

Ask me again but don't annoy me: Evaluating Re-authentication Strategies for Smartphones

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What if your
phone was
left behind?



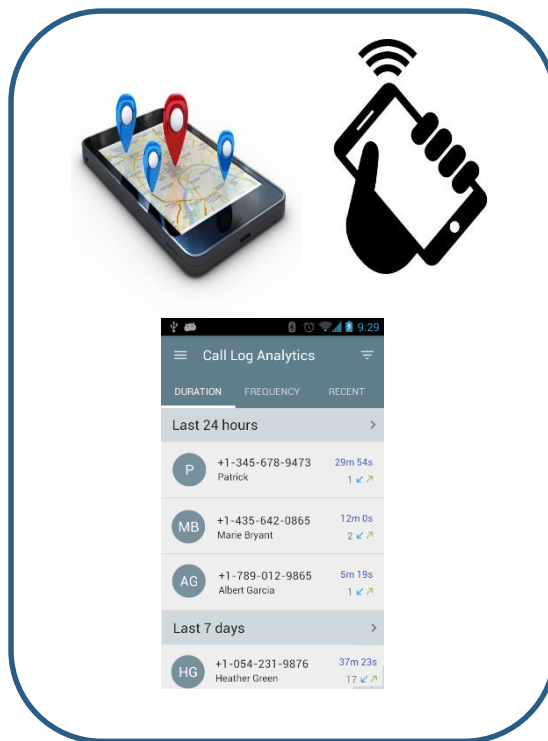
Image source: <http://www.zense.io/>

RE-AUTHENTICATION SCENARIOS

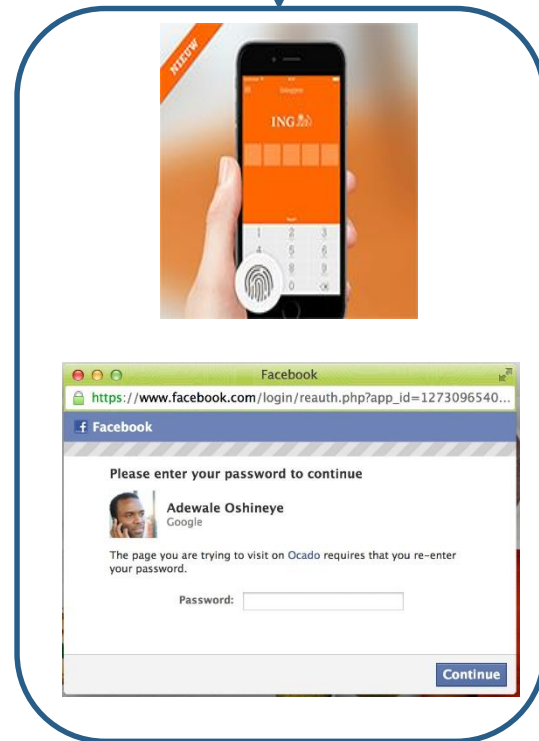
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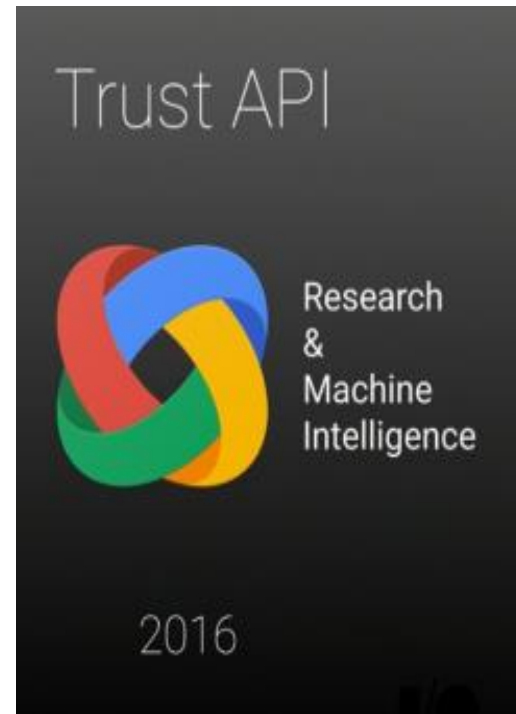
Implicit Authentication (IA)



Context-Aware Authentication



App-Specific Authentication



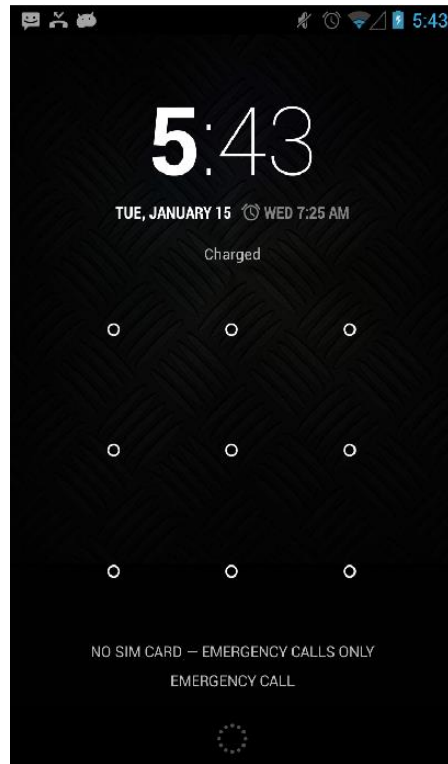
USABILITY ISSUES WITH EXISTING AUTHENTICATION SCHEMES

- ▶ Khan et al. [SOUPS '15] conducted a study to understand the usability issues arising from re-authentication
- ▶ They simulated false rejects for a touch input based behavior scheme and used the default lock configuration
- ▶ Almost 35% of the users found it annoying because of the unpredictable nature of re-authentication and the context switch overhead due to it



CONTRIBUTIONS

- ▶ We **modify** two widely deployed authentication mechanisms to make them more usable for re authentication scenarios without significantly comprising on security
- ▶ We **evaluate** the perceived security and usability of the configurations by performing lab experiments with 30 participants using synthetic tasks



CONFIGURATION PARAMETERS

SCREEN TRANSPARENCY

Affects the visibility of the current task by configuring the background of the authentication prompt

Imm-Trans

Background of the prompt turns instantaneously transparent

Imm-Dark

Background of the prompt turns instantaneously dark

Grad-Dark

Background of the prompt gradually fades into a dark screen from a transparent screen

TIME DELAY

Represents the delay in the appearance of the authentication prompt once re-authentication has been triggered

Imm-Lock

Re-authentication prompt appears immediately (without any delay)

Grad-Lock

Re-authentication prompt appears after a predefined interval with a fade-in effect

PROPOSED CONFIGURATIONS

Animation for the configurations are available at <https://github.com/cryspuwaterloo/FireLock>

IMM-DARK-IMM-LOCK

- ▶ Default lock scheme on most Android devices
- ▶ Authentication prompt appears with a dark background
- ▶ No time delay
- ▶ Completely hides the content displayed in the background



IMM-TRANS-IMM-LOCK

- ▶ Background of the re-authentication prompt remains transparent
- ▶ No time delay
- ▶ Allows users to observe the contents of their task



GRAD-DARK-IMM-LOCK

- ▶ Background of the re-authentication prompt gradually fades into a dark screen from a transparent screen
- ▶ No time delay
- ▶ Allows users to observe the contents of their task for a while



GRAD-DARK-GRAD-LOCK

- ▶ Background of the re-authentication prompt gradually fades into a dark screen
- ▶ Four-second time delay
- ▶ Allows users to continue interacting with the task during this grace period

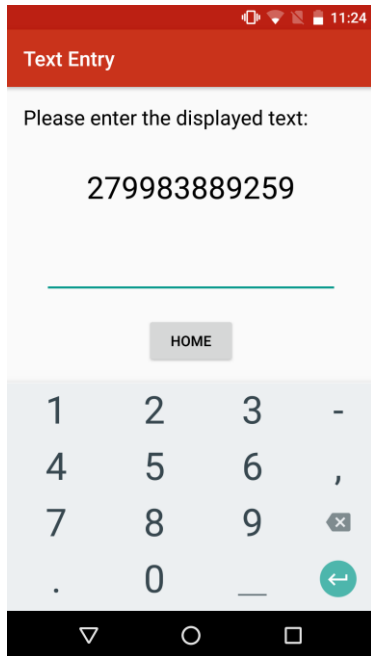


USER STUDY

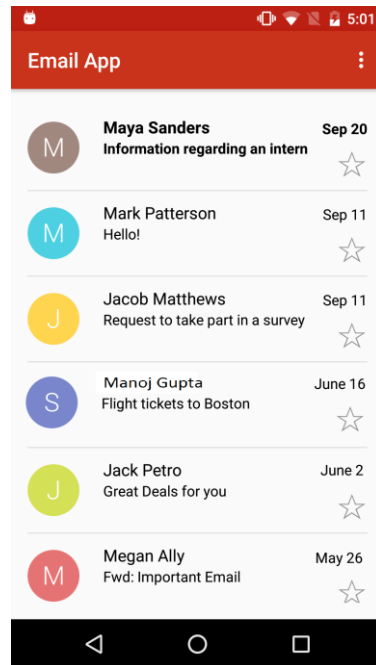
APPARATUS

- ▷ We perform a lab-based study and invite participants to experience the configurations by performing synthetic tasks
- ▷ We choose behavior-based authentication as a target use case to evaluate the different configurations
 - ▶ We simulate an IA scheme based on user's touch or keystroke behavior
- ▷ We select two popular authentication mechanisms:
 - ▶ 4-digit PIN and
 - ▶ Android pattern lock

SYNTHETIC TASKS



Text Entry Task

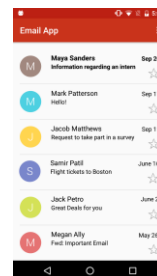
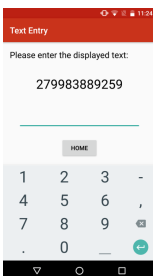
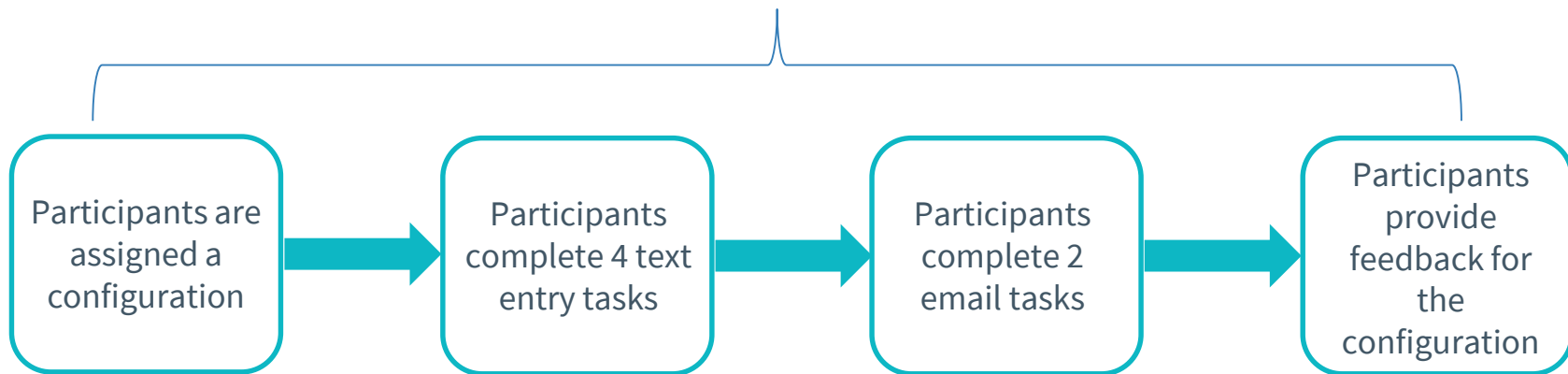


Email Task



STUDY DESIGN

ONE ROUND



EVALUATION METHODOLOGY

- ▷ Participants overall complete five rounds
- ▶ During the first round, participants do not perform a mid-task re-authentication (BASE_ROUND)
- ▶ Random order of configurations during the other four rounds

- ▷ Each participant performs:
 - ▶ 16 text entry tasks with re-authentication
 - ▶ 8 email tasks with re-authentication

CONTEXTUAL PREFERENCES

App-Specific

Banking App

Email App

Photos App

Contact App

Location-Specific

Bus Scenario

Office Scenario

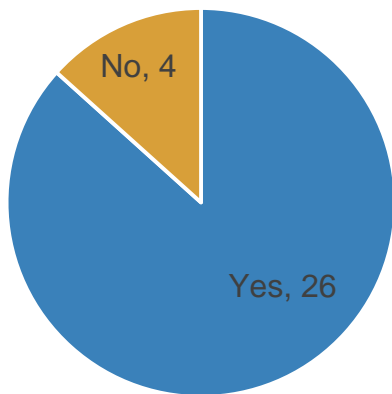
Home Scenario

PARTICIPANT SAMPLE

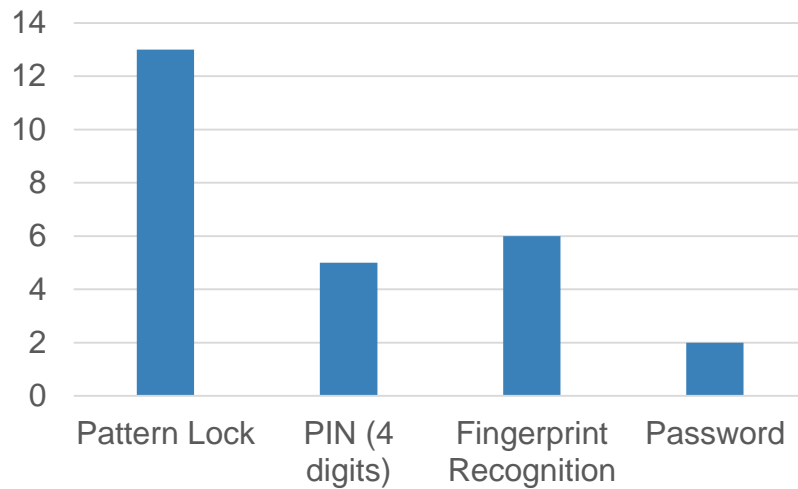
N=30		
Gender	60%	Females
	40%	Males
Age	33%	Under 20 years
	57%	21-25 years
	7%	26-30 years
	3%	31-35 years
Education	37%	Bachelor's Degree
	27%	Master's Degree
	20%	Some college
	13%	High School/GED
	3%	Ph.D., Law or Medical Degree
Occupation	100%	Student

DEVICE LOCK USAGE PATTERN

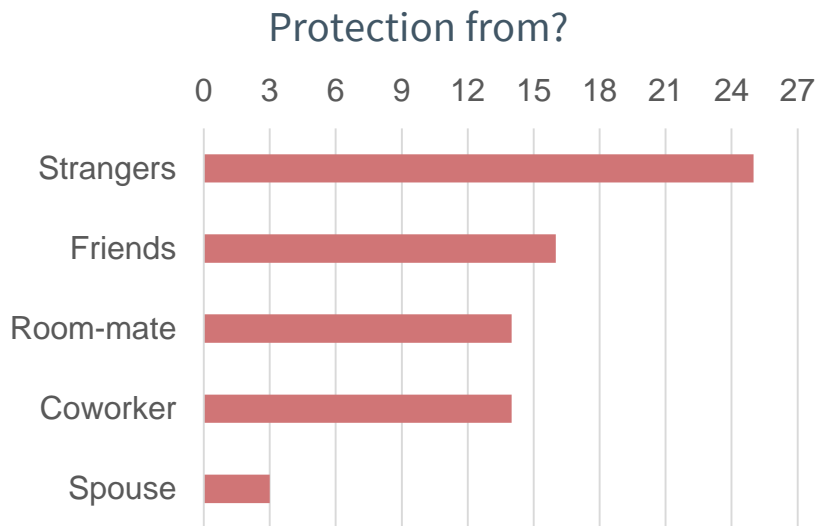
Lock Device?



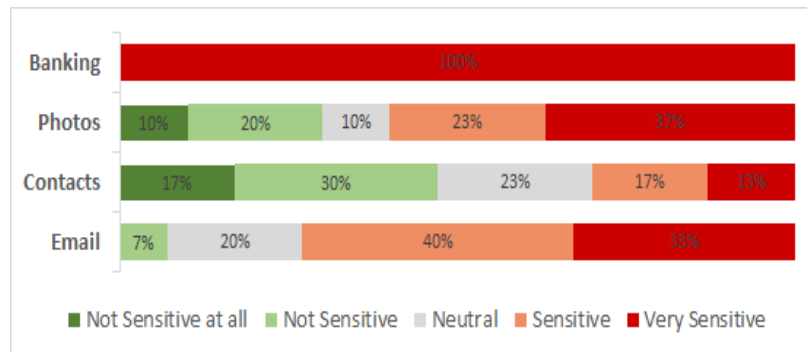
Authentication mechanism



SECURITY PREFERENCES



App Sensitivity



HYPOTHESES

Imm-Dark-Imm-Lock

Provides no visual clues on the current task of the user

Should be the most annoying and the task efficiency might be reduced

Grad-Dark-Imm-Lock

Should score similar to Imm-Trans-Imm-Lock in terms of usability with a relatively better security perception

Provides additional security by making the current task invisible after a predefined time interval

Imm-Trans-Imm-Lock

Provides a transparent background

Should be less annoying and more task efficient

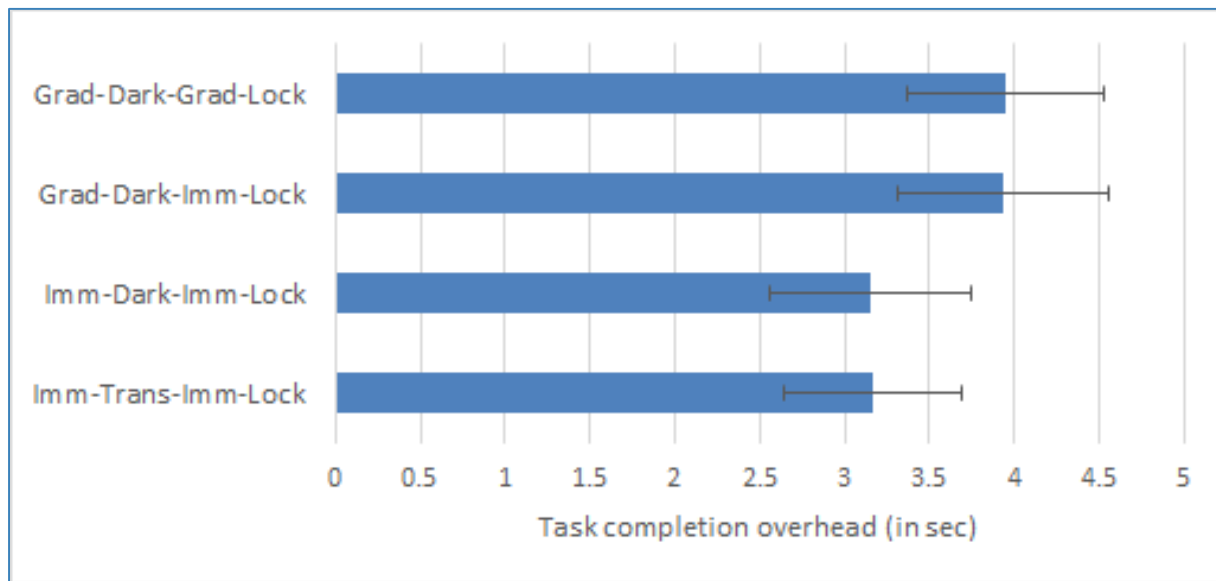
Grad-Dark-Grad-Lock

The grace period may increase the task efficiency of the users

For users who do not take advantage of this grace period and instead wait for the re-authentication prompt to appear, it may increase the anxiety and annoyance for them

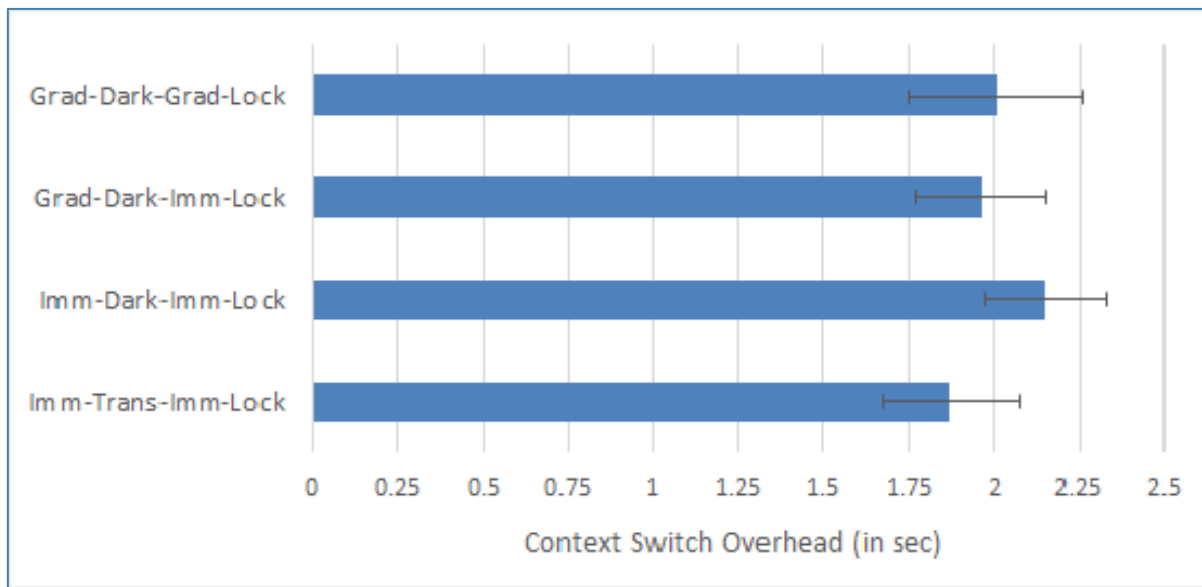
QUANTITATIVE RESULTS

TASK COMPLETION OVERHEAD



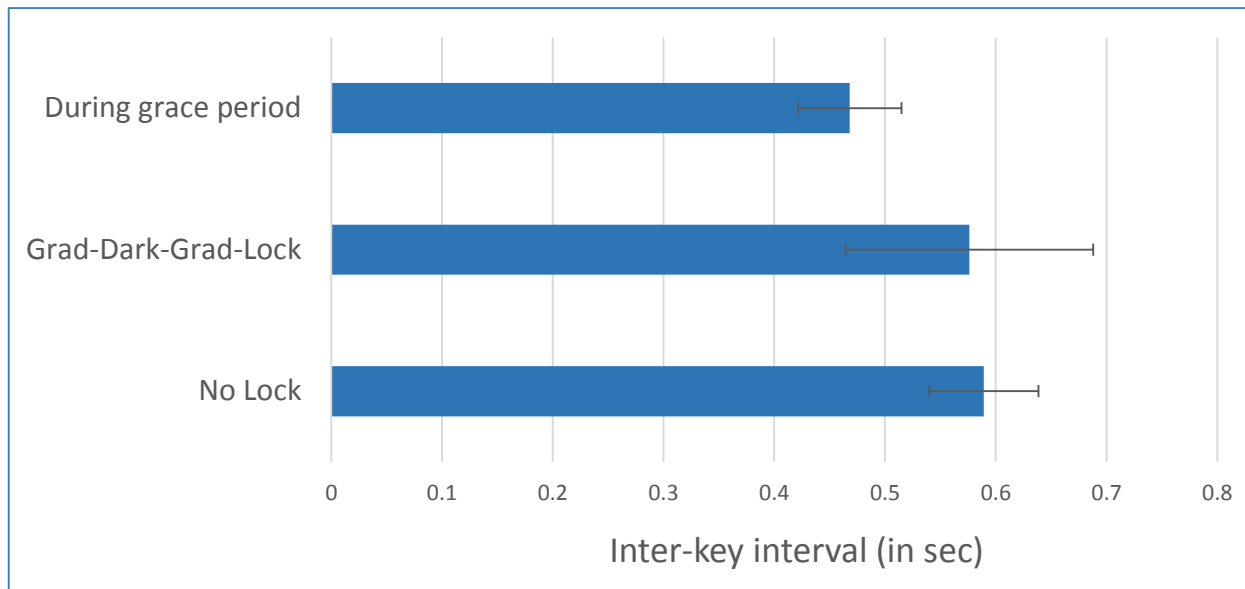
- Additional time taken to complete a text entry task as compared to the BASE_ROUND
- Users took 3-4 seconds longer when they had to re-authenticate
- No statistically significant results

CONTEXT SWITCH OVERHEAD



- Time taken by the users to resume their text entry task once they have re-authenticated
- Comparable across different re-authentication prompt configurations and contains no statistically significant differences

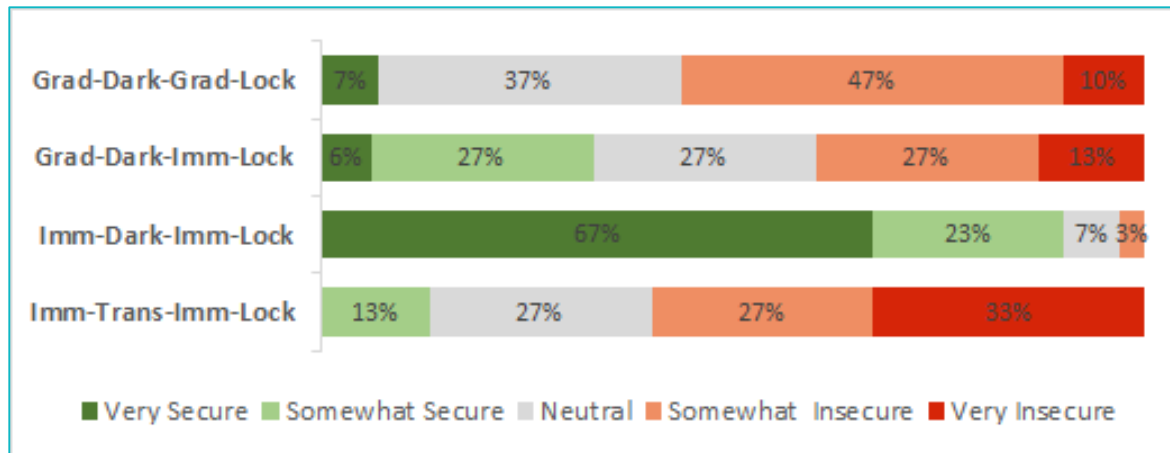
EFFECT OF GRACE PERIOD IN GRAD-DARK-GRAD-LOCK



- ▷ Inter-key interval reduced by almost 60% during the grace period
- ▷ Participants entered 38% of the text on an average during the grace period

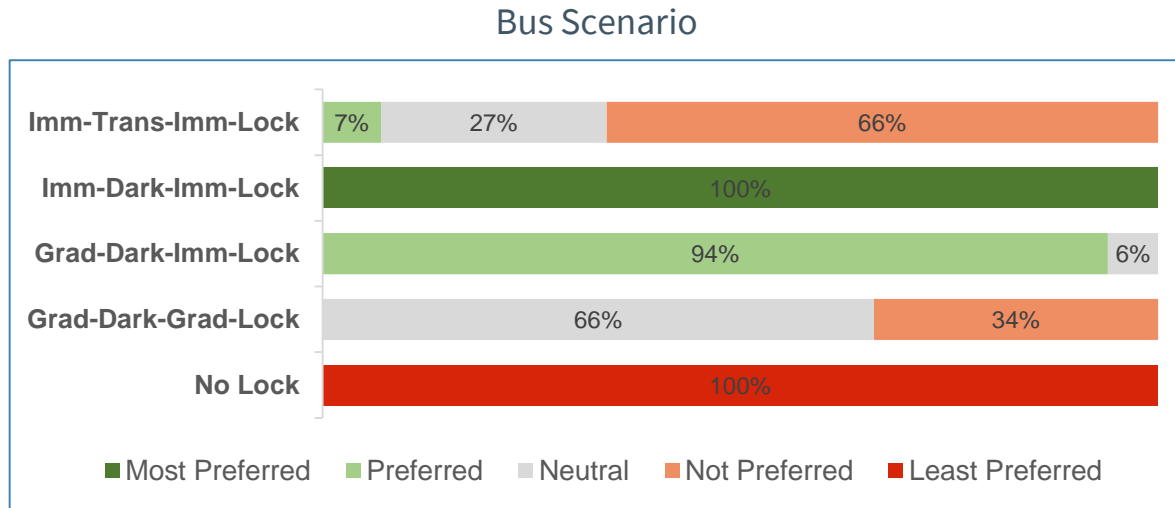
QUALITATIVE RESULTS

SECURITY PERCEPTIONS



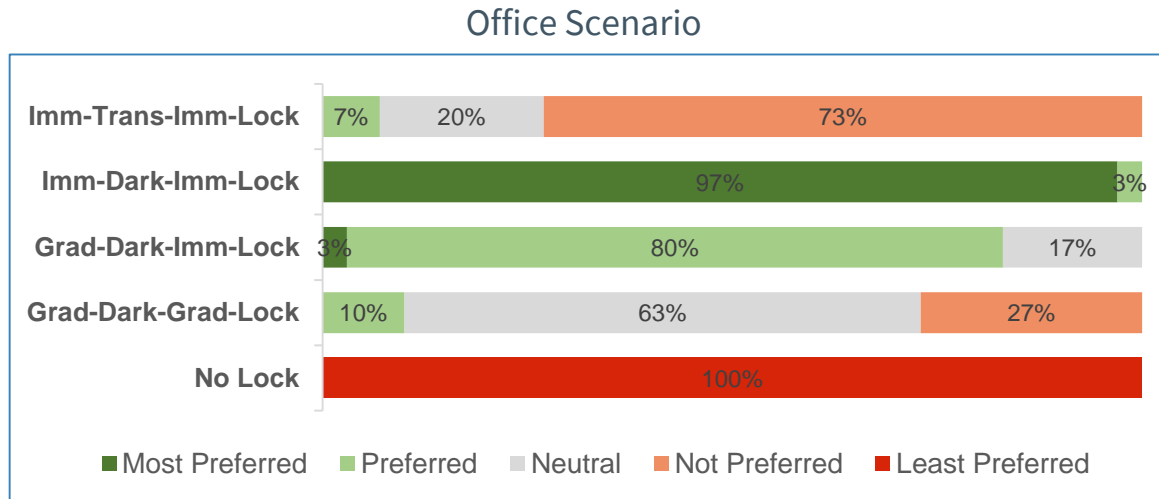
- 90% of the participants thought that the Imm-Dark-Imm-Lock configuration was secure
- The Imm-Trans-Imm-Lock and Grad-Dark-Grad-Lock scored poorly and only 13% and 7% of the participants considered them to be secure

PREFERENCES FOR BANKING APP



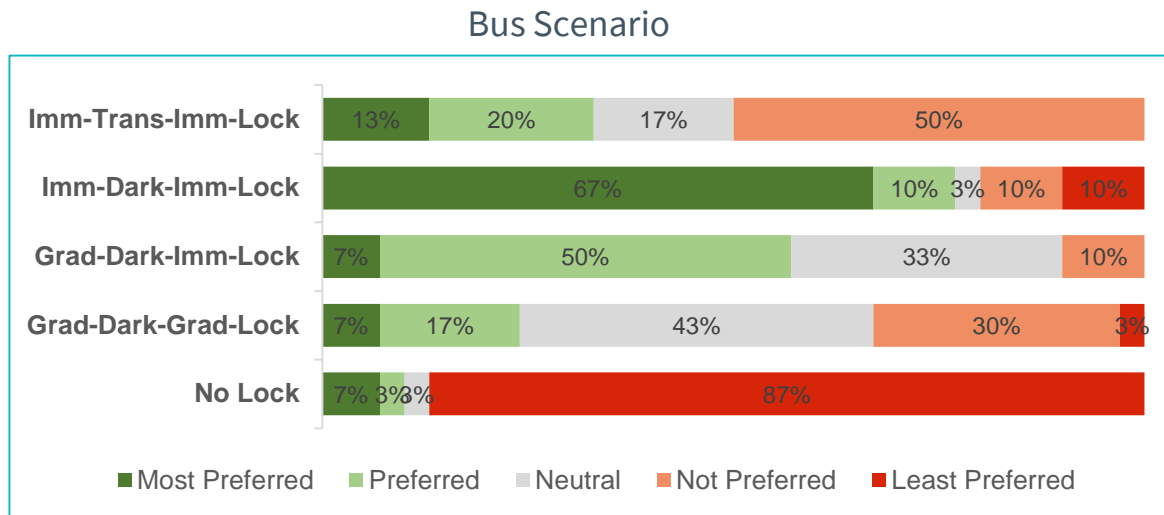
“Banking would be very sensitive, so I want it to get dark as quickly as possible” (P9)

PREFERENCES FOR BANKING APP



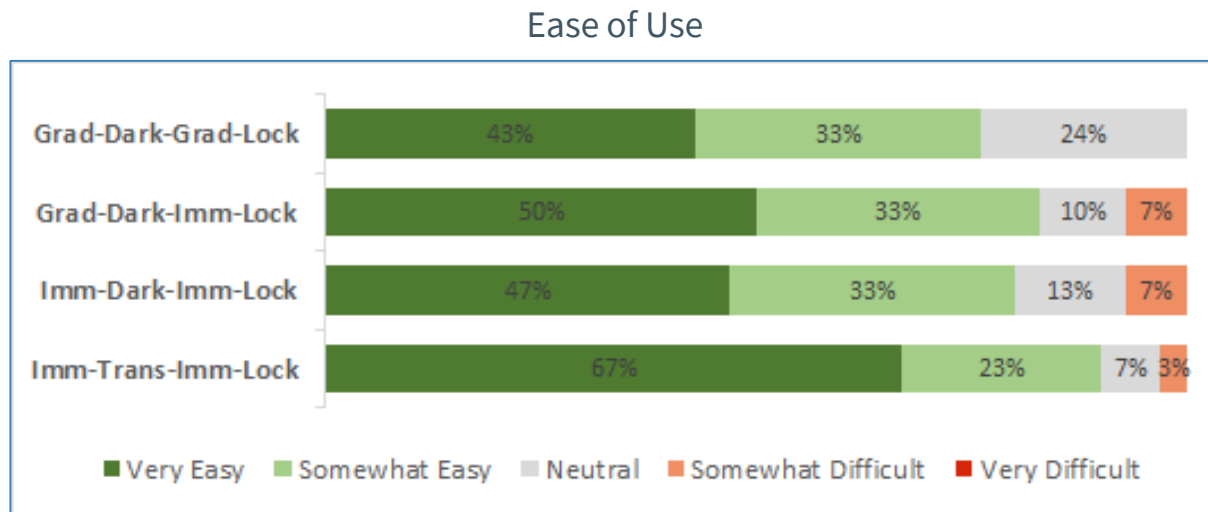
- Participants preferred using the default configuration in their office.
- For the home scenario, 40% of the users wanted to use default configuration while 23% of the users indicated that they would prefer using the Grad-Dark-Imm-Lock configuration instead

PREFERENCES FOR PHOTOS APP



- Majority of the participants preferred the Imm-Dark-Imm-Lock configuration for the bus scenario
- Some of the also wanted to protect their photos in a professional environment

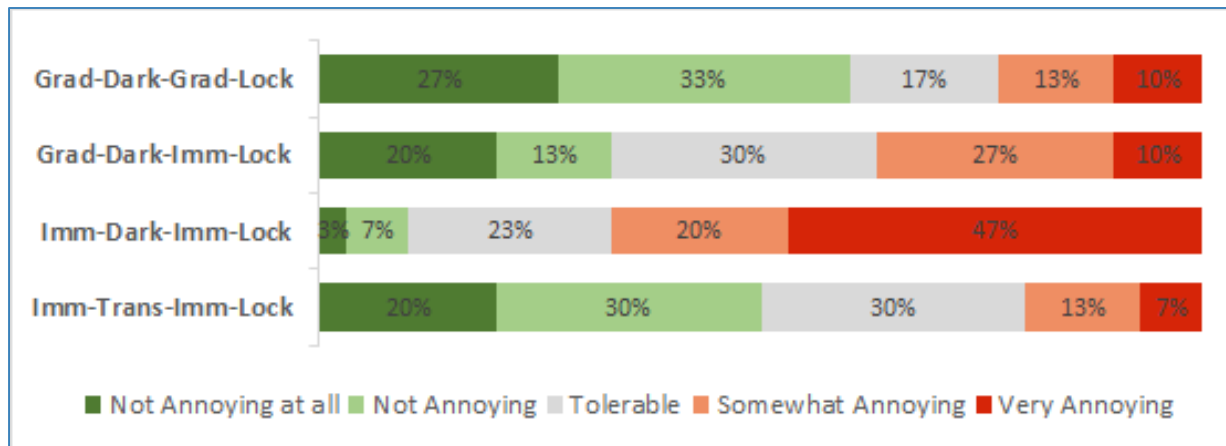
USABILITY PERCEPTION



“It [Grad-Lock] helps you to continue typing and get your thoughts out. It didn’t allow you to access the app though [after sometime] so it’s a good balance between usability and security” (P16)

USABILITY PERCEPTION

Perceived Annoyance



“I found it [Imm-Dark] very annoying because it was really an abrupt interruption to me, others were not abrupt” (P8)

CONCLUSION

- ▷ We perform the first study for designing and evaluating new re-authentication configurations
- ▷ Our proposed configurations perform as well as the default configuration in terms of task performance
- ▷ User preferences are context-based
 - ▶ Default configuration is preferred for highly sensitive apps
 - ▶ Preferences for medium and less sensitive apps vary depending on user's perceived security of the apps

<https://github.com/cryspuwaterloo/FireLock>