

Exploring the Usability, Security, and Privacy of Smart Locks From the Perspective of the End User

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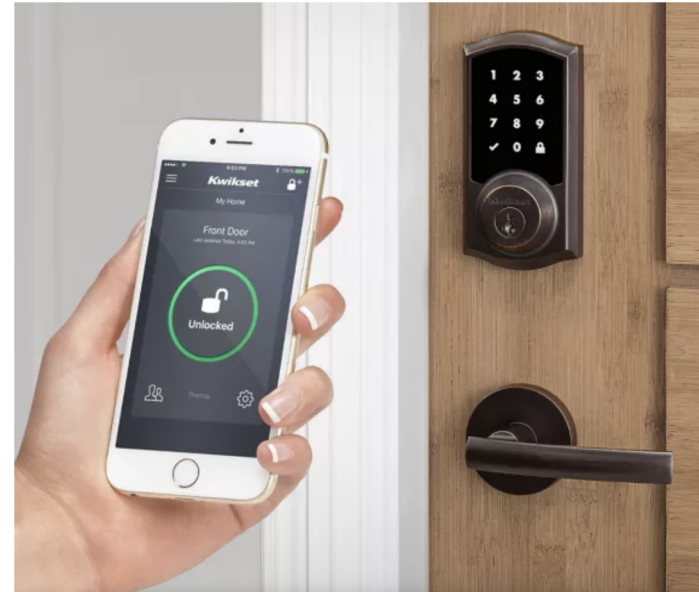
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Smart Locks

Smart locks were introduced to the market as a replacement for traditional locks.

❖ Smart locks features:

- ❖ Remote locking/unlocking
- ❖ Remote access control
- ❖ Keyless entry
- ❖ Access logs
- ❖ Auto lock
- ❖ Auto un-lock
- ❖ Automation potential



Tenants worry smart-home tech could be abused by landlords

Worst case, landlords could use smart locks to track and harass residents. And what if you just want a key?

Smart Locks Endanger Tenants' Privacy and Should Be Regulated

BY MARIO TRUJILLO AND ADAM SCHWARTZ | APRIL 4, 2023



Smart door locks in the US miss out on real privacy. This company proves it

The EU's privacy rules are good for American smart homes, too. That's something that Yale locks' brand, August, makes abundantly clear.



Molly Price 

Sept. 4, 2019 4:00 p.m. PT

4 min read 



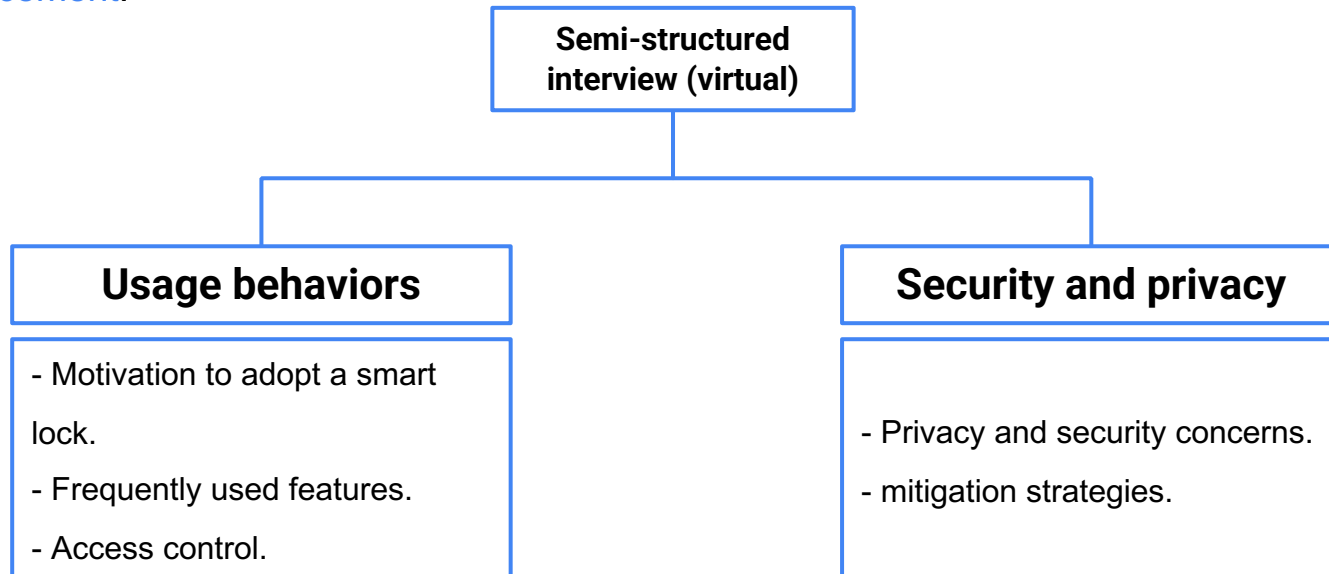
Participants and methodology

- ❖ RQ1: What aspects of the smart lock's design and functionalities make it appealing to users from a usability standpoint?
- ❖ RQ2: What privacy and security concerns do end users have regarding smart locks?
- ❖ RQ3: How do end users deal with their privacy and security concerns?
- ❖ RQ4: What are the end user's perceptions regarding how the security and privacy of smart locks can be improved?



Participants and methodology

- ❖ We recruited 29 participants (19 females, 10 males):
 - Age \geq 18.
 - At least **2 months** of using smart locks.
 - Have **shared access** to their smart lock with others in the past.
- ❖ The participants were recruited through **Reddit Forums** and the **university's mass email study announcement**.



Smart Lock Adoption

❖ Reasons for adopting a smart lock:

- Convenience (n=20): *no need to carry a physical key, remote control.*

P9: *“It's just more convenient. I'm a runner, and I go out and I run every morning and I don't really like bringing a whole key chain with me.”*

- Security (n=5): *remotely checking the lock status, no having to worry about losing the key.*

P11: *“my children will frequently come to the door, and I get something like a grub hub but might forget to lock the door. I always have my phone on me, so I can always just look and see if the door is locked.”*

- Other reasons (n=3): *convinced by a salesman, recommended by neighbors.*



Smart Lock Adoption

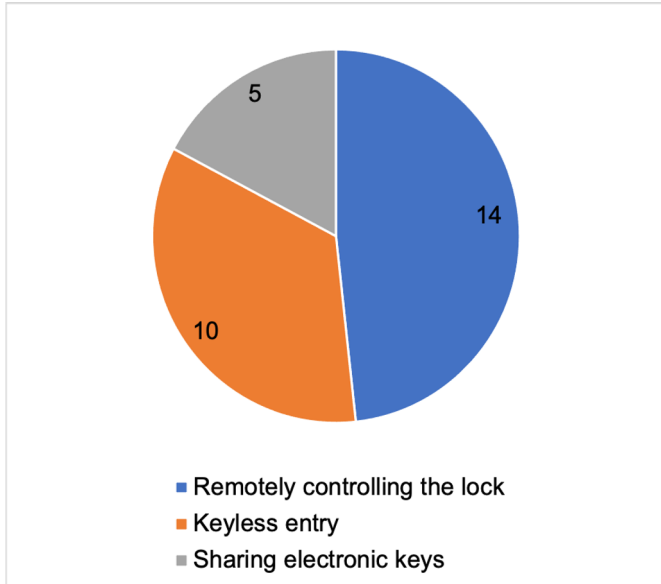
- ❖ Reasons for hesitation before adopting a smart lock? (n=12)
 - Price (n=5).
 - Security concerns (n=4): *hacking, losing the phone.*
 - Other reasons (n=4): *overwhelmed with options, worried about the difficult setup process.*

Smart Locks Features and Capabilities

- ❖ Access sharing patterns:
 - Only share access with home residents (n=13).
 - Share access with residents & non-residents (n=16).
- ❖ Some participants (n=8) have notifications turned off because they **get annoyed by how many notifications they get per day** or believe it's a **violation of the privacy of other household members**.

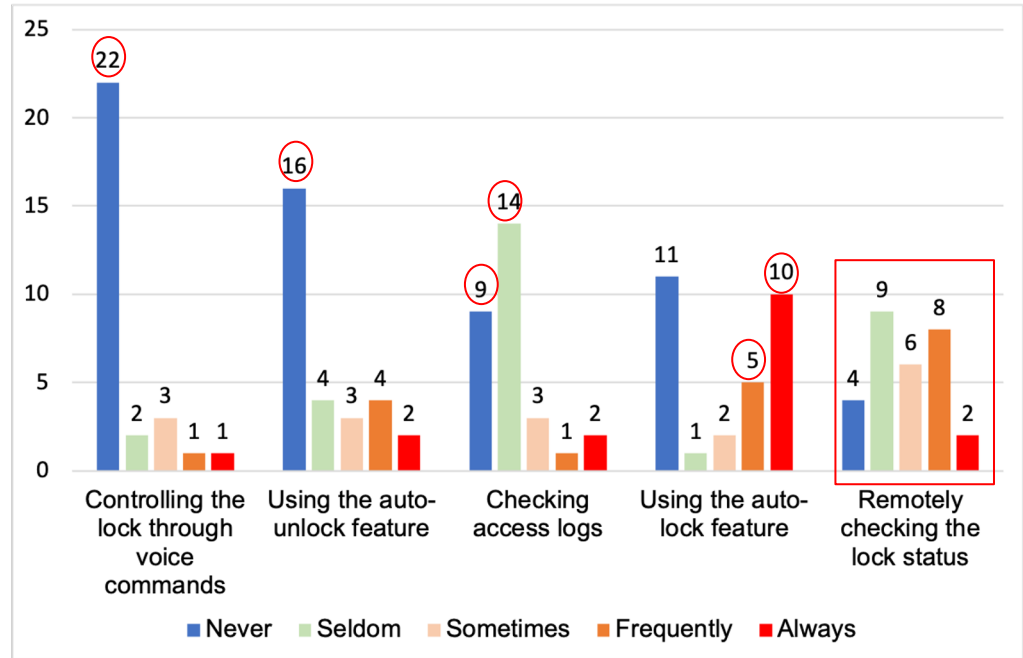


Usage Behavior



Most used feature

Unauthorized access

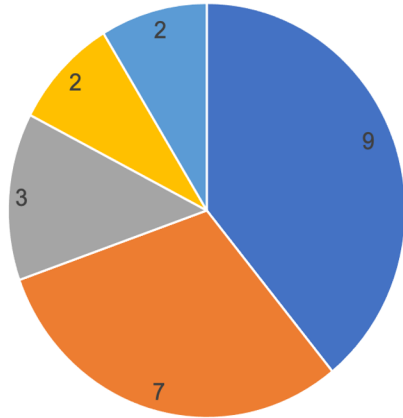


Frequency of using additional features

Trust the users

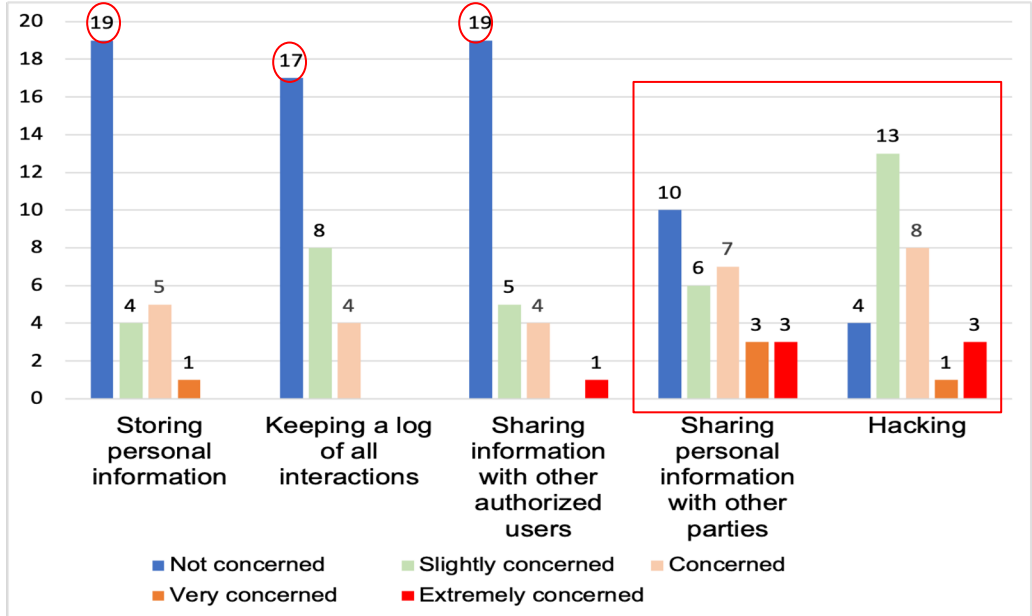
More security

Security and Privacy Concerns



- Hacking
- Using and sharing access codes
- Physical tampering with the lock
- Getting locked out
- Losing the smartphone

Main concern



Specific concerns

Not a target

Trust the manufacturer

Other apps already collect my info!

Revocation Evasion & Log Evasion

Threat	Pre-video (μ, σ)	Post-video (μ, σ)	Z-value	P-value ($\alpha=0.05$)
Revocation evasion	(1.79, 1.11)	(2.21, 1.32)	-1.530	0.13
Log evasion	(1.72, 0.88)	(2.24, 1.35)	-2.334	0.02

- ❖ Revocation evasion: a person whose **access has been recently revoked** can still operate the lock.
- ❖ Log evasion: a **legitimate user** of the lock can operate the lock without it showing on the access logs.
- ❖ The Wilcoxon Signed Ranks Test revealed a **statistically significant difference** in the participants' level of concern regarding **log evasion**.

Mitigation Strategies

- ❖ Adding another layer(s) of security (n=25).
 - Only 4 participants **wouldn't use the smart lock without the extra security layer.**
- ❖ Separate network for smart home devices (n=3).
- ❖ Managing access codes carefully (n=3).
- ❖ Maintaining the keypad/touchpad (n=2).



Lessons Learned

- ❖ Convenience over security.
- ❖ There is a lack of concern regarding possible security issues mainly caused by trust.
- ❖ Increasing security awareness
- ❖ Users tend to share electronic keys with non-residents.
- ❖ Improving access control management.

