Do Password Managers Nudge Secure (Random) Passwords?

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Motivation

• Avg. person: 26-100 accounts
• Password reuse
• Password manager (PM):
  - Password generator (PG)
  - Password storage
• How to encourage randomly generated password (RGP) adoption?
Nudging

Reusing password
Randomly generated password
Easy to remember password

Influence decisions without limiting people’s choices
Browsers’ PM Nudges

There is no data on how effective they are
Firefox Nudge

CREATE YOUR ACCOUNT

Email Address
Enter your email

Password
Enter your password

Use a Securely Generated Password
ZIBS2dM5uYoXy
Firefox will save this password for this website

View Saved Logins

Register
How effective are browser-based PMs in nudging RGP adoption?
What factors contribute to the adoption rate for RGPs?

- Noticing the nudge
- Previous use of PM
- Previous use of PG
- Website’s password policy
What are the rationales of users to (not) adopt a RGPs?

- Trust
- Convenience
- Security
- Avoid reusing password
- Lack of knowledge
User Study (n=558)

Participants recruited through Amazon’s Mechanical Turk

Three groups: (1) Chrome, (2) Firefox, (3) Safari

Users signed up for one of the groups

Password policies: 1C8, 3C12
Study Structure

Task 1: First consent form
Task 2: Account registration
Task 3: Post-registration questionnaire
Task 4: Login
Task 5: Post-study questionnaire
Task 6: Second consent form
RGP Adoption Rate

$(\chi^2 = 32.972, p < 0.001)$
Moderate effect size

RGPs (1C8 + 3C12)

<table>
<thead>
<tr>
<th></th>
<th>35.2%</th>
<th>41%</th>
<th>61.5%</th>
</tr>
</thead>
</table>

Note: The image contains a screenshot of a web page showing a password creation interface.
Did you notice the recommendation to use a random password while registering on our website?
Noticing the Nudge – RGP Adoption

<table>
<thead>
<tr>
<th>Noticed the nudge?</th>
<th>Used RGP</th>
<th>Didn’t use RGP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>51.6%</td>
<td>48.4%</td>
</tr>
<tr>
<td>No</td>
<td>19.7%</td>
<td>80.3%</td>
</tr>
</tbody>
</table>

$(\chi^2 = 39.265, p < 0.001)\)  
Moderate effect size
<table>
<thead>
<tr>
<th>Noticed the nudge?</th>
<th>Saved password</th>
<th>Didn’t save password</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>64.5%</td>
<td>35.5%</td>
</tr>
<tr>
<td>No</td>
<td>35.2%</td>
<td>64.8%</td>
</tr>
</tbody>
</table>

\( \chi^2 = 33.321, p < 0.001 \)

Moderate effect size
Past Experience Influence - PG

<table>
<thead>
<tr>
<th>Used PG before?</th>
<th>Used RGP</th>
<th>Didn’t use RGP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>58%</td>
<td>42%</td>
</tr>
<tr>
<td>No</td>
<td>29.6%</td>
<td>70.4%</td>
</tr>
</tbody>
</table>

($\chi^2 = 43.842, p < 0.001$)
Moderate effect size
Past Experience Influence - PM

<table>
<thead>
<tr>
<th>Used PM before?</th>
<th>Used RGP</th>
<th>Didn’t use RGP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>48.1%</td>
<td>51.9%</td>
</tr>
<tr>
<td>No</td>
<td>37.6%</td>
<td>62.4%</td>
</tr>
</tbody>
</table>

(χ² = 5.154, p = 0.023)
**Uses this browser regularly**

\((\chi^2 = 0.81, p = 0.366)\)

<table>
<thead>
<tr>
<th>Frequency</th>
<th>Used RGP</th>
<th>Didn’t use RGP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Daily</td>
<td>43.5%</td>
<td>56.5%</td>
</tr>
<tr>
<td>Weekly</td>
<td>44%</td>
<td>56%</td>
</tr>
<tr>
<td>Monthly</td>
<td>40.7%</td>
<td>59.3%</td>
</tr>
<tr>
<td>A few time per year</td>
<td>51%</td>
<td>49%</td>
</tr>
<tr>
<td>Never used</td>
<td>55%</td>
<td>45%</td>
</tr>
</tbody>
</table>
Password Policy

<table>
<thead>
<tr>
<th>Password policies</th>
<th>Used RGP</th>
<th>Didn’t use RGP</th>
</tr>
</thead>
<tbody>
<tr>
<td>1C8</td>
<td>40.6%</td>
<td>59.4%</td>
</tr>
<tr>
<td>3C12</td>
<td>48.9%</td>
<td>51.1%</td>
</tr>
</tbody>
</table>

($\chi^2 = 3.921, p = 0.047$)
Qualitative Analysis

“Can you describe the reason why you used/did not use the random password generator?”

• Emergent coding approach

• Cohen’s Kappa test: $K=0.98$; near-perfect agreement
## Users’ Rationale

<table>
<thead>
<tr>
<th>Reason</th>
<th>Self-Chosen Password</th>
<th>Randomly Generated Password</th>
</tr>
</thead>
<tbody>
<tr>
<td>Memorability issue</td>
<td>23.66%</td>
<td>19.89%</td>
</tr>
<tr>
<td>User’s preference</td>
<td>11.47%</td>
<td>12.19%</td>
</tr>
<tr>
<td>Didn’t notice the nudge</td>
<td>4.30%</td>
<td>5.56%</td>
</tr>
<tr>
<td>Convenience</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Security</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Remember password</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Concluding Remarks

- Valuable data on the efficacy of RGP nudges in 3 browsers
- Supports that some factors might contribute to the adoption of RGPs
- Findings useful for future PM nudge designs and interventions to encourage PM use
Future Work

Which design elements are most impactful in Safari's nudge?

How to improve password manager nudges further?

• Other nudging techniques?
• Personalizing nudges?
Questions?

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