Research Framework & Privacy Overview

INFR11158/11230 Usable Security and Privacy

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THE UNIVERSITY of EDINBURGH

Overview

- Warm-up
- A taxonomy of privacy
- Privacy by design
- Contextual integrity
- Take-home

Planning research studies

Research Studies

1. Define your research question
2. Identify your variables
3. Run your study
4. Evaluate the outcome

Step 1: Define your research question

Some research questions:

- Can people differentiate between a subdomain and a domain when reading a URL?
- Does [my new system] help people differentiate between malicious URLs and safe ones?
- Can users use [my new password manager] faster and with less errors than [the old password manager]?
- Does knowing how an app will use its permissions impact app installation decisions?
- What factors impact end-users' willingness to update software?
- Using [website], can users successfully opt-out of cookie tracking without forming inaccurate mental models?

For task based lab studies

- First decide what “usable” means
- Identify what you think your users need to be able to do using your system or what kind of attitude you want them to have
- The goals need to be specific and easy to identify if they have or have not been completed
- Examples:
  - Find a stool on a shopping page and purchase it
  - Be willing to give the app 5 stars after interacting with it for the first time
- Bad examples:
  - Have fun using the site
  - Find a bus to go somewhere

“Usable” could mean:

- User can accomplish a task in Y minutes
- User can accomplish task with no unrecoverable errors
- After interacting with an interface the user has an accurate mental model of when their message is and is not encrypted
- User feels more confident in using secure messaging
- Users voluntarily select higher entropy passwords
- User creates a password that they can remember after a month of not using it

Step 2: Identify your variables

What kind of data do you want?

- Attitudinal – User attitudes and opinions

vs.

- Behavioral – What the user actually does or is capable of doing

- Qualitative – Unstructured data. Typically unstructured language data

vs.

- Quantitative – Structured data. Typically numerical data that can be summed or counted

https://www.nngroup.com/articles/which-ux-research-methods/

For quantitative studies

What are you going to measure?

- In statistics there are classically two types of measurements (variables): dependent and independent
- Dependent
  - Also known as the outcome variable
  - “Dependent” on the study
  - Measures the usability goal
- Independent
  - Anything you are directly manipulating
  - An element of the study which is under your control
  - A pre-existing feature of your participant

Common dependent things to measure

- Number of dangerous errors made
- Time to complete task
- Percent of task completed
- Percent of task completed per unit of time
- Ratio of successes to failures
- Time spent in errors
- Percent or number of errors
- Percent or number of competitors better than it
- Frequency of help and documentation use

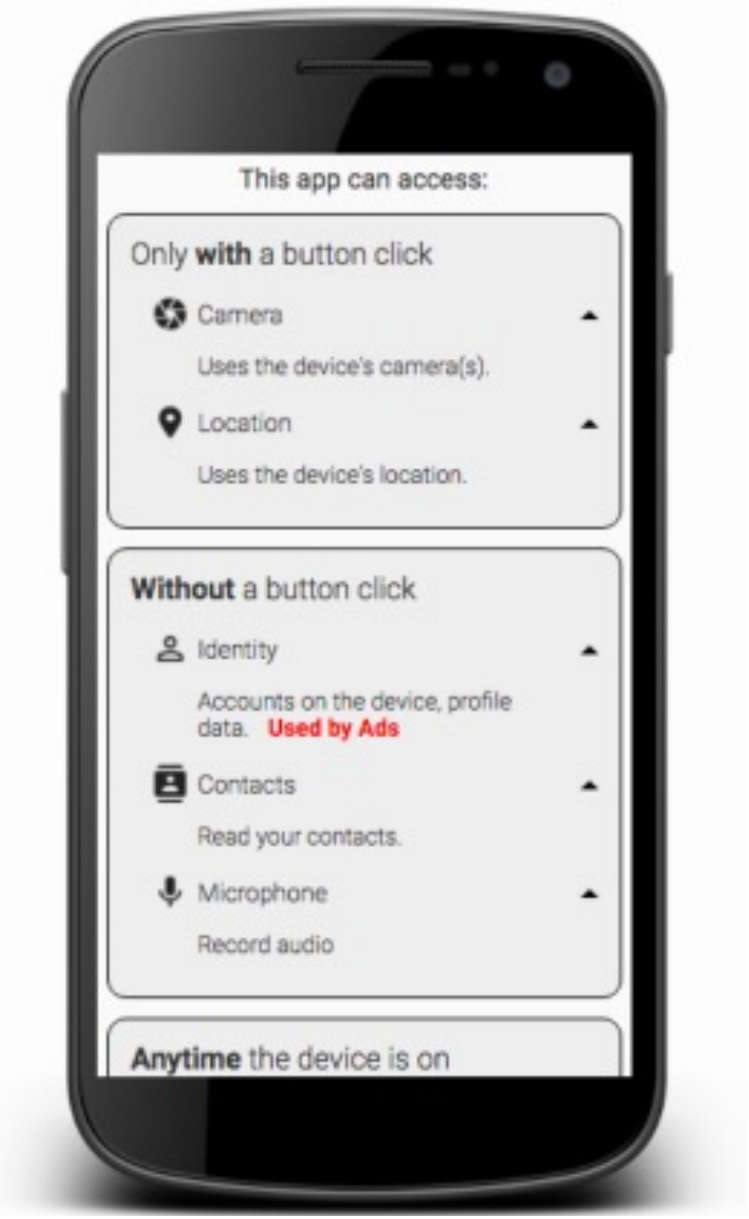
Step 3: Setup your study

Between vs. Within subjects

- Between subjects
  - Your study only shows one interface to one person
  - You are measuring how well the people randomly assigned to the A interface did compared to the people randomly assigned to the B interface
  - Lots of variability with this method
- Within subjects
  - Your study shows all interfaces to all people
  - You are measuring the difference in how they do on the two interfaces
  - Less variability (same person) but more learning effects and priming

Study design

- RQ: Does [my new interface] enable people to accurately determine what permissions an app will use?
- A/B test between the existing and new interface
- Between subjects
- 10 Tasks shown in the same order to all participants
- Dependent variables
  - Accuracy on task
- Independent variables
  - Which interface (A or B)



Step 4: Evaluate the outcome

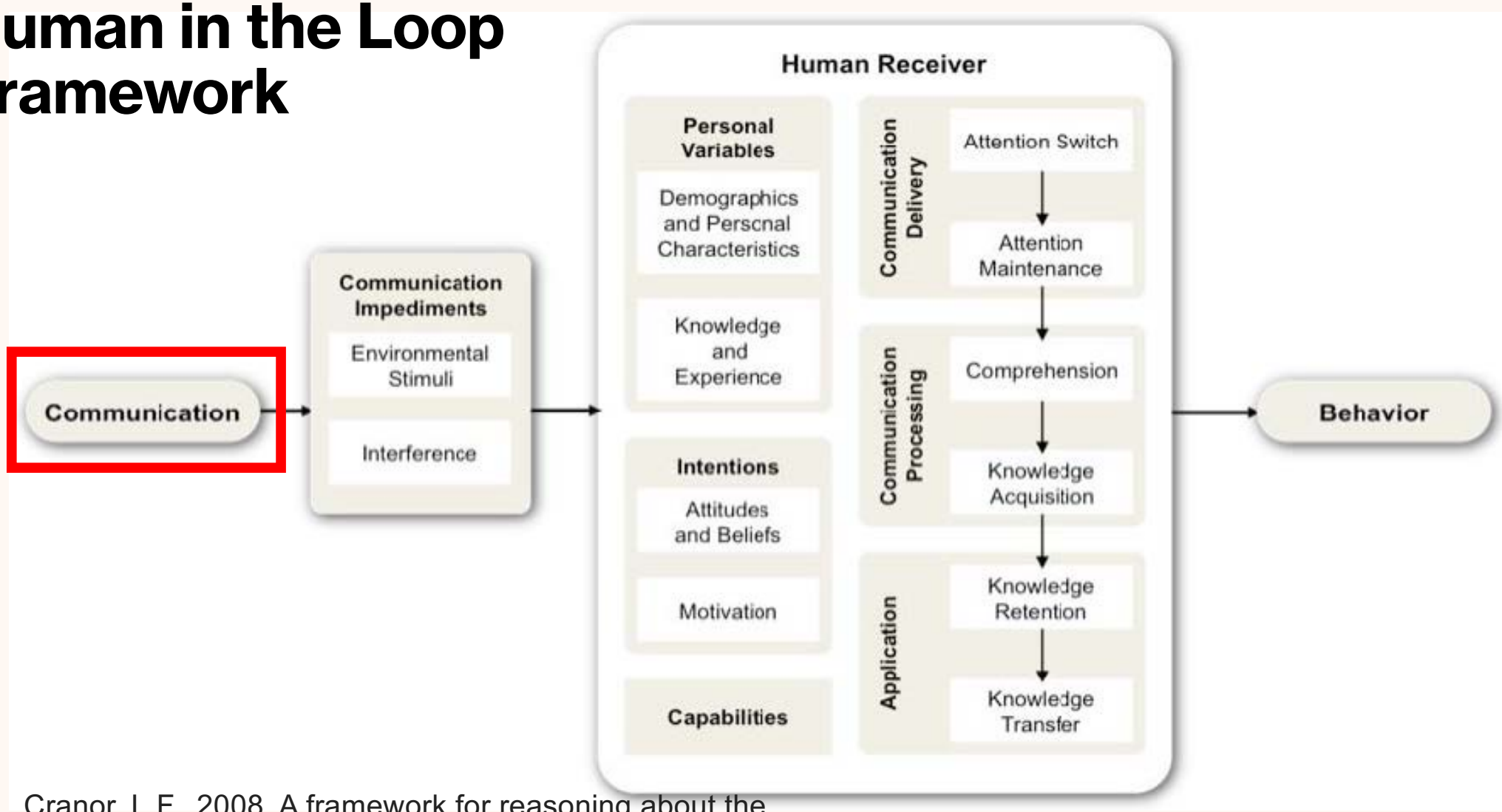
Types of data

- Numeric
  - **Continuous** – Any value on the range is possible including decimal (1-5)
  - **Discrete** – Only certain values on the range are possible (1,2,3,4,5)
  - **Interval** – Only certain values on the rage are possible and each has equal distance from its neighboring values (strongly agree, agree, neutral, disagree, strongly disagree)
- Categorical
  - **Binary** – Only two possibilities (true, false)
  - **Ordinal** – The values have an ordering (slow, medium, fast)
  - **Nominal** – The values have no ordering (apple, pear, kiwi, banana)

How do you find good research questions?

Frameworks help researchers **structure their thinking around problems**. Frameworks are proposed by experts in the field and represent how those people think about and break up certain types of problems.

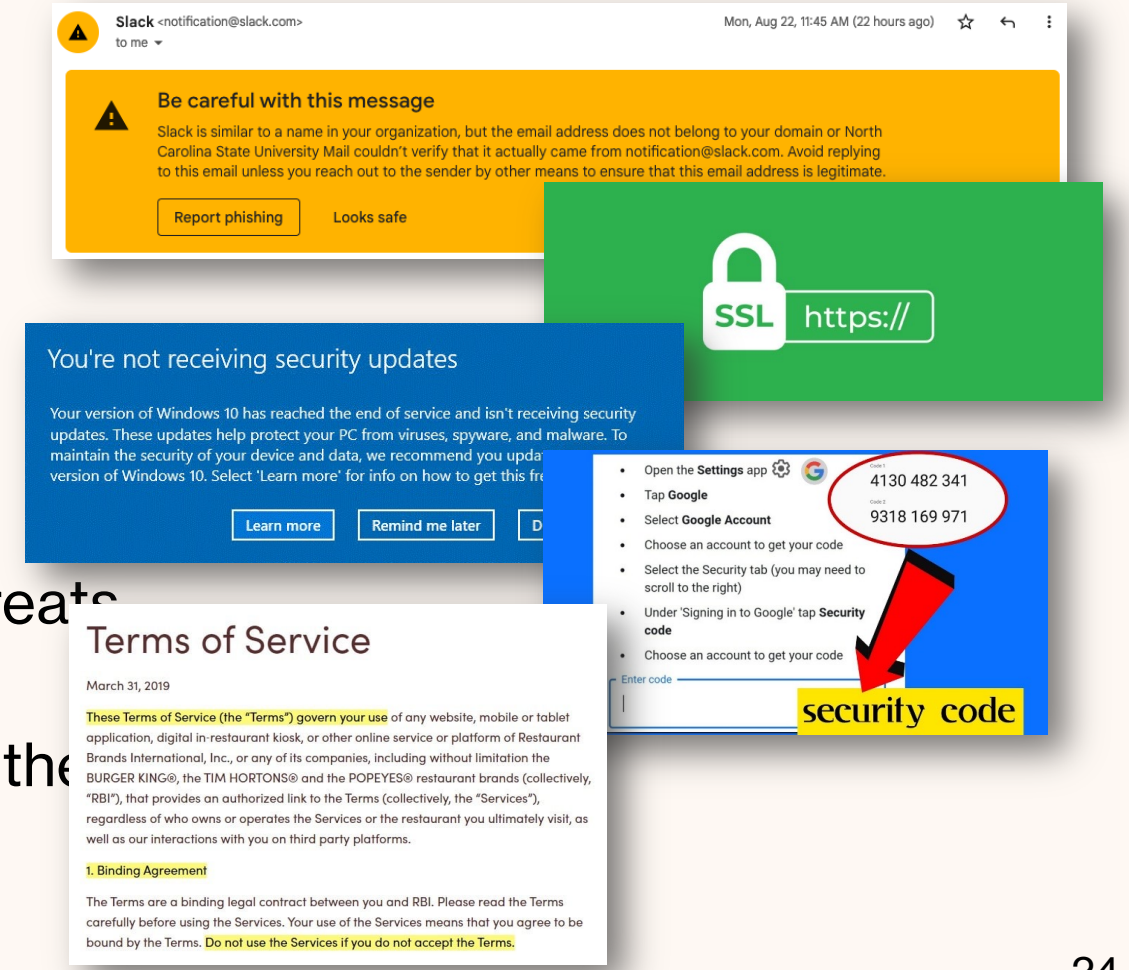
Human in the Loop Framework



Cranor, L.F., 2008. A framework for reasoning about the human in the loop.

Human in the Loop: Communication

- **Warnings** alert users to avoid a hazard
- **Notices** inform users about characteristics of an object
- **Status indicators** inform users about system info.
- **Training** teaches users about threats and mitigation
- **Policy** informs users about what the are expected to comply with



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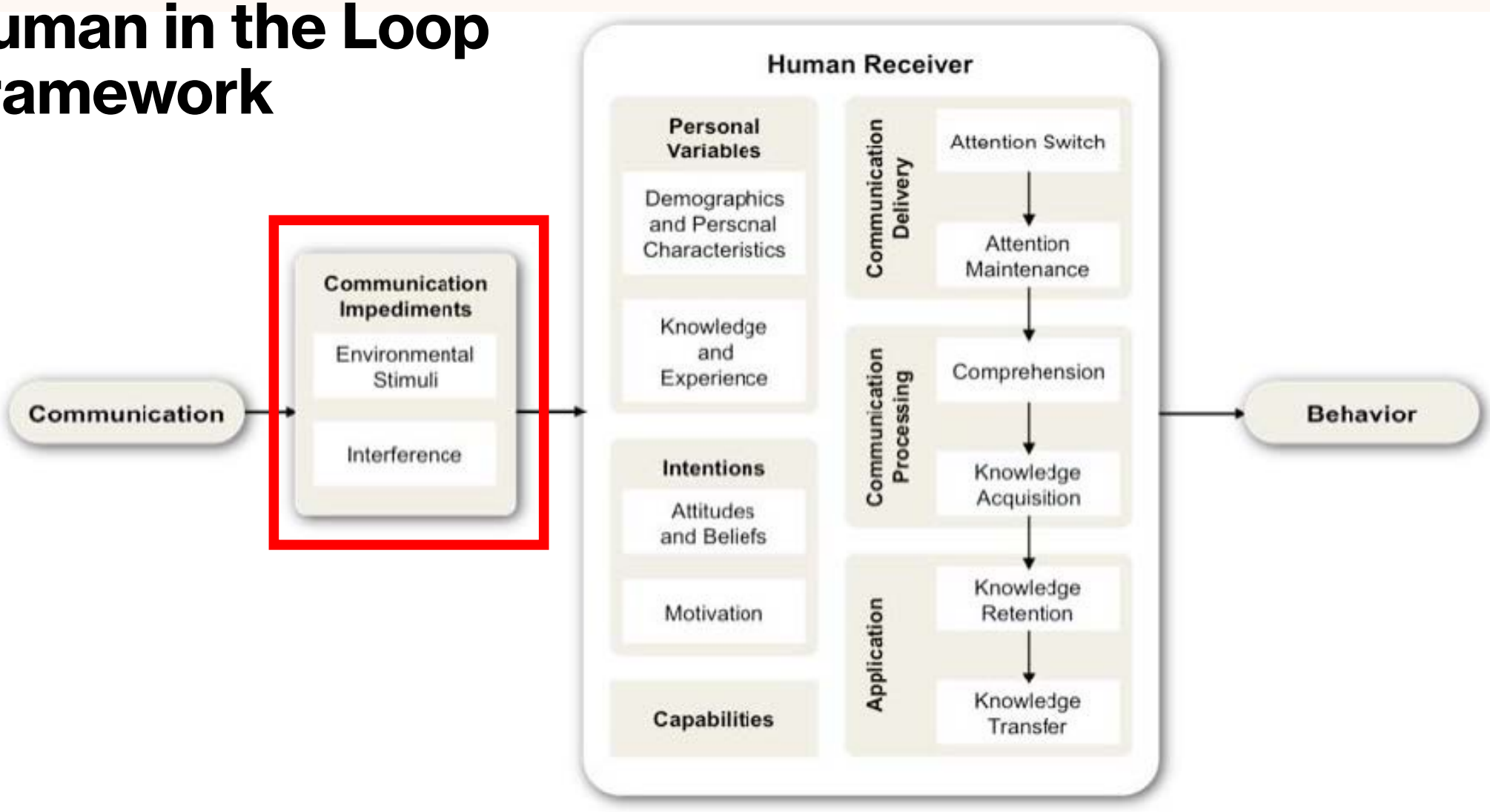
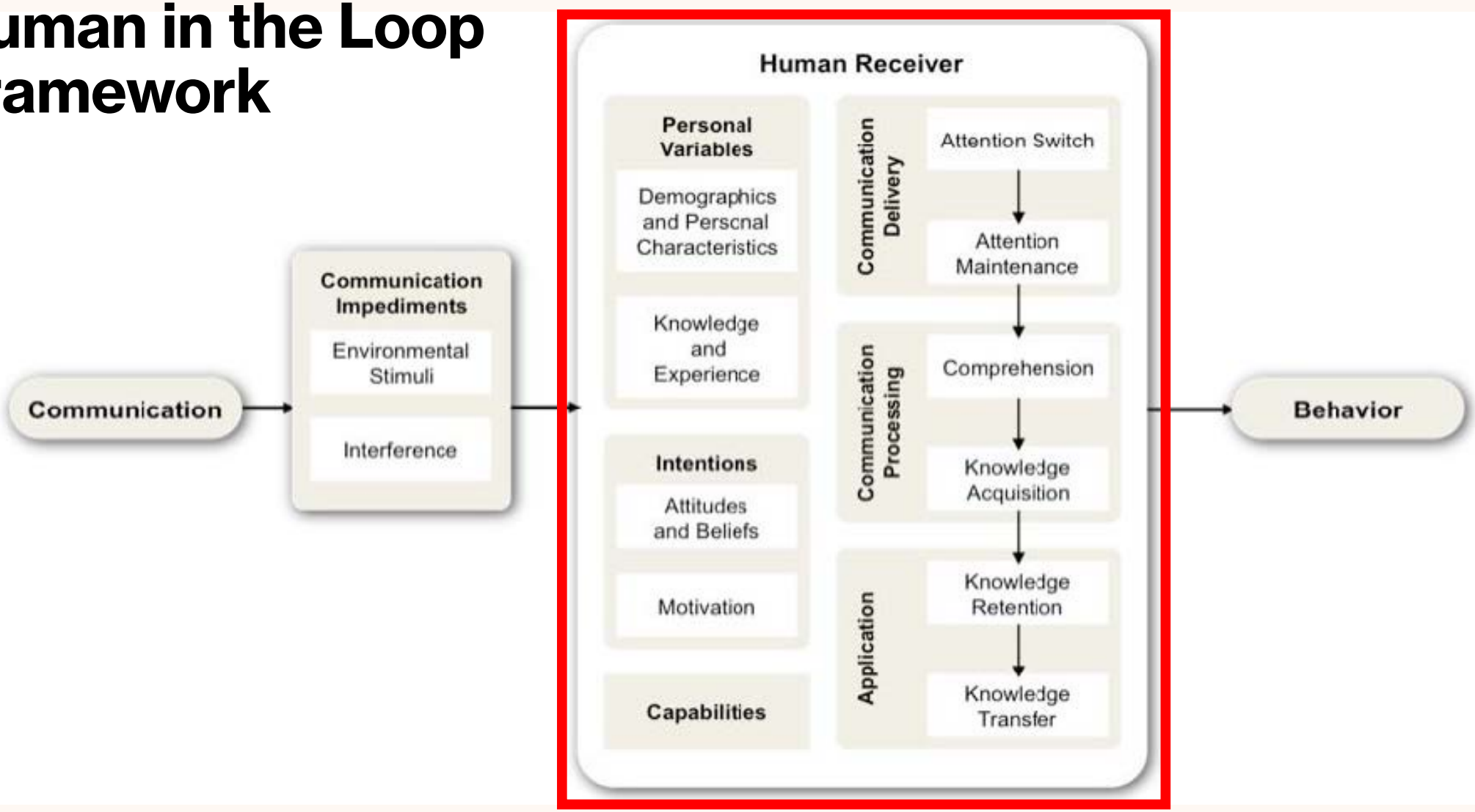



Sirani
COFFEE HOUSE
ESPRESSO DRINKS
DOUBLE ESPRESSO 2.29
AMERICANO 2.79
CAPPUCCINO 3.49
LATTE 3.79
VANILLA/MOCHA LATTE 4.29
JIRANI JUNCTION 4.29
CARAMEL MACCHIATO 4.49
ESPRESSO CON PANNA 2.99
BREWED
REG LRG
DRIP/ICED COFFEE 2.29 · 3.29
CAFÉ CON LECHE 2.59 · 3.59
POUR OVER 4.29 · —
COLD BREW 3.49 · 4.49
NITRO 3.99 · —
TEA DRINKS
HOT TEA 2.29
CHAI TEA LATTE 4.29
GREEN TEA LATTE 4.29
LONDON FOG 4.29
MORE
REG LRG
LEMONADE / ICED TEA 2.29 · 3.29
ITAL ODA 2.89 · 3.89
SMOOTHIE 4.89 · —
TRAIN FREEZE 4.89 · —
HOT CHOCOLATE 3.29 · 4.29
EXTRAS 75¢
SYRUP
ALMOND MILK
WHIPPED CREAM
thank you
WIFI PASSWORD:
8282324340
YOU WILL NEED TO LOGIN TO HOMEGROWN
(NOT HOMEGROWN GUEST)
Affogato
Syrups & Sauces
Vanilla
Mocha
Caramel
Hazelnut
White Mocha
Peppermint
Coconut
Lavender
Sugar free Vanilla
Sugar free Mocha
Cherry

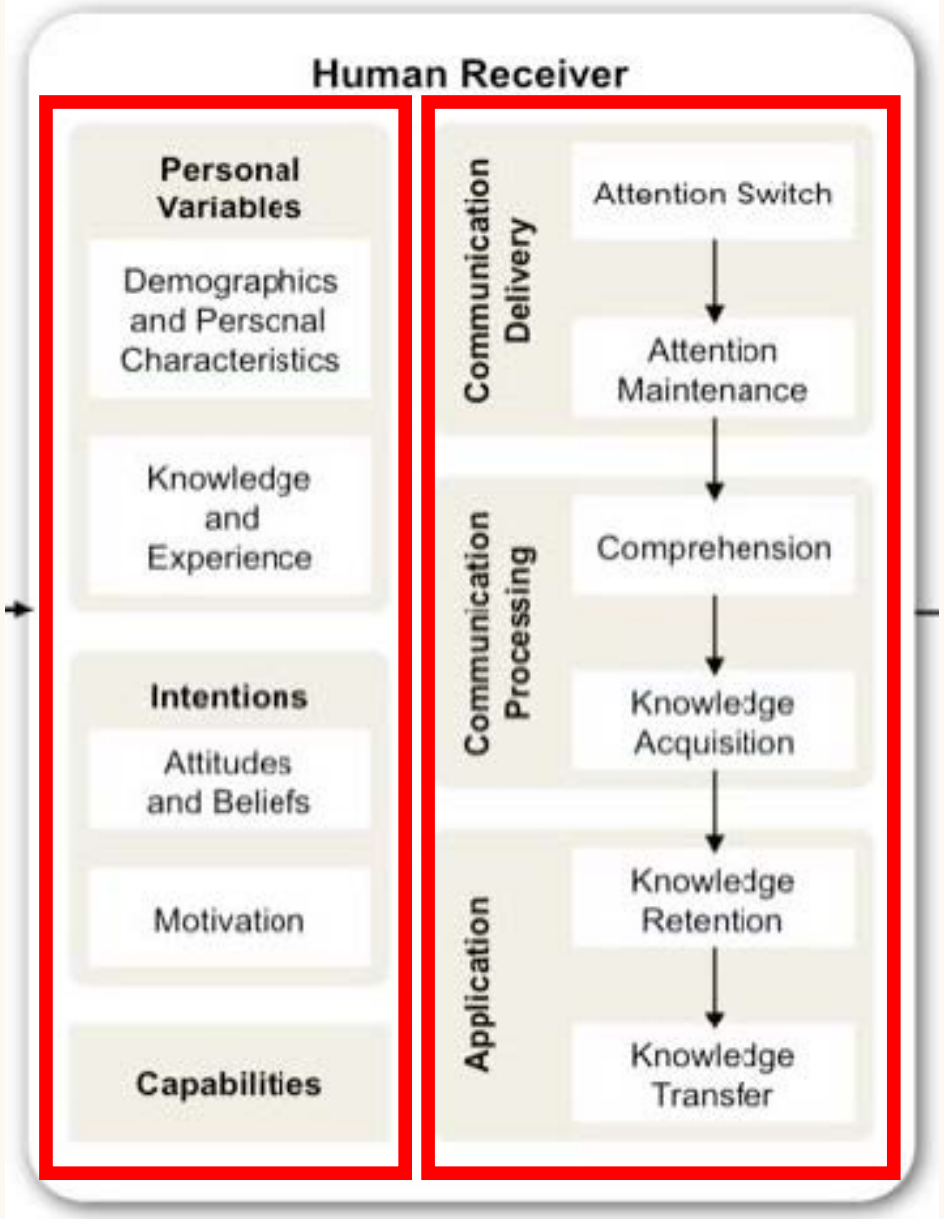
Human in the Loop: Communication Impediments

- **Environmental stimuli** (either related or unrelated) may divert users' attention away
- **Interference** prevents communication from being received as intended (can be malicious)

Human in the Loop Framework




Caution
Hot liquid


Human Receiver
Personal Variables
Demographics and Perscnal Characteristics
Knowledge and Experience
Intentions
Attitudes and Beliefs
Motivation
Capabilities
Communication Delivery
Attention Switch
Attention Maintenance
Communication Processing
Comprehension
Knowledge Acquisition
Application
Knowledge Retention
Knowledge Transfer

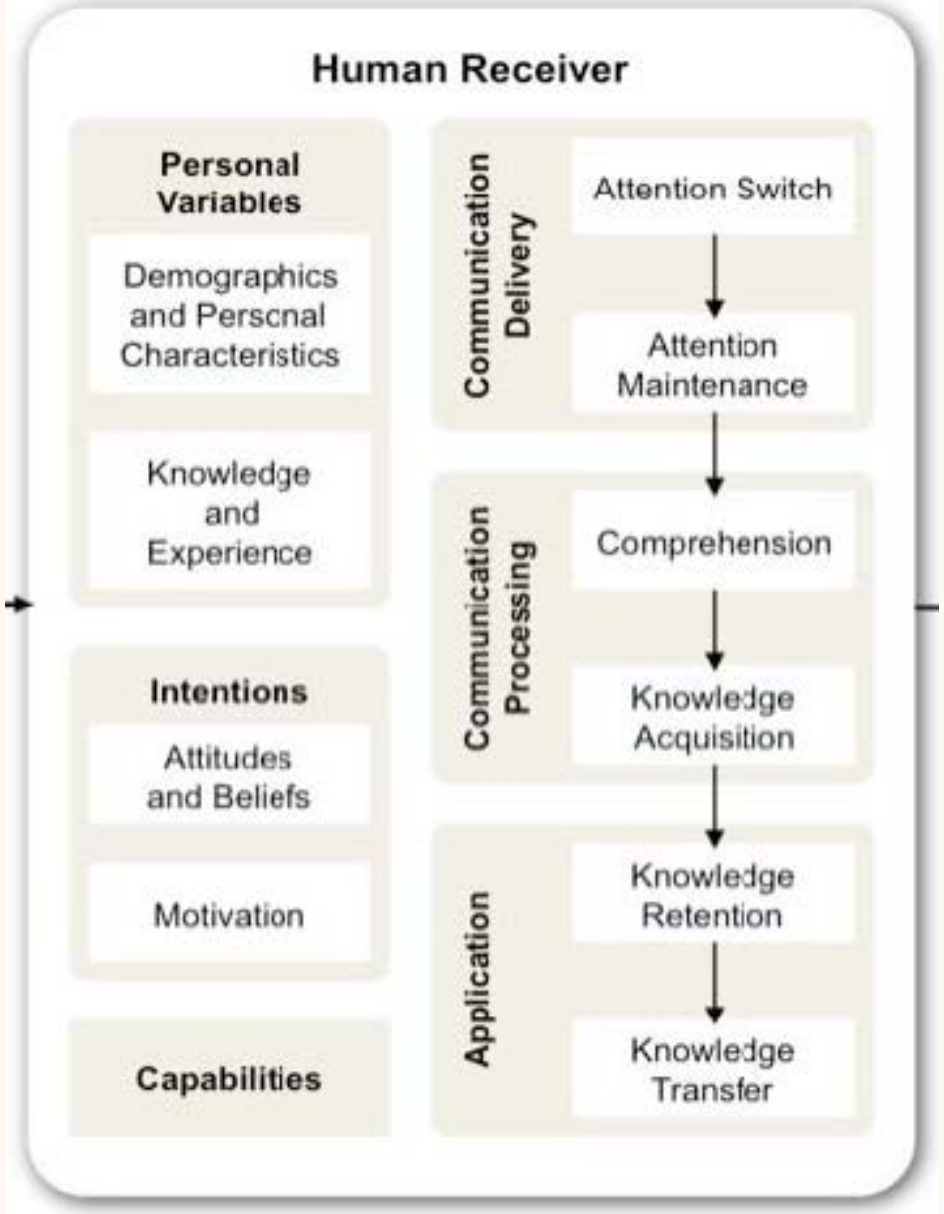
Human in the Loop: Human Receiver

- **Personal variables,** e.g., demographics, personal characteristics, knowledge , etc. – ability to comprehend and apply communications
- **Intentions** like attitudes, impacting the decision of whether to pay attention on a communication
- **Capabilities** to take proper actions

Human in the Loop: Human Receiver

- **Communication delivery:** should pay attention long enough to process it
- **Communication processing:** comprehend and acquire knowledge
- **Application:** retent the knowledge and knows when it's applicable and to apply it


WIFI PASSWORD:
8282324340
YOU WILL NEED TO LOGIN TO
HOMEGROWN
(NOT HOMEGROWN GUEST)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Communication Processing
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Knowledge Transfer

Google

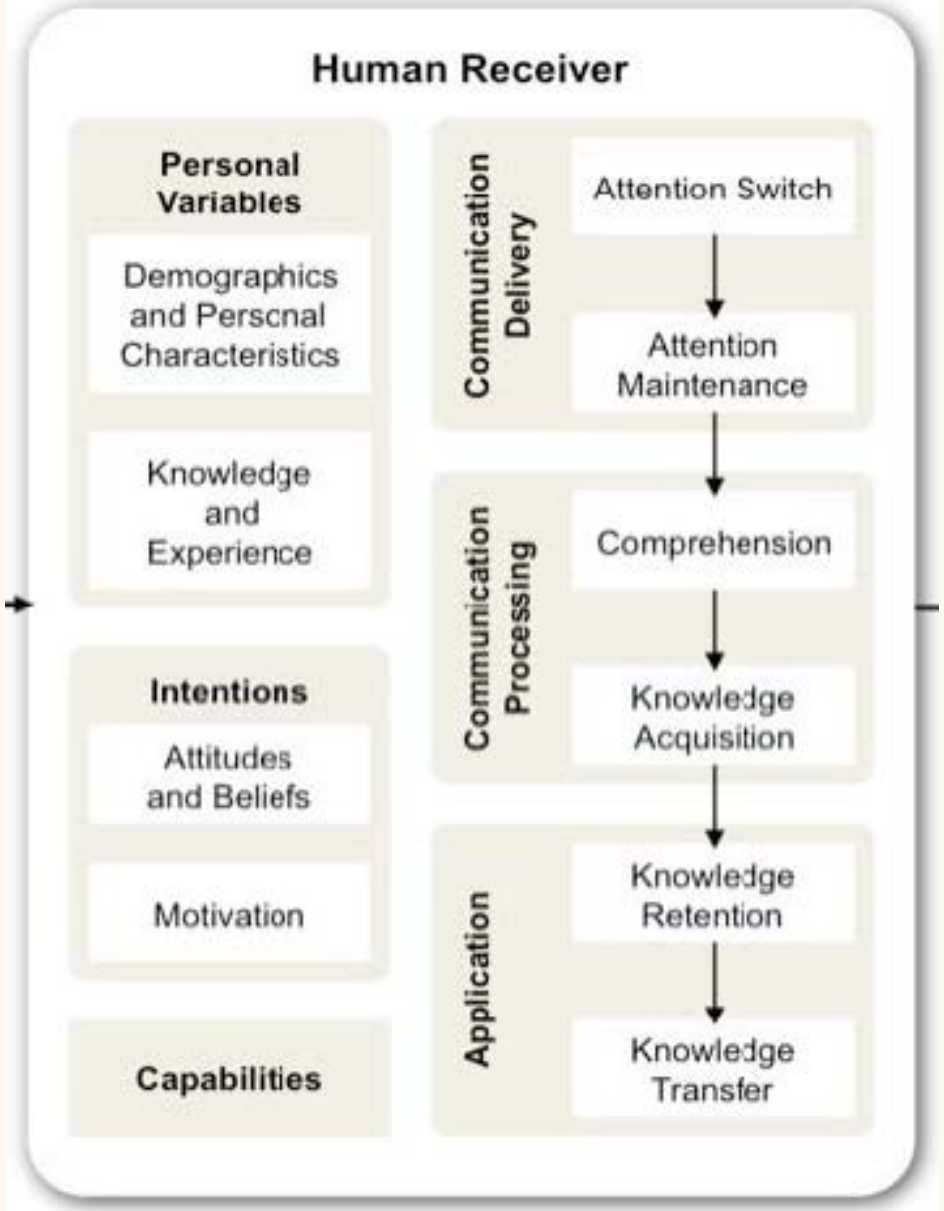
Someone knows the password to your linked Google Account

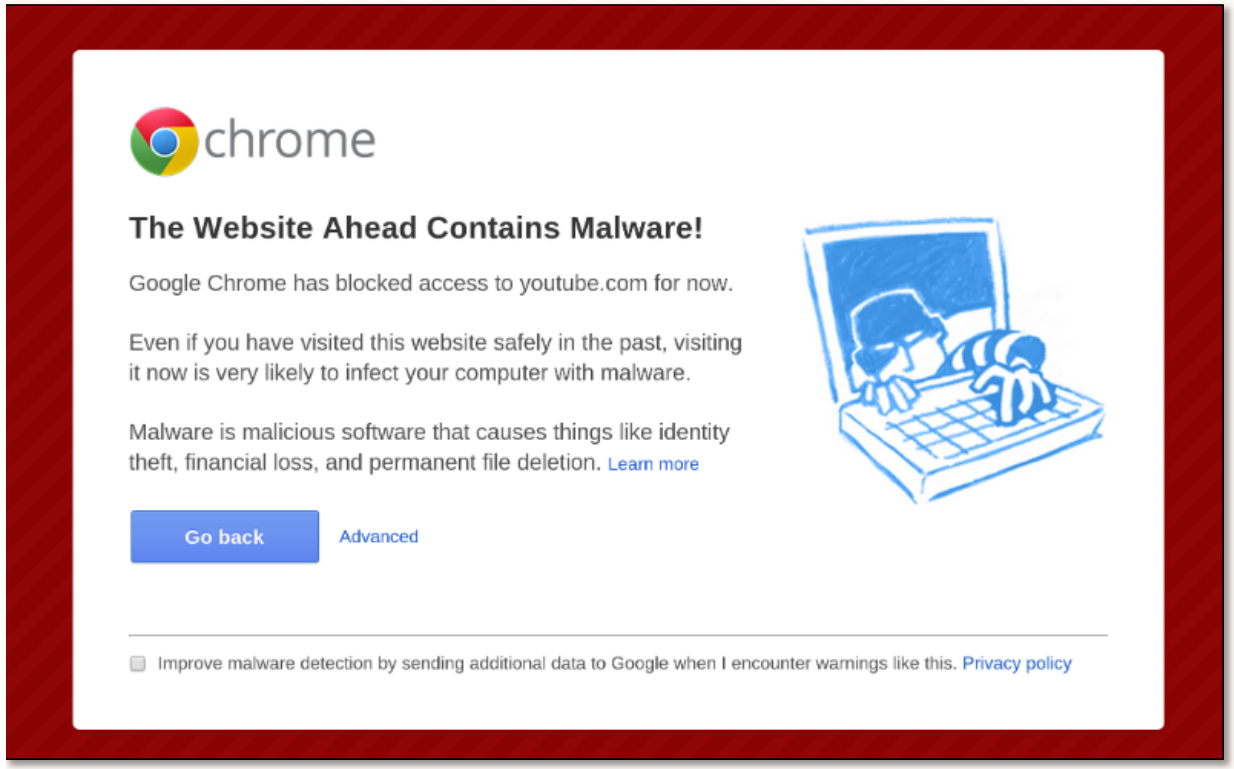
kaniea@gmail.com

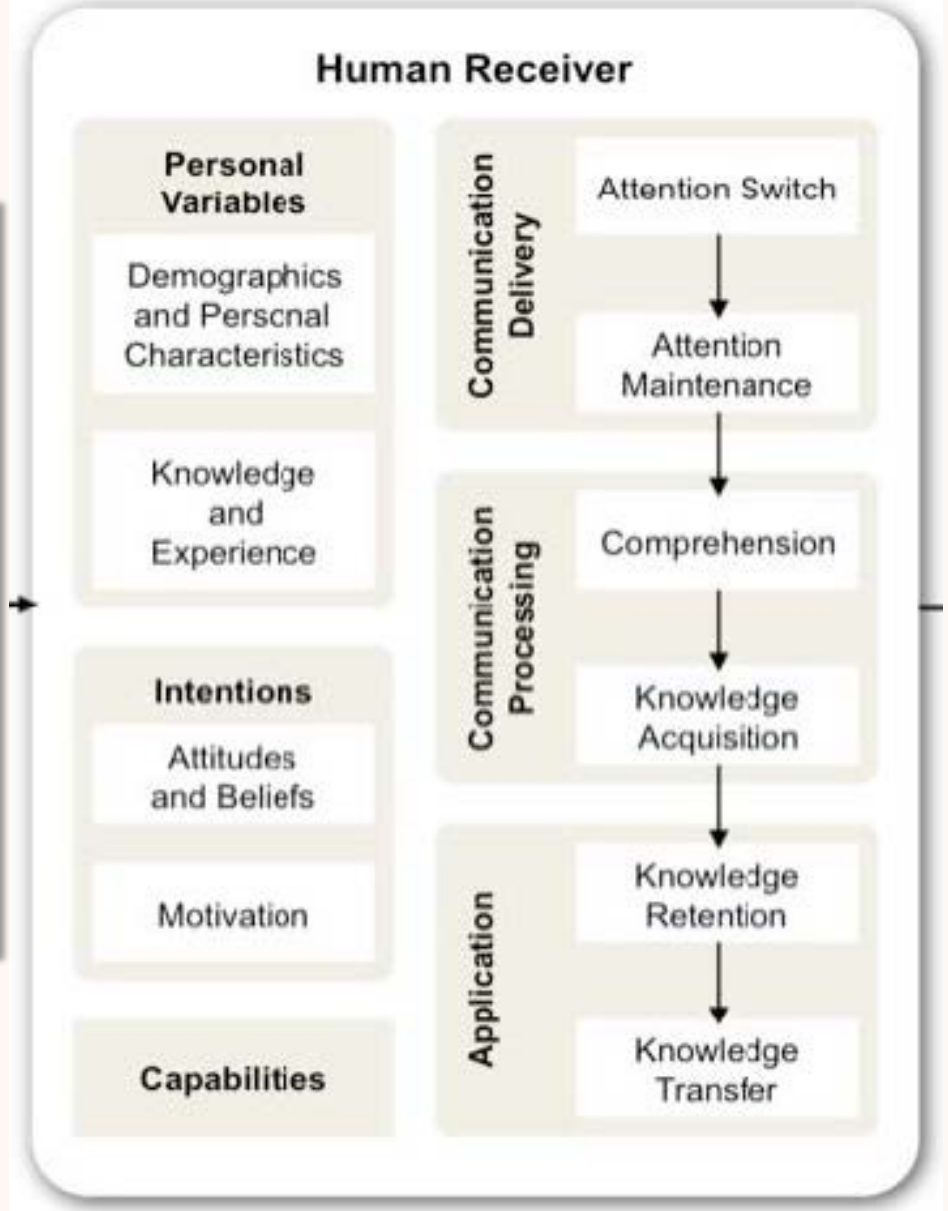
Google has become aware that someone else knows your password, and we've taken steps to protect your account. Please sign back into your account now and choose a new password to secure your account.

Learn more

You received this email to let you know about important changes to your Google Account and services.




chrome
The Website Ahead Contains Malware!
Google Chrome has blocked access to youtube.com for now.
Even if you have visited this website safely in the past, visiting it now is very likely to infect your computer with malware.
Malware is malicious software that causes things like identity theft, financial loss, and permanent file deletion. Learn more
Go back
Advanced
Improve malware detection by sending additional data to Google when I encounter warnings like this. Privacy policy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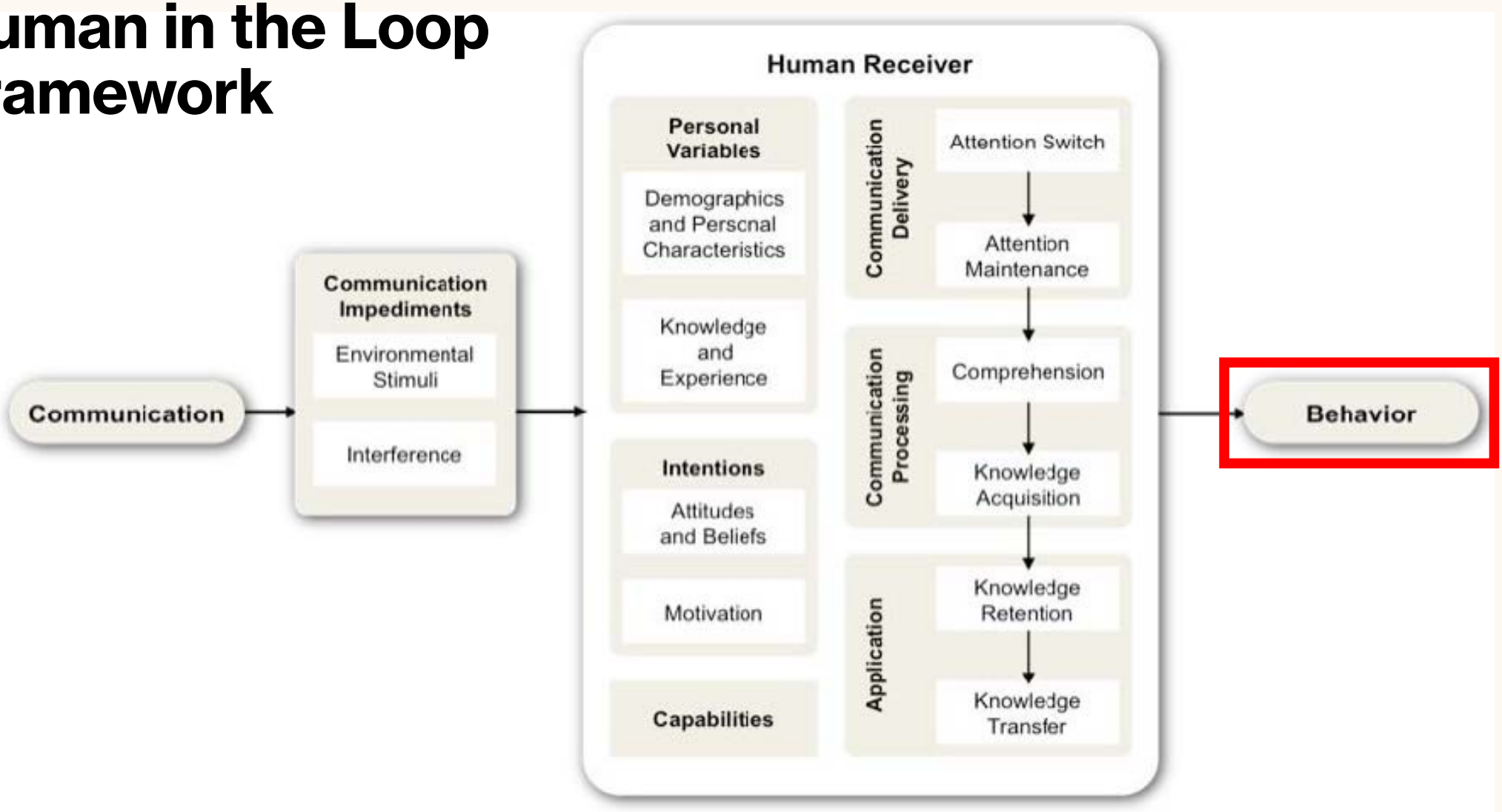
Human in the Loop Framework



Contact tracing

Have you used contact tracing? How’s your experience?

What is privacy?

Defining privacy

- There are many definitions
  - The right to be let alone
  - The right to control one's own data
- Many common security goals overlap with privacy ones
  - Confidentiality
  - Access control of information
  - Protection from unwanted intrusions

A taxonomy of privacy (by Daniel J. Solove)

A TAXONOMY OF PRIVACY

INFORMATION PROCESSING

AGGREGATION
Combining of various pieces of personal information

A credit bureau combining an individual's payment history from multiple creditors.

SECONDARY USE
Using personal information for a purpose other than the purpose for which it was collected

The U.S. Government using census data collected for the purpose of apportioning Congressional districts to identify and intern those of Japanese descent in WWII.

EXCLUSION
Failing to let an individual know about the information that others have about them and participate in its handling or use

A company using customer call history, without the customer's knowledge, to shift their order in a queue (i.e. "Your call will be answered in the order [NOT] received")

INSECURITY
Failing to protect information

An ecommerce website allowing others to view an individual's purchase history by changing the URL (e.g. enterprivacy.com?id=123)

IDENTIFICATION
Linking of information to an individual. [Sometimes called 'singling out']

A researcher linking medical files to the Governor of a state using only date of birth, zip code and gender.

COLLECTION

SURVEILLANCE
Watching, listening to, or recording of a person's activities

A website monitoring cursor movements of a visitor while visiting the website.

INTERROGATION
Questioning or probing for personal information

An interviewer asking an inappropriate question, such as marital status, during an employment interview.

INVASION

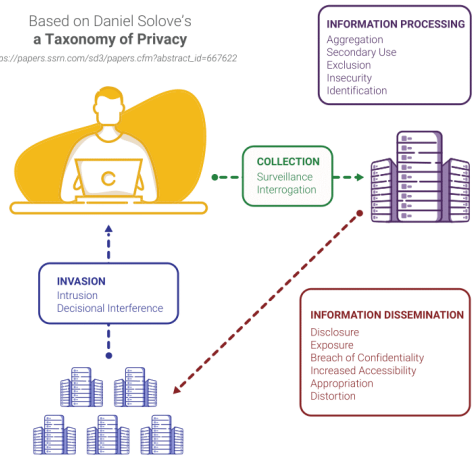
INTRUSION
Disturbing a person's tranquility or solitude

An augmented reality game directing players onto private residential property.

DECISIONAL INTERFERENCE
Intruding into a person's decision making regarding their private affairs

A payment processor declining transactions for contraceptives.

Based on Daniel Solove's
a Taxonomy of Privacy
https://papers.ssrn.com/sd3/papers.cfm?abstract_id=667622



INFORMATION DISSEMINATION

DISCLOSURE
Revealing truthful information about a person that impacts their security or the way others judge their character

A government agency revealing an individual's address to a stalker, resulting in the individual's murder.

EXPOSURE
Revealing a person's nudity, grief, or bodily functions

A store forcing a customer to remove clothing revealing a colostomy bag.

BREACH OF CONFIDENTIALITY
Breaking a promise to keep a person's information confidential.

A doctor revealing patient information to friends on a social media website.

INCREASED ACCESSIBILITY
Amplifying the accessibility of personal information

A court making proceeding searchable on the Internet without redacting personal information.

APPROPRIATION
Using an individual's identity to serve the aims and interests of another

A social media site using customer's images in advertising.

DISTORTION
Disseminating false or misleading information about a person

A creditor reporting a paid bill as unpaid to a credit bureau.

PRIVACY BY DESIGN

Version 6 (2022)

https://privacybydesign.training

https://www.jstor.org/stable/40041279

What are the privacy risks of contact tracing apps given the framework?

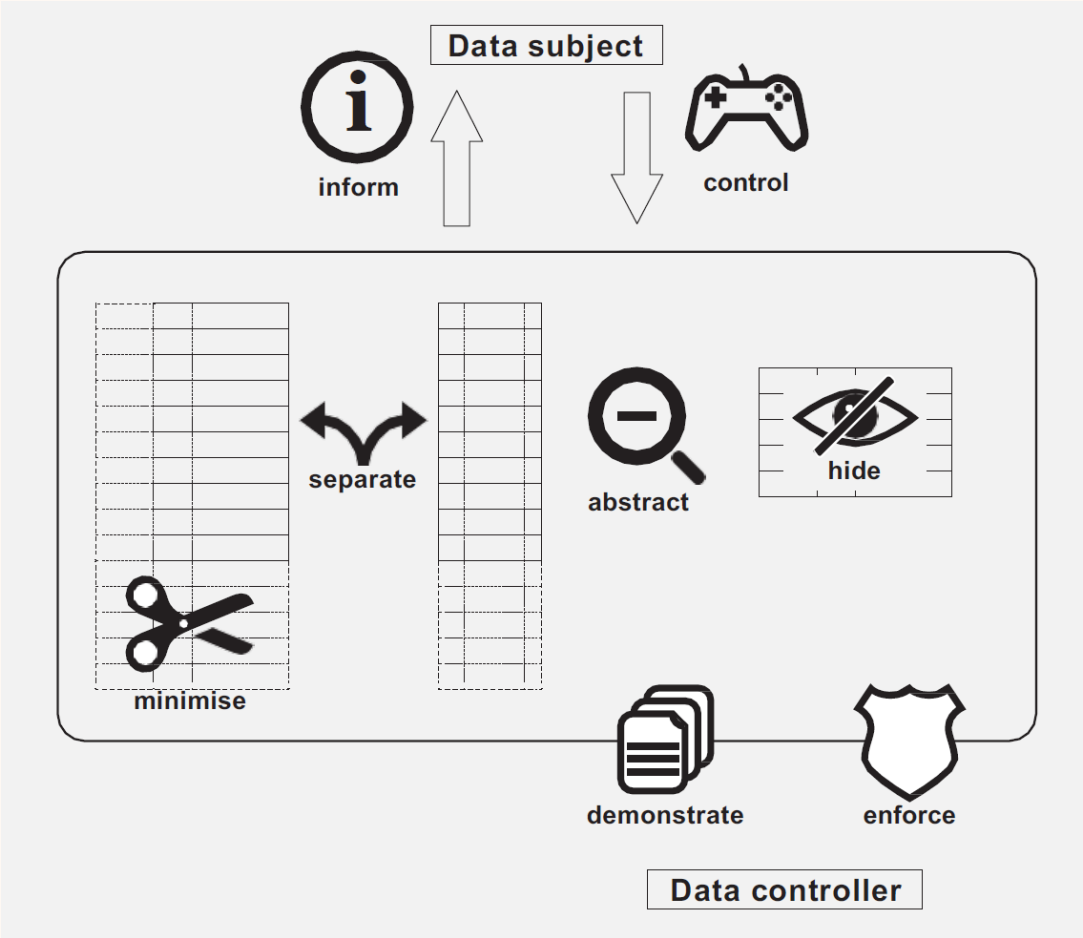
Privacy by design

Privacy by design – definition

Framework for building privacy proactively into new systems, proposed in 2009.Widely accepted as an international standard for good privacy engineering. GDPR also basis some of its principles on Privacy by Design.

- **Proactive** not Reactive; **Preventative** not Remedial
- Privacy as the **Default**
- Privacy **Embedded** into Design
- **Full** Functionality – Positive-Sum, not Zero-Sum
- End-to-End Security – Lifecycle Protection
- Visibility and Transparency
- **Respect** for User Privacy

Privacy by design – strategies



Privacy by design – Minimize

- Definition
  - Limit as much as possible the processing of personal data.
- Tactics
  - **Select** only relevant people and relevant attributes for processing.
  - **Exclude** people or attributes in advance of processing it, or better delete it.
  - **Strip** away (remove) data as soon as it is no longer needed. Also, auto-delete after is it no longer needed.
  - **Destroy** data that is no longer needed. Build systems that support complete destruction of data and do not leave it in unexpected parts of the system.
- Example
  - “Google announced a revised log retention policy, saying ’we’ll anonymize IP addresses on our server logs after 9 months,’ instead of the previous 18-24 months.”

Privacy by design – Separate

- Definition
  - Separate the processing of personal data as much as possible.
- Tactics
  - **Isolate.** Collect and process data in different databases or applications.
  - **Distribute** the collection and processing over different entities. Use the equipment of the user as much as possible.
- Example
  - Tor's Onion Routing structure along with the many organizations that host exit nodes ensures that no one entity has visibility over the whole network. Data is distributed across many nodes, knowledge of who sent the data and where it is going is also strictly distributed between nodes.

Privacy by design – Abstract

- Definition
  - Limit as much as possible the detail in which personal datais processed.
- Tactics
  - **Summarise** detailed attributes into more coarse-grained, general attributes. For example, use age categories instead of birthdate.
  - **Group.** Aggregate information about a group of people instead of processing data individually. Present data as averages.
  - **Perturb** data values to create an approximisation, for example,by adding random noise.
- Examples
  - Pubs are required to check that patrons are above the legal drinking age. But they don’t need to know the exact birthdate of the person, just if they are above that age or not.

Privacy by design – Hide

- Definition
  - Protect personal data or make it unlinkable or unobservable. Make sure it does not become public or known.
- Tactics
  - **Restrict** access to personal data. Setup a strict access-control policy.
  - **Obfuscate.** Use tools like encryption, hashs, and pseudonym's to ensure that only people with the ability to decyper can get the data.
  - **Dissociate.** Break the link between events, persons, and data.
  - **Mix** data into larger sets to ensure that data is not easy to re-connect.
- Examples
  - Most user studies promise to disassociate participants' names from their data: "you will be assigned a random participant number, your name will be stored seperately from the data we collect."

Privacy by design – Inform

- Definition
  - Inform data subjects about the processing of their personal data in a timely and adequate manner.
- Tactics
  - **Supply** resources on the processing of personal data including, policies, processes, and risks. Provide information about *which* personal data, *how* processed, and*why* processed.
  - **Explain** clearly why data needs to be processed.
  - **Notify** users when their data is being processed, shared with third parties, or after a data leak.
- Examples
  - Apple shows an icon whenever location data is being accessed by an app.

Privacy by design – Control

- Definition
  - Provide data subjects adequate control over the processing of their personal data.
- Tactics
  - **Consent.** Ask users for their explicit consent to data processing.
  - **Choose.** Offer users a real choice with basic functionality available to those who opt-out.
  - **Update.** Give users the means to review and update their personal data.
  - **Retract.** Allow users to retract (or delete) their personal information.
- Examples
  - Cookies allow users to consent (cookie pop-up) and delete the cookie (retract).

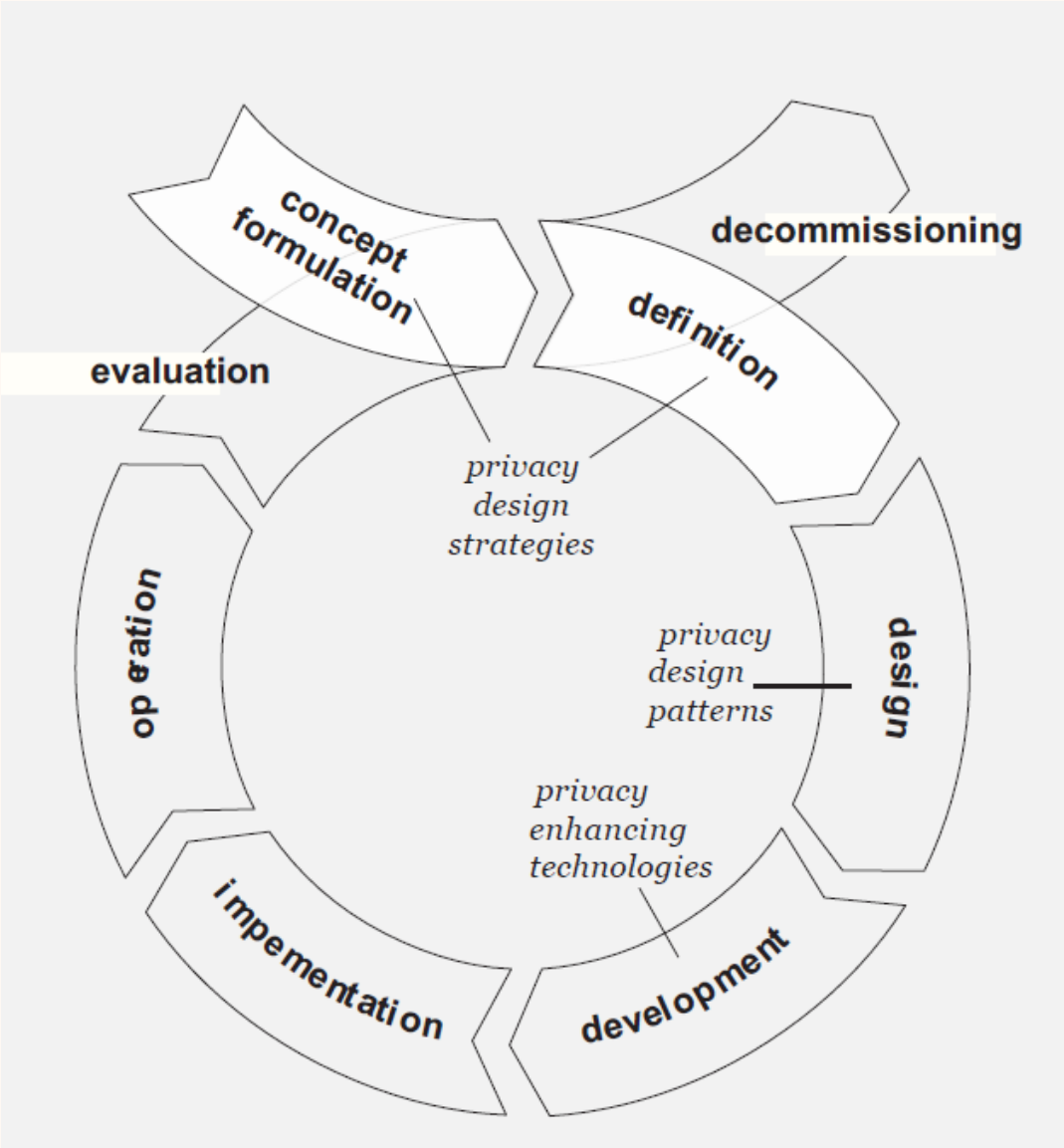
Privacy by design – Enforce

- Definition
- Commit to processing personal data in a privacy-friendly way, and adequately enforce this.
- Tactics
  - **Create.** Make a Privacy Policy, and assign resources to execute
  - **Maintain.** Uphold policy and ensure all technical and org. controls. Applyto3rdparties
  - **Uphold.** Verify policy regularly and adjust implementation when necessary.
- Examples
  - Potential approach is to implement privacy management system like the plan-do-check-act cycle from Information Security Management Standard (ISO 27001)

Privacy by design – Demonstrate

- Definition
  - Demonstrate you are processing personal data in a privacy-friendly way.
- Tactics
  - **Record.** Document all (important steps). Record decisions and motivate them.
  - **Audit.** Regularly audit and review org. processes and how personal data is processed
  - **Report.** Provide results of audits to Data Protection Authority (DPA).
- Examples
  - Certified against internationally recognised standards for privacy friendliness like TRUSTe or EuroPriSe.

Privacy by design in development cycle



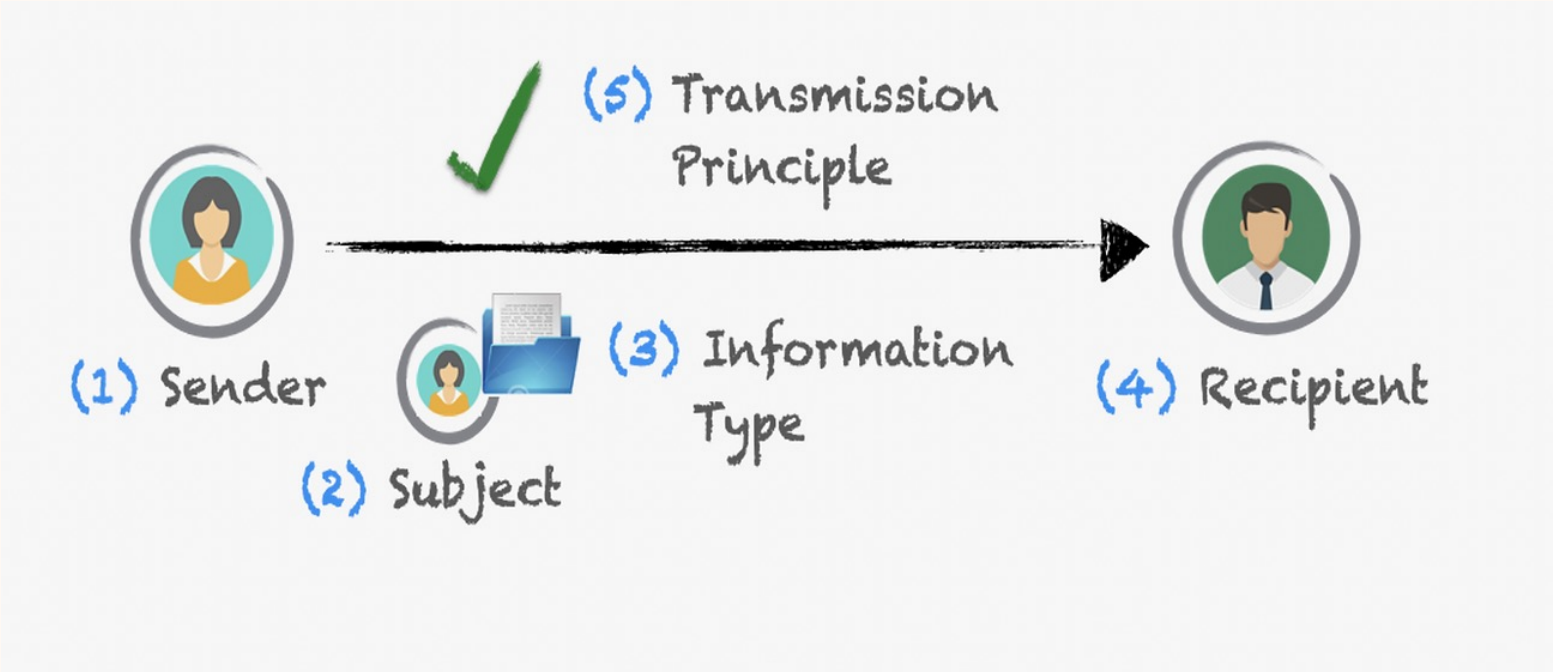
Contextual integrity

Contextual integrity

- Privacy is defined by how **information flows**
- Information flow is appropriate when it conforms with **contextual privacy norms**
- A contextual norm can be described by (at least) five parameters
  - data type (what sort of information is being shared)
  - data subject (who/what the information is about)
  - sender (who/what is sharing the data)
  - recipient (who/what is getting the data)
  - transmission principle (the constraints imposed on the flow/how), e.g., with one's consent.
- New norms and flows are evaluated through their context

Malkin, N., 2022. Contextual Integrity, Explained: A More Usable Privacy Definition. *IEEE Security & Privacy*, *21*(1), pp.58-65.

Contextual integrity



https://www.dli.tech.cornell.edu/post/privacy-policies-as-contextual-integrity-beyond-rules-compliance

Stop the Spread: A Contextual Integrity Perspective on the Appropriateness of COVID-19 Vaccination Certificates

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ABSTRACT

We present an empirical study exploring how privacy influences the acceptance of vaccination certificate (VC) deployments across different realistic usage scenarios. The study employed the privacy framework of Contextual Integrity, which has been shown to be particularly effective in capturing people's privacy expectations across different contexts. We use a vignette methodology, where we selectively manipulate salient contextual parameters to learn whether and how they affect people's attitudes towards VCs. We surveyed 890 participants from a demographically-stratified sample of the US population to gauge the acceptance and overall attitudes towards possible VC deployments to enforce vaccination mandates and the different information flows VCs might entail. Analysis of results collected as part of this study is used to derive general normative observations about different possible VC practices and to provide guidance for the possible deployments of VCs in different contexts.

CCS CONCEPTS

1 INTRODUCTION

The prolonged and devastating COVID-19 pandemic has affected every aspect of people's lives as well as the global economy. In an attempt to curb the spread of highly contagious variants, governments around the world have contemplated or adopted vaccination mandates (VMs) and vaccination certificates (or passports) (VCs) in schools, hospitals, public transportation, and other social contexts [15, 27, 42, 43, 50, 53, 62]. COVID VMs and VCs challenge established societal norms and conventions. While vaccination mandates and certificates are not new (e.g., vaccination mandates for children attending schools, "yellow cards" for travel to or from a country with a high risk of diseases such as yellow fever [55]), the sudden and unprecedented requirement to show proof of vaccination to gain access to public venues or engage in a range of daily activities has triggered a fierce global debate on the appropriateness of COVID-19 VMs and VCs in light of established societal norms and conventions, perceived privacy harms, and civil liberty expectations [9, 34, 36, 61, 69].

Some proponents of VMs and VCs argue for overriding these

Take-home

- **(Blog)** Bielova, N., Litvine, L., Nguyen, A., Chammat, M., Toubiana, V. and Hary, E., 2024. The effect of design patterns on (present and future) cookie consent decisions. In *33rd USENIX Security Symposium (USENIX Security 24)* (pp. 2813-2830).
  (Blog) BBC - Apple pulls data protection tool after UK government security row