DualCheck: Exploiting Human Verification Tasks for Opportunistic Online Safety Microlearning

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Background

Issues on online safety literacy

• **Learning online safety & ethics** is critical for everyone.

• However, not so many people learn such knowledge regularly.
  • **Only 17.9%** of smart device users had taken explicit training on online ethics[^1].

• It is important to learn about Internet security and ethics in **daily life**.
  • Conventional learning styles like e-learning may not fit well to their lifestyles.

Our Idea

We propose DualCheck

• Integrating **online safety microlearning** into **human verification task**.

• **Microlearning** is a learning style that learners do small learning tasks in a short time.

• Often used for vocabulary learning etc. in HCI fields\(^2,3\) .

\[2\] Trusty et al. “Augmenting the Web for Second Language Vocabulary Learning” (CHI ’11)
Our Idea

We propose DualCheck

• Integrating **online safety microlearning** into **human verification task**.

• Often appear when entering forms or logging in.

• The famous one is **CAPTCHA** (known as “I’m not a robot”).

• Our idea is to propose a question of online safety instead of conventional tasks.
Implementation

System design

- Users **respond to the question and read explanations.**

- DualCheck is expected to detect bot access by **cursor behavior** (like reCAPTCHA checkbox).

- Human verification does **not depend on whether the answer is correct.**
Implementation

Prototype

• We implemented prototype in a Web environment.

• In our current implementation, a human verification mechanism is not integrated into DualCheck.
  • Our main purpose is to **investigate the learning effect and the usability** of DualCheck.
  • The code of reCAPTCHA is not publicly available.
This is the demonstration movie of DualCheck. You can view it at the link below.

https://youtu.be/5W16fpjeg4M
We created a set of questions related to online safety and ethics. The questions should be moderately difficult. We collected common issues from teaching materials for high school, etc.
Deployment Study

Conducted 15-day study

- We designed the 15-day deployment study to verify the learning effect and the usability of DualCheck.

- The task imitated the practical usage of DualCheck.
  - The participants answered to a questionnaire and then responded to DualCheck.
Deployment Study

2 modes of DualCheck

- We set two modes in DualCheck: OneTime / Repeat mode.
  - OneTime mode allows the users to go through even if they answered wrong.
  - Repeat mode demands them to answer until they answer correctly.
- We recruited participants through crowdsourcing service (N=34).
  - Split them randomly into two groups: OneTime (N=16) and Repeat (N=18).
Deployment Study

Procedure

Day 1

Pretest

Participants answered **10 questions** about online safety & ethics.

The question set we made in our quiz curation process
Participants answered 10 questions about online safety & ethics.

Participants answered a questionnaire & a DualCheck’s question 3 times each day.

Randomly selected from our quiz set
Deployment Study

Procedure

Day

Pretest

Participants answered 10 questions about online safety & ethics.

Learning Process

Participants answered a questionnaire & a DualCheck’s question 3 times each day.

Posttest

Participants answered to 10 + 10 questions

Original question set + additional similar 10 questions
Results

Mean accuracy rose after the study

• We conducted a two-way ANOVA for mean accuracy (=correct answer rate).
  • Within: Day1 vs Day15 / Between: OneTime vs Repeat

• The mean accuracy rose significantly after the deployment study.
  • 0.68 (SD=0.11) -> 0.94 (SD=0.04), p<.001

• We did not find significant differences in accuracy between OneTime / Repeat mode (p=.30).
Results
Positive learning effect of original questions

9 questions showed **significantly higher accuracy** in day 15 than day 1.
Results

Positive learning effect of similar questions

5 questions showed significantly higher accuracy in day 15 than non-user’s accuracy (N=100).

![Chart showing accuracy comparison between similar questions and Day 15](chart.png)
Compared SUS score with other CAPTCHAs.

- **Checkbox-based**: 80.60
- **DualCheck**: 74.19
- **Text-based**: 54.45
- **Picture-based**: 53.10

Results

Higher SUS score

No significant difference

Significant difference
Results

Comments for DualCheck

• Qualitative analysis

For more information, please read our paper.

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<th>The categorization of participants’ comments</th>
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<td><strong>Questions</strong></td>
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Limitations and future work

• **Task design** might affect the evaluation of DualCheck.
  - Participants’ attribute, sampling method, etc.

• Investigation of **other topics / formats of questions** is important.

• Thinking about more **practical aspects** of DualCheck is also important.
  - Integrate reCAPTCHA or other CAPTCHA.
  - Maintain and update question sets.
Conclusion

DualCheck’s potential as a learning platform

• Our user study confirmed the positive learning effect of DualCheck.
• It also confirmed higher perceived usability.
• DualCheck would support Internet users learning online safety and ethics.
### Title
DualCheck: Exploiting Human Verification Tasks for Opportunistic Online Safety Microlearning

### Design
- Users answer to a multiple-choice question about online safety
- DualCheck simultaneously process human verification

### Study
- Participants used DualCheck for 15 days
- Collected the accuracy of target questions and analyzed

### Results
- Confirmed positive learning effect of DualCheck
- Also confirmed higher perceived usability

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## Extra Questions

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<thead>
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<th>Statement and answer</th>
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| **Q1** | A: Connecting a USB flash drive to a computer in public is a security risk.  
B: Charging a smartphone via USB on a computer in public is a security risk.  
Correct Answer: Both statements are correct. |
| **Q2** | A: On social networking sites, there is no privacy problem in sharing selfies and other information if you give limited access.  
B: On social networking sites, if you don’t post any personal information, your identity will not be identified.  
Correct Answer: Both statements are wrong. |
| **Q3** | A: This is the first time I visited this Website, but I thought it was safe because it had a key symbol on my browser, so I entered my personal information.  
B: I entered my personal information on a Website beginning with http://. It is risky to enter personal information on such a Website.  
Correct Answer: Only statement B is correct. |
| **Q4** | A: Passwords should be a combination of letters, numbers, and symbols that are difficult to remember.  
B: Passwords are safer if they are based on personal information, such as your hobbies, and avoid famous words that are easily guessed.  
Correct Answer: Only statement A is correct. |
| **Q5** | A: When the earthquake struck, local people posts the situation in the area. Even if you don’t know whether it is true information, it is better to share the information quickly.  
B: When spreading information when an earthquake or other event occurs, it is better to only spread posts by the government or news organizations.  
Correct Answer: Only statement B is correct. |
## Extra Questions

| Q6 | A: A cookie is a piece of information that sends a user’s name and other personal information to a site administrator.  
    B: Cookies are used for retargeting advertisements and other purposes.  
    Correct Answer: Only statement B is correct. |
| Q7 | A: Documents created with online storage services and document creation tools are not disclosed to the public.  
    B: Documents created with online services can be seen by others through searches.  
    Correct Answer: Only statement B is correct. |
| Q8 | A: The procedure for requesting information about an offensive social networking account has been made easier due to a change in the law.  
    B: Even if there is an offensive SNS account, it is difficult to identify their source address.  
    Correct Answer: Only statement A is correct. |
| Q9 | A: To verify that the email you received was sent from a real bank or other sources, you check the back of the @ in the source address.  
    B: Checking the domain is one of the most important things to ensure that the URL sent to you is authentic.  
    Correct Answer: Only statement B is correct. |
| Q10 | A: Photos taken with a smartphone may contain location information.  
    B: If you post a photo without the location information to a social networking site, your location will not be identified.  
    Correct Answer: Only statement A is correct. |
## Extra Questions

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| **Q1a** | A: If you use a computer’s USB port only to charge your smartphone, no viruses or other devices will be transferred.  
B: If you connect a USB flash drive to a shared computer, viruses and other malicious programs may be copied.  
Correct Answer: Only statement B is correct. |
| **Q2a** | A: On social networking sites, if you limit the number of people you can follow, there is no problem if you tweet personal information.  
B: Your identity can be identified based on your following relationship on social networking sites.  
Correct Answer: Only statement B is correct. |
| **Q3a** | A: Websites that start with http://... do not support encrypted communication.  
B: If the Website is capable of encrypted communication, it is safe to send personal information.  
Correct Answer: Only statement A is correct. |
| **Q4a** | A: Passwords should be a meaningless string of characters with symbols.  
B: It is preferable to create a password based on a hobby or something that you keep secret from others.  
Correct Answer: Only statement A is correct. |
| **Q5a** | A: An earthquake occurred, but there was no information from the news media or government, so I spread a post made by a person claiming to be a local.  
B: When the earthquake occurred, a person claiming to be a scholar on Twitter explained the situation. It is considered as credible information.  
Correct Answer: Both statements are wrong. |
| Q6a | A: The use of cookies can customize ads.  
     B: Allowing the use of cookies is likely to leak personal information.  
     Only statement A is correct. |
|-----|----------------------------------------------------------------------------------|
| Q7a | A: Documents created with online document creation tools are not likely to show up in a Web search.  
     B: It is important to check the publication settings of documents created with online tools.  
     Correct Answer: Only statement B is correct. |
| Q8a | A: It is difficult to identify the source address of an anonymous social networking account.  
     B: You can file a request for disclosure of sender information against an offensive social networking account.  
     Correct Answer: Only statement B is correct. |
| Q9a | A: Checking the domain of the URL is important to confirm whether it is genuine or not.  
     B: I received an email claiming to be from my bank. It was the same domain as the bank’s email, so I figured it was the right email.  
     Correct Answer: Only statement A is correct. |
| Q10a| A: The scenery and objects in the photo could lead to the identification of personal information.  
     B: Location information may be stored in the photo.  
     Correct Answer: Both statements are correct. |
Accuracy transition

The graph shows the accuracy transition over different exposure periods, with markers for each Q (Q1 to Q10) and a linear regression line. The x-axis represents the number of exposure periods, from pre-experimental to post-experimental, while the y-axis represents accuracy levels from 0.00 to 1.00.