Usability is Not the Dark Side: Secure Usable Design Seen through Star Wars

Ann-Marie Horcher, PhD
Central Michigan University
horcheram@gmail.com

Walter Dula
Central Michigan University
walterdula@me.com

Abstract

Security and usability have traditionally been at odds in the design process [3]. In spite of this, the usability of security is widely recognized as a key component of security effectiveness[6, 13, 25] Design principles for good security have been designed by security experts [21]. Similarly principles for usability in design have also been created by usability experts [18, 19, 22]. If designers see secure design as a combination of security and usability principles instead of a choice

between the two, the result will be effective but usable security[10]. Traditionally people have learned life lessons from fables, fairy tales, popular novels and even movies. A movie series like Star Wars that has influenced pop culture for over forty years is a rich source to mine for security usability examples. This study examines whether the use of pop culture references from Star Wars can communicate combined principles of secure and usable design.

Author Keywords

Security Usability; Folk Models, Mental Models, Secure Design; Science Fiction Prototyping, Gamification

H.5.2 [Information Interfaces and Presentation]: User Interfaces—evaluation/methodology, user-centered design;

Introduction

Technological design involves both theory and practice, and requires creativity in addition to following standards [15]. The greatest challenge can be visualizing a desired result in a context that can be communicated to both stakeholders and design team members. Left on their own, experts and novices formulate mental models differently[2]. The difficulty of finding mental models of technology meaningful to both
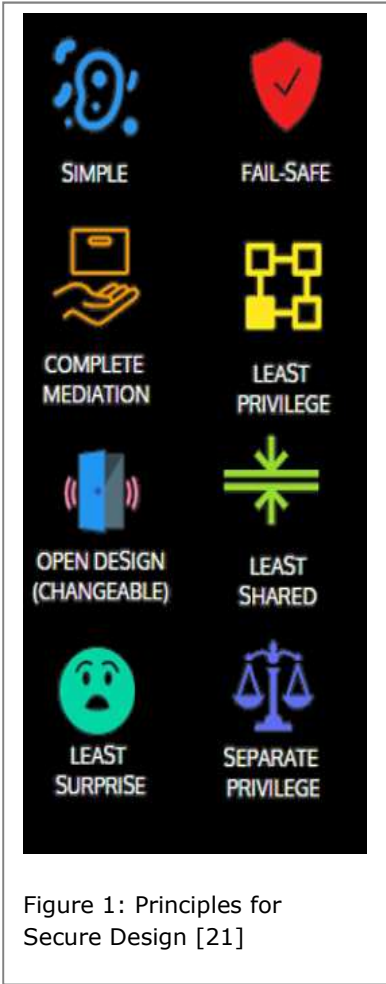
Figure 1: Principles for Secure Design [21]

novices and experts has inspired researchers to turn to feature films to communicate technology [1] .

Films have had a long tradition in liberal arts education [7, 24], and more recently in the sciences such as medicine [1, 14] with overwhelmingly positive response from the students. Science fiction films, in particular, are used not only to teach science, but stimulate creativity [15]. Because of the future world-creating emphasis of science fiction, the science fiction design methodology has been used to model new designs for oceanography [17] and the digital future [20].

This study brings together the intersection of security and usability and communicates those combined design principles in a mental model based on a very popular science-fiction film series.

Background

In 1975, Saltzer and Schroeder defined eight principles for secure design [21] seen in Figure 1. For usable design, the 8 Golden Rules of Interface Design were first formulated by Shneiderman [23]. Six combined principles for security and usability were proposed by Garfinkel in 2005 [9]. When all of these principles are mapped together into a single security-usability framework (Table 1) the equivalencies are clear [10]. Usability is a subset of good security, because over half of Saltzer and Schroeder's secure design principles are based on usability. Following ALL the principles guarantees usability.

Science-fiction prototyping is a recent theory that uses science fiction stories to combine theory with a fictional construct for improved design [12].

Table 1: Combined Security-Usability Framework

Principles of Secure Design [21]	Usability Principles I [23]	Usability & Security [9]
Simple	Reduce short-term memory load	No External Burden
Least Privilege		
Complete Mediation	Dialog to Closure Informative Feedback	Consistent Meaningful Vocabulary
Least Surprise	Internal locus of control Shortcuts for experts Easy reversal of actions	Least Surprise
Least Shared	Consistency	Consistent Controls
Failing Secure	Simple Error Handling	Provide Standard Security Policies
Open Design Separate Privilege	Not mentioned	Good Security Now

Study Design

Since using science-fiction feature films stimulates creativity [15], and science fiction prototyping improves design [17], and well-known folk models/stories are an effective way to communicate technology concepts [26], this study creates a mental model that embodies all three. Because the series is over forty years old and continues to impact popular culture [5], the *Star Wars* universe model has the potential to be equally accessible to both novice and expert when the
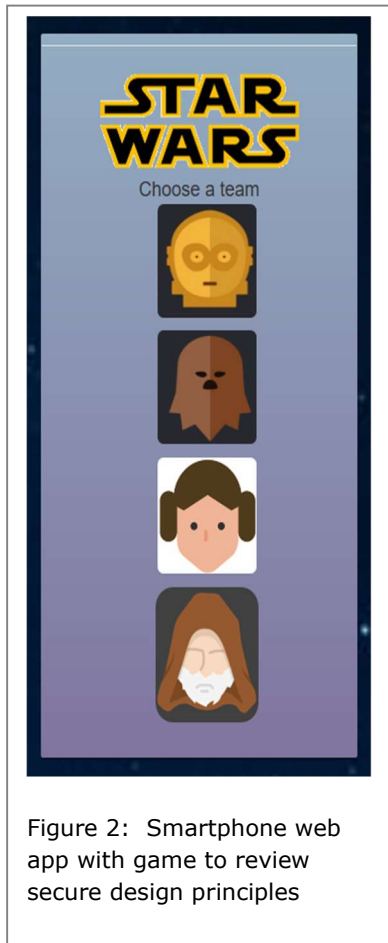
principles of secure design (Figure 1) are mapped to *Star Wars*.

The research questions are:

1. Does the mental model eliminate the difference between novices and experts in understanding secure design?
2. Are the usability-based principles are acquired as thoroughly as the security-based principles?
3. Are the examples from the model are retained?

If members of a design team have a common mental to explain it to each other and outside stakeholders (Q3), the results should be usable security by design instead of bolt-on. Consequently the study has the following hypotheses.

H0: Users will not demonstrate understanding of common security usability principles by interaction with a *Star Wars* derived mental model.

H1: Only experts will acquire and retain secure design concepts using the Star Wars-derived mental model.

H2: Participants will acquire and retain both types of secure design principles.

H3: The participants remember the story-based example as an instantiation of the design principle.

Content and Evaluation

Two groups of participants were used in the study. Novice users were 36 undergraduate business students in an introductory information systems course with little to no information systems work experience ranging in

age from 20-25 years old. The expert users were 20 graduate students in an advanced cybersecurity class with work experience in information technology and ranged in age from 25-52.

Saltzer and Schroeder's eight principles of secure design were mapped to examples from the Star Wars universe (Table 2). All of the examples come from the three earliest movies in the Star Wars because these movies have been part of pop culture the longest. The plot points are well-known, and referenced in the later Star Wars movies as canon [5] and even in scientific articles [4, 11].

The students viewed a video lecture explaining secure design using Star Wars, and emphasizing which principles are user-oriented. Data was recorded on which participants viewed the video and for how long. Next the participants took a matching quiz that evaluated their acquisition of secure design principles.

In addition to the video, a second instructional artifact was created. A smartphone web app took the participants on a journey through the Star Wars universe to review the secure design principles (Figure 2). The game included questions that evaluated whether the participants retained the story-based example to use as a tool to communicate to peers and stakeholders. The participants had the option to repeat the game as frequently as they desired.

Approximately four weeks after the initial presentation of secure design, the participants were once again evaluated using a matching choice quiz to measure their retention of secure design principles.

Figure 2: Smartphone web app with game to review secure design principles

Table 2: Data from novice user group from assessment of initial acquisition of concepts

Measure	Percent correct
Concept	87%
Example	32.9%
Image	39%
Usability	88.6%
Security	54%

Figure 1. Mapping of security-usability framework to Star Wars

Preliminary Results

All phases of the novice portion of the pilot study are complete. The expert portion of the study will complete in June with the measure of the retention of secure design principles.

In both groups all participants indicated no knowledge of secure design principles in the prior knowledge survey. Even participants who self-rated their technology experience still indicated no knowledge. Novice users indicated an acquisition of usability-focused design principle to a much higher level (Table 2). After using the game-based review, the acquisition of all principles increased, as did the ability to recall the examples and the associated images. The participants who interacted most with the game showed the highest recall. The usage data shows 50% of the participants returned voluntarily to play the mobile game multiple times. This data indicates that the game is engaging and enjoyable [8], and possibly could replace the video instruction. The mobile platform for delivery is also the platform of choice directionally [16] for users globally.

Discussion and Future

When looking at the assessment, future work should also examine whether participants are using rote memory or progressing to higher order thinking [27].

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