Swipe Authentication: Exploring Error Feedback's Impact on Over-the-Shoulder Attack Performance

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INTRODUCTION

Multi-touch smartphones provide quick and easy access to personal and valuable data. Therefore, it is critical we are able to maintain a secure authentication process. Previous research has shown gesture-based methods of authentication provide better usability and memorability compared to traditional alphanumeric passwords; benefits of gesture-passwords include motor memory (Shadmehr & Brashers-krug, 1997) and pictorial superiority (Nelson, Reed, & Walling, 1976).

We frequently access our smartphones in public places, this makes us vulnerable to attacks such as shoulder-surfing – a method of obtaining another individual's private information through direct observation (De Luca, Frauendienst, Boring, & Hussmann, 2009). Visual feedback helps users recognize and recover from their mistakes (Uellenbeck, Dürmuth, Wolf, & Holz, 2013); however, this feature may increase the risk of over-the-shoulder attacks.

We empirically explored whether the design decision to offer error feedback is more harmful than beneficial to the phone user by manipulating the visual feedback. Additionally, we examined the performance of our subjects to see which error type, missing a dot or bypassing a dot, is more vulnerable to over-the-shoulder attacks.

METHOD

34 undergraduate students participated in this study for course credit. Stimuli were created using a Samsung Galaxy Note 4 touchscreen smartphone. Each video showed a failed login attempt using a pattern-password with or without visual error feedback on the Samsung phone.

The experiment employed a within-subject factorial design with 2 Feedback (yes, no) X 2 Error Type (completion failure, knight move). This design produced four conditions, each containing 10 trials. Thus, each participant viewed 40 video clips in which a single mistake was made while entering the login pattern. Participants were asked to produce what they believe to be the correct pattern via pencil and paper. The dependent measure was their accuracy on this over-the-shoulder attack task.

FIGURE 1: Examples of Completion Failure Condition with Feedback

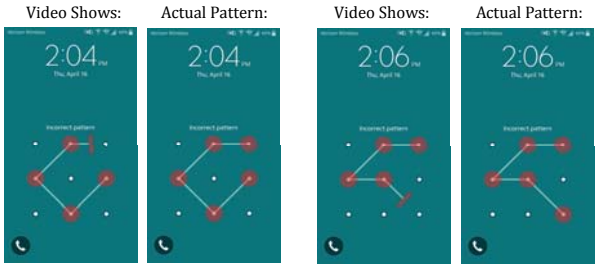
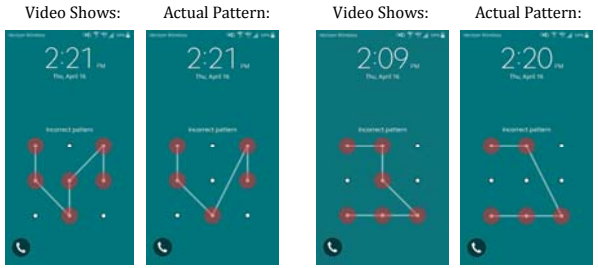


FIGURE 2: Examples of Knight Move Condition with Feedback

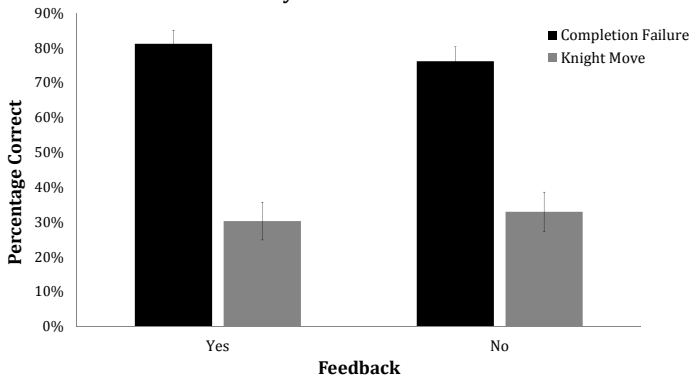


RESULTS

A repeated measures ANOVA was conducted to explore the impact of Feedback (yes, no) X Error Type (completion failure, knight move) on the accuracy of the over-the-shoulder attacks. The **accuracy of the over-the-shoulder attacks were higher when the type of error shown in the videos were of completion failure** (M = 78.68, SE = 3.66) **as compared to knight moves** (M = 31.62, SE = 5.03) , $F(1,33) = 91.84$, $p < .001$.

There was not a significant effect of visual Feedback on the accuracy of the over-the-shoulder attacks, $F(1,33) = 0.15$, $p > .05$. And, there was not a significant interaction between Feedback X Error Type, $F(1,33) = 2.201$, $p > .05$.

FIGURE 3: Accuracy of Over-the-Shoulder Attacks



DISCUSSION

Based on the findings of this study, we recommend users incorporate knight moves into their pattern-passwords. The attackers' performance was significantly lower when the condition contained a knight move error type rather than a completion error type. This implies that secure patterns with knight moves were more effective in misleading the attacker.

Surprisingly, there was no significant difference in performance when the visual feedback was enabled rather than disabled. Thus, visual feedback does not appear to compromise the security of smartphones, and can be enabled to aid the phone user in error recovery.

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