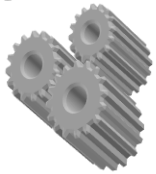
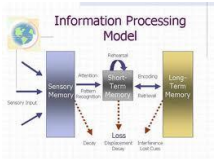
How News Briefs Change Trust in Technologies Over Time: A Cognitive Model





D. Harrison McKnight, Peng Liu, Brian Pentland and Tae Hun Kim

"…we need to know more about how trust develops over time…" – Doney and Cannon, 1997

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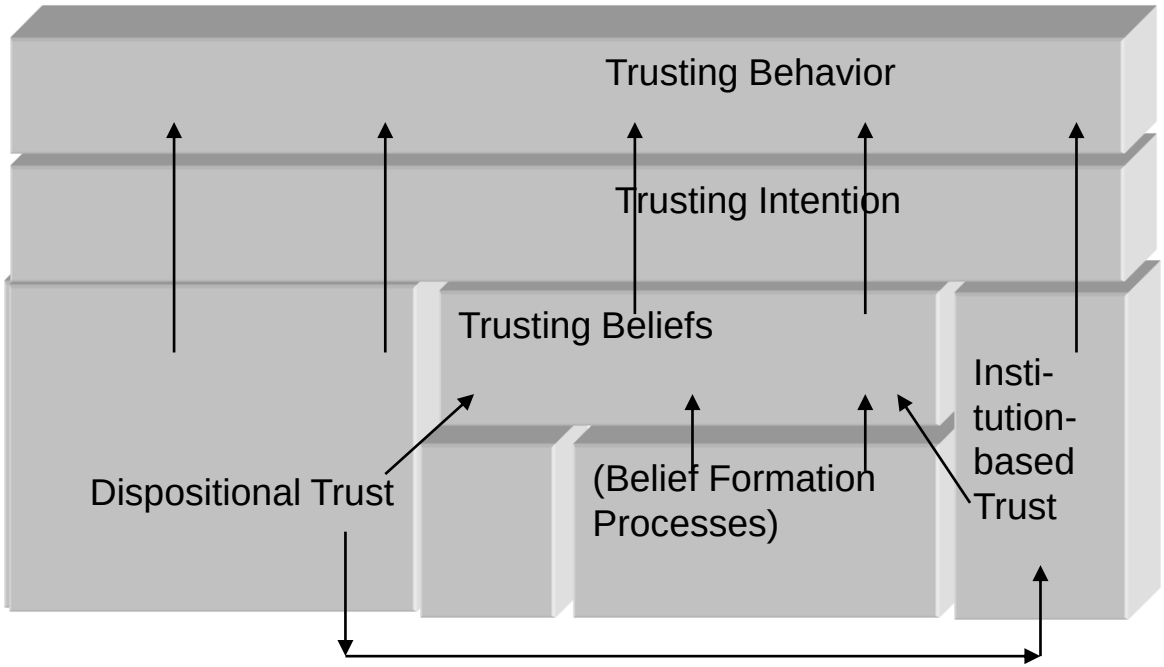
Agenda

- Definition of trust
- Social trust in autonomous systems
  - A cognitive model of trust change
- The role of trust in human-robot interaction/ collaboration
  - Behavior intention to use the robot technology
  - Loyalty to the robot technology vendor



What Does Trust Mean? A Typology of Concepts

(adapted from McKnight & Chervany 1996)

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Trust Definitions

1. Trusting behavior: The extent to which one person voluntarily depends on another party in a specific situation with a feeling of relative security, even though negative consequences are possible. A trusting behavior involves taking a risk.

2. Trusting intention: The extent to which one party is willing to depend or intends to depend on the other party in a given situation with a feeling of relative security, even though negative consequences are possible. [Measure: For going safely from place A to place B, I feel I can depend on the Google Driverless Car.]

3. Trusting beliefs: a. For trusting people: The extent to which one believes the other party is trustworthy (i.e., benevolent, competent, honest and predictable) in a situation. **b. For trusting autonomous agents:** The extent to which one believes the other party is trustworthy (i.e., helpful, functional, and reliable). If the agent is human-like, use 3a. If machine-like, use 3b. Or, modify 3b's attributes to match what the agent can do for the human.

Sources: McKnight et al. (1998); McKnight & Chervany (1996, 2001); McKnight et al. (2011); Lankton et al. (2015); Lankton et al. (2016)

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Trust Definitions

4. Institution-based trust: The extent to which favorable or protective impersonal structures or conditions are in place in the situation to enable one to act in anticipation of a successful future endeavor. Two subconstructs exist:
a. Situational normality: The extent to which one believes the situation is normal or favorable or conducive to success.
b. Structural assurance: The extent to which one believes protective structures—guarantees, contracts, regulations, legal recourse—are in place that are conducive to success in the situation.
5. Disposition (or propensity) to trust: The extent to which one displays a consistent tendency to be willing to depend on others across a broad spectrum of situations and persons. Two subconstructs:
a. Faith in others: The extent to which one believes general other parties are typically reliable and trustworthy.
b. Trusting stance: The extent to which one believes that, regardless of others' reliability, one will obtain better outcomes by dealing with others as though they are reliable and trustworthy.

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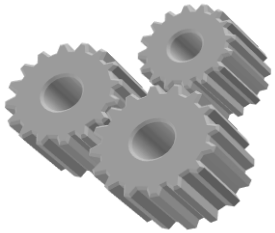
The Cognitive Model of Technology Trust Change

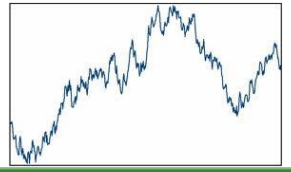
Typical IT Trust Research Question:
--What factors lead to trust in a technology?

Our Research Questions:
1. How does trust in a technology change in response to a series of events over time? (in our study, event = news brief)

2. What cognitive mechanisms are involved in this trust change?

Trust Events ➔ **Cognitive Mechanism** ➔ **Trust Change**





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Why a Cognitive Mechanism Model?

1. Existing theory (Incremental Growth Models) mis-predicts empirical results
--e.g., large, infrequent change is the opposite of prediction

2. Most trust models treat cognitive processes as a "black box"
--i.e., use various trust factors as the main theoretical tool

3. Process models can help us understand how trust forms and changes over time (not what factors lead to trust)

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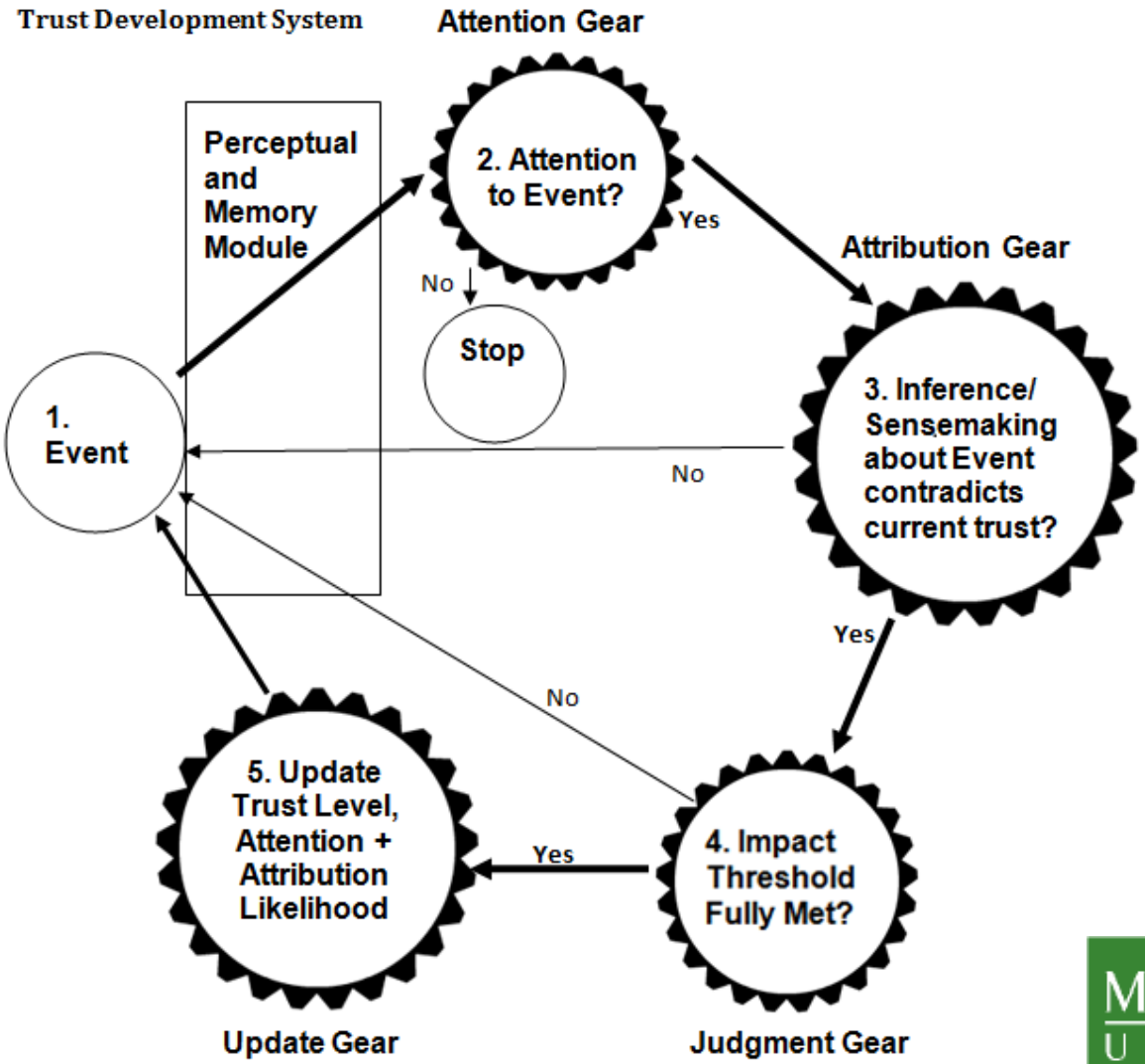
Trust in a Technology Development: A cognitive Information Processing Model



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Cognitive Gears of Trust Change

Three necessary but not sufficient conditions to change trust

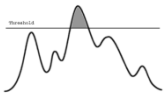
- **Cognitive Gear #1: Attention**

  - Focuses initial cognitive effort on event
  - The outcome of attention is degree of cognitive focus on the event.
  - H1: Higher trustor attention → Higher levels of trust change

- **Cognitive Gear #2: Sensemaking**

  - Trustor attribution that a behavioral event contradicts current trust
  - The outcome of sensemaking is perception one may need to re-evaluate one's trust.
  - H2: Higher trustor sensemaking→ Higher levels of trust change

- **Cognitive Gear #3: Judgment Threshold**



  - Exceeding a judgment threshold that indicates trust change is needed
  - The outcome of the threshold process is intention to change trust.
  - H3: Higher trustor threshold-met→ Higher levels of trust change

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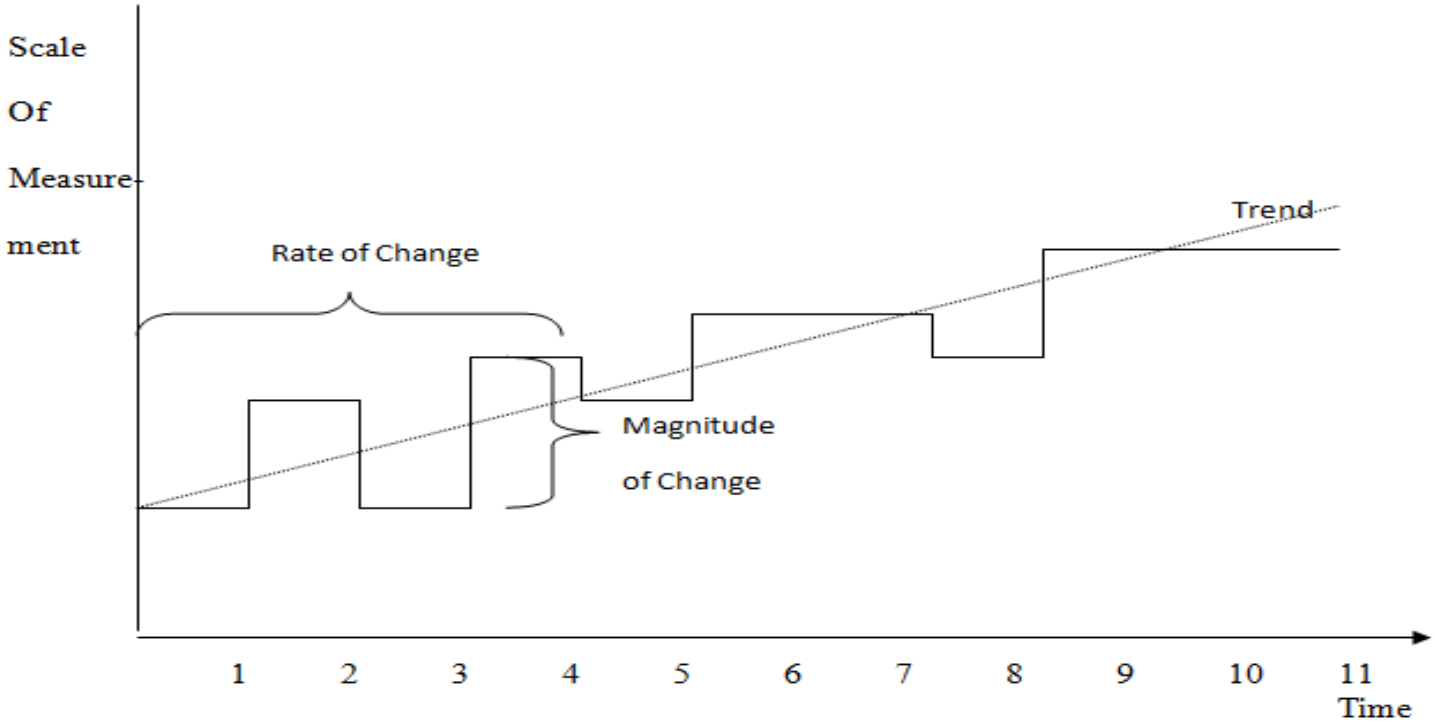
One Advantage of IPM…

- It is a testable quantitative process theory per Monge (1990), in terms of predicting and testing:
  - Frequency or Rate of change
  - Magnitude of change



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Model Testing Methodology

- **1799 subjects from four U. S. universities; 64% male, average age 22**

- **Focusing on the "IT Artifact," we studied trust in a technology**
  - **By trust, we mean a *willingness to depend* on the technology (Trust intention)**
- **Technologies chosen for relative interest for many subjects:**
  - **Apple's Siri feature**
  - **Google driverless car**
  - **TomTom GPS**
  - **Ford's SYNC (in-car tech product)**
  - **Facebook**

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Measured trust eight times

- Eight news briefs presented – four positive, four negative, with equivalent negativity and positivity ratings for each technology
- News briefs were shortened versions of actual newspaper articles gathered from Nexis (average 58 words)
- Measured trust after respondents read each news brief

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News Brief Examples—Google Driverless Car

- **Highly positive (News brief 7):**

“The average driver spends more than 400 hours per year behind the wheel. But daily distance commuters or on-the-road salespeople sometimes spend as much as double that. When you use a driverless car, you will have 400-800 more hours of free time per year. Imagine what you could do with that time.”

- **Highly Negative (News brief 8):**

"Security is a big issue," an auto analyst says. "There is a conceivable concern about terrorists hacking into an infrastructure system and intentionally crashing cars. Stolen ID is one thing. A car going 60 mph without brakes is a worry."

Method: Hierarchical Linear Model (HLM)

HLM provides simultaneous look at both levels of analysis:

-- Level 1 (Event/news brief): Attention, Sensemaking, Threshold, News Brief Relevance, Event dummies

-- Level 2 (Respondent): Loyalty, Perceived Risk, Technology and Pattern dummies, Plausible Alternatives (e.g., gender, experience with technology, trust in media, risk propensity)

Ran both Frequency of Change and Magnitude of Change models

Frequency of Trust Change Tests

Predictors	beta/p-value	Hypothesis Supported?
Attention (H1)	0.07***	Yes
Sensemaking (H2)	0.22***	Yes
Threshold (H3)	0.27***	Yes
Perceived Risk of Tech	0.03+	
Loyalty to Tech Vendor	0.00ns	
Trust in Media	0.06***	
Event Relevance	0.14***	
Tech Experience	-0.04+	
Risk Propensity	0.01ns	
Gender (0=F, 1=M)	-0.14**	
Other plausible alternatives	various (all ns)	
Event dummies	various	
Tech dummies	various	
Pattern dummies	various	
Note: Because Frequency is either 0 (no change) or 1 (change), no R^2 calculation is possible		
+p<0.10; *p<0.05; **p<0.01; ***p<0.001		

Magnitude of Trust Change Tests

Predictors	beta/p-value	Hypothesis Supported?
Attention (H1)	0.03*	Yes
Sensemaking (H2)	0.17***	Yes
Threshold (H3)	0.19***	Yes
Perceived Risk of Tech	0.02+	
Loyalty to Tech Vendor	-0.03**	
Trust in Media	0.02+	
Event Relevance	0.20***	
Tech Experience	0.01ns	
Risk Propensity	0.02+	
Gender	-0.10*	
Other plausible alternatives	various(all ns)	
Event dummies	various	
Tech dummies	various	
Pattern dummies	various	
Level 1 R^2: 0.06; Level 2 R^2: 0.30		
+p<0.10; *p<0.05; **p<0.01; ***p<0.001		

Google Driverless Car v.s. Apple Siri

	Google Driverless Car		Apple Siri	
Predictors	**Frequency**	**Magnitude**	**Frequency**	**Magnitude**
Attention (H1)	2.0*		2.6*	2.4*
Sensemaking (H2)	3.3 ***	2.0*		
Threshold (H3)	3.6 ***	3.7 ***		
Perceived Risk of Tech				
Loyalty to Tech Vendor				
Trust in Media	2.0+		2.6**	
Negativity of News		1.7+		
News Brief Word Count		1.9+	-2.9**	-2.2*
Gender	-2.2*	-1.9+		
Age	-2.7 **	-2.2 *	1.9+	
Disposition To Trust	2.4*	2.2*		
Cognitive Rigidity	-2.5*			
Structural Assurance	2.3*	2.4*		

+p<0.10; *p<0.05; **p<0.01; ***p<0.001

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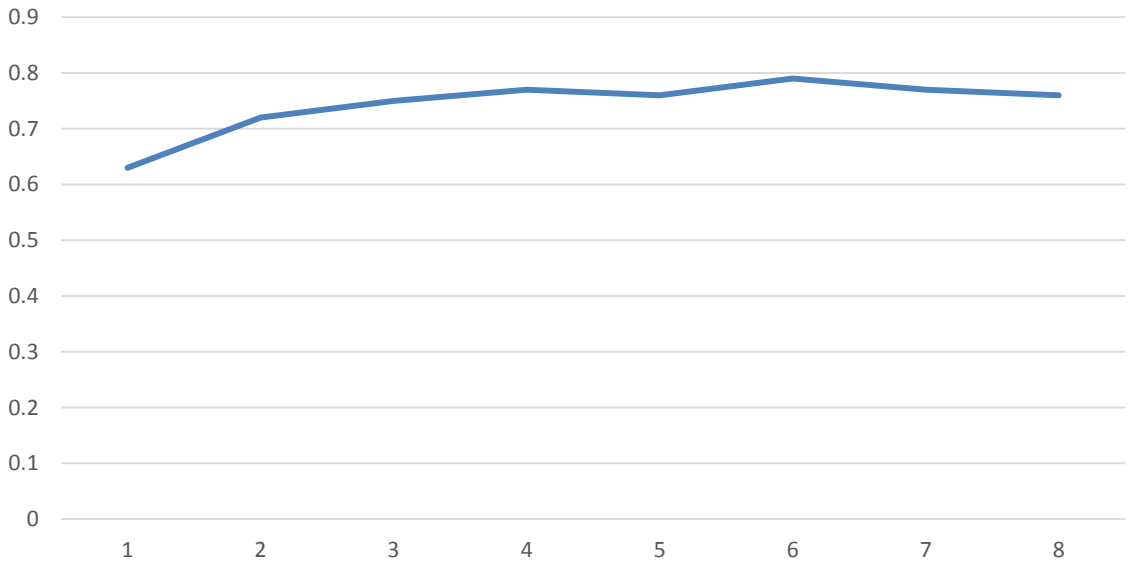
Roles of Trust in Human-Robot Interaction/Collaboration

1. Trust encourages human Intention to Use the Robot

The correlation between Trusting Intention in Google driverless car and Intention to Use* Google driverless car equals: (all significant at < 0.01)

T1: 0.63
T2: 0.72
T3: 0.75
T4: 0.77
T5: 0.76
T6: 0.79
T7: 0.77
T8: 0.76



Trend: Over time, do Trust and Intention to Use become more aligned?

*** Measure:**

If given the opportunity, I would use the Google Driverless Car.

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Roles of Trust in Human-Robot Interaction/Collaboration

2. Trust influences human Loyalty to the Robot maker/vendor, and this effect relates stronger over time to the most recent trust level

Step A: Regressed T8 Vendor Loyalty on control variables (age, gender, - T0 loyalty, perceived tech risk, trust in news media, tech reputation)

Step B. Regressed T8 Vendor Loyalty on control variables and T0 trust
- T0 trust beta = .06**

Step C. Regressed T8 Vendor Loyalty on control variables and T8 trust
- T8 trust beta = .18***

Step D. Regressed T8 Vendor Loyalty on control variables and both T0 and T8 trust
- T0 trust beta = .01ns T8 trust beta = .18***

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So T8 Trust overpowers the effect of T0 trust on Vendor Loyalty

Summary

All three Cognitive Mechanisms affect trust change

Attention, Sensemaking, and Threshold Judgment

-- Now we can unpack the 'black box' of trust change

Google Driverless Car has more predictors and therefore it is more complex to predict trust change.
Apple Siri is less complex to predict trust change.

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Research Contributions

- Theorizing and measuring trust change
  - It's not an incremental progression!
- Cognitive model of mechanisms that govern the change process
- Multi-period experiment shows trust change over time
  - Better ecological validity than pre/post measurements around a single event
  - Different kinds of technology
- Solid conceptual basis for future work
  - Study trust change in a new way: by examining what causes the three cognitive mechanisms to change
  - Examine the stability/fragility of trust over time under different **conditions**

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Questions???

Thank You.

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