Ubiquitous and Mobile Computing

CS 528: Is Implicit Authentication on Smartphones Really Popular? On Android Users' Perception of "Smart Lock for Android"

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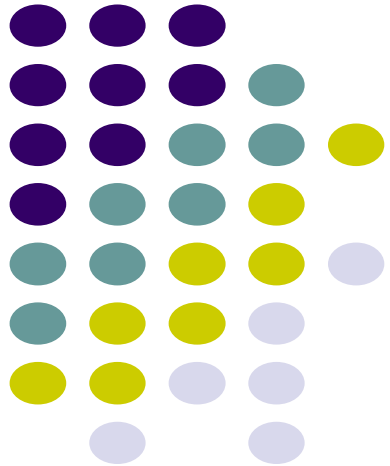


Introduction

What this paper is about?

- This paper reports on investigation how Android users perceive real world Implicit Authentication (IA) solution called Smart Lock (SL), which is the currently and only widely deployed IA solution.
- Conducted qualitative study : Cognitive walkthroughs, think aloud with interview sessions and Survey of Amazon Mechanical Turk(MTurk).
- To understand Android user's perception about (IA) for which researchers have published the model called SL-TAM (Smart Lock Technology Acceptance Model).

amazon mechanical turk

Authentication

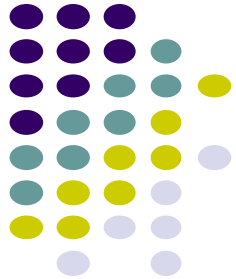
Explicit

Users are aware of the authentication process and actively participate, which can be familiar but may be perceived as cumbersome.

Implicit

The Authentication that user is not aware of participation or does not participate directly or no action required from user's side.

Conducted Study and Observations



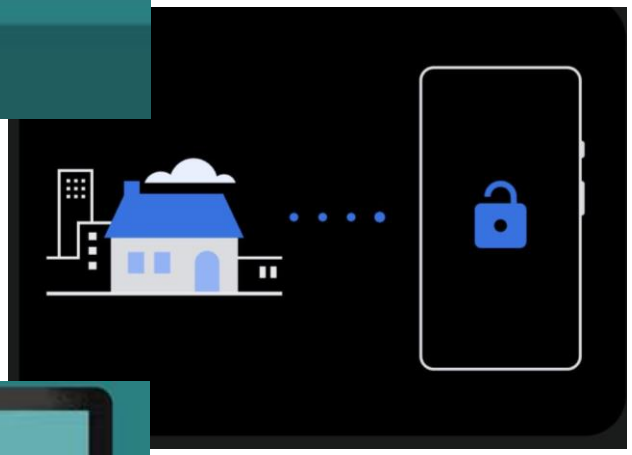
- Cumbersome unlocking process.
- 40% of users find authentication inconvenient.
- IA schemas : Touchalytics and SilentSense have studied with low fidelity prototypes.
- Roughly 13% of participants were SL-capable & around 60% users had idea about SL..
- Lack of Availability is not reason. - SL is already deployed on 100M+ device being part of Google play service packages. WSS
- Majority of SL novice participants did not find any value using SL and unwilling to use because of security/privacy concerns.

Smart Lock for Android

- Introduced at the 2014 Google I/O conference
- Designed to reduce phone unlocking frequency
- Includes On-body Detection, Trusted Places, Trusted Devices

Smart Lock for Android

- **On-body Detection (BODY):**
  - Uses behavioral biometrics (gait and body movement)
  - Keeps the phone unlocked in motion, auto-locks with no movement
- **Trusted Places (PLACE):**
  - Utilizes GPS and Wi-Fi signals
  - Automatically unlocks in specific locations (e.g., home), auto-locks outside
- **Trusted Devices (DEVICE):**
  - Uses Bluetooth signals
  - Designate paired devices as trusted for automatic unlocking, auto-locks on disconnection



Technology Acceptance Model (TAM) Essentials

- **TAM Overview:**
  - *Proposed by Davis et al. in 10.*
  - *Key elements:*
    - *Perceived Usefulness: Enhances performance.*
    - *Perceived Ease of Use: Measures effort for system use.*
- **Application:**
  - *Widely used to explain tech adoption.*
  - *Includes extensions like TAM2.*
- **Key Elements:**
  - *Usefulness:* Enhances performance.
  - *Ease of Use:* Measures effort.

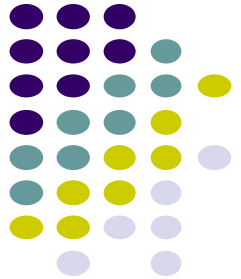
Introduction to Methodology

The methodology was designed to answer the following research questions:

- *RQ1: How widely is Smart Lock (SL) adopted by Android users?*

- *RQ2: What factors attract or deter users from adopting SL?*

Exploring Smartphone Locking Methods: A Holistic Investigation



- Background: There is a lack of in-depth understanding of smartphone unlocking methods (SL).

- Objective: To conduct a comprehensive study using **qualitative and quantitative methods** to explore in depth the usability and user attitudes of SL.

- Method Overview: Employed methods include Cognitive Walkthrough (CW) and online surveys.

Unveiling User Perceptions: Qualitative Exploration

Research Method: Cognitive Walkthrough with Users (CWU) method, involving sessions with both expert HCI participants and regular smartphone users.

Advantages of Choosing CWU: Task-oriented, focus on UI learnability, addressing limitations of traditional cognitive walkthrough.

Optimizing Study Design: Introduced new questions, validated through pilot studies and semi-structured interviews.

Recruitment and Compensation: Recruited 26 participants through word-of-mouth and online channels, providing cash and refreshments as compensation.

Validating Insights: Quantitative Survey

Quantitative Study Background: Based on qualitative findings, formulated hypotheses regarding SL adoption.

Online Survey Design: Included questions about smartphone usage habits, screen unlocking methods, an introductory SL video, etc.

Scope of Questions: Participants' familiarity with SL, experiences, reasons for attitudes, and rankings of unlocking methods.

Data Analysis: Employed chi-squared tests and binomial logistic regression to analyze data and calculate SL adoption rates.

RESULTS

Based on the following functionalities:

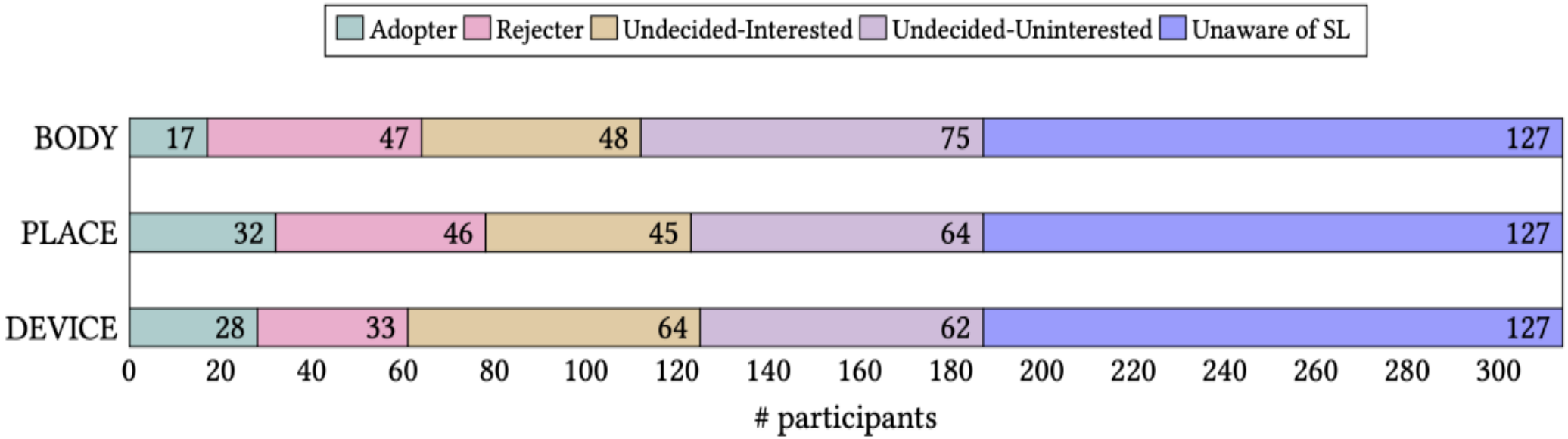
- ✓ Demography
- ✓ Security
- ✓ Privacy
- ✓ Utility
- ✓ Reliability
- ✓ Other adoption barriers

RESULTS: Demography Results

Table 1: Participant demographics for our CWU and survey studies.

Parameter	Property	CWU Study (N = 26) % (#) of participants	Survey Study (N = 343) % (#) of participants
Gender	Female	53.8 (14)	58.3 (200)
	Male	46.2 (12)	41.4 (142)
	Other	0.0 (0)	0.3 (1)
Age	19-24	38.5 (10)	5.8 (20)
	25-34	57.7 (15)	46.6 (160)
	35-44	3.8 (1)	28.9 (99)
	45-54	0.0 (0)	14.3 (49)
	55-64	0.0 (0)	3.8 (13)
	65-74	0.0 (0)	0.3 (1)
	75-84	0.0 (0)	0.3 (1)
Education	Less than high school	0.0 (0)	0.3 (1)
	High school	7.7 (2)	33.2 (114)
	University (bachelor's)	38.7 (10)	58.3 (200)
	Master's or PhD	53.4 (14)	8.2 (28)

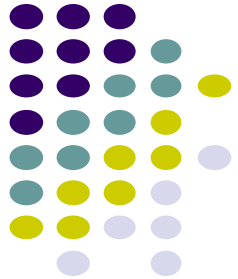
Attitudes towards adoption of each SL method



RESULTS: Adoption, Rejection, and Interest Rates

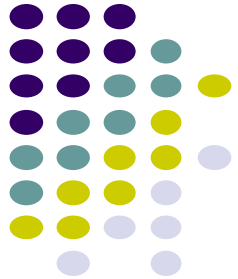
SL Method	Adoption Rate (%)	Rejection Rate (%)	Interest Rate (%)
BODY	9.1	25.1	39.0
PLACE	17.1	24.6	41.3
DEVICE	15.0	17.6	50.8
Average	13.7	22.4	43.7

RESULTS: Security



- People said SL is not very secure
  - Can unlock on trusted device
  - Can unlock on trusted places
  - Social inside attacker –like a friend or a brother

RESULTS: Privacy



- The survey did not support the role of privacy for SL adoption
- Privacy was not rated as reason for refusal of SL adoption
- Further studies are needed for to investigate the relationship between privacy and intent to use SL.

RESULTS: Reliability

- Perceived unreliability, lack of precision and accuracy (i.e.PLACE) of SL methods.
- Accidental unlocking and locking users out are main concerns.

Minimizing false positive and negative rates in authentication (reliable design of IA methods).

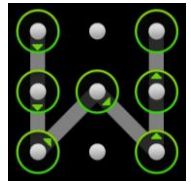
RESULTS: Utility

Main utilities:

- Convenience: *Easier than conventional methods.*
- Speed: *Faster.*
- Redundance: *Backup method.*

SL adopters mainly value convenience and speed.

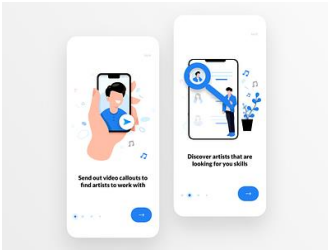
Perceived lack of utility as a major barrier to SL adoption.



Effective communication of SL's benefits (faster, avoid unlocking manually) is essential for SL adoption.

RESULTS: Other adoption barriers

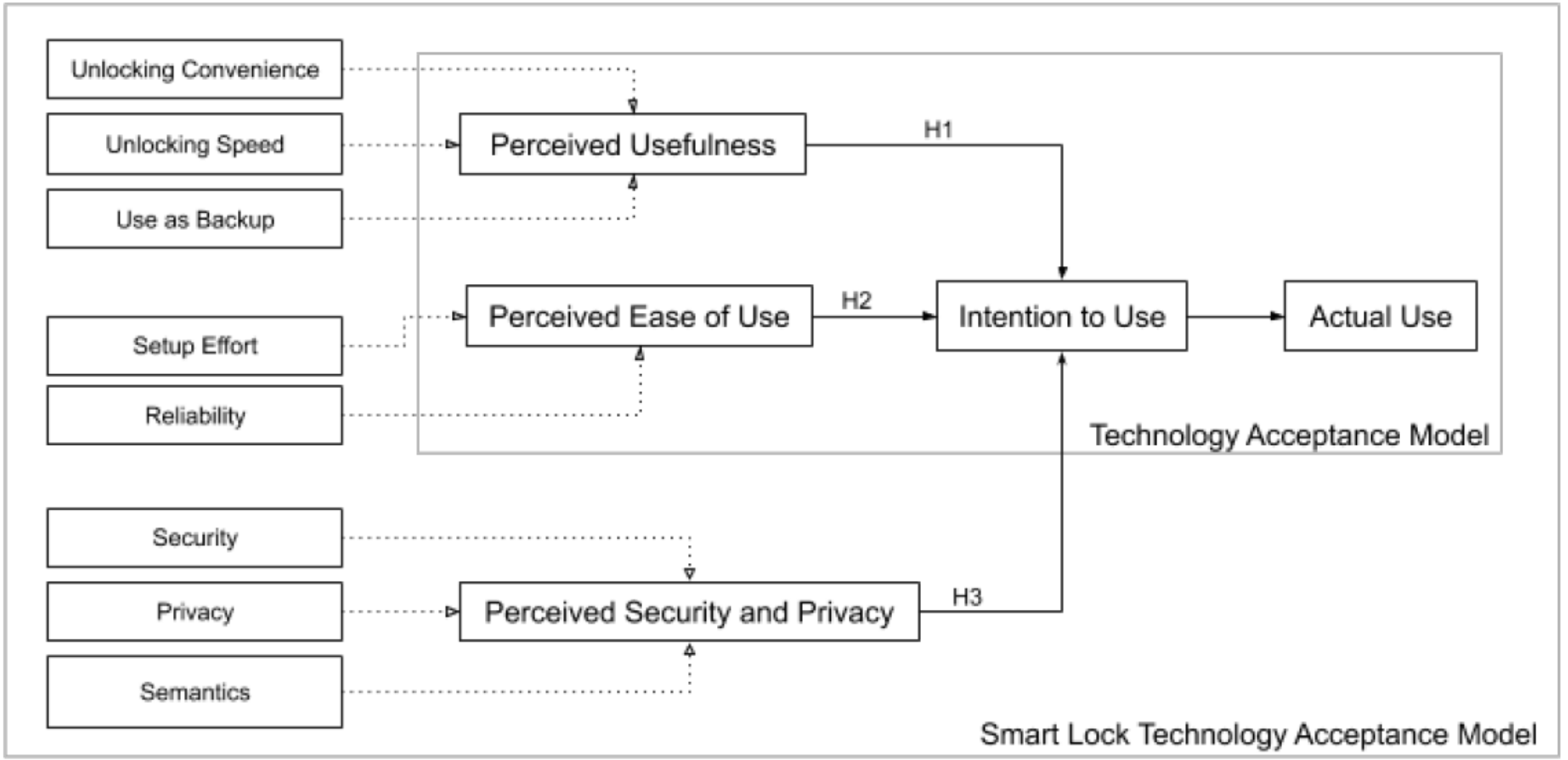
- Difficulty in understanding the semantics of SL.
- Satisfied with their current unlocking method (i.e. fingerprint unlocking).
- Usability issues with the UI affect trust in SL.

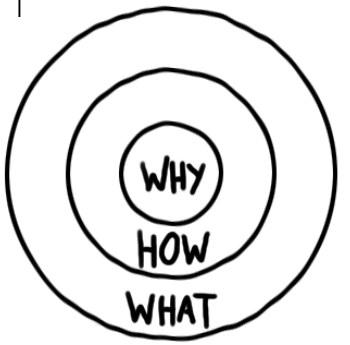


Tutorial screen

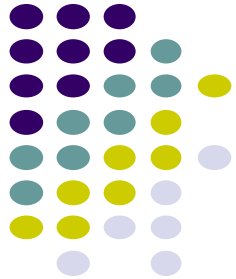
There are no guidelines reported for designing or evaluating the UI for IA on smartphones.

SMART LOCK TECHNOLOGY ACCEPTANCE MODEL (SL-TAM)





Testing SL-TAM with Survey



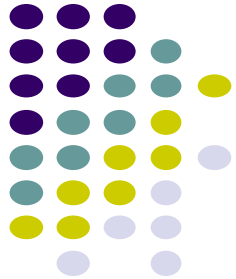
- SL-TAM was tested by evaluating how survey conforms with adoption of each SL method.
- Evaluation Factors :

  Perceived Usefulness (by Utility score)

  Perceived Ease of Use (by agg. score of convenience, speed, backup)

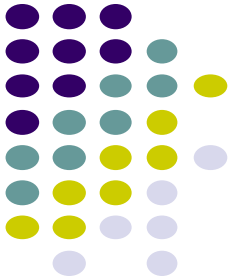
  Perceived Security and Privacy (by security + privacy + semantic score)
- Formal evaluation : BLR (Binomial Logistic Regression)
- BLR Testing showed survey data conforms with SL-TAM model's feasibility with hypothesized factors for SL adoption.

Threats to Validity [Limitations]



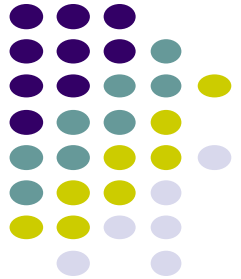
- Sample might have skewed towards people who were interested or using SL already.
- Study might not capture how using SL will affect people's opinion in long term.
- Not enough diversity, so might have found all the reasons for adopting/rejecting SL.

Threats to Validity [Limitations]



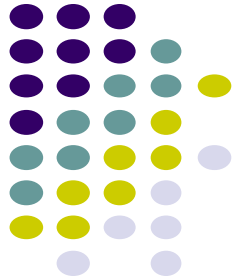
- User's perception towards SL might be same towards all IA schemes.
- People may not be honest in the surveys, which could affect validity of results.

CONCLUSION



- Explored Smart Locks as an implicit authentication solution for smartphones, utilizing qualitative sessions with 27 participants and a subsequent survey involving 343 Android users.
- Around 14% adoption rate, with majority of concerning reliability, utility & security.
- In the proposed framework:
  - SL-TAM (Smart Lock Technology Acceptance Model) was proposed.
  - Factors Influencing Adoption: Perceived usefulness, perceived ease of use, and perceived security and privacy.
- Survey data demonstrated high predictive power for the SL-TAM.

CONCLUSION



- Recommendations: Communication about IA scheme like Smart Locks schemes should be clear and accessible to users.
- Additionally, the scheme should be reliable, trustworthy, and disclose any potential malfunctions.
- To help users understand and feel comfortable with the technology, the semantics of the intelligent authentication scheme should be clearly communicated, enabling users to use it effectively and avoid errors.

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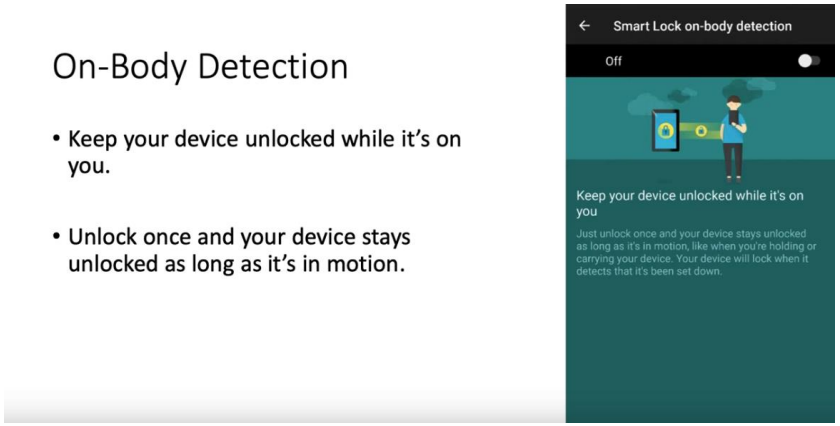

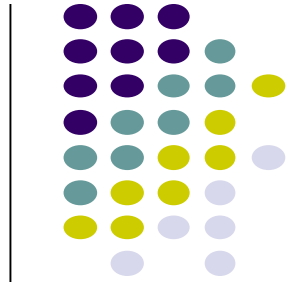

Thank you!