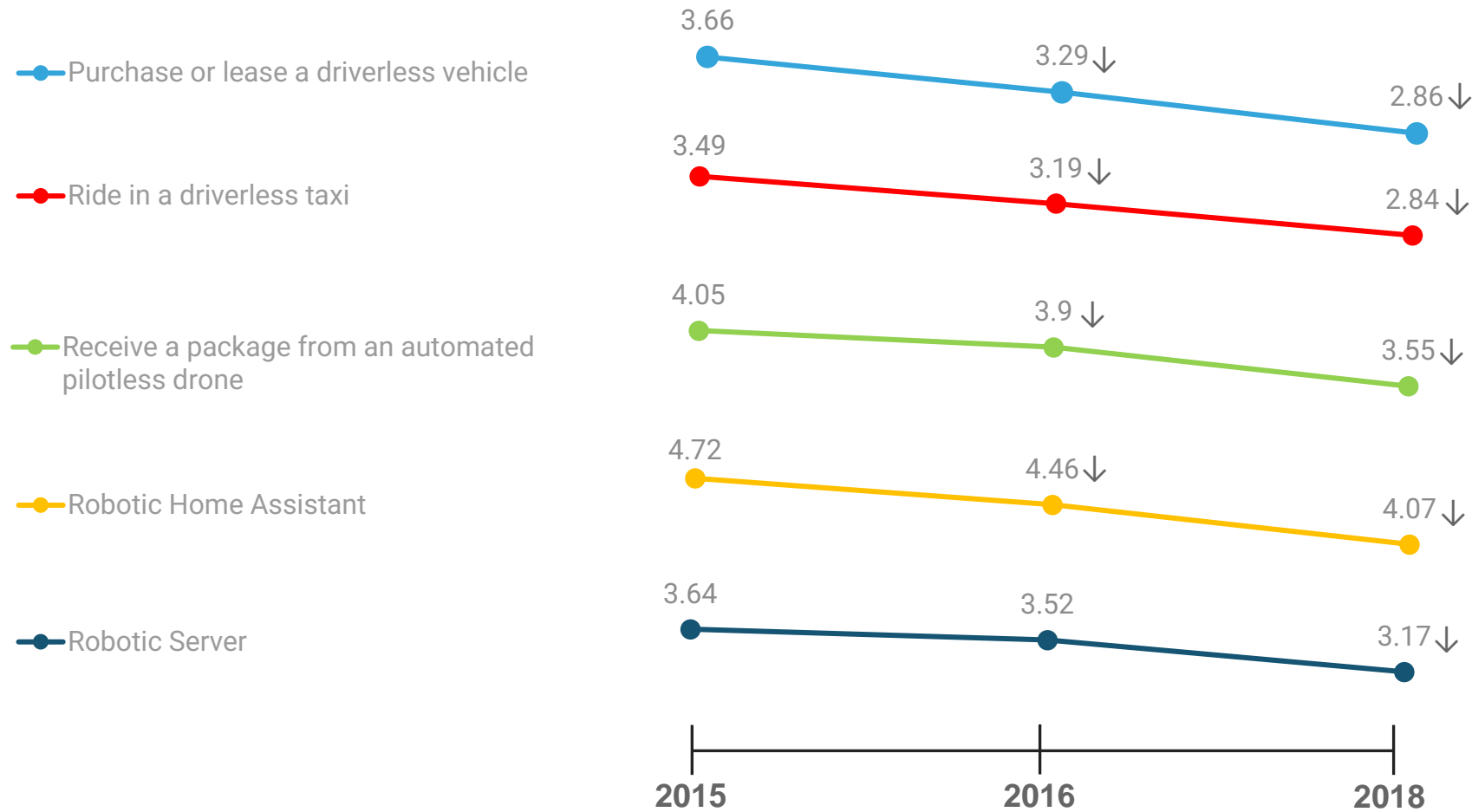| Perceived Desirability of Service Robots	TRI 2.0	Optimism	Innov-ativeness	Dis-comfort	Insecurity
Robotic Home Assistant: the robot would autonomously handle physical labor tasks inside your home including vacuuming, scrubbing floors and cleaning bathroom fixtures Desirable: 45 / Neutral: 20 / Undesirable: 35	.40**	(.43**)	.32**	-.19**	-.28**
Cashier-less store: a convenience store where you can pick up items and then pay for them without standing in line at a cashier. You would just walk out of the store. Desirable: 32 / Neutral: 23 / Undesirable: 45	.48**	.39**	(.42**)	-.25**	-.38**
Receive a package from an automated pilotless drone: the aircraft would find its way to you aided by computers Desirable: 30 / Neutral: 26 / Undesirable: 44	.45**	(.44**)	.41**	-.19**	-.30**
Social Robot: the robot would make recommendations on recipes, take pictures, play music, learn and adapt to your needs by voice recognition. Desirable: 25 / Neutral: 23 / Undesirable: 52	.36**	.34**	(.37**)	-.11*	-.23**
Robotic Server: when you go to a restaurant or coffee shop, you would be waited on by a robot that would take your order, bring to you, collect payments, and help with requests Desirable: 26 / Neutral: 20 / Undesirable: 54	.44**	.39**	(.41**)	-.20**	-.31**
Purchase or lease a driverless vehicle: the vehicle would transport you to where you request, but would drive itself aided by computers Desirable: 22 / Neutral: 17 / Undesirable: 61	.41**	.36**	(.42**)	-.15**	-.28**
Ride in a driverless taxi: the taxi would transport you to where you request, but would drive itself aided by computers Desirable: 21 / Neutral: 18 / Undesirable: 61	.43**	.38**	(.43**)	-.16**	-.30**

■ Desirable (5-7) ■ Neutral (4) ■ Undesirable (1-3)

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Desirability of service robots declined consistently across three waves

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Purchase or lease a driverless vehicle
- 3.66
- 3.29 ↓
- 2.86 ↓

Ride in a driverless taxi
- 3.49
- 3.19 ↓
- 2.84 ↓

Receive a package from an automated pilotless drone
- 4.05
- 3.9 ↓
- 3.55 ↓

Robotic Home Assistant
- 4.72
- 4.46 ↓
- 4.07 ↓

Robotic Server
- 3.64
- 3.52
- 3.17 ↓

2015　2016　2018

*Arrow indicates significant difference from previous year

Measuring Perceptions of Robots
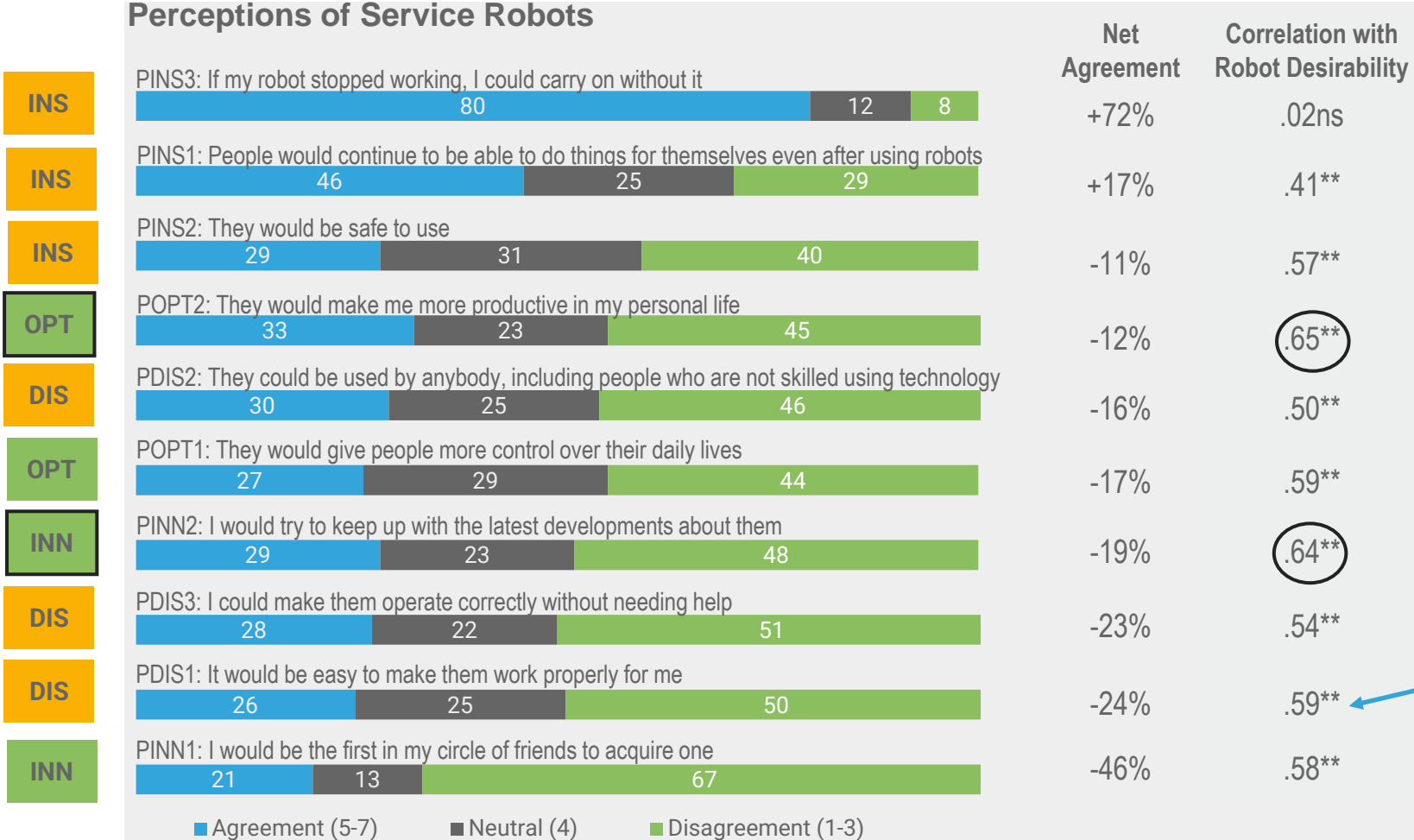
Technology Readiness **Service Robot Perceptions**

MOTIVATORS	
Optimism	• Give Control [POPT1] • Make me Productive [POPT2]
Innovativeness	• First to adopt [PINN1] • Interested in topic [PINN2]

INHIBITORS	
Discomfort	• Easy to make them work [PDIS1] • Anyone can use [PDIS2] • Don't need help to operate [PDIS3]
Insecurity	• Little risk of dependence [PINS1] • Safe to use [PINS2] • Can carry on without [PINS3]*

General Beliefs/ Psychographics   Acceptance/Robot Specific

- The Technology Readiness Index (TRI) measures consumer technology beliefs on 4 independent dimensions. It is highly stable in the short term.

- Acceptance measures for service robots were designed to mirror the dimensions of the TRI.

- "Inhibitors" are expressed as positives (negative outcome does not occur).

- 9 of 10 items form a reliable acceptance metric (Alpha = .93)

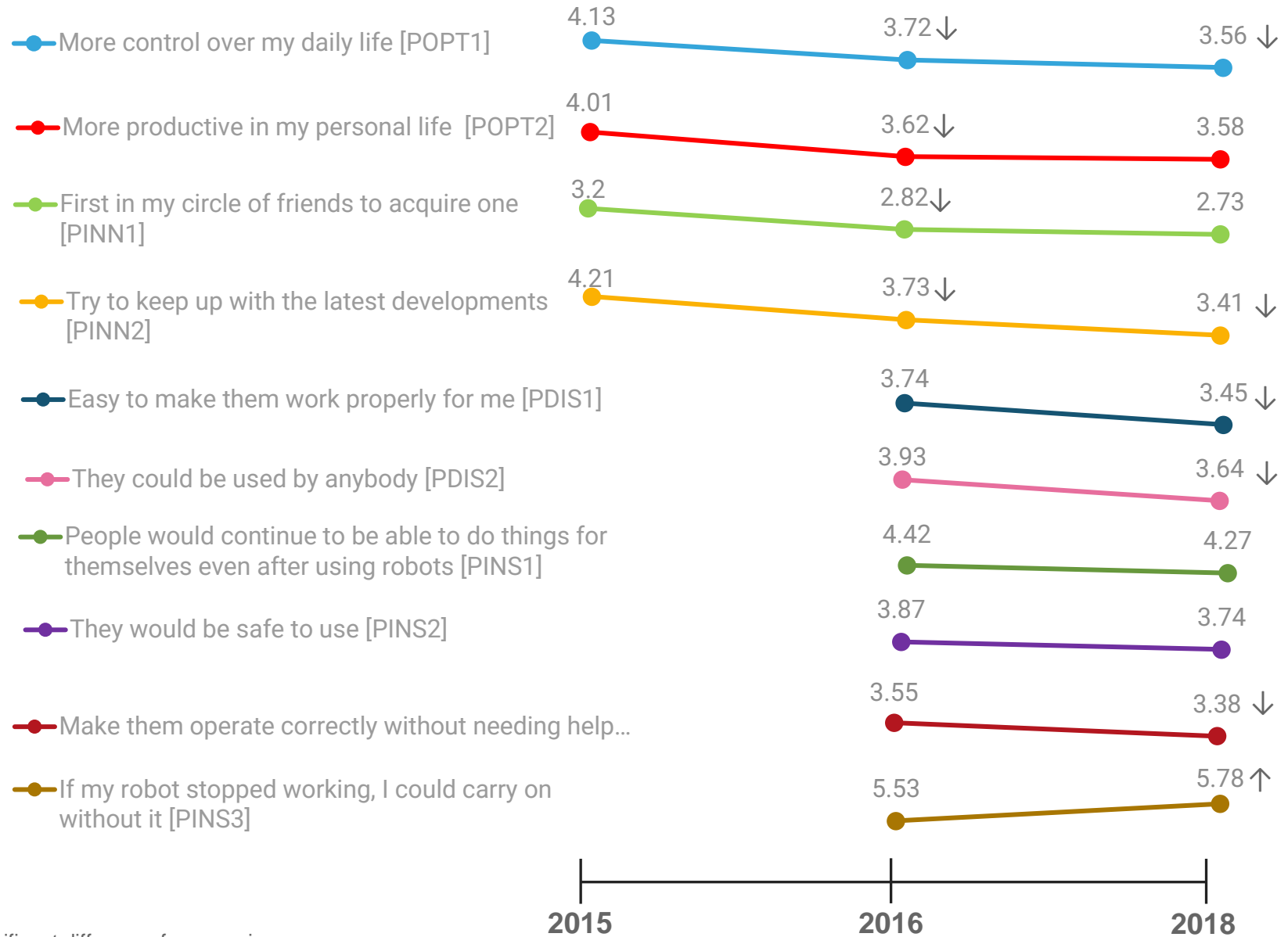*Dropped from final list based on reliability and validity tests.

- **Perceptions of service robots have become steadily more negative over the past few years.**

- **Notable changes in perception: gives me control, desire to keep up, easy to use**

More control over my daily life [POPT1]
4.13 — 3.72 ↓ — 3.56 ↓

More productive in my personal life [POPT2]
4.01 — 3.62 ↓ — 3.58

First in my circle of friends to acquire one [PINN1]
3.2 — 2.82 ↓ — 2.73

Try to keep up with the latest developments [PINN2]
4.21 — 3.73 ↓ — 3.41 ↓

Easy to make them work properly for me [PDIS1]
3.74 — 3.45 ↓

They could be used by anybody [PDIS2]
3.93 — 3.64 ↓

People would continue to be able to do things for themselves even after using robots [PINS1]
4.42 — 4.27

They would be safe to use [PINS2]
3.87 — 3.74

Make them operate correctly without needing help...
3.55 — 3.38 ↓

If my robot stopped working, I could carry on without it [PINS3]
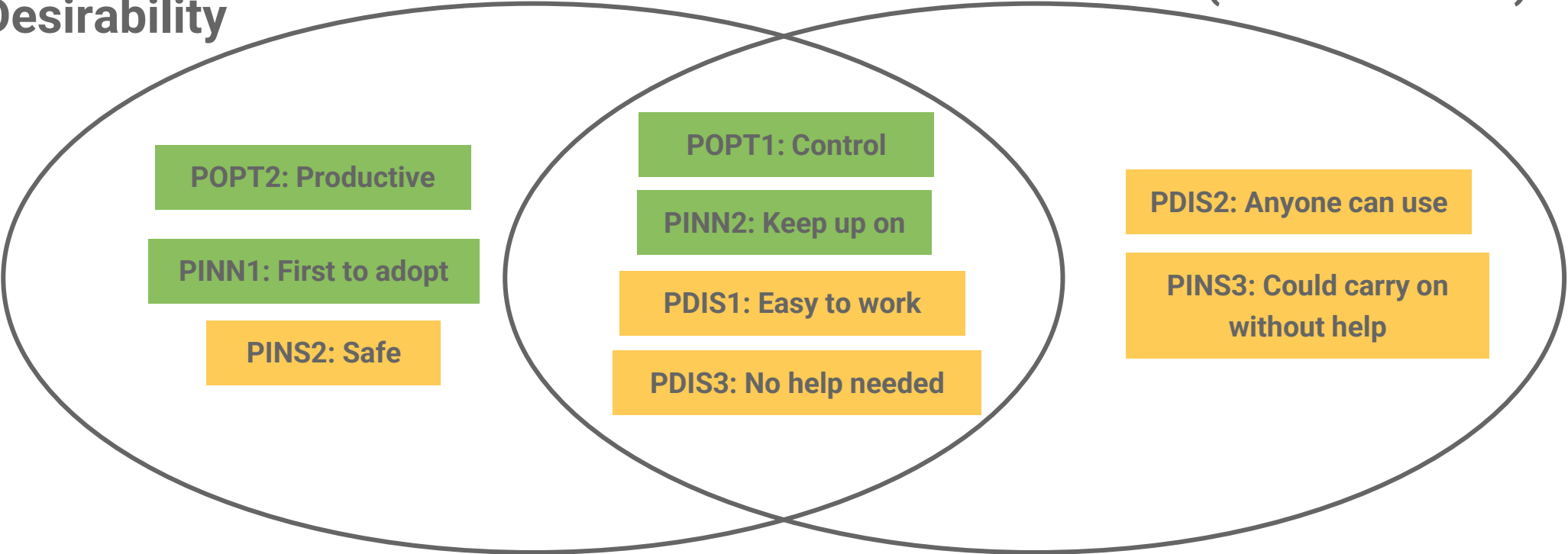5.53 — 5.78 ↑

2015 **2016** **2018**

*Arrow indicates significant difference from previous year

What is driving the decline in robot desirability?

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Top Drivers of Desirability

Significant Change (2016 to 2018)

POPT2: Productive

PINN1: First to adopt

PINS2: Safe

POPT1: Control

PINN2: Keep up on

PDIS1: Easy to work

PDIS3: No help needed

PDIS2: Anyone can use

PINS3: Could carry on without help

Takeaways on service robotics…

- While service robots are an advanced technology, consumers would most like them to free them from drudgery (better to clean the toilet than drive the kids to school).

- Consumers have grudging acceptance (less "undesirable ratings") for retail applications including drone delivery and stores without employees.

- Technology readiness is a significant correlate, which means service robots need to be marketed the same way as other cutting-edge innovations (e.g., sell the value proposition to "skeptics"). Innovativeness is the most important driver of interest, so influencers/evangelists are critical to marketing the technology.

- Service robots have experienced an image problem in the past few years. A key focus for the industry should be assuring consumers they can operate without issues and give people control (rather than lose control).

Takeaways on studying robot acceptance

- Technology Readiness is an important construct to include in models.

- Insight can be gained from measuring perceptions structured around a Technology Readiness framework. It is particularly useful for identifying reasons behind changes in perceived desirability and adoption.

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Demographic Correlates of Service Robot Desirability

- Segments that consider service robots most desirable (starting with highest correlates):

  - ✓ Younger consumers (under age 45, particularly 35 to 44)
  - ✓ Males
  - ✓ Tech professionals
  - ✓ Children under 10 years of age live in the household
  - ✓ Marital status is single
  - ✓ Higher income
  - ✓ Non-white, particularly Asian
  - ✓ Not born in U.S. or parents not born in U.S.
  - ✓ Techno-readiness Segments (Explorers = 4.5 out of 7, Avoiders = 2.1 out of 7)

- Education does not correlate strongly (some high education skew), even though it is an important correlate of techno-readiness

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Wirtz, Jochen, Patterson, Paul G., Kunz, Werner H., Gruber, Thorsten, Lu, Vinh Nhat, Paluch, Stefanie, and Martins, Antje, 2018. "Brave new world: service robots in the frontline," *Journal of Service Management*, Vol. 29 Issue: 5, 907-931.

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Self-Driving Cars:

[Uber self-driving car crash](#)

[Tesla driver using autopilot killed in crash](#)

[Google's Self-Driving Car Caused Its First Crash](#)

[Waymo has launched its commercial self-driving service in Phoenix](#)

Self-Controlled Drones:

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Robots in Restaurants:

[America's First Restaurant with a Completely Robot-Staffed Kitchen Just Opened in Boston](#)

Misc. Robots:

Hitchhiking robot found decapacited in Philadelphia

Amazon's automated grocery store of the future opens

Delivery robots at UC Berkeley